SHORELINE MANAGEMENT PLAN

CONOWINGO PROJECT

FERC PROJECT NUMBER 405

Prepared for:

Exelon

Prepared by:

TRC Companies, Inc.

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EXECUTIVE SUMMARY

The Conowingo Project Shoreline Management Plan (SMP) is a framework for the management of Project lands and river shoreline areas consistent with broader local, regional, state, and federal regulations, initiatives, and planning guidelines. The SMP enables Exelon to fulfill its license responsibilities and obligations for the Project, including the protection and enhancement of the Project's environmental and recreational values. More specifically, the SMP will:

- Protect environmental attributes such as wetlands, habitat, and spawning areas.
- Preserve the scenic quality of the Project lands for boaters and shoreline recreationists.
- Maintain existing water quality.
- Protect historic and cultural resources.
- Ensure cooperation with federal, state, and local government agencies to coordinate adjacent land uses and proposed infrastructure with shoreline uses.
- Ensure coordination with separate regulatory authority permitting review and approval efforts.
- Minimize conflicts among differing uses.

This SMP was developed as an element of Exelon's relicensing of the Project with the Federal Energy Regulatory Commission (FERC). While developing this SMP, the licensee consulted with various federal, state, county, and local regulatory agency representatives as well as non-governmental organization stakeholders throughout the study planning and development process.

The 573 megawatt (MW) Conowingo Project is located in a rural setting on the Susquehanna River in Pennsylvania (Lancaster and York counties) and Maryland (Cecil and Harford counties). Conowingo Dam and the lowermost six miles of the Project reservoir, Conowingo Pond, are located in Maryland and the upper eight miles of the reservoir are located in Pennsylvania. The Project extends approximately 1.5 miles downstream of the dam along the east bank of the river and approximately one half mile downstream along the west bank of the river. Lands within the FERC Project boundary comprise approximately 9,919 acres, including 8,850 acres of water and 1,069 acres above the normal high water elevation in Lancaster and York counties in Pennsylvania and Harford and Cecil counties in Maryland.

The Conowingo Project provides access to many recreational and natural resources within the lower Susquehanna River Corridor. Access to additional resources are provided by other FERC-regulated hydroelectric projects and through county, state and federal preservation initiatives and recreational facilities. At the Conowingo Project, Exelon provides various public recreational facilities. Over 720 acres of the 1,069 acres of Project lands are used for this purpose. These recreation facilities include trails, day use and interpretive sites, boat launch facilities, a swimming pool, shoreline fishing access, and public access lands.

Exelon has programs and policies that guide and support the recreational use and management of the Conowingo Project lands. These programs and policies are consistent with FERC regulations requiring licensees to provide public access and recreational opportunities on Project lands which meet area recreational needs. The Project's public recreation facilities are managed under a Recreation Management Plan (RMP), which is incorporated by reference into this SMP.

Exelon has developed a six category land use classification system for Project lands based on aerial photography interpretation, ground truthing and corporate operating procedures and policies. These land classifications are defined as follows:

Class 1: Project Operations: Lands used for power generation and electric transmission/distribution infrastructure and purposes.

Class 2: Developed Recreation: Lands managed for developed public recreational facilities and activities. This includes commercial recreation facilities.

Class 3: Natural/Undeveloped: Lands that are primarily undeveloped and generally available for public access and use.

Class 4: Industrial and Other Non-Project Lands: Lands managed for industrial/commercial uses and other non-Project uses including shoreline stabilization projects.

Class 5: Public Access Lands: Public access lands are Project lands managed by federal, state, county agencies or conservation organizations under agreement with Exelon. Public access and use of the lands is generally allowed, though may be governed by the managing entity according to the type or level of activity or by season. These are typically unimproved lands, though parking areas, trails and other infrastructure may be provided.

Class 6: Cottage Lands: Lands leased to individuals for seasonal use.

Consistent with these land use classifications, the SMP outlines specific shoreline management measures that have been developed to minimize or eliminate negative effects to shoreline resources. Exelon's focus on erosion control as a measure to improve overall water quality in the Susquehanna River watershed is reflected in both the shoreline management measures of the Plan and the BMPs included in Appendix 1 of the Plan. The measures included in this SMP are described below.

Shoreline Erosion Control. Modifications are allowed to shoreline vegetation in order 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. If the buffer function is impaired, a planting plan, using native species included in the native plant guide for this SMP, will be devised and implemented to mitigate for the reduced function.

General Maintenance. Modifications are allowed to shoreline vegetation to maintain the health of the shoreline vegetation, provided the modifications do not impair the overall function of the vegetated buffer. If the buffer function is impaired by vegetation removal, a planting plan, using only native species included in the native plant guide for this SMP, will be devised and implemented to mitigate for the reduced function.

Erosion and Remediation Policy. Exelon has identified and characterized incidences of erosion in the Project boundary. Erosion areas that affect Project shoreline resources will be addressed through a a remediation and monitoring program.

Woody Debris Management. Woody debris is defined as trees and woody material that extend from the shoreline into the impoundment. This material can provide important habitat for fish and wildlife and shall be left in place unless the debris is a navigational or safety hazard.

Approval of Non-Project Use of Project Lands. Any use of and/or construction within the Project boundary by a non-licensee must be permitted by all applicable local, county, state or federal agencies. Exelon must approve the activity before work can begin consistent with FERC's standard use and occupancy article and any other applicable license requirements. Parties requesting non-Project use of Project lands will provide details to Exelon regarding the location and desired development or use. If it is determined that an activity will be allowed and has received all necessary permits and approvals, including FERC approval when required, Exelon will issue written permission to the party for its development and/or use of Project lands.

Shoreline Vegetation Management. Shoreline vegetation provides many benefits to the Project including wildlife habitat, aesthetic value, and maintaining water quality by providing a filter strip to control run-off. Existing shoreline vegetation will be preserved where feasible. It currently varies in depth depending on the location of the Project boundary relative to the impoundment shoreline and current land use.. Existing improved and developed areas with limited shoreline vegetative cover such as the cottage clusters, the Peach Bottom Atomic Power Station (PBAPS), recreation sites and facilities, and the dam and associated generating facilities, can be maintained as they currently exist. Modifications to the shoreline vegetation in other areas will be considered for view shed maintenance and development, recreation access, shoreline erosion control, and general Project related maintenance of the vegetated shoreline.

View Sheds. Modifications and maintenance of vegetation is allowed to provide a reasonable view of the water, provided the modifications do not impair the overall function of the vegetated buffer. If the buffer function is impaired, a planting plan, using the native species plant list included in this SMP, will be devised and implemented to mitigate for the reduced function from vegetation removal.

Access Trails. Modification of the existing vegetation is allowed to provide access trails to the water, provided the modifications do not impair the overall function of the vegetated buffer. If the buffer function is impaired, a planting plan, using the native species plant list included in this SMP, will be devised and implemented to mitigate for the reduced function from vegetation removal.

Sensitive Natural Resource Protection Overlays and Policies. Research and numerous studies were conducted to assess and determine the potential effects of project operations on various resources. Exelon has compiled existing and new data on these resources to develop a "sensitive resources" overlay to apply to the six land use classifications described above. This overlay is defined as areas within the Project boundary that contain (or may contain) resources protected by state or federal law or executive order, and other natural features important to the area or natural environment.

Bald Eagle Management Policy. Exelon has developed a Bald Eagle Management Plan (BEMP) in consultation with the US Fish and Wildlife Service (FWS) and the Pennsylvania Game Commission (PGC) to address the use of Project lands by bald eagles for nesting, roosting and foraging. The BEMP provides for the management of bald eagle habitat on Exelon lands by implementing the FWS' National Bald Eagle Management Guidelines and state agency guidance. The range of protective measures include, but are not limited to, seasonal restrictions, distance buffers, and landscape buffers.

Osprey Management Policy. In consultation with state and federal agencies, Exelon will provide appropriate buffers dictated by the types of activities carried out in either visual or auditory proximity to Osprey nests during breeding and nesting season (January to late July). For the protection of ospreys from potential disturbances or other impacts during the breeding season the following measures will be provided for ospreys nesting on Exelon lands:

- Nest Buffers - Nest buffers of 330 feet will be implemented during breeding season for most activities. For activities with the potential to emit excessive noise (which excludes routine Project operation and maintenance activities),, larger buffers up to 600 feet will be implemented during breeding season.

- Herbicide application for vegetation control will be avoided within 330 feet of nests during breeding season.

- Tower nests – In the event that nests located in towers are identified as problem nests, Exelon will consult with the United States Fish and Wildlife Service to identify the appropriate best management practices and obtain applicable permits for nest removal or relocation. A typical best management practice for problem nests in towers is the installation of nest platforms on towers or nearby.

Historic Properties Management Plan. Exelon has developed, in consultation with Pennsylvania Historical and Museum Commission (PHMC) and the Maryland Historic Trust (MHT), an Historic Properties Management Plan (HPMP) to address historic and cultural resources. The HPMP is incorporated herein by reference.

Conowingo Island Public Use Policy. Exelon's Conowingo Island Public Use policy establishes guidelines for the use of the islands located in the upper reach of Conowingo Pond from the Pennsylvania Route 372 bridge approximately 1.3 miles downstream, as well as Mt. Johnson Island, which is located five miles downstream of the Route 372 bridge. The policy restricts and regulates island use in order to protect the islands' rare species, cultural resources, and unique geologic and physical features. The Policy is included in Appendix 5.

Leased Premises Policy for Cottages. Exelon has developed rules and regulations regarding the use of Project lands for seasonal cottages. Lessees are required to comply with all applicable local, state and federal laws for the development and use of the land, as well as Exelon's land use rules. Exelon rules and regulations for cottages address such issues as erosion control, vegetation removal, wastewater disposal, shoreline development, and cultural resource protection. It is Exelon's policy not to create any new cottage lease lots within the Project boundary. In addition, 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 and the land will be restored to a natural condition. No future cottage leases will be issued at the site. The Policy is included in Appendix 3. Exelon reserves the right to amend the policy from time to time as circumstances may require, subject to Commission approval as necessary.

Public Recreation and Access Facilities. Subject to Exelon's ability to comply with applicable license conditions, Exelon leases numerous parcels of land to local, county and state agencies and to commercial vendors for development and operation of public recreation and access facilities, within and around the Project.. The agreements specify that the respective lessees will use the properties for park and public recreation, including providing river access and facilities such as boat launches while complying with all applicable local, state and federal regulations. All of these sites and facilities, within the Project boundary, are Project recreation facilities regulated under Exelon's FERC license. Exelon will continue to partner with the agencies and vendors for the operation of these facilities and their use by the public.

In addition, Exelon has developed and implemented "Rules and Regulations Governing the Use and Occupancy of Leased Premises" for Project lands. This document has been included as part of the lease agreements for the two existing Project marina facilities, Glen Cove Marina and Peach Bottom Marina. These Rules are included in Appendix 6.

Limitations on Public Recreational Access. Exelon provides public recreation and access to Project lands and waters pursuant to its FERC license requirements. Access and use of certain portions of Project lands will be restricted for operational, safety and security reasons.

- Fishing in Project waters accessible to the public will be governed by applicable state regulations. Fishing will not be allowed within secure areas or areas that present public safety concerns. This includes shoreline fishing within 100 yards of the base of Conowingo Dam at Fishermans Park (west shore) and for 4,000 feet along the east shoreline downstream of the dam. These areas are restricted for public safety reasons due to changes in water elevations and velocities from generating flows and spilling water during gate operations. In addition to safety concerns, the area along the west shore is also used as a staging and storage area related to Project operations and maintenance.

- Hunting is not allowed within the secure area of the Project, or on other Project lands posted against hunting by Exelon. This restriction is intended to protect the public, adjacent landowners, lessees, sensitive resources, and Licensee's operating capabilities. Exelon issues permits for offshore (water access only) stationary duck blinds and duck blind sites on Exelon land to hunters on an annual basis. The permits allows applicants (up to four individuals per permit) to have no more than two blinds or sites.
- Use of off-road vehicles (ORV) on Project lands is prohibited.

Overall Land Use Monitoring and Enforcement. Exelon will conduct regular inspections and manage the Conowingo Project in accordance with the terms of its license and applicable FERC rules and regulations.

Continuing Review. Exelon will evaluate appropriate amendments to the SMP as the facts and circumstances may warrant.

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LIST OF ABBREVIATIONS

Agencies/Organizations/Companies

CBGN – Chesapeake Bay Gateways and Watertrails Network

FERC – Federal Energy Regulatory Commission

FWS – U. S. Fish and Wildlife Service

MDE – Maryland Department of the Environment

MDNR – Maryland Department of Natural Resources

MHT – Maryland Historical Trust

NPS – National Park Service

NRHP – National Register of Historic Places

PADCNR – Pennsylvania Department of Conservation and Natural Resources

PADEP – Pennsylvania Department of Environmental Protection

PBAPS - Peach Bottom Atomic Power Station

PFBC – Pennsylvania Fish and Boat Commission

PGC – Pennsylvania Game Commission

PHMC – Pennsylvania Historical and Museum Commission

Miscellaneous

ADA – Americans with Disabilities Act

APE – Area of Potential Effect

BEMP – Bald Eagle Management Plan

CLI – Conservation Landscape Initiative

HPMP – Historic Properties Management Plan

IBA – Important Bird Area

LWCF – Land and Water Conservation Fund

MW – Megawatt

NAI – Natural Areas Inventory

NOI – Notice of Intent

ORV – Off Road Vehicle

PAD – Pre Application Document

PSP – Proposed Study Plan

RMP – Recreation Management Plan

RSP – Revised Study Plan

RTE – Rare, Threatened and Endangered

SCORP – Statewide Comprehensive Outdoor Recreation Plan

SMP – Shoreline Management Plan

1.0 INTRODUCTION

1.1 Purpose and Scope of the Plan

The Shoreline Management Plan (SMP) for the Conowingo Hydroelectric Project (Project) provides rules and guidelines for managing multiple resources and uses of the Project shoreline. These rules and guidelines will ensure the protection and enhancement of the Project's recreational, environmental, historical, cultural, and scenic resources and the Project's primary function, the generation of electricity.

The SMP enables Exelon to fulfill its license responsibilities and obligations for the Project, including the protection and enhancement of the Project's environmental and recreational values. More specifically, the SMP will:

- Protect environmental attributes such as wetlands, habitat, and spawning areas.
- Preserve the scenic quality of the Project lands for boaters and shoreline recreationists.
- Maintain existing water quality.
- Protect historic and cultural resources.
- Ensure cooperation with federal, state, and local government agencies to coordinate adjacent land uses and proposed infrastructure with shoreline uses.
- Ensure coordination with separate regulatory authority permitting review and approval efforts.
- Minimize conflicts among differing uses.

The SMP applies to all Conowingo Project lands.

2.0 PROJECT DESCRIPTION

2.1 Project Location and Regional Setting

The Project is located in a rural setting on the Susquehanna River in Pennsylvania (Lancaster and York counties) and Maryland (Cecil and Harford counties). Conowingo Dam and the lowermost six miles of the Project reservoir, Conowingo Pond, are located in Maryland.The upper eight miles of the reservoir are located in Pennsylvania (Figure 2.1-1). The Project extends approximately 1.5 miles downstream of the dam along the east bank of the river and approximately one half mile downstream along the west bank of the river. Lands within the FERC Project boundary comprise approximately 9,919 acres. This includes 8,850 acres of water and 1,069 acres above the normal high water elevation.

Located at river mile 10, Conowingo Dam is the most downstream of the five hydroelectric projects located on the lower Susquehanna River. The upstream projects (York Haven, Safe Harbor, Holtwood, and Muddy Run) are located at river miles 56, 32, 24, and 22, respectively. Tidewater extends up the river to within approximately four miles of Conowingo Dam.

York and Lancaster counties in Pennsylvania have 434,972 and 519,445 residents, respectively, and population densities of 481 and 547 people per square mile, respectively. Cecil and Harford counties in Maryland have 101,108 and 244,826 residents, respectively, and population densities of 290 and 556 people per square mile, respectively. The nearest metropolitan area within the Susquehanna River watershed is Lancaster, Pennsylvania, approximately 32 miles to the northeast, with a population of about 54,779 people. Major metropolitan areas within 60 miles of the Project include Baltimore, MD, Wilmington, DE, Lancaster, PA and Harrisburg, PA with populations of approximately 620,961, 72,826, 59,322 and 49,528 respectively (U.S. Census Bureau 2010).

While 75 percent of Lancaster County's population, 71 percent of York County's population, and 77 percent of the State of Pennsylvania's population are classified as living in urban areas, a full 100 percent of the residents of the five Pennsylvania townships (Martic, Drumore, Fulton, Lower Chanceford, Peach Bottom) adjacent to the Conowingo project are classified as living in rural areas. Fifty-two percent of the population of Cecil County resides in a rural area, much lower than neighboring Harford County (78 percent) and the State of Maryland as a whole (86 percent). (city-data.com, 2011).

2.2 Project Boundary and Adjoining Land Uses

The Project has 9,919 acres of land within the Project boundary: 8,850 acres of Project waters and 1,069 acres above the normal high water elevation in Lancaster and York counties in Pennsylvania and Harford and Cecil counties in Maryland. The lands contained within the Project boundary are those lands necessary for the operation of the Project (See Figure 2.2-1). Project lands serve many project-related purposes, including (but not limited to) project operations, public access, recreational use, and wildlife habitat conservation.

There are approximately 46 miles of shoreline (excluding island shoreline) within the Project boundary: 43 miles associated with Conowingo Pond and 3 miles associated with the Susquehanna River downstream of Conowingo Dam. The Norfolk Southern rail line is largely located within the Project boundary and abuts the entire length of the east shore of Conowingo Pond. Downstream of Conowingo Dam on the easterly side of the river, MD Route 222 is located roughly parallel to and in some areas abuts the Project boundary.

Non-Project land adjoining the Project boundary is primarily undeveloped forest land with scattered agricultural, residential, and industrial use. Land to the east of the rail line is mostly undeveloped forest lands with some agricultural land and residential development. Susquehannock State Park and the Ferncliff Wildflower and Wildlife Preserve, a National Natural Landmark, abut the rail line to the east. Conowingo Community Park is located adjacent to the Project Boundary near Octoraro Creek on land leased to Cecil County by Exelon. Adjoining lands along the west shore of the impoundment consist of undeveloped forest, agricultural, and residential lands. The percentage of agricultural and residential lands is higher than on the east shore.

Peach Bottom Atomic Power Station (PBAPS) is located on the west shore of Conowingo Pond at river mile 18. Downstream of the Conowingo Dam, the Norfolk Southern rail line is west of MD Route 222, and is not located within the Project boundary.

Several recreation and land conservation sites are located on the Susquehanna River both upstream and downstream of Project lands at other FERC regulated hydroelectric projects and through County, State and Federal preservation initiatives and recreational facilities. Recreation facilities in the immediate vicinity of the Project include state and county parks, camp grounds, picnic areas, shoreline access facilities, boat launches, fishing sites, canoe portages, scenic overlooks, nature preserves, a wildflower preserve, an Environmental Center (a visitor center with interpretative displays), hiking trails, and Pennsylvania Game Lands.

2.3 Hydroelectric Facilities

The principal features of the Conowingo Project consist of the following:

- Conowingo Dam, a 4,648 foot long, 94 foot tall structure.
- Conowingo powerhouse, integral to the dam, containing 11 generating units with a capacity of 573 MW.
- An 8,850 acre reservoir (Conowingo Pond), and approximately 1,069 acres of land within the FERC Project boundary.

Conowingo Pond also serves as the lower reservoir of the Muddy Run Pumped Storage Project (FERC Project No. 2355) and provides a source of cooling water for the PBAPS. The Muddy Run powerhouse facility is located adjacent to the northeasterly portion of the Conowingo Project impoundment (river mile 22) and PBAPS is located on the west shore of the impoundment at river mile 18. Several transmission lines associated with the three electric facilities also cross Conowingo Pond and the river.

The Project boundary extends approximately 1.5 miles downstream from the Conowingo Dam (east shore), and one half mile on the west shore. Public access to some of these areas and facilities is restricted due to public safety and plant operational and security concerns.

2.4 Existing Recreation Facilities

Visitors to the Conowingo Project have the opportunity to participate in numerous recreational activities. The existing recreational facilities associated with the Project are described below and shown on Figure 2.4-1. The Project's public recreation facilities are managed under a Recreation Management Plan (RMP), which is incorporated by reference into this SMP.

2.4.1 Existing Facilities

Lock 13 (York County, PA.)

The Susquehanna and Tidewater Canal was a regionally important transportation canal which was in operation between 1840 and 1900. It was constructed on the west bank of the Susquehanna River and went as far north as Wrightsville, Pennsylvania (approximately 20 miles north of the Conowingo Dam), and terminated in Havre De Grace in Harford County, Maryland.

Lock 13, which consists of the unrestored remains of Lock 13 of the Susquehanna Tidewater Canal, is accessed via the Mason-Dixon Trail, located approximately 1,100 feet south of the U.S. Route 372 bridge over the Susquehanna River. The site is owned by the Licensee, although trailhead access is from the PPL Holtwood, LLC Lock 12 parking lot (Holtwood Project, FERC No. 1881).

Lock 15 (York County, PA.)

The restored Lock 15 of the Susquehanna and Tidewater Canal is accessed from Route 372 via River Road (south) and is owned and managed by the Licensee. The site includes parking for 35 vehicles, a footpath to the restored lock, interpretive displays, a picnic area, and portable restrooms.

Muddy Creek Boat Launch (York County, PA)

Muddy Creek boat launch is directly downstream of and connected to Lock 15 by a footpath. Improvements include a 20 foot wide hard surface boat ramp, docks, parking for 44 vehicle and trailer combinations (boat trailers) and 26 cars, interpretive and informational panels, and a portable restroom. The site is owned by the Licensee and the facilities are maintained by the Pennsylvania Fish and Boat Commission (PFBC).

Cold Cabin Boat Launch (York County, PA.)

Cold Cabin boat launch is located approximately three miles downstream of U.S. Route 372 and is accessed from Route 74 by the Paper Mill Road and Cold Cabin Road. Improvements include a 12 foot wide hard surface boat ramp, informal parking for six vehicles, a picnic area, and interpretive and information displays. The site is owned by the Licensee and the facilities are maintained by Peach Bottom Township under a lease agreement with the Licensee.

Dorsey Park (York County, PA.)

Located just upstream of the PBAPS, Dorsey Park is accessed from Flintville Road via Lay Road. The site provides two 32 foot wide hard surface boats ramps, docks, parking for 25 boat trailers and 30 cars, a picnic area, interpretive and informational displays and portable restrooms. The facility is owned and maintained by the Licensee.

Line Bridge (Harford County, MD.)

Line Bridge is located approximately one half mile south of the Pennsylvania/Maryland state line and is accessed by the Line Bridge Road from Maryland State Route 623. The site provides a small, three car parking area and unimproved shoreline access for fishing and carry-in boat launching. The site is owned by the Licensee and the facilities are managed and maintained by Harford County under lease agreement with the Licensee.

Broad Creek Public Landing (Harford County, MD.)

This site is approximately two miles south of the Pennsylvania/Maryland state line and is directly off Maryland State Route 623. Facilities include a 14 foot wide hard surface boat ramp, dock, an on-site parking area for four vehicles and an off-site parking area for 33 boat trailers. The site is owned by the Licensee and the facilities are managed and maintained by Harford County under a lease agreement with the Licensee.

Glen Cove Marina (Harford County, MD.)

This commercial marina facility is located approximately two miles upstream of Conowingo Dam and is accessed from Maryland State Route 623 by Glen Cove Road and Berkley Road. The facility provides a hard surface boat ramp, dock, 74 boat slips, a picnic area, portable restrooms and parking for 16 boat trailers and 20 cars. A launch fee is charged to use the ramp. Other services are provided including fuel, repair services, and slip rentals. This facility also serves as the take-out location for the Conowingo Dam canoe portage. The site and facilities are owned by the Licensee and managed and operated by a private vendor.

Conowingo Dam Pool and Visitors Center (Harford County, MD.)

This area is located just upstream of Conowingo Dam and is accessed directly off U.S. Route 1. The pool facility includes swimming and wading pools, a locker and changing room, a picnic area, a playground, restrooms, and a snack bar. The facility is owned by the Licensee and operated by a private vendor.

The Visitor Center contains informational displays and brochures focused on the region, restrooms and conference rooms, and office space for the Lower Susquehanna Heritage Greenway. The center is owned, operated and staffed by the Licensee. A small picnic area is also provided. A common parking lot providing 140 spaces is shared by the two facilities.

Peach Bottom Marina (Lancaster County, PA.)

This commercial marina is located approximately seven miles upstream of Conowingo Dam. Access to the facility is from Route 222 to Peach Bottom Road. The facility includes a 25 foot wide hard surface boat ramp, dock, parking for 17 boat trailers and 33 cars, and a portable restroom. A launch fee is charged to use the ramp. Other services provided include fuel dispensary, repair services and boat slip rentals. The site is owned by the Licensee and managed and operated by a private vendor.

Conowingo Creek Boat Launch (Cecil County, MD.)

The boat launch is located approximately two miles north of Conowingo Dam and is accessed from Route 222 via the Mt. Zoar Road and Conowingo Lake Road. The facility includes an 80 foot wide hard surface boat ramp, boat tie up area, parking for nine boat trailers, and a small picnic area. The site is owned and managed by the Licensee.

Funks Pond (Cecil County, MD.)

Funks Pond is located just upstream of Conowingo Dam and is accessed directly off U.S. Route 1. A non-motorized trail leads from a parking area for 24 cars off Route 1 approximately one half mile to Funks Pond, a small (approximately two acre) inlet on the Susquehanna River. A small picnic area with two tables is located at the pond. The site is owned and managed by the Licensee.

Conowingo Dam Overlook (Harford County, MD.)

The overlook is located on the west end of Conowingo Dam off U.S. Route 1 and accessed from Shuresville Road. The site provides parking and a covered pavilion and overlook of Conowingo Dam. The site is owned and managed by the Licensee.

Fisherman's Park at Shures Landing (Harford County, MD.)

This site is located directly downstream of Conowingo Dam and is accessed from the Shures Landing Road. Facilities include a newly constructed (Americans With Disabilities Act (ADA) compliant) fishing platform, a picnic pavilion, picnic areas, bank fishing access, a carry-in boat launch, observation platforms, interpretive and informational displays, parking for 14 boat trailers and 124 cars, public restrooms (open during the day), and portable restrooms. The northerly trailhead for the Lower Susquehanna Heritage Greenway is located at the southerly end of the parking lot. The site is owned and managed by the Licensee. The site also serves as a canoe portage trail put-in below the dam.

Octoraro Creek Access (Cecil County, MD.)

The Octoraro Creek Access is located approximately one mile downstream of Conowingo Dam directly off Maryland Route 222. The facility includes a parking area for 15 cars, interpretive and informational display, and ADA compliant trail (approximately one half mile in length) along Octoraro Creek to its confluence with the Susquehanna River. The site is owned and managed by the Licensee.

2.4.2 Other Recreation Sites/Facilities Using Project Lands and Waters

Mason-Dixon Trail (York County, PA. and Harford County, MD.)

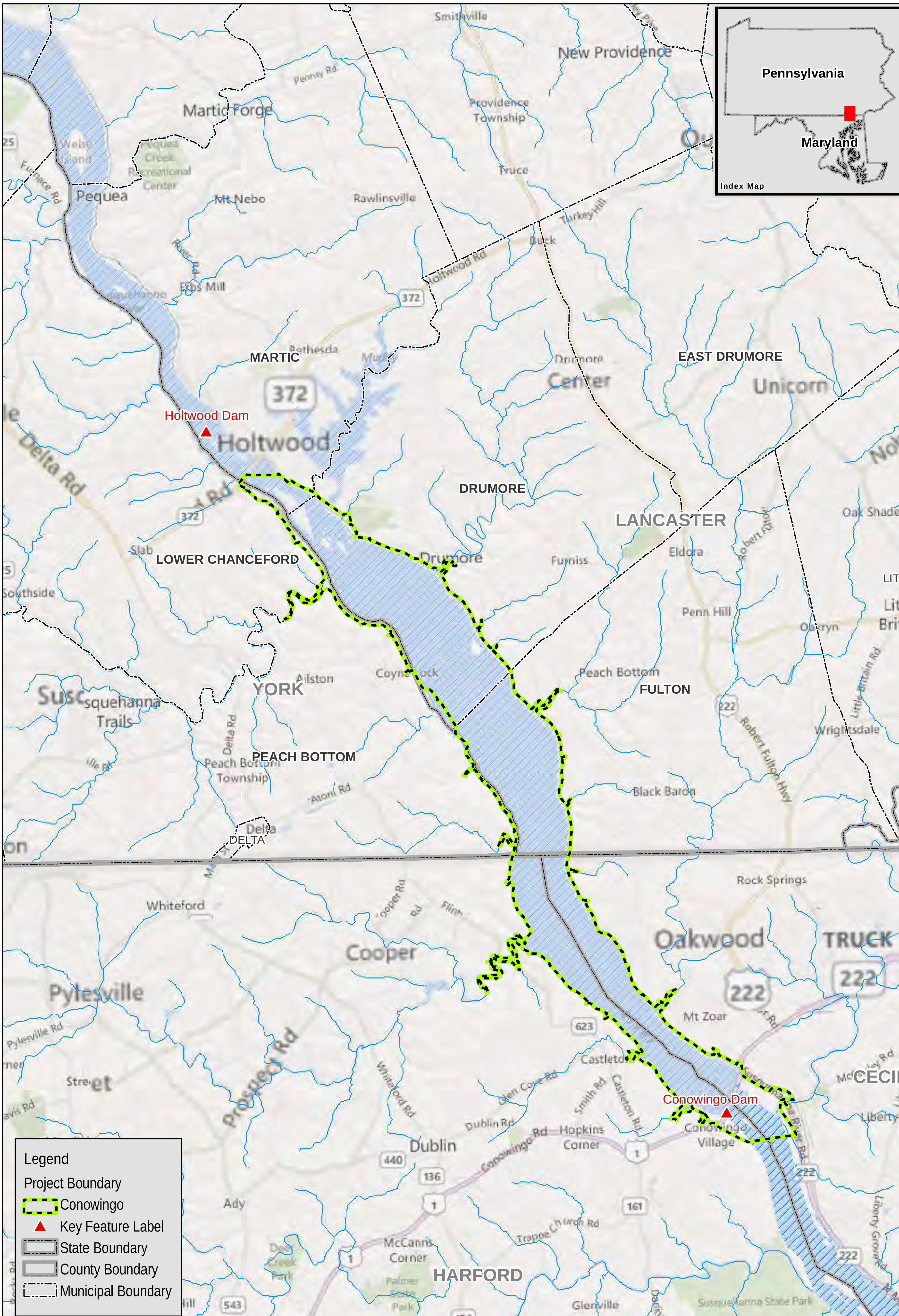
The 193 mile long Mason-Dixon Trail connects the Appalachian Trail in Cumberland County, Pennsylvania with the Brandywine Trail in Chadds Ford, Pennsylvania. While most of the trail is well outside the Conowingo Project boundary, portions of it are located on the Licensee's Project (approximately 3.75 miles) and non-project (approximately 10.5 miles) lands. The trail passes through several of the above described recreation sites (Locks 13 and 15, Muddy Creek, Cold Cabin, Broad Creek, Glen Cove, and the Conowingo Swimming Pool/Visitor Center). The trail is both within the Project boundary and on Exelon's non-Project lands, and is maintained and managed by the volunteer Mason-Dixon Trail System, Inc. organization under a contractual agreement with the Licensee.

Susquehanna River Water Trail (Pennsylvania and Maryland)

The Lower Section of the Susquehanna River Water Trail, which extends approximately 53 miles from Harrisburg, Pennsylvania to the Broad Creek Boat Launch, is part of the Chesapeake Bay Gateways and Watertrails Network, and is also a designated National Recreation Trail.

2.5 Enhanced Recreation Facilities

As part of the FERC license application for the Conowingo Project, Exelon is proposing Project recreation enhancements. These enhancements are included in the RMP that addresses Exelon's management of public recreational facilities within the Project boundary.



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EXELON GENERATION COMPANY, LLC

SHORELINE MANAGEMENT PLAN DOCUMENT
CONOWINGO HYDROELECTRIC PROJECT
PROJECT NO. 405

Figure 2.1-1
Conowingo Project Location

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Conowingo

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Figure 2.2-1
Conowingo Project Boundary

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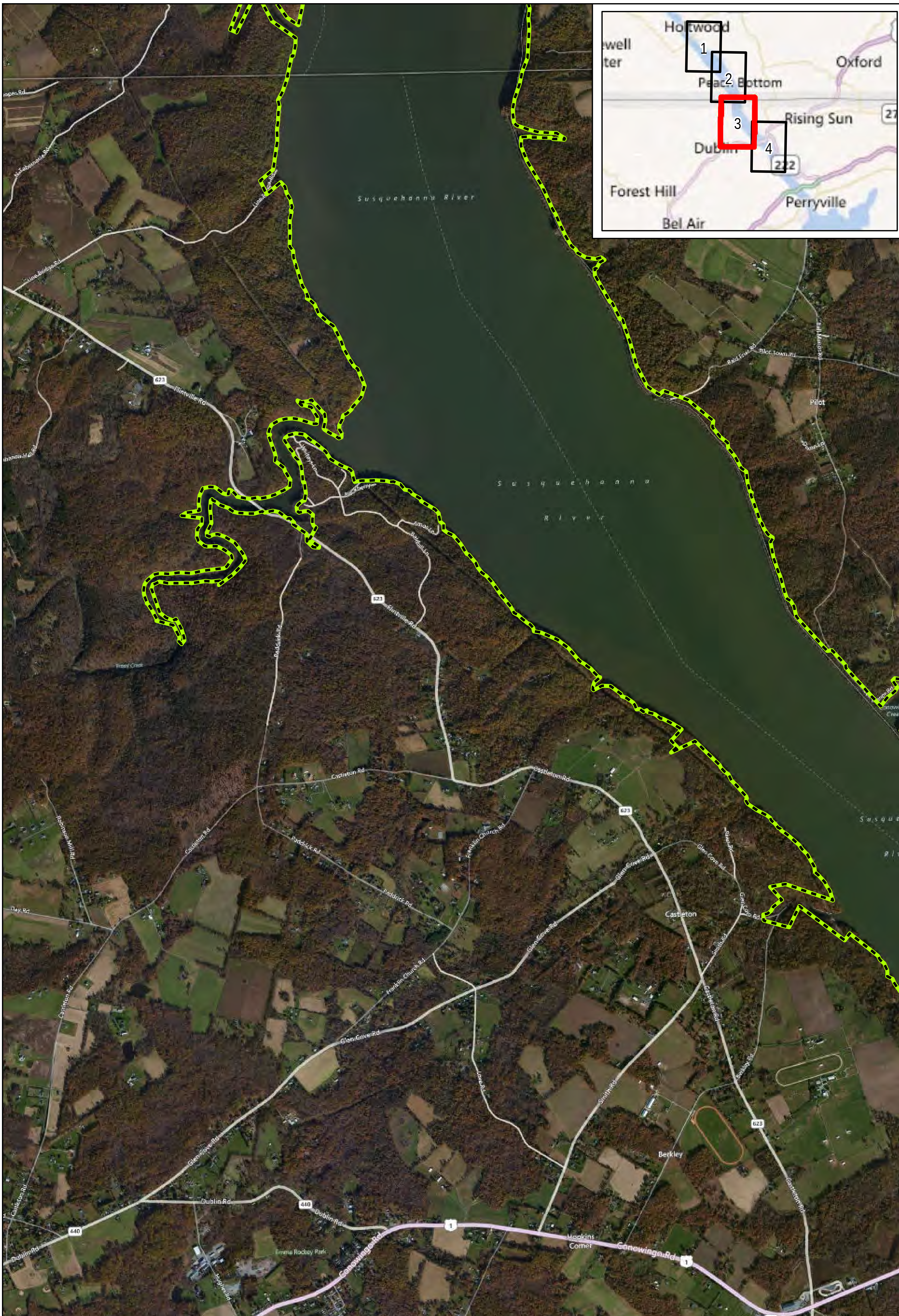

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Figure 2.2-1
Conowingo Project Boundary

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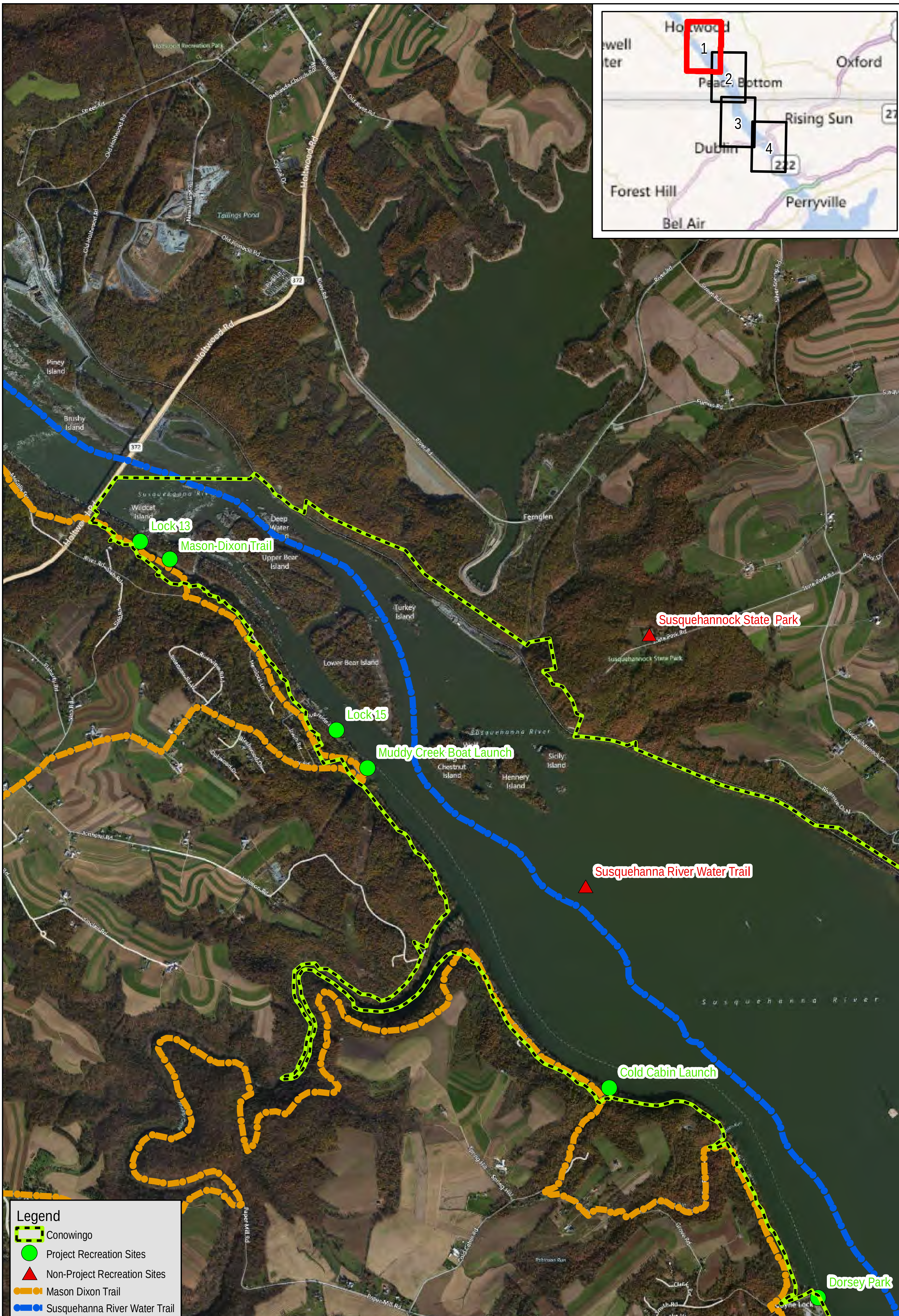

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SHORELINE MANAGEMENT PLAN DOCUMENT
CONOWINGO HYDROELECTRIC PROJECT
PROJECT NO. 405

0 1,000 2,000 4,000 Feet

Figure 2.4-1
Conowingo
Project and Non-Project
Recreation Facility Map

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Figure 2.4-1
Conowingo
Project and Non-Project
Recreation Facility Map

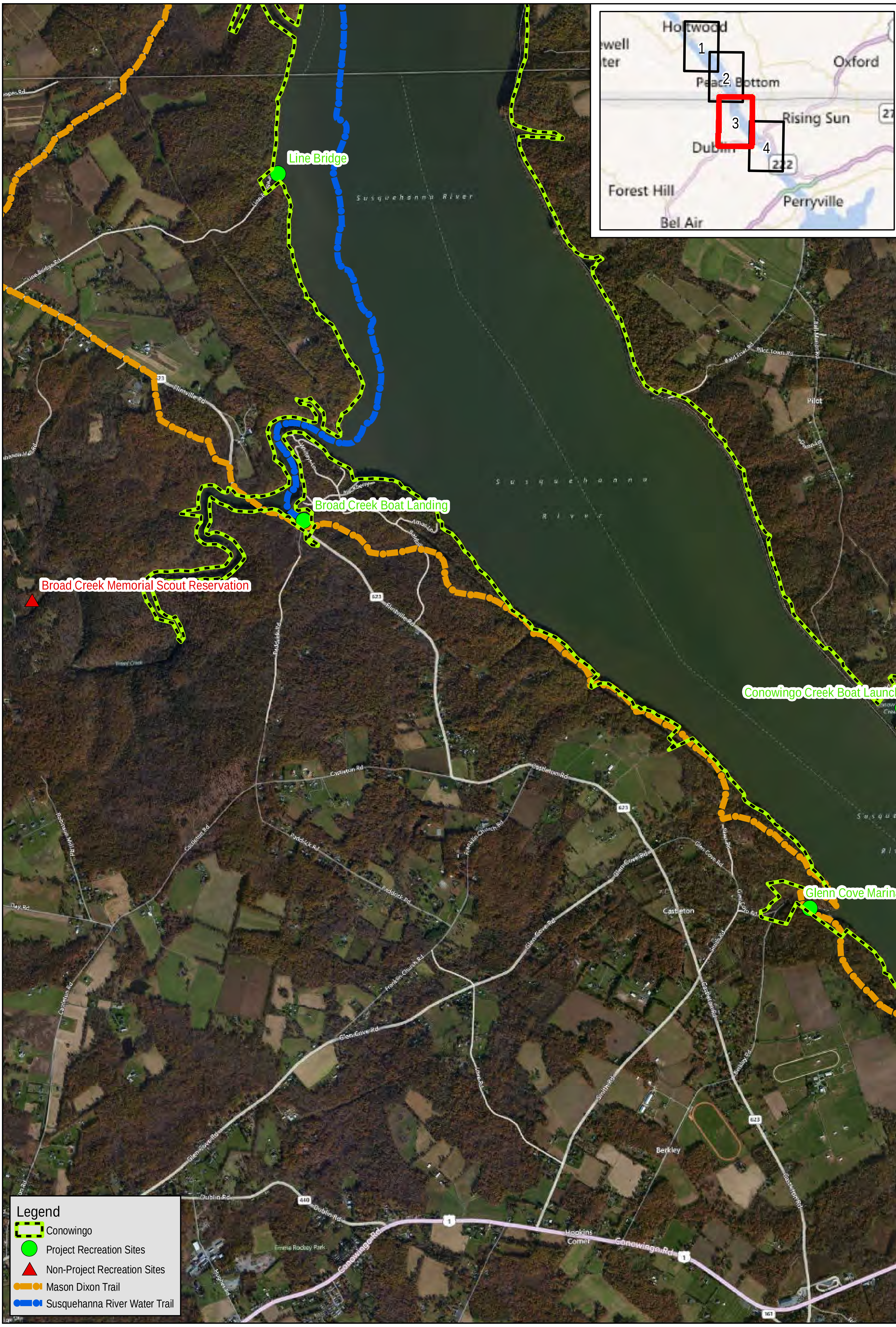

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Figure 2.4-1
Conowingo
Project and Non-Project
Recreation Facility Map

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Figure 2.4-1
Conowingo
Project and Non-Project
Recreation Facility Map

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3.0 EXISTING ENVIRONMENTAL AND CULTURAL RESOURCES

This Section discusses the resources potentially affected by activities which are managed by this SMP. Specifically, shoreline resources that are either influenced by existing land uses or influence land use decisions are discussed. A comprehensive environmental assessment for the relicensing was provided in the Project's Draft and Final License Applications.

Shoreline land uses within the Project boundary may affect existing natural resources and habitat as a result of increased surface runoff rates and nutrient loading. To address this potential impact, Exelon will incorporate best management practices (BMPs) to minimize or eliminate sediment and nutrient delivery to these resources as applicable, minimizing or eliminating any impacts resulting from both existing and proposed shoreline activities. In addition to BMPs such as soil erosion, sediment control and restriction of impervious surfaces associated with new construction activities, Exelon will implement BMPs for landscaping and lawn care (pesticide and fertilizer) practices, and restrictions for vegetation removal, all of which will be beneficial to the aquatic and terrestrial resources and associated habitat of the Project lands. A complete list of BMPs is included in Appendix 1. In conjunction with the implementation of BMPs as applicable, potential effects to aquatic and terrestrial resources have been considered in the development and implementation of Project land use restrictions outlined in Section 6.0 of the SMP.

3.1 Water Resources

Conowingo Pond extends approximately 14 miles upstream from Conowingo Dam to the lower end of the Holtwood Project (FERC No. 1881) tailrace. The Conowingo Pond exhibits a surface area of 9,850 acres and contains a variety of aquatic habitats. The upper reach of the water body (in Pennsylvania) is characterized by potholes, deep pools and channels carved into the bedrock, with rugged island rock formations. The upper reach is relatively shallow (6.5 to 20 feet). However a few potholes and deep pools of up to almost 100 feet deep occur along the eastern shoreline of Conowingo Pond in the vicinity of the Muddy Run powerhouse. Below the Muddy Run powerhouse to the

Conowingo Dam, the Conowingo Pond broadens significantly and exhibits greater average depths (> 60 feet) and lower water velocities.

Downstream of the dam, bedrock formations with scattered areas of variable-sized cobble characterize the majority of the substrate in the non-tidal habitat area below the tailrace and spillway, creating a predominance of riffle and pool[1] habitat. In the summer months, there is typically little to no spill over the spillway which creates lentic (lake like) pools among the bedrock cobble. Water will spill over the spillway when river flows exceed the capacity of the Project (86,000 cfs). Depending on the magnitude of spill over the dam, the river becomes increasingly dominated by flowing water habitat.

All surface waters in Pennsylvania are protected for aquatic life, water supply (potable, industrial, livestock, wildlife, and irrigation), and recreation (boating, fishing, water contact sports, and aesthetics). Pennsylvania has assigned a warm water fishes (WWF) aquatic life designated water use to the Pennsylvania portion of the Conowingo Pond. In addition to narrative standards that are applicable to all surface waters, specific water quality criteria for parameters such as pH, alkalinity, bacteria, color, dissolved oxygen (DO), temperature, and certain ions, metals, and nutrients, are established for critical uses (i.e., the most sensitive designated or existing use designated for protection) in Pennsylvania.

In Maryland, all surface waters must be protected to support water contact recreation, fishing, aquatic life, wildlife, and water supply (agricultural and industrial). In addition, each major stream segment within the state has been assigned to one of the eight designated use categories with associated minimum water quality criteria. Numeric water quality criteria for various water quality parameters (e.g., bacteria, DO, temperature, pH, turbidity, color, toxic substances, etc.) are specified for each designated use. In the current Maryland regulations, the reach of the Susquehanna River from the north side of the Conowingo Dam to the Maryland/Pennsylvania border (i.e., Conowingo Pond) is designated as Use I-P (Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply). The Susquehanna River main stem from Conowingo Dam downstream to

[1] A riffle is an area of shallow swift water, while a pool is an area of deep, slow water.

the confluence with the Chesapeake Bay is designated as Use II (Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting, which includes applicable Use I-P categories). Water quality standards for the Chesapeake Bay and tidal tributaries (e.g., Susquehanna River downstream of Conowingo Dam) are further assessed on a Bay Segment scale for four segments with “Migratory Spawning and Nursery Use” and “Open Water Fish and Shellfish Use” sub-category designations during specified periods of time (Exelon 2009).

3.2 Fisheries Resources

The Conowingo Pond in both Pennsylvania and Maryland maintains a diverse warm water fishery including the anadromous American shad (*Alosa sapidisima*). Studies completed for the relicensing in 2010 and 2011 show year to year similarities in catches amongst the various Susquehanna River sampling efforts. Thirty four species have been documented to be present downstream of Conowingo Dam.

Gizzard shad, channel catfish, bluegill and spotfin shiner dominate the overall species composition. All other species formed less than 5% of the catch. Flathead catfish, known to be present in the lower Susquehanna River drainage since 2002, represent a new species addition within a formal sampling program. Condition factor and length weight relationships of representative common fish species downstream of Conowingo Dam are comparable to those from other normal, natural populations. This is indicative of relatively favorable conditions and habitats in the lower Susquehanna (NAI 2011).

3.3 Terrestrial Resources

3.3.1 Upland Habitats

The region encompassing the Project area is characterized by a diversity of terrestrial botanical resources, which are influenced by soil type, hydrology, climate, and historic and current land use. The lower Susquehanna River corridor exhibits steep river banks, which create a rapid transition to upland habitat from the river’s edge. General plant communities in the Project area include woodlands, old fields, and cultivated fields. The primary natural plant communities include mixed mesophytic and rich hemlock-mesic hardwood forest, dry oak-mixed hardwood or red oak-mixed hardwood forest, and Virginia pine-mixed hardwood forest.

3.3.2 Wetland Resources

In addition to the open water wetlands of Conowingo Pond and the Susquehanna River below the Conowingo Dam, the Project encompasses a variety of water-dependent habitats that can be variously defined by frequency of inundation, water depth, and geomorphic position in the landscape adjacent to an open body of water. These habitats are primarily characterized by temporarily flooded deciduous broad-leaved forested and scrub-shrub wetlands. There are few mapped wetlands on Project lands, largely due to the relatively steep sloped shoreline topography, which creates a narrow transition zone from open water to upland habitat. National Wetland Inventory mapped wetlands within the Project boundary are depicted on Figure 3.3-1.

3.3.3 Wildlife Habitat

The forested lands within the Project boundary provide habitat for a variety of common woodland species such as red and gray fox, raccoon, opossum, red and gray squirrel, chipmunk, turkey, and white-tailed deer. Avian wildlife species such as the yellow-billed cuckoo, black capped chickadee, house wren, song sparrow, white-breasted nuthatch, brown creeper, and an assortment of woodpeckers have been documented along the wooded shorelines of the lower Susquehanna River. Avian species frequently interacting with the existing transmission lines where they cross Conowingo Pond include raptors such as bald eagles (*Haliaeetus leucocephalus*), ospreys (*Pandion haliaetus*), black vultures (*Coragyps atratus*), and turkey vultures (*Cathartes aura*) which use towers for perching and roosting. Great blue herons *(Ardea herodias*) travel up and down the shorelines of the river to forage and may be traveling back and forth to a rookery downstream below Conowingo Dam. Double-crested cormorants (*Phalacrocorax auritus*) and herring gulls (*Larus argentatus*) congregate in large numbers on rocky areas in the channels between Turkey Island and Lower Bear Island in the upper Conowingo Pond.

3.4 Rare Threatened and Endangered (RTE) Species and Habitat

3.4.1 Bald Eagle

A substantial number of eagles have established roosts within the forested shoreline of the Susquehanna River above and below the Conowingo Dam in the vicinity of the Project. Recent data from studies performed by Exelon in 2010 and 2011 document that bald eagles of all age classes utilize shoreline habitat at the Conowingo Pond and Dam area for foraging, nesting, and roosting. The shoreline forests along Conowingo Pond and the Susquehanna River downstream of Conowingo Dam provide habitat that currently supports seven nests with pairs of actively breeding bald eagles. The shoreline along the Conowingo Pond and the Susquehanna River downstream of Conowingo Dam were used with varying frequency for perching, roosting, and foraging. Nine communal roosts were found in the study area demonstrating the area's concentrated use by bald eagles (URS 2011a).

3.4.2 Osprey

Ospreys are large, fish-eating birds of prey most often seen around water. The PGC database reveals that the species has historically occurred in the Project vicinity and field studies performed by Exelon in 2010/2011 confirm that this species is present within the Project boundary. A total of 11 osprey nests (located in both Pennsylvania and Maryland) were found in the Project area in 2010, and one additional nest site (for a total of twelve) was identified in 2011. Nests in the project area ranged from sparse nests representative of newer nests to larger, well-developed nests representative of nest sites with longer nesting histories (URS 2011b).

A total of twelve osprey nests were located in the Project area, or immediate vicinity, in 2010 and 2011. Eleven of the nests were active during the 2010 survey season, and four (4) pairs of osprey successfully fledged one or more chicks. In 2011 an additional nest was observed late in the season on the unnamed island adjacent to Turkey Island (Pennsylvania) although the nest did not remain active after initial nest building activity was observed. Seven active osprey nests were located in the Pennsylvania portion of the project in 2010. In 2011, most of these same nests were present and/or active with the exception of two nests and an additional nesting attempt on an unnamed island adjacent to Turkey Island. Four active osprey nests were located in the Maryland portion of the Project. Three active osprey nests were located in the Maryland portion of the project Survey Area in 2010 and were active in the same locations in 2011. A fourth nest, active in both survey years, was located in Maryland. It is located close to but not within the project area or located on project lands. Nests in the Conowingo Dam area included one in the top of the electric superstructure directly on top of Conowingo Dam (URS 2011b).

3.5 Cultural Resources

Native American archaeological sites, as well as historic architectural sites, are known to exist within the vicinity of the Conowingo Project area and throughout the surrounding region. The presence of archaeological sites within the Project's Area of Potential Effect (APE)[2] and additional sites within a one-mile radius was initially documented through research at the Maryland Historical Trust (MHT) and Pennsylvania Historical and Museum Commission (PHMC). Historic architectural sites were documented though the completion of historical background and cartographic research at the MHT and PHMC. This research revealed that the early history of the general Project region was marked by agriculture, iron forging, quarrying, and milling, and this trend continued into the mid-nineteenth century. The development of many of the settlements and villages surrounding the Project area relate directly to the proximity to the Susquehanna River and its tributaries and creeks.

Field studies were performed by Exelon in 2010 and 2011 for historic properties including both historic architectural and archaeological resources located within the APE to determine whether any historic properties within the Project's APE are eligible for listing on the National Register of Historic Places. These studies have guided the development of an Historic Properties Management Plan (HPMP)..

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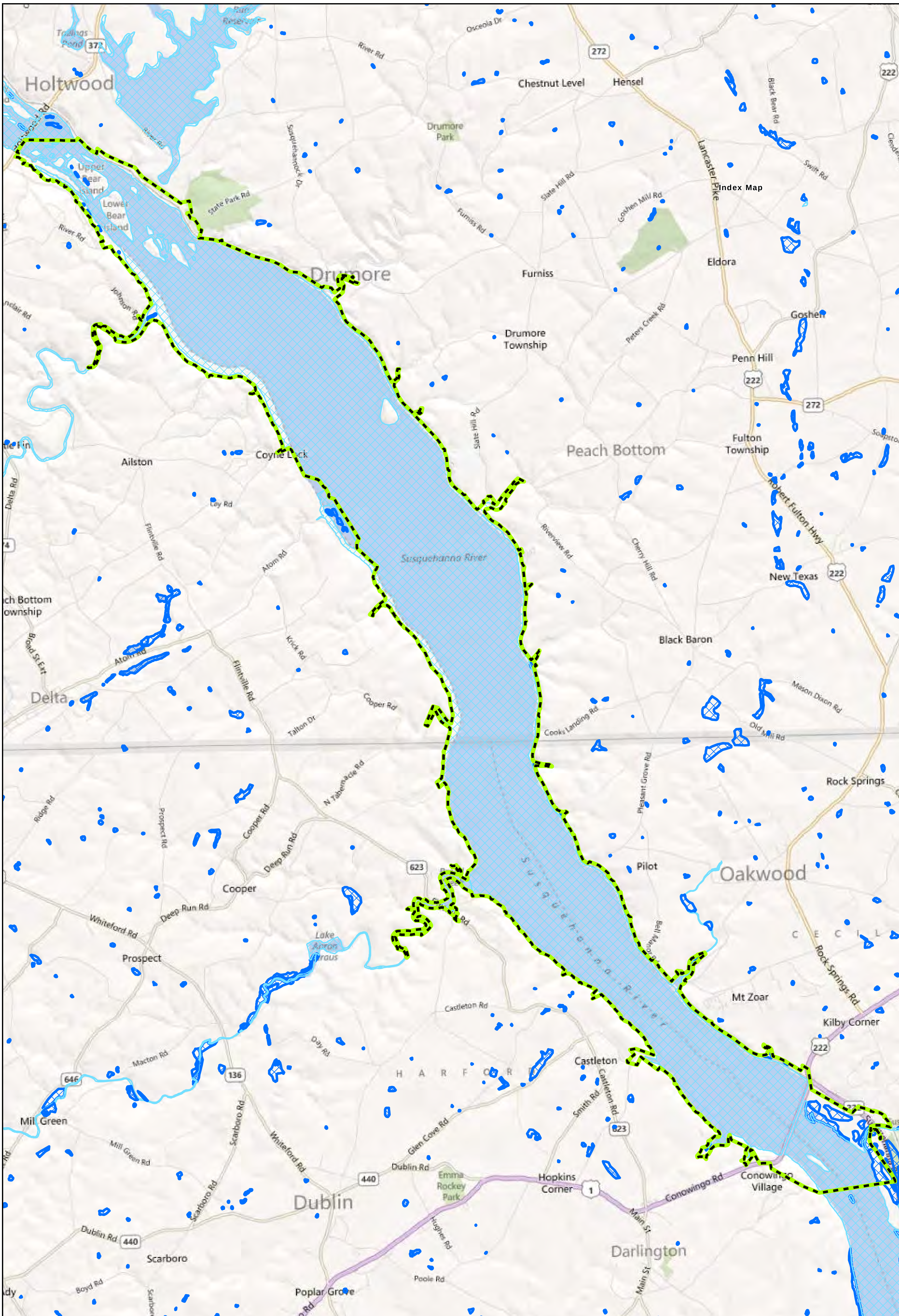
[2] The Project APE is defined as the lands enclosed by the project's boundary and lands or properties outside of the project's boundary where project construction and operation or project-related development or other enhancements may cause changes in the character or use of historic properties, if any historic properties exist.



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Legend
- Conowingo
- NWI Wetland
- NWI Open Water Wetland

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0 0.5 1 2 Miles

Figure 3.3-1
National Wetland Inventory
Wetlands Locations

4.0 FEDERAL, COMMONWEALTH AND COUNTY MANAGEMENT PLANS AND PROGRAMS

Numerous federal, state and county agencies, as well as other organizations, have developed regional plans and programs to recognize, promote, protect and conserve the cultural/historic, natural and recreational resources near the Project. During the SMP development process, Exelon identified several plans and programs that address these resources in the lower Susquehanna River. They are summarized below. Exelon intends that the SMP, where possible, be consistent with the goals and objectives of these plans and programs.

4.1 Federal Management Plans and Programs

4.1.1 National Trail System Act of 1968

The National Trail System Act of 1968 authorized creation of a trail system comprised of National Recreation Trails, National Scenic Trails and National Historic Trails. While National Scenic Trails and National Historic Trails may only be designated by an Act of Congress, National Recreation Trails may be designated by the Secretary of Interior or the Secretary of Agriculture to recognize exemplary trails of local and regional significance in response to an application from the trail's managing agency or organization. National Recreational Trails are administered by the NPS in partnership with American Trails, a national non-profit organization advocating for all trail interests (American Trails 2011). Portions of the following designated trails are located in or adjacent to the Project area:

- Captain John Smith Chesapeake National Historic Trail (within Project)
- Susquehanna River Water Trail (within Project)
- Mason-Dixon Trail (designated portion is outside Project)

4.1.2 National Park Service Chesapeake Bay Gateways and Watertrails Network

The Chesapeake Bay Gateways and Watertrails Network (CBGN) is a growing partnership system of 166 parks, refuges, museums, historic sites and water trails in the Bay watershed. Through a Memorandum of Understanding with the NPS, the partners work to provide Chesapeake experiences, interpret their Chesapeake connections, co-market the Network, and promote citizen stewardship (NPS 2010). Gateway features within the Project area include the Susquehanna River Water Trail (Lower Section) which traverses Conowingo Pond. The Gateway also includes the Susquehanna State Park, located along the Susquehanna downstream of the Project.

4.1.3 National Natural Landmark Program

Administered by the National Park Service (NPS), this voluntary program recognizes and encourages the conservation of sites containing outstanding biologic and geologic resources. Ferncliff Wildflower and Wildlife Preserve is a designated National Natural Landmark and is adjacent to the Project Boundary. (NPS 2011)

4.1.4 Audubon Society – Important Bird Area Program

Designated by Audubon Pennsylvania, Important Bird Areas (IBA's) are the primary focus of Audubon Pennsylvania's conservation efforts. IBAs include migratory staging areas, winter roost sites and prime breeding areas. The 15,875 acre Susquehanna River Gorge IBA includes Project lands. The IBA lists land conservation as an integral element to the success of an IBA designated resource.

4.2 Maryland and Pennsylvania Management Plans and Programs

4.2.1 Statewide Comprehensive Outdoor Recreation Plans (SCORP)

The Land and Water Conservation Fund (LWCF) Act of 1965 requires a SCORP from each state prior to consideration by the Secretary of the Department of the Interior for financial assistance for acquisition and development projects. The LWCF Act specifically requires the states' SCORP to:

- Identify outdoor recreation issues of statewide importance based upon, but not limited to, input from the public participation program. The plan must also identify those issues the State will address through the LWCF and those issues which may be addressed by other means.
- Evaluate demand, i.e., public outdoor recreation preferences, but not necessarily through quantitative statewide surveys or analyses.

- Evaluate the supply of outdoor recreation resources and facilities but not necessarily through quantitative statewide inventories. (NPS 2008).

Both Pennsylvania and Maryland's current SCORP address the period from 2009 to 2013. Goals of the respective plans are:

Maryland

- Improve the Maryland Department of Natural Resources' (MDNR) delivery of educational services.
- Find additional mechanisms to finance day to day operations of state land units, expansion of services, capital improvements to facilitate public access, and land acquisitions.
- Continue partnering with local governments and other land conservation interests to protect and manage land, and provide assistance to local governments and landowners on resource management matters.
- Research and planning.
- Land acquisition.
- Program Open Space (MDNR 2009).

Pennsylvania

- Strengthen connections between outdoor recreation, healthy lifestyles and economic benefits in communities.
- Reconnect people to the outdoors and develop a stewardship ethic through outdoor recreation opportunities and experiences.
- Develop a statewide land and water trail network to facilitate recreation, transportation and healthy lifestyles.
- Enhance outdoor recreation through better state agency cooperation (PADCNR 2011c).

4.2.2 Wild and Scenic Rivers

Each state, as well as the federal government, has a scenic and wild river program intended to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. No rivers within the Project area have received a wild and scenic designation by Pennsylvania. (PADCNR 2011a).

The Maryland Scenic and Wild Rivers System recognizes that many rivers in Maryland, or portions of them and their related land areas, possess outstanding scenic, geologic, historic, recreational, agricultural, fish, wildlife, cultural and other resources. Created in 1968, and administered by MDNR, the Scenic and Wild River System establishes a policy to preserve and protect the natural values of these rivers, enhance their water quality, and fulfill vital conservation purposes by wise use of resources within their surrounding environment.

No rivers within the Project area have received a wild and scenic designation by Maryland. Deer Creek, a tributary of the Susquehanna River located approximately three miles south of the Project boundary, was designated a Scenic River in 1973. A Maryland Scenic River is defined as a free-flowing river whose shoreline and related land are predominantly forested, agricultural, grassland, marshland, or swampland with a minimum of development for at least two miles of the river length (MDNR 2011a).

4.2.3 Maryland State-wide Water Trails Program

Administered by MDNR, this program is responsible for promoting the protection and creation of sites that provide public access to waterways and the development of water trails and other recreational boating opportunities throughout Maryland. Currently, MDNR is working with Harford and Cecil counties and the Lower Susquehanna Heritage Greenway to develop maps depicting the Susquehanna River based water trail. The project area for this trail extends from the Pennsylvania line to the Chesapeake Bay. (MDNR 2011b).

4.2.4 Maryland Lower Susquehanna Heritage Greenway Management Plan

This plan outlines strategies for enhancing heritage resources, achieving optimum visitations, encouraging compatible economic development, establishing mechanisms to improve stewardship and insuring long-term preservation and protection of cultural, historic, scenic, and natural resources within the Heritage Area (Glen Cove to Chesapeake Bay). The Lower Susquehanna Heritage Greenway is the oversight organization for this plan (LSHG 2011).

4.2.5 Maryland Natural Heritage Program

The program seeks to sustain populations of rare plants and animals through the maintenance of healthy natural ecosystems. The ecosystems are maintained by the restoration of degraded habitats, field surveys, research into natural history requirements and public education. The program also reviews proposed development projects for potentially harmful effects on rare species. Managed by MDNR, the program occasionally works with other agencies and private organizations to purchase properties supporting natural communities (MDNR 2011a).

4.2.6 Pennsylvania Exceptional Value Streams

Designated by PADCNR, streams with high biotic integrity and health are protected under Pennsylvania Department of Environmental Protection (PADEP) water quality regulations under the Clean Water Act. These regulations do not permit uses along the stream that leads to any degradation of the stream quality. Fishing Creek is a designated Exceptional Value Stream (PADCNR 2011b).

4.2.7 Pennsylvania Lower Susquehanna Conservation Landscape Initiative

The Conservation Landscape Initiative (CLI), a PADCNR program, is a place–based strategy for natural resources stewardship and advocacy in key landscapes (PADCNR 2011b). The CLI program focuses on lands where there are strong natural assets and local readiness and support for land conservation, locally driven planning, and community economic revitalization efforts. The Lower Susquehanna CLI encompasses the Susquehanna River and riverside lands in York and Lancaster Counties.

Goals of the Lower Susquehanna CLI include:

- Improve public access to the river.
- Preserve environmentally sensitive areas.
- Preserve the forested river landscape.
- Improve water quality.
- Provide additional land and water based recreational opportunities.

4.2.8 Maryland Green Infrastructure Assessment

Developed by MDNR, this program is implemented as a tool to help identify and prioritize areas of greatest statewide ecological importance. It identifies large contiguous blocks of natural land interconnected by corridors to allow animal and plant propagate dispersal and migration. Individual parcels are evaluated for their relative conservation value to prioritize them for acquisition funding (MDNR 2003).

4.2.9 Pennsylvania Natural Heritage Program

A partnership between The Western Pennsylvania Conservancy, PADCNR, PFBC, and Pennsylvania Game Commission (PGC), this program gathers and provides information on the location and status of important ecological resources such as plants, vertebrates, invertebrates, natural communities, and geologic features. The program provides current, reliable, objective information to help inform environmental decisions associated with land development or land use changes (PNHP 2011).

4.3 County Management Plans and Programs

4.3.1 Lancaster County, Pennsylvania Management Plans and Programs

The Lancaster County Comprehensive Plan includes a Growth Management Element that identifies areas appropriate for urban growth and reinvestment and areas that should be maintained in agriculture, natural resource conservation, and similar uses.

In 2009, Lancaster adopted a new plan, "Greenscapes; The Green Infrastructure Element" of the Lancaster County Comprehensive Plan. This plan defines goals, objectives and strategies to preserve, conserve, restore, and enhance natural resources through the establishment of a countywide, integrated green infrastructure system (Lancaster County 2009). Recreation goals and objectives of Greenscapes are as follows.

- Protect large open spaces for passive outdoor recreational opportunities.
- Provide a diversity of close-to-home, active recreation opportunities within Designated Growth Areas.
- Create a countywide network of open/green spaces and connections between them.

- Provide convenient, accessible opportunities for outdoor recreation and exercise.

4.3.2 York County, Pennsylvania Management Plans and Programs

The York County Comprehensive Plan is also composed of several components including an Agricultural Protection Plan, Environmental Resources Inventory, Natural Areas Inventory (NAI), and an Open Space and Greenways Plan. The Agricultural Protection Plan analyzes designated rural areas in townships with regard to existing and proposed development, large farm parcels, soil quality, lands adjacent to preserved farms, and use of agricultural protection tools. It also provides a detailed action plan for the protection and preservation of agricultural land in township rural areas.

The Environmental Resources Inventory distinguishes between areas appropriate for growth and development and areas appropriate for open space and conservation uses. The NAI contains information on the locations of rare, threatened, and endangered species and on the highest quality natural areas in the County.

The Open Space and Greenways Plan provides a "greenprint" for developing a statewide network of greenways. The plan provides a vision for coordinated and comprehensive system of open space and greenways, and supports the maintenance and enhancement of open space and greenways throughout York County. (York County 2011).

4.3.3 Cecil County, Maryland Management Plans and Programs

The Comprehensive Plan serves as the policy guide and framework for the future growth and development in Cecil County. The plan components examine land use, water resources, transportation, public facilities, economic development, housing, environmentally sensitive areas, mineral resources and other natural resources (Cecil County 2010). Key goals and objectives of the plan include:

- Encourage the conservation of agricultural and forested lands.
- Plan and develop bicycle/pedestrian trails to create a network of trails.
- Protect recreational open space and resource lands and integrate greenways into the County's planning and development review process.

- Protect environmentally sensitive resources and natural features in all areas of the County, comprising steep slopes, streams, wetlands, floodplains, and habitat including the habitats of threatened and endangered species.

The 2005 Land Preservation, Parks and Recreation Plan has subsequently been incorporated into the Comprehensive Plan. It addresses County goals and objectives for recreation, parks and open space, agricultural land preservation, and natural resources conservation (Cecil County 2005).

4.3.4 Harford County, Maryland Management Plans and Programs

The Harford County Master Plan and Land Use Element Plan provide direction for addressing future growth, revitalization, adequate public facilities, economic development, and preservation and protection of natural resources, agricultural lands and historic resources. The Land Use Element Plan is the core of the Master Plan (Harford County 2004).

Additional Harford County Master Plan Elements include the following:

- Rural Element Plan – addresses preservation of the County's agricultural land base and open space.
- Chesapeake Bay Critical Area Program – addresses land use within 1,000 feet of tidal waters and wetlands.
- Land Preservation, Parks, and Recreation Plan – addresses the County's needs for preserving open space, natural resources, and agricultural lands and providing a variety of quality recreational environments.
- Natural Resources Element Plan – addresses the protection of sensitive areas (streams and buffers, steep slopes, floodplains, and RTE habitats).
- Historic Preservation Element Plan – addresses the County's historic preservation efforts.

5.0 EXISTING USE OF PROJECT LANDS AND WATERS

Exelon must ensure that any shoreline development activity that occurs within the Project boundary is consistent with Project license requirements.

There are approximately 46 miles of shoreline currently within the Project boundary. Forty three miles are associated with the Conowingo Pond impoundment and three miles downstream of the Conowingo Dam. The land serves many Project-related purposes, including (but not limited to) Project operations, public access, recreational use, wildlife habitat, seasonal cottages, and protection and conservation of rare, unique and special features and biota.

Project lands along Conowingo Pond are primarily a mixture of steep wooded slopes with interspersed areas of ledge outcrops. Downstream of Conowingo Dam, Project lands consist of level wooded lands with intervals with steep slopes beyond the Project boundary. Land use is limited is some areas due to the topography and slopes; slopes in many areas exceed 25%. The majority of Project land is undeveloped.

Exelon has programs and policies that guide and support the recreational use and management of the Conowingo Project lands (Appendices 5 and 6). FERC regulations require licensees to provide public access and recreational opportunities on Project lands consistent with area recreational needs. In some instances, approval from FERC is required for the non-project use of Project lands. Numerous public recreation sites and facilities are located within the Project. These range from fully built out facilities such as a public swimming pool to minimally improved boat carry-in access sites. Other portions of Project lands are managed under agreements with state, municipal, and non-governmental agencies as public recreation facilities. Two commercial marina operations are also located on Project lands.

Various utility structures, facilities and operations also occur on and adjacent to Project lands. These include electric utility generation facilities and transmission lines, municipal and utility water intakes, and an oil pipeline. The transmission lines and the pipeline which cross Project lands impact a very minimal amount of land and shoreline. Peach Bottom Atomic Power Station is located along approximately 1.5 miles of Project land along the west shore of Conowingo Pond, but is not located within the Project boundary. The various water intakes also have a minimal footprint on Project lands. These are shown on Figure 5.0-1.

There are ten clusters of seasonal cottages (totaling approximately 420) on Project lands. The majority of the cottages are located on the shorelines, but a few are also located on islands in the upper half of Conowingo Pond. Cottages are located on Big Chestnut, Little Chestnut, Hennery and Wolf Islands, while shoreline cottages are clustered in the vicinity of Muddy Creek and Broad Creek on western side of Conowingo Pond, and Fishing Creek and Peters Creek on the eastern side.

Cottages on the Conowingo Pond islands are subject to Exelon's "Conowingo Islands Public Use Policy" (Appendix 5) which regulates vegetation management and restricts any earth disturbance to minimize erosion and protect cultural resources. All cottages on Project lands are also subject to Exelon's "Cottage Rules and Regulations" (Appendix 3) which includes numerous requirements focused on development standards, erosion control and natural resource protection.

Exelon has developed and maintains a number of designated recreational sites and facilities within the Project boundary for public recreation. The Project's public recreation facilities are managed under a RMP, which is incorporated by reference into this SMP.

In addition to the RMP, Exelon has developed a land use classification system for Project lands based on aerial photography interpretation, ground truthing and corporate operating procedures and policies. Existing land uses are placed into one of the following land use classifications on the basis of the primary land use.

Class 1: Project Operations: Lands used for power generation and electric transmission/distribution infrastructure and purposes.

Class 2: Developed Recreation: Lands managed for developed public recreational facilities and activities. This includes commercial recreation facilities.

Class 3: Natural/Undeveloped: Lands that are primarily undeveloped and generally available for public access and use.

Class 4: Industrial and Other Non-Project Lands: Lands managed for industrial/commercial uses and other non-Project uses including shoreline stabilization projects.

Class 5: Public Access Lands: Public access lands are Project lands managed by federal, state, county agencies or conservation organizations under agreement with Exelon. Public access and use of the lands is generally allowed, though may be governed by the managing entity according to the type or level of activity or by season. These are typically unimproved lands, though parking areas, trails and other infrastructure may be provided.

Class 6: Cottage Lands: Lands leased to individuals for seasonal use.

These land classifications are depicted graphically on Figure 5.0-2.

Approximately 867 acres (81 percent of the terrestrial lands within the Project boundary) of the 1,069 acres of Project lands are fully open for public use. These lands comprise approximately 40.5 miles of shoreline within the Project boundary. Table 5.0-1 provides an overview of the amount of Project lands (acres) and the amount of Project shoreline (miles) for each of the six land classifications:

Table 5.0-1: Project Acreage and Shoreline Miles by Land Use Classification

Conowingo Project	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Area (acres)	73	105	596	129	19	147
Shoreline (miles)	3	5	25	2.5	0.5	10

5.1 Project Operations (Class 1)

These lands include 73 acres and three miles of shoreline that are specifically or primarily for power generation and transmission purposes. They include generating facilities, substations/switchyards, intake and discharge areas, and transmission line facilities and corridors and, where necessary, a secure buffer area around the facilities. For security and safety purposes, access to these lands is restricted to Exelon employees and contractors.

5.2 Developed Recreational Lands (Class 2)

This classification includes 105 acres and five miles of shoreline lands that are developed and managed for public recreational opportunities and access. The lands may be managed and operated by Exelon, a commercial vendor or a private lessee. and may have specific allowable recreational uses and operating hours.

5.3 Natural/Undeveloped Lands (Class 3)

These lands include 596 acres and 25 miles of shoreline that is mostly in a natural state without significant improvement or development, and is generally available for low impact public access and use and may support improved public non-motorized trails. Natural/Undeveloped lands may be used or developed, and reclassified for other purposes subject to all applicable regulations.

5.4 Industrial and Other Non-Project Lands (Class 4)

This classification includes 129 acres and 2.5 miles of shoreline lands used for industrial or commercial purposes, including non-project electric utility facilities and other non-project uses such as agriculture. These lands may be managed and operated by third parties under agreement with Exelon. Therefore, public access and other uses may be restricted. These lands may be used or developed, and reclassified for other purposes subject to all applicable regulations.

5.5 Public Access Lands (Class 5)

These lands include 19 acres and one half mile of shoreline that are both developed recreational facilities and landsin a natural state without significant improvement or development. Public access lands are Project lands managed by federal, state, county agencies or conservation organizations under agreement with Exelon. Public access and use of the lands is generally allowed, though may be governed by the managing entity according to the type or level of activity or by season. These are typically water access recreational facilities or unimproved lands, though parking areas, trails and other infrastructure may be provided in minimally developed areas.. Other uses of these lands may be permitted by the managing entity based on the terms and conditions of the agreement with Exelon, but only if the other uses are also consistent with the requirements of the standard use and occupancy article of the FERC License.

5.6 Cottage Lands (Class 6)

Cottage lands include 147 acres and 10 miles of shoreline land that are leased to individuals for seasonal recreation. This includes the presence of seasonal structures ("cottages") and other infrastructure for their use (access roads, utilities, docks, etc.). Use of these lands is exclusive to the lessee subject to lease terms and conditions, unless the lands are needed for Project purposes. All cottages are located on Conowingo Pond (see Figure 5.6-1).

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CONOWINGO HYDROELECTRIC PROJECT
PROJECT NO. 405

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Figure 5.0-1
Utility Infrastructure Locations

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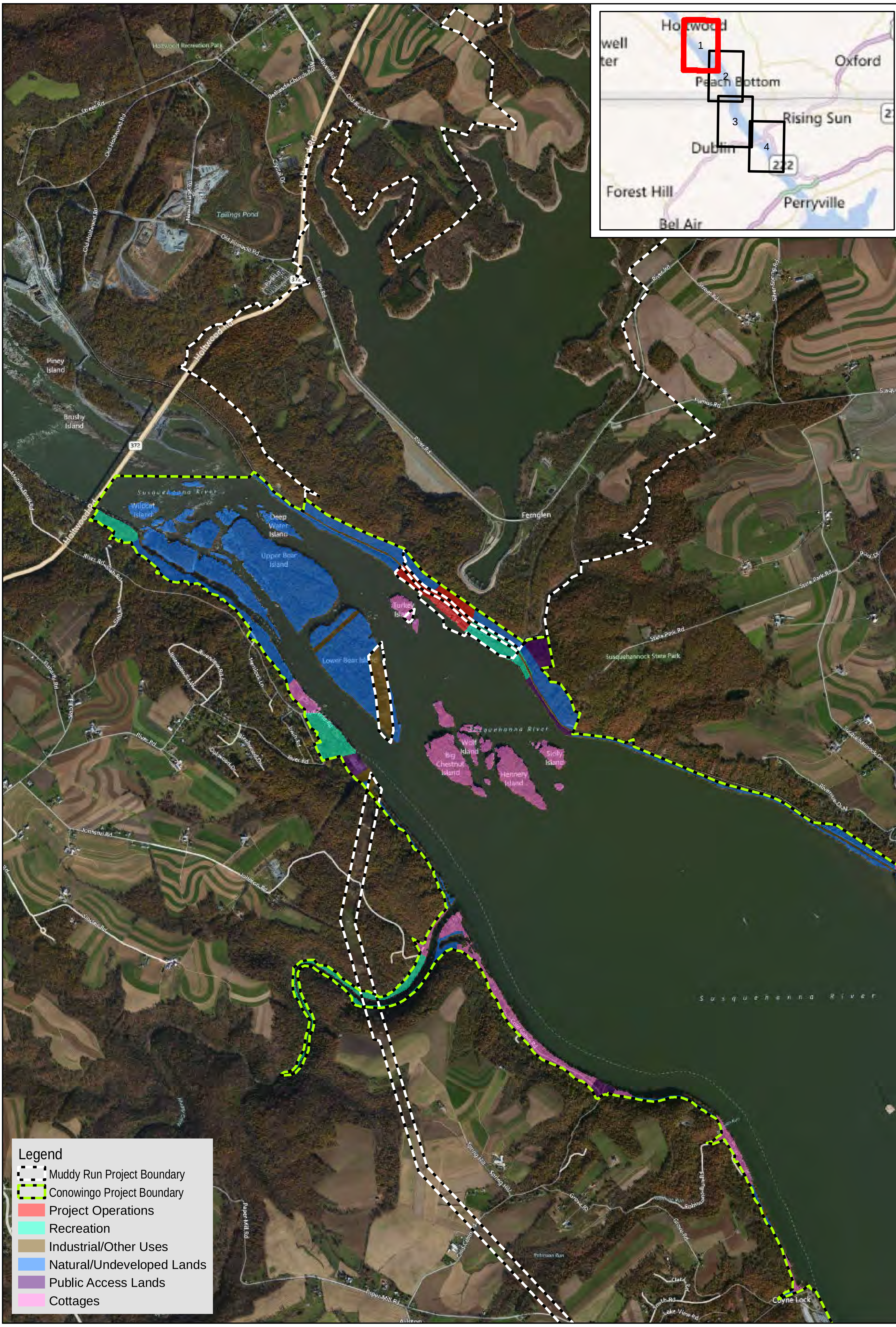

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Figure 5.0-2
Project Land Use Classification Map

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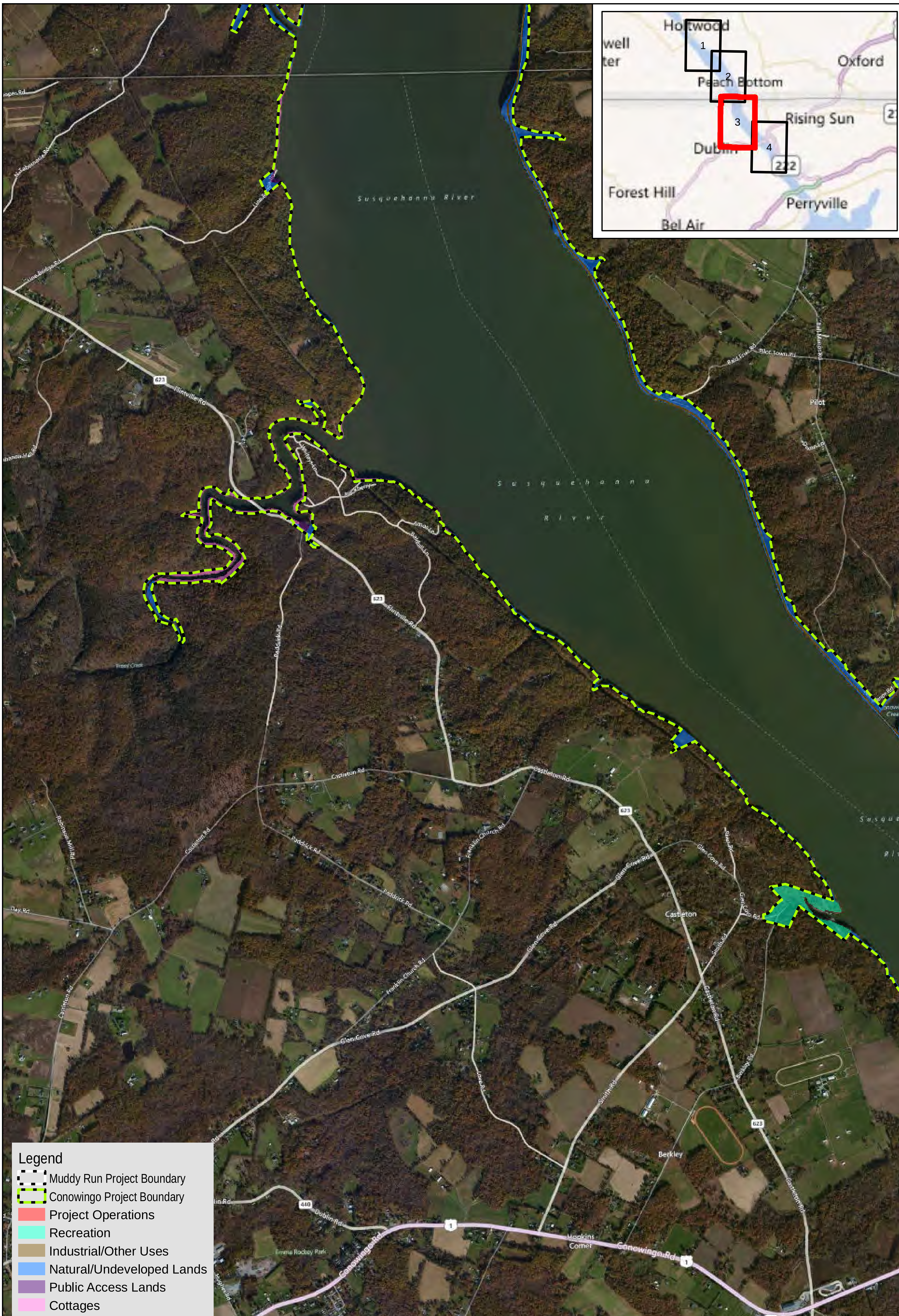

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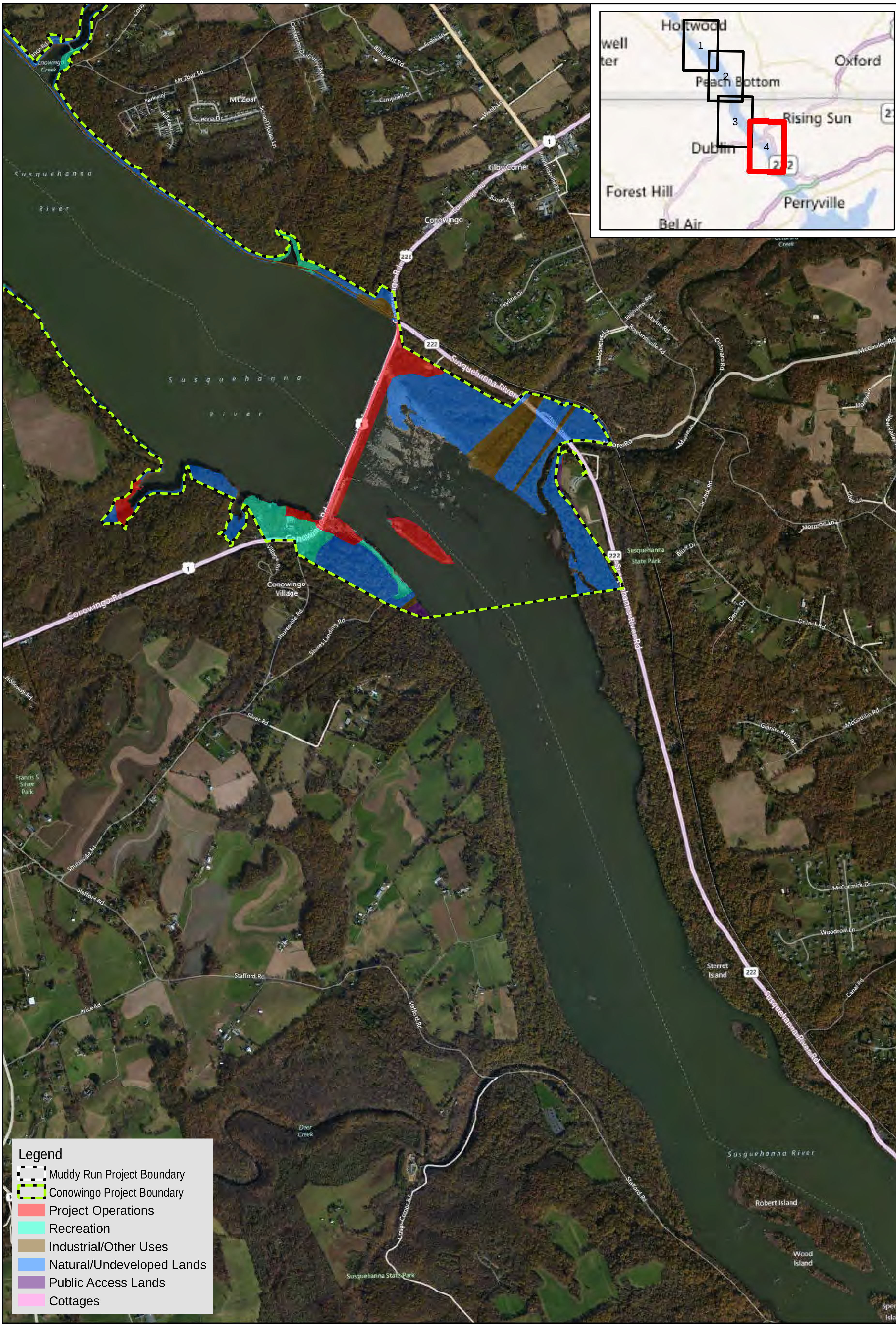

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Project Land Use Classification Map

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Figure 5.6-1
Cottage Clusters

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Conowingo
Cottage Lots

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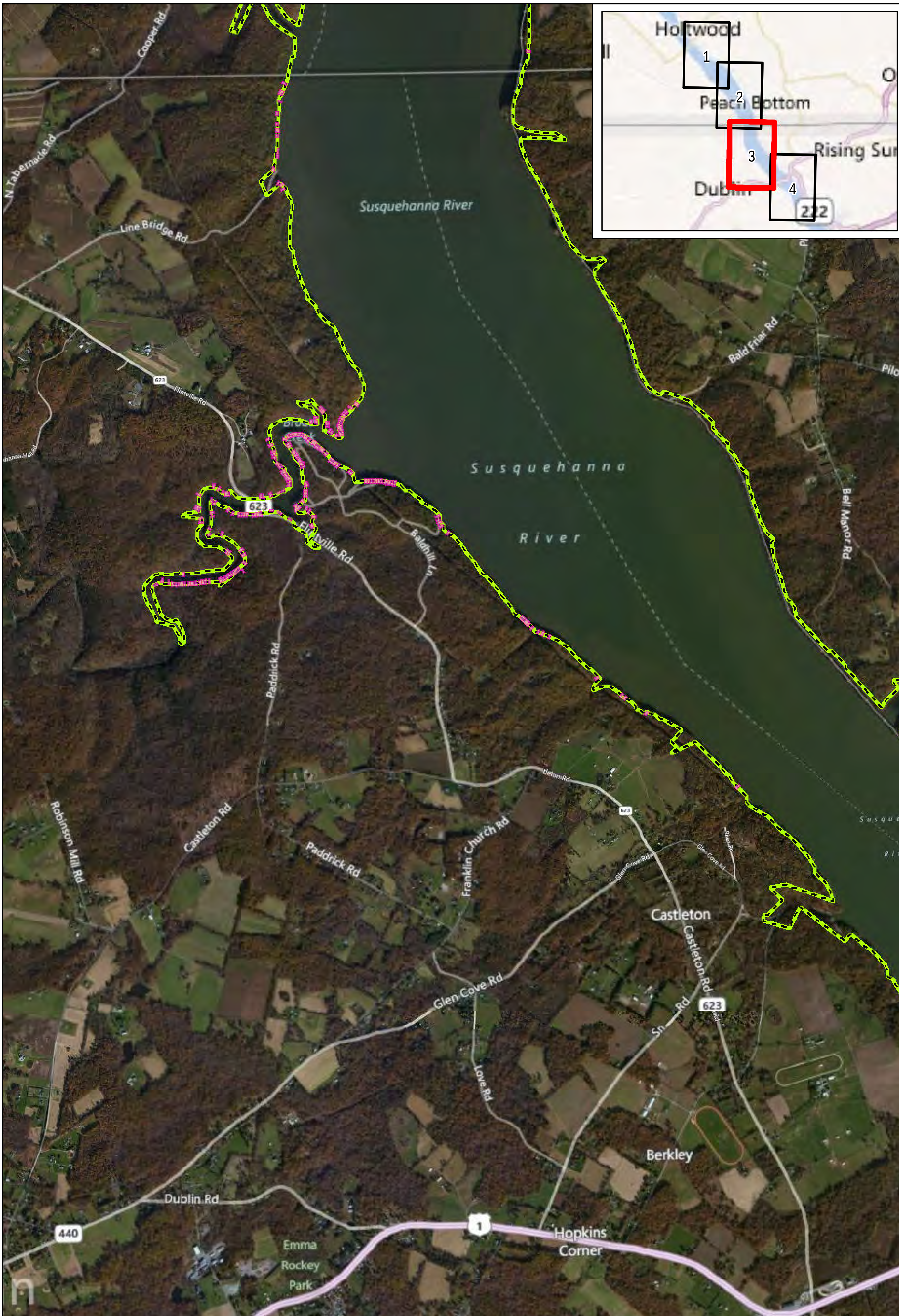

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Conowingo
Cottage Lots

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SHORELINE MANAGEMENT PLAN DOCUMENT
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Figure 5.6-1
Cottage Clusters

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Figure 5.6-1
Cottage Clusters

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6.0 SHORELINE MANAGEMENT PLAN MEASURES

Multiple resources were utilized to obtain information on the Project area in developing this SMP. Primary resources include Project relicensing studies and federal, state and regional plans pertaining to land use, development, protection and conservation, which were reviewed to determine their relationship to Project lands. Exelon's existing land use policies and programs were also reviewed, and where necessary, revised to ensure compliance with the conditions of this SMP.

6.1 Shoreline Management Policies

6.1.1 General Policy

Exelon is implementing the SMP to manage multiple resources and uses of the Project shoreline. These policies will ensure the protection and enhancement of the Project's recreational, environmental, historical, cultural, and scenic resources, consistent with the Project's primary function of generating electricity.

To accommodate safe uses of lands and waters within the Project boundary by the general public, Exelon maintains designated recreational areas for public recreation including formal camping, picnicking, hiking, fishing and other day-use activities. All other Exelon owned lands, except where specifically posted, are available for informal day use activities.

6.1.2 Shoreline Erosion Control

Modifications are allowed to shoreline vegetation in order to construct erosion control measures, provided the modifications do not impair the overall function of the vegetated buffer and are performed consistent with applicable BMPs. Trees and shrubs on steep slopes will be maintained whenever possible. If the buffer function would be impaired, a planting plan, using the native species plant list included in Appendix 2 of this SMP, will be devised and implemented to mitigate for the reduced function of the disturbed shoreline.

6.1.3 General Maintenance

Modifications are allowed to shoreline vegetation to maintain the health of the shoreline vegetation, provided the modifications do not impair the overall function of the vegetated buffer. Dead, dying, diseased or hazardous trees and shrubs may be removed. In addition, non-native invasive vegetation may be removed. If the buffer function would be impaired by vegetation removal, a planting plan will be devised and implemented to mitigate for the reduced function of the disturbed shoreline. Planting plans required by actions subject to this SMP will be prepared using the native species list included in Appendix 2.

6.1.4 Erosion and Remediation Policy

Exelon has identified and characterized incidences of erosion on lands in the Project boundary. If it is determined that any erosion areas affect Project resources, Exelon will include these areas in a remediation program, monitor the areas, and perform any required improvements in accordance with applicable BMPs.

6.1.5 Woody Debris Management

Woody debris is defined as trees and woody material that extend from the shoreline into the impoundment. This material can provide important habitat for fish and wildlife and shall be left in place unless the debris is determined, on a case by case basis, to be a navigational or safety hazard.

6.1.6 Approval of Non-Project Use of Project Lands

Any use of or construction on lands within the Project boundary by a non-licensee must be permitted by the appropriate agencies and receive Exelon approval before work can begin. Parties requesting non-Project use of Project lands will be required to provide Exelon with sufficient information for Exelon to determine if the proposed use or occupancy is consistent with the requirements of the Project license, including this SMP, and otherwise consistent with Exelon's applicable policies. Exelon will also determine whether the proposed use or occupancy can be approved pursuant to the standard use or occupancy license article, or whether prior approval by FERC is required. If Exelon, in its discretion, decides to support the proposed use or occupancy, it will execute the necessary conveyance of rights when it has received any necessary approval from FERC and the non-licensee has obtained all necessary permits and approvals.

Exelon has developed specifications and standards associated with the cottages to address shoreline development such as piers, docks, boat ramps, and bulkheads, as well as affects on cultural resources, and compliance with local, county, state and federal laws and regulations (see Appendix 3).

6.1.7 Shoreline Vegetation Management

There are approximately 46 miles of shoreline associated with the impoundments comprising the Conowingo Project including 43 miles associated with Conowingo Pond and three miles associated with the area downstream of Conowingo Dam. Much of the shoreline is currently buffered with natural vegetation.

Shoreline vegetation provides many benefits to the Project including wildlife habitat, maintaining water quality by providing a filter strip to control run-off, erosion, and aesthetics. Existing shoreline vegetation will be preserved where feasible. It currently varies in depth depending on the location of the Project boundary relative to the impoundment shoreline and current land use.. Existing improved and developed areas with limited shoreline vegetative cover such as the cottage clusters, the Peach Bottom Atomic Power Station (PBAPS), recreation sites and facilities, and the dam and associated generating facilities, can be maintained as they currently exist. Modifications to the shoreline vegetation in other areas will be considered for view shed maintenance and development, recreation access, shoreline erosion control, and general Project related maintenance of the vegetated shoreline.

6.1.8 View Sheds

Modifications and maintenance of vegetation is allowed to provide a reasonable view of the water, provided the modifications do not impair the overall function of the vegetated buffer. If the buffer function would be impaired, a planting plan, using the native species plant list included in this SMP, will be devised and implemented to mitigate for the reduced function from vegetation removal.

6.1.9 Access Trails

Modifications are allowed to the vegetation to provide access trails along the shoreline and to the water, provided the modifications do not impair the overall function of the vegetated buffer. If the buffer function would be impaired, a planting plan, using the native species plant list included in this SMP, will be devised and implemented to mitigate for the reduced function from vegetation removal.

Trees and shrubs may be pruned or removed to provide or maintain an access trail. Trails will not exceed six feet, and should be located so that a cleared line of sight to the water through the vegetated buffer is not created. Where possible, new trails will meander, in order to more effectively trap precipitation runoff with vegetation and natural depressions within the vegetated area.

To control trail surface erosion, areas of exposed soil will be vegetated, mulched, or surfaced with a permeable material.

6.1.10 Sensitive Natural Resource Protection Overlay and Policies

Research and numerous studies were conducted to assess and determine the existence of or potential effects (if present) of project operations on various resources, including rare, threatened and endangered (RTE) species terrestrial and aquatic habitat, historic and cultural sites and structures, wetlands, unique natural areas, and steep slopes. Sources for this information are listed in Appendix 4.

Exelon has compiled existing and new data on these resources to develop a "sensitive resources" overlay to apply to the six land use categories described in Section 5.0 above. This overlay is defined as areas within the Project boundary that may (or have been confirmed to) contain resources protected by state or federal law or executive order, and other natural features that Exelon considers important to the area or natural environment.

The presence of these resources may partially or completely limit or restrict land use and/or development, regardless of the applicable land classification described above.

Figure 6.1.10-1 shows the six Project land classifications with the current sensitive resources overlay applied. Due to the sensitive and confidential nature of certain resources, the overlay has been purposely developed to represent a compilation of all the individual resources so no specific resource can be readily identified.

The sensitive resource overlay data will be updated as resources are verified and as new information and data is collected from documented and verified sources. Exelon may use specific resource data from the overlay to designate resource sites and buffer areas for conservation, preservation, and protection purposes.

Prior to the implementation of any proposed modification of an existing use or new use of project lands by Exelon or a non-licensee, Exelon will determine if the potential use would affect any sensitive resources identified on the overlay. Exelon will survey (or require the non-licensee proposing a non-project use of project lands to survey) the affected land to determine if it hosts any sensitive resources not previously identified. If any sensitive resources are identified, Exelon will take appropriate protective actions developed in consultation with appropriate resource agencies prior to undertaking the proposed use, or require a non-licensee proposing to use project lands to take the same measures as a condition of conveying the right to use or occupy project lands.

6.1.11 Bald Eagle Management Plan

Bald eagles (*Haliaeetus leucocephalus*) use Project lands and waters for nesting, roosting and foraging. Exelon has developed a Bald Eagle Management Plan (BEMP) in consultation with the FWS, the PGC, and MDNR that is incorporated herein by reference. The BEMP addresses potential impacts to bald eagles on Exelon lands, including the project area lands for the Conowingo Project and adjacent lands under Exelon ownership.

The BEMP provides 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. Bald eagle habitat, including nest sites, forage sites, and communal roost sites on Exelon lands will be managed through a range of measures. The range of measures will be 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.

6.1.12 Osprey Management Policy

Exelon will 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).

6.1.13 Historic Properties Management Plan

Exelon has developed, in consultation with PHMC and MHT, an HPMP to address historic and cultural resources within the Project's APE. The HPMP is incorporated herein by reference.

6.1.14 Conowingo Island Public Use Policy

The policy establishes guidelines for the use of the islands located in the upper reach of Conowingo Pond from the Pennsylvania Route 372 bridge to approximately one mile downstream, as well as Mt. Johnson Island, which is located five miles downstream of the Route 372 bridge. The policy restricts and regulates island use in order to protect rare species, cultural resources, and unique geologic and physical features. The "Conowingo Islands Public Use Policy" is included as Appendix 5.

6.1.15 Leased Premises Policies

6.1.15.1 Cottages

Exelon has developed rules and regulations regarding the use of Project lands for seasonal cottages. 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 erosion control, vegetation removal, wastewater disposal, shoreline development, and cultural resource protection. Rules and regulations have been developed for Pennsylvania and Maryland cottages, and copies for each State are attached as Appendix 3.

It is Exelon's policy not to create any new cottage lease lots within the Project boundary. In addition, as existing cottages are abandoned or become damaged and are not replaced due to local zoning restrictions, leases will be terminated. All structures and improvements removed from the leased lot and the property will be restored to a natural condition. No future cottage leases will be issued at the site.

6.1.15.2 Public Recreation and Access Facilities

Exelon leases numerous parcels of land to local, county and state agencies and to commercial vendors for development and operation of public recreation and access facilities within and adjacent to the Project Boundary.. The agreements specify that the respective lessees will use the properties for park and public recreation access and facilities and comply with all applicable local, state and federal regulations. All of these sites and facilities within the Project boundary are Project recreation facilities under Exelon's FERC license.

Exelon has developed "Rules and Regulations Governing the Use and Occupancy of Leased Premises" and have made these part of the lease agreements for the two existing Project marina facilities, Glen Cove Marina and Peach Bottom Marina. These rules and regulations parallel those developed for the cottages in addressing many of the same issues, and a copy is attached as Appendix 3.

Exelon will continue to partner with the agencies and vendors for the operation of these facilities and their use by the public. As the Licensee, Exelon ultimately has responsibility for the operation and maintenance of the Project facilities.

6.1.16 Policy Restricting Certain Recreational Uses

Exelon provides public recreation and access to Project lands and waters pursuant to its FERC license requirements. Access and use of certain portions of Project lands will be restricted for operational, safety and security reasons.

Fishing: Fishing in Project waters accessible to the public will be governed by applicable state regulations. Fishing will not be allowed within secure areas or areas that present public safety concerns of the Conowingo Project. This includes shoreline fishing within 100 yards of the base of Conowingo Dam at Fishermans Park (west shore) and for 4,000 feet along the east shoreline downstream of the dam. These areas are restricted for public safety reasons due to changes in water elevations and velocities from generating flows and spilling water during gate operations. In addition to safety concerns, the area along the west shore is also used as a staging and storage area related to dam maintenance.

Boating: Boating in Project waters accessible to the public will be governed by applicable state regulations. Boating is prohibited in areas 400 yards above and 400 yards below Conowingo Dam pursuant to the Code of Maryland Annotated Regulations, Title 08.18.26.05. The boating exclusion zones are marked by buoys on Conowingo Pond and by signs downstream of the dam.

Hunting: Hunting on Project lands accessible to the public will be governed by applicable state regulations. Hunting will not be allowed on Project lands posted against hunting by Exelon, as necessary, to protect the public, adjacent landowners, lessees, employees, sensitive resources, and Licensee's operating capabilities. Hunting on Project lands accessible to the public will be governed by Exelon policies and applicable state regulations.

Exelon issues permits for offshore (water access only) stationary duck blinds and duck blind sites on Exelon land to hunters on an annual basis. The permits allows applicants (up to four individuals per permit) to have no more than two blinds or sites.

Off-Road Vehicles: Use of off-road vehicles (ORV) on Project lands is prohibited. Exceptions may be made for company related purposes for employees and contractors, emergency personnel, agency personnel during their normal duties, and instances where an ORV is for ADA access for an approved activity or use.

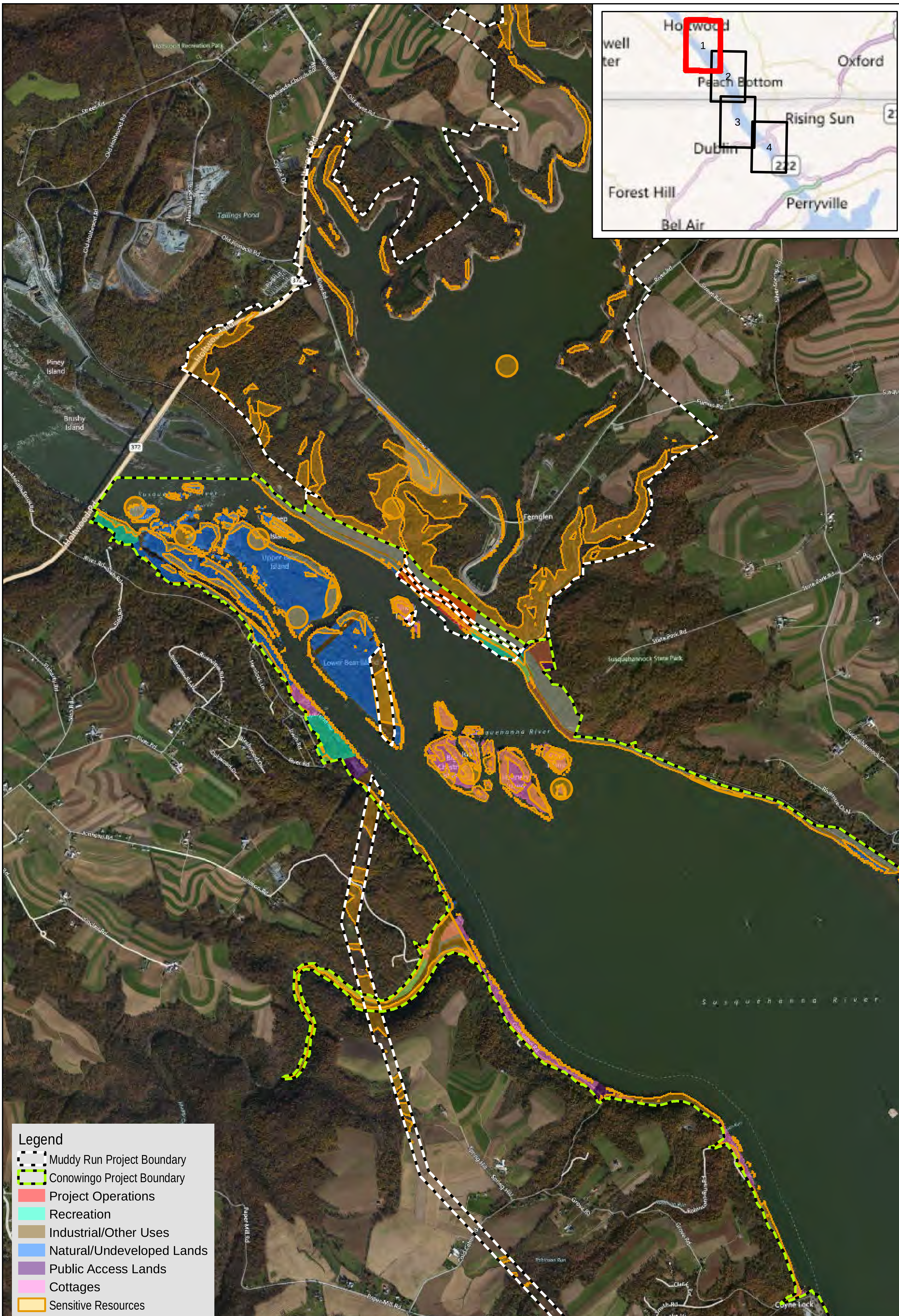

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Figure 6.1.10-1
Project Land Use Classification Map
w/ Sensitive Resources

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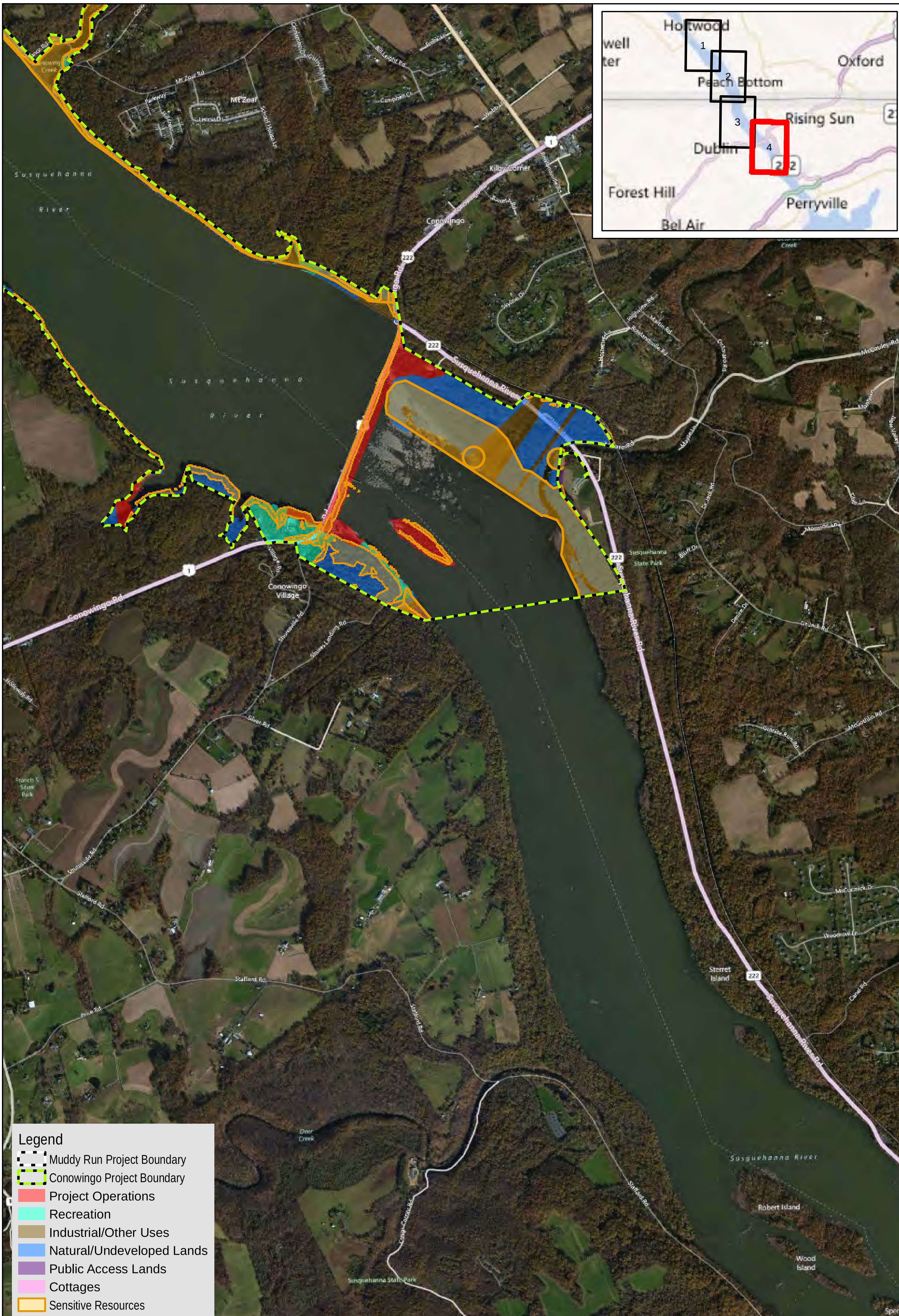

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Project Land Use Classification Map
w/ Sensitive Resources

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7.0 MONITORING OF AND COMPLIANCE BY NON-PROJECT USERS OF PROJECT LANDS

Exelon will ensure that uses and occupancies of Project lands are consistent with the license's requirements for the protection and enhancement of environmental resources, scenic character, historic and cultural resources, the provision of public recreation, public health and safety, and the safe operation of the Project's generating facilities.

Each conveyance of the right to use or occupy Project lands for a non-project purpose will be made subject to Exelon's obligation to comply with the Project license. To facilitate compliance, Exelon will periodically monitor and assess affected lands and any structures thereon, as necessary. If a non-licensee fails to cure any violation of its agreement with Exelon or acts to prevent Exelon from exercising its rights with respect to monitoring and access, Exelon will revoke the conveyance and require the non-licensee to remove any improvements on Project property and restore the site to its pre-conveyance condition. In addition, each conveyance will reserve Exelon's right to take legal action as necessary to enforce the agreement or obtain remedies for breach of the agreement.

8.0 AMENDMENTS

In order for the SMP to remain a functional plan over the life of the FERC license, Exelon will evaluate appropriate amendments to the SMP as the facts and circumstances may warrant.

9.0 SHAREHOLDER CONSULTATION

In developing this SMP, the licensee consulted with various stakeholders throughout the planning and development process. Consultation incorporated stakeholder review of several versions of the SMP study plan and opportunities for public comment, including the following.

- An August 2009 Proposed Study Plan (PSP).
- September 2009 stakeholder meetings.
- A December, 2009 Revised Study Plan (RSP) filing with FERC. Stakeholder comment periods were also provided for the PSP and RSP.
- An Interim SMP was filed with FERC in February 2011 and an agency follow up meeting was held in March, 2011.
- Public meetings were held in four locations in June 2011. Four agency and stakeholder meetings were held in July 2011 to solicit comments from interested parties. Participants at these meetings were able to ask questions and provide input into the development of the SMP. Comment cards were also provided to those not wishing to speak publically. Parties were allowed 30 day timeframes to submit written and e-mail comments on the SMP after the June and July meeting dates.
- A January, 2012 Updated Study Report filing with FERC. Stakeholder comment periods were provided for the second Updated Study Report filing.

Copies of the above-mentioned meeting minutes and subsequent correspondence are maintained and updated as necessary on Exelon's Conowingo Relicensing website, located here:

http://www.exeloncorp.com/powerplants/Conowingo/relicensing/meetings.aspx.

The correspondence record for the SMP is included in Appendix 7. Also included is a response summary to comments received on the Draft SMP distributed Feb XX, 2012.

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APPENDIX 1 – BMP MEASURES

Appendix 1

Best Management Practices for Water Quality Protection

Conowingo Shoreline Management Plan

Table of Contents

BMP Implementation Criteria

This SMP outlines management measures which apply to all of the lands within the Conowingo Project boundary. In addition to the overall measures contained in the SMP, Exelon will incorporate, where applicable, the Best Management Practices (BMPs) included herein to the extent practicable. In addition, improvement projects which occur on Project lands that involve earth disturbance and are subject to land use permitting requirements (site plan or building permits) must also be in compliance with all applicable municipal, county, state, and federal permitting requirements associated with erosion and sedimentation measures and control.

Project Facility Landscaping and Lawn Care BMPs

Proper Storage and Handling of Chemicals

- Store chemicals in a secure facility with an impervious floor and good ventilation. The floor should have a curb, sump, or lip to contain spilled contaminants.
- Research proper construction materials and designs for storage facilities.
- Provide a secondary containment system that will hold a larger volume than the largest container/tank used.
- Store the chemicals in their original containers and organize them according to application (herbicides, pesticides, insecticides).
- Prior to use check equipment calibration and look for leaking, especially valves and overflowing tanks.
- Develop a permanent mixing/loading and washing zone on an impervious surface where washwater can be easily contained or collected. Note: Pesticide washwater should be handled separately from other washwater unless a system has been developed to handle both.
- Always follow the directions pertaining to the storage, mixing, and disposal of chemicals that are on the labels.
- All areas involved in the storage, mixing, or disposal of chemicals should be located away from surface, ground, and well-water sources.
- Maintain a current material safety data sheet for each chemical on-site. Employees should be made aware of how to safely apply chemicals.
- Have an on-site emergency plan in the event of an uncontained spill or another emergency including information on what emergency response teams to notify (LandStudies Inc. & Pennsylvania Environmental Council 17).

Selection and Application of Chemicals

Selection

- Choose chemicals with short half-lives, low toxicity, and medium sorption rates to reduce the effects of leaching and reduce runoff.
- Consider how quickly a chemical accumulates in live tissue.
- Don’t use broad-spectrum herbicides, use the most specific chemicals available.
- In general limit the use of pesticides with soils that have a persistence greater than 21 days, a soil adsorption value less than 300, and a solubility greater than 30 mg/l (per the Delaware River Basin Commission).
- Avoid using wettable powders, which are more prone to runoff.
- Vary which chemicals you use to reduce pest resistance.
- Select turf species that are resistant to pests and disease.
- Limit practices or the use of products that could possibly contribute to pollution.

Application

- Consider the weather conditions prior to application. Spray drift is affected by particle size and wind. Rain within 12 hours of application can greatly increase chemical runoff. Depending on the mode of action of the applied chemical, light irrigation or rain can increase the amount of chemical reaching the soil.
- Calibrate and check that equipment application rates are appropriate.
- Strictly follow product labels.
- Regularly look for ways to improve soil health. This will improve turf health and increase its defense against pests and disease and it will limit the amount of chemical treatment required.
- Use the life cycle of pests to determine when they are most vulnerable and time when chemicals are applied.
- Record when chemicals were applied and the effectiveness of the application for future management.
- Prior to application consider environmentally sensitive areas such as groundwater recharge areas (sinkholes, highly permeable soils, soils with low adsorptive capacity, wells), surface water bodies, and non-target areas (water bodies, natural areas and wildlife). Decide if treatment is necessary and which chemicals to use. Spot treatment or the use of covered booms may be appropriate (LandStudies Inc. & Pennsylvania Environmental Council 19).

Development of a Nutrient Management Plan

- Use quick release fertilizers primarily for turf establishment. For other areas use slow release fertilizers which release nutrients at a pace which is similar to the nutrient intake rate of the plants.
- Do not apply nutrients on frozen ground.
- Follow nutrient application recommendations from a reliable source.
- Mow, topdress, and aerate to maximize fertilizer effectiveness (LandStudies Inc. & Pennsylvania Environmental Council 21).
- Apply appropriate fertilizers and amounts based upon the plant needs for that area.
- Create non-fertilized buffers along bodies of water.
- Use slow-release fertilizers on or near steep slopes and sandy soils.
- Do not use fertilizers to deice anything.
- Stabilize disturbed soils quickly.
- Route drainage systems to low-maintenance filtering zones such as tall grass (LandStudies Inc. & Pennsylvania Environmental Council 22).

Buffer Strip Vegetation

- New vegetation should be chosen from Exelon’s native plant list included in the Shoreline Management Plan for the Project.
- Limit or eliminate fertilizer or chemical use in buffers to maximize their filtering abilities.
- Buy vegetation from local nurseries.
- Monitor and maintain health of buffers using a pest management plan.
- Install signs and fencing to protect buffers.

- Do not dispose grass clippings or pruning within buffers.
- Mow buffers once or twice a year, but make sure it is done in accordance with any applicable RTE species management plans (LandStudies Inc. & Pennsylvania Environmental Council 32).

Composted Materials Usage

- Composted material should include grass and other herbaceous clippings, green leaves, non-fat/non-animal food wastes, and small woody material. This mixture will help fight diseases your vegetation may encounter.
- Maintain the correct proportions of air, water, carbon, nitrogen and pH. Appropriate levels of each will kill undesired weed seeds.
- Consult multiple sources before beginning to compost (LandStudies Inc. & Pennsylvania Environmental Council 35).
- Use compost on clay soils to reduce surface crusting and compaction, provide nutrients, promote drainage, and improve overall soil structure.
- Use compost on sandy soils to add nutrients, increase microbial activity, and increase the capacity of the soil to hold nutrients and water.
- Use core aeration to better incorporate the compost with the soil.
- Use a 3:1 ratio, by volume, of carbon-rich material (dried leaves) to nitrogen-rich material (clippings).
- Compost material for two years to maximize the benefits for the turf.
- Test the compost for nutrients prior to application and adjust fertilization practices accordingly.
- Review and familiarize yourself with local and state regulations before beginning a compost operation (LandStudies Inc. & Pennsylvania Environmental Council 36).

Pet Waste Education/Treatment

Definition

Teaching visitors the benefits to water quality from cleaning up after their pets.

Purpose

Animal waste washed into the water supply decrease oxygen supplies, carry diseases and promote eutrophication (weed and algae growth). All of which have negatively effects on water quality.

Conditions Where Practice Applies

Public recreational locations where people own and interact with pets.

Design Criteria

Launch an education campaign describing the negative effects of leaving pet waste alone and emphasize the effects on water quality.

Install signs in public spaces asking owners to pick up after their pets.

Create stations in parks, recreational areas, or other public places with plastic bag dispensers for owners to use.

Pet waste shall be picked up and disposed of appropriately by the pet owner. Removal of pet waste from the public recreation facility shall be the responsibility of the pet owner.

Maintenance

These programs require residents and recreational users to enforce the practice amongst themselves.

Signs may need to be installed.

Generic Design Parameters

NA

Structural and Natural BMPs

Vegetated Riparian Buffers

Definition

Areas of natural vegetation maintained to protect the water quality of nearby water bodies of conveyances.

Purpose

To trap sediment, improve groundwater recharge, and slow runoff.

Conditions Where Practice Applies

For all new activities, riparian buffers may be created wherever vegetation can be supported next to bodies of water, especially on floodplains, near wetlands, on unstable slopes, or along streambanks.

Design Criteria

Make sure soil is not compacted.

Determine buffer width using slope, species of vegetation, runoff sediment characteristics, annual rainfall, pollutants and potential volumes, soils, and depth to impermeable layers.

Increase buffer width as slope increases.

Mix various types of vegetation, shrubs, grasses, and trees.

In areas where there is fast, concentrated flow incorporate other measures such as level spreaders to prevent erosion and rilling.

Maintenance

Initially buffers can require weed/pest control, fertilizing, mulching, seeding, mowing, irrigating, and pruning. Once installed check the buffer after heavy rainfall or once a year, focusing on the development of gully erosion, vegetation density, damage from foot or vehicle traffic, or damage from concentrated flows. When or if 6" of sediment has accumulated remove it.

Generic Design Parameters

Slopes should be less than 5 percent unless erosion control blankets are used ("Vegetated buffers" 2006).

Rain Garden/Bioretention Pond

Definition

Parking lot islands or small landscaped areas used to detain and treat stormwater runoff.

Purpose

To slow and treat water before it is collected in storm drain systems.

Conditions Where Practice Applies

Rain Gardens/Bioretention Ponds will be considered for all future new construction or major rectonstruction. This BMP is not applicable to existing facilities.

Raingardens may be used in locations where there are concentrations of pollutants greater than in normal stormwater only when an impermeable layer has been installed along the bottom of the filter bed.

Raingardens may be developed in highly urban areas because they can fit into parking lot islands.

Design Criteria

Bioretention areas should usually be implemented with drainage areas less than 5 acres. Designing for larger drainage areas can present clogging and conveyance issues.

The slope of the drainage area is usually around 5 percent.

The raingarden should be higher than the highest groundwater table elevation in order to prevent groundwater contamination.

The raingarden should be able to direct flow to a nearby storm drain in the event of overflow during a large storm event.

In terms of landscaping most of the plants used should be native. Plants towards the bottom of the raingarden should be able to withstand wet and dry conditions. Plants at the top of the bioretention facility should be durable and resilient, while plants of the edges should be dry.

When the soils are beneficial to infiltration process the underdrain may only be installed under some of the raingarden; otherwise, install the perforated pipe underneath the entire raingarden.

Maintenance

Standard (as needed)

- Remulch
- Treat diseased plants
- Mow grass/turf

After Project Completion

- Water plants daily for 2 weeks

Monthly

- Inspect soil and repair eroded sections
- Remove litter and debris

Twice a Year

- Remove and replace dead/diseased vegetation

Once per Year

- Add mulch
- Replace tree stakes and wires

<u>Generic Design Parameters</u>

Raingardens are not flood control devices.

The size of a raingarden should be 5-10 percent of the impervious area draining to it.

The soil bed should be comprised of a sand/soil mix with a layer of mulch on top of it. The raingarden should be able to hold a small 6-9” deep pond on top of these layers of soil.

Consider using pretreatment measures such as a vegetated channel to eliminate some of the sediment and pollutants from the runoff and reduce the burden put on the rain garden (“Bioretention (rain gardens)” 2006).

Rain Barrels

Definition

Large containers used to collect rooftop runoff from.

Purpose

To collect the runoff from roofs and improve overall water quality by disconnecting impervious areas.

Conditions Where Practice Applies

Structures that have roofs and receive large quantities of rainfall.

Rain barrels will be considered for all future new construction or major rectonstruction. This BMP is not applicable to existing facilities.

Design Criteria

Consider using another method unless the water being stored will be used actively by the resident/business owner in gardening, landscaping, or in some other facet.

A plan for overflow and freezing conditions should be considered.

Maintenance

Keep the hose off the ground to avoid freezing/cracking. Clean out the tank once a year. Maintain a tight seal around the barrel to prevent mosquito breeding.

Generic Design Criteria

Use a drip tape or common garden hose for watering.

Control flow through the hose using an adjustable valve.

Storm Drain Marking

Label any newly constructed storm drain that enters surface water. Complete annual survey of storm drain covers, refresh labels as necessary.

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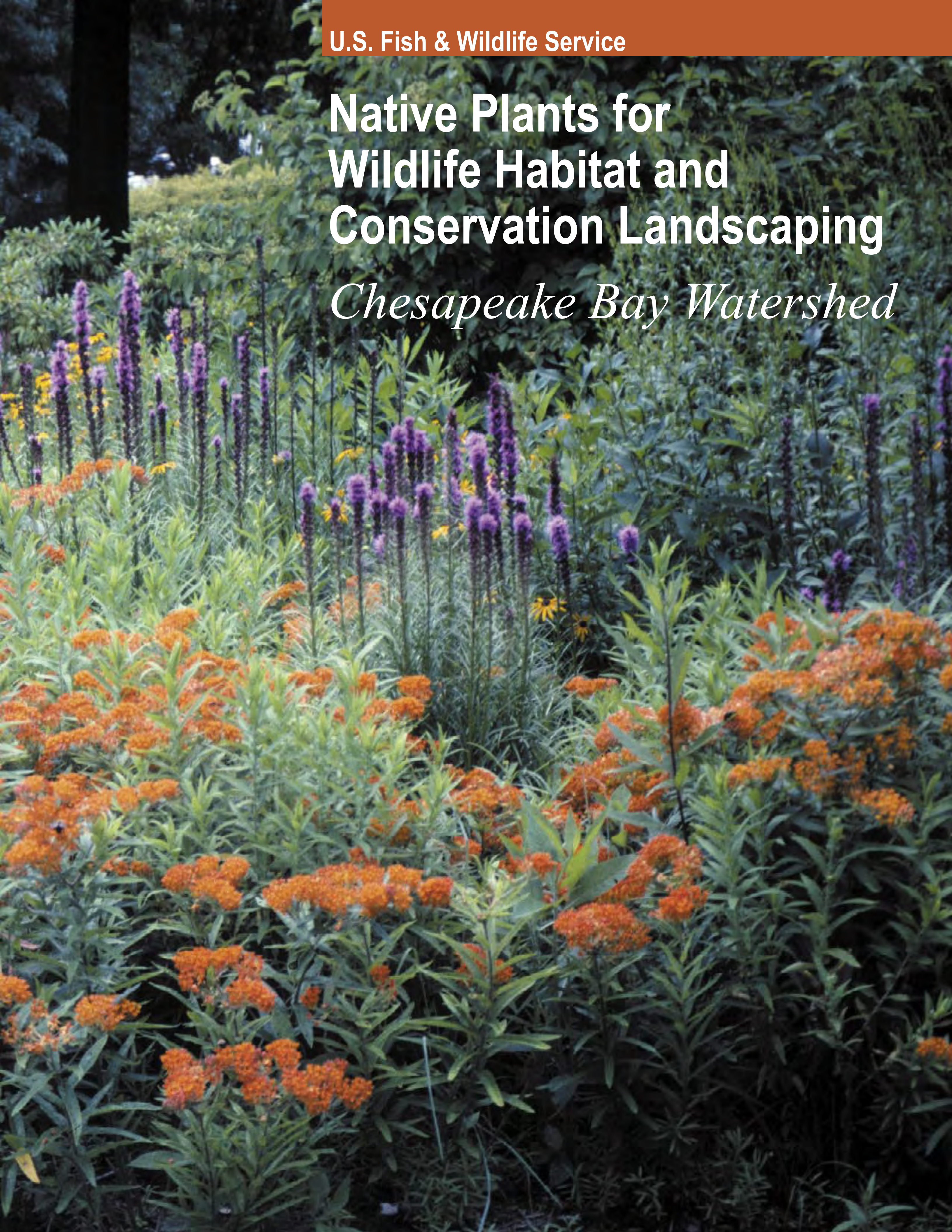
APPENDIX 2 – NATIVE PLANT LIST

U.S. Fish & Wildlife Service

Native Plants for Wildlife Habitat and Conservation Landscaping

Chesapeake Bay Watershed



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Reviewers: species included in this guide were reviewed by the following authorities regarding native range, appropriateness for use in individual states, and availability in the nursery trade:

Rodney Bartgis, The Nature Conservancy, West Virginia.
Ashton Berdine, The Nature Conservancy, West Virginia.
Chris Firestone, Bureau of Forestry, Pennsylvania Department of Conservation and Natural Resources.
Chris Frye, State Botanist, Wildlife and Heritage Service, Maryland Department of Natural Resources.
Mike Hollins, Sylva Native Nursery & Seed Co.
William A. McAvoy, Delaware Natural Heritage Program, Delaware Department of Natural Resources and Environmental Control.
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2003

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To the Reader

The use of native plants in landscaping and of course habitat restoration is certainly not new. In fact, their use has grown exponentially in recent years. Natural resources professionals in turn have been flooded with requests for information on native plants to use in various types of planting projects. Communities, schools, businesses, nonprofit organizations, watershed groups, local governments, state and federal agencies and many others are enhancing and restoring habitat, solving ecological problems, reducing maintenance, or just beautifying surroundings, all using locally native plants. Natural resources professionals, in turn, have been flooded with requests for information on native plants to use in various types of planting projects. There are many excellent resources available on native plants - some more technical than others, some more comprehensive than others. The frustration voiced most frequently by users is the lack of color photographs of the plants. After all, it is the striking visual quality of these plants that is their best "selling point."

This publication includes those pictures as well as user-friendly information on native species appropriate for planting in the Chesapeake Bay watershed and adjacent coastal regions. Although one guide cannot furnish the answers to every question, we have included as much useful information as possible in a limited space. Although the large number of species of plants included here may overwhelm some readers, this guide displays the great diversity of plants available. We hope you will bypass the over-used, non-native and sometimes invasive ornamental plants, and select the equally and often more attractive native plants. Pour through this guide the same way you look through nursery catalogs. Use it to plan and design your next planting, whether it's a small corner of your front yard, a two-acre meadow seeding, or 100 acres of wetland restoration.

Native Plants for Wildlife Habitat and Conservation Landscaping:
Chesapeake Bay Watershed

Introduction

"Conservation landscaping" refers to landscaping with specific goals of reducing pollution and improving the local environment. In the Chesapeake Bay watershed (the land that drains to the Bay and its many tributaries), this style of landscaping is sometimes called "BayScaping," or beneficial landscaping.

Conservation landscaping provides habitat for local and migratory animals, conserves native plants and improves water quality. Landowners also benefit as this type of landscaping reduces the time and expense of mowing, watering, fertilizing and treating lawn and garden areas, and offers greater visual interest than lawn. Beneficial landscaping can also be used to address areas with problems such as erosion, poor soils, steep slopes, or poor drainage.

One of the simplest ways to begin is by replacing lawn areas with locally native trees, shrubs and perennial plants. The structure, leaves, flowers, seeds, berries and other fruits of these plants provide food and shelter for a variety of birds and other wildlife. The roots of these larger plants are also deeper than that of typical lawn grass, and so they are better at holding soil and capturing rainwater.

Benefits of conservation landscaping

Americans manage approximately more than 30 million acres of lawn. We spend $750 million per year on grass seed. In managing our yards and gardens, we tend to over-apply products, using 100 million tons of fertilizer and more than 80 million pounds of pesticides annually. The average homeowner spends 40 hours per year behind a power mower, using a quart of gas per hour. Grass clippings consume 25 to 40% of landfill space during a growing season. Per hour of operation, small gas-powered engines used for yard care emit more hydrocarbon than a typical auto (mowers 10 times as much, string trimmers 21 times, blowers 34 times). A yard with 10,000 square feet of turf requires 10,000 gallons of water per summer to stay green; 30% of water consumed on the East Coast goes to watering lawns.

The practices described in this guide reduce the amount of intervention necessary to have attractive and functional landscaping. Conventional lawn and garden care contributes to pollution of our air and water and uses up non-renewable resources such as fuel and water. Many typical landscapes receive high inputs of chemicals, fertilizers, water and time, and require a lot of energy (human as well as gas-powered) to maintain. The effects of lawn and landscaping on the environment can be reduced if properties are properly managed by using organic alternatives applied correctly, decreasing the area requiring gas-powered tools, using native species that can be sustained with little watering and care, and using a different approach to maintenance practices.

With conservation landscaping, there is often less maintenance over the long term, while still presenting a "maintained" appearance. Conservation landscapes, like any new landscape, will require some upkeep, but these alternative measures are usually less costly and less harmful to the environment. New plants need watering and monitoring during the first season until they become established. Disturbed soil is prone to invasion by weeds - requiring manual removal (pulling) instead of chemical application. Over time, desired plants spread to fill gaps and natural cycles help with pest control. Garden maintenance is reduced to only minimal seasonal cleanup and occasional weeding or plant management. The savings realized by using little or no chemicals, and less water and gas, can more than make up for initial costs of installing the landscaping. Redefining landscaping goals overall and gradually shifting to using native species provide even greater rewards in terms of environmental quality, landscape sustainability, improved aesthetics, cost savings, and bringing wildlife to the property.

Why use native plants?

Native plants naturally occur in the region in which they evolved. While non-native plants might provide some of the above benefits, native plants have many additional advantages. Because native plants are adapted to local soils and climate conditions, they generally require less watering and fertilizing than non-natives. Natives are often more resistant to insects and disease as well, and so are less likely to need pesticides. Wildlife evolved with plants; therefore, they use native plant communities for food, cover and rearing young. Using native plants helps preserve the balance and beauty of natural ecosystems.

This guide provides information about native plants that can be used for landscaping projects as well as large-scale habitat restoration. All of the plants presented are native to the designated areas, however not *all* of the native species for that area have been included. Rather, plants have been included because they have both ornamental and wildlife value, and are generally available for sale. This guide covers the entire Chesapeake Bay watershed, including south central New York; most of Pennsylvania, Maryland and Virginia; the District of Columbia; Delaware, west of Delaware Bay; and the eastern panhandle of West Virginia.

The region's wildlife, plants, habitats and network of streams and rivers leading to the Bay are tremendous resources. As the human population throughout the Chesapeake Bay watershed grows and land-use pressures intensify, it is increasingly important to protect our remaining natural areas and wildlife, and restore and create habitat. By working together, these treasures can be conserved for future generations. Individual projects are great, collective measures are even better, yet every action helps no matter what size.

Conservation landscaping elements

We can incorporate elements of natural systems into the existing areas where we live, work, learn, shop and play. Landscaping provides valuable opportunities to reduce the effects of the built environment. These areas can be both aesthetically pleasing and functional. Use of native species will make your garden or landscaping more environmentally beneficial. By combining plant selection with some of the other concepts below, you can achieve more environmental benefits.

Reduce disturbance. Carefully decide where new development will occur to avoid destruction of existing habitat as much as possible. Take advantage of the site's existing natural features.

Reduce lawn or high maintenance areas. Replace turf or ornamental plantings by adding new landscaping beds and/or enlarge existing ones with native plants.

Think big, but start small. Draw up a plan for your entire yard but choose one small area for your first effort. Trial and error with the first project will help you learn without being overwhelmed. Phase in the whole project over time.

Use native plants. Start by using natives to replace dead or dying non-native plants, or as a substitute for invasive non-natives in existing gardens or landscaping. Plan to use native plants in new landscaping projects.

Avoid invasive species. Non-native plants can be invasive. They have few or no naturally occurring measures to control them, such as insects or competitors. Invasive plants can spread rapidly and smother or out-compete native vegetation. Invasive, non-native plants are not effective in providing quality habitat. A copy of the publication "Plant Invaders of Mid Atlantic Natural Areas" can be downloaded from www.nps.gov/plants/alien/pubs/midatlantic/index.htm.

Improve water quality. Native species planted on slopes, along water bodies and along drainage ditches help prevent erosion and pollution by stabilizing the soil and slowing the flow of rainwater runoff. To collect and filter runoff, depressions can be created and planted with native plants suited to temporary wet conditions. These "rain gardens" will capture water and hold it *temporarily for a*

In certain conditions, some native plants can also become aggressive spreaders, though their spread is more limited by natural controls than non-native aggressors. Plants that seed readily (such as black-eyed Susan, *Rudbeckia* species), or that spread by lateral roots (such as mint family plants *Monarda* or *Physostegia* species) should be used sparingly or controlled in gardens. Certain native species that are difficult to control or show up uninvited should not be planted, such as cattail (*Typha* species).

day or two and remove pollutants washing off of the surrounding land.

Enhance and create wildlife habitat. An animal's *habitat* is the area where it finds food, water, shelter, and breeding or nesting space, in a particular arrangement. If we want our gardens to have the greatest ecological value for wildlife, we need to mimic natural plant groupings and incorporate features that provide as many habitat features as possible.

Plants are one of the most important features of an animal's habitat, because they often provide most, or even all of the animal's habitat needs. Animals in turn help plants to reproduce through dispersal of pollen, fruits or seeds. Consequently, plants and animals are interdependent and certain plants and animals are often found together. So, it is important that plants be selected, grouped, and planted in a way that is ecologically appropriate.

Each plant prefers or tolerates a range of soil, sunlight, moisture, temperature and other conditions, as well as a variety of other factors including disturbance by natural events, animals or human activities. Plants sharing similar requirements are likely to be found together in plant *communities* that make up different habitat types - particular groupings of plant communities commonly recognized as wetlands, meadows, forests, etc. Some plants may tolerate a wider range of conditions than others, and therefore can be found at more than one type of site, in association with a different set of plants at each. By matching plants with similar soil, sunlight, moisture and other requirements, and planting them to the existing site conditions, the planted landscapes will do a good job of approximating a natural habitat.

Instead of isolated plantings, such as a tree in the middle of lawn, group trees, shrubs and perennials to create layers of vegetation. A forest has, for example, a *canopy* layer (tallest trees), *understory* layers (various heights of trees and shrubs beneath the canopy) and a ground layer or forest floor. These layers provide the structure and variety needed for shelter, breeding or nesting space for a diversity of wildlife.

To provide food and cover for wildife year-round, include a variety of plants that produce seeds, nuts, berries or other fruits, or nectar; use evergreens as well as deciduous plants (those that lose their leaves); and allow stems and seedheads of flowers and grasses to remain standing throughout fall and winter.

All animals need water year-round to survive. Even a small dish of water, changed daily to prevent mosquito growth, will provide for some birds and butterflies. Puddles, pools or a small pond can be a home for amphibians and aquatic insects. A larger pond can provide for waterfowl, such as ducks and geese, and wading birds such as herons. Running or circulating water will attract wildlife, stay cleaner and prevent mosquitoes.

Rock walls or piles, stacked wood, or brush piles provide homes for insects, certain birds and small mammals. Fallen logs and leaf litter provide moist places for salamanders, and the many organisms that recycle such organic matter, contributing nutrients to the soil. Standing dead tree trunks benefit cavity-nesting wildlife such as woodpeckers.

Consider naturalistic planting, or habitat restoration. It may be feasible to create a more natural landscape instead of a formal one. Naturalistic landscaping uses patterns found in nature, and allows some nature-driven changes to occur. Plants multiply, and succession or gradual replacement of species may take place, with less human intervention. A property located near natural areas, such as forests, wetlands and meadows, is a good candidate for a habitat project. Expand existing forest by planting trees and shrubs along the woods line, using native species that grow in the area, and allow birds and wind to bring the understory plants over time. Wet sites, areas with clay soils, or drainage ditches can be converted to wetlands. An open piece of ground or lawn can be planted as a meadow or grassland. Schools, homes, small businesses, large corporate sites, municipalities, military installations, recreational areas and other public lands can all include habitat plantings.

How to choose plants

Finding ready information about what plants “go together” for habitat restoration, enhancement, or creation projects is difficult. Often, the professional will examine a nearby natural area and try to mimic the combination of plant species found there. That may not be possible for individuals unfamiliar with natural areas. Fortunately, by following some simple guidelines, you will have garden spaces that grow well on your site and mirror the plant communities found naturally in your area. The plant lists found at the end of this guide will also help give you a start at planting appropriate groupings.

- **Know your site and plant to the existing site conditions.** Check the sun exposure, soil moisture and soil type where you plan to plant, and choose plants that will grow and thrive in those conditions. For a few dollars your state or local cooperative extension office can analyze a small soil sample you send them (for contact information, see your government listings in the phone book). The results will include soil type (sand, clay, loam, etc.), pH and fertility status and recommendations for amending the soil to make it into “average garden soil.” However, by selecting native species that thrive in the *existing* conditions, you won’t need to add soil, fertilizer, lime or compost. There are a wide variety of plants that will thrive in most conditions, even the driest, poorest soil or very wet clay soil. If, however, the soil test shows extreme pH - very acidic (pH of less than 5) or very basic (pH 8 or above), your plant choices will be fairly limited. In that case, you might choose to follow the instructions for making the soil more neutral. If the soil is hard, compacted fill dirt, you might want to improve it by adding organic matter and work the ground so that it can more easily be planted. If you alter the site, then select plants suited to the new conditions.

- **Choose plants native to your region of your state.** Along with planting to the existing site conditions, use locally native plants. Use the map on page 9 to identify which **physio-geographic region** the planting site lies in. If you’re close to a border dividing two regions, you may choose plants from either or both regions.

- **Choose a habitat type.** Try to create or emulate a specific habitat, like woods, wetland or meadow, and choose plants that are appropriate to both your site and the habitat. Look through this guide and mark the plants with growth requirements that match conditions at the planting site. This will help improve the success of your planting, the habitat value, and the ecological functioning of the project. This publication will eventually be made available online, in a format that can be electronically sorted by plant characteristics or growth conditions.

Where to find native plants

Most nurseries carry some native plants, and some nurseries specialize and carry a greater selection. As the demand for native plants has grown, so has the supply at nurseries. Some plants will be more readily available than others. Here, we’ve focused on species most appropriate for planting and available through the nursery trade. A limited number of species included here are not commonly available but are able to be nursery grown. Take this guide along with you when you visit nurseries and if you need help, ask for nursery staff familiar with native plants. If you see a plant you like, check to see if it’s included in the guide for your state and physiographic region. For those species that are more difficult to find, the hope and intention is that this publication will spark a demand, and hence a greater supply. If you have a favorite plant that you can’t obtain, be sure to ask your local nursery to consider adding it to their stock. A list of some of the many retail and wholesale native plant nurseries in the Chesapeake Bay region is available from the U.S. Fish and Wildlife Service, Chesapeake Bay Field Office at www.fws.gov/r5cbfo/bayscapes.htm.

For the greatest ecological value, select the “true” native species, especially if planting for wildlife benefit. There are cultivated varieties (*cultivars*) available for many native plants. These are named using the scientific name (Latin genus and species, such as *Rudbeckia fulgida*) plus the cultivar name, a third word in single quotation marks (such as *Rudbeckia fulgida* ‘Goldsturm’). These varieties have been grown to provide plants with certain physical characteristics, perhaps a different flower color, different foliage or a compact shape or size. Although these are suitable for gardening use, use true species (not cultivars) if you are planning a habitat project to provide food for wildlife. These plants are most suited to use by the native wildlife, and will increase your chances of attracting them.

Native plants should never be removed from the wild unless an area is about to be developed. Even then, it is difficult to transplant wild-collected plants and to duplicate their soil and other growth requirements in a home garden. Plants that are grown from seed or cuttings by nurseries have a much greater tolerance for garden conditions. Help to preserve natural areas by purchasing plants that have been grown, not collected.

Ask nurseries about the source of the native species sold. Did they come from seed or cuttings of plants found growing locally, or are they from another region? Ideally, the plants you use should come from stock from the same region, say, within about a 200-mile radius in the same physiographic province (coastal plain, Piedmont, or mountain). Differences exist from region to region even in the same plant species, due to differences in climactic conditions between distant locations. For example, a plant grown in Maine may flower at a different time than the same species grown in Maryland. They may have slight physical differences. These characteristics make a difference in designing gardens and they matter to wildlife seeking food sources. The more consumers ask for locally grown plants or seed, the more likely it is that nurseries will carry local stock.

Once you begin to explore and experiment with native plants, you'll soon discover that many of these plants go beyond just replacing worn out selections in your yard. Native plants will eventually reduce your labor and maintenance costs while inviting wildlife to your yard helping to create your own sense of place.

How to use this guide

Plant Names and Types

Plants are organized within each section alphabetically by scientific name. All scientific plant names used are based on names accepted by ITIS, the Integrated Taxonomic Information System. Plants are indexed at the back of the book by scientific as well as frequently used common names. Scientific names are changed periodically as new information is gathered; for those commonly recognized names that changed during development of this guide, the new names are used here, with a cross reference noted in the index. For example: *Aster divaricatus* is now *Eurybia divaricata*, so the plant is listed in the index under both *Aster* and *Eurybia*.

Plants are grouped by botanical categories: Ferns; Grasses & Grasslike Plants (includes grasses and plants with long slender leaves that may appear similar to a grass); Herbaceous Plants (includes flowers and groundcovers); Herbaceous Emergents (plants that grow in moist to wet soils, wetlands or in standing water with roots and part of their stems below water but with most of the plant above the water); Shrubs; Trees; and Vines.

A note about groundcovers: English ivy, periwinkle, creeping lily turf and Japanese pachysandra are some commonly used groundcovers, particularly for shade. However, these species are non-natives that are invasive in the landscape, so they should be *avoided*. What native alternatives can be used instead? A groundcover can be any plant that would physically cover or hide the bare ground from view. For the purposes of environmentally beneficial landscaping and habitat enhancement, any plant in the "herbaceous"category would make a good groundcover. For those gardeners and landscapers still seeking a low-growing, creeping, spreading, or clump-forming plant for a groundcover, these plants are marked with a GC symbol in the Notes column and a list is included at the end of the guide.

Characteristics

- **Height and/or Spread** The typical mature height or possible range of heights is given in feet, to the nearest half (0.5) foot. Height may vary depending on conditions (e.g., amount of moisture or sun). For trees and vines, spread is also given in feet. For trees, spread is the measurement of the crown of the plant; for vines, spread is the length a vine will grow along a surface.

- **Flowers: bloom period and flower color** The typical months in which the plant blooms are given. The exact time and duration of bloom may be shifted by days or weeks for different areas and/or depending on seasonal weather conditions and climactic trends. The basic, overall color of the flower is noted. The color of a flower's center or throat may not be included due to limited text space. For simplicity, some shades or tones of colors have been grouped, e.g. lavender, pale purple, bluish purple, even fuchsia may have been listed simply as purple; tan, brown, dark brown are all listed as brown; yellows and pinks may be similarly condensed.

- **Fruit: fruiting period, color and type** This information is provided for plants with more conspicuous fruits or visually interesting seeds. Terms used include: Achene, a dry flat seed such as in clematis; Berry, which includes small single berries such as blueberry, larger berries such as persimmon, aggregates such as blackberry and hips such as a rose hip; Capsule, including various types and sizes of dry fruits with two or more compartments containing seeds, such as iris, sweet pepperbush, hibiscus, or black-eyed Susan; Cone/ cone-like such as pines, hemlock, or alder; fleshy pomes or drupes such as hawthorn, beach plum, paw paw, passion flower, or cherry; Nut/nut-like, as in acorns (oaks) or hickory; Pod, which may include pea-like legumes such as partridge pea or wild senna, *follicles* or other long pod-like *capsules* such as milkweeds, delphinium, or trumpet creeper; and Winged, such as the *samaras* of maples or elm.

- **Fall Color** The color listed indicates the fall color of the leaves, or of the stems for certain plants such as grasses. Some color shades have been grouped by the basic color, as for flower color. Evergreens, species that retain their leaves throughout the winter (in all plant categories), are designated with a ▲ symbol in the Notes column. Evergreens are popular for various landscaping uses and valuable for year-round cover for wildlife.

Growth Conditions

- **Light** The amount of sunlight a plant requires is defined as: Full Sun ☼, the site is in direct sunlight for at least six hours a day during the growing season; Partial shade ◐, the site receives approximately three to six hours of direct sunlight; and Shade ●, the site receives less than three hours of direct sunlight or filtered light.

- **Moisture** The amount of soil moisture a plant requires is defined as: Dry (D), areas where water does not remain after a rain (areas may be in full sun or in a windy location, on a steep slope, or have sandy soil); Moist (M), areas where the soil is damp, and may be occasionally saturated; and Wet (W), areas where the soil is saturated for much of the growing season, except in droughts. Many of the plants designated for wet areas tolerate specific ranges of water depths (see Flood Depth). Plants with the Dry designation can be considered drought tolerant.

- **Soil pH and Type** Many of the native plants listed will tolerate a range of soil types. Soil types are listed here as Organic (O), containing a high amount of organic material such as decayed leaves and bark; Clay or fine-textured (C) soils with a high clay content and some silt - very fine soil particles; Loamy or medium-textured (L) soils that contain a mix of mostly silt and sand but may contain some clay; and Sandy or coarse-textured (S) soils with larger particles. Soil information has necessarily been simplified for this guide, and lumped into these main categories, which will suffice for the novice. Soils in actuality are often a mixture or gradations of types, categorized by the percentages they contain of clay, silt or sand, for example clay loam (a certain mix of clay and sand); sandy clay; silt loam; or silty clay loam. For best results, select plants suited to existing site conditions rather than amending the soil. However, be aware that plant selection may be limited if your site has very sandy soil, heavy clay, compacted soil, or extreme soil pH (above 8 or below 5.5). In these cases, seek advice from a nurseryman, horticulturist, botanist, Cooperative Extension agent, or other expert.

- **Flood Depth** Some plants tolerate prolonged standing water, and occur in specific water depths or range of depths. In the Herbaceous Emergents section, the depth of water tolerated is indicated (in inches). Other types of wetland plants that can tolerate only intermittent flooding appear in other sections of the guide, and their flood tolerance information is included in the Notes column. For more complete information on planning and planting wetlands, see the references listed at the end of this guide.

- **Salt Tolerance** Some plants that tolerate prolonged standing water can tolerate saltwater or brackish (partly salty) water. For plants in the Herbaceous Emergents section, the salinity range in which each of these plants will grow is given in parts (of salt) per thousand parts (of water) or ppt, from 0 ppt (fresh water) to the maximum salinity tolerated. For plants in other sections of the guide, the maximum salinity is given in the Notes column. Full seawater is approximately 32 ppt. If salinity is not given, then the plant grows in fresh water only or in drier conditions.

Habitat
For each plant in this guide, we include a description of habitats in which that plant may be found. Several habitat types may be mentioned as each plant is rarely found in one and only one habitat type. There are dozens of forest types, several types of wetlands including forested wetlands and even wet meadows. The habitats described include those that provide the conditions most preferred by each plant species. To help with planning projects, sample lists of plants to use in certain habitat types, or certain site conditions, are given in the back of this guide. More technically detailed information on plant communities can be found in resources listed in the references section.

Native To (Where To Use) - States and Physiographic Regions
From the sandy dunes of the coast to the rocky slopes of the mountains, the rich variety of habitats found throughout the region is strongly linked to its geology, topography and climate. For this guide, the states in the Chesapeake Bay watershed have been divided into three regions or provinces: (1) the coastal plain (C), an area with fairly flat topography and more southern climate; (2) the Piedmont plateau (P), with its rolling hills; and (3) the mountain zone (M), a more northern climate (see map). For simplicity, the mountain category combines all of the more specific higher-altitude provinces (Blue Ridge, Ridge and Valley, Allegheny or Appalachian Plateau). Some native plants are common throughout these provinces, while others are adapted to the unique conditions found only in one or two.

Based on the existing literature and expert input, the physiographic regions and states in which each plant species naturally occurs is noted. However, plants do not follow the political boundaries that define our states, so matching ecological boundaries with political ones is difficult. Certain plants may occur in different regions in different states. For example, the range of a species could extend throughout all of Pennsylvania, but be limited to the mountain and Piedmont regions of Maryland. An effort has been made to be as accurate as possible, while erring on the side of inclusion to cover the widest range of possibilities throughout the Chesapeake Bay watershed as a whole. This same approach has been used for other characteristics, such as height and bloom period, which may vary slightly from region to region.

Note: Some species native to a state but not commonly found may be officially designated and legally protected as “rare, threatened, or endangered” (RTE). This may be because the plant is at the edge of its natural range there, or its population has declined due to loss of habitat caused by various natural events and/or human activities in that region. Species that are listed in a state as RTE should generally not be planted there, because importing species from elsewhere could potentially lead to damaging alteration of the gene pool of the remaining population. This guide lists only those states in which a plant is common and recommended for planting. As a general rule of thumb, if a plant you like is not designated in this guide for your state or your region of the state, we strongly encourage you to forego planting that and select another plant suited to your site.

Wildlife Value
The notation “high wildlife value” is based mainly on the value of the fruits, seeds and/or nectar used as food for wildlife, and the relative number of species using the plant for food. But remember that animals use leaves, twigs, roots and shoots for food or nesting material, and every plant has value as cover and/or nesting sites. In that respect, although we’ve marked those of higher wildlife (food) value, every plant in this guide has value to wildlife, as well as other environmental values.

The **types of wildlife** noted here are those desirable species that are likely to use the plants for food, including pollinators which are critical to plant reproduction, for gardens, natural areas and agricultural crops. The information here is fairly general. The songbird icon indicates use of a plant by small usually migratory birds, but may include upland game birds. The waterfowl icon may include shorebirds and wading birds along with ducks and geese. The hummingbird icon has been indicated separately because many people are interested specifically in attracting them. The butterfly icon may refer to the adults or to the larval stage that uses the plant as a host. The beneficial insect icon, besides butterflies, includes ladybugs, bees (essential pollinators) and other insects that serve as a pest control or other desirable role. The small mammal icon is noted for plants used by any of a variety of small animals, such as raccoons, opossums, foxes, etc., depending upon location and surrounding habitat.

Absent but not forgotten: Certain wildlife species are not represented, due in part to a lack of available information for every plant related to all types of animals. However, these are all likely to inhabit or occasionally visit a native plant garden or habitat planting, and their importance in the web of life should not be underestimated. Many insects have not been represented here, though they certainly use a wide variety of plants throughout their life cycles and are an integral part of the ecosystems we’re trying to protect, conserve and enhance. Reptiles and amphibians, particularly salamanders, frogs and turtles, inhabit our yards as well as natural areas. They use plants for food and cover, and especially need water sources such as lakes, ponds, streams, puddles or even a small dish of water (aerated or changed daily to prevent mosquito breeding). Bats provide a valuable service as insect pest controllers and pollinators.

Notes
This catchall includes pertinent information that bears emphasizing or is not reflected in the other categories. It may include additional notes or clarification about the plant’s characteristics, growth, and spread; tips or suggestions on cultivation; cultivars; or general use of the plant.

By providing these characteristics for each plant species we hope to provide you with a variety of choices to meet the conditions of your property as well as your personal preferences. Whether you are replacing a few individual plants, designing a new bed or planning for an entirely new look, this guide can help narrow the choices to plants most likely to thrive in your environment and create the landscape you desire.

Songbird

Waterfowl

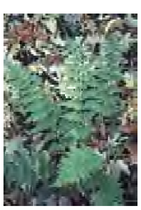
Hummingbird

Butterfly

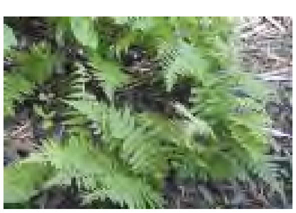
Beneficial insect

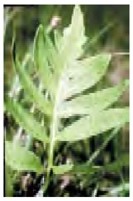
Small mammal

Providing the basic habitat structures described earlier and planting a diversity of plants (and therefore food sources) will bring a surprising and beneficial array of life to your property.

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Adiantum pedatum *northern maidenhair fern*	UWI MC 	Height: 1-2' Fruit:	Light: Moisture: M Soil pH: 4.5-6.5 Soil type: L S O	moist woods, rocky shaded habitats	Region: M P C States: DC MD NY PA VA WV		grows in clumps; delicate texture; herbal uses GC
Asplenium platyneuron *ebony spleenwort*	RHW 	Height: 0.5-1.5' Fruit: May-Sep	Light: Moisture: M Soil pH: 4.5-7 Soil type: C L S	banks, open woods and thickets, slopes, rocky ledges, swamps	Region: M P C States: DC MD NY VA WV		easily transplanted; only moderate care needed; evergreen GC
Athyrium filix-femina *northern lady fern*	UWI KJS 	Height: 1-3' Fruit:	Light: Moisture: M W Soil pH: Soil type: L S	woods, banks, wooded hillsides, sandy bogs	Region: M P C States: DC DE NY WV		varieties occur throughout region; in MD, VA can also use subspecies asplenioides (southern lady fern) GC
Botrychium virginianum *rattlesnake fern*	RHW 	Height: 1-2' Fruit:	Light: Moisture: D M Soil pH: 5.6-6.9 Soil type: L O	rich, woods	Region: M P C States: DC DE MD NY VA WV		GC
Dennstaedtia punctilobula *hay-scented fern*	UWI RWF 	Height: 1-3' Fruit: Jul-Oct	Light: Moisture: D M Soil pH: Soil type: L	open woods and fields	Region: M P C States: DC MD NY VA WV		can spread over large areas of open understory or pasture GC
Dryopteris carthusiana (D. spinulosa) *toothed or spinulose woodfern*	UWI RWF 	Height: 1-2.5' Fruit: Jun-Aug	Light: Moisture: M W Soil pH: 5-6 Soil type: L O	low woods, thickets, swamps, rich woods, rocky slopes	Region: M P States: DC DE MD NY PA VA WV		forms colonies; semi-evergreen GC
Dryopteris cristata *crested wood or shield fern, narrow swamp fern*	UWI RWF 	Height: 1.5-2.5' Fruit: Jun-Sep	Light: Moisture: M W Soil pH: 3.5-6.5 Soil type: C L	shallow emergent marshes, shrub swamps, wooded swamps, open shrubby wetlands	Region: M P C States: DC DE MD NY PA VA WV		small rosette fronds GC
Dryopteris intermedia *evergreen wood-fern*	UWI EJJ 	Height: 2.5' Fruit:	Light: Moisture: D M W Soil pH: Soil type: L O	rich, moist to dry woods	Region: M P C States: DC DE NY PA VA WV		clump-former; not common on coastal plain; hybridizes with eight species GC

Ferns

	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Dryopteris marginalis *marginal or evergreen shield fern, evergreen wood fern* UWI RWF 	Height: 1-3' Fruit:Jun-Oct	Light: Moisture: D M Soil pH: Soil type: C L S	moist woods, clearings	Region:M P C States: DC DE MD NY PA VA WV		clump-former; attractive; easily transplanted GC
Onoclea sensibilis *sensitive fern* UWI KJS 	Height: 1-3.5' Fruit:Jun-Oct	Light: Moisture: M W Soil pH: Soil type: C L S	fresh tidal and nontidal marshes, meadows, swamps, woods	Region:M P C States: DC DE MD NY PA VA WV		spreads in wet areas; fertile fronds dark brown, erect GC
Osmunda cinnamomea *cinnamon fern* RHW, UWI TK 	Height: 2-5' Fruit:Apr-May	Light: Moisture: M W Soil pH: 4.5-7 Soil type: C L	woods, marshes, swamps, bogs, streamsides	Region:M P C States: DC DE MD NY PA VA WV		tolerates drought; fertile fronds reddish brown, wooly GC
Osmunda claytoniana *interrupted fern* UWI EJJ 	Height: 1-4' Fruit:	Light: Moisture: M Soil pH: 4-6 Soil type: C L	fields, forest and swamp edges	Region:M P States: DC DE MD PA VA WV		grows in clumps GC
Osmunda regalis *royal fern* UWI EJJ 	Height: 1.5-6' Fruit:Apr-Jun	Light: Moisture: M W Soil pH: 4-6 Soil type: C L S	fresh tidal and nontidal marshes and swamps, woods, irregularly, seasonally, or permanently saturated (up to 100% of growing season)	Region:M P C States: DC DE MD NY PA VA WV		tolerates full sun if moist; tolerates drought; tolerates irregular, seasonal or permanent saturation; only tolerates flooding for a few days GC
Polystichum acrostichoides *Christmas fern* USFWS BES 	Height: 0.5-2' Fruit:Jun-Oct	Light: Moisture: M Soil pH: 4.5-7 Soil type: L S	woods, thickets, rocky slopes	Region:M P C States: DC DE MD NY PA VA WV		grows in clumps; easily grown in rock gardens and shaded places; impartial to soil type GC
Pteridium *bracken fern* CM NRCS 	Height: 1.5-6' Fruit:	Light: Moisture: D M W Soil pH: Soil type: C L S	dry pine woods, swamps, marshes, fields, waste places	Region:M P C States: DC DE MD NY PA VA WV		forms large colonies; host for several ant types GC
Thelypteris noveboracensis *New York fern* USFWS BES 	Height: 1-2.5' Fruit:Jun-Sep	Light: Moisture: M W Soil pH: 4-7 Soil type: C L S	forested wetlands, dry to damp woods, thickets	Region:M P C States: DC DE MD NY VA WV		tolerates drought; easily transplanted; forms large colonies; spreads easily GC

	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Thelypteris palustris *marsh fern*  UWI RWF	Height: 2-3' Fruit:Jun-Oct	Light: Moisture: M W Soil pH: Soil type: C L S	swamps, bogs, fields, thickets, fresh marshes, wooded streambank	Region:M P C States: DC DE MD NY VA WV		spreads GC
Woodwardia areolata *netted chain fern*  PLANTS RM91	Height: 0.5-2' Fruit:Jul-Oct	Light: Moisture: M W Soil pH: Soil type:	bogs, swamps, woods	Region: P C States: DC DE MD VA		spreads by creeping rhizome GC
Woodwardia virginica *Virginia chain fern*  PLANTS	Height: 3-6' Fruit:Jul-Sep	Light: Moisture: M W Soil pH: Soil type:	swampy places, woods	Region: P C States: DC DE MD NY VA		spreads by creeping rhizome GC


RHW

Osmunda regalis


RHW

Osmunda cinnamomea

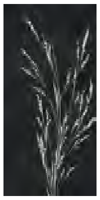
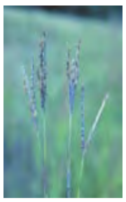
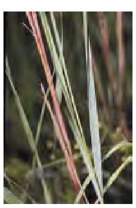
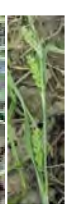

RS MNPS

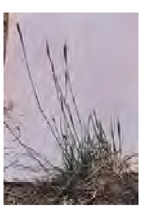
Polystichum acrostichoides


USFWS BES

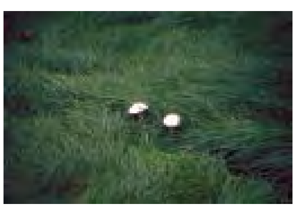
New fern fiddleheads emerging.

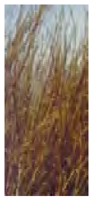
Grasses & Grasslike Plants

Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Agrostis perennans *autumn bentgrass*	PLANTS RM95 	Height: 1-3' Flowers: Jun-Oct	Light: Moisture: D M W Soil pH: 5.5-7.5 Soil type: C L	dry or moist thickets, open woods	Region: M P C States: DC DE PA VA WV		
Ammophila breviligulata *dunegrass, American beachgrass*	UWI RRK 	Height: 1.5-3.5' Flowers: Jul-Sep	Light: Moisture: D Soil pH: 5.8-7.8 Soil type: L S	maritime beaches, dunes, grasslands, shrublands	Region: C States: VA		prefers well-drained, sandy sites; spreads rapidly by rhizomes
Andropogon gerardii *big bluestem*	RHW 	Height: 2-6.5' Flowers: Jun-Sep	Light: Moisture: D M W Soil pH: 6-7.5 Soil type: C L S	dry or wet open woods, prairies, swales, shores; dry open areas	Region: M P States: DC DE NY PA VA WV		clump forming; attractive, with winter interest
Andropogon glomeratus (A. virginicus var. abbreviatus) *bushy bluestem*	PLANTS 	Height: 1.5-5' Flowers: Aug-Oct, reddish brown	Light: Moisture: M W Soil pH: 5-6.3 Soil type: C L S	fresh marshes, coastal areas	Region: M P C States: DC DE VA WV		tolerates drought; grows in tufts; reddish fall color
Andropogon virginicus *broomsedge*	PLANTS JS 	Height: 1-3' Flowers: Aug-Nov, reddish brown	Light: Moisture: D M W Soil pH: 4.9-7 Soil type: C L S	wet meadows, transition areas	Region: M P C States: DC DE MD NY VA WV		wildlife food and cover; tolerates drought; grows in tufts; reddish-tan fall color
Calamagrostis canadensis *bluejoint reedgrass*	PLANTS 1995 	Height: 1.5-5' Flowers: Jun-Aug	Light: Moisture: M W Soil pH: 4.5-8 Soil type: C L	meadows, bogs, thickets	Region: M States: DC DE NY VA WV		
Carex crinita var. crinita *long hair sedge*	RHW 	Height: 1-5' Flowers: Jun-Aug	Light: Moisture: M W Soil pH: 4-7.5 Soil type: C L	swales, thickets, low woods	Region: M P C States: DC DE NY VA WV		
Carex glaucodea *blue wood sedge*	NYNHP, NYNHP  	Height: 0.5-2' Flowers: May-Jul, brown to reddish	Light: Moisture: D M Soil pH: Soil type:	moist to dry woods and fields	Region: P C States: DC DE MD VA		clump-forming; alternative to Liriope

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Carex lurida *sallow sedge, lurid sedge*	 RHW	Height: 1-3.5' Flowers: Jun-Oct	Light: Moisture: W Soil pH: 4.9-6.8 Soil type: C L S	swales, swamps, woods	Region: M P C States: DC DE NY PA VA WV		wetland plant; interesting seeds
Carex pensylvanica *Pennsylvania sedge*	  CM NRCS, CM NRCS	Height: 0.5-1.5' Flowers: Apr-Jul, reddish to white	Light: Moisture: D M Soil pH: Soil type: S	open, dry, sandy or rocky woods, wooded slopes	Region: P C States: DC DE MD NY PA VA WV		alternative to lawn; plant densely; fine textured leaves less than 6 inches GC
Carex stricta *tussock sedge*	 CM NRCS	Height: 1-3.5' Flowers: May-Aug, reddish to purple brown	Light: Moisture: M W Soil pH: 3.5-7 Soil type: C L S	fresh tidal and nontidal marshes, shrub swamps, forested wetlands, swales, fields	Region: M P C States: DC DE MD NY VA WV		grows in clumps; partly persists in winter; tolerates flooding to 6 inches
Carex vulpinoidea *fox sedge*	 UWI RWF	Height: 0.5-3.5' Flowers: Jun-Aug	Light: Moisture: W Soil pH: 6.8-8.9 Soil type: C L	shallow emergent marshes, shrub swamps, floodplain forests, hardwood swamps	Region: M P C States: NY VA WV	high wildlife value	grows in clumps; tolerates saturation and flooding to 6 inches
Chasmanthium latifolium *wild oats, river oats, sea oats, spanglegrass*	 USFWS BES, USFWS BES	Height: 2-5' Flowers: Jul-Sep, green then tan	Light: Moisture: D M Soil pH: 5-7 Soil type: C L S	streambanks, alluvial woods	Region: M P C States: DC DE MD VA WV		
Danthonia spicata *poverty oatgrass, poverty grass*	 UWI RWF	Height: 0.5-2' Flowers: May-Jul	Light: Moisture: D M Soil pH: Soil type: S	open woods, pastures, meadows	Region: M P C States: DC DE NY PA VA WV		GC
Dichanthelium clandestinum *deer-tongue*	 USDA JE	Height: 2-5' Flowers: May-Oct	Light: Moisture: D M W Soil pH: 4-7.5 Soil type: C L S	moist woods, roadsides	Region: M P C States: DC DE NY PA VA WV		
Dichanthelium commutatum *variable panicgrass*	 PLANTS 1997	Height: 1-2.5' Flowers: May-Oct	Light: Moisture: D M Soil pH: 4-6.5 Soil type: L S	rocky or sandy woods	Region: M P C States: DC DE NY PA VA WV		

Grasses & Grasslike Plants

Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Elymus canadensis *Canada wild rye*	 CM NRCS	Height: 2-6.5' Flowers: Jun-Oct	Light: Moisture: D M Soil pH: 5-7.9 Soil type: C L S	dry, sandy, gravelly, or rocky soil	Region: M P C States: DC MD VA WV		
Elymus hystrix (Hystrix patula) *bottlebrush grass*	 RHW	Height: 2-4' Flowers: Jun-Aug	Light: Moisture: M Soil pH: Soil type: L	alluvial woods	Region: M P C States: DC DE MD NY PA VA WV		
Elymus riparius *riverbank wild-rye*	 UWI EJJ	Height: 0.5-5' Flowers: Jul-Sep	Light: Moisture: D M W Soil pH: 4.5-7.2 Soil type: C L S O	rich thickets, streamsides, alluvial flats, meadows	Region: P C States: DE PA VA WV		good for streambank conditions
Elymus virginicus *Virginia wild rye*	 CM NRCS	Height: 1-5.5' Flowers: Jun-Oct	Light: Moisture: D M Soil pH: 5-7 Soil type: C L S O	rich thickets, shores, meadows	Region: M P C States: DC DE MD PA VA WV		tolerates a wide range of conditions; forms clumps
Festuca rubra *red fescue*	 RS MNPS	Height: 0.5-3' Flowers: May-Jul	Light: Moisture: M W Soil pH: 5-8 Soil type: C L	dry woods, roadsides, waste areas	Region: M States: DC DE MD VA		can be used as turf grass; grows best in part shade GC
Leersia oryzoides *rice cutgrass*	 PLANTS 1995	Height: 5' Flowers: Jun-Oct	Light: Moisture: M W Soil pH: 5.1-8.8 Soil type: C L S	fresh tidal and nontidal marshes, meadows, ditches, muddy shores	Region: M P C States: DC DE NY PA VA WV		good for sediment stabilization, erosion control; tolerates drought; tolerates flooding to 6 inches
Panicum amarum *bitter or coastal panic grass, beachgrass*	 CM NRCS	Height: 1-3' Flowers: Aug-Oct	Light: Moisture: D M Soil pH: 5-7.5 Soil type: L S	sandy coastal shores and dunes	Region: C States: DC DE MD VA		prostrate form, produces little viable seed, use transplants; Panicum amarum var. amarulum (coastal panicgrass), taller form, can be seeded.
Panicum virgatum *switchgrass*	 USFWS BES	Height: 3-6' Flowers: Jul-Oct	Light: Moisture: D M W Soil pH: 4.5-8 Soil type: C L S	fresh and brackish tidal and nontidal marshes, wet meadows, open woods, prairies, dunes	Region: M P C States: DC DE MD NY PA VA WV		food for sparrow species; grows in clumps; controls erosion

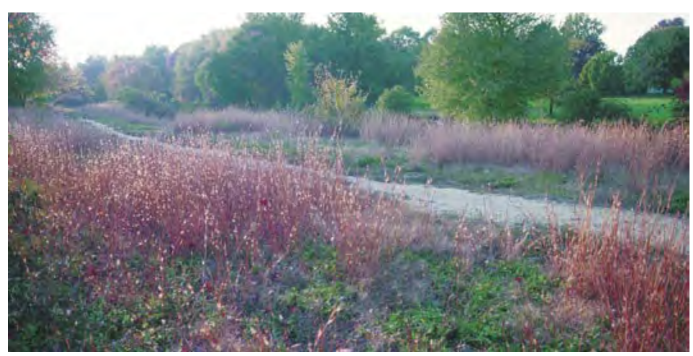
	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Saccharum giganteum (Erianthus giganteus) *giant plumegrass, sugar cane* USDA NRCS 	Height: 3.5-10' Flowers: Aug-Oct	Light: Moisture: M W Soil pH: 3.5-7 Soil type: L S	swamps, low woods, swales	Region: P C States: DC DE VA		
Schizachyrium scoparium (Andropogon scoparius) *little bluestem* USFWS BES, USFWS BES  	Height: 1.5-4' Flowers: Aug-Oct	Light: Moisture: D Soil pH: Soil type: L S	open woods, pinelands, clearings	Region: M P C States: DC DE MD NY PA VA WV		tolerates poor soil; clump grass; winter interest and wildlife cover; excellent forage grass
Sorghastrum nutans *Indiangrass* RHW 	Height: 2.5-8' Flowers: Aug-Sep	Light: Moisture: D M Soil pH: 4.8-8 Soil type: C L S	dry slopes, prairies, borders of woods	Region: M P C States: DC DE MD NY PA VA WV		tall clump grass with beautiful seed head; nutritious for livestock
Tridens flavus *redtop, purpletop* UWI EJJ 	Height: 2-6.5' Flowers: Aug-Oct	Light: Moisture: D M Soil pH: 4.5-6.5 Soil type: C L S	dry fields, roadsides, openings, forest	Region: M P C States: DC DE VA WV		
Tripsacum dactyloides *gama grass* CM NRCS 	Height: 6-10' Flowers: Jun-Oct	Light: Moisture: M W Soil pH: 5.7-7.5 Soil type: C L	swales, fields, forest edges, shores	Region: M P C States: DC DE MD VA WV		excellent forage grass; often grows wild near corn fields; can hybridize with corn

See also:

In the *Herbaceous Plants* section:
- **Allium cernuum**
- **Liatris pilosa v. pilosa (graminifolia), scariosa, spicata, squarrosa**
- **Sisyrinchium angustifolium (graminoides), atlanticum**

In the *Herbaceous Emergents* section:
- **Distichlis spicata**
- **Dulichium arundinaceum**
- **Iris prismatica, versicolor, virginica**
- **Juncus canadensis, effusus**
- **Schoenoplectus pungens v. pungens (Scirpus pungens, americanus), validus (Scirpus validus)**
- **Scirpus atrovirens, cyperinus**
- **Sparganium americanum**
- **Spartina alterniflora, cynosuroides, patens, pectinata**
- **Zizania aquatica**

Andropogon virginicus provides a transition between the road and woods.

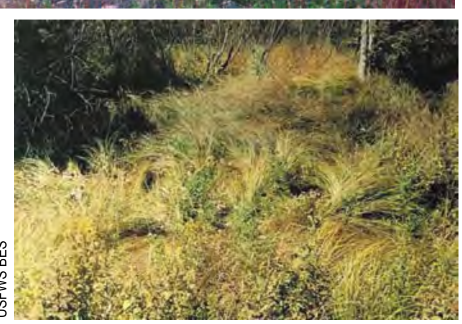
CM NRCS


Schizachyrium scoparium in a garden with **Liatris spicata** and **Asclepias tuberosa**.

USFWS BES

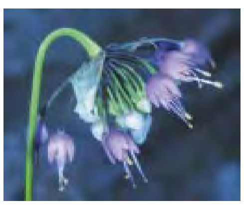

USFWS

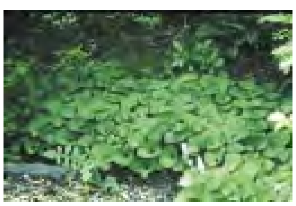
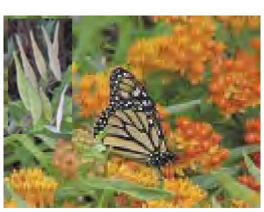

Schizachyrium scoparium in fall.

USFWS BES


Characteristic swirls of **Carex stricta**.

Herbaceous Plants

Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Actaea pachypoda *doll's eyes*	 RHW, RHW	Height: 1-3' Flowers: Apr-Jun, whitish Fruit: Jul-Oct, white or red, berry	Light: Moisture: M Soil pH: Soil type: C L S	rich open woods, thickets	Region: C States: DE NY PA VA WV		interesting berries; infrequent in Piedmont and mountain regions
Agalinis purpurea *purple false foxglove*	 RHW	Height: 1-4' Flowers: Jul-Sep, rose-purple, white Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: S	moist fields, rocky shores, serpentine barrens	Region: P C States: DC DE MD NY VA WV		
Ageratina altissima var. altissima (Eupatorium rugosum) *white snakeroot*	 UWI KJS, USFWS BES	Height: 1-5' Flowers: Jul-Oct, white Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: C L S	rich woods, thickets, clearings, meadows	Region: M P C States: DC DE MD NY PA VA WV		tough plant; cultivars available; prefers basic soils
Allium cernuum *nodding onion*	 RHW	Height: 0.5-2.5' Flowers: Jun-Aug, pink, rose, white Fruit: capsule	Light: Moisture: M Soil pH: Soil type: L S	ledges, gravels, rocky or wooded slopes	Region: M States: DC MD VA WV		
Anemone canadensis *round-leaved or Canadian anemone, thimbleweed*	 RHW	Height: 0.5-3' Flowers: May-Jul, white Fruit:	Light: Moisture: M Soil pH: Soil type: C L	damp thickets, meadows, gravelly shores	Region: P States: DC NY VA		
Anemone virginiana *thimbleweed, tall anemone*	 RHW	Height: 1-2.5' Flowers: May-Aug, whitish Fruit:	Light: Moisture: D M Soil pH: Soil type: C L S	dry rocky open woods, slopes, thickets	Region: M P States: DC DE MD NY PA VA WV		
Antennaria neglecta *field pussytoes*	 UWI JRS	Height: 0.5-1.5' Flowers: Apr-Jul, white Fruit:	Light: Moisture: D M Soil pH: 5.5-7.5 Soil type: C L	upland meadows, pastures, open woods	Region: M P States: DC DE MD NY PA VA WV		
Aquilegia canadensis *eastern or wild columbine*	  RHW, USFWS BES	Height: 0.5-3' Flowers: Apr-Jul, red-yellow Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L	rich rocky woods, slopes, cliffs, ledges, pastures, roadside banks	Region: M P C States: DC DE MD NY PA VA WV		commonly cultivated; spreads by seed GC

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Aralia nudicaulis *wild sarsaparilla*	 RHW	Height: 0.5-1.5' Flowers: May-Jul, white or green Fruit: May-Jul, purple-black, berry	Light: Moisture: D M Soil pH: 5-7.2 Soil type: C L S	dry to moist woods	Region: M P C States: DC DE MD NY PA VA WV		aromatic; single-leaved; lacks an above-ground stem; not common in coastal plain
Aralia racemosa *spikenard*	 RHW, RHW	Height: 1.5-6.5' Flowers: Jun-Aug, greenish-white Fruit: dark purple, berry	Light: Moisture: M Soil pH: Soil type: C L S	rich woods, thickets, wooded slopes and edges	Region: M P C States: DC DE MD PA VA WV		not common in coastal plain
Arisaema triphyllum *Jack-in-the-pulpit*	 USFWS BES, RHW	Height: 1-3' Flowers: Mar-Jun, striped, purple or green Fruit: berry	Light: Moisture: M W Soil pH: 4.8-7 Soil type: L S	woods, bogs swamps	Region: M P C States: DC DE MD NY PA VA WV		red berry clusters appear late summer to fall; unusual flower; spreads rapidly from seed
Aruncus dioicus *goat's-beard*	 USFWS BES	Height: 3.5-6.5' Flowers: May-Jul, white Fruit: pod	Light: Moisture: M W Soil pH: Soil type: C L S	wooded roadsides, rich woods, ravines	Region: M States: DC VA WV		
Asarum canadense *wild ginger*	 USFWS BES	Height: 0.5' Flowers: Apr-May, brownish-purple Fruit: brown, capsule	Light: Moisture: M Soil pH: Soil type: C L S	rich woods	Region: M P C States: DC DE MD NY PA VA WV		flower inconspicuous; attractive leaves; will spread; semi-evergreen GC
Asclepias incarnata *swamp milkweed*	 USFWS RL	Height: 4-6' Flowers: May-Jun, pink to reddish Fruit: Aug-Nov, pod	Light: Moisture: M W Soil pH: 5-8 Soil type: C L	fresh tidal and nontidal marshes, meadows, shrub swamps, woods, shores, ditches	Region: M P C States: DC DE MD NY PA VA WV		can tolerate drought; interesting seed pod
Asclepias syriaca *common milkweed*	 RHW, RHW	Height: 3.5-6.5' Flowers: May-Aug, pale purple Fruit: Aug-Nov, pod	Light: Moisture: D Soil pH: Soil type: L S	thickets, roadsides, fields	Region: M P C States: DC DE MD NY PA VA WV		interesting seed pods; fragrant flower
Asclepias tuberosa *butterflyweed, butterfly milkweed, butterfly flower*	 USFWS RL, USFWS BES	Height: 1-3' Flowers: May-Jul, orange Fruit: Aug-Nov, pod	Light: Moisture: D M Soil pH: 4.8-6.8 Soil type: L S	dry fields, roadsides, shale barrens	Region: M P C States: DC DE MD NY PA VA WV		taproot does not transplant well but seedlings do; attractive seed pod

Herbaceous Plants

Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Baptisia australis *wild blue indigo, false blue indigo*	 USFWS BES, USFWS BES	Height: 3-5' Flowers: May-Jun, blue, purple Fruit:	Light: Moisture: D M Soil pH: Soil type: S	open woods, alluvial thickets, streambanks, floodplains	Region: M P States: DC MD VA WV		tolerates poor soils; flowers very showy; shrublike form
Baptisia tinctoria *yellow wild indigo*	 RHW	Height: 1-3' Flowers: May-Sep, yellow Fruit:	Light: Moisture: D Soil pH: 5.8-7 Soil type: L S	open woods, clearings	Region: M P C States: DC DE MD PA VA WV		tolerates poor soils
Bidens cernua *nodding beggar-ticks, nodding bur marigold*	 RHW	Height: 0.5-3' Flowers: Aug-Oct, yellow Fruit:	Light: Moisture: D M Soil pH: 5.1-7 Soil type: C L S	tidal marsh, sloughs, springs, pools, shore	Region: M P C States: DC DE MD NY PA VA WV		
Boltonia asteroides *star boltonia, white doll's daisy*	 USFWS BES	Height: 0.5-2.5' Flowers: Jul-Sep, white Fruit:	Light: Moisture: D M W Soil pH: 5.3-7 Soil type: L S	gravelly shores, sandy thickets	Region: C States: DC DE VA WV		
Caltha palustris *marsh marigold*	 RHW	Height: 1-2' Flowers: Apr-Jun, bright yellow Fruit:	Light: Moisture: W Soil pH: 4.9-6.8 Soil type: C L	forested wetlands, shrub swamps, streambanks, seeps, meadows	Region: M C States: DC DE MD NY VA WV		clump-forming; needs some periods of drier soil; tolerates flooding to 6 inches
Campanulastrum americanum (Campanula americana) *American or tall bellflower*	 RHW	Height: 1.5-6.5' Flowers: Jun-Aug, light blue Fruit: capsule	Light: Moisture: M Soil pH: 5.5-7.5 Soil type: C L S	rich moist woods, rocky wooded slopes, streambanks	Region: M P States: DC MD NY VA WV		
Cardamine concatenata (Dentaria laciniata) *toothwort*	 RHW	Height: 1-1.5' Flowers: Apr-Jun, white, purplish Fruit:	Light: Moisture: M Soil pH: Soil type: L S	rich woods, wooded bottoms, calcareous rocky banks	Region: M P States: DC DE MD NY VA WV		
Caulophyllum thalictroides *blue cohosh*	 RHW	Height: 1-2.5' Flowers: Apr-Jun, green-yellow, green-purple Fruit: dark blue, berry	Light: Moisture: M Soil pH: 4.5-7 Soil type: L	rich woods	Region: M P C States: DC DE MD NY PA VA WV		

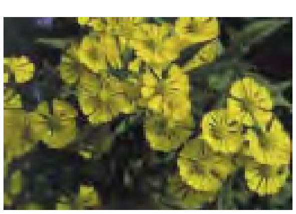
Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Chamaecrista fasciculata (Cassia fasciculata) *partridge pea, prairie senna*	 RHW	Height: 0.5-3' Flowers: Jul-Sep, yellow Fruit: pod	Light: Moisture: D Soil pH: Soil type: S	upland meadows, fields, streambanks	Region: M P C States: DC DE MD PA VA WV		pods coil after split open; spreads
Chamerion angustifolium spp. angustifolium (Epilobium angustifolium) *fireweed*	 RHW, PLANTS GAM	Height: 3-10' Flowers: Jun-Sep, magenta, pink, rarely white Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: C L S	recent clearings, burned woodlands, damp ravines, open sandy areas	Region: M States: DC DE MD PA VA WV		
Chelone glabra *white turtlehead, turtlehead*	 RHW	Height: 1.5-6.5' Flowers: Jul-Oct, white Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: C L S	woods, streambanks, swamps, thickets	Region: M P C States: DC DE MD NY PA VA WV		strong grower; herbal uses; host for Baltimore checkerspot butterfly
Chimaphila maculata *striped wintergreen, striped prince's pine*	 RHW	Height: 0.5' Flowers: Jun-Aug, white Fruit: capsule	Light: Moisture: D Soil pH: Soil type: C L S	acidic woods, frequently under pines	Region: M P C States: DC MD NY PA VA WV		flowers fragrant GC
Chrysogonum virginianum *green-and-gold, golden knees*	 USFWS BES	Height: 0.5-1' Flowers: Mar-Jun, yellow Fruit:	Light: Moisture: D M Soil pH: Soil type: L	open woods on limestone, rocky open woods	Region: M P C States: DC MD VA WV		will bloom longer if kept moist GC
Chrysopsis mariana *golden aster, Maryland golden aster*	 RHW	Height: 0.5-2.5' Flowers: Jul-Oct, yellow Fruit:	Light: Moisture: D Soil pH: Soil type: S	woods, openings, roadsides, serpentine barrens	Region: P C States: DC DE MD VA		GC
Cimicifuga racemosa *black snakeroot, black cohosh, fairy candles*	 RHW	Height: 2.5-8.5' Flowers: Jun-Sep, white Fruit: pod	Light: Moisture: M Soil pH: Soil type: C L S	rich woods, wooded slopes, ravines, thickets	Region: M P C States: DC DE MD NY PA VA WV		
Claytonia virginica *narrowleaf spring beauty, spring beauty*	 RHW	Height: 0.5-1' Flowers: Mar-May, white with pink Fruit: capsule	Light: Moisture: M Soil pH: Soil type: L	rich woods, thickets, clearings	Region: M P C States: DC DE MD NY PA VA WV		

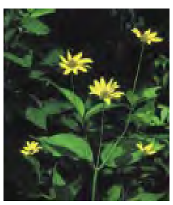
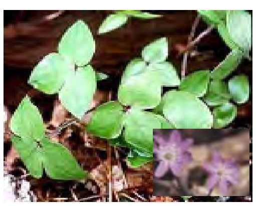
Herbaceous Plants

Plant	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Clitoria mariana *Maryland butterfly pea*  RHW	Height: 6' Flowers: Jun-Sep, pale blue or pinkish Fruit: pod	Light: Moisture: D Soil pH: Soil type: S	open areas	Region: M P C States: DC DE VA WV		vine-like
Conoclinium coelestinum (Eupatorium coelestinum) *mistflower, wild ageratum*  RHW	Height: 1-3.5' Flowers: Jul-Oct, blue, violet or purple Fruit: capsule	Light: Moisture: D M W Soil pH: Soil type: C L	old fields, meadows; dry sandy woods and clearings, damp thickets, streambanks	Region: C States: DC DE VA WV		
Coreopsis tripteris *tall coreopsis, tall tickseed*  RHW	Height: 3.5-10' Flowers: May-Sep, yellow Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	thickets, old fields, forest edges, roadsides	Region: M P C States: DC VA WV		flower has anise scent
Coreopsis verticillata *threadleaf coreopsis*  USFWS BES	Height: 0.5-3.5' Flowers: Jun-Oct, yellow Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L	dry open woods, clearings, roadsides	Region: P States: DC MD VA WV		GC
Delphinium tricorne *dwarf larkspur*  RHW	Height: 0.5-3' Flowers: Apr-Jun, blue, violet, white, variegated Fruit: pod	Light: Moisture: M Soil pH: Soil type:	rich woods, calcareous slopes, thickets, river bluffs	Region: M P States: DC VA WV		
Desmodium paniculatum *panicled or narrow-leaf tick-trefoil*  RHW	Height: 1-3.5' Flowers: Jul-Sep, purplish or green Fruit: pod	Light: Moisture: D Soil pH: 6-7 Soil type: C L	clearings, edges of moist or dry woods	Region: M P C States: DC DE MD NY VA WV		not found near coast
Dicentra canadensis *squirrel corn*  RHW	Height: 0.5-1' Flowers: Apr-May, greenish-white, rose tinge Fruit: capsule	Light: Moisture: M Soil pH: Soil type: L	rich woods	Region: M P States: DC MD NY PA VA WV		flowers hyacinth scented
Dicentra cucullaria *Dutchman's breeches*  RHW	Height: 0.5-1' Flowers: Apr-Jun, white to cream Fruit: capsule	Light: Moisture: M Soil pH: Soil type: L S	rich woods	Region: M P States: DC DE MD NY PA VA WV		leaves basal; dormant in summer

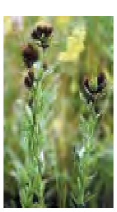
		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Dicentra eximia *wild bleeding heart*	 RHW	Height: 1.5-2' Flowers: Apr-Sep, pink/white Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L	rocky woods and cliffs, rich woods	Region: M P States: DC MD VA WV		sometimes cultivated
Dodecatheon meadia *shooting star*	  RHW, RHW	Height: 0.5-2' Flowers: Apr-Jun, white with yellow, lilac Fruit: capsule	Light: Moisture: M Soil pH: Soil type: L S	open woods, meadows, slopes, prairies	Region: M States: DC MD VA WV		
Doellingeria umbellata var. umbellata (Aster umbellatus) *flat-top white aster, parasol whitetop*	 RHW	Height: 1-7.5' Flowers: Aug-Oct, white Fruit:	Light: Moisture: M W Soil pH: Soil type: L S	open areas, woods	Region: M P States: DC DE MD NY PA VA WV		
Erigeron pulchellus *robin's plantain*	 RHW	Height: 0.5-1.5' Flowers: Apr-Sep, blue, pink, white Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	open woods, meadows, wooded slopes, roadsides	Region: M P C States: DC DE MD NY PA VA WV		GC
Erythronium americanum *trout lily, yellow trout lily, dogtooth violet*	 RHW	Height: 0.5-1' Flowers: Mar-Jun, yellow Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: L S	woods, rich slopes, bottomlands, meadows	Region: M P States: DC DE MD NY PA VA WV		
Eupatorium dubium *Joe-Pye weed*	 RHW	Height: 2-5' Flowers: Jul-Oct, purple, rarely white Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: S	swamps, bogs, marshes, swales	Region: M P C States: DC DE MD VA		
Eupatorium fistulosum *Joe-Pye weed, trumpet weed*	 RHW	Height: 1.5-10' Flowers: Jul-Oct, pink-purple Fruit: capsule	Light: Moisture: D M W Soil pH: 4.5-7 Soil type: C L	floodplains, meadows, thickets, roadsides	Region: M P C States: DC DE MD NY PA VA WV		herbal uses
Eupatorium hyssopifolium *hyssop-leaved thoroughwort, hyssop-leaved eupatorium*	 RHW	Height: 1-4.5' Flowers: Jul-Oct, white Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: S	dry fields, roadsides, railroad right of ways, woods, fields, salt meadows	Region: C States: DC DE MD VA		

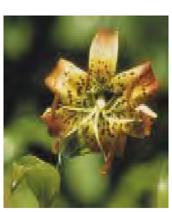
Herbaceous Plants

Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Eupatorium maculatum *spotted Joe-Pye weed*	CAB 	Height: 2-6.5' Flowers: Jul-Sep, purple to pale lavender Fruit: capsule	Light: Moisture: M Soil pH: 5.5-7 Soil type: C L	floodplains, swamps, alluvial thickets, grasslands	Region: M P States: DC NY WV		
Eupatorium perfoliatum *common boneset*	RHW 	Height: 1-5' Flowers: Jul-Oct, white Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: C L S	floodplains, swamps, bogs, streambanks, meadows	Region: M P C States: DC DE MD NY PA VA WV		
Eupatorium purpureum *green-stemmed Joe-Pye weed*	RHW 	Height: 2-6.5' Flowers: Jul-Oct, pink, purple, cream Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: C L S	open woods, fields, floodplains	Region: M P C States: DC DE MD NY PA VA WV		occurs in drier, shadier habitats than other joe-pye-weeds; injured or dried plant has vanilla scent
Eurybia divaricata (Aster divaricatus) *white wood aster*	RHW, USFWS BES 	Height: 0.5-3' Flowers: Jul-Oct, white Fruit:	Light: Moisture: D M Soil pH: Soil type:	dry woods, clearings	Region: M P States: DC DE MD NY PA VA WV		GC
Gentiana clausa *closed gentian, bottle gentian*	USFWS BES 	Height: 1-3.5' Flowers: Aug-Oct, blue Fruit: capsule	Light: Moisture: M W Soil pH: 5.8-7.2 Soil type: L	moist open woods, streambanks, meadows	Region: M P C States: DC MD PA VA WV		
Geranium maculatum *wild geranium, wood geranium*	RHW 	Height: 1-2' Flowers: Apr-Jul, lavender or pink Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L	woods, roadsides, fields	Region: M P C States: DC DE MD NY PA VA WV		adaptable plant; long bloom time; spreader; herbal uses; explosive seed capsule GC
Goodyera pubescens *downy rattlesnake plantain*	USFWS BES 	Height: 0.5-1.5' Flowers: Jun-Aug, whitish Fruit:	Light: Moisture: D M Soil pH: Soil type: C L S	dry to moist woods	Region: M P C States: DC DE MD NY VA WV		very handsome throughout winter
Helenium autumnale *yellow or common sneezeweed*	USFWS BES 	Height: 1.5-6' Flowers: Jul-Nov, yellow Fruit: capsule	Light: Moisture: M Soil pH: 4-7.5 Soil type: C L S	woods, swamps, riverbanks, alluvial thickets, meadows, marshes, ditches	Region: M P C States: DC DE MD NY PA VA WV		tolerates wet areas; showy flowers; herbal uses

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Helianthus angustifolius *swamp sunflower*	RHW 	Height: 1.5-5.5' Flowers: Aug-Oct, yellow Fruit: capsule	Light: Moisture: M W Soil pH: 4-7 Soil type: L S	swamps, moist, sandy areas	Region: C States: DC DE MD VA		
Helianthus decapetalus *ten-petaled or thin-leaved sunflower*	BZ 	Height: 1.5-5' Flowers: Jul-Oct, yellow Fruit: capsule	Light: Moisture: M Soil pH: Soil type: S	fields, bottomlands, stream banks, roadsides	Region: M P C States: DC DE NY PA VA WV		
Helianthus divaricatus *woodland sunflower, rough sunflower*	RHW 	Height: 1.5-6.5' Flowers: Jul-Sep, yellow Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: S	dry open woods, wooded slopes, shale barrens, roadsides	Region: M P C States: DC DE MD NY PA VA WV		
Heliopsis helianthoides *oxeye sunflower, oxeye*	RHW 	Height: 1-5' Flowers: Jun-Sep, pale yellow Fruit: capsule	Light: Moisture: D M Soil pH: 5.6-6.8 Soil type: L S	fields, open woods, floodplains, thickets, streambanks	Region: P C States: DC DE MD PA VA WV		long bloom time
Hepatica nobilis var. acuta (H. acutiloba) *sharp-lobed hepatica*	UWI KJS, UWI KJS, UWI JRS 	Height: 0.5-2' Flowers: Mar-Jun, bluish, white, pink Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	rich upland woods, rocky slopes	Region: M States: NY PA VA		may bloom throughout year (rarely) GC
Hepatica nobilis var. obtusa (H. americana) *round-lobed hepatica, liverleaf*	RHW 	Height: 0.5-2' Flowers: Mar-Jun, white to lavender Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	dry or rocky woods, dry upland slopes	Region: M P C States: DC DE MD NY PA VA WV		GC
Heracleum maximum (H. lanatum) *cow parsnip*	RHW 	Height: 3.5-10' Flowers: May-Aug, white to pink Fruit:	Light: Moisture: M W Soil pH: 5.4-7.3 Soil type: C L S	rich woods, wooded roadside banks, marshy flats, streambanks, ditches	Region: M P C States: DC DE MD NY PA VA WV		can cause a dermatitis (skin) reaction
Heuchera americana *alumroot*	MOBOT 	Height: 1-3.5' Flowers: Apr-Jun, green, white, pink, purple Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	rich woods, rocky slopes, shale cliffs	Region: M P States: DC DE MD NY PA VA WV		long bloom time; many cultivars and hybrids; semi-evergreen GC

Herbaceous Plants

Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Heuchera villosa *hairy heuchera, hairy alumroot*	 PLANTS JSP	Height: 1-2.5' Flowers: Jun-Oct, white to greenish to pinkish Fruit: capsule	Light: Moisture: D M Soil pH: Soil type:	damp rocks, rich wooded slopes	Region: M States: DC MD VA		GC
Houstonia caerulea *bluet, innocence, Quaker-ladies*	 RHW	Height: 0.5-1' Flowers: Apr-Jun, blue, lilac, white Fruit: capsule	Light: Moisture: M Soil pH: Soil type:	meadows, fields, and thickets, open woods, forest edges	Region: M P C States: DC DE MD VA WV		
Hydrophyllum virginianum *Virginia waterleaf*	 RHW	Height: 1-2.5' Flowers: May-Aug, lavender, white Fruit: capsule	Light: Moisture: M Soil pH: Soil type: C L S	woods, thickets, streambanks	Region: M P C States: DC DE MD NY PA VA WV		
Hylotelephium telephioides (Sedum telephioides) *Allegheny stonecrop*	 RHW	Height: 0.5-1.5' Flowers: Aug-Sep, pale pink Fruit: pod	Light: Moisture: Soil pH: Soil type:	dry rocky places	Region: M States: DC MD NY VA WV		naturally occurs in bare rock outcrops, but does well in garden; rare in PA, threatened in NY GC
Impatiens capensis (I. biflora) *jewelweed, touch-me-not*	 USFWS BES	Height: 1.5-5' Flowers: May-Oct, orange, yellow, white Fruit: capsule	Light: Moisture: M W Soil pH: 5.4-7.4 Soil type: C L S	moist meadows, swamps, streambanks, open woods	Region: M P C States: DC DE MD NY PA VA WV		ripe seed pod explodes with contact; remedy for poison ivy itching
Ionactis linariifolius (Aster linariifolius) *stiff-leaf aster, flaxleaf whitetop aster*	 RHW	Height: 0.5-2' Flowers: Aug-Oct, blue, yellow eye Fruit:	Light: Moisture: D M Soil pH: Soil type: S	grasslands, successional shrublands, oak-hickory forest, dry rocky woods and edges	Region: M P C States: DC DE MD NY VA WV		
Jeffersonia diphylla *twinleaf*	 RHW	Height: 0.5-1' Flowers: Apr-May, white Fruit: capsule	Light: Moisture: M Soil pH: Soil type: L	rich woods	Region: M P States: DC MD VA WV		
Lespedeza capitata *round-head bush clover*	 UWI KJS	Height: 2-6' Flowers: Jul-Sep, yellowish white Fruit:	Light: Moisture: D Soil pH: Soil type: L S	fields, thin woods	Region: M P C States: DC DE NY PA VA WV		

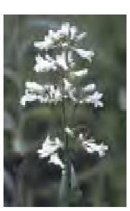
		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Liatris pilosa var. pilosa (L. graminifolia) *grass-leaf blazingstar*	 RHW	Height: 1-3.5' Flowers: Aug-Oct, purple Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: C L S	open woods, forest edge, salt marsh edges, dune hollows	Region: P C States: DC DE MD VA		
Liatris scariosa *eastern or northern blazing star, tall gayfeather*	 RHW	Height: 1-3.5' Flowers: Aug-Sep, lavender to rose-purple Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	dry upland woods	Region: M P C States: DC DE MD VA WV		
Liatris spicata *gayfeather, blazingstar, spiked blazing star*	 USFWS RL	Height: 1-6.5' Flowers: Jul-Aug, rose-purple or white Fruit: capsule	Light: Moisture: D M Soil pH: 5.6-7.5 Soil type: C L S	moist meadows, open areas	Region: P C States: DC DE VA WV		
Liatris squarrosa *plains blazing star*	 RHW	Height: 0.5-2.5' Flowers: Jul-Sep, rose Fruit: capsule	Light: Moisture: M Soil pH: Soil type: L S	dry open fields and banks	Region: P C States: DC DE VA		
Lilium canadense *Canada lily*	 RHW	Height: 1.5-6.5' Flowers: Jun-Aug, yellow, orange, red Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: L	fields, thickets, woods	Region: M P States: DC DE MD NY PA VA WV		
Lilium philadelphicum *wood lily*	 RHW	Height: 1-3.5' Flowers: Jun-Aug, yellow, red-orange Fruit: capsule	Light: Moisture: D Soil pH: Soil type: L S	open woods, forest edges, thickets	Region: M P C States: DC DE NY PA VA WV		
Lilium superbum *Turk's cap lily*	 RS MNPS	Height: 4-8' Flowers: Jul-Aug, yellow-orange, orange-red Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: L S	meadows, streamsides	Region: M P C States: DC DE MD NY PA VA WV		leaves in whorl around stem; takes several years to bloom
Limonium carolinianum *sea lavender*	 PLANTS LA	Height: 0.5-2' Flowers: Jul-Oct, lavender Fruit:	Light: Moisture: M W Soil pH: 6-8.5 Soil type: C L S	irregularly flooded high salt marshes	Region: C States: DE MD NY VA		tolerates salinity to 30 ppt

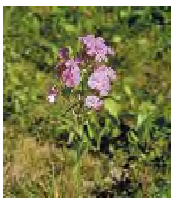
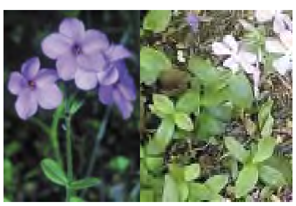
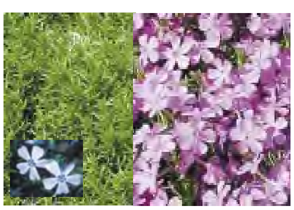
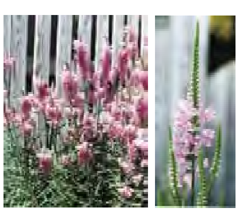
Herbaceous Plants

Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Lobelia cardinalis *cardinal flower*	 RHW	Height: 2-4' Flowers: Jul-Oct, red Fruit:	Light: Moisture: M W Soil pH: 5.8-7.8 Soil type: C L	fresh tidal and nontidal marshes, wooded swamps, seeps, banks of ponds, rivers, streams	Region: M P C States: DC DE MD NY PA VA WV		long bloom time; biennial, must reseed
Lobelia siphilitica *great blue lobelia*	  RHW, USFWS BES	Height: 1-5' Flowers: Aug-Oct, blue, violet Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: C L S	woodlands, meadows, swamps	Region: M P States: DC DE MD NY PA VA WV		long bloom time; white cultivars available
Lupinus perennis *lupine, sundial lupine*	 RHW	Height: 1-2' Flowers: Apr-Jul, blue, rarely pink or white Fruit: pod	Light: Moisture: D M Soil pH: Soil type: S	open woods, fields, roadsides, streambanks	Region: M P C States: DC DE NY VA WV		prefers acidic soil
Maianthemum canadense *Canada mayflower*	 RHW	Height: 0.5' Flowers: May-Jul, white Fruit: pale red speckled, berry	Light: Moisture: M Soil pH: Soil type: C L S	woods	Region: M P C States: DC DE MD NY PA VA WV		fragrant flowers GC
Maianthemum racemosum ssp. racemosum (Smilacina racemosa) *false Solomon's seal*	 PLANTS JA, PLANTS WSJ	Height: 1-3.5' Flowers: May-Jul, white Fruit: red, berry	Light: Moisture: M Soil pH: Soil type: C L S	dry to moist woods, clearings, bluffs	Region: M P C States: DC DE MD NY PA VA WV		flowers in plume-like clumps at tip of stem; herbal uses
Medeola virginiana *Indian cucumber*	  RHW, RHW	Height: 1-3.5' Flowers: May-Jun, yellowish Fruit: dark purple or black, berry	Light: Moisture: M Soil pH: Soil type: L S	woods	Region: M P C States: DC DE MD NY PA VA WV		rhizome is edible
Melanthium virginicum *Virginia bunchflower*	 RHW	Height: 2.5-6.5' Flowers: Jun-Aug, greenish Fruit: capsule	Light: Moisture: M Soil pH: Soil type: C L S	woods, seepages, clearings	Region: P C States: DC DE MD VA WV		
Mertensia virginica *Virginia bluebells*	 RHW	Height: 1-2.5' Flowers: Mar-Jun, pink turning blue Fruit: Mar-May, nut/nut-like	Light: Moisture: M W Soil pH: 4.5-8 Soil type: C L	rich wooded slopes, floodplains	Region: M P C States: DC DE MD NY PA VA WV		dormant in summer; flower color blue, pink, or white according to soil acidity

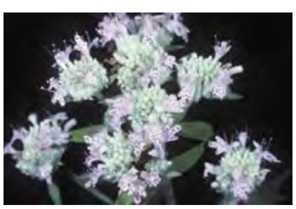
		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Mimulus ringens *monkeyflower, Allegheny monkeyflower*	 RHW	Height: 1-3' Flowers: Jun-Oct, blue Fruit: capsule	Light: Moisture: W Soil pH: Soil type: L	open swamps, meadows, shores	Region: M P C States: DC DE NY PA VA WV		interesting flowers
Mitchella repens *partridgeberry*	 USFWS, RHW	Height: 0.5' Flowers: May-Jul, white Fruit: July-Dec, scarlet, berry	Light: Moisture: D M Soil pH: Soil type: L S	dry acidic woods	Region: M P C States: DC DE MD NY PA VA WV		two flowers form one fruit; berry edible; slow creeper, forms mats under trees GC
Mitella diphylla *twoleaf miterwort, bishop's cap*	  RHW, RHW	Height: 0.5-1.5' Flowers: Apr-Jun, white Fruit: capsule	Light: Moisture: M Soil pH: Soil type: C L S	rich, woods	Region: M P C States: DC DE MD NY PA VA WV		
Monarda bradburiana (M. fistulosa) *wild bergamot, horsemint*	 RS MNPS	Height: 1.5-5' Flowers: Jun-Sep, pink to purple Fruit: nut/nut-like	Light: Moisture: D M Soil pH: 6-8 Soil type: C L	fields, thickets, roadsides, forest edges	Region: M P C States: DC DE MD NY PA VA WV		confused with bee-balm (M. didyma); aromatic; herbal uses
Monarda didyma *beebalm, Oswego tea*	 USFWS BES	Height: 2-5' Flowers: Jul-Sep, red Fruit: nut/nut-like	Light: Moisture: M W Soil pH: Soil type: L	creek banks, floodplains, woods	Region: M States: DC MD NY PA VA WV		showy flowers; aromatic; herbal uses
Monarda punctata *horsemint, spotted bee-balm*	 RHW	Height: 0.5-3.5' Flowers: Jun-Oct, yellow and purple Fruit: nut/nut-like	Light: Moisture: D Soil pH: Soil type: L S	open sandy fields	Region: M P C States: DC DE MD NY VA		
Nuttallanthus canadensis (Linaria canadensis) *blue, old-field, or Canada toadflax*	 PLANTS WSJ	Height: 0.5-2.5' Flowers: Apr-Sep, light blue Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	maritime grasslands and shrublands, successional shrubland, woods, fields	Region: M P C States: MD NY VA WV		delicate flowers; prefers well-drained soil
Oenothera biennis *common evening primrose*	 RHW	Height: 1.5-6.5' Flowers: Jun-Oct, yellow Fruit: capsule	Light: Moisture: D Soil pH: 5-7 Soil type: C L S	cultivated fields, waste ground, roadsides	Region: M P C States: DC DE MD NY PA VA WV		flowers open in evening; biennial

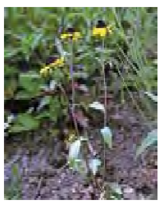
Herbaceous Plants

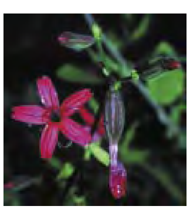
	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Oenothera fruticosa *narrow-leaved sundrops*  RHW	Height: 1-3' Flowers: May-Sep, yellow Fruit: capsule	Light: Moisture: D M Soil pH: 4.5-7 Soil type: C L S	fields, meadows, roadsides	Region: M P C States: DC DE MD NY PA VA WV		
Oenothera perennis *sundrops*  UWI RWF	Height: 0.5-3' Flowers: May-Aug, yellow Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	fields, pastures, roadsides, shaly slopes	Region: M P States: DC DE MD NY PA VA WV		similar to evening primrose (O. biennis); long bloom time; spreader
Opuntia humifusa (O. compressa) *eastern prickly-pear cactus*  RHW	Height: 0.5-1' Flowers: Jun-Jul, yellow Fruit: purplish to deep red, fleshy	Light: Moisture: D Soil pH: Soil type: L S	sandy coastal dunes, shaly soils	Region: M C States: DC DE MD VA WV		fruit edible, used for jelly GC
Osmorhiza longistylis *sweet cicely, anise root*  RHW	Height: 1.5-4' Flowers: May-Jun, white to green Fruit:	Light: Moisture: M Soil pH: Soil type: C L S	rich woods, wooded slopes, thickets	Region: M P C States: DC DE MD NY VA WV		all plant parts have anise scent
Oxalis violacea *violet wood sorrel*  RHW	Height: 0.5' Flowers: Apr-Jul, violet Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L	woods	Region: M P States: DC DE MD PA WV		GC
Packera aurea (Senecio aureus) *golden ragwort, golden groundsel*  RHW	Height: 0.5-2.5' Flowers: Apr-Aug, yellow Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: L	moist fields, woods, floodplains, roadsides	Region: M P C States: DC DE MD NY PA VA WV		wetland plant; long bloom time; aggressive spreader
Penstemon digitalis *beardtongue, tall white or foxglove beardtongue*  USFWS BES, RHW	Height: 2-5' Flowers: Jun-Aug, white or faintly purple Fruit: capsule	Light: Moisture: D M Soil pH: 5.5-7 Soil type: C L S	open woods, meadows	Region: M P C States: DC DE MD NY PA VA WV		tolerates poor drainage; variety of cultivars
Penstemon laevigatus *smooth or eastern beardtongue*  UWI MRB	Height: 1-3.5' Flowers: May-Jul, purplish Fruit: capsule	Light: Moisture: M Soil pH: Soil type:	rich woods, fields	Region: M States: DC MD VA WV		

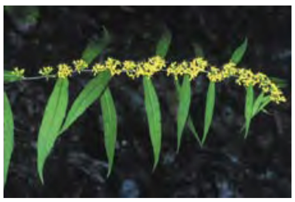
Plant		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Phlox carolina *thick-leaved phlox*	 PLANTS WSJ	Height: 1-2.5' Flowers: May-Jun, pink to purple, rarely white Fruit: capsule	Light: Moisture: D M W Soil pH: Soil type: L S	open woods	Region: M States: DC VA		GC
Phlox divaricata *woodland or wild blue phlox, wild sweet William*	 RHW	Height: 1.5' Flowers: Apr-Jun, blue, lavender, white Fruit: capsule	Light: Moisture: M Soil pH: 5.5-7.2 Soil type: C L S	rich woods	Region: M P States: DC MD NY PA VA WV		aromatic; showy flower; dormant in summer (leaves disappear); frequently cultivated; evergreen
Phlox maculata *phlox, meadow phlox, wild sweet William*	 PLANTS WSJ	Height: 1-3' Flowers: May-Sep, rose, pink, purple, rarely white Fruit: capsule	Light: Moisture: M W Soil pH: 5.9-6.8 Soil type: C L	meadows, streambanks, thickets	Region: M P C States: DE PA VA WV		aromatic; showy flowers; a frequent escapee from cultivation
Phlox paniculata *summer phlox, garden phlox*	 RHW, USFWS BES	Height: 1.5-6.5' Flowers: Jul-Oct, pink, red-purple, white Fruit: capsule	Light: Moisture: M Soil pH: Soil type: L	rich, open woods, roadsides, streambanks, thickets	Region: M P C States: DC PA VA WV		aromatic; showy flowers frequently escapes from cultivation
Phlox stolonifera *creeping phlox*	 RHW, USFWS BES	Height: 0.5-1.5' Flowers: Apr-Jun, blue, red-purple, violet Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	rich woods	Region: M States: DC MD VA WV		GC
Phlox subulata *moss phlox, moss-pink*	 USFWS BES, USFWS BES, RHW	Height: 0.5' Flowers: Apr-Jun, rose, pink, white Fruit: capsule	Light: Moisture: D Soil pH: 5.7-7.5 Soil type: C L S	rock crevices, ledges	Region: M P States: DC MD NY VA WV		nice rock garden plant GC
Physostegia virginiana *obedient plant, false dragonhead*	 USFWS BES, USFWS BES	Height: 1.5-5' Flowers: Jun-Sep, pink to purple Fruit: nut/nut-like	Light: Moisture: D M Soil pH: Soil type: C L S	moist open areas, streambanks, shorelines	Region: M P States: DC MD PA VA WV		flowers showy; spreads rapidly by underground stems; best in full sun; can escape cultivation
Podophyllum peltatum *Mayapple*	 RHW	Height: 1-2' Flowers: Apr-May, white Fruit: yellow, berry	Light: Moisture: M Soil pH: Soil type: L	rich woods, open fields	Region: M P C States: DC DE MD NY PA VA WV		ripe fruit edible; woodland groundcover; mottled foliage GC

Herbaceous Plants

Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Polemonium reptans *Jacob's ladder, Greek valerian*	 RHW	Height: 0.5-1.5' Flowers: Apr-Aug, blue Fruit: capsule	Light: Moisture: M Soil pH: Soil type: L S	rich or rocky woods, wooded floodplains	Region: M P States: DC DE MD PA VA WV		attractive flowers; slow spreader; herbal uses GC
Polygonatum biflorum *Solomon's seal, dwarf Solomon's seal*	 RHW	Height: 0.5-6.5' Flowers: Apr-Jun, white or green Fruit: blue to black, berry	Light: Moisture: D M Soil pH: Soil type: L	woods	Region: M P C States: DC DE MD NY PA VA WV		flowers dangle along stalk
Polygonatum pubescens *Solomon's seal, downy Solomon's seal*	 UWI KJS	Height: 1-3.5' Flowers: Apr-Jun, yellowish-green Fruit: blue to black, berry	Light: Moisture: D M Soil pH: Soil type: C L S	dry to moist woods	Region: M P C States: DE NY PA VA WV		herbal uses; edible
Porteranthus trifoliatus (Gillenia trifoliata) *Bowman's root*	 RHW	Height: 1.5-4' Flowers: May-Jul, white Fruit: pod	Light: Moisture: M Soil pH: Soil type: C L S	open upland woods, clearings, rocky slopes, roadsides	Region: M P States: DC DE MD PA VA WV		established plants drought tolerant; spreads to form tight clumps; seldom needs dividing; yellow fall color
Pycnanthemum incanum *hoary mountain mint*	 RHW	Height: 3' Flowers: Jul-Sep, white to lavender, purple spots Fruit: nut/nut-like	Light: Moisture: D Soil pH: Soil type: C L S	upland woods, fields, thickets, barrens	Region: M P C States: DC DE MD NY PA VA WV		
Pycnanthemum tenuifolium *narrow-leaved mountain mint*	 PLANTS RM89	Height: 1.5-2.5' Flowers: Jul-Sep, purple to white Fruit: nut/nut-like	Light: Moisture: D M Soil pH: Soil type: S	streambanks, floodplains, moist fields	Region: M P C States: DC DE NY PA VA WV		
Rhexia virginica *Virginia meadow-beauty*	 RHW	Height: 1-3.5' Flowers: Jun-Sep, dark pink Fruit: capsule	Light: Moisture: W Soil pH: Soil type: L	open areas	Region: M P C States: DC DE VA WV		also R. mariana for MD
Rudbeckia fulgida *early, eastern, or orange coneflower*	 USFWS RL	Height: 1.5-3.5' Flowers: Jul-Oct, yellow-orange, black eye Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L	moist fields, meadows	Region: P States: DC DE MD VA		cultivars have nice foliage

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Rudbeckia hirta *black-eyed Susan*	 USDA MG	Height: 1-3.5' Flowers: Jun-Oct, yellow, black eye Fruit: capsule	Light: Moisture: D M Soil pH: 6-7 Soil type: C L	fields, meadows, roadsides	Region: M P C States: DC DE MD NY PA VA WV		
Rudbeckia laciniata *tall, green-headed, or cutleaf coneflower*	 RHW	Height: 1.5-10' Flowers: Jul-Sep, yellow Fruit: capsule	Light: Moisture: M W Soil pH: 4.5-7 Soil type: C L S	floodplains, streambanks, fields	Region: M P C States: DC DE MD NY PA VA WV		herbal uses
Rudbeckia triloba *three-lobed coneflower*	 PLANTS WSJ	Height: 1.5-4.5' Flowers: Jun-Oct, yellow or orange Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	fields, open woods, rocky slopes	Region: M P States: DC MD NY PA VA WV		
Ruellia caroliniensis *Carolina wild petunia*	 RHW	Height: 0.5-3' Flowers: May-Aug, lavender-blue Fruit: capsule	Light: Moisture: M Soil pH: Soil type: C L S	woods, roadsides, thickets, waste places	Region: C States: DC DE MD VA WV		actually in the nightshade family, flower fragile; a highly variable species
Sabatia angularis *rose pink, common marsh-pink*	 RHW	Height: 1-3' Flowers: Jul-Oct, pink or white Fruit: capsule	Light: Moisture: M Soil pH: Soil type: C L S	moist open woods, fields, marshes, meadows; uplands, shores	Region: M P C States: DC DE MD VA WV		
Salvia lyrata *lyre-leaf sage*	 RHW	Height: 1-2' Flowers: Apr-Jun, violet Fruit: nut/nut-like	Light: Moisture: D M Soil pH: Soil type: L S	moist pastures, upland woods, thickets, waste areas	Region: M P C States: DC DE VA WV		
Sanguinaria canadensis *bloodroot*	 RHW	Height: 0.5' Flowers: Mar-May, white Fruit: capsule	Light: Moisture: M Soil pH: Soil type: L	rich woods, open roadsides	Region: M P C States: DC DE MD NY PA VA WV		showy flowers, but blooms fleetingly; herbal uses
Saxifraga pensylvanica *eastern swamp saxifrage*	 RHW	Height: 1-3' Flowers: Apr-Jun, white to green Fruit: capsule	Light: Moisture: W Soil pH: Soil type: C L S	wet woods, bogs, swamps	Region: M P C States: DC DE MD NY PA VA		

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Saxifraga virginiensis *early saxifrage*	 RHW	Height: 0.5-1' Flowers: Mar-May, white Fruit: capsule	Light: Moisture: D M Soil pH: Soil type:	rock crevices, dry slopes, woods	Region: M P C States: DC DE MD NY PA VA WV		
Scutellaria integrifolia *rough or hyssop skullcap, helmet flower*	 RHW	Height: 1-2.5' Flowers: May-Jul, blue, pink, white Fruit: blackish, nut/nutlike	Light: Moisture: D M W Soil pH: Soil type:	swamps, bogs, moist woods, fields	Region: M P C States: DC DE MD VA WV		
Sedum ternatum *mountain stonecrop, wild stonecrop*	 RHW	Height: 0.5' Flowers: Apr-Jun, greenish-white Fruit: pod	Light: Moisture: M Soil pH: Soil type:	damp rocks, rocky banks, cliffs, woods	Region: M P C States: DC DE MD NY PA VA WV		creeping stems; used in rock gardens GC
Senna marilandica (Cassia marilandica) *Maryland or southern wild senna*	 USFWS BES  USFWS BES	Height: 3-6.5' Flowers: Jul-Aug, yellow Fruit: pod	Light: Moisture: D M Soil pH: 4-7 Soil type: L S	dry roadsides, thickets, open woods	Region: M P C States: DC DE MD VA WV		pods important food for upland gamebirds
Silene caroliniana *wild pink*	 RHW	Height: 0.5-1' Flowers: Apr-Jun, white to pink Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L	dry open woods, rocky slopes, roadside banks, shale barrens	Region: M C States: DC DE MD VA		semi-evergreen; native to limestone areas GC
Silene stellata *starry campion, widow's frill*	 RHW	Height: 1-3.5' Flowers: Jun-Sep, white Fruit: capsule	Light: Moisture: D M Soil pH: Soil type:	wooded slopes, roadside banks, barrens	Region: M P C States: DC DE MD NY PA VA WV		drought-tolerant; naturalizes in woods
Silene virginica *fire pink*	 RHW	Height: 1-3' Flowers: Apr-Jul, dark pink to red Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L	upland woods, wooded slopes, streambanks, clearings	Region: M P States: DC DE VA WV		
Silphium perfoliatum *cup plant*	 PLANTS DL	Height: 3-8' Flowers: Jul-Oct, yellow Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L	floodplains, fields, moist meadows, woods	Region: M P States: DC VA WV		

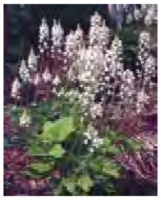
Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Sisyrinchium angustifolium (S. graminoides) *blue-eyed grass*	 CM NRCS	Height: 0.5-1.5' Flowers: Apr-Jun, blue-violet Fruit: brown, capsule	Light: Moisture: D M Soil pH: 5-7 Soil type: C L	grassy areas, damp woods	Region: M P C States: DC DE MD NY VA WV		grasslike leaves; also S. montanum in NY
Sisyrinchium atlanticum *coastal or eastern blue-eyed grass*	 UWI JS	Height: 0.5-2.5' Flowers: May-Jul, blue-violet Fruit: capsule	Light: Moisture: M W Soil pH: Soil type:	marshes, meadows, low woods	Region: P C States: DC DE MD VA		leaves grasslike, more slender than S. angustifolium
Solidago caesia *bluestem goldenrod, wreath goldenrod*	 RHW	Height: 1-3.5' Flowers: Aug-Oct, yellow Fruit: capsule	Light: Moisture: D M Soil pH: 5.5-7 Soil type: C L	rich deciduous woods	Region: M P C States: DC DE MD NY PA VA WV		stems bluish or purplish
Solidago canadensis var. scabra (S. altissima) *tall or late goldenrod*	 UWI, RRK	Height: 3.5-6.5' Flowers: Jul-Nov, yellow Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L	woods, fields, riverbanks, roadsides	Region: M P C States: DC DE MD NY PA VA WV		
Solidago canadensis *Canada goldenrod*	 UWI MRB	Height: 1-6.5' Flowers: Jul-Oct, yellow Fruit: capsule	Light: Moisture: D M Soil pH: 4.8-7.5 Soil type: C L S	fields, roadsides	Region: M P C States: DE NY VA WV		
Solidago flexicaulis *broad leaf or zig zag goldenrod*	 RHW	Height: 1-3.5' Flowers: Jun-Oct, yellow Fruit: capsule	Light: Moisture: D M Soil pH: 5.3-7 Soil type: L	moist woods, rocky wooded slopes	Region: M P States: DC DE MD NY PA VA WV		
Solidago juncea *early goldenrod*	 RHW	Height: 1-4' Flowers: Jun-Oct, yellow Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: S	fields, meadows, rocky slopes, roadsides	Region: M P C States: DC DE MD NY PA VA WV		
Solidago nemoralis *gray, dwarf, old-field, or one-sided goldenrod*	 RHW	Height: 0.5-3' Flowers: Jun-Nov, yellow Fruit: capsule	Light: Moisture: D Soil pH: 6.5-7.5 Soil type: L S	fields, open woods, roadsides	Region: M P C States: DC DE MD NY PA VA WV		tolerates poor soils

Herbaceous Plants

Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Solidago odora *sweet goldenrod*	 RHW	Height: 1.5-5' Flowers: Jul-Oct, yellow Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: C L S	dry open woods, barrens	Region: M P C States: DC DE NY VA WV		
Solidago rugosa *wrinkle-leaf or rough-stemmed goldenrod*	 RHW	Height: 1-6.5' Flowers: Aug-Nov, Fruit: capsule	Light: Moisture: M W Soil pH: 5-7.5 Soil type: L S	fields, woods, floodplains, roadsides, waste places	Region: M P C States: DC DE MD NY PA VA WV		tough plant; aggressive; strongly colonial
Solidago sempervirens *seaside goldenrod*	 RHW	Height: 1-6.5' Flowers: Jul-Nov, yellow Fruit: capsule	Light: Moisture: D M Soil pH: 5.5-7.5 Soil type: L S	coastal areas, dunes	Region: C States: DC DE MD VA		coastal plant, may occur where road salts are used
Solidago speciosa *showy or slender goldenrod*	 PLANTS TGB	Height: 2-6.5' Flowers: Jul-Oct, yellow Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	dry to moist open woods and fields	Region: M P States: DC MD NY VA		
Spiranthes cernua *nodding ladies' tresses*	 USFWS BES	Height: 0.5-2' Flowers: Jul-Nov, white Fruit:	Light: Moisture: M W Soil pH: 4.5-6.5 Soil type: C L S	meadows, open woods, roadsides, bogs	Region: M P C States: DC DE MD NY PA VA WV		orchid flowers; herbal uses
Stachys tenuifolia (S. hispida) *hedge nettle*	 RHW	Height: 1.5-3.5' Flowers: Jun-Aug, white to pink Fruit: nut/nut-like	Light: Moisture: M W Soil pH: 5.7-7.4 Soil type: C L S	wooded bottomlands, streambanks, meadows, fields	Region: P C States: DC DE MD VA WV		
Stellaria pubera *star chickweed, great chickweed*	 RHW	Height: 0.5-1.5' Flowers: Mar-Jun, white Fruit: capsule	Light: Moisture: M Soil pH: Soil type:	woods, shaded rocky areas	Region: M P ? States: DC MD VA WV		
Symphyotrichum cordifolium (Aster cordifolius) *heart-leaved aster*	 RHW	Height: 1-5' Flowers: Aug-Oct, blue-violet to rose Fruit:	Light: Moisture: D M Soil pH: Soil type: C L S	upland meadows, woods	Region: M P C States: DC NY PA VA WV		

Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Symphyotrichum ericoides var. ericoides (Aster ericoides) *heath, white heath, or dense-flowered aster; frostweed*	 RHW	Height: 0.5-6.5’ Flowers: Jul-Nov, white, rarely blue, violet, rose Fruit:	Light: Moisture: D M Soil pH: Soil type: L S	dry fields, forest edges, woods, thickets	Region: M P States: DC DE MD NY WV		forms dense mounds
Symphyotrichum laeve var. laeve (Aster laevis) *smooth blue aster*	 MOBOT	Height: 1-5’ Flowers: Aug-Oct, pale blue, violet, white Fruit:	Light: Moisture: D Soil pH: Soil type: C L S	open areas, forest edges	Region: M P C States: DC DE MD NY PA VA WV		
Symphyotrichum novae-angliae (Aster novae-angliae) *New England aster*	 USFWS	Height: 1-6’ Flowers: Aug-Oct, violet capsule Fruit:	Light: Moisture: M Soil pH: Soil type: L	open woods, seasonal wetlands, shores, meadows	Region: M P C States: DC DE MD NY PA VA WV		showy, frequently cultivated; tolerates drier soils and seasonal flooding GC
Symphyotrichum novi-belgii var. novi-belgii (Aster novi-belgii) *New York aster*	 RHW	Height: 1-4.5’ Flowers: Jul-Oct, blue-violet Fruit:	Light: Moisture: M W Soil pH: Soil type: L	thickets, meadows, shores	Region: P C States: DC DE MD NY VA		
Symplocarpus foetidus *skunk cabbage*	 RHW, USFWS BES	Height: 1-3’ Flowers: Feb-May, green to purple-brown Fruit:	Light: Moisture: W Soil pH: 4-7 Soil type: C L S	fresh tidal and nontidal marshes and shrub swamps, forested wetlands, seeps	Region: M P C States: DC DE MD NY VA WV		flower inconspicuous, emerges before leaves; sap has skunk-like odor
Thalictrum dioicum *early meadow rue*	 RHW	Height: 1-2.5’ Flowers: Apr-May, green to purple Fruit: capsule	Light: Moisture: M Soil pH: Soil type: L	rich rocky woods, ravines, alluvial terraces	Region: M P C States: DC MD NY PA VA WV		
Thalictrum pubescens (T. polygamum) *tall meadow rue*	 RHW	Height: 1.5-9’ Flowers: Jun-Aug, white Fruit:	Light: Moisture: M W Soil pH: Soil type:	rich woods, low thickets, swamps, meadows, streambanks	Region: M P C States: DC DE MD NY PA VA WV		foliage similar to columbines; clump-forming; delicate flowers; species very variable
Thalictrum thalictroides (Anemonella thalictroides) *rue anemone, windflower*	 RHW	Height: 0.5-1’ Flowers: Apr-Jun, white Fruit:	Light: Moisture: D M Soil pH: Soil type: C L S	wooded banks and thickets	Region: M P C States: DC DE MD NY PA VA WV		foliage similar to columbines

Herbaceous Plants

Plant	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Tiarella cordifolia *foamflower, false miterwort*	 USFWS BES	Height: 0.5-1' Flowers: Apr-Jul, white Fruit: capsule	Light: ☼ ◐ ● Moisture: M Soil pH: Soil type: L	rich woods, moist rocky wooded slopes	Region: M P C States: DC MD NY PA VA WV		attractive, long-blooming; creeping, clump-forming; many cultivars GC
Tradescantia virginiana *Virginia spiderwort, widow's tears*	 RHW	Height: 1-3' Flowers: Apr-Jul, deep blue-purple Fruit: capsule	Light: ☼ ◐ ● Moisture: M Soil pH: 4-8 Soil type: C L	wooded slopes, shale outcrops, fields, roadsides	Region: M P C States: DC DE MD VA WV		flowers showy
Trillium erectum *purple or red trillium, wakerobin*	 RHW	Height: 1-1.5' Flowers: Apr-Jun, purple or greenish to white Fruit: dark red, berry	Light: ● Moisture: M Soil pH: Soil type: L	woods	Region: M P States: DC MD NY PA VA WV		flowers ill-scented
Trillium grandiflorum *white or large-flowered trillium*	 RHW	Height: 0.5-1.5' Flowers: Apr-Jun, white then pink Fruit: black, berry	Light: ● Moisture: M Soil pH: Soil type: L	woods	Region: M P C States: DC MD NY PA VA WV		showy flowers; common, often in large colonies
Trillium sessile *toadshade*	 RHW	Height: 0.5-1' Flowers: Apr-May, maroon, purple, green Fruit: berry	Light: ◐ ● Moisture: M Soil pH: Soil type: L	woods, floodplains	Region: M P States: DC MD VA WV		
Trillium undulatum *painted trillium*	 RHW	Height: 1-1.5' Flowers: May-Jun, white with purple Fruit: bright red, berry	Light: ☼ ◐ ● Moisture: M Soil pH: Soil type: L	woods	Region: M P States: DC MD NY PA VA WV		
Uvularia grandiflora *large-flowered bellwort*	 RHW	Height: 2.5' Flowers: Apr-Jun, orange-yellow Fruit: capsule	Light: ● Moisture: M Soil pH: Soil type: L	woods	Region: M States: DC NY VA WV		rhizome can be cooked and eaten; young shoots can be substituted for asparagus
Uvularia perfoliata *perfoliate bellwort, mealy bellwort*	 RHW	Height: 0.5-2' Flowers: Apr-Jul, yellow Fruit: capsule	Light: ☼ ◐ Moisture: M Soil pH: Soil type: L	woods	Region: M P C States: DC DE MD NY PA VA WV		rhizome can be cooked and eaten; young shoots maybe substituted for asparagus

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Uvularia sessilifolia *straw lily*	 RHW	Height: 0.5-1' Flowers: May-Jun, yellow Fruit: capsule	Light: Moisture: D M Soil pH: Soil type: L S	dry to moist woodlands	Region: M P C States: DC DE MD NY PA VA WV		rhizomes may be cooked and eaten; young shoots may be substituted for asparagus GC
Veratrum viride *green false hellebore, white hellebore*	 RHW	Height: 2-5' Flowers: May-Jul, yellow-green Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: C L S	swamps, woods	Region: M P C States: DC DE MD NY PA VA WV		leaf edges will brown if soil dries and plant is in windy area; does best in cooler temps; slugs like the foliage
Verbena hastata *blue vervain, simpler's joy*	 RHW	Height: 1.5-5' Flowers: Jun-Oct, blue to purple Fruit: nut/nut-like	Light: Moisture: M W Soil pH: Soil type: C L S	meadows, swamps, floodplains, ditches, roadsides	Region: M P C States: DC DE MD NY PA VA WV		bright flowers; herbal uses
Verbesina alternifolia *wingstem, yellow ironweed*	 RHW	Height: 3.5-8' Flowers: Aug-Oct, yellow Fruit: capsule	Light: Moisture: M Soil pH: Soil type:	wooded slopes, open woodlands, riverbanks, shaded lowlands, roadsides, fields	Region: M P C States: DC DE MD NY VA WV		threatened in NY
Vernonia noveboracensis *New York ironweed*	 RHW	Height: 3.5-8' Flowers: Aug-Oct, purple Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: L	streambanks, fields, freshwater marshes	Region: M P C States: DC DE MD NY PA VA WV		brilliant flowers; tall upright form adds structure to garden; spreads
Veronicastrum virginicum (Veronica virginica) *Culver's root*	 RHW	Height: 3-6.5' Flowers: Jun-Sep, white, pink Fruit: capsule	Light: Moisture: M W Soil pH: Soil type: C L S	rich woods, meadows, thickets, swamps	Region: M P States: DC DE MD NY VA WV		
Viola conspersa *American dog violet*	 UWI RWF	Height: 0.5-1' Flowers: Apr-Jul, pale blue, violet Fruit: green, capsule	Light: Moisture: M W Soil pH: Soil type:	woods, fields, swamps	Region: M P C States: NY PA VA WV		delicate plant and flower; edible GC
Viola cucullata *marsh blue violet, blue marsh violet*	 RHW	Height: 0-0.5' Flowers: Apr-Jul, pale purple Fruit: green, capsule	Light: Moisture: M W Soil pH: Soil type: C L S	bogs, meadows, swamps	Region: M P C States: DC DE PA VA WV		stemless; self-sows; can become a nuisance GC

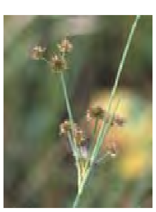
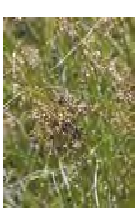
Herbaceous Plants

Plant		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Viola hastata *halberdleaf yellow violet*	RHW 	Height: 0.5-1' Flowers: Apr-May, yellow w/ violet Fruit: green, capsule	Light: Moisture: D Soil pH: Soil type:	rich deciduous woods	Region: M States: DC MD VA WV		GC
Viola pedata *bird's foot violet*	RHW 	Height: 0-0.5' Flowers: Mar-Jun, pale blue or w/ purple-black tips Fruit: green, capsule	Light: Moisture: D M Soil pH: Soil type: L S	sandy or rocky barrens, dry forested slopes	Region: M P C States: DC DE MD VA WV		stemless GC
Viola pubescens var. pubescens (V. pennsylvanica) *yellow violet, downy violet*	RHW 	Height: 0.5-1.5' Flowers: May-Jun, yellow, purple veins Fruit: green, capsule	Light: Moisture: M Soil pH: 6-7 Soil type: L	moist or dry woods, swamps	Region: M P States: DC DE NY PA VA WV		
Viola sororia (V. papilionacea) *common blue violet*	RHW 	Height: 0.5' Flowers: Mar-Jun, dark blue, violet Fruit: green with purple, capsule	Light: Moisture: M Soil pH: 6-7.8 Soil type: C L	dry to moist woods, swamps, thickets	Region: M P C States: DC DE MD NY PA VA WV		delicate plant and flower; edible; spreader; stemless
Viola striata *striped cream violet, striped violet*	MP 	Height: 0.5-1' Flowers: Apr-Jun, ivory w/ purple Fruit: green, capsule	Light: Moisture: M W Soil pH: Soil type: L	alluvial woods, swamps, fields	Region: M P C States: DC DE MD NY PA VA WV		
Yucca filamentosa (Y. flaccida) *Adam's needle*	RHW 	Height: 2-2.5' Flowers: Jun-Sep, white Fruit:	Light: Moisture: D Soil pH: 5.5-7.5 Soil type: L S	coastal sand dunes, outcroppings on thin rocky soils	Region: C States: DC DE MD VA		flower stalk can rise 5-15 feet above foliage
Zizia aurea *golden-alexanders*	RHW 	Height: 1-2.5' Flowers: Apr-Jun, yellow Fruit:	Light: Moisture: D M Soil pH: Soil type: C L S	wooded bottomlands, streambanks, moist meadows, floodplains	Region: M P C States: DC DE NY PA VA WV		

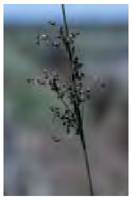
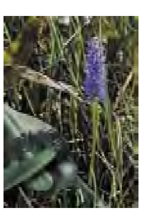
See also:

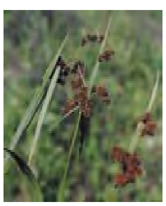
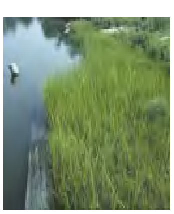
In the *Vines* section:
Smilax herbacea

In the *Herbaceous Emergents* section:
Iris prismatica, versicolor, virginica

Species	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Distichlis spicata *saltgrass*	 UWI EJJ	Height: 0.5-1.5' Flowers: Aug-Oct Fruit: pod	Light: Moisture: M W Soil pH: 6.4-10.5 Soil type: C L Flood Depth: Salinity: 0-50 ppt	tidal salt marshes, from Mean High tide above to spring tide level; high salinity; wet depressions	Region: C States: DC DE MD VA		often intermixed with Spartina patens, forms dense mats
Dulichium arundinaceum *three-sided sedge*	 UWI AH	Height: 1-3.5' Flowers: Jul-Oct Fruit: brown, nut/nut-like	Light: Moisture: W Soil pH: 4.7-7.5 Soil type: C L S Flood Depth: 0-12"	fresh tidal and nontidal marshes, bogs, swamps, pond edges	Region: M P C States: DC DE NY PA VA WV		grows best where water rarely draws down
Hibiscus moscheutos (H. palustris) *rose mallow, eastern rosemallow*	 CM NRCS	Height: 3-6' Flowers: Jul-Sep, cream, pink Fruit: Sep-Mar, brown, capsule	Light: Moisture: M W Soil pH: 4-7.5 Soil type: C L Flood Depth: 0-6" Salinity: 0-15 ppt	fresh to brackish tidal marshes, occasionally nontidal marshes	Region: C States: DC DE MD VA WV		common along coast; persists in winter; split seed capsules; use H. laevis in Piedmont
Iris prismatica *slender blueflag*	 RHW	Height: 1-3' Flowers: May-Jun, blue Fruit: green to brown, capsule	Light: Moisture: M W Soil pH: Soil type: Flood Depth: 0-6" Salinity: 0-0.5 ppt	fresh to moderately brackish tidal marshes, meadows, shores, swamps, forested wetlands	Region: C States: DC DE VA		leaves 1/4-inch wide, narrower than Iris versicolor
Iris versicolor *blue flag*	 RHW	Height: 3' Flowers: May-Jun, blue Fruit: green to brown, capsule	Light: Moisture: M W Soil pH: Soil type: L S Flood Depth: 0-6" Salinity 0-0.5 ppt	fresh to moderately brackish tidal marshes, meadows, shores, swamps, forested wetlands	Region: M P C States: DC DE MD NY PA VA		
Iris virginica *Virginia blue flag*	 RHW	Height: 1-2' Flowers: May-Jul, blue Fruit: green to brown, capsule	Light: Moisture: W Soil pH: 4.8-7.3 Soil type: C L Flood Depth: 0-6" Salinity: 0-0.5 ppt	fresh to moderately brackish tidal marshes, meadows, shores, swamps, forested wetlands	Region: P C States: DC VA WV		
Juncus canadensis *Canada rush*	 UWI AH	Height: 1-4' Flowers: Jul-Oct, greenish brown Fruit: brown, capsule	Light: Moisture: M W Soil pH: 4.5-5.9 Soil type: C L S Flood Depth: Salinity: 0-0.5 ppt	fresh to slightly brackish tidal and nontidal marshes, swamps, ponds and pond borders, shores, wet meadows, shallow water	Region: P C States: DC DE MD NY PA WV		
Juncus effusus *soft rush*	  CM NRCS, USFWS BES	Height: 1-4' Flowers: Jun-Sep, greenish brown Fruit: brown, capsule	Light: Moisture: M W Soil pH: 5.5-7 Soil type: C L S Flood Depth: 0-12"	fresh tidal and nontidal marshes, shrub swamps, meadows, ditches	Region: M P C States: DC DE MD NY PA VA WV		often grows in clumps

Herbaceous Emergents

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Juncus roemerianus *black needlerush, needlegrass rush, needlegrass rush*	PLANTS LA 	Height: 1-4' Flowers: May-Oct, yellow-green Fruit: July-Nov, brown, capsule	Light: Moisture: M W Soil pH: 3.5-7 Soil type: C L Flood Depth: Salinity: 0-25 ppt	brackish and salt marshes, above Mean High tide to spring tide level	Region: C States: DE MD VA		some nitrogen fixing value
Justicia americana *American water-willow*	RHW 	Height: 1-3' Flowers: Jun-Oct, white with purple Fruit: achene (dry, flat seed)	Light: Moisture: W Soil pH: 5.4-7.6 Soil type: C L S Flood Depth:	muddy edges of shallow freshwater streams, lakes, ponds; shores	Region: M P States: DC MD PA VA WV		has underground stems and forms colonies
Kosteletzkya virginica *seashore mallow*	RHW 	Height: 1.5-4.5' Flowers: Jul-Sep, pink Fruit: brown, capsule	Light: Moisture: W Soil pH: Soil type: Flood Depth: Salinity: 0-10 ppt	irregularly flooded salt and brackish marshes, above Mean High tide to spring tide level	Region: C States: DC DE MD VA		common near the coast; looks similar to Hibiscus
Nuphar lutea (N. advena) *spatterdock, yellow water lily, cow-lily, American lotus*	RHW 	Height: 1-1.5' Flowers: May-Oct, yellow Fruit: green, berry	Light: Moisture: W Soil pH: Soil type: C L S Flood Depth: 12-36"	fresh tidal and nontidal marshes, swamps, ponds	Region: M P C States: DC DE MD NY VA WV		large leaves floating but rooted; fruit berry-like, many seeded, somewhat flattened, leathery
Nymphaea odorata *fragrant water lily, American water lily, white water lily*	RHW 	Height: 1-4' Flowers: Jun-Sep, white Fruit: green, berry	Light: Moisture: W Soil pH: Soil type: C L S Flood Depth: 12-48"	tidal and nontidal fresh waters, shallow lakes, ponds	Region: P C States: DC DE MD NY VA		large leaves floating but rooted; fruit berry-like, many seeded, somewhat flattened, leathery
Orontium aquaticum *golden club*	RHW 	Height: 1.5-2' Flowers: Apr-Jun, yellow Fruit: green, berry	Light: Moisture: W Soil pH: Soil type: C L S Flood Depth:	edges of regularly flooded tidal fresh marshes, inland shores, pond borders, on mud or in shallow water	Region: C States: DC DE MD VA WV		fruit is a thick fleshy spike covered with small dark green berry-like structures
Peltandra virginica *arrow arum*	RHW, RHW  	Height: 2' Flowers: Apr-Jul, green to white Fruit: green or black	Light: Moisture: W Soil pH: 5.2-9.5 Soil type: C L S Flood Depth: 0-12" Salinity: 0-2 ppt	fresh to moderately brackish tidal and nontidal marshes, swamps, shallow waters of lakes and ponds	Region: C States: DC DE MD NY VA WV		globular head of berries enclosed in green leathery case, curved downward
Pontederia cordata *pickerelweed*	UWI MC 	Height: 3.5' Flowers: Jun-Nov, purple Fruit:	Light: Moisture: W Soil pH: 6-8 Soil type: C L S Flood Depth: 0-18" Salinity: 0-3 ppt	fresh to moderately brackish, tidal and nontidal marshes, shallow water of ponds or lakes	Region: P C States: DC DE MD NY VA		spreads vigorously; a small bladder-like structure crested with toothed ridges holds one seed

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Sagittaria latifolia *duck potato, arrowhead, broadleaf arrowhead*	 RHW	Height: 0.5-4' Flowers: Jul-Sep, white Fruit: green, achene (dry, flat seed)	Light: Moisture: W Soil pH: 4.7-8.6 Soil type: C L Flood Depth: 0-24" Salinity:	fresh tidal and nontidal marshes, swamps; borders of lakes, streams and ponds	Region: P C States: DC DE MD NY PA VA WV		
Saururus cernuus *lizard's tail*	 RHW	Height: 1.5-4.5' Flowers: Jun-Sep, greenish white Fruit: capsule	Light: Moisture: W Soil pH: Soil type: C L S Flood Depth: 0-12"	fresh tidal and nontidal marshes, swamps, shallow water	Region: C States: DC DE MD VA WV		fragrant flower; often forms extensive colonies
Schoenoplectus pungens var. pungens (Scirpus pungens, Scirpus americanus) *common three-square*	 CM NRCS	Height: 4' Flowers: Jun-Sep, brown Fruit: Jun-Sep, brown, achene (dry, flat seed)	Light: Moisture: W Soil pH: Soil type: C L S Flood Depth: 0-6" Salinity: 0-15 ppt	fresh and brackish tidal and nontidal marshes, shores, shallow water	Region: M P C States: DC DE MD VA	high wildlife value	spike above flower is up to 5 inches tall
Schoenoplectus validus (Scirpus validus) *great bulrush, soft stem bulrush*	 PLANTS 1995	Height: 6-10' Flowers: Jun-Sep, brown Fruit: Jun-Sep, brown, achene (dry, flat seed)	Light: Moisture: W Soil pH: Soil type: C L S Flood Depth: 0-12" Salinity: 0-5 ppt	fresh to brackish tidal and nontidal marshes, pond edges, quiet waters, emergent marshes	Region: M P C States: MD NY PA VA	high wildlife value	spreads rapidly
Scirpus atrovirens *black or green bulrush, dark green bulrush*	 PLANTS JA	Height: 3-6' Flowers: Jun-Aug, brown Fruit: Jun-Aug, brown, achene (dry, flat seed)	Light: Moisture: W Soil pH: 4-8 Soil type: C L Flood Depth: Salinity:	shallow emergent marshes, shrub swamps, floodplain forests, wooded swamp, bogs, wet meadows, swales, ditches	Region: M P C States: MD NY PA VA WV	high wildlife value	grows in clumps or sod-forming
Scirpus cyperinus *woolgrass, woolgrass bulrush*	 USDA JK	Height: 4-5' Flowers: Aug-Sep, brown Fruit: Aug-Sep, brown, achene (dry, flat seed)	Light: Moisture: M W Soil pH: 4.8-7.2 Soil type: C L S Flood Depth: Salinity:	fresh tidal and nontidal marshes, swamps, forested wetlands, meadows, ditches, ponds, bogs	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	grows in large clumps, often extensive colonies
Sparganium americanum *American bur-reed*	 RHW	Height: 5' Flowers: May-Aug, greenish Fruit: green to brown, achene (dry, flat seed)	Light: Moisture: W Soil pH: 4.9-7.3 Soil type: C L S Flood Depth: 0-6"	fresh nontidal marshes, shallow waters, muddy shores	Region: M P C States: DC DE NY PA VA WV		good for sediment stabilization
Spartina alterniflora *salt marsh or smooth cordgrass*	 USFWS	Height: 2-7' Flowers: Jul-Sep Fruit:	Light: Moisture: M W Soil pH: 5.4-7 Soil type: C L S Flood Depth: Salinity: 0-35 ppt	salt and brackish tidal marshes (mid-tide up to Mean High tide level)	Region: C States: DC DE MD VA		good for shore stabilization; important in seaside habitats; short form (<1.5 ft) found in irregularly flooded high marsh, tall form in regularly flooded low marsh

Herbaceous Emergents

	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Spartina cynosuroides *big cordgrass*  PLANTS LA	Height: 3.5-10' Flowers: Aug-Oct Fruit:	Light: Moisture: M W Soil pH: 5.8-7.5 Soil type: C L S Flood Depth: Salinity: 0-10 ppt	fresh and brackish tidal marshes, near Mean High tide and above to spring tide level	Region: C States: DC DE MD NY PA VA		soil stabilizer; not drought tolerant
Spartina patens *salt meadow hay*  CM NRCS	Height: 1-3' Flowers: Jul-Sep Fruit: achene (dry, flat seed)	Light: Moisture: M W Soil pH: 5.3-7.5 Soil type: C L S Flood Depth: Salinity: 0-35 ppt	coastal salt and brackish tidal marshes; irregularly flooded high marsh at or above Mean High tide line	Region: C States: DC DE MD VA		forms large mats; good for shore erosion control
Spartina pectinata *freshwater cordgrass, prairie cordgrass*  CM NRCS	Height: 4' Flowers: Jul-Sep Fruit: achene (dry, flat seed)	Light: Moisture: M W Soil pH: 6-8.5 Soil type: L Flood Depth: 0-6" Salinity: 0-3 ppt	brackish and fresh tidal and nontidal marshes, shores, wet meadows; upper half of intertidal zone and above to spring tide level	Region: M P C States: DC DE MD NY PA VA WV		shore stabilizer; low drought tolerance
Zizania aquatica *wild rice*  RHW	Height: 6-10' Flowers: Jun-Sep Fruit: achene (dry, flat seed)	Light: Moisture: M W Soil pH: 6.4-7.4 Soil type: C L S Flood Depth: 0-36" Salinity:	fresh tidal and nontidal marshes, streamsides, shallow waters	Region: C States: DC DE MD NY VA		annual; edible

See also:

In the *Ferns* section:
- **Dryopteris cristata**
- **Onoclea sensibilis**
- **Osmunda cinnamomea, regalis**
- **Thelypteris palustris**
- **Woodwardia areolata, virginica**

In the *Grasses & Grasslike Plants* section:
- **Andropogon glomeratus (virginicus var abbreviatus), virginicus**
- **Calamagrostis canadensis**
- **Carex crinita var. crinita, lurida, stricta, vulpinoidea**
- **Elymus virginicus**
- **Leersia oryzoides**
- **Panicum amarum, virgatum**

In the *Herbaceous Plants* section:
- **Asclepias incarnata**
- **Bidens cernua**
- **Caltha palustris**
- **Doellingeria umbellata var. umbellata (Aster umbellatus)**
- **Lobelia cardinalis**
- **Sabatia angularis**
- **Symphyotrichum novae-angliae (Aster novae-angliae)**
- **Symplocarpus foetidus**
- **Verbena hastata**
- **Vernonia noveboracensis**

Wetland plants (**Spartina alterniflora**, here) stabilize the shoreline without obstructing the homeowner's view.

USFWS

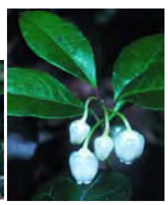
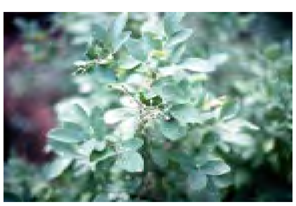
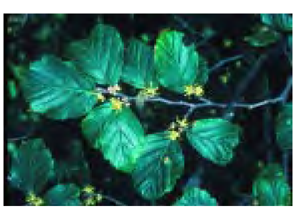
Wetlands of any size provide valuable habitat for wildlife.

USFWS BES

USFWS RM

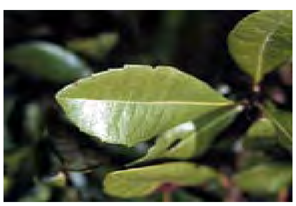
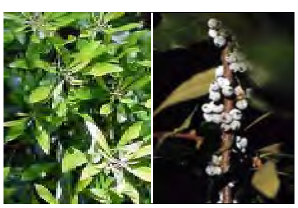
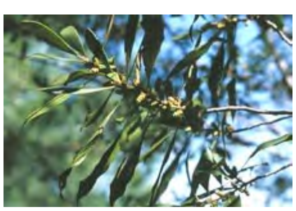
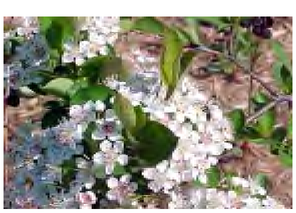
		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Alnus serrulata *smooth alder, hazel alder*	 USFWS BES, PLANTS WSJ	Height: 12-20' Flowers: Mar-Apr, purple Fruit: Aug-Feb, brown, cone/cone-like Fall color: yellow, red	Light: Moisture: M W Soil pH: 5.5-7.5 Soil type: C L	fresh tidal and nontidal marshes, shrub swamps, forested wetlands	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	forms thickets along watercourses; nitrogen fixing; tolerates flooding to 3 inches
Aralia spinosa *Devil's walking stick*	 RHW	Height: 20-30' Flowers: Jul-Aug, white Fruit: Aug-Sep, black, berry Fall color: yellow	Light: Moisture: D M Soil pH: 5.5-7.1 Soil type: C L S	moist woods, stream banks, roadsides	Region: M P C States: DC DE MD VA WV	high wildlife value	seeds are poisonous if chewed; low maintenance; spreads from new shoots; thorny, clublike stem
Baccharis halimifolia *high-tide bush, groundsel tree, sea myrtle*	 USFWS BES	Height: 6-12' Flowers: Aug-Sep, white Fruit: Oct-Nov, silvery white, achene Fall color: purple	Light: Moisture: D M W Soil pH: 7-8.5 Soil type: C L S O	fresh to salt marshes, ditches, shores, dunes	Region: C States: DE MD VA		volunteers in disturbed places; shallow, lateral roots; tolerates flooding to 6 inches; tolerates salinity to 15 ppt
Callicarpa americana *American beautyberry, French mulberry*	 USFWS BES	Height: 6' Flowers: Jun-Aug, lavender-pink Fruit: Sep-Mar, lavender, berry Fall color:	Light: Moisture: D M Soil pH: 4.8-7 Soil type: C L S		Region: C States: DC VA		flowers from new growth; if overgrown prune to 6-18 inches tall; will regain height in one season
Ceanothus americanus *New Jersey tea*	 RHW	Height: 3' Flowers: May-Sep, white Fruit: Sep-Oct, black Fall color: yellow to tan	Light: Moisture: D Soil pH: 4.3-6.5 Soil type: C L S	meadows, fields, glades, open woods, borders, rocky areas, openings	Region: M P C States: DC DE MD NY PA VA WV		tough; tolerates moist soil if well drained; fixes nitrogen; tolerates dryness
Cephalanthus occidentalis *buttonbush*	 RHW	Height: 6-12' Flowers: Jul-Aug, creamy white Fruit: Sep-Jan, green to brown Fall color: yellow-green	Light: Moisture: M W Soil pH: 6.1-8.5 Soil type: C L S O	fresh tidal and nontidal marshes, shrub swamps, forested wetlands; stream, lake and pond edges	Region: M P C States: DC DE MD NY PA VA WV		needs sun to flower; flowers fragrant; interesting fruit; tolerates drought; leaves may persist into winter; tolerates flooding to 36 inches
Clethra alnifolia *sweet pepperbush, summersweet*	 USFWS	Height: 6-12' Flowers: Jul-Aug, white/ pink Fruit: Sep-Feb, brown, capsule Fall color: yellow	Light: Moisture: M W Soil pH: 4.5-6.5 Soil type: C L S	tidal and nontidal forested wetlands, shrub swamps, bogs, woods, coastal river floodplains, lakeshores	Region: C States: DC DE MD NY VA		very fragrant; tolerates some flooding by partly salty water
Comptonia peregrina *sweetfern*	 USFWS BES	Height: 3' Flowers: Apr-May, yellow-green Fruit: Aug-Oct, green to brown, cone/cone-like Fall color: brown	Light: Moisture: D Soil pH: 4-7 Soil type: L S O	hillsides, cliffs, woods openings, sand flats and barrens, fields, dunes	Region: M P C States: DC DE MD NY PA VA WV		fragrant; fixes nitrogen, leaves may persist into winter

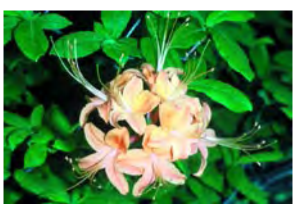
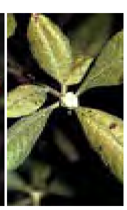
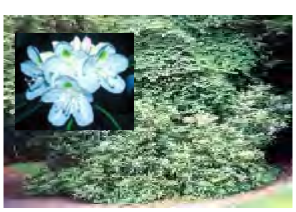
Shrubs

Species	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Cornus amomum *silky dogwood, red willow, silky cornel*	 RHW	Height: 6-12' Flowers: May-Jun, white Fruit: Aug, blue, berry Fall color: orange, red or purple	Light: ○ ◐ Moisture: M W Soil pH: 6.1-7.5 Soil type: C L S	forested wetlands, floodplains, shrub wetlands, stream and pond banks, clearings	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	
Cornus racemosa *red-panicled or gray dogwood*	 UWI KJS, UWI KJS	Height: 6-12' Flowers: May-Jun, white Fruit: Aug-Sep, white, red stems, berry Fall color: purple	Light: ○ ◐ ● Moisture: D M Soil pH: 6.1-8.5 Soil type: C L	open wooded floodplains, forested wetlands, shrub swamps, rocky woods or ledges, fencerows	Region: M P States: NY VA WV	high wildlife value	tolerates a variety of conditions; berries are food for many songbirds and small mammals
Corylus americana *American hazelnut or filbert*	   UCONN, UCONN, UCONN	Height: 10-15' Flowers: Mar-Apr, brown or red Fruit: Aug-Sep, light brown, nut/nut-like Fall color: yellow orange	Light: ◐ Moisture: D M Soil pH: 6.1-7.5 Soil type: C L	dry woodlands, forest edges, hillsides, fence rows, ravines, floodplain woods, brushy pastures	Region: M P States: DC DE MD NY PA VA WV		forms large thickets; edible nut; male catkins brown, female red
Gaultheria procumbens *wintergreen, checkerberry*	  RHW, RHW	Height: 0.5' Flowers: May-Aug, white to pink Fruit: Jul-Apr, red, berry Fall color: evergreen	Light: ◐ ● Moisture: D M Soil pH: 4-6.5 Soil type: L S O	clearings, steep rocky open slopes, sandy oak woods, hummocks in bogs	Region: M P C States: DC DE MD NY PA VA WV		dense, mat-like form; forms colonies; edible fruits, leaves; wintergreen taste and scent GC
Gaylussacia baccata *black huckleberry*	 RHW	Height: 1.5-3' Flowers: May-Jun, white to pink Fruit: Jul-Sep, black, berry Fall color: reddish-purple	Light: ◐ ● Moisture: D M W Soil pH: 4.5-6.5 Soil type: C L S	woods, thickets	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	very common; fruits edible but many-seeded
Gaylussacia frondosa *dangleberry*	 CM NRCS	Height: 2-4' Flowers: Apr-Jun, greenish to purple Fruit: Jul-Oct, blue, berry Fall color: reddish-purple	Light: ○ ◐ ● Moisture: D M W Soil pH: 4.5-6.5 Soil type: S	woods and thickets	Region: M C States: DC DE MD NY VA	high wildlife value	berries borne on long, drooping stems
Hamamelis virginiana *witch hazel*	 RHW	Height: 15-30' Flowers: Sep-Dec, yellow Fruit: Oct-Nov, tan brown, capsule Fall color: yellow	Light: ◐ ● Moisture: D M Soil pH: 5.5-6.5 Soil type: C L S	woods or brushy fields, moist or dry	Region: M P C States: DC DE MD NY PA VA WV		noted for fall/winter bloom; medicinal uses, leaves may persist into winter
Hydrangea arborescens *wild or smooth hydrangea*	 RHW	Height: 3-6' Flowers: Jun-Aug, white Fruit: Oct-Jan, brown, capsule Fall color: yellow	Light: ◐ ● Moisture: M Soil pH: 6.1-8.5 Soil type: L S	rich upland or floodplain woods, streambanks	Region: M P States: DC MD PA VA WV		eaves poisonous to humans; does best on loamy soils

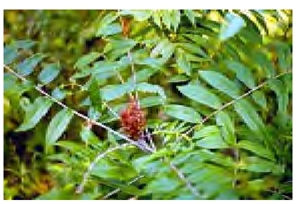
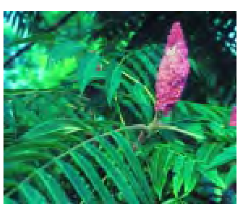
		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Hypericum densiflorum *dense St. John's wort*	 RHW	Height: 1.5-6' Flowers: Jul-Sep, yellow Fruit: Oct-Apr, brown, capsule Fall color: yellow green	Light: Moisture: D M W Soil pH: 5.5-7 Soil type: C L S O	low boggy places, seepage slopes, pond and lake edges, wet meadows, streambanks, ditches, moist pinelands	Region: M P C States: DC DE MD VA		blooms small but form dense flat-topped clusters; can spread aggressively
Ilex glabra *inkberry*	  USFWS BES, USFWS BES	Height: 6-10' Flowers: May-Jun, greenish white Fruit: Sep-Mar, black, berry Fall color: evergreen	Light: Moisture: D M Soil pH: 4.5-6 Soil type: C L S O	forested wetlands, shrub swamps, sandy woods	Region: C States: DE NY VA	high wildlife value	berries persist through winter; male and female flowers on separate plants; tolerates some salt flooding; short cultivars (4-5') available
Ilex laevigata *smooth winterberry*	  RHW, RHW	Height: 10-12' Flowers: May-Jul, white to cream Fruit: Sep-Feb, red, scarlet, berry Fall color: yellow	Light: Moisture: M Soil pH: 4.5-6.5 Soil type: C L S O	wooded swamps	Region: C States: DC DE MD VA	high wildlife value	berries provide winter bird food; prefers soil with a calcareous layer
Ilex verticillata *winterberry, winterberry holly, black alder*	 USFWS BES	Height: 6-12' Flowers: Jun-Jul, greenish white Fruit: Aug-Feb, red, Fall color:yellow to brown	Light: Moisture: M W Soil pH: 4.5-6.5 Soil type: C L S O	fresh tidal swamps, shrub swamps, forested wetlands	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	berries provide winter bird food, poisonous to humans; berries on female plants, need male plant to pollinate
Itea virginica *tassel-white, Virginia sweetspire*	 USFWS BES	Height: 6-10' Flowers: Jun-Jul, white Fruit: Aug-Mar, brown, capsule Fall color: red to purple	Light: Moisture: M W Soil pH: 5.1-7.5 Soil type: C L S	forested wetlands, shrub swamps, streambanks, shallow water	Region: C States: DC DE MD VA		fruit capsules on stalk; plant will sucker, form thickets; tolerates flooding to 6 inches
Iva frutescens *marsh elder, high tide bush*	  PLANTS LA, RHW	Height: 2-10' Flowers: Aug-Oct, greenish white Fruit: not conspicuous, capsule Fall color:	Light: Moisture: D M Soil pH: 5-5.7 Soil type: C L S	tidal brackish and salt marshes	Region: C States: DE MD VA		similar to Baccharis halimifolia but with opposite leaves; tolerates salinity to 15 ppt
Kalmia angustifolia *sheep laurel, lambkill*	 CM NRCS	Height: 2-3' Flowers: May-Jul, white, pink, purple, red Fruit: Sep-Mar, brown, capsule Fall color: evergreen	Light: Moisture: M W Soil pH: 4.5-6 Soil type: C L S O	pastures, barrens, slow wooded streams, swamp borders, bogs, thickets	Region: C States: DC DE MD NY PA VA		foliage poisonous to hoofed browsers (not eaten by deer)
Kalmia latifolia *mountain laurel*	 USFWS BES	Height: 12-20' Flowers: May-Jul, white to pink/purple Fruit: May-Jun, brown, capsule Fall color: evergreen	Light: Moisture: D M W Soil pH: 4.5-6 Soil type: C L S O	woods, ridge tops, fields, swamps, mountain meadows and slopes	Region: M P C States: DC DE MD NY PA VA WV		foliage poisonous to hoofed browsers; PA state flower

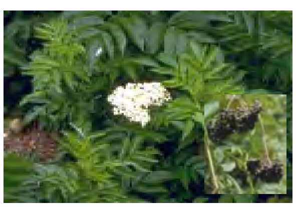
Shrubs

Species	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Leucothoe racemosa *fetterbush, sweetbells*	RHW, PLANTS WSJ 	Height: 13' Flowers: May-Jun, white, pinkish Fruit: brown, capsule Fall color:	Light: Moisture: M W Soil pH: 4.5-6 Soil type: C L	swamps, woods, thickets	Region:M P C States: DC DE MD NY PA VA		zig-zag twigs, reddish or greenish; tends to sucker, forming thickets
Lindera benzoin *spicebush*	CM NRCS, RHW, CM NRCS 	Height: 6.5-16' Flowers: Mar-May, yellow Fruit: Sep-Oct, scarlet, berry Fall color: yellow	Light: Moisture: M W Soil pH: 4.5-6.5 Soil type: L S	woods, wooded slopes, dunes, floodplain forests	Region:M P C States: DC DE MD NY PA VA WV	high wildlife value	all parts edible and aromatic; herbal uses
Lyonia ligustrina *male-berry*	RHW 	Height: 6-12' Flowers: May-Jul, white Fruit: Sep-Mar, brown, capsule Fall color: orange to red	Light: Moisture: M Soil pH: 4-6 Soil type: C L S O	open areas, swamps, woods	Region:M P C States: DC DE MD NY PA VA WV		berry-like capsules persist through winter
Lyonia mariana *stagger-bush*	RHW, CM NRCS 	Height: 0.5-6.5' Flowers: May-Jun, white, pale pink Fruit: Sep-Feb, brown, capsule Fall color: red	Light: Moisture: D M Soil pH: 4-6 Soil type: S	swamps, moist or dry woods	Region: C States: DC DE MD VA		interesting woody capsules persist through winter
Morella caroliniensis (Myrica heterophylla) *southern or swamp bayberry*	PLANTS 	Height: 8-12' Flowers: Apr-Jun, yellowish-green Fruit: Sep-Apr, bluish white, berry Fall color: evergreen	Light: Moisture: D M W Soil pH: 4.5-7 Soil type: C L S	dry or moist thickets, woods, bogs	Region: C States: DE VA		glossy dark green leaves, leaves larger than M. cerifera, plants fuller
Morella cerifera (Myrica cerifera) *wax myrtle, southern bayberry*	USFWS BES, PLANTS 	Height: 6-15' Flowers: Mar-Jun, yellowish-green Fruit: Sep-Apr, bluish white, berry Fall color: evergreen in southern areas	Light: Moisture: D M W Soil pH: 5.5-7 Soil type: C L S	tidal and nontidal fresh and brackish marshes, swamps, sandy dune swales, upland woods	Region: C States: DE MD VA		fragrant; loses leaves north and west of Ches. Bay, MD north; may reach 30 feet; can be pruned as hedge; nitrogen fixer; tolerates salinity to 10 ppt
Morella pensylvanica (Myrica pensylvanica) *northern bayberry, candleberry*	CM NRCS 	Height: 5-10' Flowers: Mar-Apr, yellowish-green Fruit: Sep-Apr, bluish white, berry Fall color:	Light: Moisture: D M W Soil pH: 5.1-6.5 Soil type: C L S	tidal and nontidal fresh and brackish marshes, swamps, sand flats, dunes	Region: C States: DC DE MD NY VA	high wildlife value	fragrant leaves; tends to sucker and form large colonies; waxy berries persist through winter; tolerates salinity to 20 ppt
Photinia melanocarpa (Aronia melanocarpa) *black chokeberry*	USFWS BES 	Height: 3-6' Flowers: Apr-May, white or pink-tinged Fruit: Sep-Nov, black, berry Fall color: crimson red	Light: Moisture: D M W Soil pH: 5.1-6.5 Soil type: C L S O	bogs, swamps, springs, dunes, cliffs, fields, clearings, wet or dry thickets, creek banks, balds, rock outcroppings	Region:M P C States: DE MD NY PA VA WV		can be pruned as hedge

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Photinia pyrifolia (Aronia arbutifolia) *red chokeberry*	 USFWS BES, VT	Height: 1.5-13' Flowers: Mar-May, white, purple-tinged Fruit: Sep-Dec, red, berry Fall color: orange to red	Light: Moisture: D M W Soil pH: 5.1-6.5 Soil type: C L S	forested wetlands, shrub bogs, upland forests, fields, dunes	Region: M P C States: DC DE MD NY PA VA WV		tolerates infrequent flooding by water with some salt; can be pruned as hedge
Physocarpus opulifolius *ninebark*	 USFWS BES	Height: 5-12' Flowers: May-Jul, white, pink Fruit: Jul-Mar, orange to red, capsule Fall color:yellow to purple	Light: Moisture: M W Soil pH: 6.1-8.5 Soil type: C L	thickets, along streams in sand or gravel bars, rocky slopes	Region: M P States: DC NY PA VA WV		papery bark continually molts in thin strips; very drought tolerant; adaptable
Prunus maritima *beach plum*	 CM NRCS	Height: 1-8' Flowers: Apr-May, white Fruit: Aug, blue-purple, fleshy Fall color:	Light: Moisture: D M Soil pH: 5.8-7.7 Soil type: L S	ocean dunes, roadsides, hedgerows	Region: C States: DE MD	high wildlife value	edible fruit, prized for jams and jellies; salt tolerant
Rhododendron atlanticum *dwarf or coast azalea*	  GM ARS, USFWS BES	Height: 1-2.5' Flowers: Apr-May, white, purple-tinged Fruit: brown, capsule Fall color:	Light: Moisture: M Soil pH: 4.2-5.7 Soil type: S	coastal, sandy soils	Region: C States: DE MD VA		flowers very fragrant; colonial, arising from spreading underground stems;
Rhododendron calendulaceum *flame azalea*	 RHW	Height: 5-9' Flowers: May-Jun, yellow, orange, red Fruit: Aug-Feb, brown, capsule Fall color: yellow green	Light: Moisture: D M Soil pH: 5.1-6 Soil type: C L	open oak woods, dry rocky woodlands, damp slopes, mountain streambanks, heath balds	Region: M States: VA WV		
Rhododendron canescens *sweet azalea*	  PLANTS, PLANTS	Height: 3-10' Flowers: Apr-May, white or pink Fruit: brown, capsule Fall color:	Light: Moisture: M Soil pH: 4.2-5.7 Soil type: S	woods	Region: C States: DC DE MD		
Rhododendron maximum *great laurel, rosebay rhododendron*	 RHW, USFWS BES	Height: 15-20' Flowers: May-Aug, white, pink Fruit: Sep-Nov, tan to red, capsule Fall color: evergreen	Light: Moisture: M W Soil pH: 4.5-6 Soil type: L	mountain slopes, woods, sheltered coves, ravines, streamsides	Region: M P States: DC MD NY PA VA WV		needs space; may form dense thicket
Rhododendron periclymenoides *pinxterbloom, pink azalea, pinxter flower*	 RHW	Height: 3-10' Flowers: Apr-May, pink, purple, white Fruit: Aug-Mar, brown, capsule Fall color: dull yellow	Light: Moisture: D M W Soil pH: 4.5-5.5 Soil type: L	woods, low swampy areas, limestone cliffs	Region: M P C States: DC DE MD NY PA VA WV		will tolerate thin soils over bedrock; open, airy quality; susceptible to disease and insects

Shrubs

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Rhododendron prinophyllum *rose, roseshell, mountain or early azalea*	 PLANTS	Height: 2-8' Flowers: May-Jun, pink Fruit: May-Sep Fall color:	Light: Moisture: D M Soil pH: Soil type: O	rocky or rich woods	Region:M States: PA VA WV		may reach 15 feet tall, but rarely; flowers have clove-like scent
Rhododendron viscosum *swamp azalea*	 RHW	Height: 6.5-10' Flowers: May-Aug, white, pink Fruit: Aug-Mar, brown, capsule Fall color: yellow, orange, to purple	Light: Moisture: M W Soil pH: 4-6 Soil type: C L S O	wet floodplain woods, streambanks, swamp edges, hillside bogs, ditch banks, clearings	Region:M P C States: DC DE MD NY VA		attractive spreading, loose-branched habit; demands acid soil; susceptible to disease and insects
Rhus aromatica *fragrant sumac*	 RHW, RHW	Height: 6' Flowers: Mar-May, greenish yellow Fruit: Jul-Mar, dark wine red, berry Fall color: red	Light: Moisture: D Soil pH: 6.1-8.5 Soil type: L S	limestone cliffs, open upland woods, rocky bluffs, oak barrens, foredunes, barren rock	Region:M P States: DC MD NY VA WV	high wildlife value	fuzzy edible berry clusters; aromatic leaves; shorter cultivars available; male and female separate plants
Rhus copallina *shining, winged, flameleaf, or dwarf sumac*	 RHW, CM NRCS	Height: 20-35' Flowers: Jul-Sep, greenish yellow Fruit: Oct-Nov, red, berry Fall color: rich red	Light: Moisture: D Soil pH: 5.3-7.5 Soil type: C L S	thickets, fields, open woods, roadsides, fencerows	Region:M P C States: DC DE MD NY PA VA WV	high wildlife value	forms large colonies; winter food for wildlife
Rhus glabra *sweet or smooth sumac*	 CM NRCS	Height: 2-20' Flowers: Jun-Jul, greenish Fruit: Aug-Oct, red, berry Fall color: red	Light: Moisture: D M Soil pH: 5.3-7.5 Soil type: L S	dry or moist open areas, shale barrens, fields, dry open slopes, roadsides, fencerows	Region:M P C States: DC DE MD NY PA VA WV	high wildlife value	fuzzy berry clusters; male and female may be on separate plants; extremely drought resistant
Rhus hirta (R. typhina) *staghorn sumac*	 RHW	Height: 35-50' Flowers: Jun-Jul, yellow-green Fruit: Jul-Feb, red, berry Fall color: orange-red	Light: Moisture: D M Soil pH: 4.5-7.2 Soil type: C L S	fields, roadsides, forest edges	Region:M P C States: DC DE MD NY PA VA WV	high wildlife value	spreads by lateral roots to form colonies; female plants produce seed; winter food for wildlife
Ribes rotundifolium *Appalachian or eastern gooseberry*	 USFWS BES	Height: 3-6' Flowers: May-Jul, greenish purple Fruit: Jul-Aug, purple or greenish, berry Fall color: red	Light: Moisture: D Soil pH: 6.1-8.5 Soil type: C L S	rocky upland woods	Region:M P States: DC MD NY VA WV		do not use near apple orchards; may spread cedar apple rust
Rosa carolina *pasture rose*	  RHW, RS MNPS	Height: 0.5-3' Flowers: May-Jun, pale pink Fruit: Aug-Mar, red, berry Fall color: yellowish to orange	Light: Moisture: D M Soil pH: 6.1-8.5 Soil type: C L S	dry fields, open woods; rocky banks, shale barrens	Region:M P C States: DC DE MD NY VA WV	high wildlife value	edible fruit is a berry-like hip; thorns

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Rosa palustris *swamp rose*	 PLANTS WSJ	Height: 8' Flowers: Jun-Aug, pink Fruit: Jul-Mar, red, berry Fall color:	Light: Moisture: M W Soil pH: 4-7 Soil type: C L	fresh tidal and nontidal marshes, forested wetlands, shrub swamps, streambanks	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	edible fruit is a berry-like hip; thorns; tolerates flooding to 3 inches
Rubus allegheniensis *Allegheny blackberry*	 USFWS BES, RHW	Height: 3-9' Flowers: May-Jun, white Fruit: Jul-Sep, black, berry Fall color: orange, red, to purple	Light: Moisture: D M Soil pH: 4.5-7.5 Soil type: C L	roadsides, fence rows, fields, thickets, open woods, clearings	Region: M P States: DC DE MD NY PA VA WV	high wildlife value	prickly; juicy edible fruit used by people and wildlife
Rubus odoratus *purple flowering raspberry, fragrant thimbleberry*	 PLANTS WSJ	Height: 3-6' Flowers: Jun-Sep, rose purple Fruit: Jul-Sep, dull red, berry Fall color: pale yellow	Light: Moisture: M Soil pH: 5.1-6 Soil type: C L S	forest edges, rocky ledges, rocky wooded slopes	Region: M P States: DC DE MD NY PA VA WV	high wildlife value	feels sticky; fruit edible; spreads by suckers
Salix humilis *prairie willow*	 PLANTS 1997	Height: 6-12' Flowers: Apr-May, greenish yellow Fruit: May-Jun, brown, capsule Fall color: dull yellow	Light: Moisture: D M W Soil pH: 6.1-7.5 Soil type: C L S O	dry thickets, openings, boggy swales; mountain ridges, barrens, meadows, roadsides	Region: M P C States: DC DE PA VA WV	high wildlife value	typically spreads up to twice it's height; flowers are catkins
Sambucus nigra ssp. canadensis (S. canadensis) *common elderberry, American elder*	 RS MNPS, USFWS	Height: 6-12' Flowers: Jun-Jul, white Fruit: Aug-Sep, purple to black, berry Fall color: yellow green	Light: Moisture: D M W Soil pH: 6.1-7.5 Soil type: C L S O	fresh tidal and nontidal marshes, swamps, wet meadows, moist woods, fields	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	berries eaten by 48 species of birds
Sambucus racemosa var. racemosa (S. pubens) *red elderberry, scarlet elder*	 RHW, RHW	Height: 6-12' Flowers: May, white Fruit: Jun-Jul, red, berry Fall color: yellow green	Light: Moisture: D M Soil pH: 6.1-8.5 Soil type: L	rich woods, dry rocky woods, along creeks, rock crevices, sheltered coves, ravines	Region: M States: PA VA WV	high wildlife value	important summer wildlife food; one of earliest blooming shrubs; fragrant
Spiraea alba var. latifolia (Spiraea latifolia) *broad-leaved meadow-sweet*	 RHW	Height: 3-6' Flowers: Jun-Sep, white or pinkish Fruit: Sep-Mar, brown, capsule Fall color: yellow	Light: Moisture: M Soil pH: Soil type: L S	bogs, woods, barrens, swamps	Region: M States: DC DE MD NY VA WV		similar to S. alba but twigs more purplish or red
Spiraea alba *narrow-leaved meadow-sweet*	 RHW	Height: 3-6' Flowers: Jun-Sep, white Fruit: Sep-Mar, brown to red brown, capsule Fall color: yellow	Light: Moisture: M Soil pH: 6.6-7.5 Soil type: C L S O	bogs, swamps, meadows	Region: M States: DC DE MD NY VA WV		bark may be shaggy, orange-brown

Shrubs

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Spiraea tomentosa *steeplebush, hardback spirea*	RHW 	Height: 3-6' Flowers: Jul-Sep, pink to purple Fruit: Sep-Mar, brown, capsule Fall color: yellow green	Light: Moisture: M W Soil pH: 5.1-6 Soil type: C L S O	meadows, fields, bogs, swamps, lake edges, marshes, dunes, swales	Region: M P C States: DC DE MD NY VA WV		cultivars available with white or red flowers
Staphylea trifolia *American bladdernut*	RHW 	Height: 3-15' Flowers: May, greenish white Fruit: Aug-Dec, red-brown, capsule Fall color: yellow	Light: Moisture: M Soil pH: 6.1-8 Soil type: L	rich woods, floodplain woods, ravines, shores of lakes and ponds, rocky wooded streambanks, shaded dunes	Region: M P States: DC MD PA VA WV		fruit is 3-lobed, papery, balloon-like capsule; branches green-white striped
Vaccinium angustifolium *lowbush blueberry*	BES 	Height: 1-2' Flowers: May-Jun, white or pink-tinged Fruit: Jul-Aug, blue to black, berry Fall color: red	Light: Moisture: D M Soil pH: 4-6 Soil type: C L S	dry woods, barrens, rock outcroppings	Region: M P States: DC MD NY PA VA WV	high wildlife value	edible berries often harvested, makes a nice ground layer GC
Vaccinium corymbosum *highbush blueberry*	USFWS BES, USFWS BES  	Height: 6-12' Flowers: Apr-Jun, white or pink-tinged Fruit: Jul-Aug, blue to black, berry Fall color: yellow to red	Light: Moisture: D M W Soil pH: 4-6.5 Soil type: L S O	forested wetlands, shrub swamps, bogs, dry to wet woods, thickets, streambanks, rock outcroppings	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	edible berries commonly cultivated
Vaccinium macrocarpon *cranberry*	RHW 	Height: 0.5-1' Flowers: Jun-Jul, white to pink Fruit: Sep-Nov, red, berry Fall color: dark green to purple to red	Light: Moisture: W Soil pH: 4-6 Soil type: L S O	sphagnum bogs, cool swampy areas	Region: M C States: DC DE MD NY PA WV		low mat form, can spread indefinitely; edible cranberries GC
Vaccinium pallidum (V. vacillans) *early lowbush blueberry*	RHW 	Height: 1.5-2' Flowers: Apr-May, white, reddish Fruit: Jul-Aug, blue, berry Fall color:	Light: Moisture: D M Soil pH: Soil type: L S	dry woods and barrens	Region: M P C States: DC DE MD PA VA WV	high wildlife value	sweet berries GC
Vaccinium stamineum *deerberry*	RHW 	Height: 6-12' Flowers: Apr-Jun, white or purple Fruit: Sep-Oct, bluish black, berry Fall color: red	Light: Moisture: D M Soil pH: 4-6.5 Soil type: C L S	dry woods, openings, barrens; uplands, floodplain forests, clearings, thickets, rock outcroppings	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	berries edible but sour
Viburnum acerifolium *maple-leaved arrowwood*	RHW, RHW 	Height: 3-6' Flowers: Jun, creamy-white, pink Fruit: Aug-Dec, blue to black, berry Fall color: orange, red, purple	Light: Moisture: D M Soil pH: 5.1-6 Soil type: C L	floodplain forests, dry wooded slopes, woods, rocky slopes, rock outcrops, wooded ravines	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	dry, edible berries

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Viburnum dentatum (V. recognitum) *southern arrowwood*	 USFWS BES, RS MNPS	Height: 10-15' Flowers: May-Jun, white Fruit: Sep-Nov, blue to black, berry Fall color: reddish-purple	Light: Moisture: D M W Soil pH: 5.1-6.5 Soil type: L S O	swamps, wet woods, bogs, floodplain forests, streambanks, low, wet acid-sand habitats	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	stems very straight, nice structure in winter
Viburnum nudum var. cassinoides (V. cassinoides) *witherod*	 USFWS BES	Height: 6-12' Flowers: May-Jun, creamy white Fruit: Aug-Sep, pink to blue-black, berry Fall color: orange-red to purple	Light: Moisture: D M W Soil pH: 5.1-6.5 Soil type: L O	swamps, bogs, moist woods, barrens	Region: M P C States: MD PA		handsome stature; multiple fruit colors at once
Viburnum nudum *naked witherod, possum-haw viburnum*	 RHW	Height: 6.5-20' Flowers: Jun-Jul, white to cream Fruit: Sep-Oct, red to blue, then black, berry Fall color: red to purple	Light: Moisture: M W Soil pH: 5.1-6 Soil type: L S	wet woods, rich upland woods, swamps, margins of vernal ponds, heath bogs	Region: M P C States: DC DE MD VA	high wildlife value	edible fruit but very acidic; shallow fibrous roots, transplants well
Viburnum prunifolium *black haw*	 RHW	Height: 12-24' Flowers: Apr-May, white Fruit: Jul-Nov, pink to bluish-black, berry Fall color: reddish purple	Light: Moisture: D M W Soil pH: 4.8-7.5 Soil type: C L	woods, thickets, fields, roadsides	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	fruits edible, used for preserves

See also:

In the *Trees* section:
Castanea pumila
Cornus alternifolia
Juniperus virginiana
Magnolia virginiana
Malus (Pyrus) coronaria
Quercus ilicifolia
Salix sericea

Rhus copallina

CM NRCS

Rosa palustris

CM NRCS

Itea virginica

USFWS BES

Vaccinium corymbosum in fall.

USFWS BES

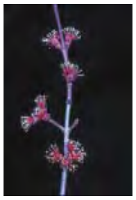
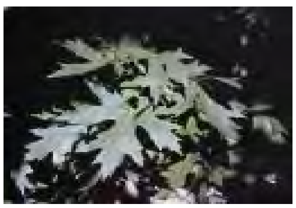
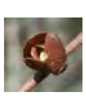
Kalmia angustifolia

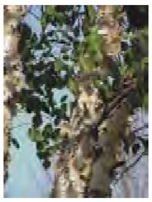
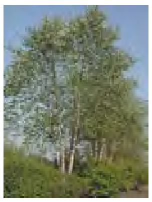
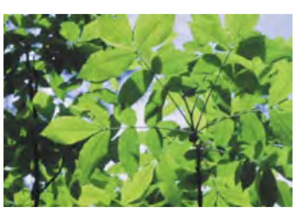
RHW

Kalmia latifolia

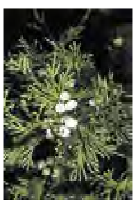
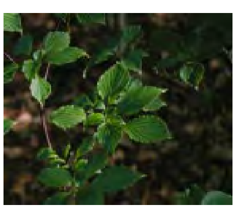
RHW

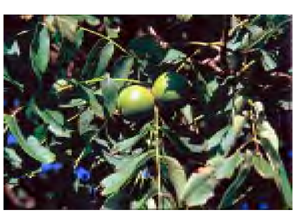
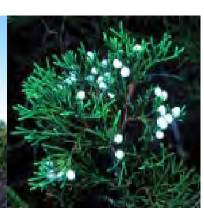
Trees

Species	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Acer negundo *box elder, ash leaf maple, Manitoba maple*	USFWS BES, RHW 	Height: 30-60' Spread: 30-60' Flowers: Apr-May, yellow-green Fruit: Jul-Sep, tan brown, winged Fall color: yellow, red	Light: Moisture: M W Soil pH: 5.2-7 Soil type: C L S	along rivers, streams, ponds, and seasonally flooded areas	Region: M P C States: DC DE MD NY PA VA WV		brittle wood; thicket-forming
Acer rubrum *red, scarlet, swamp, or soft maple*	USFWS BES, RHW 	Heighy: 40-100' Spread: 30-75' Flowers: Mar-Apr, (inconspicuous) Fruit: Apr-Jun, red-brown or yellow, winged Fall color: red, orange, yellow	Light: Moisture: M W Soil pH: 5.4-7.1 Soil type: C L S	swamps, uplands, rocky hillsides, dunes	Region: M P C States: DC DE MD NY PA VA WV		earliest spring bloomer; adaptable
Acer saccharinum *silver, white, river, or soft maple*	PLANTS DEH 	Height: 50-100' Spread: 75-100' Flowers: Feb-Mar, greenish yellow Fruit: Apr-May, tan brown, winged Fall color: yellow	Light: Moisture: M W Soil pH: 5.2-7.1 Soil type: C L S	floodplains, streamsides, river bottoms, pond and lake edges	Region: M P States: DC DE MD NY PA VA WV		
Acer saccharum *sugar maple*	USDA JE 	Height: 60-100' Spread: 50-75' Flowers: Apr-May, yellow-green Fruit: Sep-Oct, green, tan at maturity, winged Fall color: yellow, orange, red	Light: Moisture: M Soil pH: 4-7.3 Soil type: L S	upland woods, mountain coves and slopes	Region: M P States: DC DE NY PA VA WV	high wildlife value	fall color; maple syrup; state tree of New York and West Virginia
Acer spicatum *mountain maple*	RHW 	Height: 20-35' Spread: 20-35' Flowers: May-Jun, yellow green Fruit: Jul-Sep, red or yellow, winged Fall color: orange to red	Light: Moisture: M Soil pH: 5.5-7 Soil type: L	cool rich woods, moist rocky slopes and flats, along small streams	Region: M States: MD NY PA VA WV	high wildlife value	short-lived, strong acid preference
Amelanchier arborea *downy serviceberry, shadbush*	RHW 	Height: 15-25' Spread: Flowers: Mar-May, white Fruit: red to dark purple, fleshy Fall color: yellow, red	Light: Moisture: D M Soil pH: 5.5-7.5 Soil type: L S	wooded river banks, swamps, rocky slopes	Region: M States: DC DE MD NY PA VA WV		used by 58 wildlife species; 35 bird species; important early summer food; berries edible to people
Amelanchier canadensis *serviceberry, shadbush, shadblow*	CM NRCS 	Height: 35-50' Spread: 35-50' Flowers: Apr-May, white Fruit: Jun-Jul, red to purple, fleshy Fall color: orange to red	Light: Moisture: M W Soil pH: 5.6-7.5 Soil type: C L S	swamps, low ground, woods, thickets	Region: M P C States: DC DE MD NY VA		
Asimina triloba *paw-paw*	PLANTS JSP, USFWS BES 	Height: 20-35' Spread: 20-35' Flowers: Apr-Jun, purple Fruit: Aug-Sep, yellow, berry Fall color: yellow/ copper-red	Light: Moisture: M Soil pH: 5.2-7.2 Soil type: L S	river valleys, bottomlands, understory of woods	Region: C States: DC DE MD PA VA WV		

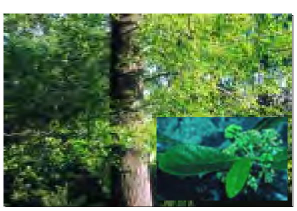
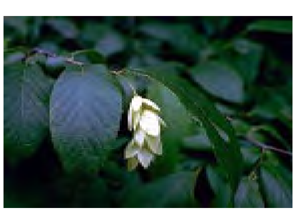
		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Betula alleghaniensis *yellow birch*	 PLANTS RM	Height: 60-80' Spread: 35-50' Flowers: Apr-May, yellow green Fruit: Jul-Oct, green to tan, cone/cone-like Fall color: golden yellow	Light: Moisture: M W Soil pH: 4.6-8 Soil type: L S	rich uplands, low swamps, streamsides, elevated floodplain terraces and knobs	Region: M States: MD NY PA VA WV	high wildlife value	fall color; attractive winter texture and color; prefers cool, moist conditions, common on calcareous
Betula lenta *sweet birch, black birch, cherry birch*	  USFWS BES, RHW	Height: 50-75' Spread: 35-50' Flowers: Apr-May, yellow green Fruit: Aug-Nov, green to tan, cone/cone-like Fall color: golden yellow	Light: Moisture: D M Soil pH: 4.8-6.8 Soil type: L S	steep rocky land and lower	Region: M P States: DE MD NY PA VA WV	high wildlife value	excellent fall color; prefers moist sites, tolerates dry; colonizes open or disturbed areas
Betula nigra *river birch, red birch, black birch*	  USFWS BES, USFWS BES	Height: 50-75' Spread: 35-50' Flowers: Apr-May, dark brown Fruit: Jun-Aug, tan brown, cone/cone-like Fall color: yellow	Light: Moisture: M W Soil pH: 4-6 Soil type: C L	along streams, rivers, ponds and swamps	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	attractive peeling bark;
Carpinus caroliniana *American hornbeam, musclewood, ironwood*	 USFWS BES	Height: 13-40' Spread: 35-50' Flowers: Apr-May, red or reddish-green Fruit: Jun-Oct, nut/nut-like Fall color: orange, red	Light: Moisture: M Soil pH: 4-7.4 Soil type: L S	river margins, bottomlands, swamps	Region: M P States: DC DE MD NY PA VA WV		slow growing and short lived
Carya alba (C. tomentosa) *mockernut hickory*	 USDA NRCS	Height: 60-100' Spread: 35-50' Flowers: May-Jun, light green Fruit: Sep-Oct, light reddish brown, nut/nut-like Fall color: yellow	Light: Moisture: D M Soil pH: 6.5-7.4 Soil type: L S	ridges, dry hills, hillsides	Region: M P C States: DC DE MD NY PA VA WV		good fall color
Carya cordiformis *bitternut or swamp hickory, pignut*	 PLANTS	Height: 60-100' Spread: 60-100' Flowers: Apr-May, yellow-green Fruit: Aug-Oct, yellowish green, nut/nut-like Fall color: yellow	Light: Moisture: M W Soil pH: 6.5-7.4 Soil type: C L S	rich bottomlands, swamps, frequently flooded areas, dry hillsides	Region: M P C States: DC DE MD NY PA VA WV		
Carya glabra *pignut, sweet pignut, or smooth bark hickory*	 CM NRCS	Height: 60-100' Spread: 35-50' Flowers: Apr-May, yellow-green Fruit: Sep-Oct, dark brown, nut/nut-like Fall color: yellow	Light: Moisture: D M W Soil pH: 6.5-7.4 Soil type: L	dry woods on hillsides and ridges	Region: M P C States: DC DE MD NY PA VA WV		
Carya ovata *shagbark, scalybark, or shellbark hickory*	 USDA NRCS	Height: 70-100' Spread: 35-50' Flowers: May-Jun, yellow-green Fruit: Sep-Oct, dark or reddish brown, nut/nut-like Fall color: brown	Light: Moisture: M Soil pH: 4-6.7 Soil type: L S	dry upland slopes, lowlands, valleys	Region: M P C States: DC DE MD NY PA VA WV		attractive peeling bark

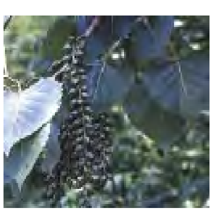
Trees

	Photo	Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Castanea pumila *chinquapin, eastern or Allegany chinkapin*	 RHW	Height: 12-20' Spread: 12-20' Flowers: Jun, pale yellow Fruit: Sep-Oct, dark brown, nut/nut-like Fall color: yellow or purple	Light: Moisture: D Soil pH: 4.5-7.5 Soil type: L S	rocky slopes, steep rocky land, rocky streambanks, sandy ridges, swamp edges, open woods	Region: M P C States: DC DE MD VA WV		sweet, edible fruit
Celtis occidentalis *common hackberry, sugarberry, nettletree*	 UWI KK	Height: 40-100' Spread: 40-100' Flowers: Apr-May, yellow green, brown tint Fruit: Sep-Dec, purple brown, berry Fall color: yellow	Light: Moisture: D M W Soil pH: 6-7.8 Soil type: C L S	drainage basins, floodplains, wooded slopes, high rocky limestone bluffs bordering streams, windbreaks	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	butterfly larval host; drought tolerant; tolerates occasional flooding; saplings can sprout in deep shade, common on limestone soils
Cercis canadensis *eastern redbud*	  USFWS BES, USFWS BES	Height: 20-35' Spread: 20-35' Flowers: Apr-May, pink to lavender Fruit: Jul-Dec, black, pod Fall color: golden yellow	Light: Moisture: D M Soil pH: 4.5-7.5 Soil type: L S	river bottoms and streambanks	Region: M P C States: DC DE MD PA VA WV		fixes nitrogen
Chamaecyparis thyoides *Atlantic white cedar*	  PLANTS 1997, PLANTS GFR	Height: 75' Spread: Flowers: Mar-Apr, greenish brown Fruit: bluish, cone/cone-like Fall color: evergreen	Light: Moisture: M W Soil pH: 4.5-5.5 Soil type: C L S	freshwater swamps, woods	Region: C States: DE MD VA		
Chionanthus virginicus *white fringetree*	  USFWS RS, RHW	Height: 20-35' Spread: 20-35' Flowers: May-Jun, white Fruit: Sep-Oct, bluish black, berry Fall color: yellow	Light: Moisture: D M Soil pH: 4.5-6.5 Soil type: L S	moist streambanks, ridges, hillsides in sandy to deep-rich soils	Region: M P C States: DC DE MD VA WV		
Cornus alternifolia *alternate-leaf or pagoda dogwood*	 CM NRCS	Height: 15-25' Spread: 15-35' Flowers: May-Jun, creamy white Fruit: Jul-Aug, bluish black, berry Fall color: maroon	Light: Moisture: M Soil pH: 5.8-7.5 Soil type: L	dry woods, forest edges, rocky slopes	Region: M States: DE MD NY PA VA WV	high wildlife value	used by 64 wildlife species; 43 bird species; keep root zone moist and acidic; tolerates full sun; young stems often purple
Cornus florida *flowering dogwood*	 RHW, USFWS RM	Height: 20-50' Spread: 20-50' Flowers: Apr-May, white Fruit: Sep-Dec, red to orange, berry Fall color: scarlet red	Light: Moisture: D M Soil pH: 5-7 Soil type: L	woods, woodland edges and openings, mountain slopes, coves	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	fall migrant birds eat berries; tolerates sun, best in moist, well-drained, acidic soil with organic matter, VA state tree
Crataegus crus-galli *cockspur hawthorn*	 USDA JE	Height: 20-35' Spread: 20-35' Flowers: May-Jun, white Fruit: Aug-Jan, dull red or green, fleshy Fall color: orange to red	Light: Moisture: D M Soil pH: 4.5-7.2 Soil type: C L S	thickets, open areas, especially in dry or rocky places, low rich slopes	Region: M P C States: DC DE MD NY PA VA WV		

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Crataegus viridis *southern thorn, green hawthorn*	PLANTS 	Height: 20-35' Spread: Flowers: Apr, white Fruit: bright red to orange, fleshy Fall color: purple, scarlet	Light: Moisture: M W Soil pH: 6-7.3 Soil type: C L	lowlands and valleys	Region: C States: DE MD NY VA		
Diospyros virginiana *common persimmon*	PLANTS 1997, PLANTS 1997  	Height: 50-75' Spread: 35-50' Flowers: Jun, greenish yellow to cream Fruit: Sep-Nov, orange purple, berry Fall color: yellow or purple	Light: Moisture: D M Soil pH: 5-7 Soil type: C L	open, disturbed areas, deciduous woods	Region: M P C States: DC DE MD PA VA WV	high wildlife value	edible fruits
Fagus grandifolia *American beech*	CM NRCS, CM NRCS 	Height: 50-100' Spread: 50-75' Flowers: Apr-May, yellow-green Fruit: Sep-Nov, orange-green, nut/nut-like Fall color: yellow/ tan; retains leaves till spring	Light: Moisture: M Soil pH: 4.1-6.5 Soil type: L S	rich uplands and lowlands	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	edible nuts; attractive bark; leaves may persist into winter
Fraxinus americana *white ash*	UWI KJS 	Height: 50-100' Spread: 50-75' Flowers: Apr-May, deep purple Fruit: Aug-Feb, tan brown, winged Fall color: yellow, maroon	Light: Moisture: M Soil pH: 5-7.5 Soil type: C L S	upland slopes, valleys, coves, bottomlands	Region: M P C States: DC DE MD NY PA VA WV		fast growth; fall color
Fraxinus pennsylvanica *green ash, red ash, swamp ash*	UWI KK 	Height: 50-75' Spread: 35-50' Flowers: Apr-May, purple Fruit: Aug-Dec, tan brown, winged Fall color: yellow to orange	Light: Moisture: D M W Soil pH: 5-8 Soil type: C L S	tidal and nontidal freshwater forested wetlands; seasonally to regularly flooded or saturated	Region: M P C States: DC DE MD NY PA VA WV		tolerates drought; tolerates infrequent flooding and some salt; male and female flowers on separate plants
Ilex opaca *American holly*	USFWS BES 	Height: 15-50' Spread: 18-40' Flowers: May-Jun, white or cream Fruit: red, fleshy Fall color: evergreen	Light: Moisture: M Soil pH: 4-7.5 Soil type: C L	sandy woods	Region: M P C States: DC DE MD VA		birds eat berries; state tree of Delaware
Juglans nigra *black walnut, American walnut*	PLANTS DEH 	Height: 70-90' Spread: 75-100' Flowers: May-Jun, yellow-green Fruit: Aug-Sep, yellow-green, nut/nut-like Fall color: yellow	Light: Moisture: M Soil pH: 5.5-8 Soil type: L	woods, slopes, streamsides	Region: M P C States: DC DE MD NY PA VA WV		may stunt growth of nearby planst
Juniperus virginiana *eastern red cedar*	RHW, CM NRCS  	Height: 50-75' Spread: 35-50' Flowers: Mar-Apr, red purple Fruit: Jul-Mar, pale green to dark blue, cone/cone-like Fall color: evergreen	Light: Moisture: D M Soil pH: 5-8 Soil type: C L S	broad range of habitats	Region: M P C States: DC DE MD NY PA VA WV		berries consumed by over 50 species of birds; berries have culinary use

Trees

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Liquidambar styraciflua *sweet gum, red gum, sap gum*	 CM NRCS	Height: 60-100’ Spread: 50-75’ Flowers: Apr-May, yellow-green Fruit: Jul-Jan, brown, capsule Fall color: yellow, red	Light: Moisture: M W Soil pH: 4.5-7 Soil type: C L S	upland woods, slopes, ravines, floodplains, streambanks	Region: M P C States: DC DE MD NY VA		
Liriodendron tulipifera *tulip tree, tulip poplar, yellow poplar*	 RHW	Height: 70-100’ Spread: 35-50’ Flowers: Jun, greenish yellow Fruit: Aug-Nov, brown, winged Fall color: yellow	Light: Moisture: M Soil pH: 4.5-6.5 Soil type: L S	bottomland woods, mountain coves, lower slopes	Region: M P C States: DC DE MD NY PA VA WV		fast growth
Magnolia acuminata *cucumber magnolia*	 DFT DL, DFT HW, DFT HW	Height: 70-100’ Spread: 35-50’ Flowers: May-Jun, greenish-yellow Fruit: Sep-Nov, brown cone w/ scarlet seed, pod Fall color: ashy brown	Light: Moisture: M Soil pH: 5.2-7 Soil type: C L S	slopes, ravines, valleys, streamsides	Region: M States: MD NY VA WV		
Magnolia virginiana *sweetbay magnolia*	  RHW, USFWS BES	Height: 12-30’ Spread: 12-30’ Flowers: May-Jul, white to cream Fruit: Sep-Oct, red, berry Fall color: semi-evergreen	Light: Moisture: M W Soil pH: 5-6.5 Soil type: C L S	forested wetlands, seeps, stream and pond edges, sandy woods	Region: P C States: DC DE MD VA		semi-evergreen; fragrant flowers; tolerates occasional flooding, some salt
Malus coronaria (Pyrus coronaria) *sweet crabapple, American crabapple*	 PLANTS WSJ	Height: 10-30’ Spread: 20-30’ Flowers: Apr-May, pink to white Fruit: Sep-Oct, greenish, fleshy Fall color:	Light: Moisture: M Soil pH: Soil type: C L S	forest edges, rocky streams, fields	Region: M P C States: DC DE MD PA VA WV	high wildlife value	flowers fragrant; susceptible to insects and diseases; plant at least 500 feet from cedars; attracts bees and wasps; fruit sour;
Morus rubra *red mulberry, moral*	 UWI KK	Height: 35-60’ Spread: 35-60’ Flowers: May-Jun, greenish Fruit: Jun-Jul, red, berry Fall color: yellow	Light: Moisture: M Soil pH: 5-7 Soil type: C L S	floodplains, river valleys, hillsides	Region: M P C States: DC DE MD PA VA WV		fruit sweet
Nyssa sylvatica *black gum, sourgum, black or swamp tupelo*	 CM NRCS, RHW	Height: 30-75’ Spread: 20-50’ Flowers: Apr-Jun, greenish white Fruit: Sep-Oct, blue-black, fleshy Fall color: red	Light: Moisture: D M W Soil pH: 4.5-6 Soil type: L S	forested seasonal wetlands, swamp borders, upland woods, dry slopes; seasonally flooded or saturated	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	outstanding fall color
Ostrya virginiana *eastern hop-hornbeam, ironwood*	 PLANTS WSJ	Height: 25-50’ Spread: 20-35’ Flowers: May, red-brown Fruit: Jun-Oct, green turning brown, nut/nut-like Fall color: yellow	Light: Moisture: M Soil pH: 4.2-7.6 Soil type: C L S	slopes and ridges	Region: M P C States: DC DE MD NY PA VA WV		leaves may persist into winter

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Pinus echinata *shortleaf pine, shortstraw pine, southern yellow pine*	 BUG RFW	Height: 100' Spread: Flowers: Fruit: reddish brown, cone/cone-like Fall color: evergreen	Light: Moisture: D M Soil pH: 4.6-6 Soil type: C L S	dry mountain ridges, fields, floodplains	Region: M P C States: DC DE MD VA WV		best used for naturalizing
Pinus rigida *pitch pine*	 CM NRCS	Height: 50-75' Spread: 50-75' Flowers: May, red- purple Fruit: light brown, cone/cone-like Fall color: evergreen	Light: Moisture: D Soil pH: 3.5-5.1 Soil type: L S	slopes and ridges of mountains, river valleys, and swamps	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	many birds feed on the seeds; provides winter cover; old trees are fire resistant due to thick bark
Pinus serotina *pond pine, marsh pine, pocosin pine*	 VT	Height: 50-60' Spread: Flowers: Fruit: yellowish brown, cone/cone-like Fall color: evergreen	Light: Moisture: M W Soil pH: 4.8-6.8 Soil type: L S	swamps, pocosins, bays, pond margins, flatwoods	Region: C States: DE PA VA	high wildlife value	many birds feed on the seeds; provides winter cover
Pinus strobus *white pine, Eastern white pine*	 USDA NRCS	Height: 75-100' Spread: 50-75' Flowers: May-Jul, red to purplish Fruit: Aug-Oct, green to light brown, cone/cone-like Fall color: evergreen	Light: Moisture: D M Soil pH: 4-6.5 Soil type: L	variety of habitats; does best on moist, well drained, sandy loam soils of ridges	Region: M P States: DC MD NY PA VA WV	high wildlife value	many birds feed on the seeds; provides winter cover
Pinus taeda *loblolly, old field, or North Carolina pine*	 USFWS BES	Height: 70-90' Spread: Flowers: Fruit: yellowish, cone/cone-like Fall color: evergreen	Light: Moisture: D M W Soil pH: 4.5-7 Soil type: C L S	floodplains fields, slopes	Region: C States: DE MD VA	high wildlife value	many birds feed on the seeds; provides winter cover
Pinus virginiana *Virginia pine, scrub pine, Jersey pine*	 USDA NRCS	Height: 50-80' Spread: Flowers: Fruit: reddish brown, cone/cone-like Fall color: evergreen	Light: Moisture: D M Soil pH: 4.5-7.5 Soil type: C L S	well drained sites; often a pioneer species	Region: M P C States: DC DE MD PA VA WV	high wildlife value	many birds feed on the seeds; provides winter cover
Platanus occidentalis *American sycamore, American planetree*	 PLANTS LA, USDA NRCS	Height: 75-100' Spread: 75-100' Flowers: Apr-Jun, yellow-green Fruit: Aug-Dec, brown, achene (dry, flat seed) Fall color: yellow	Light: Moisture: M W Soil pH: 4.9-6.5 Soil type: L S	river bottoms, lake shores	Region: M P C States: DC DE MD NY PA VA WV		leafs out late spring; showy bark; leaves may persist into winter
Populus deltoides *eastern or southern cottonwood, Carolina poplar*	 UWI JK	Height: 75-100' Spread: 50-100' Flowers: Mar-Apr, red Fruit: May-Jul, yellow-green, capsule Fall color: yellow	Light: Moisture: M W Soil pH: 5.2-7.3 Soil type: C L S	along waterways	Region: P States: DC DE MD NY VA WV	high wildlife value	best used for naturalizing; grows fast but short lived

Trees

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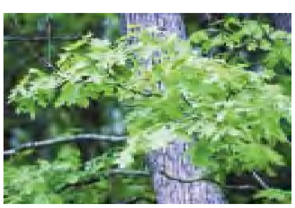
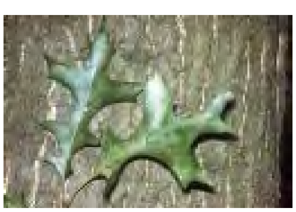
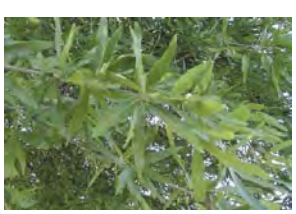
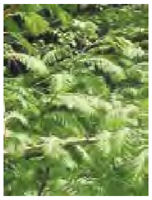
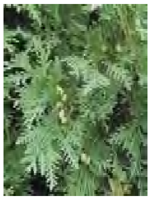
Populus heterophylla *swamp cottonwood, swamp poplar, black cottonwood, downy poplar*	VT, PLANTS 1997  	Height: 80' Spread: Flowers: Mar Fruit: Apr-May, , capsule Fall color: yellow	Light: Moisture: W Soil pH: 4.6-5.9 Soil type: C L	swamps and bottomlands	Region: P States: DE MD VA		
Prunus americana *American wild plum*	RHW 	Height: 20-35' Spread: 20-35' Flowers: Apr-May, white Fruit: Aug-Sep, orange to red, fleshy Fall color: pale yellow	Light: Moisture: D M Soil pH: 5-7 Soil type: L S	woods, pastures, fencerows, streamsides	Region: M P States: DC DE MD NY PA VA WV	high wildlife value	edible fruit, used for making pies and jellies
Prunus pensylvanica *pin cherry, fire cherry*	RHW 	Height: 20-35' Spread: 20-35' Flowers: May, white Fruit: Jul-Sep, bright red, fleshy Fall color: yellow	Light: Moisture: D Soil pH: 4.3-6.6 Soil type: C L S	woods	Region: M States: MD NY PA VA WV	high wildlife value	
Prunus serotina *black or wild cherry, black chokecherry*	CM NRCS, RHW 	Height: 40-75' Spread: 20-35' Flowers: May-Jun, white Fruit: Aug-Sep, black, fleshy Fall color: yellow/ red	Light: Moisture: D M Soil pH: 5-7.5 Soil type: L	forests, fence rows, fields, forest edges	Region: M P C States: DC DE NY VA WV	high wildlife value	birds eat fruit
Prunus virginiana *choke cherry*	RHW 	Height: 25-50' Spread: 20-35' Flowers: May-Jun, white Fruit: Aug-Sep, red, black, or yellow, fleshy Fall color: dark red-purple	Light: Moisture: M Soil pH: 5.2-8.4 Soil type: C L S	open moist sites; pioneer species after fires	Region: M States: DC DE MD NY PA VA WV		fast growing, short lived; fruit sometimes used for making jelly
Quercus alba *white oak, stave oak*	CM NRCS 	Height: 75-100' Spread: 75-100' Flowers: Mar-May, yellow-green Fruit: Sep-Oct, brown, nut/nut-like Fall color: red	Light: Moisture: D M Soil pH: 4.5-6.8 Soil type: L S	dry to moist woods	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	acorns food for wildlife; majestic; MD state tree; leaves may persist into winter
Quercus bicolor *swamp white oak, swamp oak*	PLANTS RM89, OSU 	Height: 60-100' Spread: 50-75' Flowers: May, yellow-green Fruit: Sep-Oct, tan brown, nut/nut-like Fall color: red/brown	Light: Moisture: W Soil pH: 4.3-6.5 Soil type: C L S	bottomlands, swamp and stream edges	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	acorns food for wildlife
Quercus coccinea *scarlet oak, red oak, black oak*	CM NRCS 	Height: 40-75' Spread: 50-75' Flowers: May-Jun, yellow-green Fruit: Sep-Oct, reddish brown, nut/nut-like Fall color: scarlet	Light: Moisture: D M Soil pH: 4.5-6.9 Soil type: L S	dry uplands and slopes	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	acorns food for wildlife

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Quercus falcata *southern or swamp red oak, Spanish oak*	 DFT HW	Height: 70-80' Spread: Flowers: Apr-May Fruit: Oct, orange brown, nut/nut-like Fall color: brown	Light: Moisture: D M Soil pH: 4.8-7 Soil type: C L S	uplands	Region: C States: DC DE MD VA		acorns food for wildlife
Quercus ilicifolia *bear oak, scrub oak*	 CM NRCS	Height: 12-20' Spread: 12-20' Flowers: May-Jun, yellow-green or reddish Fruit: Sep-Jan, light brown, nut/nut-like Fall color: yellow, scarlet red to purplish	Light: Moisture: D Soil pH: 4-7.5 Soil type: C L S	barrens, balds, woods, dunes, fields	Region: M P States: PA VA WV	high wildlife value	leaves may persist into winter
Quercus marilandica *blackjack oak, Jack oak*	 CM NRCS	Height: 35-50' Spread: 35-50' Flowers: Apr-Jun, yellow-green Fruit: Sep-Oct, tan brown, nut/nut-like Fall color: yellow/brown	Light: Moisture: D Soil pH: 4.6-5.6 Soil type: L S	woods, ridges, slopes, sandy flatwoods	Region: P C States: DC DE MD VA WV	high wildlife value	acorns food for wildlife, leaves may persist into winter
Quercus michauxii (Q. montana) *swamp chestnut oak, basket oak, cow oak*	 PLANTS 1995	Height: 50-80' Spread: 75-100' Flowers: May, yellow-green Fruit: Sep-Oct, tan brown, nut/nut-like Fall color: red/ brown	Light: Moisture: M W Soil pH: 4.5-6.5 Soil type: L	bottomlands, ravine slopes, flatwoods over limestone	Region: M P C States: DE MD NY VA WV	high wildlife value	acorns food for wildlife
Quercus muehlenbergii *Chinquapin or chinkapin oak, yellow oak, chestnut oak*	 UWI KJS	Height: 35-50' Spread: 35-50' Flowers: May-Jun, yellow-green Fruit: Sep-Oct, light brown, nut/nut-like Fall color: yellow-brown	Light: Moisture: D M Soil pH: 6.5-8 Soil type: L	rich, woods, uplands, outcrops, dry bluffs, slopes	Region: M P C States: DC MD NY VA WV	high wildlife value	
Quercus nigra *water oak*	 PLANTS LA	Height: 50-80' Spread: Flowers: Apr-May Fruit: Oct, black, nut/nut-like Fall color: green persists late	Light: Moisture: M W Soil pH: 4.8-5.8 Soil type: C L	upland woods, bottomlands, hammocks, fields	Region: C States: DC DE MD VA		acorns food for wildlife
Quercus palustris *pin oak, swamp oak, Spanish oak*	 PLANTS RM91	Height: 50-80' Spread: 50-75' Flowers: Apr-May, yellow-green Fruit: Sep-Oct, light brown, nut/nut-like Fall color: red	Light: Moisture: M W Soil pH: 4.5-6.5 Soil type: C L	bottomlands or upland flats	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	popular shade tree; fall color; acorns food for wildlife; leaves may persist into winter
Quercus phellos *willow oak, pin oak, peach oak*	 USFWS BES	Height: 80-100' Spread: Flowers: Feb-May Fruit: light yellow or greenish brown, nut/nut-like Fall color: red	Light: Moisture: M W Soil pH: 4.5-5.5 Soil type: C L	bottomlands, low flatwoods, upland fields	Region: P C States: DC DE MD VA WV		acorns food for wildlife

Trees

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Quercus prinus (Q. montana) *chestnut oak, rock oak*	PLANTS 1997 	Height: 40-80' Spread: Flowers: May-Jun, yellowish Fruit: Sep-Oct, brown, nut/nut-like Fall color: yellow/orange	Light: Moisture: D Soil pH: 4.5-7 Soil type: L S	rocky ridges and slopes	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	acorns food for wildlife; fall color
Quercus rubra *northern red oak*	UWI KJS 	Height: 90' Spread: Flowers: Apr-May Fruit: scales reddish-brown, nut/nut-like Fall color: red or yellow	Light: Moisture: D M Soil pH: 4.3-6.5 Soil type: C L	slopes, coves, and drier ridges	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	acorns food for wildlife; hardy and long-lived; fall color
Quercus stellata *post oak, iron oak*	CM NRCS 	Height: 35-50' Spread: 35-50' Flowers: Apr-Jun, yellow-green Fruit: Sep-Oct, light brown to almost black, nut/nut-like Fall color: brown	Light: Moisture: D M Soil pH: 4.8-7 Soil type: C L S	upland dry ridges to moist flatwoods	Region: M P C States: DC DE MD VA WV	high wildlife value	acorns food
Quercus velutina *black oak, yellow bark oak, quercitron oak*	BUG DJM 	Height: 75-100' Spread: 75-100' Flowers: Apr-May, yellow-green Fruit: Sep-Oct, light red-brown, nut/nut-like Fall color: red/brown	Light: Moisture: D M Soil pH: 4.5-6 Soil type: C L S	dry upland ridges and slopes, flatwoods	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	acorns food for wildlife; leaves may persist into winter
Salix nigra *black willow, swamp willow*	CM NRCS 	Height: 35-50' Spread: 20-35' Flowers: Mar-Apr, yellow green Fruit: Apr-May, green yellow, cone/cone-like Fall color: yellow green	Light: Moisture: M W Soil pH: 6-8 Soil type: C L S	fresh tidal marshes and swamps, forested wetlands, floodplains, wet meadows; seasonally to regularly flooded or saturated	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	streambank stabilizer; spreads by suckers; preferred food of ruffed grouse and pine grosbeak; tolerates flooding; tolerates salinity to 0.5 ppt
Salix sericea *silky willow*	CM NRCS 	Height: 12' Spread: Flowers: Jun-Jul Fruit: Fall color: yellow	Light: Moisture: M W Soil pH: 5.2-7 Soil type: C L S	marshes, ditches, low woods	Region: M P States: DC DE MD NY PA VA WV	high wildlife value	
Sassafras albidum *sassafras*	USFWS BES, RHW 	Height: 35-50' Spread: 35-50' Flowers: Apr, yellow-green Fruit: Sep-Oct, dark blue, fleshy Fall color: yellow, orange, purple	Light: Moisture: D M Soil pH: 4.5-7.2 Soil type: L S	moist, open woods	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	edible and medicinal uses; provides spring and fall color
Sorbus americana (Pyrus americana) *American mountain ash*	RHW, RHW  	Height: 30-40' Spread: Flowers: May-Jul, white Fruit: Aug-Dec, orange, fleshy Fall color: orange, purple	Light: Moisture: M Soil pH: 5.3-6.8 Soil type: C L S	areas from borders of swamps to rocky hillsides; openings, uplands along forest edges, roadsides	Region: M States: MD VA WV	high wildlife value	slow-growing, short-lived; not drought or heat tolerant; plant at least 500 feet from cedars

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Taxodium distichum *bald cypress, cypress, swamp cypress*	USFWS BES, USFWS BES 	Height: 50-100' Spread: 20-35' Flowers: Mar-Apr, deep purple Fruit: Oct-Dec, brown, cone/cone-like Fall color: purple to brown	Light: Moisture: W Soil pH: 4.5-6 Soil type: C L S	rivers, lake and pond margins, swamps, coastal marshes, pocosins, river bottoms	Region: C States: DE MD VA		deciduous conifer
Thuja occidentalis *arborvitae, northern white cedar*	USFWS BES, USFWS BES 	Height: 50-75' Spread: 35-50' Flowers: May, red brown Fruit: Aug-Dec, reddish-brown, cone/cone-like Fall color: evergreen	Light: Moisture: M W Soil pH: 5.2-7 Soil type: C L S	calcareous areas	Region: M States: NY VA		prefers wet calcareous areas
Tilia americana *American basswood, linden*	PLANTS DEH, PLANTS DEH 	Height: 70-100' Spread: 50-75' Flowers: Jun-Jul, yellow Fruit: Sep-Oct, tan brown, winged Fall color: yellow or brown	Light: Moisture: M Soil pH: 4.5-7.5 Soil type: L S	woods, slopes	Region: M States: DC DE MD NY PA VA WV		fragrant flowers; important pollen source for honey
Tsuga canadensis *eastern hemlock*	USDA NRCS 	Height: 75-100' Spread: 35-50' Flowers: May-Jun, tan brown Fruit: Sep-Jan, light brown, cone/cone-like Fall color: evergreen	Light: Moisture: M Soil pH: 4.2-5.7 Soil type: L S	cool valleys	Region: M P States: DE MD NY PA VA WV	high wildlife value	susceptible to wooly adelgid and red spider mite; also T. caroliniana for VA
Ulmus americana *American elm, white elm, soft elm*	USDA NRCS 	Height: 75-100' Spread: 75-100' Flowers: Mar-Apr, red brown Fruit: May, tan brown, winged Fall color: bright yellow	Light: Moisture: M W Soil pH: 5.5-8 Soil type: C L S	river bottoms, swamps, disturbed fields, road sides, cutover forests	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	Dutch elm disease caused decline; distinctive vase shape; favorite nesting site of Baltimore oriole
Ulmus rubra *slippery elm, red elm, soft elm*	UWI DWW 	Height: 70' Spread: Flowers: Mar-May Fruit: winged Fall color: yellow	Light: Moisture: D M Soil pH: 5.5-7 Soil type: C L S	moist slopes and bottomlands, drier sites on calcareous soils	Region: P States: DC DE MD NY PA VA WV	high wildlife value	

See also:

In the *Shrubs* section:
- **Hamamelis virginiana**
- **Morella (Myrica) cerifera**
- **Rhododendron maximum**
- **Rhus copallina, hirta (typhina)**
- **Viburnum prunifolium**

Cornus florida

USFWS BES

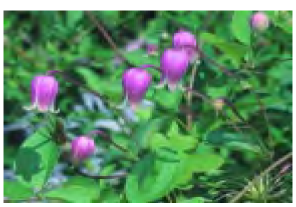
A diverse forest offers food and cover throughout all seasons.

USFWS RM

Ilex opaca

CM NRCS

Vines

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Aristolochia macrophylla (A. durior) *pipevine, Dutchman's pipe*	 RHW	Spread: Flowers: May-Jun, yellowish to purplish Fruit: green to brown, pod Fall color: yellow green	Light: Moisture: M Soil pH: 6.1-8.5 Soil type: L O	rich woods, streambanks	Region: M States: VA WV		occasionally escapes from cultivation; host for pipevine swallowtail butterfly
Bignonia capreolata *crossvine*	 USFWS BES	Spread: 20-35' Flowers: May-Jun, orange with red Fruit: Aug-Oct, brown, pod Fall color: semi-evergreen; reddish-purple	Light: Moisture: D M W Soil pH: 6.1-8.5 Soil type: C L S	swampy forests, calcareous river banks, cliffs, dry open woods, bogs, fence rows, rock outcrops	Region: C States: MD VA		spreads across ground and climbs any structure it meets (control by cutting); semi-evergreen GC
Campsis radicans *trumpet vine, trumpet creeper*	 USFWS BES	Spread: 20-35' Flowers: Jul-Sep, orange Fruit: Aug-Mar, brown, pod Fall color: yellow green	Light: Moisture: D M Soil pH: 6.1-7.5 Soil type: C L S	moist woods, fence rows, roadside thickets, floodplain forests, rocky hillsides, open woods, streambanks, fields	Region: M P C States: DC DE MD PA VA		thick, twisted, aged woody vines; leaves/flowers may cause dermatitis (skin irritation) GC
Celastrus scandens *American bittersweet*	 PLANTS TGB, UWI DK	Spread: 6-20' Flowers: May-Jun, greenish Fruit: Sep-Dec, orange and red, capsule Fall color: yellow	Light: Moisture: D M Soil pH: 6.1-7.5 Soil type: C L S	roadsides, forest edges, fence rows, pastures, hedges, bluffs, rocky slopes, dunes, sandy oak woods	Region: M P C States: DC DE MD NY PA VA WV		distinguished from nonnative invasive Oriental bittersweet by flowers/fruits in clusters at ends of twigs GC
Clematis viorna *leather flower, vasevine*	 RHW	Spread: Flowers: May-Aug, purple Fruit: Aug-Nov, dark brown, achene (dry, flat seed) Fall color:	Light: Moisture: D M Soil pH: Soil type:	rich wooded banks, thickets	Region: P States: DC DE MD VA WV		feathery seeds
Clematis virginiana *virgin's bower*	 USFWS BES	Spread: 6-12' Flowers: Jul-Sep, white Fruit: Aug-Nov, brown, achene (dry, flat seed) Fall color: yellow, green or purplish	Light: Moisture: D M Soil pH: 6.1-8.5 Soil type: C L S O	fencerows, riverbanks, thickets, woods edge, roadside swales, swamps, overhanging cliffs	Region: M P C States: DC DE MD NY PA VA WV		fragrant flowers; feathery seeds; young plants can be transplanted; yellow, green or purplish fall color
Lonicera sempervirens *trumpet or coral honeysuckle*	 RHW, USFWS BES	Spread: 6-12' Flowers: Apr-Oct, coral to red with yellow Fruit: Aug-Mar, red, berry Fall color: semi-evergreen	Light: Moisture: D M Soil pH: 6.1-7.5 Soil type: C L S	thickets, fence rows, open woods, dry stony woods, forest edges, cliffs	Region: M P C States: DC DE MD NY VA		flowers intermittently until frost; flowers/fruits present together; transplants well; may have aphids - hose off, snip new growth and damaged buds; semi-evergreen
Mikania scandens *climbing hempvine*	 RHW	Spread: Flowers: Jun-Oct, pink or whitish Fruit: blue Fall color:	Light: Moisture: M W Soil pH: 5.7-7.5 Soil type: C L	swamps, thickets	Region: M P C States: DC DE MD NY VA		vines herbaceous, not woody

		Characteristics	Conditions	Habitat	Native to	Wildlife	Notes
Parthenocissus quinquefolia *Virginia creeper*	 RHW, USFWS BES	Spread: 25-35' Flowers: Jun-Aug, greenish white Fruit: Sep-Feb, bluish black, berry Fall color: purple to crimson	Light: Moisture: D M W Soil pH: 5.1-7.5 Soil type: C L S	fence rows, forest edges, open woods, ravines, bluffs, cliffs	Region: M P C States: DC DE MD NY PA VA WV	high wildlife value	bank stabilizer; control by trimming; fruits eaten by variety of wildlife; purple to crimson fall color GC
Passiflora incarnata *passionflower, Maypops*	 RHW	Spread: Flowers: Jun-Sep, purple and white Fruit: Sep-Oct, yellow, fleshy Fall color:	Light: Moisture: D M Soil pH: Soil type: C L S	fields, rocky slopes, thin woods, roadsides, fencerows, thickets	Region: C States: MD VA		herbaceous vine; large fleshy berry edible; fragrant
Smilax herbacea *smooth carrion flower*	  RHW, RHW	Spread: Flowers: Apr-Jun, greenish-yellow Fruit: Jul-Nov, blue-black, berry Fall color:	Light: Moisture: M Soil pH: Soil type: C L S	thickets, woods, floodplains	Region: M P C States: DC DE MD NY WV		herbaceous, climbing vine, not prickly; flower malodorous; male and female plants separate
Wisteria frutescens *Atlantic wisteria, American wisteria*	  SMSU, SMSU	Spread: Flowers: Apr-Aug, lilac Fruit: brown, pod Fall color:	Light: Moisture: M W Soil pH: 4-7 Soil type: C L S	forest and forested swamp edges, streambanks, thickets	Region: C States: DE VA		

See also:

In the *Herbaceous Plants* section:
Clitoria mariana

Characteristic pipe-shaped flower of **Aristolochia macrophylla.**

RHW

Lonicera sempervirens may bloom year-round.

USFWS BES

Bignonia capreolata in bloom adorns a porch.

USFWS BES

Parthenocissus quinquefolia used as a groundcover.

USFWS BES

Plants With a Purpose

This section includes lists of plant combinations that can be used to mimic the natural communities of plants found in wetlands, meadows, forests, etc. They can be used to create, restore or enhance existing habitat for wildlife. Also included are plants that can be used in solving problems such as stabilizing soils, or for specific landscaping uses. No matter what the purpose, it is imperative that species are chosen to suit planting site conditions and the physiographic location of the site. None of these lists are complete – there are additional suitable plants in this guide (and even more native species not included in this publication) that would suit these purposes. This document is intended to give project planners guidance in choosing appropriate plants for various projects, and additional learning is encouraged. For the most ecologically "correct" habitat restoration projects, consultation with professionals is recommended, as there are other factors to consider that are not addressed here.

Plants For Coastal Dunes

Note: the shrubs and trees listed would occur on the inner or secondary dunes and/or on interdunal swales.

Grasses and Grasslike Plants
Ammophila breviligulata
Panicum amarum (and var. amarulum)
Spartina patens
Panicum virgatum

Herbaceous Plants
Baptisia tinctoria
Liatris pilosa v. pilosa (graminifolia)
Nuttallanthus canadensis (Linaria canadensis)
Opuntia humifusa (compressa)
Oenothera biennis
Solidago sempervirens
Yucca filamentosa (flaccida)

Shrubs
Baccharis halimifolia
Morella (Myrica) cerifera, pensylvanica
Prunus maritima
Rhus copallina
Rosa carolina

Trees
Acer rubrum
Amelanchier arborea
Diospyros virginiana
Juniperus virginiana
Pinus rigida
Prunus pensylvanica, serotina

Vines
Celastrus scandens
Parthenocissus quinquefolia

Plants For Saltwater or Brackish Water Marshes

Plants in this list can be used for marsh plantings or to stabilize tidal fresh, brackish or saltwater shorelines based on salinity and wetness tolerances. Check the salinity and moisture requirements given in this publication for each plant, so they will be planted in the appropriate conditions. Those species for use in salinity greater than 15 ppt are marked (*).

Grasses and Grasslike Plants
Ammophila breviligulata *
Distichlis spicata *
Juncus canadensis
Juncus roemerianus *
Panicum amarum (and var. amarulum) *
Panicum virgatum
Schoenoplectus pungens v. pungens (Scirpus pungens, americanus)
Schoenoplectus (Scirpus) validus
Spartina alterniflora *
Spartina cynosuroides
Spartina patens *
Spartina pectinata

Note: Although grasslike, *Distichlis, Juncus, Schoenoplectus,* and *Spartina* species information can be found in the Herbaceous Emergents section of the guide.

Herbaceous Plants
Agalinus purpurea
Limonium carolinianum
Solidago sempervirens *

Herbaceous Emergents
Hibiscus moscheutos (palustris)
Iris prismatica, versicolor, virginica
Kosteletzkya virginica
Peltandra virginica
Pontederia cordata

Shrubs
Baccharis halimifolia *
Iva frutescens *
*Morella (Myrica) cerifera *, pensylvanica* *

Plants for Freshwater Wetlands and Other Wet Sites

The following plants may be used to create or enhance freshwater marshes or swamps or to stabilize and enhance streambanks, riverbanks or pond edges.

Remember to match the plants' growth requirements with the site conditions. Wetness tolerated by these plants is provided in this guide in terms of frequency and duration of soil saturation or inundation (flooding), and depth of standing water.

Ferns

Athyrium filix-femina
Dryopteris carthusiana (spinulosa), cristata, intermedia
Onoclea sensibilis
Osmunda cinnamomea, regalis
Pteridium aquilinum
Thelypteris noveboracensis, palustris
Woodwardia areolata, virginica

Grasses and Grasslike Plants

Agrostis perennans
Andropogon gerardii, glomeratus, virginicus
Calamagrostis canadensis
Carex crinita var. crinita, lurida, stricta, vulpinoidea
Dichanthelium clandestinum
Elymus riparius
Festuca rubra
Leersia oryzoides
Panicum virgatum
Saccharum giganteum (Erianthus giganteus)
Tripsacum dactyloides

Herbaceous Plants

Arisaema triphyllum
Asclepias incarnata
Caltha palustris
Chelone glabra
Conoclinium (Eupatorium) coelestinum
Doellingeria umbellata var. umbellata (Aster umbellatus)
Eupatorium dubium, perfoliatum
Gentiana clausa
Helianthus angustifolius
Heracleum maximum (lanatum)
Impatiens capensis (biflora)
Lobelia cardinalis, siphilitica
Mertensia virginica
Mimulus ringens
Monarda didyma
Packera aurea (Senecio aureus)
Phlox maculata
Rudbeckia laciniata
Saxifraga pensylvanica
Scutellaria integrifolia
Sisyrinchium atlanticum
Spiranthes cernua
Stachys tenuifolia (hispida)
Symphyotrichum (Aster) novae-angliae, novi-belgii
Symplocarpus foetidus
Thalictrum pubescens (polygamum)
Veratrum viride
Verbena hastata
Vernonia noveboracensis
Veronicastrum virginicum (Veronica virginica)
Viola conspersa, cucullata, striata

Herbaceous Emergents

Dulichium arundinaceum
Hibiscus moscheutos (palustris)
Iris prismatica, versicolor, virginica
Juncus effusus
Justicia americana
Nuphar lutea (advena)
Nymphaea odorata
Orontium aquaticum
Peltandra virginica
Pontederia cordata
Sagittaria latifolia
Saururus cernuus
Schoenoplectus (Scirpus) validus
Scirpus atrovirens, cyperinus
Sparganium americanum
Spartina pectinata
Zizania aquatica

Shrubs

Alnus serrulata
Cephalanthus occidentalis
Clethra alnifolia
Cornus amomum
Gaylussacia baccata, frondosa
Hypericum densiflorum
Ilex verticillata
Itea virginica
Kalmia angustifolia, latifolia
Leucothoe racemosa
Lindera benzoin
Lyonia ligustrina
Morella (Myrica) caroliniensis (heterophylla), cerifera, pensylvanica
Photinia (Aronia) melanocarpa, pyrifolia (arbutifolia)
Physocarpus opulifolius
Rhododendron maximum, periclymenoides, viscosum
Rosa palustris
Rubus allegheniensis
Salix humilis
Sambucus nigra ssp. canadensis (S. canadensis)
Spiraea alba v. latifolia (latifolia), tomentosa
Vaccinium corymbosum, macrocarpon
Viburnum dentatum (recognitum), nudum, nudum v. cassinoides (cassinoides), prunifolium

Trees

Acer negundo, rubrum, saccharinum
Amelanchier canadensis
Betula alleghaniensis, nigra
Carpinus caroliniana
Carya cordiformis, glabra
Celtis occidentalis
Chamaecyparis thyoides
Crataegus viridis
Fraxinus pennsylvanica
Liquidambar styraciflua
Magnolia virginiana
Nyssa sylvatica
Pinus serotina, strobus, taeda
Platanus occidentalis
Populus deltoides, heterophylla
Quercus bicolor, michauxii (montana), nigra, palustris, phellos
Salix nigra, sericea
Taxodium distichum
Thuja occidentalis
Tsuga canadensis
Ulmus americana

Vines

Bignonia capreolata
Mikania scandens
Parthenocissus quinquefolia
Wisteria frutescens

Plants Appropriate for Bogs or Bog Gardens

Ferns
Athyrium filix-femina
Onoclea sensibilis
Osmunda cinnamomea
Thelypteris noveboracensis , palustris
Woodwardia areolata

Grasses and Grasslike Plants
Calamagrostis canadensis
Carex stricta
Leersia oryzoides

Herbaceous Plants
Arisaema triphyllum
Caltha palustris
Chelone glabra
Doellingeria umbellata var. umbellate (Aster umbellatus)
Eupatorium dubium, perfoliatum
Gentiana clausa
Saxifraga pensylvanica
Scutellaria integrifolia
Spiranthes cernua
Symplocarpus foetidus
Veratrum viride
Viola cucullata

Herbaceous Emergents
Dulichium arundinaceum
Juncus effusus
Orontium aquaticum
Sagittaria latifolia
Scirpus atrovirens, cyperinus
Sparganium americanum

Shrubs
Clethra alnifolia
Gaultheria procumbens
Hypericum densiflorum
Kalmia angustifolia
Morella caroliniensis (Myrica heterophylla)
Photinia (Aronia) melanocarpa, pyrifolia (arbutifolia)
Rhododendron viscosum
Salix humilis
Spiraea alba, alba v. latifolia (latifolia)
Spiraea tomentosa
Vaccinium corymbosum, macrocarpon
Viburnum dentatum (recognitum), nudum, nudum v. cassinoides (cassinoides)

Trees
Acer rubrum
Chamaecyparis thyoides
Nyssa sylvatica

Vines
Bignonia capreolata

Plants for Dry Meadows

Grasses and Grasslike Plants
Andropogon gerardii
Danthonia spicata
Elymus canadensis, riparius, virginicus
Schizachyrium scoparium (Andropogon scoparius)
Sorghastrum nutans
Tridens flavus

Herbaceous Plants
Ageratina altissima v. altissima (Eupatorium rugosum)
Antennaria neglecta
Asclepias syriaca, tuberosa
Chamaecrista (Cassia) fasciculata
Conoclinum (Eupatorium) coelestinum
Coreopsis tripteris, verticillata
Desmodium paniculatum
Dodecatheon meadia
Erigeron pulchellus
Eupatorium hyssopifolium, purpureum
Heliopsis helianthoides
Ionactis (Aster) linariifolius
Lespedeza capitata
Liatris spicata, squarrosa
Lupinus perennis
Monarda bradburiana (fistulosa), punctata
Nuttallanthus (Linaria)canadensis
Oenothera biennis, fruticosa, perennis
Penstemon digitalis
Pycnanthemum incanum
Rudbeckia fulgida, hirta, triloba
Solidago canadensis, canadensis v. scabra (altissima), juncea, nemoralis, speciosa
Symphyotrichum (Aster) cordifolius, ericoides var. ericoides, laeve var. laeve (laevis), novae-angliae

Shrubs
Note: Listed are a few of the shorter shrubs that may appear in or at the edges of meadows. Using shrubs in a planting that is to remain as a meadow is not recommended, as they provide perching spots for birds, whose droppings will seed in unwanted plants, including trees. If the meadow is to be allowed to succeed eventually to forest, then adding shrubs is one prescribed method.

Ceanothus americanus
Comptonia peregrina
Rhus glabra
Rosa carolina
Rubus allegheniensis

Plants for Wet Meadows

Ferns
Onoclea sensibilis
Osmunda cinnamomea
Thelypteris palustris

Grasses and Grasslike Plants
Andropogon gerardii, virginicus
Calamagrostis canadensis
Carex glaucodea, stricta
Elymus riparius
Leersia oryzoides
Panicum virgatum
Tripsacum dactyloides

Herbaceous Plants
Agalinis purpurea
Asclepias incarnata
Caltha palustris
Doellingeria umbellata var. umbellata (Aster umbellatus)
Gentiana clausa
Eupatorium fistulosum, maculatum, perfoliatum
Helenium autumnale
Impatiens capensis (I. biflora)
Lilium canadense, superbum
Lobelia cardinalis, siphilitica
Mimulus ringens
Packera aurea (Senecio aureus)
Phlox maculata
Rudbeckia laciniata
Sabatia angularis
Scutellaria integrifolia
Silphium perfoliatum
Sisyrinchium atlanticum
Solidago rugosa
Spiranthes cernua
Stachys tenuifolia (hispida)
Symphyotrichum (Aster) novi-belgii
Thalictrum pubescens (polygamum)
Verbena hastata
Viola conspersa
Viola striata

Herbaceous Emergents
Iris prismatica, versicolor, virginica
Juncus effusus
Scirpus atrovirens, cyperinus
Spartina pectinata

Shrubs
Note: Listed are a few of the shorter shrubs that may appear in or at the edges of meadows. Using shrubs in a planting that is to remain as a meadow is not recommended, as they provide perching spots for birds, whose droppings will seed in unwanted plants, including trees. If the meadow is to be allowed to succeed eventually to forest, then adding shrubs is one prescribed method.

Cephalanthus occidentalis
Ilex verticillata
Rhododendron viscosum
Rosa palustris
Spiraea tomentosa

Plants for Forest or Woodland Plantings

Forests contain a diversity of plant types arranged in vertical layers, from the tallest (canopy or overstory) trees, through the understory of shorter trees and shrubs, to the forest floor or ground layer of low shrubs and herbaceous plants. Forest types are classified by the dominant trees present (e.g., oak-hickory-pine forest). Plant species occurring together in these different forest types are a function of the climate, altitude, geology and physiographic location, soil type, moisture, sunlight, and other conditions. So many combinations of plants occur in these different forests that space limitations prevent listing them all. Instead, the following represent plants found in a few of the more common forest types in the Chesapeake Bay watershed. These lists provide the basis for a viable forest or woodland project. Common ferns, grasses and herbaceous plants for the ground layer are listed separately, as they may occur in many of the forest types in various combinations. Remember to match the plants' growth requirements with the site conditions.

For new projects at open sites, it may take years for young trees to provide adequate shade. Consult other restoration resources and/or professionals for alternative methods of developing the ground layer, and for more comprehensive forest community information.

Forest Types, Basic Structure

Oak-Mixed Forest (Coastal Plain)

Canopy trees for well-drained sites
Carya cordiformis, tomentosa
Quercus alba, falcata, marilandica, phellos, prinus, stellata, velutina
Pinus species, occasional intermixed with the above

Canopy trees for moist sites
Acer rubrum
Fagus grandifolia
Quercus bicolor, michauxii, nigra, palustris, phellos
Liquidambar styraciflua
Liriodendron tulipifera
Nyssa sylvatica

Understory trees
Asimina triloba
Cercis canadensis
Cornus florida
Ilex opaca
Magnolia virginiana

Understory shrubs
Comptonia peregrina
Gaylussacia frondosa
Ilex glabra
Kalmia angustifolia, latifolia
Morella (Myrica) cerifera, pensylvanica
Vaccinium pallidum (vacillans), stamineum
Viburnum dentatum (recognitum), prunifolium

Pine Forest (Coastal Plain)

Overstory trees
Pinus taeda, virginiana, rigida (occasional)

Understory trees
Ilex opaca
Sassafras albidum

Understory shrubs
Clethra alnifolia
Morella (Myrica) cerifera, pensylvanica
Rhus copallina

Oak-Hickory Forest (Piedmont and Mountain, occasional on Coastal Plain)

Dominant overstory trees

Carya cordiformis, ovata
Quercus alba, prinus, rubra, velutina

Other trees

Amelanchier arborea, canadensis
Carya alba, glabra, tomentosa
Celtis occidentalis
Cercis canadensis
Cornus florida
Crataegus viridis
Fraxinus Americana
Juglans nigra
Prunus serotina
Quercus coccinea, falcata, lyrata, marilandica, muhlenbergii, stellata
Sassafras albidum
Tilia americana
Ulmus Americana

Additional trees for more moist sites

Acer rubrum
Liquidambar styraciflua
Liriodendron tulipifera
Ulmus americana

Shrubs

Kalmia latifolia
Vaccinium angustifolium, corymbosum, pallidum (vacillans), stamineum
Viburnum acerifolium

Red Oak - Mixed Hardwood Forest (Piedmont)

Dominant overstory trees

Acer rubrum
Carya ovata, tomentosa
Betula alleghaniensis (lutea), lenta
Fraxinus americana
Fagus grandifolia
Liriodendron tulipifera
Quercus alba, rubra, velutina
*Pinus strobus**
*Tsuga canadensis**

* These would be in the Hemlock-White Pine-Red Oak-Mixed Hardwood Forest (Piedmont and Mountain regions).

Understory trees and shrubs

Amelanchier species
Carpinus caroliniana
Hamamelis virginiana
Lindera benzoin
Viburnum acerifolium, dentatum (recognitum)

Hemlock-White Pine Forest (Mountain)

Dominant overstory trees

Acer saccharum
Betula alleghaniensis (lutea)
Fagus grandifolia
Pinus strobus
Tilia americana
Tsuga canadensis
also *Picea* rubens (red spruce, not included in this guide, but native in the Bay watershed in mountain region)

Other trees

Acer rubrum
Betula lenta
Liriodendron tulipifera
Quercus rubra, velutina

Shrubs

Hamamelis virginiana
Rhododendron maximum
Viburnum acerifolium

Mixed Mesophytic Forest (Mountain)
These forests are relicts of ancient mesic (moist) broadleaf deciduous forests. They can be very diverse.

Dominant overstory trees

Acer saccharum
Betula lenta
Carya ovata
Carpinus caroliniana
Fagus grandifolia
Fraxinus americana
Juglans nigra
Liriodendron tulipifera
Magnolia acuminata
Prunus serotina
Quercus rubra
Tilia americana

Understory trees and shrubs

Cercis canadensis
Hamamelis virginiana
Hydrangea arborescens
Lindera benzoin
Rhododendron maximum
Staphylea trifolia

Woodland Floor or Ground Layer Plants
These plants can also be used for gardens in or adjacent to wooded areas. Refer to specific habitat and growing conditions to match plants in appropriate groupings.

Ferns
All species included in this guide occur in woodlands.

Grasses and Grasslike Plants

Agrostis perennans
Andropogon gerardii
Carex crinita var. crinita, glaucodea, lurida, pensylvanica, vulpinoidea
Chasmanthium latifolium
Danthonia spicata
Dichanthelium clandestinum, commutatum
Elymus hystrix (Hystrix patula)
Festuca rubra
Panicum virgatum
Saccharum giganteum (Erianthus giganteus)
Schizachyrium scoparium (Andropogon scoparius)
Sorghastrum nutans
Tridens flavus
Tripsacum dactyloides

Herbaceous Plants

Actaea pachypoda
Ageratina altissima v. altissima (Eupatorium rugosum)
Aquilegia canadensis
Aralia nudicaulis, racemosa
Arisaema triphyllum
Aruncus dioicus
Asarum canadense
Campanulastrum americanum (Campanula americana)
Cardamine concatenata (Dentaria laciniata)
Caulophyllum thalictroides
Chelone glabra
Chimaphila maculata
Chrysogonum virginianum
Cimicifuga racemosa
Claytonia virginica
Delphinium tricorne
Dicentra canadensis, cucullaria, eximia
Erythronium americanum
Eurybia divaricata (Aster divaricatus)
Geranium maculatum
Helenium autumnale
Helianthus divaricatus
Heliopsis helianthoides
Hepatica nobilis var. acuta (acutiloba), var. obtusa (americana)
Heracleum maximum (lanatum)
Heuchera americana, villosa

(continued)

Hydrophyllum virginianum
Impatiens capensis (biflora)
Ionactis (Aster) linariifolius
Jeffersonia diphylla
Liatris scariosa
Lilium canadense, philadelphicum
Maianthemum canadense, racemosum (Smilacina racemosa)
Medeola virginiana
Melanthium virginicum
Mertensia virginica
Mitchella repens
Mitella diphylla
Monarda didyma
Osmorhiza longistylis
Oxalis violacea
Packera aurea (Senecio aureus)
Penstemon laevigatus
Phlox carolina, divaricata, stolonifera
Podophyllum peltatum
Polemonium reptans
Polygonatum biflorum, pubescens
Sanguinaria canadensis
Saxifraga pensylvanica, virginiensis
Scutellaria integrifolia
Sedum ternatum
Silene caroliniana, stellata, virginica
Solidago caesia, flexicaulis, rugosa
Stachys tenuifolia (hispida)
Stellaria pubera
Thalictrum dioicum, pubescens (polygamum), thalictroides (Anemonella t.)
Tiarella cordifolia
Tradescantia virginiana
Trillium erectum, grandiflorum, sessile, undulatum
Uvularia grandiflora, perfoliata, sessilifolia
Veratrum viride
Viola conspersa, hastata, pubescens (pennsylvanica), sororia (papilionacea), striata
Zizia aurea

Vines
Any of the vines included in this guide may be found in woodlands, occupying various vegetative layers, from the ground up.

Solutions for Slopes

Slopes of any kind are prone to erosion from rain, runoff; wave action, stream or river currents, and foot or lawnmower traffic. Plants with deep, spreading root systems help prevent erosion by holding soil in place. Some plants that are particularly well suited to and recommended for holding or stabilizing soils on a dry upland slope or hillsides such as a sloping yard or road embankment are listed below.

However, any plant suited to the site's sun, soil, and moisture conditions that could be planted on a flat surface could be planted on a slope, as long as the slope is accessible. Plants that naturally occur on slopes or hillsides can be found by searching the "habitat" notes provided with each plant in this guide.

For plants to use on a tidal shoreline, see the list of saltmarsh or freshwater marsh plants. For plants to use on a stream, pond or riverbank, see the list of freshwater marsh plants.

Plants That Provide Stabilization on Dry, Sunny Slopes or Hillsides

Grasses & Grasslike Plants
Ammophila breviligulata
Andropogon gerardii
Dichanthelium clandestinum
Elymus canadensis
Panicum virgatum
Panicum amarum
Schizachyrium scoparium

Herbaceous Plants
Any of the herbaceous plants that thrive in a sunny, dry site tend to be deep-rooted and would provide good slope stabilization. See the dry meadow plants list on for additional choices.

Baptisia tinctoria
Lespedeza capitata
Chamaecrista (Cassia) fasciculata

Shrubs
Comptonia peregrina
Ceanothus americanus
Clethra alnifolia
Cornus racemosa
Gaylussacia baccata, frondosa
Hypericum densiflorum
Kalmia latifolia
Morella pensylvanica
Physocarpus opulifolius
Rhus aromatica
Rhus copallina
Rhus glabra
Rosa carolina
Rubus allegheniensis
Vaccinium angustifolium
Viburnum acerifolium

Trees
The following are some of the tree species that may occur on slopes. However, for stabilization purposes, practitioners recommend planting herbaceous plants and shrubs, as trees will appear in time through succession.

Acer rubrum, saccharum, spicatum
Amelanchier arborea
Betula lenta
Carya alba (tomentosa), cordiformis, glabra, ovata
Castanea pumila
Celtis occidentalis
Chionanthus virginicus
Cornus alternifolia, florida
Crataegus crus-galli
Fraxinus americana
Juglans nigra
Liquidambar styraciflua
Liriodendron tulipifera
Magnolia acuminata
Morus rubra
Nyssa sylvatica
Ostrya virginiana
Pinus rigida, taeda
Quercus coccinea
Quercus marilandica, michauxii, muehlenbergii, prinus, rubra, velutina
Sorbus (Pyrus) americana
Ulmus rubra

Vines
Campsis radicans
Celastrus scandens
Passiflora incarnata
Parthenocissus quinquefolia

Evergreens

Ferns
Asplenium platyneuron
Dryopteris carthusiana (spinulosa), cristata, intermedia, marginalis
Polystichum acrostichoides

Herbaceous Plants
Asarum canadense
Goodyera pubescens
Heuchera americana
Mitchella repens
Phlox carolina, stolonifera, subulata
Sedum ternatum
Silene caroliniana
Solidago sempervirens
Yucca filamentosa (flaccida)

Shrubs
Gaultheria procumbens
Ilex glabra
Kalmia angustifolia, latifolia
Morella (Myrica) caroliniensis (heterophylla), cerifera
Rhododendron maximum
Vaccinium macrocarpon

Trees
Chamaecyparis thyoides
Ilex opaca
Juniperus virginiana
Magnolia virginiana
Pinus any species in this guide
Thuja occidentalis
Tsuga canadensis

Vines
B*ignonia capreolata*
Lonicera sempervirens

Plants to use as Groundcovers

Ferns
Any species in this guide

Grasses and Grasslike Plants
Carex glaucodea, pensylvanica
Danthonia spicata
Festuca rubra

Herbaceous Plants
Aquilegia canadensis
Asarum canadense
Chimaphila maculata
Chrysogonum virginianum
Chrysopsis mariana
Coreopsis verticillata
Erigeron pulchellus
Eurybia divaricata (Aster divaricatus)
Geranium maculatum
Hepatica nobilis var. acuta (acutiloba), nobilis var. obtusa (americana)
Heuchera americana, villosa
Hylotelephium (Sedum) telephioides
Maianthemum canadense
Mitchella repens
Opuntia humifusa (compressa)
Oxalis violacea
Phlox carolina, stolonifera, subulata
Podophyllum peltatum
Polemonium reptans
Sedum ternatum
Silene caroliniana
Tiarella cordifolia
Uvularia sessilifolia
Viola conspersa, cucullata, hastata, pedata

Shrubs
Gaultheria procumbens
Vaccinium angustifolium, macrocarpon
Vaccinium pallidum (vacillans)

Vines
Bignonia capreolata
Campsis radicans
Celastrus scandens
Parthenocissus quinquefolia

Plants for Spring and Fall Color

A search through this guide will reveal literally hundreds of plants of all types that will flower or fruit in spring or fall, providing a wide variety of choices to color a native landscaping project and to offer a diversity of food for wildlife. Remember to consider trees, shrubs and vines when choosing plants for their flower color; and to include fruit color in the palette. The fall color of many plants, particularly grasses, trees, shrubs and vines adds interest to the landscape. A landscape planned for seasonal color, throughout *all* seasons of the year, can also provide year-round food, cover and nesting structure for wildlife.

Deer Resistant Plants

Gardeners challenged by browsing deer often look for a definitive list of plants that deer will leave alone. Unfortunately, deer are not quite that predictable. In areas where high populations of deer have over-browsed the woodland understory, they are likely to eat any plant they can find to survive. Gardeners and habitat restorationists are strongly encouraged to use other appropriate barriers to exclude deer, in consultation with a local wildlife agency. Plants marked with an asterisk (*) may be browsed occasionally.

The list below was compiled from Bowman's Hill Wildflower Preserve and Deer Proofing Your Yard (Hart), see references.

Grasses and Grasslike Plants
Andropogon gerardii
Panicum virgatum

Herbaceous Plants
Actaea pachypoda
Allium cernuum
Aquilegia canadensis
Arisaema triphyllum
Aruncus dioicus
*Asarum canadense **
Asclepias tuberose
Baptisia australis
Campanulastrum americanum (Campanula americana)
Coreopsis tripteris
Dicentra eximia
Geranium maculatum
Helenium autumnale
Hibiscus moscheutos (H. palustris)
Jeffersonia diphylla
*Lobelia cardinalis *, siphilitica **
Lupinus perennis
Monarda didyma
Phlox divaricata, stolonifera
*Podophyllum peltatum **
Polemonium reptans
Rudbeckia fulgida, hirta
Solidago species
Symphyotrichum (Aster) novae-angliae
Veronicastrum virginicum (Veronica virginica)

Herbaceous Emergents
Iris prismatica, versicolor, virginica

Shrubs
Aralia spinosa
Clethra alnifolia
Cornus amomum
Hamamelis virginiana
Hypericum densiflorum
Ilex glabra, laevigata, verticillata
Kalmia latifolia
Leucothoe racemosa
Lindera benzoin
Morella (Myrica) cerifera, pensylvanica
Ribes rotundifolium
Spiraea alba, alba v. latifolia (latifolia), tomentosa
Viburnum acerifolium, dentatum (recognitum), prunifolium

Trees
Acer negundo, rubrum
Amelanchier canadensis
Betula nigra
Carpinus caroliniana
Cercis canadensis
Cornus alternifolia
*Cornus florida **
Diospyros virginiana
Fagus grandifolia
Fraxinus americana, pennsylvanica
Ilex opaca
Juniperus virginiana
Magnolia acuminata, virginiana
Nyssa sylvatica
Pinus — any species in this guide
Quercus — any species in this guide
Sambucus racemosa v. racemosa (S. pubens)

Vines
Celastrus scandens
*Clematis virginiana **
Lonicera sempervirens
*Wisteria frutescens **

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Each photograph is marked with an abbreviated form for the corresponding photographer, due to space limitations. Those abbreviations are listed here in alphabetical order, followed by the full credit information.

The Bugwood Network and Forestry Images Image Archive and Database Systems, The University of Georgia-Warnell School of Forest Resources and College of Agricultural and Environmental Sciences-Department of Entomology. www.bugwood.org

BUG DJM David J. Moorhead
BUG RFW Robert F. Wittwer

BZ Bob Zuberbuhler, www.westernpawildflowers.com

CAB Carole Ann Barth, Heal Earth Gardens, Silver Spring, Maryland.

CM NRCS Christopher F. Miller, Regional Plant Materials Specialist, U.S. Department of Agriculture, Natural Resources Conservation Service, Somerset, New Jersey.

Digital Flora of Texas Vascular Plant Image Library. www.csdl.tamu.edu/FLORA/galfolks.htm, or www.texasflora.org

DFT DL David Lemke, The State University-San Marcos, Department of Biology Herbarium.
DFT HW Hugh Wilson, TAMU Herbarium, Texas A&M University.

GM ARS George McLellan, Species Study Group of the Middle Atlantic Chapter, American Rhododendron Society. tjhsst.edu/~dhyatt/azaleas/atlanticum.html

MOBOT Missouri Botanical Garden. www.mobot.org/gardeninghelp/plantfinder/service.shtml. Digital images in this database were contributed by Martha Hill, Glenn Kopp and Alan Stentz.

MP Dan Tanaglia, Missouriplants. www.missouriplants.com

NYNHP Stephen M. Young, New York Natural Heritage Program. www.dec.state.ny.us/website/dfwmr/heritage

OSU Scott Biggs, Ohio State University. http://PlantFacts.osu.edu

PLANTS **USDA-NRCS. 2003. The PLANTS Database,** plants.usda.gov/plants. National Plant Data Center. Baton Rouge, LA 70874-4490 USA. PLANTS Database images that were used in this guide were contributed by the following:

PLANTS 1995 U.S. Department of Agriculture Natural Resources Conservation Service. 1995 Midwestern Wetlands Flora.
PLANTS 1997 U.S. Department of Agriculture Natural Resources Conservation Service. 1997 Northeastern Wetlands Flora.
PLANTS DEH Herman, D.E. et.al. 1996 North Dakota Tree Handbook. USDA NRCS. ND State Soil Conservation Committee. NDSU Extension and Western Area Power Administration. Bismark, ND.
PLANTS DL Douglas Ladd. U.S. Department of Agriculture Soil Conservation Service. 1989 Midwest Wetland Flora: Field Office Illustrated Guide to Plant Species. Midwest National Technical Center, Lincoln, NE.
PLANTS GAM Gary A. Monroe
PLANTS GFR George F. Russell
PLANTS JA Jennifer Anderson
PLANTS JS Jim Stasz
PLANTS JSP J.S. Peterson
PLANTS LA Larry Allain
PLANTS RM89 Robert H. Mohlenbrock. U.S. Department of Agriculture, Soil Conservation Service. 1989 Midwest Wetland Flora: Field Office Illustrated Guide to Plant Species. Midwest National Technical Center, Lincoln, NE.
PLANTS RM91 Robert H. Mohlenbrock. U.S. Department of Agriculture, Soil Conservation Service. 1991 Southern Wetland Flora: Field Office Guide to Plant Species. South National Technical Center, Fort Worth, TX.
PLANTS RM95 Robert H. Mohlenbrock. U.S. Department of Agriculture,Natural Resources Conservation Service. 1995 Northeast Wetland Flora: Field Guide to Plant Species. Northeast Technical Center, Chester, PA.
PLANTS TGB Thomas G. Barnes
PLANTS WSJ William S. Justice

RHW R. Harrison Wiegand, Maryland Department of Natural Resources, Wildlife and Heritage Service. www.dnr.state.md.us

RS MNPS Rod Simmons, Maryland Native Plant Society. www.mdflora.org

SMSU Paul Redfearn, Ozarks Regional Herbarium, Southwest Missouri State University. biology.smsu.edu/Herbarium

UCONN Mark Brand, UConn Plant Database, University of Connecticut. www.hort.uconn.edu/plants/about.html

USDA NRCS **U.S. Department of Agriculture, Natural Resources Conservation Service,** National Plant Materials Center, Beltsville, MD. www.plantmaterials.nrcs.usda.gov/mdpmc
USDA JE John Englert
USDA JK Jennifer Kujawski
USDA MG Martin van der Grinten

USFWS **U.S. Fish and Wildlife Service Chesapeake Bay Field Office,** Annapolis, MD 21401. www.fws.gov/r5cbfo
USFWS BES Britt Slattery
USFWS RL Randy Loftus
USFWS RM Rich Mason
USFWS RS Rich Starr

University of Wisconsin, Wisconsin State Herbarium, Madison, WI 53706-1381. www.botany.wisc.edu/herbarium

UWI AH Andrew Hipp, University of Wisconsin-Madison.
UWI DK Darrin Kimbler, University of Wisconsin-Madison.
UWI DWW Dennis W. Woodland, Andrews University.
UWI EJJ Emmet J. Judziewicz University of Wisconsin-Stevens Point and Madison.
UWI JK John Kohout, donated to Wisconsin Department of Natural Resources.
UWI JRS James R. Sime, Middleton, Wisconsin.
UWI JS Janice Stiefel, Bailey's Harbor, Wisconsin.
UWI KJS Kenneth J. Sytsma, University of Wisconsin-Madison.
UWI KK Kitty Kohout, donated to Wisconsin Department of Natural Resources.
UWI MC Michael Clayton, University of Wisconsin-Madison.
UWI MRB Merel R. Black, University of Wisconsin-Madison.
UWI RRK Robert R. Kowal, University of Wisconsin-Madison.
UWI RWF Robert W. Freckmann, University of Wisconsin-Stevens Point.
UWI TK Tim Kessenich, Wisconsin Department of Natural Resources.

VT Virginia Tech (Virginia Polytechnic Institute and State University), College of Natural Resources, Forest Biology and Dendrology Educational Sites. www.cnr.vt.edu/dendro/wwwmain.html

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Index

Latin name

Common Name

U.S. Fish & Wildlife Service
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177 Admiral Cochrane Dr.
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Adkins Arboretum
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www.adkinsarboretum.org

Baltimore County Department of Environmental Protection and Resource Management
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Towson, MD 21204
410/887 4488
www.baltimorecountyonline.info

Chesapeake Bay Trust
60 West Street, Ste. 200-A
Annapolis, MD 21401
410/974 2941
www.chesapeakebaytrust.org

Irvine Nature Center
8400 Greenspring Avenue
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410/484 2413
www.explorenature.org

Maryland Native Plant Society
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Silver Spring, MD 20914
301/809 0139
www.mdflora.org
mnps@toad.net

National Fish and Wildlife Foudation
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The Nature Conservancy
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www.nature.org

USDA NRCS
Cape May Plant Materials Center
1536 Rt. 9 North
Cape May Court House, NJ 08210
609/465 5901
plant-materials.nrcs.usda.gov

APPENDIX 3 – COTTAGE RULES AND REGULATIONS (PENNSYLVANIA AND MARYLAND)

RULES AND REGULATIONS - PENNSYLVANIA

I. GENERAL CONDITIONS

A. General Information

All questions, complaints, and requests for applications should be directed to:

Exelon Generation Company, LLC ("Landlord")
300 Exelon Way
Kennett Square, PA 19348
Attn: Cottage Project Leasing Manager
Telephone: 610-765-5505

B. General Conduct

1. Tenant shall use the leased premises only for a vacation retreat and recreational activities. Tenant shall <u>not</u> use or occupy the leased premises as a primary permanent residence. Landlord has the right to verify Tenant's permanent address, including but not limited to requiring Tenant to provide acceptable proof of domicile.

2. All of the conduct required of the Tenant shall be required of Tenant's guests, and Tenant shall ensure that such guests adhere strictly to these Rules and Regulations. Tenants are responsible for the actions of their guests.

3. Tenant shall not permit any noise, or other nuisance to interfere with the quiet enjoyment of other tenants' use of their properties.

4. Tenant shall not cause or allow un-permitted or uncontrolled fires. No open fires are permitted except in properly constructed barbecue pits and any burning must comply with all federal, state and local laws, rules, regulations and ordinances. No open burning of leaves or other vegetation debris is permitted.

5. A six (6) digit Cottage Identification Number (CIN) will be assigned to each Tenant and is to be placed on the outside wall of the cottage facing the water, and must be visible from the water. If the cottage is accessible from a road or fronts on a road, the CIN must also be placed on the side of the cottage facing the road. Under the CIN, the Tenant must also post an emergency response telephone number and address. All posted characters must be at least 4 inches in height.

6. All dogs must be kept securely tied or on a leash at all times.

7. Immediately upon discovery, Tenant must report any potentially hazardous condition to the Landlord and, as required by law, to the appropriate state and local authority or agency.

8. Tenant shall be responsible for the correction and/or control of any erosion caused by or resulting from improvements, and/or changes made to, or on the leased premises. Landlord may require Tenant to rectify any erosion problems on or affecting the leased premises. However, Landlord has no duty to Tenant to correct any naturally occurring erosion problems.

9. The Rules and Regulations contained herein are not intended to substitute for or absolve Tenant of his or her legal responsibility to comply with all applicable federal, state, and local laws. In a situation where the Rules and Regulations contained herein are in conflict with, or are less restrictive than, the applicable federal, state, or local law, the more restrictive statute, rule, regulation, or ordinance shall apply.

II. IMPROVEMENTS

A. Removal of Improvements

1. In these Rules and Regulations, "improvements" shall mean and include all dwellings, fixtures, outhouses, sheds, decks, buildings, roads, driveways, bridges and Shoreline Improvements (defined in Section VII) and any other artificial structures or material constructed by or placed on the leased premises by the Tenant or any former tenant, whether or not said improvement is affixed in any manner to the land.

2. All improvements shall remain the personal property of the Tenant at all times and shall be removed by the Tenant upon the termination of the Tenant's lease, unless Landlord has approved the transfer to a new tenant. Tenant is responsible for any and all costs incurred by Landlord should Landlord elect to remove Tenant's improvements after the termination of Tenant's lease.

B. Construction or Demolition

1. Landlord is not responsible for constructing, maintaining, repairing, reconstructing or demolishing Tenant's improvements. Should Tenant wish to construct any new improvement, to demolish an existing improvement, or to renovate, alter or replace an existing improvement in a manner that requires a local, state or federal permit ("construction"), a Construction Application must be submitted (with all appropriate attachments) and all required fees paid to Landlord <u>prior</u> to applying for any applicable building

permits or to beginning any such construction. Tenant must be in compliance with the terms of the Lease, including but not limited to being current with any Rent or other sums due and payable, prior to submitting a Construction Application. Applications must contain a list of all applicable licenses and permits which Tenant must obtain by law prior to beginning any work and a survey or drawing showing the proposed improvement. A Construction Application form is attached hereto as Attachment 1. Tenant is responsible for determining which federal, state, and/or local laws apply to their proposed construction or demolition activities and to contact the applicable government or agency as required by said laws.

2. Applications will be reviewed by Landlord for compliance with the terms and conditions of the Tenant's lease. If the application is acceptable to Landlord, Landlord shall issue to Tenant a preliminary approval in writing. If the Application is denied, Landlord will give Tenant written notice of the items that are not in compliance and an opportunity to cure in accordance with the terms of Tenant's lease.

3. Within 90 days after Landlord's preliminary approval of the Application and prior to beginning any work, Tenant must obtain all permits and licenses required by federal, state and local law and provide copies of all such permits and licenses to Landlord.

4. Upon receipt of the applicable permits and licenses for the work approved by Landlord, Landlord shall issue written final approval of the Construction Application to the Tenant.

5. The final approval issued by Landlord expires one (1) year from the date of issuance. If the approved construction is not completed on or before the expiration date, the Tenant must resubmit a Construction Application to the Landlord.

6. Setback regulations are variable based upon site conditions, and are governed by local regulations. Landlord's approval is contingent upon compliance with setback requirements and all other applicable laws and regulations.

7. Within thirty (30) days of completion of the approved construction, Tenant must submit photographs of the completed work to Landlord.

8. Tenant must notify Landlord in writing anytime a building or other improvement is to be razed or removed. Within ninety (90) days after the improvement is razed or removed, the area must be restored to a condition satisfactory to Landlord, which restorations

shall include but are not limited to establishing the appropriate vegetative cover.

C. Maintenance

1. Tenant must maintain the leased premises and all improvements thereon in good repair and appearance at all times. Should Landlord determine that the leased premises is not in a state of good repair and appearance, Landlord may require a Tenant to perform all reasonable and necessary repairs and maintenance, including but not limited to painting and removal of any and all junk, trash, debris, or other items determined by Landlord to constitute a nuisance.

2. Improvements shall not present a hazard to the health or safety of any Tenant or other persons or property or to the environment.

3. Landlord may require Tenant to correct, at Tenant's sole expense, any conditions that Landlord determines to be potentially hazardous, harmful to the environment, or in violation of these Rules and Regulations.

4. All chimneys must be fireproof and constructed of tile, brick, stone, or other approved material, equipped with spark arresters, and must otherwise comply with all applicable code specifications. Tenant must install and maintain in good working condition at least one smoke detector in each dwelling on the leased premises.

D. Sale of Improvements and Lease Transfer Application

1. Tenant may not transfer Tenant's interest in Tenant's lease without the prior written approval of Landlord. At least forty-five (45) days prior to settlement on the sale of Tenant's improvements, Tenant and the proposed transferee shall submit a Lease Transfer Application to Landlord. Lease Transfer Applications must include a code compliance report, a Use & Occupancy Certificate from the township in which the leased premises is located (or alternative vendor inspection report and Sanitary System certification as set forth in the Lease Transfer Application), a copy of the agreement of sale of the improvements, and payment of applicable fees. A Lease Transfer Application form is attached as Attachment 2. If the transfer is approved, Landlord will require the purchaser of the improvements to enter into a new lease of the leased premises substantially in the form attached hereto as Attachment 3. Tenant must be in compliance with the terms of the Tenant's lease, including but not limited to being current in the payment of Rent or other sums due and payable, prior to submitting a Lease Transfer Application. Landlord reserves the right to deny the Lease

Transfer Application if Landlord determines the proposed transferee is not financially or otherwise qualified.

2. If the Lease Transfer Application is approved, Landlord shall issue a new Lease Agreement prior to the settlement date, which shall be properly executed by the proposed transferee at settlement and returned to Landlord for Landlord's execution, along with a copy of a valid Bill of Sale for the improvements, and a termination of the existing Tenant's lease executed by Tenant. Landlord will then forward to the new tenant a fully executed copy of the new Lease Agreement and these Rules and Regulations.

3. If the Lease Transfer Application is denied, Landlord will give Tenant written notice of the reason for the denial and an opportunity to cure in accordance with the terms of Tenant's lease.

4. <u>All</u> Sales Agreements for the improvements must contain a statement that only the Tenant's improvements are being sold and that neither land, nor water rights are included in the sale, and that Landlord has no responsibility for providing, maintaining or improving access to the leased premises. Bills of Sale must contain the same statement.

5. Installment Sales Agreements or Lease Purchase Agreements that are intended to give possession of the cottage to the buyer while the current Tenant (seller) holds the existing lease <u>are not permitted</u>.

6. Proposed transfers to remove or add a co-tenant shall be subject to Landlord's approval in accordance with the procedures in this Section II (D).

III. ROADS AND BRIDGES

A. Construction or Alteration of Roads, Driveways and Bridges

1. Written permission is required from Landlord for the construction or alteration of roads, driveways, or bridges in accordance with the procedures set forth in Section II (B) above. A survey and/or drawing showing the location of the road, driveway or bridge must accompany the Construction Application submitted to Landlord.

2. In addition to obtaining written permission from the Landlord, Tenant must obtain all federal, state and local permits, where required, before constructing or altering any road, driveway or bridge.

B. Maintenance

1. Tenant must maintain roads, driveways or bridges on the leased premises in good condition, and provide proper drainage in accordance with Landlord's specifications.

2. Tenant is responsible for its proportionate share of the cost of maintenance and general upkeep of non-public roads and bridges used in common with other cottage owners.

3. Tenant is prohibited from blocking or otherwise limiting access to any roads, driveways or bridges located on the leased premises or any other property owned by Landlord.

4. Should Tenant fail to perform its maintenance obligations under these Rules and Regulations, Landlord, after notice to Tenant, may in its sole discretion, (i) perform such maintenance and charge Tenant for its share of the cost, or (ii) prohibit the use of the road, driveway or bridge in need of repair. Landlord shall have no obligation to repair or maintain such roads, driveways or bridges.

IV. TREES & PLANTS

1. No trees or ornamental shrubs shall be injured or damaged, by Tenants or their guests. The attaching of lights, electric lines, clotheslines, docks, or any other item to any tree or shrub, either on a temporary or permanent basis, is prohibited. Care must be taken during any construction activities to prevent injuring trees or ornamental shrubs, and if necessary, temporary protective shields shall be installed around the trees or shrubs.

2. Tenant shall not remove any tree or shrub over two (2) inches in diameter without prior written permission of Landlord. If a tenant desires to trim, cut or remove significant portions of a tree, they must first obtain written permission from Landlord.

3. Requests for tree or shrub removals can only be made by the current Tenant.

4. Tenant is responsible for correcting hazardous tree conditions on or adjoining the leased premises. Landlord may notify in writing the Tenant of any trees that Landlord believes should be removed. It will be the responsibility of the Tenant to have such trees removed. If such trees are not removed within the specified time period, Landlord at its option my terminate the Tenant's lease and/or remove the tree at the Tenant's expense.

5. Tenant shall not introduce any invasive plant species or noxious weeds onto the leased premises, on any of Landlord's properties, or within or upon any waters of the State and is responsible for removing any such growth from the leased premises.

V. WATER

1. Tenant shall take all reasonable measures to limit the use of water. Accordingly, swimming pools, hot tubs and spas, whether above or below ground, temporary or permanent, are prohibited.

2. All use of water by Tenant, in and about the leased premises, shall be at the sole risk of Tenant. Landlord has not performed any water potability tests and makes no representations with regard to the suitability of the water for domestic purposes. Tenant is responsible for performing any applicable potability testing or other water analysis and all costs incurred in connection with such testing shall be the responsibility of the Tenant. Landlord assumes no liability for, or on account of, any water used in any manner by Tenant or Tenant's guests.

3. No exclusive rights are given or inferred as being given as to the use of any water or spring, even though a spring may be located on the leased premises.

4. Tenant's storage and disposal of all water used for domestic non-sanitary purposes at the leased premises, otherwise known as "gray water," shall be in accordance with federal, state and/or local laws. All systems for the storage and disposal of gray water must be maintained in a good and sanitary condition and in compliance with all applicable laws, regulations and ordinances at all times.

5. Construction or drilling of a new well or other water source is subject to the prior approval of Landlord in accordance with the procedures set forth in Section II (B) above.

VI. SANITARY SYSTEM REQUIREMENTS

1. Before beginning construction, installation or alteration of any sanitary system (including, by illustration and not limitation, any septic system, holding tank, privy, outhouse, sanitary toilet or composting toilet) ("Sanitary System"), Tenant shall comply with the procedures set forth in Section II (B) above.

2. In the event a Sanitary System does not exist on the leased premises, Tenant must provide the site with a Sanitary System in compliance with all applicable laws, regulations and ordinances and these rules and regulations. No Sanitary System shall be

located closer than one hundred (100) feet of any spring, stream, or other water supply source (except as otherwise permitted by applicable laws or regulations).

3. In the event a public sanitary sewer system is installed in the area, Tenant shall be required to connect into the system, whereupon Tenant shall be responsible for all connection, maintenance, and operation fees or costs.

4. All garbage, trash or refuse must be removed from the leased premises every seven (7) days. In the interim, all garbage, trash and refuse must be kept in a closed container intended for the temporary storage of garbage, trash or refuse and secure from flies, rats or other insect or animal intrusion.

5. All Sanitary Systems and trash receptacles must be maintained in a good and sanitary condition and in compliance with all applicable laws, regulations and ordinances at all times. TENANT SHALL PROVIDE LANDLORD WITH A CERTIFICATION THAT ANY EXISTING SANITARY SYSTEM IS IN GOOD WORKING ORDER IN ACCORDANCE WITH APPLICABLE LAWS BY A CERTIFIED VENDOR REASONABLY ACCEPTABLE TO LANDLORD ON OR BEFORE AUGUST 1 ANNUALLY.

VII. SHORELINE PROTECTION PROGRAM

A. Application Procedures

1. The “shoreline” is considered to be the existing shoreline at mean high water.

2. Prior to the construction or repair of a pier, dock, boathouse, boat ramp, marine railway, bulkhead, retaining wall, or sea wall (“Shoreline Improvements”) or the installation of any erosion control measures or excavation in any areas that may affect the shoreline, Tenant, must submit a Construction Application to Landlord in accordance with Section II (B) of these Rules and Regulations. Landlord will make an on-site inspection of the area to determine if what the applicant has proposed should be allowed or if another type of measure may be more appropriate. No construction may begin until the Tenant has received Landlord’s written Approval and obtained all required local, state and federal permits and authorizations, including but not limited to all permits required by the Pennsylvania Department of Environmental Protection and the U.S. Army Corps of Engineers.

B. Specifications and Procedures

In addition to the applicable local, state and federal laws, and all requirements set forth by the applicable permitting authorities, the following specifications shall apply. Should any specification herein conflict with any applicable local, state, or federal law or regulation, the most restrictive requirement shall apply.

1. Piers or Docks

a. Piers may be permanent, floating, or a combination of both and may not exceed a total length of fifty (50) feet (or extend more than fifty (50) feet from the shoreline). If the pier is located in a cove or in a stream, the length may not exceed 25% (1/4) of the width of the cove or stream where the pier is located.

b. All permanent piers (or permanent sections of piers) must be built above the mean high water line.

c. Piers must be constructed of preservative treated lumber and pilings. Concrete, masonry, and metal construction is not permitted. Hand railings and covers on piers are permitted provided that the sides are open so as not to obscure cross vision. Covers are permitted only over the pier itself and may not extend out over the water.

d. Flotation devices for floating piers must be constructed of environmentally sound material as approved by Landlord and permitting authorities. Styrofoam, barrels or similar flotation devices are not permitted.

e. Piers may not interfere with navigation, present a safety hazard, or block ingress or egress to adjoining areas.

f. If an existing pier must be replaced or repaired (other than minor repairs), it must conform to current standards.

g. Piers may not be anchored or tied to trees at any time.

2. Boat Ramps and Marine Railways

a. Ramps must be constructed of poured concrete pads or precast concrete panels properly anchored and fastened together. Asphalt or other petroleum-based products are prohibited.

b. Ramps may not exceed fifteen (15) feet in width and thirty (30) feet in length. The length should not exceed that necessary to be functional.

c. Marine railways may use either treated wood or concrete ties.

d. Marine railways may not exceed fifteen (15) feet in width and should be no longer than necessary to be functional. Landlord may, however, restrict the length because of site conditions.

3. Erosion Control Measures (Bulkheads, Retaining Walls, Sea Walls, Rip Rap, etc.)

a. No erosion control measure shall significantly alter the existing shoreline.

b. The planting of vegetative cover and/or rip-rapping shall be used if adequate to control the problem.

c. Bulkheads and retaining walls must be constructed of preservative treated wood, concrete, or masonry.

d. The structure shall not significantly detract from the scenic value of the area.

C. Landlord assumes no liability for injury or damage in the construction, use or removal of any Shoreline Improvement made by the current or any former Tenant.

VIII. COMPLIANCE; AMENDMENTS

In the event of Tenant's failure to comply with these Rules and Regulations, Landlord may impose a fee on Tenant of up to $250 per day until such failure is cured, which fees shall be due and payable within ten (10) days after Tenant receives a bill for the same and/or terminate Tenant's lease in accordance with its terms. Landlord shall have the right to amend these Rules and Regulations at any time as Landlord deems reasonably necessary.

IX. CULTURAL RESOURCE PROTECTION GUIDELINES

Landlord has developed, in cooperation with the Pennsylvania Bureau of Historic Preservation and the Maryland Geological Survey, Division of Archeology, the following rules and regulations. The specific intent of these guidelines is to provide for the protection of cultural resources, and to avoid any disturbance of historic and prehistoric sites except when justified for scientific purposes and/or when performed in accordance with such State and Federal regulations and guidelines as may apply.

A. No one shall mar, deface, remove, destroy or in any other way damage, any standing structure, ruins, foundation or other man-made feature of a potentially historic nature on lands of Landlord, without first having obtained the written permission of Landlord.

B. No one shall perform any sub-surface archaeological investigations, or in any way disturb the soil for the purpose of searching for and/or obtaining historic or prehistoric artifacts on land of Landlord without having first obtained the written permission of Landlord, nor shall same be performed without the prior knowledge and written sanction of the following:

In Pennsylvania: The Bureau of Historic Preservation

C. Full and complete reports must be prepared. Said reports shall incorporate maps, site profiles, descriptions and photographs of artifacts and features, soil descriptions, topography, excavation procedures, directions and distance to the nearest water and all such other related details as may be required.

D. Landlord shall be supplied with a copy of each report so generated. The appropriate State agency shall be supplied with two copies of same, one of which shall contain original photographs.

E. All artifacts and related material recovered in sub-surface investigations shall become the property of Landlord, and shall be turned over to the respective State agency. Same shall remain available to Landlord and other responsible public and private organizations and agencies for the purpose of study and/or public display.

F. All artifacts must be properly labeled with site number and lot and must be readily identifiable by pit and level. Site numbers must conform to the trinomial numbering system adopted by both Pennsylvania and Maryland.

G. All burials encountered during the course of such archeological investigations shall be treated with the highest respect, and shall be handled on a case by case basis under the strict control of the State agency having jurisdiction. It is the policy of said agencies and of Landlord, to discourage the removal or disturbance of human remains, unless there is a significant scientific purpose to be served by same, and unless provisions are made, in consultation with, and with the approval of living descendants of the interred, for the timely study and the ultimate reburial of the remains.

H. While the collection of artifacts from the surface is widespread, and though not strictly prohibited under these regulations, it does have a significantly negative effect on archeological sites. The distribution of surface artifacts is the only information available for many sites. Those finding artifacts are therefore encouraged to report finds to Landlord so that same might be photographed and recorded.

I. Tenant is required to consult with the appropriate State Preservation Office prior to any construction work that may affect surface or sub-surface archaeological sites, and prior to new additions to existing structures or the construction of new structures.

J. On property which is within the boundaries of Federally-regulated projects such as the Conowingo Hydro-Electric Project (F.E.R.C. No. 405), Tenants' properties require additional precautions regarding cultural resources under the provisions of the National Historic Preservation Act of 1978 (section 106), Executive Order 11593, and the regulations of the Advisory Council on Historic Preservation (36 CFR 800).

X. CONTACT INFORMATION

DISCLAIMER: The following list is intended as a reference to the Tenant for contacting the municipalities or agencies that may require permits or approvals for specified construction activities. The list is not intended to be an exclusive list and Landlord makes no guarantees or warranties as to the accuracy of the information contained herein below. Tenant is responsible for determining which federal, state, and/or local laws apply to their proposed construction activities and to contact the applicable government or agency as required by said laws.

Pennsylvania

Pennsylvania Fish and Boat Commission
Executive Director
P.O. Box 67000
1601 Elmerton Avenue
Harrisburg, PA 17106-7000
717.705.7800

Fulton Township Supervisors
777 Nottingham Road
Peach Bottom, PA 17563
717.548.3514

Martic Township Supervisors
370 Steinman Farm Road
Pequea, Pa. 17565
717.284-2167

Drumore Township Supervisors
1675 Furniss Road
Drumore, PA 17518-0038
717.548.2660

Lancaster County Conservation District
1383 Arcadia Road, Room 200
Lancaster, PA 17601
717.200.5361 ext 5

Pennsylvania Department of
Environmental Protection (PADEP)
Department of Environmental Protection Headquarters
Rachel Carson State Office Building
400 Market Street
Harrisburg, PA 17101
717.783.2300

Peach Bottom Township Supervisors
545 Broad Street, Extended
Delta, PA 17314
717.456.5083

Lower Chanceford Township Supervisors
4120 Delta Road
Airville, PA 17302
717.862.3589

York County Conservation District
118 Pleasant Acres Road
York, PA 17402
717.840.7430

U.S. Army Corps of Engineers
Philadelphia District
The Wanamaker Building
100 Penn Square East
Philadelphia, PA 19107
215.656.6728

ATTACHMENT 1

CONSTRUCTION APPLICATION

Tenant Information **Application Date:** ___________

Name:____ C.I.N. ____________
Address:____
City:______________________________ State:_____________ Zip:__________
Home Phone:_______________________ Office Phone:______________________

Authorization Requested For (check appropriate items)

Addition to Cottage ________ Deck ________ Boat Ramp _______
Outbuilding ______________ Well ________ Bulkhead ________
Fence ___________________ Road ________ Riprap ___________
Parking Area _____________ Pier ________ Boathouse _______
New Construction (specify) ______________________________________
Removal or demolition of ____
Other (specify) ____

Procedure

1) Tenant must obtain written preliminary approval from Exelon prior to applying for local, state or federal building permits. A plan or sketch of the proposed construction, demolition or modification must be attached and shall include the following information: a) Dimensions of the structure(s); b) Construction materials; c) Location of the structure(s); and current photos of the existing cottage front, rear and shoreline (if applicable).
2) If Exelon denies this application, Exelon shall give Tenant written notice of the reasons for the denial.
3) Within 90 days after receipt of the preliminary approval, Tenant must submit to Exelon copies of the building permits issued by the appropriate local, state or federal authority.
4) Upon receipt of copies of the building permits, Exelon will issue a written approval of this application.
5) **No work can be started until Exelon issues its written approval of this application.**
6) Failure to comply with this procedure may result in a fee of up to $250 per day and/or termination of the Tenant's Lease in accordance with the Rules and Regulations.

Preparation Fee: Please submit a check in the amount of $250.00 with this application made payable to: Exelon Generation Company, LLC.

Please submit this application to:

Exelon Generation Company, LLC
300 Exelon Way
Kennett Square, PA 19348
Attn: Cottage Project Leasing Manager

PLEASE DIRECT QUESTIONS TO (610) 765-5505 (Conowingo Project Leasing Manager)

EXELON USE ONLY

Reviewed (I) _________ APPROVED _________________________ ___________
(F) _________ DATE
Fee Rec'd (C) _________

ATTACHMENT 2

LEASE TRANSFER APPLICATION

This application must be submitted to Exelon Generation Company, LLC at least forty-five (45) days prior to the date of settlement.

PRESENT TENANT INFORMATION **APPLICATION DATE:** ____________________

Name: ____ CIN: ______________

Address: ____

City: ____________________ State: ____________ Zip: ____________________

Home Phone: ____________________ Office Phone: ________________________

NEW TENANT INFORMATION

Name (as it should appear on Lease): ____________________________________

____

Address: ____

City: ____________________ State: ____________ Zip: ____________________

Home Phone: ____________________ Office Phone: ________________________

Social Security: ____________________

SETTLEMENT DATE: ____________________ **PURCHASE PRICE:** ____________________

Please submit this Request to: **Exelon Generation Company, LLC**
300 Exelon Way
Kennett Square, PA 19348
Attn: Cottage Project Leasing Manager

TO BE SUBMITTED WITH THIS APPLICATION:

1. An application fee in the amount of $250 by check made payable to Exelon Generation Company, LLC.
2. A code compliance inspection report and a use & occupancy certificate from the township in which the leased premises is located. If the township does not require a code compliance inspection or a use and occupancy certificate, Tenant must submit a code compliance inspection report and a current certification that the Sanitary System, including without limitation any existing septic, holding tank, privy, outhouse or compost toilet, and any gray water system, are in good working order and in compliance with applicable law from one or more certified vendor reasonably acceptable to Exelon.
3. Copy of the agreement of sale for the cottage and other Tenant improvements ("improvements").
4. At Exelon's option, a credit report on the proposed new tenant from Equifax or a similar nationally known credit reporting company.

TO BE SUBMITTED AFTER SETTLEMENT:

Within ten (10) days after settlement, the following must be submitted:

1. A "Bill of Sale" for the improvements signed by both parties.
2. Two copies of the required new lease agreement (form attached) signed by the new tenant(s) on the appropriate lines and witnessed on the line to the left of their signatures. A fully executed copy of the lease will be returned to the new tenant.
3. The new tenant will be billed at a later date for any additional rents that may be due under the new lease. **Seller must be reimbursed by Buyer for all prepaid rent and taxes.**

Failure to comply with this procedure may result in denial of the application and/or termination of the Tenant's Lease in accordance with the Rules and Regulations.

PLEASE DIRECT ALL QUESTIONS TO (610) 765-5505 (Conowingo Project Leasing Manager).

EXELON USE ONLY

Fee received: ____________________ Date: ____________________

Approved: ____________________ Date: ____________________

File No.: ____________________

SAMPLE

ATTACHMENT 3

FORM LEASE

LEASE

THIS LEASE AGREEMENT (this "Lease") is made ____ day of ________________, 2010 (the "Effective Date"), by and between Exelon Generation Company, LLC ("Landlord") and ____("Tenant").

BACKGROUND

A. Landlord, as successor by merger to PECO Energy Power Company, is the owner of a parcel of land located in ________________Township, ________________ County, Pennsylvania, identified as Lot No. __________, as outlined in red on the plan attached to this Lease as Exhibit A (the "Land").

B. Landlord and Tenant desire to enter into a lease of the Land on the following terms and conditions.

1. Term. Unless sooner terminated in accordance with the terms of this Lease, Landlord agrees to lease the Land to Tenant for a term beginning on the Effective Date and ending on September 30th of the calendar year following the Effective Date (the "Term"). Thereafter, this Lease shall continue upon the same terms and conditions, subject to the adjustment of Rent in accordance with Paragraph 2 hereof, from year to year until terminated by either party by written notice at least thirty (30) days prior to the expiration of the then current term.

2. Payment of Rent. Tenant agrees to pay to Landlord annual rent in the amount of $________ ("Rent") on the first day of September, except, however, that payments of Rent may be pro-rated on a monthly basis for partial years. Tenant will send or deliver the Rent to Exelon Generation Company, LLC, 2301 Market Street, N3-3, Philadelphia, PA 19103, Attn: Real Estate & Facilities, unless Landlord notifies Tenant in writing that the Rent should be sent or delivered to another address. Except as otherwise provided herein, Landlord is not required to send Tenant a bill for the Rent, and the lack of a bill does not mean that Tenant is not required to pay Rent on or before the date set forth above. The Rent shall increase annually by the amount of three percent (3%). Tenant shall pay to Landlord the adjusted Rent within five (5) days after receipt of a bill from Landlord for the adjusted Rent amount. Landlord reserves the right to charge Tenant as additional rent Landlord's costs arising out of this Lease, including without limitation the cost of enforcing the provisions of this Lease.

3. Late Charge. Tenant must pay the Rent by the first day of each September. If the Rent is not received by Landlord within ten (10) days after the Rent is due, Tenant must pay an additional charge equal to five percent (5%) of the overdue Rent.

4. Condition of Land. Tenant has inspected the Land before signing this Lease. Tenant accepts the Land "AS IS" on the day Tenant signs this Lease. Landlord has made no promises or representations to Tenant concerning the condition of the Land.

5. Maintenance and Repair; Ownership of Buildings and Structures. Tenant owns and is solely responsible for all buildings and other structures on the Land. Tenant agrees to maintain in good condition all buildings and structures on the Land, including without limitation all sheds, outhouses, decks, fences, driveways, piers, bulkheads and all other improvements ("Tenant's Improvements"). At the expiration or earlier termination of this Lease, Tenant will leave the Land in at least as good condition as when this Lease began, except for normal wear and tear.

6. Non-Interference. Landlord may use the Land to operate Landlord's facilities, including without limitation Conowingo Hydro-Electric Station, Muddy Run Pumped Storage Facility and Peach

Bottom Generating Station (the "Project"). Tenant understands that efficient and economical operation of the Project is the main purpose of Landlord's use of its property including the Land. Tenant understands that the Landlord's operation of the Project may limit Tenant's use of the Land from time to time. Regardless of what else this Lease says, Tenant will not interfere with Landlord's use of the Land or the use of the Land by Landlord or its affiliates for the Project. Tenant waives or gives up any rights to file a lawsuit against Landlord or its affiliates for anything relating to the maintenance, operation or new construction of the Project or the use of the Land for Landlord's corporate purposes.

7. <u>Landlord Reservations</u>. Landlord may grant easements (the right to use parts of the Land) over any part of the Land to others for any purpose, such as (a) roads and/or highways; (b) utility lines, either underground or overhead. All standing timber on the Land shall remain the property of Landlord. Tenant may not cut, remove or destroy any timber nor remove any rock, stone, gravel, soil or other material from the Land.

8. <u>Rules and Regulations</u>. Tenant's use of the Land is subject to Landlord's rules and regulations, a copy of which is attached hereto as Exhibit B as they may be amended from time to time (the "Rules and Regulations"). Landlord shall provide Tenant with copies of all changes in the Rules and Regulations as they occur. FAILURE TO COMPLY WITH ANY OF THE RULES AND REGULATIONS WILL BE CONSIDERED A VIOLATION OF THE TERMS AND CONDITIONS OF THIS LEASE AGREEMENT AND MAY RESULT IN A FEE OF UP TO $250.00 PER DAY IMPOSED AGAINST TENANT BY LANDLORD AND/OR TERMINATION OF THE LEASE. In addition to Landlord's right and option to assess fees against Tenant and to terminate the Lease, Landlord has the right but not the duty to enter the Land and cure any violation of the Rules and Regulations or other terms and conditions of this Lease, and to assess all costs incurred by Landlord as a result of curing any such violation(s) against Tenant.

9. <u>Use of Land</u>. Tenant shall use the Land only for a vacation retreat and recreational activities. Tenant shall <u>not</u>:

(a) USE OR OCCUPY THE LAND AS A PRIMARY PERMANENT RESIDENCE.

(b) Construct or install any new buildings, structures or other improvements on the Land or enlarge any buildings, structures or improvements, without the prior written consent of Landlord in accordance with the procedures set forth in the Rules and Regulations.

(c) Dispose of or store any toxic or hazardous substances, including but not limited to hazardous waste, on the Land.

(d) Disturb other tenants of Landlord.

(e) Interfere with the Landlord's use of the properties surrounding the Land.

(f) Dispose or store any flammable, explosive or hazardous materials on the Land.

(g) Engage in any commercial activities, including without limitation operating or leasing campgrounds or dock facilities.

10. <u>No Representations</u>. Tenant agrees that:

(a) Landlord makes no promises about the condition of the Land.

(b) Landlord is not required to make any repairs or alterations to the Land either now or in the future.

(c) Landlord is not required to maintain the Land, the surrounding property, or the improvements, building or structures on the Land.

(d) Landlord is not required to provide any utility service to the Land, such as telephone, electricity, heat, water, gas, sewer or trash removal, regardless of whether such services exist at the time the Tenant signs this Lease.

11. Access. Tenant is responsible for acquiring and maintaining access to the Land. Landlord has no responsibility for providing, maintaining or improving access.

12. Inspection of Premises. Landlord, its employees and representatives may inspect the Land at any time without providing Tenant with notice.

13. Taxes. Landlord will pay real estate taxes on the Land, including Tenant's Improvements, unless real estate taxes on Tenant's Improvements are separately assessed and billed directly to Tenant. Landlord will send Tenant a bill for the real estate taxes and Tenant will reimburse Landlord for the real estate taxes as additional rent within thirty (30) days after the date of the bill.

14. No Waiver. Landlord is not required to enforce this Lease. If Landlord does not enforce a part of this Lease, this does not mean Landlord cannot enforce the same part, or a different part, later. The payment of Rent by Tenant after Tenant violates this Lease does not mean that the violation of this Lease is forgiven.

15. Compliance with Laws. Tenant agrees to comply at its expense with all Federal, state and local laws that apply to Tenant's Improvements or Tenant's use of the Land. It is Tenant's responsibility to be aware of all laws that apply to the Land.

16. Indemnification. Tenant assumes responsibility for any action by Tenant, Tenant's contractors, representatives or guests on or near the Land. If a claim is made against Landlord because of something that Tenant, its contractors, representatives or guests do on the Land, Tenant shall pay all of Landlord's costs and expenses which occur because of the claim (including Landlord's attorney's fees). If Landlord pays any money in order to settle or defend the claim, Tenant shall pay Landlord the amount that Landlord paid.

17. Insurance. (a) Tenant will be solely responsible for purchasing insurance to cover damage or theft of the Tenant's Improvements and personal property located on the Land. Tenant assumes responsibility for any action by Tenant, Tenant's contractors, representatives or guests which violates the Tenant's insurance policy.

(b) In addition to the indemnifications contained in Paragraph 16, but not in limitation thereof, Tenant agrees to carry and maintain Liability Insurance providing bodily injury and property damage with a limit of not less than One Million Dollars ($1,000,000) per occurrence with an insurance company or companies acceptable to Landlord. Tenant shall furnish Landlord with evidence of such insurance in the form of a certificate of insurance. The certificate shall name Landlord as an additional insured, and provide for a waiver of all rights of subrogation which Tenant's insurance carrier may have against Landlord.

18. Waiver of All Claims. Tenant understands and recognizes that, by signing this Lease, Tenant waives any and all claims against Landlord relating to the Land, Tenant's Improvements or personal property thereon or any previous leases of the Land. This includes, but is not limited to, claims for lost value of Tenant's property; lost use of the Land; or, loss, removal or destruction of Tenant's Improvements or personal property. Tenant further waives any claims for damages grounded upon an expectation of future gain, restitution or unjust enrichment.

19. Default. Tenant shall be in default under this Lease, if any of the following occur (each an "Event of Default"):

(a) Tenant does not pay the Rent, additional rent or other amounts Tenant is required to pay under this Lease when it is due and fails to make payment to Landlord of the overdue Rent within five (5) days written notice from Landlord;

SAMPLE

(b) Tenant violates any part of this Lease or the Rules and Regulations and fails to cure such violation within thirty (30) days after receipt of notice from Landlord to cure such violation;

(c) Tenant has not used or occupied the Land for more than twelve (12) consecutive months;

(d) Tenant becomes insolvent or files for bankruptcy; or

(e) Tenant's rights to the Land are sold under execution or other legal process.

After the expiration of applicable cure periods, Landlord shall have the right to terminate this Lease by sending written notice to Tenant. If Landlord does not immediately terminate the Lease after Tenant violates this Lease, Landlord can terminate the Lease at a later date.

20. Removal of the Tenant's Property. Prior to the expiration of this Lease or within ninety (90) days after the earlier termination of this Lease due to an Event of Default or otherwise, Tenant shall remove all of Tenant's Improvements and personal property, including trailers, mobile homes and personal belongings, owned by Tenant and restore the Land to a condition satisfactory to Landlord, unless Landlord has previously approved the sale of the Tenant's Improvements in accordance with the Rules and Regulations and has issued a new lease to the purchaser of the Tenant's Improvements. In the event Tenant fails to remove the Tenant's Improvements and personal property prior to the expiration of this Lease or within ninety (90) days after the earlier termination of this Lease, then the Tenant's Improvements and personal shall become the property of Landlord without any further act or notice by Landlord to Tenant. Landlord may thereafter occupy, sell, lease, repair or remove Tenant's Improvements and personal property. However, in the event Landlord elects to remove Tenant's Improvements and personal property, Tenant agrees to pay Landlord the cost incurred by Landlord for such removal within thirty (30) days of receipt of a bill from Landlord.

21. Notices. All notices under this Lease, shall be deemed to have been properly given only when written notice has been served by (i) personal delivery, (ii) by certified mail, return receipt requested, or (iii) by recognized overnight carrier, to the other party at its address as follows:

If to Landlord:

300 Exelon Way
Kennett Square, PA 19348
Attn: Cottage Project Leasing Manager

If to Tenant:

If a notice sent to Tenant by certified mail is not accepted by Tenant, Landlord may post the notice at the Land.

22. Brokerage Commissions. There are no commissions or fees to be paid to any real estate broker or salesperson for this Lease. If Tenant has agreed to pay any commission or fee to a real estate broker, Tenant will pay that commission or fee. If Landlord has agreed to pay any commission or fee to a real estate broker, the Landlord will pay that commission or fee.

23. Federal Energy Regulatory Commission ("FERC"). The Land is part of a project licensed by the Federal Energy Regulatory Commission (FERC). Because of the FERC License the following requirements apply:

(a) Tenant's use of the Land will not endanger health, create a nuisance or otherwise be incompatible with the recreational use on any part of Landlord's land. Tenant will take all reasonable precautions to ensure that the use and maintenance of the Land will protect the scenic, cultural, recreational and environmental value of the Land.

(b) Landlord may terminate this Lease if Landlord's License from FERC is terminated. If Landlord terminates the Lease for this reason, Landlord will give Tenant thirty (30) days notice before the termination date.

24. Floods. Tenant waives or gives up any claims against Landlord for flooding by water or the presence or flow of ice on the Susquehanna River or any of its tributaries.

25. Severability. If any part of this Lease is not legal for any reason, the rest of this Lease shall continue to be valid and enforceable.

26. Governing Law. This Lease is made in the laws of the Commonwealth of Pennsylvania.

27. Legal Action. A lawsuit regarding this Lease may only be filed in the county where the Land is located, or in the United State District Court in the state in which the Land is located and in the division closest in proximity to the Land. BOTH PARTIES ALSO WAIVE THEIR RIGHT TO A TRIAL BY JURY IF A LAWSUIT IS FILED REGARDING THIS LEASE AGREEMENT. Tenant shall pay Landlord all of its costs and expenses, including without limitation attorneys' fees, incurred by Landlord in enforcing Tenant's obligations under this Lease whether or not Landlord files a lawsuit against Tenant.

28. No Assignment. Tenant shall not assign, sublease or otherwise transfer or encumber this Lease without the prior written consent of Landlord. Tenant shall make all requests for Landlord's consent to assignment in accordance with the Rules and Regulations. Any assignment without the prior written request of Landlord shall be null and void.

29. Entire Agreement. This Lease replaces and cancels all other leases between Landlord and Tenant for the Land. Tenant understands the promises in this Lease shall be binding upon Tenant. This Lease contains the full and complete agreement between Tenant and Landlord. Any change, modification or waiver of the promises in this Lease may only be made by a written agreement signed by Landlord and Tenant. No promises were made by Landlord to Tenant other than those promises contained in this Lease.

EXECUTED BY THE PARTIES ON THE NEXT PAGE

SAMPLE

Landlord and Tenant, intending to be legally bound, agree to the terms of this Lease effective as of the Effective Date.

Sealed and delivered
in the presence of:

TENANT:

____
As to the Tenant

______________________________(SEAL)

____
As to the Tenant

______________________________(SEAL)

LANDLORD:

EXELON GENERATION COMPANY, LLC

BY:______________________________

File No. ______________
Initials _______-

SAMPLE

EXHIBIT A

Site Plan

RULES AND REGULATIONS - MARYLAND

I. GENERAL CONDITIONS

A. General Information

All questions, complaints, and requests for applications should be directed to:

Exelon Generation Company, LLC ("Landlord")
300 Exelon Way
Kennett Square, PA 19348
Attn: Conowingo Project Leasing Manager
Telephone: 610-765-5505

B. General Conduct

1. Tenant shall use the leased premises only for a vacation retreat and recreational activities. Tenant shall not use or occupy the leased premises as a primary permanent residence. Landlord has the right to verify Tenant's permanent address, including but not limited to requiring Tenant to provide acceptable proof of domicile.

2. All of the conduct required of the Tenant shall be required of Tenant's guests, and Tenant shall ensure that such guests adhere strictly to these Rules and Regulations. Tenants are responsible for the actions of their guests.

3. Tenant shall not permit any noise, or other nuisance to interfere with the quiet enjoyment of other tenants' use of their properties.

4. Tenant shall not cause or allow un-permitted or uncontrolled fires. No open fires are permitted except in properly constructed barbecue pits and any burning must comply with all federal, state and local laws, rules, regulations and ordinances ("applicable regulations"). No open burning of leaves or other vegetation debris is permitted.

5. A six (6) digit Cottage Identification Number (CIN) will be assigned to each Tenant and is to be placed on the outside wall of the cottage facing the water, and must be visible from the water. If the cottage is accessible from a road or fronts on a road, the CIN must also be placed on the side of the cottage facing the road. Under the CIN, the Tenant must also post an emergency response telephone number and address. All posted characters must be at least 4 inches in height, with numbers treated with a reflective material in a color contrasting with the sign background.

6. All dogs must be kept securely tied or on a leash at all times.

7. Immediately upon discovery, Tenant must report any potentially hazardous condition to the Landlord and, as required by law, to the appropriate state and local authority or agency.

8. Tenant shall be responsible for the correction and/or control of any erosion caused by or resulting from improvements, and/or changes made to, or on the leased premises. Landlord may require Tenant to rectify any erosion problems on or affecting the leased premises. However, Landlord has no duty to Tenant to correct any naturally occurring erosion problems.

9. The Rules and Regulations contained herein are not intended to substitute for or absolve Tenant of his or her legal responsibility to comply with all applicable federal, state, and local laws. In a situation where the Rules and Regulations contained herein are in conflict with, or are less restrictive than, the applicable federal, state, or local law, the more restrictive statute, rule, regulation, or ordinance shall apply.

II. IMPROVEMENTS

A. Removal of Improvements

1. In these Rules and Regulations, "improvements" shall mean and include all dwellings, fixtures, outhouses, sheds, decks, buildings, roads, driveways, bridges and Shoreline Improvements (defined in Section VII) and any other artificial structures or material constructed by or placed on the leased premises by the Tenant or any former tenant, whether or not said improvement is affixed in any manner to the land.

2. All improvements shall remain the personal property of the Tenant at all times and shall be removed by the Tenant upon the termination of the Tenant's lease, unless Landlord has approved the transfer to a new tenant. Tenant is responsible for any and all costs incurred by Landlord should Landlord elect to remove Tenant's improvements after the termination of Tenant's lease.

B. Construction or Demolition

1. Landlord is not responsible for constructing, maintaining, repairing, reconstructing or demolishing Tenant's improvements. Should Tenant wish to construct any new improvement, to demolish an existing improvement, or to renovate, alter or replace an existing improvement in a manner that requires a local, state or federal permit ("construction"), a Construction Application must be

submitted (with all appropriate attachments) and all required fees paid to Landlord prior to applying for any applicable building permits or to beginning any such construction. Tenant must be in compliance with the terms of the Lease, including but not limited to being current with any Rent or other sums due and payable, prior to submitting a Construction Application. Applications must contain a list of all applicable licenses and permits which Tenant must obtain by law prior to beginning any work and a survey or drawing showing the proposed improvement. A Construction Application form is attached hereto as Attachment 1. Tenant is responsible for determining which federal, state, and/or local laws apply to their proposed construction or demolition activities and to contact the applicable government or agency as required by said laws.

2. Applications will be reviewed by Landlord for compliance with the terms and conditions of the Tenant's lease. If the application is acceptable to Landlord, Landlord shall issue to Tenant a preliminary approval in writing. If the Application is denied, Landlord will give Tenant written notice of the items that are not in compliance and an opportunity to cure in accordance with the terms of Tenant's lease.

3. Within 90 days after Landlord's preliminary approval of the Application and prior to beginning any work, Tenant must obtain all permits and licenses required by federal, state and local law ("applicable permits") and provide copies of all such permits and licenses to Landlord.

4. Upon receipt of the applicable permits and licenses for the work approved by Landlord, Landlord shall issue written final approval of the Construction Application to the Tenant.

5. The final approval issued by Landlord expires one (1) year from the date of issuance. If the approved construction is not completed on or before the expiration date, the Tenant must resubmit a Construction Application to the Landlord.

6. Setback regulations are variable based upon site conditions, and are governed by local regulations. Landlord's approval is contingent upon compliance with setback requirements and all other applicable laws and regulations.

7. Within thirty (30) days of completion of the approved construction, Tenant must submit photographs of the completed work to Landlord.

8. Tenant must notify Landlord in writing anytime a building or other improvement is to be razed or removed. Within ninety (90) days

after the improvement is razed or removed, the area must be restored to a condition satisfactory to Landlord, which restorations shall include but are not limited to establishing the appropriate vegetative cover.

C. Maintenance

1. Tenant must maintain the leased premises and all improvements thereon in good repair and appearance at all times. Should Landlord determine that the leased premises is not in a state of good repair and appearance, Landlord may require a Tenant to perform all reasonable and necessary repairs and maintenance, including but not limited to painting and removal of any and all junk, trash, debris, or other items determined by Landlord to constitute a nuisance.

2. Improvements shall not present a hazard to the health or safety of any Tenant or other persons or property or to the environment.

3. Landlord may require Tenant to correct, at Tenant's sole expense, any conditions that Landlord determines to be potentially hazardous, harmful to the environment, or in violation of these Rules and Regulations.

4. All chimneys must be fireproof and constructed of tile, brick, stone, or other approved material, equipped with spark arresters, and must otherwise comply with all applicable code specifications. Tenant must install and maintain in good working condition at least one smoke detector in each dwelling on the leased premises.

D. Sale of Improvements and Lease Transfer Application

1. Tenant may not transfer Tenant's interest in Tenant's lease without the prior written approval of Landlord. At least forty-five (45) days prior to settlement on the sale of Tenant's improvements, Tenant and the proposed transferee shall submit a Lease Transfer Application to Landlord. Lease Transfer Applications must include a code compliance report, a Use & Occupancy Certificate from the appropriate county or municipal corporation in which the leased premises is located (or alternative vendor inspection report and Sanitary System certification as set forth in the Lease Transfer Application), a copy of the agreement of sale of the improvements, and payment of applicable fees. A Lease Transfer Application form is attached as Attachment 2. If the transfer is approved, Landlord will require the purchaser of the improvements to enter into a new lease of the leased premises substantially in the form attached hereto as Attachment 3. Tenant must be in compliance with the terms of the Tenant's lease, including but not limited to

being current in the payment of Rent or other sums due and payable, prior to submitting a Lease Transfer Application. Landlord reserves the right to deny the Lease Transfer Application if Landlord determines the proposed transferee is not financially or otherwise qualified.

2. If the Lease Transfer Application is approved, Landlord shall issue a new Lease Agreement prior to the settlement date, which shall be properly executed by the proposed transferee at settlement and returned to Landlord for Landlord's execution, along with a copy of a valid Bill of Sale for the improvements, and a termination of the existing Tenant's lease executed by Tenant. Landlord will then forward to the new tenant a fully executed copy of the new Lease Agreement and these Rules and Regulations.

3. If the Lease Transfer Application is denied, Landlord will give Tenant written notice of the reason for the denial and an opportunity to cure in accordance with the terms of Tenant's lease.

4. All Sales Agreements for the improvements must contain a statement that only the Tenant's improvements are being sold and that neither land, nor water rights are included in the sale, and that Landlord has no responsibility for providing, maintaining or improving access to the leased premises. Bills of Sale must contain the same statement.

5. Installment Sales Agreements or Lease Purchase Agreements that are intended to give possession of the cottage to the buyer while the current Tenant (seller) holds the existing lease are not permitted.

6. Proposed transfers to remove or add a co-tenant shall be subject to Landlord's approval in accordance with the procedures in this Section II (D).

III. ROADS AND BRIDGES

A. Construction or Alteration of Roads, Driveways and Bridges

1. Written permission is required from Landlord for the construction or alteration of roads, driveways, or bridges in accordance with the procedures set forth in Section II (B) above. A survey and/or drawing showing the location of the road, driveway or bridge must accompany the Construction Application submitted to Landlord.

2. In addition to obtaining written permission from the Landlord, Tenant must obtain all federal, state and local permits, where

required, before constructing or altering any road, driveway or bridge.

B. Maintenance

1. Tenant must maintain roads, driveways or bridges on the leased premises in good condition, and provide proper drainage in accordance with Landlord's specifications.

2. Tenant is responsible for its proportionate share of the cost of maintenance and general upkeep of non-public roads and bridges used in common with other cottage owners.

3. Tenant is prohibited from blocking or otherwise limiting access to any roads, driveways or bridges located on the leased premises or any other property owned by Landlord.

4. Should Tenant fail to perform its maintenance obligations under these Rules and Regulations, Landlord, after notice to Tenant, may in its sole discretion, (i) perform such maintenance and charge Tenant for its share of the cost, or (ii) prohibit the use of the road, driveway or bridge in need of repair. Landlord shall have no obligation to repair or maintain such roads, driveways or bridges.

IV. TREES & PLANTS

1. No trees or ornamental shrubs shall be injured or damaged, by Tenants or their guests. The attaching of lights, electric lines, clotheslines, docks, or any other item to any tree or shrub, either on a temporary or permanent basis, is prohibited. Care must be taken during any construction activities to prevent injuring trees or ornamental shrubs, and if necessary, temporary protective shields shall be installed around the trees or shrubs.

2. Tenant shall not remove any tree or shrub over two (2) inches in diameter without prior written permission of Landlord. If a tenant desires to trim, cut or remove significant portions of a tree, they must first obtain written permission from Landlord.

3. Requests for tree or shrub removals can only be made by the current Tenant.

4. Tenant is responsible for correcting hazardous tree conditions on or adjoining the leased premises. Landlord may notify in writing the Tenant of any trees that Landlord believes should be removed. It will be the responsibility of the Tenant to have such trees removed. If such trees are not removed within the specified time period,

Landlord at its option my terminate the Tenant’s lease and/or remove the tree at the Tenant's expense.

5. Tenant shall not introduce any invasive plant species or noxious weeds onto the leased premises, on any of Landlord’s properties, or within or upon any waters of the State and is responsible for removing any such growth from the leased premises.

V. WATER

1. All leased premises must be served by an approved potable water source, which could include a permitted well or bottled water.

2. Tenant must obtain all applicable permits for existing or future wells prior to use. Wells may not be shared by more than 4 cottages or 24 occupants. All unpermitted or prohibited wells must be abandoned in accordance with applicable regulations.

3. The use of river, creek or spring water for human consumption is prohibited and such water sources may not be attached to pressurized plumbing. Human consumption includes drinking, bathing or showering, cooking, dish washing and oral hygiene.

4. River, creek or spring water may be used for purposes other than human consumption, provided it is not attached to pressurized plumbing and that Tenant obtains all applicable permits prior to its use.

5. Tenant shall take all reasonable measures to limit the use of water. Accordingly, swimming pools, hot tubs and spas, whether above or below ground, temporary or permanent, are prohibited.

6. All use of water by Tenant, in and about the leased premises, shall be at the sole risk of Tenant. Landlord has not performed any water potability tests and makes no representations with regard to the suitability of the water for domestic purposes. Tenant is responsible for performing any applicable potability testing or other water analysis and permitting. All costs incurred in connection with such testing and permitting shall be the responsibility of the Tenant. Landlord assumes no liability for, or on account of, any water used in any manner by Tenant or Tenant’s guests.

7. No exclusive rights are given or inferred as being given as to the use of any water or spring, even though a spring may be located on the leased premises.

8. Construction or drilling of a new well or other water source is subject to the prior approval of Landlord in accordance with the

procedures set forth in Section II (B) above, including without limitation the obligation to obtain applicable permits prior to construction.

VI. SANITARY SYSTEM REQUIREMENTS

1. All leased premises must be served by an approved sanitary system, which may be a septic system, holding tank, sealed pit privy, incinerator toilet, composting toilet or chemical toilet (temporary only) ("Sanitary System"). Before beginning the construction, installation or alteration of any Sanitary System, Tenant shall comply with the procedures set forth in Section II (B) above, including the obligation to obtain all applicable permits.

2. In the event an approved and permitted Sanitary System does not exist on the leased premises, Tenant must provide the site with a Sanitary System in compliance with all applicable regulations and these Rules and Regulations. No Sanitary System shall be located closer than one hundred (100) feet of any spring, stream, or other water supply source (except as otherwise permitted by applicable regulations).

3. Subject to Landlord's prior approval, sealed pit privies, holding tanks, composting toilets, incinerator toilets and chemical toilets are permitted. Tenant must enter into a written maintenance agreement with Landlord and Harford County and obtain all applicable permits prior to installing such systems.

4. Gray water must be collected and disposed of in an approved, permitted wastewater disposal system. Tenant must enter into a written maintenance agreement with Landlord and Harford County and obtain all applicable permits prior to installing such systems.

5. In the event a public sanitary sewer system is installed in the area, Tenant shall be required to connect into the system, whereupon Tenant shall be responsible for all connection, maintenance, and operation fees or costs.

6. All garbage, trash or refuse must be removed from the leased premises every seven (7) days. In the interim, all garbage, trash and refuse must be kept in a closed container intended for the temporary storage of garbage, trash or refuse secure from flies, rats or other insect or animal intrusion and maintained in a good and sanitary condition in compliance with applicable regulations.

7. All Sanitary Systems and gray water systems must be maintained at all times in good working order and sanitary condition and in compliance with all applicable regulations and any applicable

holding tank agreement or sealed pit privy agreement. Tenant shall be responsible for the annual winterization of all water source, sanitary, and gray water systems. EFFECTIVE 2012, TENANT SHALL PROVIDE LANDLORD WITH A CERTIFICATION THAT ALL SANITARY AND GRAY WATER SYSTEMS ARE IN GOOD WORKING ORDER IN ACCORDANCE WITH APPLICABLE REGULATIONS, AND THAT TENANT IS NOT IN DEFAULT UNDER ANY SEWAGE PUMPING AGREEMENT OR HOLDING TANK AGREEMENT, BY A CERTIFIED VENDOR REASONABLY ACCEPTABLE TO LANDLORD ON OR BEFORE NOVEMBER 1 ANNUALLY.

VII. SHORELINE PROTECTION PROGRAM

A. Application Procedures

1. The "shoreline" is considered to be the existing shoreline at mean high water.

2. Prior to the construction or repair of a pier, dock, boathouse, boat ramp, marine railway, bulkhead, retaining wall, or sea wall ("Shoreline Improvements") or the installation of any erosion control measures or excavation in any areas that may affect the shoreline, Tenant, must submit a Construction Application to Landlord in accordance with Section II (B) of these Rules and Regulations. Landlord will make an on-site inspection of the area to determine if what the applicant has proposed should be allowed or if another type of measure may be more appropriate. No construction may begin until the Tenant has received Landlord's written Approval and obtained all required local, state and federal permits and authorizations, including but not limited to all permits required by the Maryland Department of the Environment, and the U.S. Army Corps of Engineers.

B. Specifications and Procedures

In addition to the applicable local, state and federal laws, and all requirements set forth by the applicable permitting authorities, the following specifications shall apply. Should any specification herein conflict with any applicable local, state, or federal law or regulation, the most restrictive requirement shall apply.

1. Piers or Docks

a. Piers may be permanent, floating, or a combination of both and may not exceed a total length of fifty (50) feet (or extend more than fifty (50) feet from the shoreline). If the pier is located in a cove or in a stream, the length may not exceed

25% (1/4) of the width of the cove or stream where the pier is located.

b. All permanent piers (or permanent sections of piers) must be built above the mean high water line.

c. Piers must be constructed of preservative treated lumber and pilings. Concrete, masonry, and metal construction is not permitted. Hand railings and covers on piers are permitted provided that the sides are open so as not to obscure cross vision. Covers are permitted only over the pier itself and may not extend out over the water.

d. Flotation devices for floating piers must be constructed of environmentally sound material as approved by Landlord and permitting authorities. Styrofoam, barrels or similar flotation devices are not permitted.

e. Piers may not interfere with navigation, present a safety hazard, or block ingress or egress to adjoining areas.

f. If an existing pier must be replaced or repaired (other than minor repairs), it must conform to current standards.

g. Piers may not be anchored or tied to trees at any time.

2. Boat Ramps and Marine Railways

a. Ramps must be constructed of poured concrete pads or precast concrete panels properly anchored and fastened together. Asphalt or other petroleum-based products are prohibited.

b. Ramps may not exceed fifteen (15) feet in width and thirty (30) feet in length. The length should not exceed that necessary to be functional.

c. Marine railways may use either treated wood or concrete ties.

d. Marine railways may not exceed fifteen (15) feet in width and should be no longer than necessary to be functional. Landlord may, however, restrict the length because of site conditions.

3. Erosion Control Measures (Bulkheads, Retaining Walls, Sea Walls, Rip Rap, etc.)

a. No erosion control measure shall significantly alter the existing shoreline.

b. The planting of vegetative cover and/or rip-rapping shall be used if adequate to control the problem.

c. Bulkheads and retaining walls must be constructed of preservative treated wood, concrete, or masonry.

d. The structure shall not significantly detract from the scenic value of the area.

C. Landlord assumes no liability for injury or damage in the construction, use or removal of any Shoreline Improvement made by the current or any former Tenant.

VIII. COMPLIANCE; AMENDMENTS

In the event of Tenant's failure to comply with these Rules and Regulations, Landlord may impose a fee on Tenant of up to $250 per day until such failure is cured, which fees shall be due and payable within ten (10) days after Tenant receives a bill for the same and/or terminate Tenant's lease in accordance with its terms. Landlord shall have the right to amend these Rules and Regulations at any time as Landlord deems reasonably necessary.

IX. CULTURAL RESOURCE PROTECTION GUIDELINES

Landlord has developed, in cooperation with the Pennsylvania Bureau of Historic Preservation and the Maryland Geological Survey, Division of Archeology, the following rules and regulations. The specific intent of these guidelines is to provide for the protection of cultural resources, and to avoid any disturbance of historic and prehistoric sites except when justified for scientific purposes and/or when performed in accordance with such State and Federal regulations and guidelines as may apply.

A. No one shall mar, deface, remove, destroy or in any other way damage, any standing structure, ruins, foundation or other man-made feature of a potentially historic nature on lands of Landlord, without first having obtained the written permission of Landlord.

B. No one shall perform any sub-surface archaeological investigations, or in any way disturb the soil for the purpose of searching for and/or obtaining historic or prehistoric artifacts on land of Landlord without having first obtained the written permission of Landlord, nor shall same be performed without the prior knowledge and written sanction of the following:

In Maryland: The State Historic Preservation Officer and/or the Geological Survey, Division of Archeology

C. Full and complete reports must be prepared. Said reports shall incorporate maps, site profiles, descriptions and photographs of artifacts and features, soil descriptions, topography, excavation procedures, directions and distance to the nearest water and all such other related details as may be required.

D. Landlord shall be supplied with a copy of each report so generated. The appropriate State agency shall be supplied with two copies of same, one of which shall contain original photographs.

E. All artifacts and related material recovered in sub-surface investigations shall become the property of Landlord, and shall be turned over to the respective State agency. Same shall remain available to Landlord and other responsible public and private organizations and agencies for the purpose of study and/or public display.

F. All artifacts must be properly labeled with site number and lot and must be readily identifiable by pit and level. Site numbers must conform to the trinomial numbering system adopted by both Pennsylvania and Maryland.

G. All burials encountered during the course of such archeological investigations shall be treated with the highest respect, and shall be handled on a case by case basis under the strict control of the State agency having jurisdiction. It is the policy of said agencies and of Landlord, to discourage the removal or disturbance of human remains, unless there is a significant scientific purpose to be served by same, and unless provisions are made, in consultation with, and with the approval of living descendants of the interred, for the timely study and the ultimate reburial of the remains.

H. While the collection of artifacts from the surface is widespread, and though not strictly prohibited under these regulations, it does have a significantly negative effect on archeological sites. The distribution of surface artifacts is the only information available for many sites. Those finding artifacts are therefore encouraged to report finds to Landlord so that same might be photographed and recorded.

I. Tenant is required to consult with the appropriate State Preservation Office prior to any construction work that may affect surface or sub-surface archaeological sites, and prior to new additions to existing structures or the construction of new structures.

J. On property which is within the boundaries of Federally-regulated projects such as the Conowingo Hydro-Electric Project (F.E.R.C. No. 405), Tenants' properties require additional precautions regarding cultural resources under the provisions of the National Historic Preservation Act of

1978 (section 106), Executive Order 11593, and the regulations of the Advisory Council on Historic Preservation (36 CFR 800).

X. CONTACT INFORMATION

DISCLAIMER: The following list is intended as a reference to the Tenant for contacting the municipalities or agencies that may require permits or approvals for specified construction activities. The list is not intended to be an exclusive list and Landlord makes no guarantees or warranties as to the accuracy of the information contained herein below. Tenant is responsible for determining which federal, state, and/or local laws apply to their proposed construction activities and to contact the applicable government or agency as required by said laws.

Maryland

River Basin Permit Section
Baltimore District
U.S. Army Corps of Engineers
P.O. Box 1715
Baltimore, MD 21203

Water Resources Administration
Maryland Department of Natural Resources
Tawes State Office Building
Annapolis, MD 21401

State Administrator of Archeology
Maryland Historical Trust
Shaw House
21 State Circle
Annapolis, MD 21401

Department of Planning and Zoning
Harford County, Maryland
220 S. Main Street
Bel Air, MD 21014

Office of Planning and Economic Development
Cecil County, Maryland
Room 300, Court House
Elkton, MD 21921

Department of Inspections, Licenses and Permits
Harford County, Maryland
220 S. Main Street
Bel Air, MD 21014
410.638.3344
http://www.harfordcountymd.gov/dilp/

Cecil County Dept of Permits & Inspections
200 Chesapeake Blvd., Suite 2200
Elkton, MD. 21921
Office: 410.996.5235
http://www.ccgov.org/dept_permits/

Port Deposit
64 South Main Street
Port Deposit, MD 21904
Administration: 410-378-2121

Updated 6/21/11

ATTACHMENT 1

CONSTRUCTION APPLICATION

Tenant Information **Application Date:** ___________

Name:____ C.I.N. ______________
Address:____
City:_________________________________ State:_______________ Zip:__________
Home Phone:________________________ Office Phone:_________________________

Authorization Requested For (check appropriate items)

Addition to Cottage ________	Deck ________	Boat Ramp _______
Outbuilding ______________	Well ________	Bulkhead _________
Fence ___________________	Road ________	Riprap ___________
Parking Area ______________	Pier _________	Boathouse ________

New Construction (specify) ____
Removal or demolition of ____
Other (specify) ____

Procedure

1) Tenant must obtain written preliminary approval from Exelon prior to applying for local, state or federal building permits. A plan or sketch of the proposed construction, demolition or modification must be attached and shall include the following information: a) Dimensions of the structure(s); b) Construction materials; c) Location of the structure(s); and current photos of the existing cottage front, rear and shoreline (if applicable).
2) If Exelon denies this application, Exelon shall give Tenant written notice of the reasons for the denial.
3) Within 90 days after receipt of the preliminary approval, Tenant must submit to Exelon copies of the building permits issued by the appropriate local, state or federal authority.
4) Upon receipt of copies of the building permits, Exelon will issue a written approval of this application.
5) **No work can be started until Exelon issues its written approval of this application.**
6) Failure to comply with this procedure may result in a fee of up to $250 per day and/or termination of the Tenant's Lease in accordance with the Rules and Regulations.

Preparation Fee: Please submit a check in the amount of $250.00 with this application made payable to: Exelon Generation Company, LLC.

Please submit this application to: **Exelon Generation Company, LLC**
300 Exelon Way
Kennett Square, PA 19348
Attn: Conowingo Project Leasing Manager

PLEASE DIRECT QUESTIONS TO (610) 765-5505 (Conowingo Project Leasing Manager)

EXELON USE ONLY

Reviewed (I) __________ APPROVED __________________________ ____________
(F) __________ DATE
Fee Rec'd (C) __________

ATTACHMENT 2

LEASE TRANSFER APPLICATION

This application must be submitted to Exelon Generation Company, LLC at least forty-five (45) days prior to the date of settlement.

PRESENT TENANT INFORMATION **APPLICATION DATE:** ___________________
Name: _____________________________________ CIN: _______________
Address: ____
City: ________________________ State: _____________ Zip: ________________________________
Home Phone: _____________________ Office Phone:_____________________________________

NEW TENANT INFORMATION
Name (as it should appear on Lease): ____
____
Address: ____
City: ________________________ State: ____________ Zip: __________________________________
Home Phone: _________________________ Office Phone: ________________________
Social Security:________________________
SETTLEMENT DATE: __________________ **PURCHASE PRICE:** ___________________

Please submit this Request to: **Exelon Generation Company, LLC**
300 Exelon Way
Kennett Square, PA 19348
Attn: Conowingo Project Leasing Manager

TO BE SUBMITTED WITH THIS APPLICATION:

1. An application fee in the amount of $250 by check made payable to Exelon Generation Company, LLC.
2. A code compliance inspection report and a use & occupancy certificate from the county or municipal corporation, as applicable, in which the leased premises is located. If the county and/or municipal corporation does not require a code compliance inspection or a use and occupancy certificate, Tenant must submit a code compliance inspection report and a current certification that the Sanitary System, including without limitation any existing septic, holding tank, privy, outhouse or compost toilet, and any gray water system, are in good working order and in compliance with applicable law from one or more certified vendor reasonably acceptable to Exelon.
3. Copy of the agreement of sale for the cottage and other Tenant improvements (“improvements”).
4. At Exelon's option, a credit report on the proposed new tenant from Equifax or a similar nationally known credit reporting company.

TO BE SUBMITTED AFTER SETTLEMENT:

Within ten (10) days after settlement, the following must be submitted:

1. A "Bill of Sale" for the improvements signed by both parties.
2. Two copies of the required new lease agreement (form attached) signed by the new tenant(s) on the appropriate lines and witnessed on the line to the left of their signatures. A fully executed copy of the lease will be returned to the new tenant.
3. The new tenant will be billed at a later date for any additional rents that may be due under the new lease. **Seller must be reimbursed by Buyer for all prepaid rent and taxes.**

Failure to comply with this procedure may result in denial of the application and/or termination of the Tenant’s Lease in accordance with the Rules and Regulations.

PLEASE DIRECT ALL QUESTIONS TO (610) 765-5505 (Conowingo Project Leasing Manager).

EXELON USE ONLY

Fee received: __________________________ Date: ______________________________
Approved: ___________________________ _ Date: ______________________________
File No.: ______________________________

SAMPLE June 21, 2011

ATTACHMENT 3

FORM LEASE

LEASE

THIS LEASE AGREEMENT (this “Lease”) is made ____ day of __________________, 2010 (the “Effective Date”), by and between Exelon Generation Company, LLC (“Landlord”) and ____(“Tenant”).

BACKGROUND

A. Landlord, as successor by merger to PECO Energy Power Company, is the owner of a parcel of land located __________________ County, Maryland, identified as Lot No. __________, as outlined in red on the plan attached to this Lease as Exhibit A (the “Land”).

B. Landlord and Tenant desire to enter into a lease of the Land on the following terms and conditions.

1. Term. Unless sooner terminated in accordance with the terms of this Lease, Landlord agrees to lease the Land to Tenant for a term beginning on the Effective Date and ending on September 30th of the calendar year following the Effective Date (the “Term”). Thereafter, this Lease shall continue upon the same terms and conditions, subject to the adjustment of Rent in accordance with Paragraph 2 hereof, from year to year until terminated by either party by written notice at least thirty (30) days prior to the expiration of the then current term.

2. Payment of Rent. Tenant agrees to pay to Landlord annual rent in the amount of $_______ (“Rent”) on the first day of September, except, however, that payments of Rent may be pro-rated on a monthly basis for partial years. Tenant will send or deliver the Rent to Exelon Generation Company, LLC, 2301 Market Street, N3-3, Philadelphia, PA 19103, Attn: Real Estate & Facilities, unless Landlord notifies Tenant in writing that the Rent should be sent or delivered to another address. Except as otherwise provided herein, Landlord is not required to send Tenant a bill for the Rent, and the lack of a bill does not mean that Tenant is not required to pay Rent on or before the date set forth above. The Rent shall increase annually by the amount of three percent (3%). Tenant shall pay to Landlord the adjusted Rent within five (5) days after receipt of a bill from Landlord for the adjusted Rent amount. Landlord reserves the right to charge Tenant as additional rent Landlord’s costs arising out of this Lease, including without limitation the cost of enforcing the provisions of this Lease.

3. Late Charge. Tenant must pay the Rent by the first day of each September. If the Rent is not received by Landlord within ten (10) days after the Rent is due, Tenant must pay an additional charge equal to five percent (5%) of the overdue Rent.

4. Condition of Land. Tenant has inspected the Land before signing this Lease. Tenant accepts the Land “AS IS” on the day Tenant signs this Lease. Landlord has made no promises or representations to Tenant concerning the condition of the Land.

5. Maintenance and Repair; Ownership of Buildings and Structures. Tenant owns and is solely responsible for all buildings and other structures on the Land. Tenant agrees to maintain in good condition all buildings and structures on the Land, including without limitation all sheds, outhouses, decks, fences, driveways, piers, bulkheads and all other improvements (“Tenant’s Improvements”). At the expiration or earlier termination of this Lease, Tenant will leave the Land in at least as good condition as when this Lease began, except for normal wear and tear.

6. Non-Interference. Landlord may use the Land to operate Landlord’s facilities, including without limitation Conowingo Hydro-Electric Station, Muddy Run Pumped Storage Facility and Peach Bottom Generating Station (the “Project”). Tenant understands that efficient and economical operation of

the Project is the main purpose of Landlord's use of its property including the Land. Tenant understands that the Landlord's operation of the Project may limit Tenant's use of the Land from time to time. Regardless of what else this Lease says, Tenant will not interfere with Landlord's use of the Land or the use of the Land by Landlord or its affiliates for the Project. Tenant waives or gives up any rights to file a lawsuit against Landlord or its affiliates for anything relating to the maintenance, operation or new construction of the Project or the use of the Land for Landlord's corporate purposes.

7. Landlord Reservations. Landlord may grant easements (the right to use parts of the Land) over any part of the Land to others for any purpose, such as (a) roads and/or highways; (b) utility lines, either underground or overhead. All standing timber on the Land shall remain the property of Landlord. Tenant may not cut, remove or destroy any timber nor remove any rock, stone, gravel, soil or other material from the Land.

8. Rules and Regulations. Tenant's use of the Land is subject to Landlord's rules and regulations, a copy of which is attached hereto as Exhibit B as they may be amended from time to time (the "Rules and Regulations"). Landlord shall provide Tenant with copies of all changes in the Rules and Regulations as they occur. FAILURE TO COMPLY WITH ANY OF THE RULES AND REGULATIONS WILL BE CONSIDERED A VIOLATION OF THE TERMS AND CONDITIONS OF THIS LEASE AGREEMENT AND MAY RESULT IN A FEE OF UP TO $250.00 PER DAY IMPOSED AGAINST TENANT BY LANDLORD AND/OR TERMINATION OF THE LEASE. In addition to Landlord's right and option to assess fees against Tenant and to terminate the Lease, Landlord has the right but not the duty to enter the Land and cure any violation of the Rules and Regulations or other terms and conditions of this Lease, and to assess all costs incurred by Landlord as a result of curing any such violation(s) against Tenant.

9. Use of Land. Tenant shall use the Land only for a vacation retreat and recreational activities. Tenant shall not:

(a) USE OR OCCUPY THE LAND AS A PRIMARY PERMANENT RESIDENCE.

(b) Construct or install any new buildings, structures or other improvements on the Land or enlarge any buildings, structures or improvements, without the prior written consent of Landlord in accordance with the procedures set forth in the Rules and Regulations.

(c) Dispose of or store any toxic or hazardous substances, including but not limited to hazardous waste, on the Land.

(d) Disturb other tenants of Landlord.

(e) Interfere with the Landlord's use of the properties surrounding the Land.

(f) Dispose or store any flammable, explosive or hazardous materials on the Land.

(g) Engage in any commercial activities, including without limitation operating or leasing campgrounds or dock facilities.

10. No Representations. Tenant agrees that:

(a) Landlord makes no promises about the condition of the Land.

(b) Landlord is not required to make any repairs or alterations to the Land either now or in the future.

(c) Landlord is not required to maintain the Land, the surrounding property, or the improvements, building or structures on the Land.

(d) Landlord is not required to provide any utility service to the Land, such as telephone, electricity, heat, water, gas, sewer or trash removal, regardless of whether such services exist at the time the Tenant signs this Lease.

11. Access. Tenant is responsible for acquiring and maintaining access to the Land. Landlord has no responsibility for providing, maintaining or improving access.

12. Inspection of Premises. Landlord, its employees and representatives may inspect the Land at any time without providing Tenant with notice.

13. Taxes. Landlord will pay real estate taxes on the Land, including Tenant's Improvements, unless real estate taxes on Tenant's Improvements are separately assessed and billed directly to Tenant. Landlord will send Tenant a bill for the real estate taxes and Tenant will reimburse Landlord for the real estate taxes as additional rent within thirty (30) days after the date of the bill.

14. No Waiver. Landlord is not required to enforce this Lease. If Landlord does not enforce a part of this Lease, this does not mean Landlord cannot enforce the same part, or a different part, later. The payment of Rent by Tenant after Tenant violates this Lease does not mean that the violation of this Lease is forgiven.

15. Compliance with Laws. Tenant agrees to comply at its expense with all Federal, state and local laws that apply to Tenant's Improvements or Tenant's use of the Land. It is Tenant's responsibility to be aware of all laws that apply to the Land.

16. Indemnification. Tenant assumes responsibility for any action by Tenant, Tenant's contractors, representatives or guests on or near the Land. If a claim is made against Landlord because of something that Tenant, its contractors, representatives or guests do on the Land, Tenant shall pay all of Landlord's costs and expenses which occur because of the claim (including Landlord's attorney's fees). If Landlord pays any money in order to settle or defend the claim, Tenant shall pay Landlord the amount that Landlord paid.

17. Insurance. (a) Tenant will be solely responsible for purchasing insurance to cover damage or theft of the Tenant's Improvements and personal property located on the Land. Tenant assumes responsibility for any action by Tenant, Tenant's contractors, representatives or guests which violates the Tenant's insurance policy.

(b) In addition to the indemnifications contained in Paragraph 16, but not in limitation thereof, Tenant agrees to carry and maintain Liability Insurance providing bodily injury and property damage with a limit of not less than One Million Dollars ($1,000,000) per occurrence with an insurance company or companies acceptable to Landlord. Tenant shall furnish Landlord with evidence of such insurance in the form of a certificate of insurance. The certificate shall name Landlord as an additional insured, and provide for a waiver of all rights of subrogation which Tenant's insurance carrier may have against Landlord.

18. Waiver of All Claims. Tenant understands and recognizes that, by signing this Lease, Tenant waives any and all claims against Landlord relating to the Land, Tenant's Improvements or personal property thereon or any previous leases of the Land. This includes, but is not limited to, claims for lost value of Tenant's property; lost use of the Land; or, loss, removal or destruction of Tenant's Improvements or personal property. Tenant further waives any claims for damages grounded upon an expectation of future gain, restitution or unjust enrichment.

19. Default. Tenant shall be in default under this Lease, if any of the following occur (each an "Event of Default"):

(a) Tenant does not pay the Rent, additional rent or other amounts Tenant is required to pay under this Lease when it is due and fails to make payment to Landlord of the overdue Rent within five (5) days written notice from Landlord;

(b) Tenant violates any part of this Lease or the Rules and Regulations and fails to cure such violation within thirty (30) days after receipt of notice from Landlord to cure such violation;

(c) Tenant has not used or occupied the Land for more than twelve (12) consecutive months;

(d) Tenant becomes insolvent or files for bankruptcy; or

(e) Tenant's rights to the Land are sold under execution or other legal process.

After the expiration of applicable cure periods, Landlord shall have the right to terminate this Lease by sending written notice to Tenant. If Landlord does not immediately terminate the Lease after Tenant violates this Lease, Landlord can terminate the Lease at a later date.

20. Removal of the Tenant's Property. Prior to the expiration of this Lease or within ninety (90) days after the earlier termination of this Lease due to an Event of Default or otherwise, Tenant shall remove all of Tenant's Improvements and personal property, including trailers, mobile homes and personal belongings, owned by Tenant and restore the Land to a condition satisfactory to Landlord, unless Landlord has previously approved the sale of the Tenant's Improvements in accordance with the Rules and Regulations and has issued a new lease to the purchaser of the Tenant's Improvements. In the event Tenant fails to remove the Tenant's Improvements and personal property prior to the expiration of this Lease or within ninety (90) days after the earlier termination of this Lease, then the Tenant's Improvements and personal shall become the property of Landlord without any further act or notice by Landlord to Tenant. Landlord may thereafter occupy, sell, lease, repair or remove Tenant's Improvements and personal property. However, in the event Landlord elects to remove Tenant's Improvements and personal property, Tenant agrees to pay Landlord the cost incurred by Landlord for such removal within thirty (30) days of receipt of a bill from Landlord.

21. Notices. All notices under this Lease, shall be deemed to have been properly given only when written notice has been served by (i) personal delivery, (ii) by certified mail, return receipt requested, or (iii) by recognized overnight carrier, to the other party at its address as follows:

If to Landlord:

300 Exelon Way
Kennett Square, PA 19348
Attn: Conowingo Project Leasing Manager

If to Tenant:

If a notice sent to Tenant by certified mail is not accepted by Tenant, Landlord may post the notice at the Land.

22. Brokerage Commissions. There are no commissions or fees to be paid to any real estate broker or salesperson for this Lease. If Tenant has agreed to pay any commission or fee to a real estate broker, Tenant will pay that commission or fee. If Landlord has agreed to pay any commission or fee to a real estate broker, the Landlord will pay that commission or fee.

23. Federal Energy Regulatory Commission ("FERC"). The Land is part of a project licensed by the Federal Energy Regulatory Commission (FERC). Because of the FERC License the following requirements apply:

(a) Tenant's use of the Land will not endanger health, create a nuisance or otherwise be incompatible with the recreational use on any part of Landlord's land. Tenant will take all reasonable precautions to ensure that the use and maintenance of the Land will protect the scenic, cultural, recreational and environmental value of the Land.

(b) Landlord may terminate this Lease if Landlord's License from FERC is terminated. If Landlord terminates the Lease for this reason, Landlord will give Tenant thirty (30) days notice before the termination date.

24. Floods. Tenant waives or gives up any claims against Landlord for flooding by water or the presence or flow of ice on the Susquehanna River or any of its tributaries.

25. Severability. If any part of this Lease is not legal for any reason, the rest of this Lease shall continue to be valid and enforceable.

26. Governing Law. This Lease is made in the laws of the State of Maryland.

27. Legal Action. A lawsuit regarding this Lease may only be filed in the county where the Land is located, or in the United State District Court in the state in which the Land is located and in the division closest in proximity to the Land. BOTH PARTIES ALSO WAIVE THEIR RIGHT TO A TRIAL BY JURY IF A LAWSUIT IS FILED REGARDING THIS LEASE AGREEMENT. Tenant shall pay Landlord all of its costs and expenses, including without limitation attorneys' fees, incurred by Landlord in enforcing Tenant's obligations under this Lease whether or not Landlord files a lawsuit against Tenant.

28. No Assignment. Tenant shall not assign, sublease or otherwise transfer or encumber this Lease without the prior written consent of Landlord. Tenant shall make all requests for Landlord's consent to assignment in accordance with the Rules and Regulations. Any assignment without the prior written request of Landlord shall be null and void.

29. Entire Agreement. This Lease replaces and cancels all other leases between Landlord and Tenant for the Land. Tenant understands the promises in this Lease shall be binding upon Tenant. This Lease contains the full and complete agreement between Tenant and Landlord. Any change, modification or waiver of the promises in this Lease may only be made by a written agreement signed by Landlord and Tenant. No promises were made by Landlord to Tenant other than those promises contained in this Lease.

EXECUTED BY THE PARTIES ON THE NEXT PAGE

Landlord and Tenant, intending to be legally bound, agree to the terms of this Lease effective as of the Effective Date.

Sealed and delivered in the presence of:	TENANT:
______________________________ As to the Tenant	__________________________________(SEAL)
______________________________ As to the Tenant	__________________________________(SEAL)
	LANDLORD:
	EXELON GENERATION COMPANY, LLC
	BY:____________________________________

File No. _______________
Initials _______-

SAMPLE June 21, 2011

EXHIBIT A

Site Plan

SAMPLE June 21, 2011

EXHIBIT B

Rules and Regulations

APPENDIX 4 – SOURCE DATA FOR SENSITIVE RESOURCE OVERLAY

Appendix 4 - Source Data for Sensitive Resources Overlay

Dataset	Description	Notes	Source
Slopes Greater Than 25%	Polygon of areas with greater than 25% slope, clipped to the project boundary for display purposes	Created using the spatial analyst slope tool from 10M Dems.	TRC
Erosion Shoreline Condition	Line feature of shoreline erosion conditions	Created by URS in support of 2009 PAD.	URS
Historic Site	Point features of historic sites and structures	Data provided by URS	URS
Historic District	Polygon feature of historically significant areas and districts	Data provided by URS	URS
Osprey Nests	General location of identified Osprey Nests	Data provided by URS, obtained during a field survey conducted April 2010 through July 2010	URS
Turtle Nesting Area	Location of Turtle Nests	Data received from Towson University on 5/3/2011, data collected during 2008 field survey	Towson University
Turtle Basking Area	Locations of Turtle Basking Areas	Data received from Towson University on 5/3/2011, data collected during 2008 field survey	Towson University
Sensitive Area	Polygon features of ecological and archeaological sensitive areas.	Dataset is compilations of various sensitive areas including data from RTE studies, endangered species areas, as well as cultural and archaeological sensitive data. Where data was received as points and buffer was placed to give a general location area rather than specific location. Data was obtained from RTE surveys, DEP, and SHPO.	PDEP, PNHP, TRC, SHPO
EAV/SAV	Contains data pertaining to the emergent and submergent aquatic vegetation downstream of the Conowingo Project	Data was collected during a field survey conducted by URS during low flow conditions in July and August 2010.	URS
NWI Wetland	National Wetlands Inventory clipped to the Susquehanna River Basin	Data was downloaded from the NWI website on 6/29/2009	NWI
DNR Wetland	Wetland locations based on mapping from Maryland Department of Natural Resources	Data obtained from Maryland Department of Natural Resources	MDNR
Wetlands of Special State Concern	Location of wetlands of State Concern	Data provided by Barry Baker on 2/24/2009	URS

APPENDIX 5 – CONOWINGO ISLAND PUBLIC USE POLICY

DRAFT

CONOWINGO ISLANDS

PUBLIC USE POLICY

The "Conowingo Islands" are a group of islands located in the Susquehanna River (Conowingo Pond) extending from the Norman Wood Bridge (PA Route 372) south approximately 1.3 miles and including Mount Johnson Island located 5 miles south of PA Route 372. The islands "... constitute one of Pennsylvania's most unusual and important assemblages of rare species (Cook, 1986). The Islands also posses unique geological and other physical features (Erdmann, 1978) and important cultural resources. The Philadelphia Electric Company and its subsidiaries, The Susquehanna Power Company and Philadelphia Electric Power Company recognize the importance of these Islands and have developed this policy to maximize the protection afforded the Islands.

It is the policy of the Philadelphia Electric Company, The Susquehanna Power Company and Philadelphia Electric Power Company that use of the Islands will be restricted to:

1. Employees of Philadelphia Electric Company and Susquehanna Electric Company in performance of their official duties

2. Persons conducting bona fide scientific studies on the Islands and who have obtained prior written permission from the Real Estate Department, Philadelphia Electric Company

3. Persons participating in group tours approved in writing by the Real Estate Department, Philadelphia Electric Company

4. Tenants (and invited guests) of the Philadelphia Electric Power Company who have a current Agreement of Lease for use of (or portion of) said Islands

5. Personnel of either a law enforcement or regulatory agency, having jurisdiction over the islands, in performance of their official duties, and

6. Employees of approved contractors for the Philadelphia Electric Company, The Susquehanna Power Company or Philadelphia Electric Power Company in the performance of their official duties.

All persons not meeting one of the six critieria described above will be considered to be tresspassing and are subject to prosecution under the law.

9/1/88

RULES AND REGULATIONS GOVERNING THE USE AND OCCUPANCY OF LEASED PREMISES ON ISLANDS

PURPOSE

The Islands located in the Conowingo Pond contain important biological and cultural resources. The Company recognizes the importance of these valuable resources and seeks to protect them. In addition, the Conowingo Hydro-electric Project is a federally licensed project and the Company is required under its License to protect the environmental, scenic, and cultural resources found in the project. As tenants of the Philadelphia Electric Power Company you also have an obligation to help protect these important resources.

The following rules and regulations have been developed specifically for Island tenants. All conditions, procedures, and restrictions contained in the "Rules and Regulations Governing The Use and Occupancy of Leased Premises" shall apply.

GENERAL CONDITIONS

1. Tenants and their guests are responsible for helping to protect the exceptional biological, cultural, and physical features of the islands.

2. Tenants shall restrict their regular use activities on the islands to their leased premises except when required for a means of access to their leased premises.

3. Tenants are restricted to one access (or landing area) per tenant. Tenants are encouraged, when possible, to share access areas. All access areas must be properly stabilized to prevent erosion. A path from the landing area to the leased premises must be designated and properly maintained.

4. Tenants are required to report (as soon as practical) to the Real Estate Department any unauthorized use(s) of the Islands. The tenant shall supply the Department as much information about the violator(s) as possible. Pertinent information may include; boat registration numbers, hunting or fishing license numbers, physical description of persons, date, time, location, activity, etc. Violations of State laws should be reported directly to the appropriate state law enforcement Agency(Fish Commission, Game Commission, or State Police).

5. Tenants must display their cottage identification number (C.I.N.) on the stern of their boat(s) using 3 inch high letters.

6. Tenants will not be allowed to expand their existing structures or add any new structures. Exceptions may be made if the proposed structure will reduce other negative impacts to the island (ex. boardwalks).

7. Tenants are not allowed to use any rock outcrop areas (except for currently existing uses) because these areas are very fragile and ecologically important. Tenants are encouraged to phase out existing uses of these areas.

VEGETATION

1. Tenants shall not plant any type of non-native vegetation (including trees, shrubs, vines, flowers, grass, etc.) without obtaining prior written permision from the Real Estate Department. If you have any questions or doubts, contact the Department by telephone (215 841-6894) or in writing for clarification.

2. **NO** trees, shrubs, vines, flowers or vegetation of any kind may be removed from the island. No vegetation of any kind may be cut or trimmed except for the regular trimming of ornamental shrubs and mowing of lawns.

3. The Department may require the tenant to remove any non-native plants.

4. Many of the islands and adjacent shallow water areas contain plants that are listed as species of special concern by the Commonwealth of Pennsylvania.
NOTE: It is a violation of State Law to "... disturb, pick, take possess, destroy, mutilate, remove, collect, or transplant plants classified as Pennsylvania Endangered or Pennsylvania Threatened..."

5. Certain Islands or portions of Islands may be designated as ecological resource protection areas and will be off limits to all unauthorized personnel.

CULTURAL RESOURCES

1. No digging of any type is allowed on any island except as authorized in writing by the Real Estate Department under paragraphs 2 and 3 of this section.

2. A Building License Application must be submitted to the Department prior to beginning any construction activity or removal of existing structures. This provision also applies to any repair work that requires excavation or the placing of fill on the islands.

3. Tenant is required to obtain the approval of the Pennsylvania Historical and Museum Commission for any new construction or repairs that will require subsurface soil disturbance.

4. Upper and Lower Bear (Bare) Islands are on the National Register of Archeologcial Sites. The disturbance of any archeological site (whether previously known or not) is a violation of federal law.

5. Certain Islands or portions of Islands may be designated as cultural resource protection areas and will be off limits to all unauthorized personnel.

EROSION CONTROL MEASURES

1. Tenant is responsible for correcting or controlling any erosion problems resulting from their use of the leased premises, even if the problem is not on the leased premises.

2. Non-structural erosion control measures should be utilized if sufficient to correct or control the problem. These measures include using vegetation and/or rip rap.

FOR INFORMATION OR QUESTIONS, CONTACT:

Real Estate Department
Philadelphia Electric Power Company
2301 Market Street
Philadelphia, PA 19101 (215) 841-6894

Conowingo Recreation Office & Visitors Center
P. O. Box 71
Conowingo, MD 21918 (301) 457-5011

TO REPORT VIOLATIONS OF STATE LAW:

PENNSYLVANIA FISH COMMISSION:	
Jim Wagner	(717) 786-4662
PENNSYLVANIA GAME COMMISSION:	
Southeast Division Office	1 800-228-0791
PENNSYLVANIA STATE POLICE:	
Lancaster	(717) 367-4141

APPENDIX 6 – MARINA RULES AND REGULATIONS GOVERNING USE AND OCCUPANCY OF LEASED PREMISES

RULES AND REGULATIONS
GOVERNING THE USE AND OCCUPANCY
OF LEASED PREMISES

GENERAL CONDITIONS

A. General Information

All questions, complaints, and problems should be directed to:
Real Estate & Facilities
PECO Energy Company
2301 Market Street, N3-3
Philadelphia, PA 19101.

Telephone: (215) 841-5409

B. General Conduct

1. Tenants and their guests shall not permit any noise, or other disturbance to interfere with the quiet enjoyment of others.

2. Tenants and their quests shall exercise great care to avoid the possibility of fire. No open fires are permitted except in properly constructed barbecue pits, or trash burning containers, and any burning must comply with local ordinances.

3. Tenants are responsible for the actions of their guests.

4. A six (6) digit Cottage Identification Number (C.I.N.) will be assigned to each Tenant and is to be placed on the outside wall of the cottage facing the water, and must be visible from the water. If the cottage is accessible from a road or fronts on a road, the C.I.N. must also be placed on the side of the cottage facing the road. All numbers must be at least 4 inches high.

5. All dogs must be kept securely tied or on a leash at all times.

6. Tenant must report possible hazardous conditions to the Landlord immediately upon discovery.

7. Tenant shall be responsible for the correction and/or control of any erosion caused by or resulting from improvements, and/or changes made to, or on the leased premises. Landlord may require Tenant to rectify any erosion problems on or affecting the leased premises.

However, Landlord has no duty to Tenant to correct any erosion problems.

IMPROVEMENTS

A. New Construction or Additions (Application Procedure)

1. A BUILDING LICENSE APPLICATION must be submitted (with all appropriate attachments and a check for application fee) to Landlord prior to beginning any new construction or additions, removals, or repairs which alter existing structures. (Application forms may be obtained from the Landlord in Philadelphia).

2. If the application is approved, Tenant will be notified in writing by Landlord. Tenant must then obtain a Building Permit from the local municipality. A copy of the Building Permit must be forwarded to Landlord prior to beginning any work.

3. Landlord will then issue a Building License which must be displayed in a prominent, visible location at the construction site along with the required local municipality Building Permit. If a Municipal Permit is not required, the Building License will be issued upon approval of the application by Landlord.

4. Set back regulations are variable based on site conditions, are guided by local regulations where applicable, and will be specified in the approval of the application issued by Landlord.

5. Within 30 days of completion of the approved construction, photographs of the completed construction must be submitted to Landlord.

6. Some construction projects may require permits in addition to the Municipal Building Permit. Tenants are responsible for obtaining any additional permits or approvals required by the appropriate government agencies. (The table at the end of these rules and regulations is intended as a guide to the permits or approvals required by the various agencies for specified construction activities. It is suggested that you consult with the appropriate agency prior to beginning construction.) Copies of all required permits or approvals must be submitted to Landlord before construction can begin.

7. Landlord must be notified in writing anytime a building or other improvement is to be razed or removed. The area must be

restored to a condition satisfactory to Landlord which shall include but is not limited to establishing the appropriate vegetative cover.

B. Maintenance

1. The leased premises and all improvements must be maintained in good repair and appearance. Landlord may require a Tenant to make repairs and perform necessary maintenance, including but not limited to painting, removal of junk, trash, vehicles, or other detractions from a neat and orderly appearance.

2. Improvements should not present a hazard to Tenants, or other persons or property.

3. Landlord may require conditions which it deems to be hazardous, or environmentally damaging, corrected to Landlord's specifications.

4. All chimneys must be fireproof and constructed of tile, brick, stone, or other approved material, and equipped with spark arresters.

C. Sale of Cottage (Application Procedure)

1. An "APPLICATION FOR SALE" form must be completed and submitted to Landlord at least <u>45 days prior</u> to the date of settlement for the sale of the cottage. (Forms are available from Landlord or at the Recreation Office.)

2. A check for the current processing fee (as stated on the application) must accompany the completed form.

3. If the "APPLICATION FOR SALE" is approved, a new Lease Agreement will be issued prior to the settlement date, which shall be properly executed by the new owner at settlement and returned to Landlord for Landlord's execution, along with a valid Bill of Sale. A fully executed copy of the Lease Agreement will then be forwarded to the new owner.

4. <u>All</u> Sales Agreements must contain a statement that only the personal property of the Tenant is being sold and that no land or land rights are included in the sale. Bills of Sale must contain the same statement.

5. Installment Sales Agreements or Lease Purchase Agreements which are intended to give possession of the cottage to the buyer

while the current Tenant (seller) holds the existing Lease Agreement <u>are not permitted</u>.

6. Current Tenant <u>must</u> inform the prospective Tenant of all rules and regulations.

ROADS

A. Construction of new roads or alterations to existing roads (Application Procedure)

Written permission is required from Landlord for the construction of new roads or the alteration of existing roads. A sketch indicating the location of the road must accompany the Building License Application submitted to Landlord.

B. Maintenance of existing roads

1. Roads must be maintained in good condition, with proper drainage and meet with Landlord's specifications.

2. Landlord may require that a road be repaired to its satisfaction or the use of the road must be discontinued.

3. Tenants are responsible for maintenance and general upkeep of non-public roads in cottage areas, in common with other users.

TREES

1. No trees shall be injured or damaged, by Tenants or their guests. The attaching of lights, electric lines, clothes lines, docks, etc., either on a temporary or permanent basis is prohibited. Care must be taken during construction to prevent injuring trees, and if necessary, temporary protective shields shall be installed around the trees.

2. No trees (over 2 inches in diameter) can be cut without prior written permission of Landlord. If a tenant desires to cut down or remove significant portions of a tree, they must first obtain written permission from Landlord. Requests should be directed to the Recreation Office.

3. Requests for tree removals can only be made by the current Tenant.

4. Tenants are responsible for correcting hazardous tree conditions on or adjoining the leased premises. Landlord may notify the Tenant of any trees that Landlord believes should be removed. It will be the responsibility of the Tenant to have such trees removed. If such trees are not removed within the specified time period, Landlord at its option my terminate the Lease and/or remove the tree at the Tenant's expense.

WATER

1. All use of water by Tenant, in and about the leased premises, shall be at the sole risk of Tenant. Landlord makes no representations with regard to the water nor has it caused any of said water to be analyzed. If Tenant is using or intends to use any water for domestic purposes, it is suggested for Tenant's own protection, that before doing so and periodically thereafter, Tenant shall have said water tested by an approved lab for the purpose of determining the feasibility of safety using the water. All costs incurred in connection with such tests shall be the responsibility of the Tenant. Landlord assumes no liability for, or on account of any water used by Tenants or their guests.

2. No exclusive rights are given or inferred as being given as to the use of any water or spring, even though a spring may be located on the leased premises. Adjoining Tenants may use such water but may not unreasonably interfere with the enjoyment or use of the leased premises where the water is located.

3. All waterlines crossing roads must be buried to a depth of at least 30 inches.

SANITARY REQUIREMENTS

1. In the event a septic system does not exist on an improved site, said site must be provided with a sanitary toilet, with a vault at least four (4) feet in depth from the surface of the ground. No toilet shall be located closer than one hundred (100) feet to any spring, stream, or other water source of supply.

2. Before initiating the construction of any septic system, tenant shall consult with the appropriate county or township health department and obtain the necessary approval(s).

3. In the event a sanitary sewer system is installed in the area, Tenant shall be required to connect into the system, whereupon

tenant shall be responsible for all connection, maintenance, and operation fees or costs.

4. If garbage and/or trash is not removed from the area on a weekly (or more often) basis, each site must be provided with a garbage pit at least three (3) feet square and three (3) feet deep, and shall have a tight wooden (or other suitable material) cover. All trash and garbage must be kept in a closed container.

5. The toilet and/or garbage pit must be maintained in a good and sanitary condition.

6. In a situation where there is a difference between these regulations and the local ordinances or other regulations, the more stringent of the two shall apply.

SHORELINE PROTECTION PROGRAM

General Information (Application Procedure)

1. Anyone desiring to construct, replace, expand, or do major repairs to a pier (or dock), boathouse, boat ramp, marine railway, bulkhead, retaining wall, install any erosion control measures, or excavate in any areas that may affect the pond (or river) shoreline must submit a "BUILDING LICENSE APPLICATION" to Landlord with all appropriate attachments and/or application fees.

2. The applicant is responsible for obtaining all necessary permits (or other forms of permission) from the responsible government regulatory agencies. The table at the end of these rules and regulations is intended as a guide to the permits required by the various agencies for specified construction activities. Copies of all necessary permits or approvals must be sent to Landlord before construction can begin. Following completion of construction, photographs showing the new or modified structures must be submitted to Landlord. <u>Landlord suggests that the Tenant consult with the appropriate agencies to determine what permits may be required before submitting the BUILDING LICENSE APPLICATION.</u>

Specifications and Procedures

NOTE: The shoreline is considered to be the existing shoreline at mean high water.

A. Piers or Docks

1. Piers may be either permanent, floating, or a combination of both and may not exceed a total length of 50 feet (or extend more than 50 feet from the shoreline). If the pier is located in a cove or in a stream, the length may not exceed 25% (1/4) of the width of the cove or stream where the pier is located.

2. The width of the pier may not encroach across the projected lot lines or exceed 30 feet in width (whichever is less). A variance of this provision may be granted if the pier is used in common with other Tenants, permittees or licensees.

3. All permanent piers (or permanent sections of piers) must be built above the mean high water line.

4. Piers must be constructed of preservative treated lumber and pilings. Concrete, masonry, and metal construction is not permitted. Handrailings and covers on piers are permitted provided that the sides are open so as not to obscure cross vision. Covers are permitted only over the pier itself and may not extend out over the water.

5. Flotation devices for floating piers must be constructed of styrofoam billets or floats, or equivalent construction. Barrels or similar flotation devices are not permitted.

6. Piers may not interfere with navigation, present a safety hazard, or block ingress or egress to adjoining areas.

7. If an existing pier must be replaced or repaired (other than minor repairs), it must conform to current standards.

8. Piers may not be anchored or tied to trees at any time.

B. Boat Ramps and Marine Railways

1. Ramps must be constructed of poured concrete pads or precast concrete panels properly anchored and fastened together. Asphalt or other petroleum based products are prohibited.

2. Ramps may not exceed 15 feet in width and 30 feet in length. The length should not exceed that necessary to be functional.

3. Marine railways may use either treated wood or concrete ties.

4. Marine railways may not exceed 15 feet in width and should be no longer than necessary to be functional. Landlord may, however, restrict the length because of site conditions.

C. Erosion Control Measures (Bulkheads, Retaining Walls, Sea Walls, Rip Rap, etc.)

Anyone desiring to construct a bulkhead or other erosion control measure must submit a "Building License Application" to Landlord. A Division representative will make an on-site inspection of the area to determine if what the applicant has proposed should be allowed or if another type of measure may be more appropriate. If the Division approved of the proposed measure, the applicant must obtain the appropriate government agency permits or approvals before a "Building License" will be issued.

1. No erosion control measure shall significantly alter the existing shoreline.

2. The planting of vegetative cover and/or rip-rapping shall be used if adequate to control the problem.

3. Bulkheads and retaining walls must be constructed of preservative treated wood, concrete, or masonry.

4. The structure shall not significantly detract from the scenic value of the area.

CULTURAL RESOURCE PROTECTION GUIDELINES

PECO Energy Company has developed, in cooperation with the Pennsylvania Bureau of Historic Preservation and the Maryland Geological Survey, Division of Archeology, the following rules and regulations, which apply to all land owned by the Company and its subsidiaries. The specific intent of these regulations is to provide for the protection of cultural resources, and to avoid any disturbance of historic and prehistoric sites except when justified for scientific purposes and/or when performed in accordance with such State and Federal regulations and guidelines as may apply.

1. No one shall mar, deface, remove, destroy or in any other way damage, any standing structure, ruins, foundation or other man-made feature of a potentially historic nature on lands of PECO Energy Company (PECO Energy) or its subsidiaries, without first having obtained the written permission of Landlord.

2. No one shall perform any sub-surface archaeological investigations, or in any way disturb the soil for the purpose of searching for and/or obtaining historic or prehistoric artifacts on land of PECO Energy or its subsidiaries without having first obtained the written permission of Landlord, nor shall same be performed without the prior knowledge and written sanction of the following:

In Pennsylvania, The Bureau of Historic Preservation; In Maryland, The State Historic Preservation Officer and/or the Geological Survey, Division of Archeology.

a. Full and complete reports must be prepared. Said reports shall incorporate maps, site profiles, descriptions and photographs of artifacts and features, soil descriptions, topography, excavation procedures, directions and distance to the nearest water and all such other related details as may be required;

b. Landlord shall be supplied with a copy of each report so generated. The appropriate State agency shall be supplied with two copies of same, one of which shall contain original photographs;

c. All artifacts and related material recovered in sub-surface investigations shall become the property of PECO Energy, and shall be turned over to the respective State agency. Same shall remain available to PECO Energy and other responsible public and private organizations and agencies for the purpose of study and/or public display;

d. All artifacts must be properly labeled with site number and lot and must be readily identifiable by pit and level. Site numbers must conform to the trinomial numbering system adopted by both Pennsylvania and Maryland.

e. All burials encountered during the course of such archeological investigations shall be treated with the highest respect, and shall be handled on a case by case basis under the strict control of the State agency having jurisdiction. It is the policy of said agencies and of PECO Energy, to discourage the removal or disturbance of human remains, unless there is a significant scientific purpose to be served by same, and unless provisions are made, in consultation with, and with the approval of living descendants of the interred, for the timely study and the ultimate reburial of the remains.

3. While the collection of artifacts from the surface is widespread, and though not strictly prohibited under these regulations, it does have a significantly negative effect on archeological sites. The distribution of surface artifacts is the only information available for many sites. Those finding artifacts are therefore encouraged to report finds to Real Estate & Facilities (R. T. Stark, 215-841-5193), PECO Energy Company, 2301 Market Street, Philadelphia, PA 19101, so that same might be photographed and recorded.

4. Tenant is required to consult with the appropriate State Preservation Office prior to any construction work that may affect surface or sub-surface archaeological sites, and prior to new additions to existing structures or the construction of new structures. Evidence of such consultation must be supplied to Landlord before a Building License will be issued.

<u>Note: On property which is within the boundaries of Federally-regulated projects such as the Conowingo Hydro-Electric Project (F.E.R.C. No. 405), tenants' properties require additional precautions regarding cultural resources under the provisions of the National Historic Preservation Act of 1978 (section 106), Executive Order 11593, and the regulations of the Advisory Council on Historic Preservation (36 CFR 800).</u>

FAILURE TO COMPLY WITH ANY OF THESE RULES AND REGULATIONS WILL BE CONSIDERED A VIOLATION OF THE TERMS AND CONDITIONS OF THE LEASE AGREEMENT AND MAY RESULT IN EITHER A $250.00 FINE LEVIED AGAINST THE TENANT OR POSSIBLE TERMINATION OF THE LEASE AGREEMENT.

River Basin Permit Section (COE)
Baltimore District
U. S. Army Corps of Engineers
P. O. Box 1715
Baltimore, MD 21203

Water Resources Administration (WRA)
Maryland Department of Natural Resources
Tawes State Office Building
Annapolis, MD 21401

State Administrator of Archeology
Maryland Historical Trust (MHT)
Shaw House
21 State Circle
Annapolis, MD 21401

Executive Director
Pennsylvania Fish Commission (PFC)
P. O. Box 1673
Harrisburg, PA 17120

Division of Waterways and Stormwater Management (DER)
Pennsylvania Department of Environmental Resources
P. O. Box 2357
Harrisburg, PA 17108-1026

Department of Planning and Zoning
Harford County, Maryland
220 S. Main Street
Bel Air, MD 21014

Office of Planning and Economic Development
Cecil County, Maryland
Room 300, Court House
Elkton, MD 21921

Martic Township Supervisors
R. D. #1
Pequea, PA 17565

Drumore Township Supervisors
R. D. #1
Drumore, PA 17518

Fulton Township Supervisors
R. D. #1
Peach Bottom, PA 17563

Peach Bottom Township Supervisors
R. D. #1
Delta, PA 17314

Lower Chanceford Township Supervisors
R. D. #2
Airville, PA 17303

Harford Soil Conservation District
1208 Churchville Road, Suite 201
Bel Air, MD 21014

Cecil Soil Conservation District
125 E. High Street
Elkton, MD 21921

York County Conservation District
118 Pleasant Acres Road
York, PA 17402

Lancaster County Conservation District
Room 6, Farm and Home Center
1383 Arcadia Road
Lancaster, PA 17601

APPENDIX 7 – CONSULTATION RECORD

A. Karen Hill, Esq.
Vice President
Federal Regulatory Affairs

Telephone 202.347.7500
Fax 202.347.7501
www.exeloncorp.com

Exelon Corporation
101 Constitution Avenue, NW
Suite 400 East
Washington, DC 20001

Via Electronic Filing

March 28, 2011

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Re: Conowingo Hydroelectric Project, FERC Project No. 405
Muddy Run Pumped Storage Project, FERC Project No. 2355
Filing of the Initial Study Report Meeting Notes Summary

Dear Secretary Bose:

In accordance with Title 18 Code of Federal Regulations (18 C.F.R.), Section 5.15 (c)(3) of the regulations of the Federal Energy Regulatory Commission (Commission or FERC), Exelon Corporation, on behalf of its wholly-owned subsidiary, Exelon Generation Company, LLC (Exelon), encloses for filing the Initial Study Report Meeting Notes Summary for the relicensing of the Conowingo Hydroelectric Project (Conowingo Project), FERC Project No. 405, and the Muddy Run Pumped Storage Project, FERC Project No. 2355.

Exelon is filing this document with the Commission electronically. To access the document on the Commission's website (http://www.ferc.gov), go to the "eLibrary" link, and enter the docket number, P-405 or P-2355. Exelon is also making the document available for download at its corporate website. To access the document here, navigate to http://www.exeloncorp.com/powerplants/conowingo/relicensing/Pages/overview.aspx.

In addition to this electronic filing with the Commission, paper copies of the document are also available upon request to Colleen Hicks (610-765-6791). Finally, Exelon is making available to the public the document at the Visitor's Center at Muddy Run Recreation Park in Holtwood, Pennsylvania, and the Darlington Public Library in Darlington, Maryland, during regular business hours.

Exelon appreciates the work and involvement of Commission Staff, resource agencies, local governments, and members of the public in the development and work completed to date. If you have any questions regarding the above, please do not hesitate to contact Colleen Hicks. Thank you for your assistance in this matter.

Respectfully submitted,

Colleen E. Hicks

Colleen E. Hicks
Manager Regulatory and Licensing, Hydro
Exelon Power
300 Exelon Way
Kennett Square, PA 19348
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Email: Colleen.hicks@exeloncorp.com

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Exelon Corporation
101 Constitution Ave.
Suite 400E
Washington, DC 20001
Tel: (202) 347-8092
Email: Karen.Hill@exeloncorp.com

CC: Distribution List-Attachment D

Conowingo and Muddy Run Project FERC Relicensing
Initial Study Report Meeting
Meeting Notes Summary
March 9-11, 2011
Darlington Volunteer Fire Department
2600 Castleton Road, Darlington, MD

List of Attendees: See Attachment A

Introductions, Meeting Purpose, and Process Timeline

Colleen Hicks (Exelon) opened the meeting and welcomed everyone. Parties introduced themselves and gave their affiliation. Tom Sullivan (Gomez and Sullivan) described the meeting structure and reviewed the meeting agenda. Each study was scheduled to have approximately 20 minutes for presentation followed by questions and discussion. Tom Sullivan also provided an overview of the next steps in the ILP process (See Attachment B-Meeting Presentation).

Larry Miller (USFWS) raised concern that the stakeholders have incomplete studies with which to make judgments regarding requests for the Year Two study season. Shawn Seaman (MDNR), Mike Hendricks (PFBC) and Andy Shiels (PFBC) stated that there is not enough time from a process perspective to properly design the Year Two spring studies. The stakeholders felt that they will not have enough time to file comments, discuss results, and participate in designing Year Two studies. Mike Helfrich (Riverkeeper) stated that the delay with some study reports places the stakeholders at a disadvantage by holding up the entire process. In light of these concerns there was a specific request made to push the license application filing date to a point farther out in time. Tom Sullivan indicated that the Federal Power Act precludes pushing back the license application filing date. Tom Sullivan also indicated that Exelon is prepared to perform necessary Year Two studies and that Exelon has met all required regulatory obligations by filing complete reports where they are available and report summaries in lieu of complete reports where necessary. Emily Carter (FERC) also commented that the stakeholders will have the ability to comment throughout the licensing process, and if FERC determines that the stakeholders have legitimate concerns about the conducted studies that are not addressed, Exelon could be required to complete additional studies in 2012 or later to fill-in information gaps.

Tom Sullivan (Gomez and Sullivan) went over criteria for proposing a new study, including the 7 criteria for new studies. Andy Shiels (PFBC) asked if there was a study report matrix outlining the studies with expected and actual completion dates, and indicated it would be helpful for Exelon/FERC to provide this information and maintain it as "living document" (See Attachment C-Study Report Schedule).

<u>Wednesday March 9, 2011</u>

Session 1: Fish and Aquatics

Conowingo 3.10 – Maryland Darter Surveys (Tim Brush – Phone)

Tim Brush (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Andy Shiels (PFBC) asked what was the last sampling event included in the report summary. Tim Brush responded that it was the January 14, 2011 sampling event. Additional sampling had been conducted in February 2011, but could not be included in the study report submission. Geoff Smith (PFBC) asked which additional four species were caught in the February sampling event. Tim responded that they were flathead catfish, goldfish, walleye, and creek chubsucker.

Conowingo 3.22 – Shortnose and Atlantic Sturgeon Life History Studies (Steve Leach – Phone)

Steve Leach (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Andy Shiels asked that a comparison (physical conditions, attraction flow etc.) be made of Conowingo East Fish Lift with other facilities that successfully pass sturgeon species, specifically those facilities at Holyoke Dam. Andy noted that Holyoke has passed some sturgeon (> 100 fish over 30 years) while Conowingo has not. Steve Leach described the mechanical differences at the fish lift facilities and the differences in the river characteristics (i.e., river width). Steve mentioned that attraction flows are different at the lifts. Availability of sturgeon in the river was also mentioned as the reason for the Conowingo East Fish Lift not passing sturgeon. Andy Shiels asked if the East Fish Lift at Conowingo is sufficient to pass sturgeon should they become available in the Susquehanna River. Don Pugh (American Rivers) indicated that the East Fish Lift is a surface entrance and that is a major difference compared to the spillway lift at Holyoke Dam, which is several feet deep. However, the East Fish Lift may be comparable with the tailrace lift at Holyoke Dam. It was decided that Exelon would provide a conclusion on whether the East Fish Lift is capable of passing sturgeon species- **Action Item**.

Mike Helfrich suggested that an effort be made to ask river guides, anglers, bait shop owners, etc. to see if they had any information about sturgeon presence. He indicated that may be a useful method of gathering data on presence/absence of sturgeon in the river.

Conowingo 3.16 – Instream Flow Habitat Assessment below Conowingo Dam (Kirk Smith)

Kirk Smith (Gomez and Sullivan) presented the study objectives, work completed, findings, and schedule for this study. Geoff Smith asked what the source of the macroinvertebrate data was to develop the EPT curves, and why they were included in the assessment. Tom Sullivan indicated that the curves were developed in consultation with the resource agencies, and that these species were being assessed, at the resource agencies request, because of a relative lack of abundance in the study reach. Bill Richkus (Versar) suggested combining study summary tables 3 and 4 in the study report.

Conowingo 3.19 – Freshwater Mussel Characterization Study (Bill Ettinger)

Bill Ettinger (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Matt Ashton (MDNR) indicated that he had major disagreements on the conclusions drawn from the study results, and how flow peaking may be impacting mussel diversity. Matt also had concerns about how the sampling methodology was established, and thought the sampling areas were not representative of the entire river. Matt stated that many areas were not sampled, especially on the west side of the river. There was a concern from some stakeholders that a few large mussels found in the study are the ones that have found refuge in areas more protected from peaking operations, and that they do not indicate a healthy population.

Don Pugh also expressed disagreement with the study conclusion that Conowingo operations have no impact on mussel abundance and composition. He noted that the Catch Per Unit Effort (CPUE) increased in the lower portions of the study reach, away from the influence of the Conowingo Project.

Don Pugh requested that the report tables and appendices be made available in electronic form. Bill agreed to make the data available to all interested parties on March 14, 2011-**Action Item**.

Andy Shiels asked why eastern elliptio is rare above Conowingo Dam but dominant below the dam. Bill said others have hypothesized that this difference may be due to the presence of American eel, while Matt Ashton suggested that there may be water quality influences as well.

It was agreed that a conference call would be scheduled to discuss MDNR comments on the study methodology and results. The call was scheduled for Friday, March 25, 2011 from 9 am-Noon-**Action Item**. Interested stakeholder participants were Matt Ashton, Don Pugh, Geoff Smith, Shawn Seaman, Mike Helfrich, Steve Minkkinen, and Andy Bernick.

Session 2: Fish Passage

Conowingo 3.2 – Downstream Fish Passage Effectiveness Study (Jennifer Griffin – Phone)

Jennifer Griffin (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Don Pugh asked if the proposed blade strike model would consider if the turbine blade was blunt or sharp, and what was the turbine configuration at Conowingo. Jennifer stated that she would research the turbine design at Conowingo and address this issue in the report-**Action Item**. Bill Richkus ask whether the entrainment analysis would consider the impact of turbine aeration. Jennifer responded that the literature database to be used in the entrainment analysis did not indicate whether turbines were aerated or not, but that she would investigate the issue further and address it within the study report to the extent possible-**Action Item**. Don Pugh asked whether the turbine/runner configuration (i.e., wicket gates, guide vanes) would be factored into the entrainment analysis. Jennifer said that this will be addressed in the study report. Andy Shiels asked which projects would be used as a comparison to Conowingo. Jen Griffin responded that she has not narrowed the list at this time, but this component will be described in the study report.

Conowingo 3.5 – Upstream Fish Passage Effectiveness Study (Eric White)

Eric White (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Shawn Seaman contended that there was a deviation from the study plan in that the tailrace area was to be defined as the area from the powerhouse to the downstream end of Rowland Island. Eric stated that extending the definition to the downstream end of Rowland Island would add one fish to "the number of fish available" in the tailrace in the report.

Mike Hendricks stated that the composite telemetry animation showing all of the tagged fish ends on April 29, and that a composite animation of all fish through the end of the study period would be helpful. Doug Royer (Normandeau) mentioned that the file sizes were very large, and to alleviate this problem, he would create 10-day animations over the study period and provide this information to stakeholders-**Action Item**.

Larry Miller indicated that he would like to know more about what happened to the fish that dropped downstream from the study tailrace after tagging and release. Eric indicated that only mobile tracking was available for the area downstream of Spencer Island.

John Mudre (FERC) asked how fish that passed back downstream after being lifted were counted. Eric White responded they were only counted once for the study purposes.

Don Pugh indicated that it would be helpful to have the electronic data of all tagged fish, including detection times at each station. Eric indicated that this would be provided-**Action Item**.

Shawn Seaman noted that most fish appear to be favoring the west side of the river near Rowland Island, and appeared to be attracted to the small turbine units (Francis). He also indicated the results seemed to show that when flows ramped up to generation the fish left the area immediately downstream of the turbines. Bob Sadzinski (MDNR) also noted that only one tagged fish was captured in the West Fish Lift, even though several tagged fish were in that area.

Mike Hendricks recommended investigating the crowder gate operations, and stated that perhaps lifts should also be increased in frequency to as often as every 15 minutes, as part of the Year Two shad telemetry study design. Ray Bleistine (Normandeau) stated that it is only possible to lift every 20-30 minutes; and that the current protocol is to lift a minimum of every hour. In terms of Year Two study design, Don Pugh suggested adding to the radio telemetry monitoring array, rather than re-positioning, and several stakeholders suggested discontinuing the transport of tagged fish from the tailrace down to the Lapidum boat launch for release.

It was noted that the last fixed telemetry monitoring station was in the trough of the East Fish Lift, and there was some manual tracking in Conowingo Pond up to the Norman Wood Bridge. A clarification was also made with regard to the fate of tagged fish that passed into Conowingo Pond. Six of these radio tagged fish passed Safe Harbor Dam and 2 fish passed York Haven Dam. Larry Miller also deployed additional fixed telemetry monitoring stations in the upper portions of the river. He agreed to make this data available the group-**Action Item**.

Tom Sullivan indicated that a work plan for the Year Two shad telemetry study would be circulated to stakeholders by Friday, March 18, 2011-**Action Item**. He indicated that Exelon would like to work with the agencies to refine this study at a meeting on April 7, 2011 if they would be willing to participate.

Conowingo 3.6 – Conowingo East Fish Lift Attraction Flows (Ray Bleistine)

Ray Bleistine (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Andy Shiels asked if there was a correlation between overall river flow and fish passage efficiency at the East Fish Lift. Ray indicated that lower flows generally had better fish passage, possibly due to a larger percentage of fish finding the fish lift entrance.

Mike Hendricks asked how passage efficiency was affected by operations, specifically lift frequency. Mike suggested that a lift be done every time a project operations change is made. Ray Bleistine indicated that this is already done.

Bill Richkus stated that the statistical analysis of turbine operation and fish catch data were not analyzed the way the study plan stated, as the study plan called for correlated matrices. Ray responded that the t-test and Pearson correlation did not show any multi-variable correlations. Larry Miller and Don Pugh suggested that there were better statistical methodologies available, and Larry Miller indicated he would get back to Ray with statistical analysis recommendations, after he consulted with the USFWS statistician-**Action Item**. Larry specifically mentioned looking at percentage of shad passed during each specific day, to give a better normalization on the day-to-day passage number variability.

Bill Richkus requested that Table 4.2-2 from the report present data for the 2001-2009 period as well-**Action Item**. Don Pugh asked where the attraction flow velocity probe was positioned. Ray stated that the probe was put in the middle of the gate, approximately 15 inches below the surface, and that the gate opening was variable.

Don Pugh and Shawn Seaman stated that the telemetry animations do not support the conclusion that operations do not have an effect on fish passage efficiency, since the animations show indirect routes taken to get to the East Fish Lift. Ray stated that his statistical analysis does not attribute a specific turbine operation to good or bad passage.

Don Pugh noted that 43% of fish were making forays to tailrace area during the night, when the East Fish Lift was not operating. Mike Hendricks mentioned that in the Year Two shad telemetry study design, Exelon should examine the effects of running the attraction flow starting at dawn. Ray Bleistine explained that starting the attraction flow early could cause gizzard shad to congregate and clog the lift entrance.

Conowingo 3.7 – Fish Passage Impediments Study (Brian Hanson – Phone)

Brian Hanson (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Don Pugh asked why there are many fish that appear to be traveling upriver, only to fall back right before they reach the tailrace. Don said this holds true even for fish that do eventually enter the tailrace and pass Conowingo Dam. Brian stated that while there are some high velocity areas at the full generation flow, the high velocity area is relatively small, and fish can maneuver around those areas. Brian postulated that the multiple forays made by some fish were simply a result of individual fish behavior.

Mike Hendricks suggested looking at the tailrace shad telemetry study (Conowingo 3.5) to see if velocity is an issue, particularly plots of telemetry spot readings in the tailrace versus generation to get an idea of any relationship between generation and fallback-**Action Item**.

Conowingo 3.9 – Biological and Engineering Studies of the East and West Fish Lifts (Tom Hoffman)

Tom Hoffman (Gomez and Sullivan) presented the study objectives, work completed, findings, and schedule for this study. Larry Miller wanted to ensure that the study report would explain the rationale behind the conclusion that providing volitional passage at the West Fish Lift was not feasible. Tom Hoffman stated that the report would do so. Don Pugh asked if an increase in bucket size and/or attraction flow would be investigated as methods to improve hopper entry. Tom indicated these would be explored in the study report.

Conowingo 3.3 – Biological and Engineering Studies of American Eel (Terry Euston)

Terry Euston (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Terry Euston mentioned that the sampling dates from the Year One study season began 17 days late, and that the goal is to begin sampling around Mid-May as part of the Year Two study.

Don Pugh stated that a wider range of eels may be caught by increasing attraction flows through the ramp, or possibly setting up two ramps with differing substrates. Terry stated that it is possible that attraction flow issues could be worked out for the 2011 study season. Larry Miller noted that nighttime spotlighting has been effective. Larry Miller also mentioned that the USFWS sampling on the west side of the river was much more effective, and was wondering why there may be such a discrepancy. Terry mentioned flow attraction differences, substrate differences, and the late start to the study sampling relative to the USFWS sampling may be possible explanations.

Tom Sullivan indicated that a work plan for the Year Two elver sampling study would be circulated to stakeholders by Friday, March 18, 2011-**Action Item**.

Muddy Run 3.3 – Entrainment and Impingement Study (Jen Griffin – Phone)

Jennifer Griffin (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Andy Shiels asked why expected survival at Muddy Run is higher than similar projects. Jen Griffin responded that the runner speed and trash rack spacing is different than other projects and are better suited for fish survival. Jen Griffin also stated that habitat is generally not good near the intakes as well. Sheila Eyler (USFWS) asked if migratory fish entrained are counted twice as they would have to pass the turbines twice to go back and forth to Muddy Run and back down to Conowingo Pond. Tom Sullivan stated that for some of the fish the survival probability should be calculated twice (American eel, but not American shad) as they are not necessarily taken out of the population. Don Pugh stated that any entrained migratory fish should be considered extirpated from the system.

Larry Miller suggested that the pressure differential experienced by fish moving through the water conveyance system at Muddy Run may be problematic for fish survival, and this warranted further investigation by Exelon-**Action Item**. Don Pugh asked for a description of any structures (i.e., gates, valves) in the water conveyance system at Muddy Run-**Action Item**.

Andy Shiels suggested that the generation/pumping diurnal schedule may have an impact on some species more than others, and suggested investigating this relationship further-**Action Item**.

Don Pugh indicated that egg and larvae entrainment had historically been reported as high, but the current report suggests entrainment is more modest. Don asked that the report explain the reasons for these differences.

Muddy Run 3.3 –Adult American Eel Telemetry Study (Terry Euston)

Terry Euston (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Larry Miller asked if Exelon could confirm that the acoustic frequencies from the Year One study were input to the ACT (Atlantic Coastal Tag) database, and whether Exelon requested to be notified of any detections-**Action Item**.

Mike Hendricks asked that appropriate steps be taken to make sure the acoustic receivers for the Year Two study can be operated without any interference related to Project noise. Steve Leach stated that noise is high near the Project draft tubes, but this should not interfere with the study. Don Pugh mentioned that he would like to see the receivers in the canal as close to the Muddy Run intake towers as possible, and that they should be tested prior to the study to ensure that project noise does not interfere with them.

Bob Sadzinski asked how often and how many total nights were sampled in Deer and Octoraro Creeks, and mentioned MDNR typically nets for 8 or 9 consecutive weeks. Bob mentioned that the number of eels that did not migrate may be due to a maturity difference between the in-basin and out of basin eels. Terry said that a maturity difference is possible, but that all of the indicators (coloring, eyes) suggested that the in-basin eels were silver, just like the out-of-basin eels. Terry stated that Exelon's expectation is to use out-of-basin eels for the Year Two study.

Muddy Run 3.5 – Nearfield Effects of the Muddy Run Project on Migratory Fishes (Doug Royer)

Eric White (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Sheila Eyler (USFWS) asked why the pit tag reader is impractical at Muddy Run. Steve Leach indicated because the antenna read range is small; an array of nearly 100 antennas would be needed to provide full coverage around the intake/tailrace areas.

Andy Shiels asked how the cruise speeds were estimated for historic telemetry studies and the 2010 telemetry study. It was agreed that this item will be addressed in the study report to the extent possible-**Action Item**. For entrainment percentages discussed in the study report, Andy Shiels requested that the numerator and denominator be given. Andy also asked what the velocities were at certain locations in the water column; since the depth-averaged velocity may not be the best metric to show when there are potentially complex velocity eddies around the Muddy Run tailrace. Terry Euston indicated that the raw data would be reviewed to determine if velocities over the vertical water column could be included in the study report, rather than a depth averaged velocity-**Action Item**.

<u>Thursday March 10, 2011</u>

Conowingo 3.13 – Study to Assess Tributary Access in Conowingo Pond (Enn Kotkas)

Enn Kotkas (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Bob Sadzinski asked for clarification of the extra survey and Enn stated that it was because of the low pond level due to a LIDAR survey that occurred in mid-September. Bob Sadzinski also asked if boat size was taken into account when assessing tributary access. Bob Sadzinski indicated that the launches with obstructions (bridges) should have signs indicating low overhangs. Andy Shiels requested frequency tables of Conowingo Pond waters levels in lieu of the frequency graphs currently included in the study report-**Action Item**.

Conowingo 3.8 – Downstream Flow Ramping and Fish Stranding Study (Terry Euston)

Terry Euston (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Mike Hendricks requested that arrows showing when the stranding surveys occurred be added to the water level figures within the study report-**Action Item**.

Don Pugh asked if the individual stranding data could be extrapolated over a season, and if one minimum flow yielded less bird predation than another. Tom Sullivan indicated that the study was meant to characterize individual events, and that the data was not meant to be extrapolated. Don Pugh also asked if an estimate of dewatered areas could be provided for different flow pairs. Terry stated that there was not existing aerial photography/mapping under the various minimum flow conditions to make an accurate assessment of dewatered area.

Don Pugh also asked if there was any assessment of connectivity between the stranded areas completed, and whether any relationships with connectivity and predation or flow could be developed. Terry stated that only a qualitative assessment of connectivity could be completed based on data collected as part of this study.

Conowingo 3.18 – Characterization of Downstream Aquatic Communities (John Pierce – Phone)

John Pierce (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Andy Shiels requested a fish length frequency distribution be completed for the 2010 West Fish Lift data (i.e., fish length-weight data) to supplement the current study report.-**Action Item**.

Bob Sadzinski and Andy Shiels expressed concern that collecting fish from different times of year may throw off the weight vs. length relationship. Terry indicated that this is possible, but there is no way to separate the cumulative dataset out by individual season. Bob Sadzinksi suggested that the length/weight relationship regression relationships for yellow perch seem to have changed from the 1980s to present.

Conowingo 3.21 – Impact of Plant Operations on Migratory Fish Reproduction (Steve Leach, Brian Hanson – Phone)

Brian Hanson and Steve Leach (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Mike Hendricks asked when the Year Two study plan would be ready for the ichthyoplankton sampling. Terry Euston stated that the ichthyoplankton study plan would be circulated to stakeholders on March 18, 2011-**Action Item**. Mike also indicated that there was a need for more field observational information on American shad spawning locations in the river below Conowingo Dam. Steve Leach indicated that the Year Two ichthyoplankton sampling would help address this issue, along with the results of the Instream Flow Study (Conowingo 3.16).

Conowingo 3.24 – Zebra Mussel Monitoring Study (Steve Adams)

Steve Adams (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. It was asked if Exelon is doing any treatment for zebra mussels. Kim Long (Exelon) indicated that Exelon is considering treatment, but that there is no current plan in place.

Muddy Run 3.4 –Impacts of Muddy Run Project on Conowingo Pond Fishes (Terry Euston)

Terry Euston (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Andy Shiels asked if black crappie was present and if the population was healthy. Terry Euston indicated they are present, but have always been lower in abundance than white crappie. Andy Shiels asked why relative weight was used in this study report, while condition factor was used for fish lift data evaluated as part of Conowingo 3.18. Terry Euston indicated that MDNR has used relative weight recently and this study tried to mimic their methods for easy comparison. Aaron Henning (SRBC) asked if the data showed any logperch within Conowingo Pond. Terry stated that this species had been caught in all gear types.

Muddy Run 3.6 – Interactions with the PBAPS Thermal Plume (Terry Euston)

Terry Euston (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Larry Miller asked for clarification as to the withdrawal capacity and cooling water temperature differential at the Peach Bottom Station. Terry replied that the Peach Bottom withdrawal capacity is approximately 3,450 cfs, while the design cooling water temperature differential is approximately 22°F.

Session 3: Water Quality

Conowingo 3.1 – Water Quality in Conowingo Pool and below Dam (Ray Bleistine, Steve Adams)

Steve Adams and Ray Bleistine (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. John Mudre (FERC) asked if the boils of the larger units had lower DO readings. Ray indicated that some of the boil readings were rather low, but this was primarily during low-flow summertime periods, just after turbine start-up. He then mentioned that during low-flow periods the larger units are rarely used. Larry Miller followed up with a request that the run times of the turbine units in July and August of 2010 be analyzed versus previous years to see if the collected data was a representative sample-**Action Item**. Bob Sadzinski suggested that a GIS map be considered for Conowingo Pond DO levels, to show the areas of higher and lower DO.

Muddy Run 3.1 – Water Quality Study (Ray Bleistine, Steve Adams)

Steve Adams and Ray Bleistine (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Mike Helfrich requested information related to the dead storage volume versus the active storage volume for the Muddy Run Power Reservoir-**Action Item**[1]. Tom Sullivan indicated that Exelon anticipated completing a Year Two study related to Water Quality at Muddy Run.

Conowingo 3.14 – Debris Management (Marjie Zeff)

Marjie Zeff (URS) presented the study objectives, work completed, findings, and schedule for this study. Shawn Seaman (MDNR) asked how the estimates of the amount of debris that sank, was removed, and passed were derived. Tom Sullivan (Gomez and Sullivan) responded that the source of these estimates will be provided-**Action Item**. Andy Shiels (PFBC) stated that the report should depict where debris along Conowingo Dam is collected and removed**-Action Item**.

Conowingo 3.15 – Sediment Introduction and Transport (Marjie Zeff)

Marjie Zeff (URS) presented the study objectives, work completed, findings, and schedule for this study. In response to a question from Larry Miller (USFWS), Marjie Zeff (URS) indicated that historic maps would be included in the final report. Woohee Choi (FERC) mentioned that wind influences can impact sediment movement when water depths are 20 feet or less. Mike Helfrich (Riverkeeper) requested that the study report include the peak flows associated with Hurricane Hazel (1954) and Tropical Storms Connie and Diane (1955), as well as the storm events examined in the HEC-6 modeling analysis-**Action Item**. Mike also contended that the Hazel, Connie, and Diane storms did not cause significant flood events (greater than ~400,000 cfs) to result in scour within Conowingo Pond.

[1] The water storage between elevations 520 feet and 470 feet is available for generation purposes at the Muddy Run Power Reservoir. The volume of water between these elevations constitutes approximately 60% of the total storage in the Power Reservoir.

There was a discussion on the objectives and data sources for the USGS HEC-6 model. Mike Helfrich expressed concern that the modeling completed does not address any future storms, and that the bathymetry used in the model may be outdated. Marjie Zeff responded that the goal of the HEC-6 modeling was to take a more detailed look at historic storm events to better understand the local movement and distribution of sediment during those events.

Session 4: Water Use

Muddy Run 3.2 –Hydrologic Study of Muddy Run Water Withdrawal and Return Characteristics (Kirk Smith)

Kirk Smith (Gomez and Sullivan) presented the study objectives, work completed, findings, and schedule for this study. Woohee Choi (FERC) asked why the Muddy Run withdrawal and discharges were greater during a 30-day low flow period than the 30-day high flow period. Kirk Smith responded that the low-flow and high-flow periods were referring to the Susquehanna River flow, and that river flow does not necessarily have any correlation with Muddy Run operations. Kirk stated that Muddy Run operations are typically driven by power demand, which likely explains the difference.

Larry Miller requested that if more bathymetry and/or velocity data is collected this year that the shad staging area near Sicily Island be included in the survey-**Action Item**. It was suggested that a note be included on the bathymetry map indicating normal pool elevation. Drew Dehoff (SRBC) requested that an hourly maximum withdrawal and discharge be included for each period in the final report for all analyzed periods-**Action Item**.

With regard to the bathymetric mapping of the Muddy Run tailrace, Jim Spontak (PFBC) requested that the normal water surface elevation be included on the map, and Andy Shiels (PFBC) requested that the location of the Muddy Run draft tubes be included on the map-**Action Item**.

Conowingo 3.11 – Hydrologic Study of the Lower Susquehanna River (Gary Lemay)

Gary Lemay (Gomez and Sullivan) presented the study objectives, work completed, findings, and schedule for this study. Don Pugh (American Rivers) asked when the Conowingo USGS gage had most recently been verified. Gary Lemay responded that he believes it was last year, but that it was at minimum flow, which does not apply well to flows at 40,000 cfs, where the inconsistencies were being noticed[2]. Only four flow verification measurements have taken place since 1980, two of which were below 4,000 cfs, and two of which were above 200,000 cfs.

Conowingo 3.20 – Salinity and Salt Wedge Encroachment (Gary Lemay)

[2] A review of the USGS gage data reveals that the last verification was in the fall of 2009, at 3,910 cfs http://waterdata.usgs.gov/nwis/measurements/?site_no=01578310&agency_cd=USGS

Gary Lemay (Gomez and Sullivan) presented the study objectives, work completed, findings, and schedule for this study. Don Pugh (American Rivers) asked if salinity tolerances for young-of-year had been provided. Gary Lemay indicated that no analysis had examined those thresholds. Bob Sadzinski stated that he could provide data comparing yellow perch young-of-year and egg collections to salinity levels. Follow-up conversations with Bob Sadzinski and Paul Piavis (MDNR) yielded information relating to eggs, larval, and young-of-year yellow perch. Observational data showed that eggs could tolerate salinities up to 8 ppt. Larvae tolerated salinities up to 12-13 ppt. Young-of-year have been collected in salinities as high as 13 ppt. Paul Piavis also stated that the preferred salinity levels for these life stages would likely be closer to 2 ppt. This is well above the maximum salinity level recorded at any of the salinity stations, where the maximum salinity recorded was 0.46 ppt at the MDNR station.

Conowingo 3.29 – Effect of Project Operations on Downstream Flooding (Gary Lemay)

Gary Lemay (Gomez and Sullivan) presented the study objectives, work completed, findings, and schedule for this study. Woohee Choi (FERC) requested that the HEC-RAS model cross-sections be provided-**Action Item**. Woohee Choi (FERC) also requested information related to Conowingo's Flood Operations Plan-**Action Item**.

<u>Friday, March 11, 2011</u>

Session 5: Recreation, Shoreline Management, Cultural Resources

Muddy Run 3.11 – Recreational Inventory and Needs Assessment (Bud Newell)

Bud Newell (TRC) presented the study objectives, work completed, findings, and schedule for this study. Mike Hendricks (PFBC) noted that a few specific recreation areas had parking shortages, such as the mouth of Deer Creek during the hickory shad run. Bob Sadzinski and Kevin Mendik (National Park Service) asked if Exelon had a web page showing recreation facilities, and what methods of outreach were being employed by Exelon. Shawn Seaman (MDNR) expressed concern that perhaps the incorrect groups were being targeted in the recreation user survey, and that Exelon should reach out to those who may be interested in using the facilities but for whatever reason are not. Andy Shiels stated that where the users originate is important, and Bob Sadzinski recommended collecting a zip code from those being surveyed to get at this answer. Terry Euston mentioned that the zip code of all anglers interviewed as part of the creel survey was recorded. Tom Sullivan requested input for the stakeholder list, and some local residents provided suggestions.

Conowingo 3.26 – Recreational Inventory and Needs Assessment (Bud Newell)

Bud Newell (TRC) presented the study objectives, work completed, findings, and schedule for this study. Lee Haille expressed concern with the 400-yard boating access restriction above and below Conowingo Dam. Lee stated that a float line will not stop a security threat, and it restricts what would otherwise be good fishing areas. Doug Clark also expressed concern with the time limits for the Conowingo Fishermans Park, as he and others he knows like to go nighttime float fishing, but they cannot access the boat ramp after certain hours.

A discussion was held relative to the closing of the Rock Run boat ramp, and whether it should be addressed in the study report since it is outside the project boundary. Bud Newell (TRC) stated that boat ramp would be included in the regional discussion of available facilities, but would not receive the same level of treatment as facilities within the project boundary. Several stakeholders reiterated that parking at Deer Creek is not adequate for certain times of the year.

Muddy Run 3.12 – Shoreline Management and Conowingo 3.27 – Shoreline Management (Bud Newell)

Bud Newell (TRC) presented the study objectives, work completed, findings, and schedule for these studies. In response to a question from Larry Miller (USFWS), Bud confirmed that Year One study results (i.e., wetland, significant habitats) would be considered in the shoreline management planning process.

Muddy Run 3.10 – Creel Survey of Muddy Run Recreation Lake (Mike Martinek)

Mike Martinek (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. Mike Hendricks (PFBC) asked if parking availability was investigated at all of the creel survey locations. Mike Martinek (Normandeau) indicated that it was not. Andy Shiels (PFBC) stated that it would be helpful if the study report could identify pulses of angling activity related to PFBC stocking activities-**Action Item.**

Conowingo 3.25 – Creel Survey of Conowingo Pond and the Susquehanna River (Mike Martinek)

Mike Martinek (Normandeau) presented the study objectives, work completed, findings, and schedule for this study. It was suggested that the final report include seasonal use, as well as a weekday/weekend breakdown of results-**Action Item**. It was also requested that the length-frequency distribution based on the creel survey results be included in the final report-**Action Item**. Shawn Seaman requested that the aerial photos from the surveys be included in the final report-**Action Item**. Andy Shiels suggested the black bass catch data be partitioned by season (i.e., catch and release)-**Action Item**. Bob Sadzinski (MDNR) asked for the raw data to be included with the report, as well as length-frequency distributions. Tom Sullivan indicated that this information will be included in the study report-**Action Item**. Mike Helfrich suggested that creel survey data from for the fisherman's wharf and Conowingo tailrace be partitioned to examine the impacts of the catwalk closing.

Conowingo 3.32 – Re-evaluate the Closing of the Catwalk (Tom Sullivan)

Tom Sullivan (Gomez and Sullivan) presented the study objectives, work completed, findings, and schedule for this study. Shawn Seaman stated that the study summary included no comparison of fishing access at other projects (Safe Harbor) relative to Conowingo. Kevin Mendik (National Park Service) said that even though a security consultant made a determination that there was a threat posed by re-opening the catwalk, Exelon could still choose to do otherwise.

Several stakeholders suggested that Exelon did not investigate the feasibility of re-opening the catwalk, since no steps were identified showing what would have to be done in order for the catwalk to be reopened, such as completing a cost estimate for increased security presence to monitor the catwalk. It was also suggested that fisherman safety (i.e., accidents on the catwalk) be documented, as well as a risk assessment analysis to anglers on the catwalk.

Muddy Run 3.14 – Cultural Resource Review and Assessment (Kirk Smith)

Kirk Smith (Gomez and Sullivan) presented the study objectives, work completed, findings, and schedule for this study. In response to a question from Emily Carter (FERC), Kirk stated that Exelon hopes to file the Historic Properties Management Plans as part of the project license applications.

Conowingo 3.28 – Cultural Resource Review and Assessment (Kirk Smith)

Kirk Smith (Gomez and Sullivan) presented the study objectives, work completed, findings, and schedule for this study. There were no questions or comments.

Muddy Run 3.13 – Visual and Noise Assessment (Kirk Smith)

Kirk Smith (Gomez and Sullivan) presented the study objectives, work completed, findings, and schedule for this study. Mike Helfrich requested that the field notes be provided so that specific noise sources could be determined at each assessment site-**Action Item**.

Session 6: Terrestrial and Wetland Resources

Muddy Run 3.9 – Bog Turtle and Rough Green Snake Habitat Study (Deb Poppel)

Deb Poppel (URS) presented the study objectives, work completed, findings, and schedule for this study. Andy Shiels (PFBC) asked why no other herptiles were noted on any of the bog turtle Phase I surveys. Deb Poppel responded that the time expended to determine whether the wetland was potential bog turtle habitat was limited to the amount of time necessary for the habitat evaluation, and additional time was not spent searching for herpetofauna. Because the wetland areas investigated were very small, the time needed to make an accurate habitat determination was not substantial, and therefore it is not unusual that no animals were observed. However, Deb will review her field notes to confirm that no herpetofauna were observed during the field collection of information for the overall project area landscape habitat descriptions.-**Action Item**.

Conowingo 3.12 Water Level Management (Mike Rondinelli)

Mike Rondinelli (URS) presented the study objectives, work completed, findings, and schedule for this study. Doug Clark (Coastal Conservation Association) requested that the study include a description of critical water levels associated with the management of Conowingo Pond (e.g., the minimum pond level that requires a shutdown of the Peach Bottom Atomic Power Station).

Doug also noted recreational boat access issues at several launches can become apparent at low Conowingo Pond levels.

Conowingo 3.17 – Downstream EAV/SAV Study (Mike Rondinelli)

Mike Rondinelli (URS) presented the study objectives, work completed, findings, and schedule for this study. In response to a question from Larry Miller, Bryan Strawn (URS) stated that the vegetative communities below Conowingo Dam were generally similar to those seen in other reaches of the Susquehanna. In response to a question from Larry Miller, Mike Rondinelli indicated that the growth of EAV appears to be limited by the availability of substrate.

Muddy Run 3.7 – Transmission Line Avian Interaction Study (Deb Poppel)

Deb Poppel (URS) presented the study objectives, work completed, findings, and schedule for this study. No major comments or questions.

Muddy Run 3.8 and Conowingo 3.23 – Critical Habitat use Areas for Bald Eagle (Deb Poppel)

Deb Poppel (URS) presented the study objectives, work completed, findings, and schedule for this study. In response to a question from Doug Clark, Deb stated that assessment of the eagle nest in the Holtwood tailrace was not included as part of these studies, as its management is PPL's responsibility.

Muddy Run 3.15 and Conowingo 3.30 – Osprey Nesting Survey (Deb Poppel)

Deb Poppel (URS) presented the study objectives, work completed, findings, and schedule for this study. It was agreed that the coordinates of the identified osprey nests should be provided to the Pennsylvania Game Commission and the MDNR Wildlife and Heritage Service. Deb indicated that a work plan for the Year Two Osprey nesting study would be circulated to stakeholders by Friday, March 18, 2011-**Action Item**.

Conowingo 3.31 – Black-Crowned Night Heron Nesting Survey (Deb Poppel)

Deb Poppel (URS) presented the study objectives, work completed, findings, and schedule for this study. Deb indicated that a work plan for the Year Two black-crowned night heron nesting study would be circulated to stakeholders by Friday, March 18, 2011-**Action Item**.

Tom Sullivan stated that Exelon would like to convene a conference call on March 28th, 2011 from 1:00 pm to 3:00 pm, and a follow-up meeting on April 7th, 2011 from 11:00 am to 4:00 pm at the Conowingo Visitors Center to discuss the following Year Two study plans, which require spring field work commencing in April 2011.

1. Conowingo 3.3-Biological and Engineering Studies of American Eel at the Conowingo Project (i.e., American eel sampling below the Conowingo Dam spillway)

2. Conowingo 3.5- Upstream Fish Passage Effectiveness Study (i.e., American shad radio telemetry study)
3. Conowingo 3.21- Impact of Plant Operations on Migratory Fish Reproduction (i.e., Ichthyoplankton sampling below Conowingo Dam)
4. Conowingo 3.30- Osprey Nesting Survey
5. Conowingo 3.31- Black-crowned Night Heron Nesting Survey
6. Muddy Run 3.15- Osprey Nesting Survey

Several resource agencies stated that they would have to give further consideration to Exelon's proposed meeting schedule before making a determination on whether to participate.

Exelon Proposed Year Two Studies

Year Two Studies for the Conowingo Project

RSP No.	Study	Description
3.2	Downstream Fish Passage Effectiveness Study	Balloon tagging field entrainment study of adult and juvenile American shad.
3.3	Biological and Engineering Studies of American Eel at the Conowingo Project	American eel sampling below the Conowingo Dam spillway.
3.4	American Shad Passage Study	Development of shad population model in consultation with stakeholders.
3.5	Upstream Fish Passage Effectiveness Study	American shad radio telemetry study below Conowingo Dam.
3.10	Maryland Darter Surveys	Second year of survey program
3.21	Impact of Plant Operations on Migratory Fish Reproduction	Ichthyoplankton sampling below Conowingo Dam.
3.22	Shortnose and Atlantic Sturgeon Life History Studies	Second year of placement of acoustic receiver array below Conowingo Dam.
3.23	Study to Identify Habitat Use Areas for Bald Eagle	Winter roost surveys.
3.26	Recreational Inventory and Needs Assessment	Recreation plan development.
3.27	Shoreline Management	Shoreline management plan development.
3.28	Archaeological and Historic Cultural Resource Review and Assessment	Phase IB Archeology Survey and Phase II Historic Structures Evaluation
3.30	Osprey Nesting Survey	Second year of nesting surveys.
3.31	Black-crowned Night Heron Nesting Survey	Second year of nesting surveys.

Year Two Studies for the Muddy Run Project

RSP No.	Study	Description
3.1	Water Quality Study	Second year of water quality sampling in the MR Power Reservoir and Tailrace
3.3	Adult American Eel Telemetry Study Juvenile American shad Telemetry Study	Radio telemetry studies near the MR Tailrace.
3.5	Nearfield Effects of the Muddy Run Project on Migratory Fishes	Water velocity measurements in the MR Intake Canal and Tailrace.
3.8	Study to Identify Critical Habitat Use Areas for Bald Eagle	Winter roost surveys.
3.9	Rough Green Snake Habitat Study	Rough green snake presence/absence surveys.
3.11	Recreational Inventory and Needs Assessment	Recreation plan development.
3.12	Shoreline Management	Shoreline management plan development.
3.14	Archaeological and Historic Cultural Resource Review and Assessment	Phase IB Archeology Survey and Phase II Historic Structures Evaluation.
3.15	Osprey Nesting Survey	Second year of nesting surveys.

Exelon

Attachment A-List of Attendees

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Attachment B-Meeting Presentation

Conowingo Hydroelectric Project (FERC No. 405)
Muddy Run Pumped Storage Project (FERC No. 2355)

Initial Study Report Meeting

March 9-11, 2011

Purpose of the Initial Study Report Meeting [18 CFR 5.15(C)(2)]

- Within 15 days following the filing of the Initial Study Report (February 22, 2011), the Applicant shall hold a meeting with licensing participants and Commission staff to discuss the study results and the potential applicant's and/or other participant's proposals, if any, to modify the study plan in light of the progress of the study plan and the data collected.

Meeting Objectives

- Discuss the results of the relicensing studies to date

- Discuss any upcoming study activities

- Discuss any proposed study modifications and/or proposals based on the results and data provided at the meeting

Criteria for Modification of Approved Study [18 CFR 5.15(d)]

- Any proposal to modify an ongoing study must be accompanied by a showing of good cause why the proposal should be approved, and must include, as appropriate to the facts of the case, a demonstration that:
  - Approved studies were not conducted as provided for in the approved study plan; or
  - The study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way.

Criteria for New Study [18 CFR 5.15(e)]

- Any proposal for new information gathering or studies must be accompanied by a showing of good cause why the proposal should be approved, and must include, as appropriate to the facts of the case, a statement explaining:
  - Any material changes in the law or regulations applicable to the information request;
  - Why the goals and objectives of any approved study could not be met with the approved study methodology;
  - Why the request was not made earlier;
  - Significant changes in the project proposal or that significant new information material to the study objectives has become available; and
  - Why the new study request satisfies the seven (7) study criteria.

Seven Study Criteria [18 CFR 5.9(b)]

- Identify goals and objectives of the study proposal
- Identify relevant management plans
- Relevant public interest (if not a resource agency)
- Describe existing information and the need for additional information
- Explain any nexus between project operations and effects to studied resource and how the results would inform the development of license requirements
- Explain how any proposed study methodology is consistent with generally accepted scientific practice
- Describe level of effort and cost and why any alternatives would not be sufficient to meet stated information needs.

Relicensing Process Dates

Exelon

- Initial Study Report Meeting (All Stakeholders and Exelon)
  - March 9-11, 2011
- Initial Study Report Meeting Summary Filed (Exelon)
  - March 28, 2011
- Study Disputes/Requests to Modify Study Plan Due, *if no one files a disagreement, the amendment to the study plan is deemed approved* (All Stakeholders)
  - April 27, 2011
- Responses to Disputes/Study Requests Due (All Stakeholders)
  - May 27, 2011
- Last date for the Director to resolve disagreements and amend the approved study plan (FERC)
  - June 27, 2011

Fish and Aquatics

Conowingo 3.10-Maryland Darter Surveys

- Study Objective
  - Determine if Maryland darter are present in the Susquehanna River below Conowingo Dam and/or the lower riffles of Deer and Octoraro creeks.

- Work Completed
  - Deer Creek – October and November, 2010
    - Six sampling sites to date (5 electrofisher/seine combination; 1 snorkeled)
    - Included the so-called Stafford Bridge riffle – the only location within the study area that Maryland darter has ever been found
    - Ice prevented sampling from December through present
  - Octoraro Creek – October and November, 2010
    - Three sampling sites to date (electrofisher/seine combination)
    - Ice prevented sampling from December through present
  - Susquehanna River – January and February, 2011
    - Used electrified benthic trawl
    - 33 sites sampled over four day period in January
    - 12 sites sampled on 20 February (NOTE: study report was submitted prior to this sampling event)
- Findings
  - No Maryland darters have been collected or observed
  - Five of six darter species known to occur in the study area have been collected = sampling program is effective for darters
  - Through January, 43 species representing 11 families have been collected
  - Number of species per water body to date: Deer C. – 40; Octoraro C. – 37; Susquehanna R. – 12 through January (+4 additional species collected in February after the progress report was submitted)

- Work Remaining & Schedule
  - Deer Creek – tentatively scheduled for March (electrofisher/seine); spring, summer, early fall (electrofisher/seine & snorkeling)
  - Octoraro Creek – tentatively scheduled for March (electrofisher/seine); spring, summer, early fall (electrofisher/seine & snorkeling)
  - Susquehanna River – tentatively scheduled for March (elec. benthic trawl); spring, summer, early fall (elec. benthic trawl & snorkeling)

Conowingo 3.22-Shortnose and Atlantic Sturgeon Life History Studies

- Study Objective
  - Review shortnose and Atlantic sturgeon status, occurrence in the Susquehanna River, and habitat requirements.
  - Compare Conowingo east fish lift and any East Coast passage facilities where successful upstream passage has been documented.
  - Assess habitat availability below Conowingo Dam.
  - Assess sturgeon stranding below Conowingo Dam.
  - Monitor the lower Susquehanna River for use by sturgeons.
- Work Completed
  - Literature review of sturgeon status, occurrence, and habitat requirements with emphasis on Susquehanna River and regional information.
  - Comparison of the Conowingo east fish lift with two facilities documented to pass / collect both shortnose and Atlantic sturgeons.
  - Monitored the lower Susquehanna River for acoustic transmitter tagged sturgeons from March 24 – November 8 +.
  - Potential stranding sites examined after peak generation periods in 12 events from April 29 – November 17, 2010 (Study 3. 8-Downstream Flow Ramping and Stranding Study).
  - An analysis of project operational impacts on shortnose sturgeon habitat below Conowingo Dam is being conducted in a separate study (Study 3.16-Instream Flow Habitat Assessment Below Conowingo Dam).
- Findings
  - Contemporary records of shortnose sturgeon are limited and there is no contemporary record of Atlantic sturgeon in the river;
  - Suitable habitat appears to exist in the lower river and upper Chesapeake Bay, but water quality could be limiting.
  - No acoustic transmitter tagged fish (from Delaware River or lower Chesapeake Bay) were detected using the Susquehanna River during 2010.
  - No evidence of stranding below Conowingo Dam.
- Work Remaining
  - Informal Consultation with NOAA to determine what, if any additional studies are required for 2011.
- Schedule
  - Study Report has been completed
  - Informal consultation will follow Initial Study Report Meeting.

Conowingo 3.16-Instream Flow Habitat Assessment below Conowingo Dam

- Study Objective
  - Determine the relationship between flow and aquatic habitat conditions in the Susquehanna River below Conowingo Dam

- Work Completed
  - Development and calibration of hydraulic model
  - Selection of Habitat Suitability Indices (HSI) for target species/life stages
  - Development of habitat models for all target species/life stages

- Findings
  - Habitat (WUA) versus flow relationships for target species/life stages

- Work Remaining
  - Habitat analysis for mussel species using hydraulic model output parameters
  - Habitat persistence analysis for immobile target species/life stages (e.g., spawning , fry, macroinvertebrates) at combinations of the current minimum flows and full generation flow
  - Habitat time series analysis for all target species/life stages for alternative flow regime scenarios (i.e. existing conditions).

- Schedule
  - Completion of Study Report in April 2011

Conowingo 3.19-Freshwater Mussel Characterization Study below Conowingo Dam

- Study Objectives
  - Characterize the freshwater mussel community in 4.5 miles of the Susquehanna River below Conowingo Dam
  - Determine if plant operations at Conowingo Dam affect the mussel community in this river reach
- Work Completed
  - Search for published and unpublished locality records
  - Semi-quantitative mussel survey
  - Quantitative mussel survey
  - Habitat parameter measurements
- Findings
  - Contacts with nine museums identified two species collected in the study reach in the 1960s and two other species collected several miles downstream in the 1950s. The Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment reported six species collected in the survey reach in 2008-2010.
  - A total of 4,265 live mussels of five species were observed in a total of 87.4 search hours of semi-quantitative survey at 72 stations. The majority (96.5%) were eastern elliptio, a species widely observed in Maryland. Two other species were identified from dead/empty shells. None of the seven species appear on the official State Threatened and Endangered Species List and none are Federally-listed.
  - The highest numbers of mussels ($\geq$ 100 mussels per search hour) were observed in the lower part of the study reach, mostly near Robert, McGibney, Spencer, and Sterrett islands. Fewer than 5 mussels per search hour were observed at 16 stations, mostly in the upstream end of the study reach, but here and there in the middle and lower end of the study reach as well.
  - Quantitative sampling (0.25 m^2 quadrats following a systematic sampling design) at five stations resulted in total mussel density estimates ranging from 2.13 to 4.27 mussels/m^2, with the highest densities observed near McGibney Island. The majority (94.8%) of the live mussels collected were eastern elliptio, with small numbers of two other species also observed.
  - Small numbers of juvenile eastern elliptio (shell length < 50 mm) were observed in the semi-quantitative and quantitative surveys, suggesting that the species is reproducing in the study reach. The presence of large individuals (> 135 mm shell length) suggests that fluctuating river conditions do not exceed ecological requirements for eastern elliptio. Overall, any effects of Conowingo Project operation on the downstream mussel community are not discernable and likely not ecologically significant.
- Work Remaining
  - None
- Schedule
  - Study Report has been completed

Fish Passage

Conowingo 3.2-Downstream Fish Passage Effectiveness Study

- Study Objective
  - Provide estimates of entrainment and impingement potential and survival for the three turbine types at the Conowingo Project for target fish species using existing data, and describe downstream fish passage measures already in place.
  - The target fish species are American eel, American shad, bluegill, channel catfish, gizzard shad, largemouth bass, smallmouth bass, and walleye.
- Work Completed
  - Project description relative to impingement, entrainment and survival of target species.
  - Life history and habitat requirements of target species.
  - Assessment of the potential for target species/life stages to be impinged on Project trash racks.
  - Calculation of survival probabilities for target species/life stages passed through three turbine types at the Project using models developed by Franke et al. (1997).
- Findings
  - Impingement unlikely unless fish are stressed. Trash rack spacing (5.375 inches) sufficient to pass all but very large (30 inch) channel catfish.
  - Turbine survival probability is a function of size more than species. Initial calculations predict survival for small fish (<8 inches) to range between about 94-99% for the Kaplan and Francis turbines. For fish up to 30 inches which could include large juvenile or adult American eel, adult American shad, adult channel catfish and adult walleye, survival potential ranges from about 76-91% with higher survival potential through the Kaplan turbines.
- Work Remaining
  - Review of target species in Conowingo Pond.
  - Assessment of entrainment potential based on comparison to other projects.
  - Assessment of survival potential based on comparison to other projects.
- Schedule
  - Completion of Study Report in March 2011.

Conowingo 3.5 Upstream Fish Passage Effectiveness Study

- Study Objective
  - Estimate the upstream fish passage effectiveness of migratory adult American shad at Conowingo EFL
  - Identify factors that may influence EFL effectiveness on a daily or seasonal basis
- Work Completed
  - 151 adult American shad were radio-tagged and released downstream of Conowingo Dam
  - 102 shad were angled, tagged and released directly into Conowingo tailrace
  - 49 shad were trapped, tagged, and transported 5 miles downstream to Lapidum, Maryland
  - 75 shad were tagged, and released in April for the early-mid shad run segment
  - 76 shad were tagged and released in May for the mid-late shad run segment
- Findings
  - Under existing station and EFL operational conditions, 58.9% (89 of 151) of all radio-tagged were detected in the tailrace, making them accessible to the EFL, while the remaining 41.1% (62 of 151) did not re-enter the tailrace
  - **Fishway Attraction Effectiveness**: of the 89 radio- tagged shad, 73.0% (65 of 89) entered into the EFL
  - **Upstream Fish Passage Efficiency**: of the 89 radio-tagged shad detected in the tailrace, 44.9% (40 of 89) completed passage through the EFL
  - **Upstream Fish Passage Effectiveness:** of the 89 radio-tagged shad detected in the tailrace, 43.8% (39 of 89) completed passage through the EFL and remained upstream for 48 or more hours after passage
- Work Remaining
  - Collect all American shad by means of angling and release immediately upon tagging to reduce transport stress
  - Analyze EFL structures and hydraulics to increase shad retention inside the structure and to improve passage from the Entrance Channels to the Hopper
  - Compare unit preference in relationship to **fishway attraction effectiveness** for 2010 and 2011 shad run seasons
- Schedule
  - Study Report has been completed
  - 2011: Begin adult American shad tag and release in April

Conowingo 3.6 Attraction Flow Study

- Study Objective
  - Review/analyze applicable historical data (2001-2009)
  - Analyze 2010 turbine generation, water temperature, attraction flow velocity data, and hourly fish passage data
  - Analyze radio-telemetered shad passage as it relates to EFL and Conowingo station operations

- Work Completed
  - Analysis of Historical Data (2001-2009)
  - Analysis of Station and EFL operations, attraction flow velocity data and hourly fish passage data
  - Analysis of radio-telemetered shad passage relating to EFL and Conowingo station operations

- Findings
  - No strong correlation between station generation, attraction flow velocity, and fish passage
  - 89 radio tagged shad monitored in tailrace
  - 65 of 89 shad detected in EFL (73% attraction effectiveness)
  - 40 of the 65 RT shad successfully passed upstream
  - Remaining 25 RT shad made forays into the EFL but did not pass upstream
  - Overall passage efficiency of radio-tagged shad was 44.9% (40 of 89 fish)

- Work Remaining
  - None
- Schedule
  - Study Report has been completed

Conowingo 3.7- Fish Passage Impediments Study for the Susquehanna River below Conowingo Dam

- Study Objective
  - Determine if project operations adversely impact upstream migrations of American shad, river herrings (blueback herring and alewife), and Hickory shad
  - Utilize the River2D model (see Conowingo Study 3.16-Instream Flow Habitat Assessment below Conowingo Dam) to ascertain if areas in the tailrace and other portions of the river below Conowingo Dam could present adverse velocity barriers under typical dam operating regimes
- Work Completed
  - Performance of American shad radio telemetry study below Conowingo Dam
  - Development and calibration of hydraulic model
  - Development of velocity models for three Conowingo Dam discharges
- Findings
  - No indication that migratory behavior or movement of radio tagged shad was adversely influenced by operations of Conowingo Dam (discharges between 8,618 and 82,085 cfs) in the 5-mile river reach between the dam tailrace and the Lapidum boat launch area
  - River 2D modeling for three Conowingo Dam discharges indicated that for only the highest (86,000 cfs) discharge, some areas near the dam tailrace and Rowland Island exhibited velocities exceeding burst speed for American shad and river herrings
  - Despite some high velocity areas modeled, there is no evidence to suggest that high velocities impeded migration, based on telemetry data of American shad
- Work Remaining
  - None
- Schedule
  - Study Report has been completed

Conowingo 3.9-Biological and Engineering Studies of the East and West Fish Lifts

- Study Objectives
  - Determine how and to what extent the West Fish Lift and spawning tanks can be expanded to enhance biomonitoring and egg collection to promote American shad restoration
  - Ensure that excess fish taken in the West Fish Lift can be moved upstream so as to contribute to natural spawning stock upstream
  - Conduct an engineering analysis of the remaining life cycle and maximum fish passage capacity of the existing East Fish Lift and West Fish Lift
  - Determine the costs and logistics of upgrading or replacing the existing fish passage facilities
  - Assess the logistics and cost of utilizing the West Fish Lift as an interim measure to increase fish passage at the project via trap and truck
  - Assess the need for, impact of, and logistics and costs of adding the second hopper to the East Fish Lift
  - Investigate modification or replacement of the existing West Fish Lift and a protocol for upstream transport of American shad and river herring collected in the West Fish Lift, but not needed for biomonitoring and/or egg collection programs
  - Investigate other upstream fish passage measures or facilities interim or permanent

- Work Completed
  - Cost alternatives and preliminary layouts for East Fish Lift modifications
  - Cost alternatives and preliminary layouts for West Fish Lift modifications
  - Cost estimates and preliminary layouts for trap-and-transport program

- Findings
  - Replacement of the West Fish Lift with a full-capacity lift is not feasible due to location of the powerhouse
  - Initial cost estimates vary considerably with modification or full replacement alternatives

- Work Remaining
  - Investigate expanded spawning and biomonitoring capabilities
  - Finalize cost estimates and layouts upstream passage alternatives
  - Analyze biological implications of upstream passage alternatives

- Schedule
  - Completion of Study Report in April 2011

Conowingo 3.3-Biological and Engineering Studies of American eel

- Study Objective
  - Describe the spatial distribution and size characteristics of American eels in the Conowingo Dam tailrace and spillway
- Work Completed
  - Sampling for eels in the Conowingo tailrace by USFWS (31 May-2 August)
  - Sampling for eels below the spillway by Exelon (16 June-30 September)
  - Elvers and yellow eels from the spillway area were aged
- Findings
  - Spillway sampling collected 258 eels; 167 elvers and 91 yellow eels
  - Most elvers were caught on the east side of spillway; most yellow eels on the west side
  - Elvers were 92-154 mm; yellow eels were 301-640 mm
  - Relationships to rainfall and lunar phase were weak due to low catch
  - Most elvers Age I & II; most yellow eels Age VII, VIII, IX
  - USFWS caught 24,000 elvers and 28 yellow eels of similar size
- Work Remaining
  - Investigate biological and engineering feasibility of upstream and downstream passage options
- Schedule
  - The study in the spillway will be repeated in 2011
  - Completion of biological and engineering feasibility study report in April 2011

Muddy Run 3.3-Fish Entrainment and Impingement Assessment

- Objective
  - Describe physical characteristics of the intake structures and describe the likely effects of Project-induced entrainment and impingement on target fish resources using Project characteristics and existing fishery information.
  - Target species are: American eel, American shad, bluegill, channel catfish, rock bass, smallmouth bass, walleye and white crappie.
- Work Completed
  - Report written.
- Findings
  - Overall potential for impact to fishes due to entrainment and turbine passage is low-moderate. Standing crop of fish species in MR Reservoir comparable to other lakes and reservoirs. No changes in abundance and distribution of fishes in Conowingo Pond attributable to MR Project.
  - Impingement unlikely unless fish are stressed. Trash rack spacing (5.375 and 5.5 inch) sufficient to pass all but very large (30 inch) channel catfish.
  - Entrainment potential relatively low for juvenile and adult stages of resident target species other than channel catfish, due to swim speeds in excess of intake flow velocity or habitat preferences that generally keep them away from intake structures. Channel catfish more susceptible due to benthic habitat preference and occurrence near intake structures. Life stages most susceptible to entrainment are egg and larvae. Entrainment potential higher during pump-back than generation.
  - Turbine survival probability is a function of size more than species. Survival potential of small (≤4 inches) fishes passing the Project, the life stage more likely to be entrained, is high (≥95%). Survival probability for large adult resident species (30 inch channel catfish and walleye) ranged from moderate (85-90%) to low-moderate (80-85%).
  - Juvenile (yellow) American eel have a small home range, unless home range near intake, entrainment potential is low. Survival potential is moderate (85-90%) to low-moderate (80-85%). Adult (silver) American eel entrainment potential is low-moderate; migrate in upper water column away from intake, but follow flow cues. Survival probability moderate (85-90%) to low (≤80%).
  - Juvenile American shad entrainment expected to be low-moderate due to swim speeds lower than flow velocity at the intake; survival probability is high (95-100%). Adult American shad entrainment is expected to be low, and survival potential moderate (85-90%) to low (≤80%) due to their potential to grow up to 30 inches.
- Work Remaining
  - Adult American eel telemetry study (Fall 2011)
  - Juvenile American shad telemetry study (Fall 2011)
- Schedule
  - Report has been submitted.
  - Adult American eel telemetry study report in January 2012
  - Juvenile American shad telemetry study report in January 2012

Muddy Run 3.3-Study to Monitor Movement of Telemetered American Eel Downstream of Conowingo Dam

- Study Objective
  - Original-evaluate the vulnerability of emigrating silver eels to entrainment by Muddy Run Station
  - Alternate-Compare migratory behaviors of in-basin silver eels with active migrant out-of-basin eels

- Work Completed
  - Sampling for active migrant in-basin eels by fyke nets; proved to be ineffective
  - Obtained adequate samples of in-basin silver eels by electrofishing and emigrating out-of-basin eels at commercial weir
  - Implanted 49 silver eels with acoustic transmitters; 25 out-of-basin; 24 in-basin
  - Eels released in four batches between 27 October and 4 November

- Findings
  - All 25 out-of-basin eels moved four miles downstream to tidal water by 28 November
  - Two of 24 in-basin eels moved to tidal water by 28 November
  - All 27 eels that reached tidal water had left by 2 December
  - Non-tidal reach below Conowingo Dam is a noisy acoustic environment

- Work Remaining
  - Plan for 2011 Study near Muddy Run Project

- Schedule
  - Study Report for 2010 completed.
  - Conduct 2011 study near Muddy Run Project when silver eels become available

Muddy Run 3.5-Near Field Effects of the Muddy Run Project on Migratory Fishes

- Study Objectives
  – Delineate the effects of the Muddy Run operations on upstream and downstream migration of migratory fishes, principally American shad in Conowingo Pond, particularly in the vicinity of the Muddy Run Project
  – Identify temporal and spatial availability of migration zones of passage.
  – Address the potential effects, if any, of pumping and generating operations at Muddy Run on emigration of juvenile and post-spawned American shad, and juvenile and adult American eel (*Anguilla rostrata*)
  – Evaluate the feasibility of installing passive integrated transponder (PIT) tag monitoring equipment at Muddy Run to assess potential entrainment
  – Respond to comments provided by the PA Fish and Boat Commission relative to the 2008 adult American shad radio telemetry study conducted in Conowingo Pond.

- Work Completed
  – The delineation of temporal exposure of upstream migrating adult American shad to Muddy Run operations was performed by examining the passage counts at the Conowingo EFL and Holtwood Fish Lift.
  – Six (6) historical radio telemetry investigations conducted in Conowingo Pond, were reviewed to extract information for assessing the potential effects of Muddy Run on upstream migrating American shad.
  – For juveniles, the emigration period was determined from lift net sampling at Holtwood
  – Data on water velocity and direction in the vicinity of Muddy Run were collected with Acoustic Doppler Current Profiler (ADCP) equipment during station operating conditions (pumping and generating).

- Findings
  – The upstream migration of American shad, as indexed by passage counts, begins in early to mid April (water temperature > 50° F) and extends into early June.
  – The initial run of American shad is comprised primarily of pre-spawned "green" fish with males arriving early and in higher proportion than females; females arrive in greater numbers later in the season. As the season progresses, coincident with increasing water temperatures and typically declining natural river flows, the proportion of ripe, partially spent, and spent (post-spawned) fish increases.

Muddy Run 3.5-Near Field Effects of the Muddy Run Project on Migratory Fishes (cont.)

- Findings Continued
  - Ninety percent of the shad run is completed by late May, generally at water temperatures ≤ 70°F. Low water temperature (< 50° F) and high natural river flow (≥ 150,000 cfs) may delay the onset of passage at Conowingo.
  - Higher water temperatures and low river flows may initiate early passage.
  - American shad passage may also be disrupted or terminated by high river flows during the season.
  - The migration of adult and juvenile American shad through Conowingo Pond occurs in two distinct seasons (spring and fall) with different hydrology for each season.
  - Most adult American shad migrate past Conowingo and Holtwood Dams at river flows < 50,000 cfs
  - A large percentage of American shad successfully passed upstream of Muddy Run at the prevailing hydrological and station operating conditions.
  - In 2008, operations of Muddy Run , as indexed by a joint function of Muddy Run generation or pumping, did not appear to affect the upstream migration of American shad.
  - Some 48.8% of shad migrated past Muddy Run during generation (mostly daytime) and 51.2% during pumping (mostly during evening/night) or shutdowns; the latter conditions were coincident with full discharge from the upstream Holtwood station.
  - Prevailing natural river flows seemed to affect upstream passage to a greater extent. Most shad (86.6%) migrated upstream at river flows < 50,000 cfs.
  - Average travel times of most pre-spawned fish past Muddy Run were short and similar.
  - Most radio-tagged American shad that migrated past Muddy Run had a tendency to congregate near Deepwater Island, Norman Wood Bridge, or selected areas nearer the Holtwood Project.
  - There was little evidence of American shad congregating in the vicinity of Muddy Run ; most successfully migrated past Muddy Run and congregated upstream of the Project
  - The estimated cruising speeds of 0.03 to 0.4 mph compare well with that of prespawned radio-tagged American shad primarily released into more of a “riverine habitat” type.

Muddy Run 3.5-Near Field Effects of the Muddy Run Project on Migratory Fishes (cont.)

- Findings Continued
  - ADCP surveys showed much higher flow velocities during generating operations at Muddy Run.
  - Minimum observed depth-averaged velocities were 0.07 ft/s (0.02 m/s)
  - Average observed depth-averaged velocities were 1.97 ft/s (0.60 m/s)
  - Maximum observed velocities were located proximal to the Muddy Run discharge, during generating conditions, and reached depth-averaged velocities of 5.1 ft/s (1.55 m/s).
  - The highest velocities occurred in a portion of the tailrace just downstream of Muddy Run .
  - Pumping conditions greatly reduced the flow velocities downstream of Muddy Run .
  - Estimated entrainment rates at Muddy Run were considered low (5.1% in 2001 and 3.6% in 2008).
  - The majority of entrainment occurred late in the migration season and all but three of 384 shad were located upstream at Holtwood prior to being entrained.
  - Installation and operation of a PIT tag reader system at the Muddy Run pump intakes is technically feasible, but the potential for missed tag reads and number of antennas and readers required render it impractical.
- Work Remaining
  - Completion of Study Report
  - Revision of 2008 Telemetry Report
- Schedule
  - Completion of Study Report in April 2011

Fish and Aquatics (cont.)

Conowingo 3.13- Study to Assess Tributary Access in Conowingo Pond

- Study Objective
  - Identify potential blockages associated with Project operations to fish and recreational boating access into Conowingo Pond tributaries at the reservoir confluence under several commonly encountered water levels.
  - If access to fish is denied at certain water levels due to Project operations, identify those fish species most affected, when it occurs, and at what water levels.
  - Develop potential mitigation options to enhance fish or recreational access if problems are encountered.

- Work Completed
  - Preliminary field investigations of the Conowingo Pond tributaries were conducted on 14 and 15 June 2010 to identify the 18 tributaries that were included in the more detailed surveys.
  - Two tributary access surveys, one at 109.2 National Geodetic Vertical datum (NGVD) and the other at 107.2 NGVD, were completed between 30 June, 2010 and 30 July, 2010.
  - An additional opportunistic survey was conducted on 18 September, 2010 at selected tributaries when Conowingo Pond elevation was lowered to below 106.2 NGVD.
  - Annual duration curves of Pond elevation were generated for all elevation data available from January 2004 through September 2010. Annual duration curves were also generated for peak recreational periods (weekends only from Memorial Day weekend through Labor Day weekend.
- Findings
  - No evidence was found that fish access into Conowingo Pond tributaries was affected by obstacles that might be exposed at lowered Pond levels, at least not within the Pond levels experienced during the current study (109.2 to 105.8 (NGVD).
  - All four boat launches located inside Conowingo Pond tributaries are accessible to recreational power boats at Full Pond (109.2 NGVD) and minimum recreational Pond (107.2 NGVD) but only Glen Cove boat launch remained usable when Pond elevation was lowered to 105.9 (NGVD).
  - During the peak recreation period in Conowingo Pond the license required minimum recreation pool level of 107.2 NGVD was maintained from 2004 through September 2010. During non peak periods, Pond elevations ranged from a low of 104.1 to a high of 110.1 NGVD between January 2004 and September 2010.
- Work Remaining
  - None
- Schedule
  - Study Report has been completed

Conowingo 3.8-Downstream Flow Ramping and Stranding Study

- Study Objectives
  - Evaluate locations below Conowingo Dam where stranding potential exists; document fish numbers, species affected, and their condition
  - Describe project operations during the survey periods and effects on water levels
  - Relate stranding to characteristics of impacted populations
- Work Completed
  - Conducted 12 stranding studies, 4 each in spring, summer and fall
  - Documented the numbers and locations of various species affected and physical condition
  - Described changes in water levels associated with each survey
  - Related study findings to plant operations for each study
- Findings
  - Spring stranding surveys documented 5,030 fish of at least 14 taxa; 82% were alive
  - Summer stranding studies documented 10,308 fish of at least 13 taxa plus blue crab; 99% were alive
  - Fall stranding studies documented 1,779 fish of at least 12 taxa; 96% were alive
  - Resident fish species formed 90% or more of stranded fish each season
  - Anadromous fish species were found mainly in spring
  - Most dead fish were gizzard shad
  - Most adult fish stranded in the west spillway area nearest the tailrace; east side was mostly juveniles
  - Principal consequences of stranding include desiccation (spring) and predation by birds (fall)
- Work Remaining
  - None
- Schedule
  - Study Report has been completed

Conowingo 3.18-Characterization of Downstream Aquatic Communities

- Study Objectives
  - Conduct a literature-based study to provide a characterization of the current aquatic community below Conowingo Dam
  - Describe the benthic macroinvertebrate communities below Conowingo Dam collected by various common collection gears including rock basket, drift sampler, a Surber sampler, and a T-Sampler
  - Characterize resident fish abundance, size structure, condition, and reproductive success below Conowingo Dam from existing data that includes fish lift catches and results from other common fisheries gear types such as electrofishing, gill nets, and ichthyoplankton nets

- Work Completed
  - Data from 1972 to 2010 was analyzed to provide a characterization of the fisheries and macroinvertebrate communities in the aquatic ecosystem below Conowingo Dam to the area just below Spencer Island.

- Findings
  - Quantitative benthic studies in the non-tidal area of the Lower Susquehanna River below Conowingo Dam from 1980 through 1991 characterized the invertebrate community as moderately rich, moderately dense and generally comprised of facultative or tolerant warm-water genera primarily consisting of:

    Corbicula (clam) Dugesia (flat worm) Goniobasis (gastropod, snail) Manayunkia (fan worm) Oligochaeta (Nais, segmented worm) Cheumatopsyche (caddisflies) Hydroptila (micro-caddisfly) Gammarus (scuds and sideswimmers, arthropods) Chironomidae (Cricotopus, Dicrotendipes, and Polypedilum, midges)

  - EFL, WFL fish catches coupled with electrofishing, gill nets, and ichthyoplankton nets and the 2010 fish stranding study found a core assemblage of inhabitants and migrants consisting of:

gizzard shad	**white perch**	**common carp**	**quillback**	**comely shiner**	**channel catfish**	**walleye**
smallmouth bass	**largemouth bass**	**American shad**	**alewife**	**sea lamprey**	**striped bass**	**blueback herring**

  - Changes to the relative abundance of species within the fish assemblage were evident over the period studied; most notably with regards to clupeids. Gizzard shad became the increasingly dominant species over time, American shad generally increased proportionally, and blueback herring decreased proportionally over the study period.
  - Despite gains in the 1990's and early 2000's American shad collected at the fish lifts has declined since 2001.
  - Condition factor and length weight relationships of representative common fish species downstream of Conowingo Dam are comparable to those from other normal, natural populations and are indicative of relatively favorable conditions and habitats in the lower Susquehanna.

- Work Remaining
  - None

- Schedule
  - Study Report has been completed

Conowingo 3.21- Impact of Plant Operation on Migratory Fish Reproduction

- Study Objective
  - Determine if project operations adversely impact the reproduction of target anadromous fishes: American shad (*Alosa sapidissima*), hickory shad (*A. mediocris*), river herring (blueback herring, *A. aestivalis*, and alewife, *A. pseudoharengus*), striped bass (*Morone saxatilis*), and white perch (*M. americana*) in Conowingo Pond and the Susquehanna River below Conowingo Dam

- Work Completed
  - Review of existing information on 1) spawning habitat requirements for these species, 2) relevant survey data for early life stages for these species and, 3) data regarding characterization of hydraulic conditions below Conowingo Dam

- Findings
  - Based on 1980's ichthyoplankton monitoring, shad telemetry monitoring, and observations, the American shad spawning habitat in the lower Susquehanna River (between Robert, Wood, and Spencer Islands and between Port Deposit and Lapidum) should not be adversely impacted by routine Conowingo Project operations
  - The hickory shad population, based in Deer Creek, is robust and the largest in Maryland and it is evident that suitable habitat is available and being successfully used for spawning in the Susquehanna River and Deer Creek tributary – operations of the Project has not adversely impacted this species
  - River herring early life stages were collected in the lower river in the early survey indicating that suitable spawning habitat was available and utilized and that young were transported downstream
  - River herring populations in the northeast have been in decline for years, and population declines in the Susquehanna River are likely attributable to sources unrelated to Conowingo Project operations
  - There is no evidence that striped bass utilize the Susquehanna River for spawning, thus Conowingo Project operations do not affect this species spawning success
  - White perch spawning habitat was determined to be the upper tidal reach of the Susquehanna River and Conowingo Project operations are considered to impact success spawning minimally
  - Little suitable spawning habitat likely exists in the Conowingo Pond for anadromous fishes based on studies commissioned by the PFBC

- Work Remaining
  - Ichthyoplankton survey in 2011

- Schedule
  - Study report complete
  - Ichthyoplankton surveys results in January 2012

Conowingo 3.24-Dreissenid Mussel Monitoring Study

- Study Objective
  - Determine the presence and abundance of Dreissenid mussels, particularly zebra mussels (*Dreissena polymorpha*) within the Project boundary;
  - Identify potential mitigation measures to minimize the impact of Dreissenid mussels to Project structures.

- Work Completed
  - Three replicate samples were collected at each sampling event for microscopic analysis in the laboratory.
  - All pad samplers and veliger net samples were examined microscopically (30-40X) for Dreissenid mussels. Laboratory examinations were completed on live (unpreserved) samples, usually within 48 hours after collection, using the cross polarization technique.
  - Sampling for detection of settled juvenile mussels was accomplished using three PVC plates, one PVC tube with netting material inside and one scouring pad collector secured at the West Fish Lift in tailrace and in Conowingo Pond (six tube samplers). Natural substrate inspections were conducted at Shure's Landing Area (west shoreline 0.5 mi downstream of Conowingo Dam) for settled juveniles and adults.

- Findings
  - No Dreissenid mussel veligers or settled juveniles were found in any of the collected net or substrate samples collected during the 2010 monitoring period at Conowingo Dam.
  - Sampling frequency increased to weekly at Conowingo Dam in July after Dreissenid mussel veligers were observed in collected samples from the Peach Bottom Atomic Power Station intake area, located approximately six miles upstream of Conowingo Dam.
  - The Asiatic clam (*Corbicula fluminea*), another biofouling organism, was routinely observed in samples taken at Conowingo Dam in June through November 2010.
  - River temperatures during the monitoring period ranged from 9.0°C to 30.0°C (48.2°F to 86.0°F) in the Susquehanna River at Conowingo Dam.

- Work Remaining
  - None

- Schedule
  - Study report has been completed

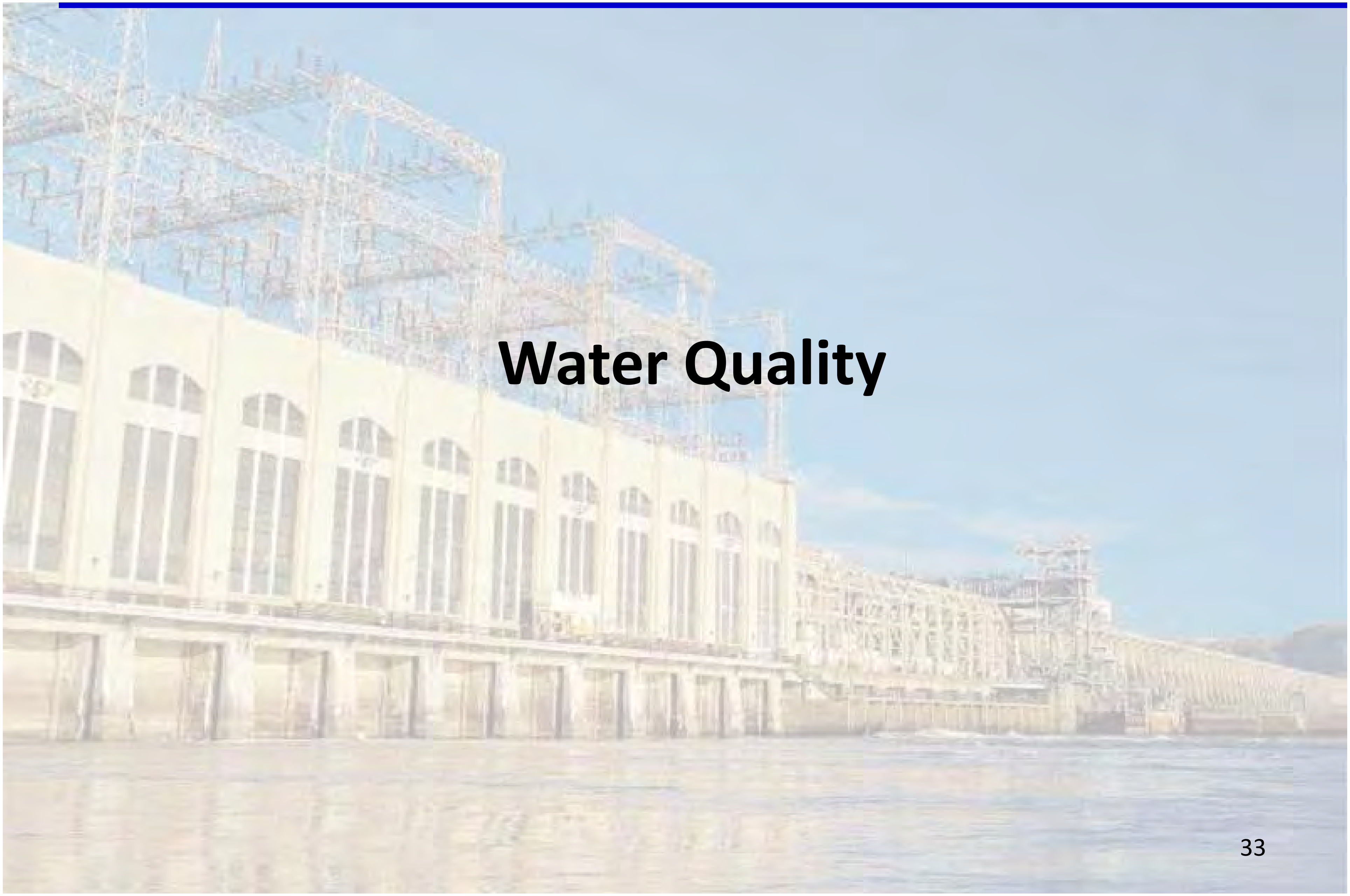
Muddy Run 3.4-Impacts of Muddy Run Project on Conowingo Pond Fishes

- Study Objectives
  - Review historical fisheries data in Conowingo Pond; compare trends in composition and abundance
  - Review biological data to describe fish length, weight, and condition
  - Update report with 2010 fisheries data collected for PBAPS as available
- Work Completed
  - Summarized species composition and abundance, indexed by catch per unit effort (CPUE), for historical data
  - Summarized historical biological data and fish condition for five target species; white crappie, channel catfish, smallmouth bass, largemouth bass, walleye
  - Analyzed CPUE, size structure, and fish condition (Wr) in 2010 for target species
- Findings
  - Changes in species composition largely reflect additions: gizzard shad, mimic shiner, banded darter, flathead catfish, occasional anadromous fishes since volitional passage
  - CPUE for species tracked by each gear type fluctuates annually but without trend; exception is white crappie
  - Growth and condition unchanged after Muddy Run became operational until effects of gizzard shad as forage were documented
  - 2010 CPUE within historic range for tracked fishes, except for white crappie
  - 2010 fish condition: relative weight (Wr) for target species good (97; 99) to excellent (104; 109)
- Work Remaining
  - Complete analyses of historic data
- Schedule
  - Completion of Study Report in April 2011

Muddy Run 3.6- Interactive Effects of Muddy Run and PBAPS Thermal Plume on Migratory Fishes

Exelon

- Study Objective
  - Analyze the spatial and temporal migratory fish presence in Conowingo Pond to the timing, duration, and probability of coincidence of shifts in characteristics of PBAPS thermal plume attributable to Muddy Project operations
  - Identify the temporal availability of migration corridors (zones of passage) for migratory fishes.
- Work Completed
  - Established hydrological conditions (river flow of approximately 10,000 cfs) from hydraulic-thermal model at which PBAPS thermal plume shifts upstream
  - Developed joint probability occurrence of hydrological conditions (river flow and water temperature) for thermal plume shifts
  - Used empirical thermal profiles to get an idea of upstream shift in thermal plume
  - Established run timing and species/lift stage periodicity occurrence
  - Summarized findings of 8 radio telemetry studies on adult American shad in Conowingo Pond
  - Literature review of American shad responses to thermal plume
- Findings
  - Joint probability occurrence of American shad migration timing and upstream thermal plume shift is essentially nil
  - American shad migrated upstream without impedance
  - Post-spawned shad migrated freely downstream through Conowingo Pond
  - Emigrating juvenile shad have the entire pond available for passage
  - Joint probability occurrence of hydrological conditions conducive for thermal plume upstream shift and emigration time is essentially nil
  - Because of overlap in migration time findings for American shad also apply to river herring
  - American eel population in Conowingo Pond is negligible; little passage through Conowingo East Fish Lift
  - When eels are present in Conowingo Pond, they would encounter the same hydrological conditions as American shad and river herring
- Work Remaining
  - Present results of new thermal model, when available
- Schedule
  - Study Report is complete



Water Quality

Conowingo 3.1-Seasonal and Diurnal Water Quality in Conowingo Pond and below Conowingo Dam

- Study Objective
  - Document water quality within Conowingo Pond under a variety of conditions
  - Confirm the dissolved oxygen (DO) of turbine discharges under all operational configurations is accurately monitored to ensure state DO water quality standards are being met downstream of the project

- Work Completed
  - Weekly monitoring of DO, water temperature, surface pH, and turbidity at five historically (1996-1999) established transects in Conowingo Pond and three newly established transects for this study below Conowingo Dam occurred between April and October 2010
  - Fecal coliform samples were also collected once per month at the midpoint station of each transect
  - Discharge boils of operating turbines were sampled hourly (0600 hr to 1800 hr) on FERC preselected dates (N = 20) in July and August.

- Findings
  - Thermal stratification, (a decrease in water temperature of 1°C per 1 m increase in depth or 0.55 °F decrease per 1 ft increase in depth) was not observed in Conowingo Pond in 2010. However, summer DO stratification (top to bottom differences in DO) did occur in the lower half of Conowingo Pond in 2010.
  - Comparison of water temperature data collected upstream and downstream of Conowingo Dam in 2010 confirmed that the operation of the project has almost no effect on the temperature of the water being released downstream.
  - The water temperature recorded at downstream Station 643 was virtually identical to that of turbine discharge “boils”.
  - Aeration capabilities on the smaller Francis generating units (Units 1-7), increase the DO concentration of the water being released from the Project and allow the project discharge to meet state DO standards (5.0 mg/L).
  - Average DO conditions within all the turbine boils were always at or above standards, and were usually similar to the DO conditions measured at Station 643.
  - Station 643 consistently measured DO concentrations 1-2 mg/L lower than the DO measured at Transect 8. This difference seems most likely due to natural aeration in the river, as waters move downstream from Station 643.

- Work Remaining
  - None
- Schedule
  - Completion of Study Report in March 2011

Muddy Run 3.1-Water Quality of Muddy Run Project

- Study Objective
  - Characterize water quality within the power reservoir and within the project discharge under prevailing conditions
  - Include project generation flows, pumping operations, incoming river flows, meteorological conditions, and seasons
- Work Completed
  - Systematic collection (April-October, 2010) of water quality data (DO, temperature, pH, conductivity, turbidity, and chlorophyll *a*) in the power reservoir
  - Continuous monitoring of DO, temperature, pH, and conductivity at intake cylinder gate and tailrace to assess project effects on water quality
  - Compared historical river flows (1952-2009) and water temperature (1956-2009) with 2010 data
  - Compared historical patterns of DO, temperature, pH, conductivity, and chlorophyll *a* in power reservoir with the 2010 data
  - Assessed effects of project operations on tailrace DO, temperature, pH, and conductivity
  - Assessed project effects on water quality of upper Conowingo Pond
- Findings
  - River flows were lower in April through September and water temperatures higher in 2010 compared to historical period (1952-2009)
  - No thermal stratification in the Power Reservoir
  - Strength, duration, and timing of DO stratification varied with locations in the Power Reservoir, none seen at location at the head of intake canal (frequent exchange of water transfer)
  - Substandard DO occurred in both the tailrace and canal at pumping, generating, and idle modes
  - Substandard DO in the Susquehanna River at Muddy Run may be due to low DO in the Power Reservoir or be the result of low DO water discharge from the Holtwood Project or some combination of the two.
- Work remaining
  - None
- Schedule
  - Completion of Study Report in April 2011

Conowingo 3.14 Debris Management Study

- Study Objective
  - Review current debris management practices at the Conowingo Project including debris sources and hydrologic conditions
  - Evaluate the need for implementation of additional measures to reduce impacts to Pond and downstream users
- Work Completed
  - Collection of historic data on debris collection at Conowingo Dam and similar facilities upstream
  - Identification of current practices to manage debris
- Findings
  - Debris is an issue throughout the Susquehanna River Basin especially during high river flows
  - Current operations at the Conowingo Dam safely remove debris collected at the intake structure
  - A majority of the debris collected by Conowingo is natural material
- Work Remaining
  - None
- Schedule
  - Study Report has been completed

Conowingo 3.15 Sediment Introduction and Transport

- Study Objective
  - Provide data that will be useful in the future development of an overall sediment management strategy for the Susquehanna River and Chesapeake Bay
- Work Completed
  - Review and compilation of existing information on processes influencing sediment transport past the Conowingo Dam to the upper Chesapeake Bay and the impacts of these processes
    - Previous studies of project area were reviewed with respect to sedimentary context; sediment accumulation rates; reservoir storage volume; reservoir sediment-storage capacity; sediment quality; sediment transport modeling.
    - Other studies relevant to project area were reviewed with respect to sedimentary processes downstream of dams; storm events and sediment pulses; sediment record of Agnes in upper Chesapeake Bay; sea level rise and sediment supply in upper Chesapeake Bay.
    - Sediment management methods and existing programs were reviewed with respect to methods of sediment management in reservoirs; sediment management options at Conowingo Pond; Chesapeake Bay TMDL; the current Army Corps Sediment Task Force sediment transport modeling proposal.
  - HEC-6 simulation of deposition and scour through LSR reservoirs during 4 major storm events with peak discharges greater than 400,000 cfs
  - Bottom scour analysis with USGS regression model for Conowingo Pond
  - River 2D model output of bottom shear stress values below Conowingo Dam under different simulated release scenarios
- Findings
  - Historical and geological data suggest the river prior to dam construction had enough energy to sustain a mobile bedload with little sediment deposition until river mouth was reached.
  - Updated computations (2009) of sediment accumulation in Conowingo Pond since construction of the dam suggest average annual sediment accumulation rates have declined. Climate (number, duration, timing and magnitude of storm events) and implementation of sediment-erosion and runoff-control BMPs in the watershed are important factors influencing this trend.
  - In the absence of major scour events, reducing the quantity of sediment delivered to the pond by 20% will extend the estimated time to reaching sediment-storage capacity by 5 to 10 years.
  - Reported sediment trapping efficiencies of Conowingo Pond vary widely (17% to 70%) depending on computation methodology (volumetric changes in bathymetry; radionuclides in sediments; reservoir geometry and inflow rates).

Conowingo 3.15 Sediment Introduction and Transport (cont)

- Patchy distribution of coarse sediment downstream of Conowingo Dam is not solely due to trapping of coarse sediment behind the dam, but is a consequence of many inter-related factors: flow strength and timing of regulated water releases and storm discharges; sediment load from upstream passing the dam; tributary sediment supply downstream of the dam; and sediment-transport capacities of water releases and storm flows.
- The slower recovery after Tropical Strom Agnes (1972) of SAV population on Susquehanna Flats from pulses of sediment in comparison to Hurricane Hazel (1954) and Tropical Storms Connie and Diane (1955) has been attributed to the overprint of declining water quality rather than to an inability to recover from the sediment pulse.
- For wetlands in upper Chesapeake Bay to keep from drowning under predicted rises in sea level, the sediment supplied by the Susquehanna River during storm events will be important for them to maintain an intertidal position by vertical accretion.
- Preliminary results of HEC-6 simulations
  - Very fine sand and finer particles pass through the three reservoir system during major storm events.
  - Gravel load that appears at model cross section nearest Conowingo Dam (immediately upstream) and passes the dam may be due to turbulence created by flood gates
  - Lake Aldred passes a greater proportion of the sediment that enters it than Lake Clarke or Conowingo Pond. Channel shape may be factor.
  - HEC-6 simulations support the record of suspended sediment grain sizes transported past Conowingo Dam and deposited in upper Chesapeake Bay during major storms – i.e., silts and clays with minor amounts of sand are transported past the dam and deposited in the upper Bay.
  - HEC-6 appears to under estimate scour quantities compared to the regression model. Reasons for this are being explored.

- Work Remaining
  - Analysis of HEC-6 and scour model output data for storm event transport
  - Analysis of shear stress data for downstream impacts
  - Integration of model analyses and existing data/literature to characterize sediment introduction transport
  - Development of sediment and nutrient management options
- Schedule
  - Completion of Study Report in April 2011

Water Use

Muddy Run 3.2-Hydrologic Study of Muddy Run Water Withdrawal and Return Characteristics

- Study Objectives
  - Describe historic flow management in the lower Susquehanna River
  - Examine the water withdrawal and return characteristics of the Muddy Run Project
  - Describe the operations of the Muddy Run Project
  - Develop bathymetric mapping of the Middy Run Project reservoir and tailrace
  - Examine the impacts of alternative flow management regimes in the lower Susquehanna River on Muddy Run Project generation.
- Work Completed
  - Flow statistics computed with hourly operational data from 2008 to 2010
    - Average and maximum daily withdrawals and discharges for select periods
    - Maximum, average, median, and minimum headwater and tailwater elevations for select periods
    - Total amount of consumed and generated energy for select periods
  - Bathymetric mapping of the Muddy Run power reservoir, recreation lake, and tailrace
- Findings
  - Operational characteristics described
  - Muddy Run stage-storage curve developed
- Work Remaining
  - Alternative flow management regimes (operations modeling)
- Schedule
  - Completion of Study Report in April 2011

Conowingo 3.11-Hydrologic Study of the Lower Susquehanna River

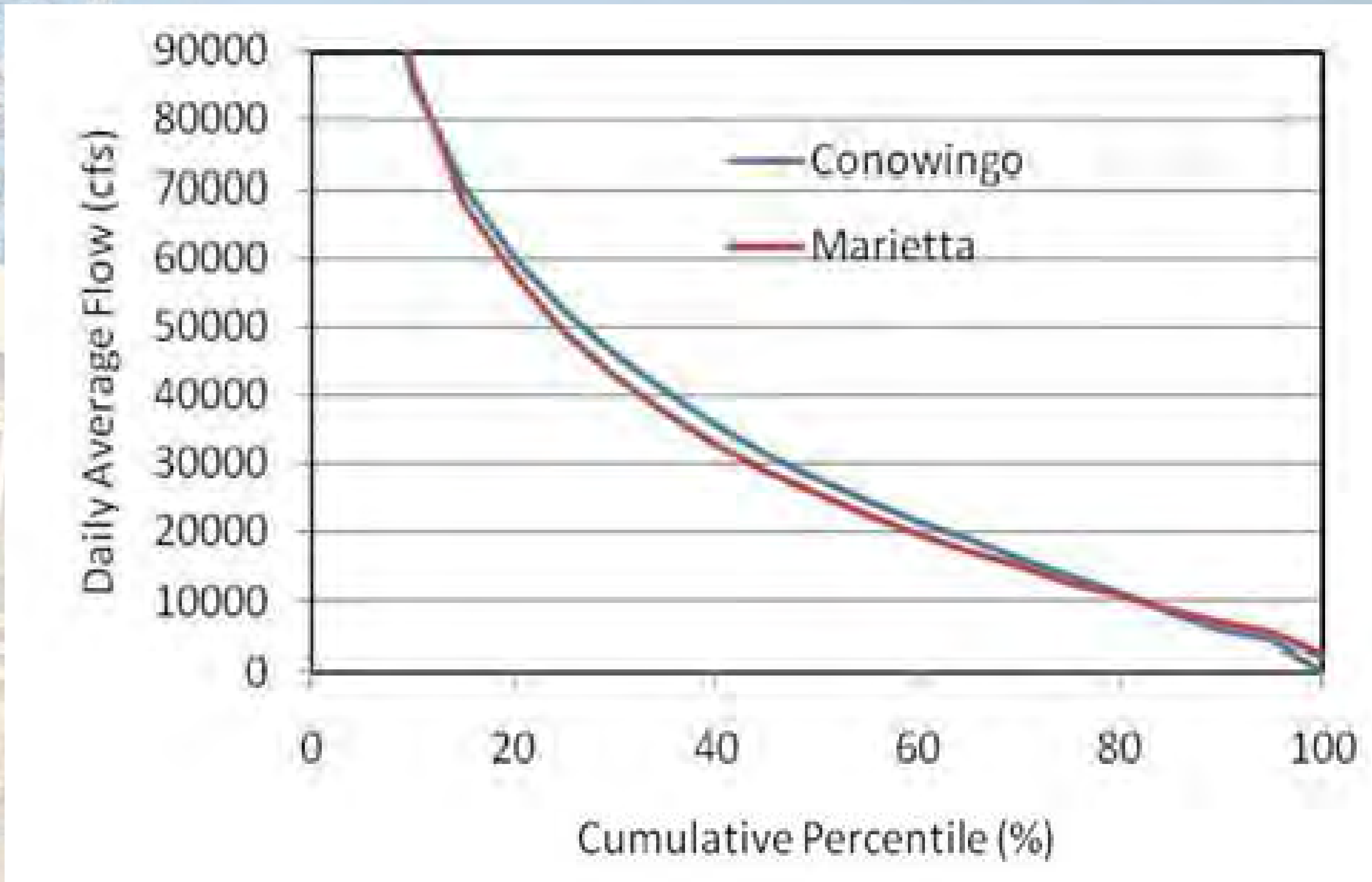
- Study Objectives
  - Describe the history of flow management practices in the lower Susquehanna River basin
  - Perform a statistical analysis to describe the lower Susquehanna River flow regime
  - Evaluate changes in Conowingo Project operations since
    - Minimum flow requirements were established (1989)
    - Energy deregulation laws came into effect (1998)
  - Confirm the accuracy of the Conowingo USGS gage
  - Develop a bathymetric map of the tailwater area below Conowingo Dam
  - Conduct operations modeling production runs to evaluate various operating scenarios to understand how operation changes may impact water use in the lower Susquehanna River

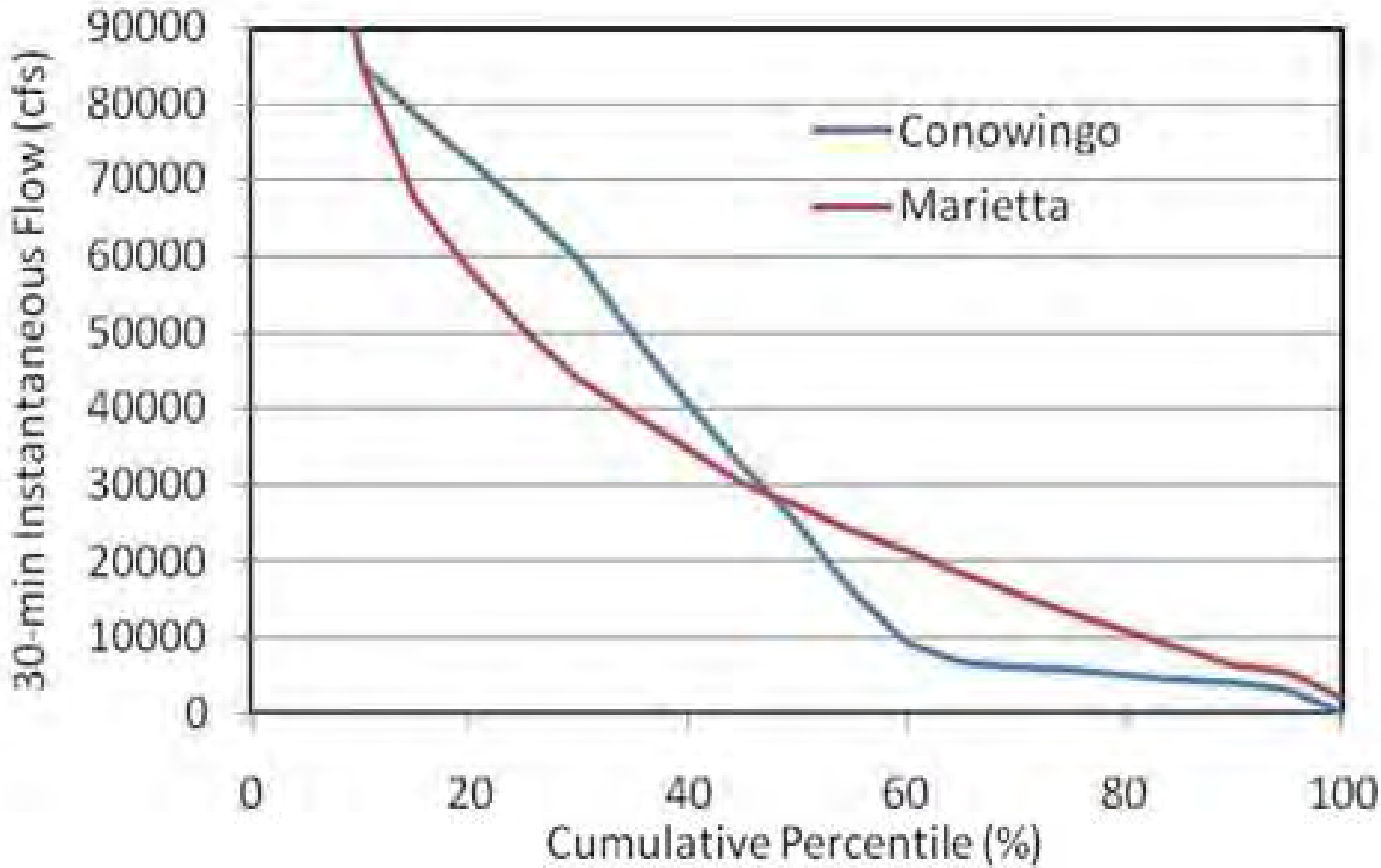
- Work Completed
  - Flow management practices in the lower Susquehanna River basin have been described
  - Statistical analyses of the Marietta and Conowingo USGS gages, to describe the river's flow regime
  - Statistical analyses comparing pre-minimum flow and pre-deregulation and recent flow data
  - USGS Conowingo gage assessment
  - Bathymetric map of the tailwater area below Conowingo Dam

- Findings
  - Over long time steps (i.e. daily and weekly) Conowingo flows generally mirror Marietta flows
  - Sub-daily (e.g. hourly) flows downstream of Conowingo are influenced more by project minimum flows and generation flows than flows observed at Marietta
  - Deregulation (1998) had little impact on Conowingo flow magnitude and frequency
  - The Conowingo USGS gage appears to experience stage fluctuations not observed farther downstream

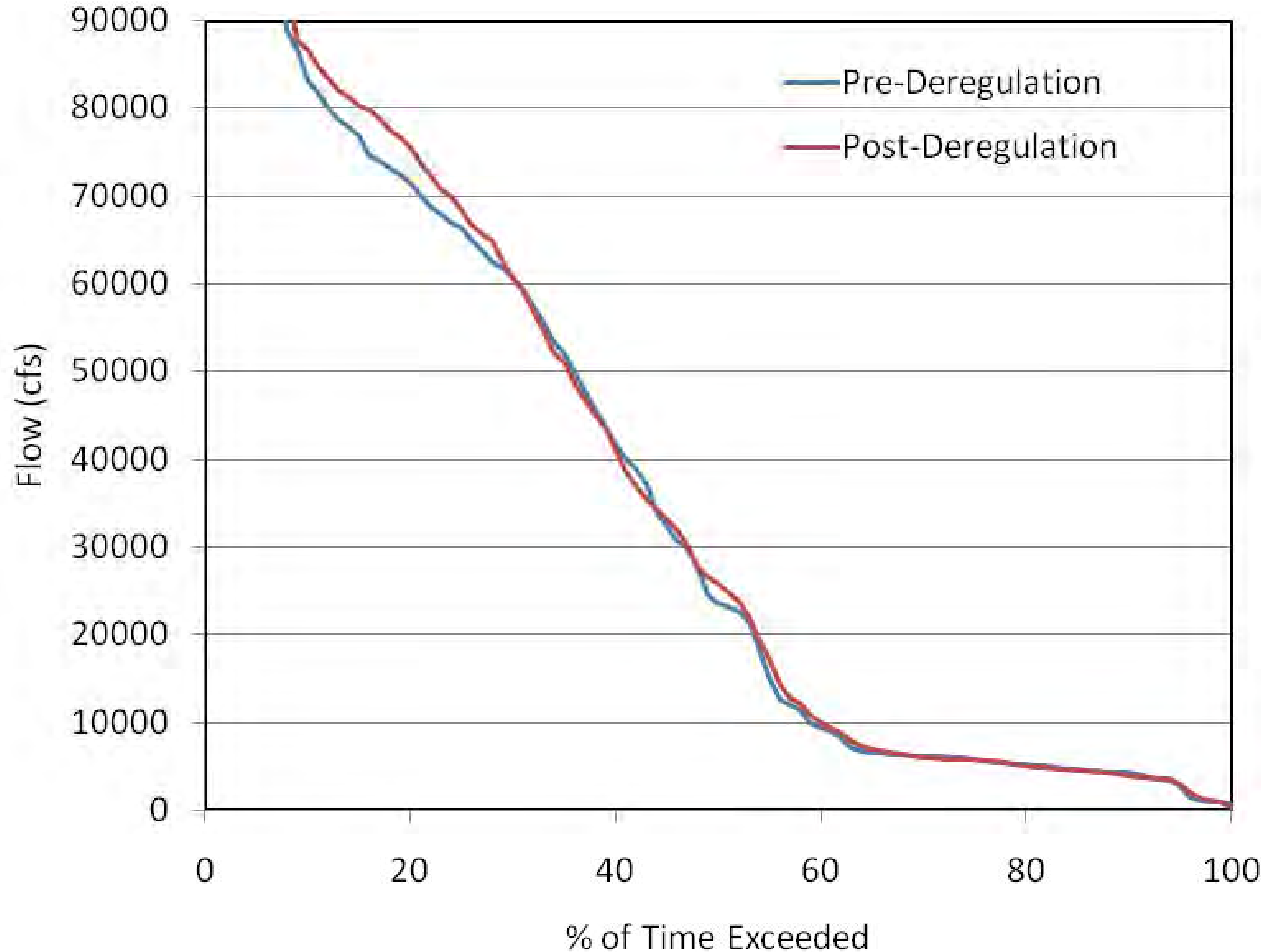
- Work Remaining
  - Operations modeling production runs

- Schedule
  - Completion of Study Report in April 2011


Daily Average Flow (cfs)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Conowingo
Marietta
0
20
40
60
80
100
Cumulative Percentile (%)



90000
80000
70000
60000
50000
40000
30000
20000
10000
0
30-min Instantaneous Flow (cfs)
Conowingo
Marietta
0
20
40
60
80
100
Cumulative Percentile (%)



90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Flow (cfs)
0
20
40
60
80
100
% of Time Exceeded
Pre-Deregulation
Post-Deregulation

Conowingo 3.20-Salinity and Salt Wedge Encroachment

- Study Objectives
  - Determine if Project operations adversely impact downstream salinity levels
  - Determine if Project operations have the ability to change the frequency and duration of salinity level exceedences above drinking water standards
  - Identify and evaluate the potential biotic impacts from salinity changes in the lower Susquehanna River due to Project operations

- Work Completed
  - Collected salinity data from Havre de Grace (daily instantaneous) and MDNR stations (15-min continuous) from 1997-2010 and 2007-2010, respectively
  - Time series comparisons and correlations of salinity versus flow, tidal levels, wind speed
  - Salinity duration analyses

- Findings
  - Salinity levels varied season-to-season, with levels lowest during the spring and early summer, and highest in the fall and winter
  - Salinity levels rarely exceeded the EPA secondary (taste and appearance) standard for salinity (0.25 ppt)
    - Havre de Grace daily data exceeded 0.25 ppt three days in 13 years (one event)
    - At the MDNR station (15-min data) 225 out of 80,161 readings over 4 years exceeded 0.25 ppt (0.05%)
  - A sub-daily flow and salinity analysis showed project operations had no relationship with salinity level exceedences' frequency or duration
  - Based on published salinity tolerances, observe salinity changes had no impact on aquatic biota

- Work Remaining
  - None

- Schedule
  - Study Report has been completed

Conowingo 3.29-Effect of Project Operations on Downstream Flooding

Exelon[SM]

- Study Objective
  - Use a hydraulic model to estimate water surface elevations for a full-range of flood events at Port Deposit
  - Document the areas of inundation and flooding depths during these events
  - Document the flow conditions during which flooding of the Port Deposit area has occurred
  - Identify the impact of the project on downstream water surface elevations
  - Determine the operational feasibility, generation effects, and implementation costs of any procedures that might attenuate flooding conditions

- Work Completed
  - Modeled flooding impacts at Port Deposit under 10, 50, 100 and 500-year flood events:
    - Existing conditions
    - No-dam (run-of-river) scenario
    - Three (3) alternative management scenarios
  - Completed inundation mapping of Port Deposit under existing conditions scenario for 10, 50, 100 and 500-year events

- Findings
  - Minor flooding occurs at Port Deposit at 250,000 cfs, and more major inundation begins to occur between 350,000 cfs and 481,000 cfs (~10-yr event).
  - Existing and alternative Conowingo Dam operations have little impact on flooding conditions at Port Deposit due to the limited storage available in Conowingo Pond
  - 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-yr storm events.

- Work Remaining
  - None

- Schedule
  - Study Report has been completed

Recreation, Shoreline Management, Cultural Resources

Muddy Run 3.11- Recreational Inventory and Needs Assessment

- Study Objective
  - Conduct a recreation inventory in the vicinity of the Project to identify public access points within the Project boundary
  - Estimate the amount of recreational use occurring within the Project
  - Determine what, if any, enhanced and/or new recreation facilities are needed to support the recreational use of the Muddy Run Project
  - Determine if changes or improvements can be made to enhance recreational opportunities
- Work Completed
  - Inventory of Project-related recreational facilities and access
  - Estimate of existing and potential recreational use
- Findings
  - Existing facilities meet current and projected use
- Work Remaining
  - Consultation meeting with interested parties
  - Draft recreation plan
  - Final recreation plan
- Schedule
  - Consultation meeting with interested parties in Summer 2011
  - Draft recreation plan completed in Fall 2011
  - Final recreation plan in January 2012

Conowingo 3.26-Recreational Inventory and Needs Assessment

- Study Objective
  - Conduct a recreation inventory in the vicinity of the Project to identify public access points within the Project boundary
  - Estimate the amount of recreational use occurring within the Project
  - Determine what, if any, enhanced and/or new recreation facilities are needed to support the recreational use of the Conowingo Project
  - Determine if changes or improvements can be made to enhance recreational opportunities

- Work Completed
  - Inventory of Project-related recreational facilities and access
  - Estimate of existing and potential recreational use
- Findings
  - Existing facilities meet current and projected use
- Work Remaining
  - Consultation meeting with interested parties
  - Draft recreation plan
  - Final recreation plan

- Schedule
  - Consultation meeting with interested parties in Summer 2011
  - Draft recreation plan completed in Fall 2011
  - Final recreation plan in January 2012

Muddy Run 3.12- Shoreline Management

- Study Objective
  - Conduct an inventory of Exelon real estate assets in the vicinity of the Project and identify and classify current uses
  - Identify issues and constraints that affect land management and land use
  - Review current corporate land use guidelines and policies
  - Identify lands potentially needed (or not needed) for current and potential future project purposes.
- Work Completed
  - Research existing data (natural resources, local/regional plans and guidelines)
  - Develop existing land use maps
  - Developed Interim Shoreline Management Report
- Work Remaining
  - Develop constraints mapping based on available regional data and licensing studies
  - Integrate regional plans and guidelines with Licensee land management policies
  - Consultation meeting with interested parties
  - Develop Shoreline Management Plan (SMP)
- Schedule
  - Develop draft SMP in September 2011
  - Develop and distribute final SMP in December 2011

Conowingo 3.27-Shoreline Management

- Study Objective
  - Conduct an inventory of Exelon real estate assets in the vicinity of the Project and identify and classify current uses
  - Identify issues and constraints that affect land management and land use
  - Review current corporate land use guidelines and policies
  - Identify lands potentially needed (or not needed) for current and potential future project purposes.

- Work Completed
  - Research existing data (natural resources, local/regional plans and guidelines)
  - Develop existing land use maps
  - Developed Interim Shoreline Management Report

- Work Remaining
  - Develop constraints mapping based on available regional data and licensing studies
  - Integrate regional plans and guidelines with Licensee land management policies
  - Consultation meeting with interested parties
  - Develop Shoreline Management Plan (SMP)
- Schedule
  - Develop draft SMP in September 2011
  - Develop and distribute final SMP in December 2011

Muddy Run 3.10 Creel Survey at Muddy Run Recreation Lake

- Study Objectives
  - Determine the angling effort estimates
  - Determine the catch and harvest estimates and rates
  - Identify demographics and biological data of fish caught for both boat and shore anglers at Muddy Run Recreation Lake
- Work Completed
  - The survey was conducted April 3 through November 30, 2010
  - Boat interviews were conducted at the boat ramp/rental area and consisted of 1,033 anglers interviewed representing 531 fishing parties
  - Shore interviews were obtained from 760 anglers representing 414 parties at two access sites along the lake
- Findings
  - Boat fishing parties had an average of 2 anglers; greatest number of interviews occurred in summer; average fishing time was 3.6 hours
  - Shore fishing parties had an average of 2 anglers; greatest number of interviews occurred in summer; average fishing time was 2.5 hours
  - Length measurements of fish harvested by boat anglers were obtained from 129 fish representing 8 species or species groups
  - Length measurements of fish harvested by shore anglers were obtained from 163 fish of 5 species
  - Length measurements of fish released by boat anglers were obtained from 625 fish representing 12 species and 3 species groups
  - Largemouth bass represented 69% of the fish measured and released.
  - 82% of released largemouth bass were reported as legal (≥12 inches)
  - Length measurements of fish released by shore anglers were obtained from 228 fish
  - 80% of all anglers interviewed resided in Lancaster County or York County, Pa, and residents from 7 other states were interviewed
- Work Remaining
  - Analysis of data to provide estimates of fishing pressure, catch, harvest, and catch and harvest rates
- Schedule
  - Report to be completed in April 2011

Conowingo 3.25 Conowingo Pond Creel Survey

- Study Objectives
  - Determine the angling effort estimates
  - Determine the catch and harvest estimates and rates
  - Identify demographics and biological data of fish caught for both boat and shore anglers on Conowingo Pond
- Work Completed
  - The survey was conducted March 1 through November 30, 2010
  - Interviews were obtained from access points arrayed from the Norman Wood Bridge (Pa Rt. 372) downstream to Conowingo Dam
  - Completed boat interviews were conducted at seven boat ramps and consisted of 646 anglers representing 365 fishing parties
  - Completed shore interviews were conducted at access points and consisted of 57 parties
- Findings
  - Boat fishing parties had an average of 1.8 anglers; weekend boat parties accounted for over 76% of all interviews; average fishing time was 5.3 hours
  - Shore fishing parties had an average of 2.1 anglers; average fishing time was 2.1 hours; 80% of shore anglers were seeking “anything”
  - Length measurements of fish harvested by boat anglers were obtained from 44 fish representing 4 species
    - Flathead catfish accounted for 61% of all fish measured and harvested, Channel catfish accounted for 30% of all fish measures and harvested
  - Length measurements of fish harvested by shore anglers were obtained from 5 fish
  - Length measurements of fish released by boat anglers were obtained from 954 fish representing 13 species or species groups
    - 85% of all released black bass measured were reported as legal size (≥12 inches)
  - Length measurements of fish released by shore anglers were obtained from 65 fish representing 8 species of species groups
    - Black bass accounted for 51% of fish released by shore anglers
  - 65% of all anglers interviewed resided in Lancaster County and York County, PA, and Cecil County and Harford County, MD, and residents from 5 other states were interviewed
- Work Remaining
  - Analysis of data to provide estimates of fishing pressure, catch, harvest, and catch and harvest rates
  - Documentation of the Conowingo Pond winter fishery (Dec. 1, 2010 – Feb. 28, 2011) is in progress
- Schedule
  - Report to be completed in April 2011

Conowingo 3.25 Lower Susquehanna River Creel Survey

- Study Objectives
  - Determine the angling effort estimates
  - Determine the catch and harvest estimates and rates
  - Identify demographics and biological data of fish caught for both boat and shore anglers downstream of Conowingo Dam
- Work Completed
  - The survey was conducted March 1 through November 30, 2010
  - Interviews were obtained from access points arrayed from the northern-most reach of west shoreline below the Conowingo Dam tailrace downstream to the Amtrak bridge and Havre de Grace (mouth of the Susquehanna River)
  - Completed boat interviews were conducted at seven boat ramps and consisted of 797 anglers representing 383 fishing parties
  - Completed shore interviews were conducted at eleven access points and consisted of 554 parties
- Findings
  - Boat fishing parties had an average of 2.1 anglers; weekend boat parties accounted for over 70% of all interviews; average fishing time was 4.4 hours
  - Shore fishing parties average fishing time was 3.1 hours
  - Length measurements of fish harvested by boat anglers were obtained from 230 fish representing 7 species
    - White perch accounted for 48% of all fish measured and harvested
  - Length measurements of fish harvested by shore anglers were obtained from 389 fish of 13 species or species groups
  - Length measurements of fish released by boat anglers were obtained from 707 fish representing 14 species or species groups
    - Black bass comprised 31% of the released fish measured
    - 77% of all released black bass measured were reported as legal size (≥12 inches)
  - Length measurements of fish released by shore anglers were obtained from 431 fish representing 17 species of species groups
    - Striped bass accounted for 34% of fish released by shore anglers
  - 56% of all anglers interviewed resided locally in Baltimore County, Cecil County or Harford County, MD, and anglers from 9 other states and the District of Columbia were interviewed (PA (32%)and MD(65%) not included)
- Work Remaining
  - Analysis of data to provide estimates of fishing pressure, catch, harvest, and catch and harvest rates
- Schedule
  - Report to be completed in April 2011

Conowingo 3.32- Re-evaluate the Closing of the Catwalk

- Study Objectives
  - Conduct a feasibility analysis to evaluate re-opening the Conowingo Project catwalk for recreational fishing by the general public

- Work Completed
  - Exelon retained an independent security consultant, Security Management Solutions (SMS).
  - SMS conducted a *Vulnerability and Security Assessment* of the Conowingo Project in August 2010. The assessment included an identification of critical assets, vulnerabilities, and potential consequences from an attack on the Project.
  - A separate *Vulnerability Assessment and Threat Assessment* of the Conowingo Project's Catwalk Platform was conducted in November 2010.
  - SMS used FERC's Dam Assessment Matrix for Security and Vulnerability Risk (DAMSVR) methodology to conduct the assessments.

- Findings
  - The Vulnerability Assessment concluded the "close proximity of the Cat Walk to the Conowingo Dam Powerhouse provides access to several operational assets."
  - The Vulnerability Assessment, therefore, recommends that the Conowingo Project "[k]eep the functional area attached to the Catwalk, and the entire Catwalk structure, closed to general public access for safety and security purposes."

- Work Remaining
  - Evaluate the need for fishing access at the Project to determine if it is adequate to meet demand (Conowingo RSP 3.26)

- Schedule
  - SMS has completed its vulnerability assessment and the final report will be reviewed by FERC.

Muddy Run 3.14-Cultural Resource Review and Assessment

- Study Objectives
  - Identify properties listed or eligible for listing in the National Register of Historic Places (NRHP) in the Muddy Run Project Area of Potential Effect (APE) and to identify and assess possible effects from Project operations.

- Work Completed
  - Phase 1A archaeological assessment
    - Background research of historical documents and cultural resource site files
    - Field reconnaissance of the project shorelines
  - Preliminary historic structures assessment
    - Background research on previously identified architectural resources in the APE
    - Preparation of an historic context
    - Field reconnaissance of the APE

- Findings
  - Phase 1A archaeological assessment
    - Two sites were identified as having a Moderate to High Probability for archaeological deposits and are recommended as High Priority for Phase 1B field survey
  - Historic structures assessment
    - The Ritchie-Robinson House located at the southern end of the Project transmission line.

- Work Remaining
  - Phase 1B survey of two archaeological sites near Power Reservoir
  - Update the existing survey information on the Ritchie-Robinson House and its evaluation for NRHP eligibility.
- Schedule
  - Completion of Study Report in March 2011
  - Phase 1B evaluation (Summer 2011)
  - Ritchie-Robinson House NRHP evaluation (Summer 2011)

Conowingo 3.28-Cultural Resource Review and Assessment

- Study Objectives
  - Identify properties listed or eligible for listing in the National Register of Historic Places (NRHP) in the Conowingo Project Area of Potential Effect (APE) and to identify and assess possible effects from Project operations.

- Work Completed
  - Phase 1A archaeological assessment
    - Background research of historical documents and cultural resource site files
    - Field reconnaissance of the project shorelines
  - Preliminary historic structures assessment
    - Background research on previously identified architectural resources in the APE
    - Preparation of an historic context
    - Field reconnaissance of the APE

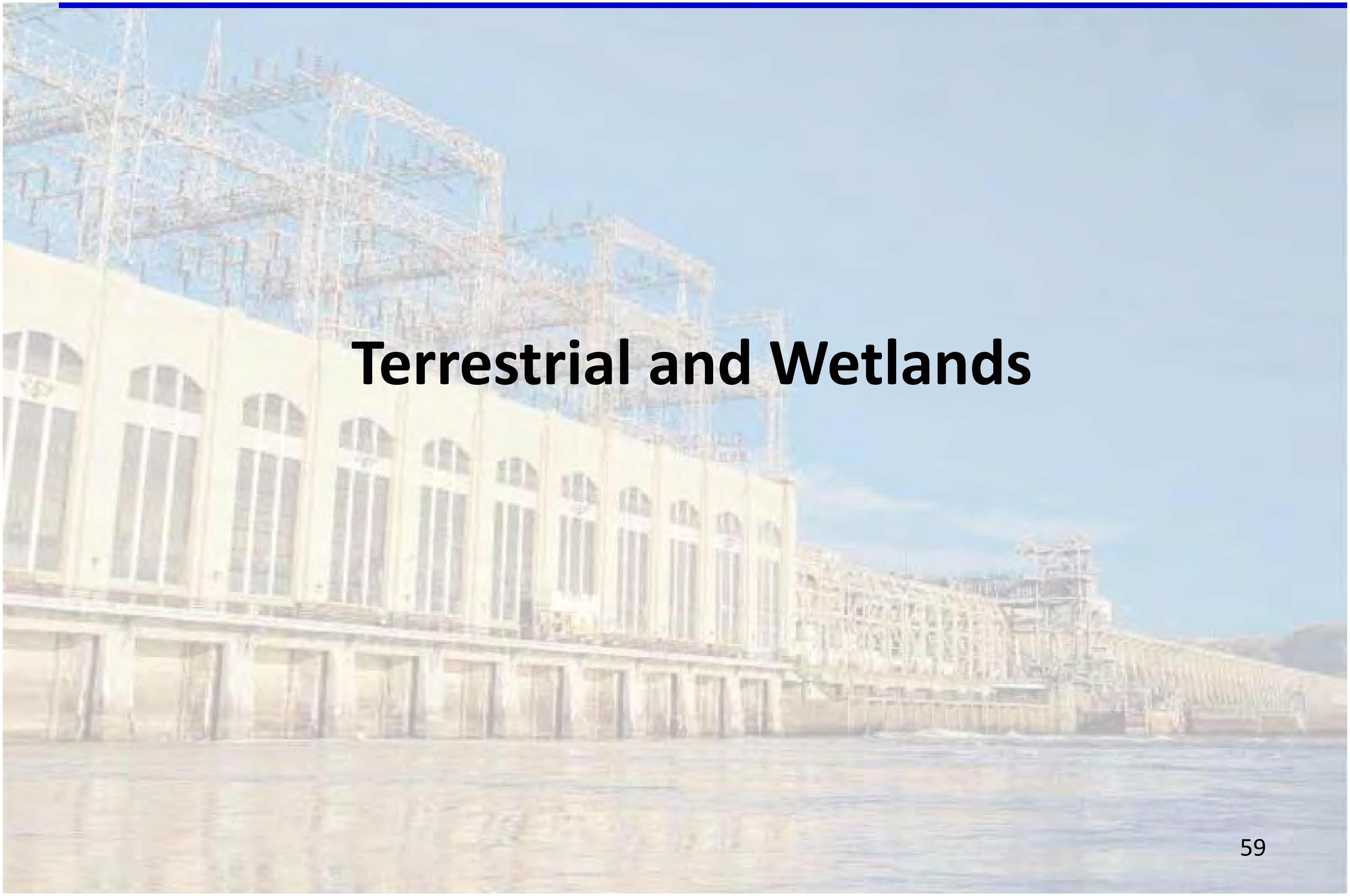
- Findings
  - Phase 1A archaeological assessment
    - Eight (8) sites were identified as having a Moderate to High Probability for archaeological deposits and are recommended as High Priority for Phase 1B field survey
  - Historic structures assessment
    - Three NRHP-listed architectural resources and three architectural resources determined NRHP-eligible are within the Project APE.
    - There are three previously identified resources within the APE (two in Maryland and one in Pennsylvania), that have as yet not been evaluated for the NRHP.
    - Sixteen (16) other sites 50 years or older for NRHP-eligibility within the Project APE.

- Work Remaining
  - Phase 1B survey of eight (8) archaeological sites
  - Phase II architectural survey within the APE to update information on the three previously identified resources and to evaluate 16 other sites 50 years or older for NRHP-eligibility within the Project APE.

- Schedule
  - Completion of Study Report in March 2011
  - Phase 1B evaluation (Summer 2011)
  - Phase II architectural survey (Summer 2011)

Muddy Run 3.13-Visual and Noise Assessment

- Study Objectives
  - Assess the visual impacts of the Muddy Run Project, particularly the effects of the angle and intensity of the lighting at night on the surrounding public and recreation areas.
  - Evaluate the impacts of noise generated from the facility on the surrounding public and recreation areas during both day and night operation.
- Work Completed
  - Audio and visual assessments were conducted in the spring, summer, fall, and winter of 2010 during both daylight and nighttime hours.
- Findings
  - Noise levels were comparable to areas not affected by the Project.
  - Project lighting is most noticeable at select locations (i.e., Conowingo Islands); however the Conowingo Islands have restrictions against public use at night, so any impacts to recreation is minor.
- Work Remaining
  - None
- Schedule
  - Study Report has been completed



Terrestrial and Wetlands

Muddy Run 3.7- Transmission Line Avian Interaction Study

- Study Objective
  - Collect data that describe avian use of Project transmission lines and structures
  - Determine if protection measures are needed to reduce electrocutions and collisions of large birds
- Work Completed
  - 86 hours of avian interaction observations (N=1,367) between April 2010 and October 2010
- Findings
  - Highest avian use area is where project lines and structures span Conowingo Pond
  - Avian mortality was not observed to be a significant occurrence
- Work Remaining
  - None
- Schedule
  - Study Report has been completed

Muddy Run 3.8- Study to Identify Habitat Use Areas for Bald Eagle

- Study Objectives
  - Determine abundance levels of bald eagles
  - Determine specific locations of foraging, roosting, and nesting habitat
  - Determine daily/seasonal patterns of use by migrant and nesting bald eagles
- Work Completed
  - Aerial flyover nesting surveys
  - Communal roost boundary delineations
  - Ground monitoring surveys of communal roosts
- Findings
  - One (1) breeding pair of eagles in study area
  - 1 active nest produced 3 eagle nestlings in 2010
  - 1 communal roost within study area; maximum number of individuals observed was 62 eagles
- Work Remaining
  - Winter 2011 roost monitoring surveys
  - Finalization of foraging area delineation with satellite telemetry data
- Schedule
  - 2010 Study Report has been completed; 2011 Study Report to be submitted in January 2012

Conowingo 3.23- Study to Identify Habitat Use Areas for Bald Eagle

- Study Objectives
  - Determine abundance levels of bald eagles
  - Determine specific locations of foraging, roosting, and nesting habitat
  - Determine daily/seasonal patterns of use by migrant and nesting bald eagles
- Work Completed
  - Aerial flyover nesting surveys
  - Communal roost boundary delineations
  - Ground monitoring surveys of communal roosts
- Findings
  - 12 breeding pairs of eagles
  - 11 active nests produced 15 eagle nestlings in 2010
  - 18 communal roosts within study area; maximum number observed was 105 eagles in one roost
- Work Remaining
  - Winter 2011 roost monitoring surveys
  - Finalization of foraging area delineation with satellite telemetry data
- Schedule
  - 2010 Study Report has been completed; 2011 Study Report to be submitted in January 2012

Muddy Run 3.15- Osprey Nesting Survey

- Study Objective
  - Identify locations within the project area used by osprey for nesting
- Work Completed
  - Surveys of Muddy Run power reservoir area
  - Surveys of Project Transmission Line ROW
- Findings
  - One osprey nest identified with at least one nestling fledged
  - 12 additional observations of osprey within project area
- Work Remaining
  - Nesting surveys planned for spring/summer 2011
- Schedule
  - 2010 Study Report has been completed; 2011 Study Report to be submitted in early 2012

Conowingo 3.30- Osprey Nesting Survey

- Study Objective
  - Identify locations within the project area used by osprey for nesting
- Work Completed
  - Surveys of Conowingo project area in Pennsylvania and Maryland
- Findings
  - 11 osprey nests identified (4 in Maryland, 7 in Pennsylvania)
  - Young fledged from at least 4 nests in project area
- Work Remaining
  - Nesting surveys planned for spring/summer 2011
- Schedule
  - 2010 Study Report has been completed; 2011 Study Report to be submitted in early 2012

Conoowingo 3.31- Black-crowned Night-heron Nesting Survey

- Study Objective
  - Determine presence/absence of BCNH in project area
  - Verify existing and new nesting locations of BCNH in project area
- Work Completed
  - Nesting surveys per PGC protocol for BCHN in Pennsylvania
  - Additional Visual Encounter Surveys in Maryland (Conowingo Dam area)
- Findings
  - No BCNH nests were identified in project area
  - BCNH presence was verified below Conowingo Dam
- Work Remaining
  - 2011 nesting surveys planned
- Schedule
  - 2010 Study Report has been completed; 2011 Study Report to be submitted in early 2012

Muddy Run 3.9- Study to Identify Potential Habitat of Bog Turtle

- Study Objective
  - To identify potential habitats
  - To survey all potential habitats for suitability to support bog turtle
  - To determine if bog turtle exist on project lands (as applicable)
- Work Completed
  - Search of project lands to identify wetland locations
  - Habitat evaluation of wetlands to identify potential bog turtle habitat
- Findings
  - No potential bog turtle habitat present in study area; therefore further presence/absence surveys are unnecessary
- Work Remaining
  - None
- Schedule
  - Study Report has been completed

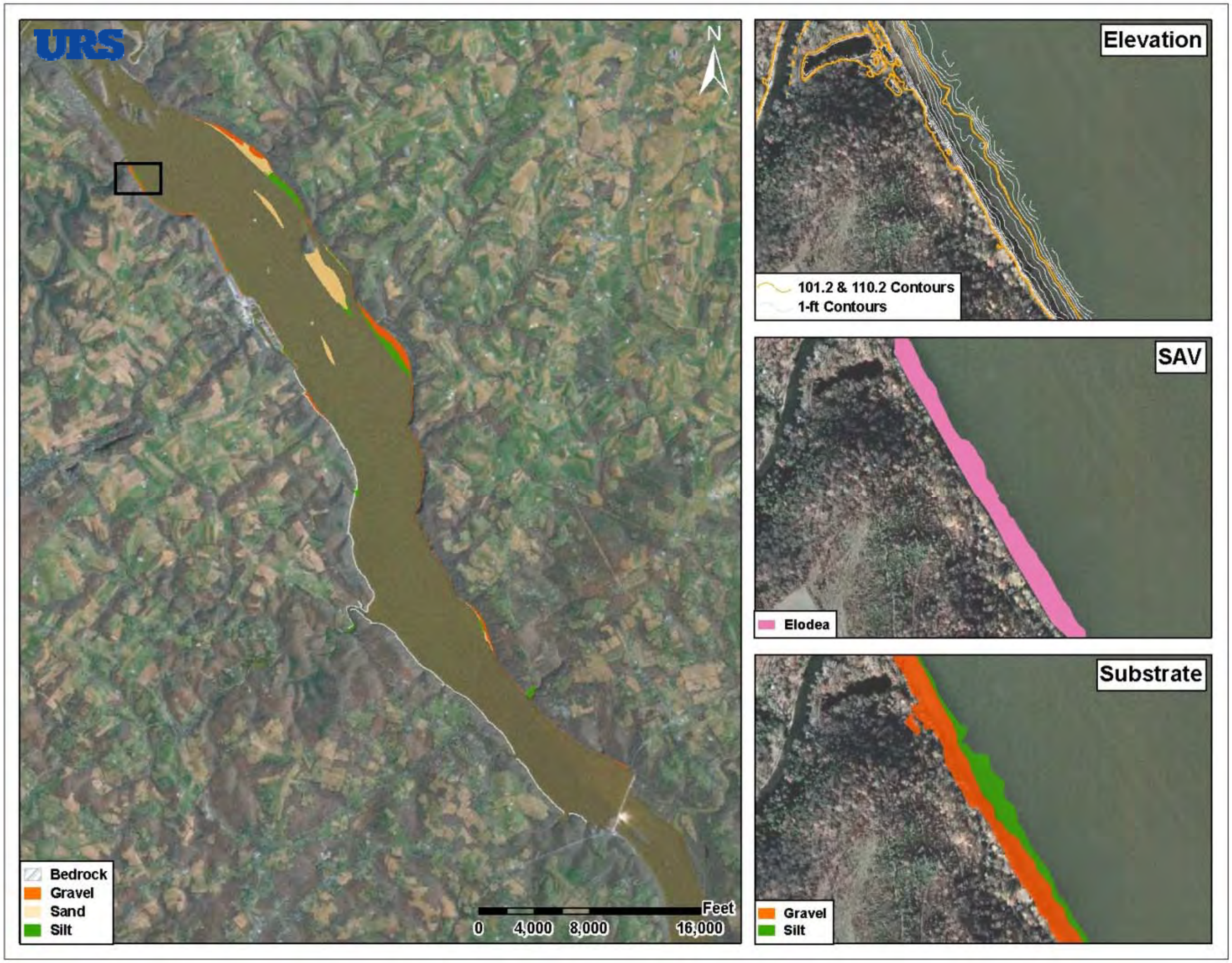
Muddy Run 3.9- Study to Identify Potential Habitat of Rough Green Snake

- Study Objective
  - To identify potential habitats
  - To survey all potential habitats for suitability to support rough green snake
  - To determine if rough green snake exist on project lands (as applicable)
- Work Completed
  - Evaluation of all project lands to identify potential rough green snake habitat
- Findings
  - Potential rough green snake habitat is present within study area
- Work Remaining
  - Presence/absence surveys for rough green snake in 2011
- Schedule
  - 2010 Study Report has been completed, 2011 Study Report to be submitted in early 2012

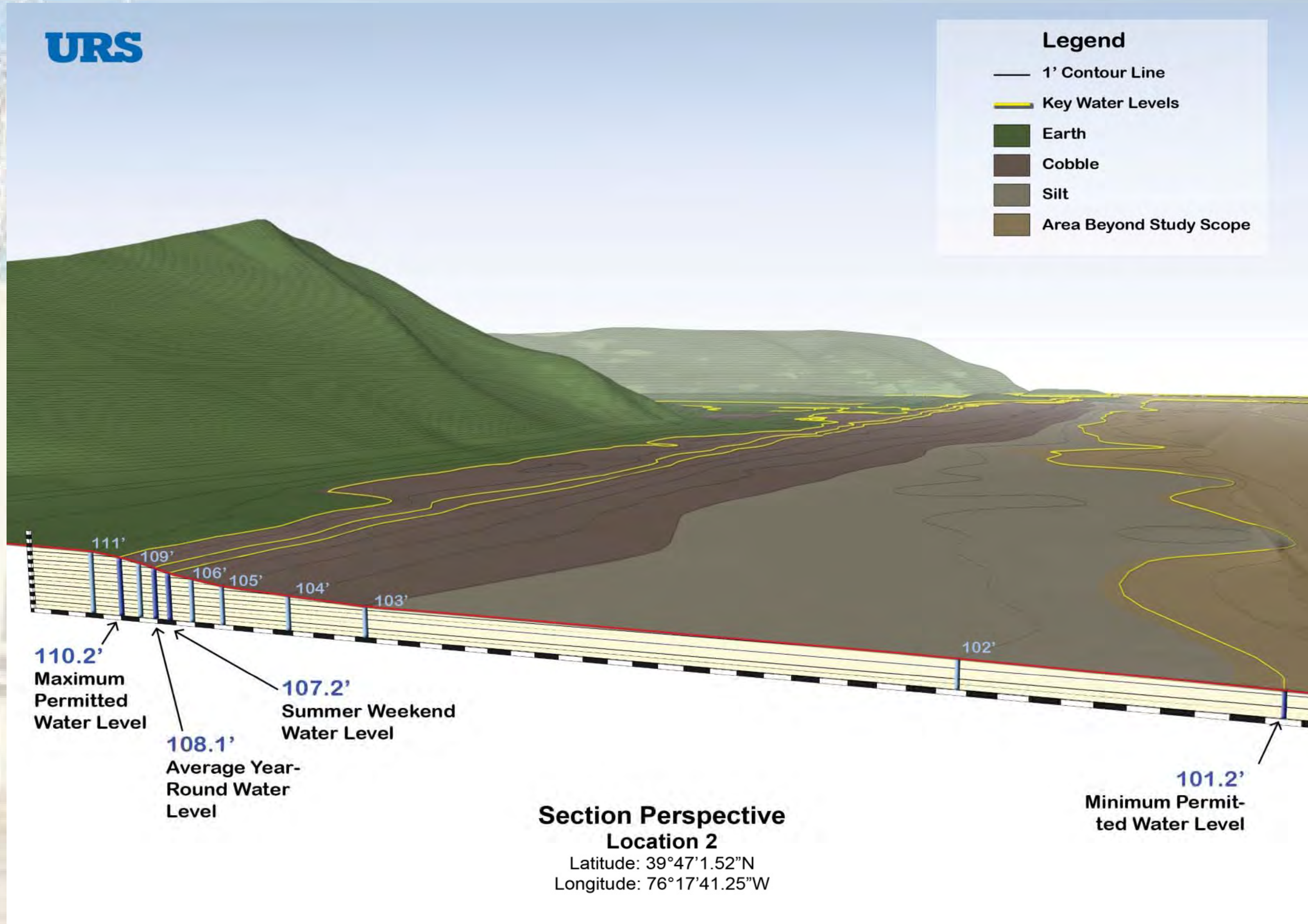
Conowingo 3.12 Water Level Management (Littoral Zone and Water Level Fluctuation)

- Study Objective
  - Quantify and describe the littoral habitat within the permitted 9-foot drawdown range (101.2 to 110.2 ft NGVD 1929)
  - Investigate effects of water level fluctuations over 1-foot contour intervals on littoral habitat, including EAV and SAV
  - Determine whether a need exists for enhancement of EAV and SAV in Conowingo Pond
- Work Completed
  - Development of 1-foot contour mapping of the littoral habitat from Hennery Island to Conowingo Dam
  - Quantification of habitat types within the permitted drawdown range
  - Quantification of water level fluctuations in the Pond based on historic water elevation data
  - Integration of aquatic habitat data and bathymetric data
- Findings
  - Current operational water level fluctuation is limited in magnitude and duration, providing favorable littoral habitat conditions for SAV growth in some areas
  - Limited habitat exists for growth of EAV and, in several areas, SAV based on natural geologic conditions
  - Variable substrate types exist in the littoral zone of Conowingo Pond
- Work Remaining
  - Analyses of integrated habitat and bathymetric data
- Schedule
  - Completion of Study Report in April 2011

Conowingo 3.12 Water Level Management (Littoral Zone and Water Level Fluctuation)



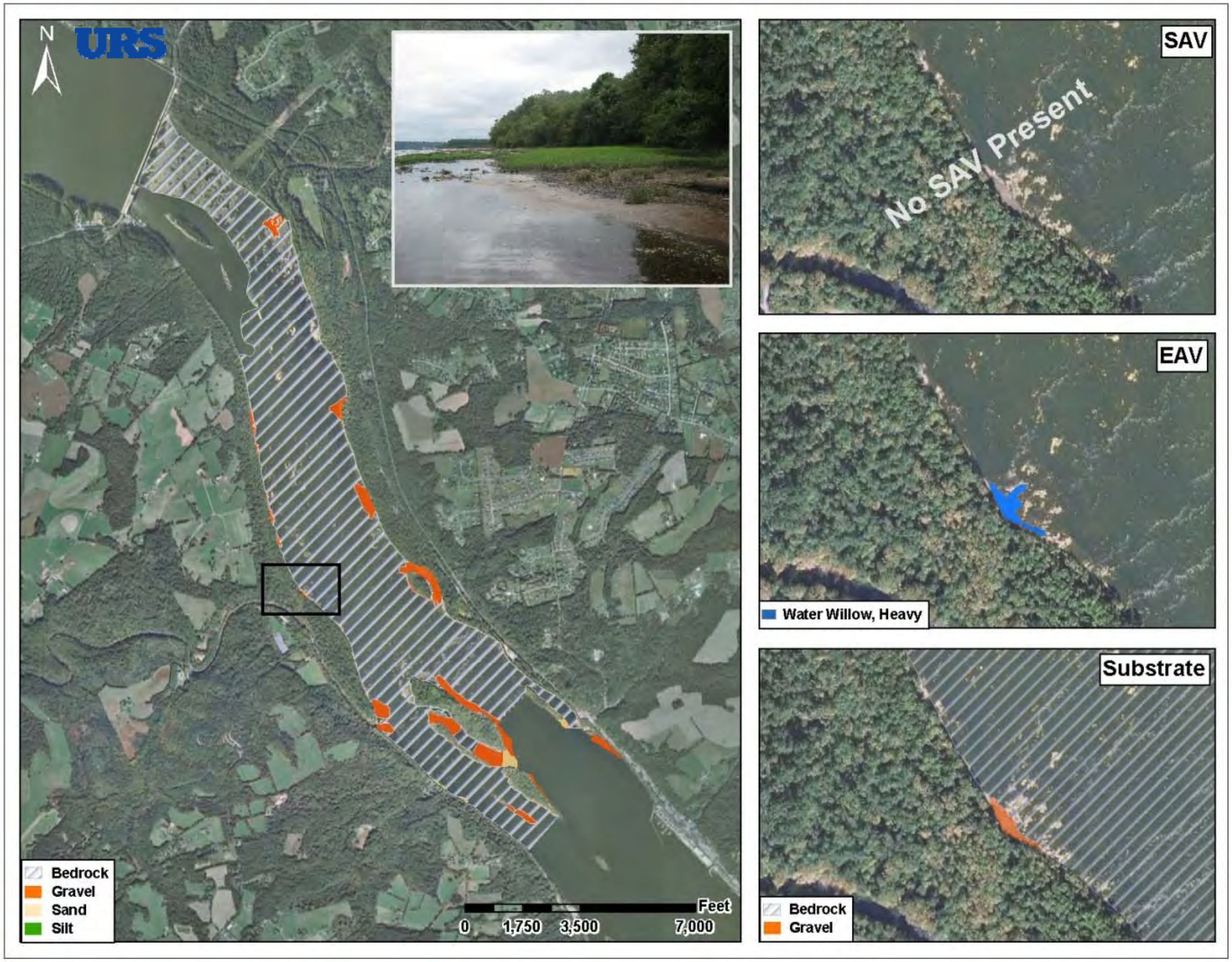
Conowingo 3.12 Water Level Management (Littoral Zone and Water Level Fluctuation)



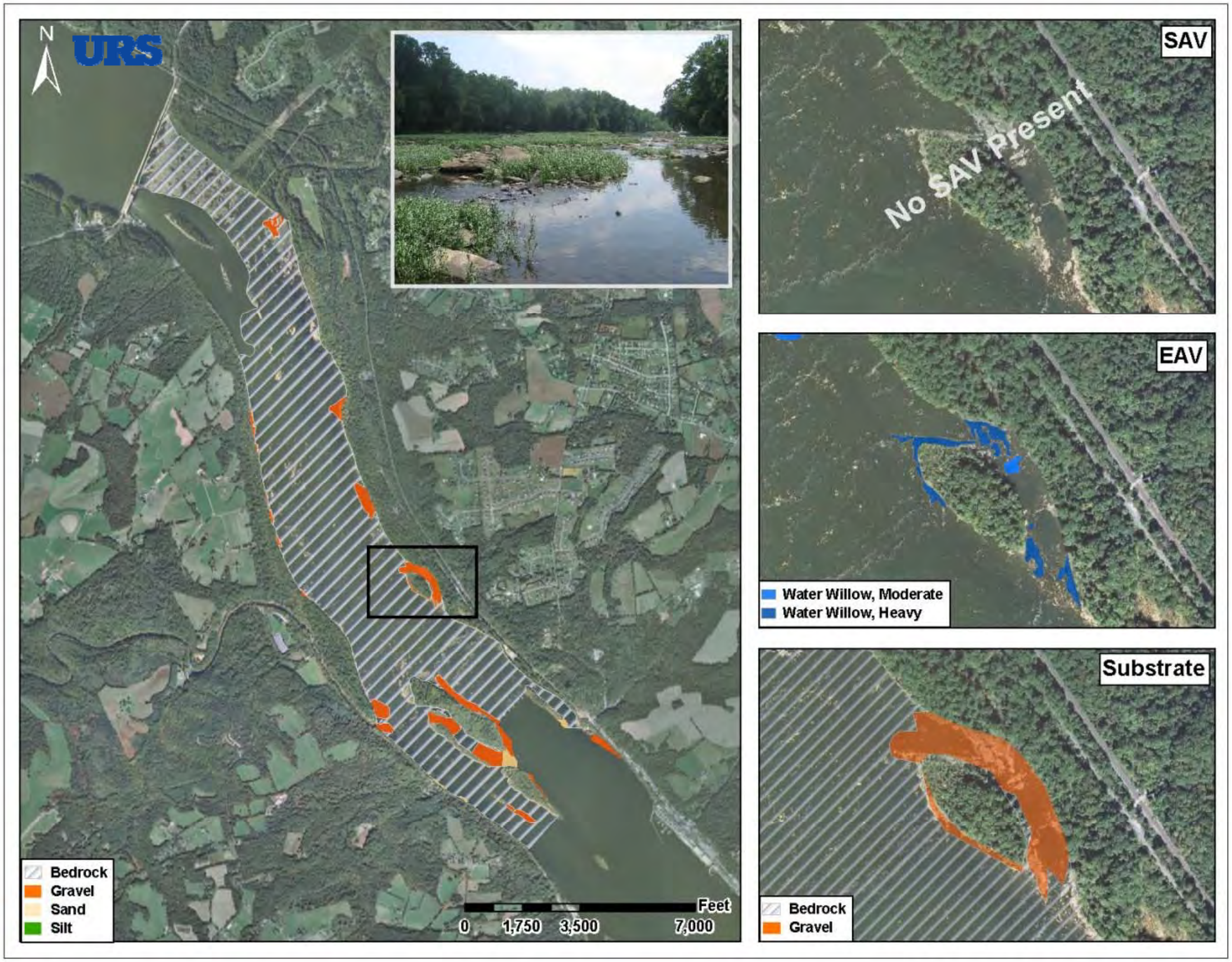
Conowingo 3.17 Downstream EAV/SAV Study (Water Level Vegetative Cover Study)

- Study Objective
  - Map the current distribution of EAV and SAV downstream of the Conowingo Dam
  - Identify adverse impacts of Project operations, if any, on existing EAV/SAV
  - Determine whether or not EAV and SAV can be enhanced downstream of the Conowingo Dam.
- Work Completed
  - Review of historic data, including VIMS surveys completed since 1978
  - Quantification of EAV and SAV below the Dam based on 2010 field surveys
- Findings
  - SAV growth is more prevalent in downstream portions of the study area where a combination of a lower river gradient and finer substrate composition is present
  - EAV growth is opportunistic, and is generally concentrated along the river margins and island perimeters
  - Non-native SAV species dominated the study area; EAV was comprised of mainly native species
- Work Remaining
  - Analysis of potential impacts to EAV and SAV communities based on hydraulic modeling data
- Schedule
  - Completion of Study Report in April 2011

Conowingo 3.17 Downstream EAV/SAV Study (Water Level Vegetative Cover Study)



Conowingo 3.17 Downstream EAV/SAV Study (Water Level Vegetative Cover Study)



Attachment C-Study Report Schedule

Study Report Schedule for the Conowingo Project

RSP No.	Study	Anticipated Date of Study Report Availability
3.1	Seasonal and Diurnal Water Quality in Conowingo Pond and below Conowingo Dam	March 2011
3.2	Downstream Fish Passage Effectiveness Study	March 2011
3.3	Biological and Engineering Studies of American Eel at the Conowingo Project	Complete-Biological Portion April 2011-Engineering Portion
3.5	Upstream Fish Passage Effectiveness Study	Complete
3.6	Conowingo East Fish Lift Attraction Flows	Complete
3.7	Fish Passage Impediments Study below Conowingo Dam	Complete
3.8	Downstream Flow Ramping and Fish Stranding Study	Complete
3.9	Biological and Engineering Studies of the East and West Fish Lifts	April 2011
3.10	Maryland Darter Surveys	Complete
3.11	Hydrologic Study of the Lower Susquehanna River	April 2011
3.12	Water Level Management (Littoral Zone and Water Level Fluctuation)	April 2011
3.13	Study to Assess Tributary Access in Conowingo Pond	Complete
3.14	Debris Management Study	Complete
3.15	Sediment Introduction and Transport (Sediment and Nutrient Loading)	April 2011
3.16	Instream Flow Habitat Assessment below Conowingo Dam	April 2011
3.17	Downstream EAV/SAV Study (Water Level Vegetative Cover Study)	April 2011
3.18	Characterization of Downstream Aquatic Communities	Complete
3.19	Freshwater Mussel Characterization Study below Conowingo Dam	Complete
3.20	Salinity and Salt Wedge Encroachment	Complete
3.21	Impact of Plant Operations on Migratory Fish Reproduction	Complete
3.22	Shortnose and Atlantic Sturgeon Life History Studies	Complete
3.23	Study to Identify Habitat Use Areas for Bald Eagle	Complete
3.24	Dreissenid Mussel Monitoring Study	Complete
3.25	Creel Survey of Conowingo Pond and the Susquehanna River below Conowingo Dam	April 2011
3.26	Recreational Inventory and Needs Assessment	Complete
3.27	Shoreline Management	Complete
3.28	Archaeological and Historic Cultural Resource Review and Assessment	March 2011
3.29	Effect of Project Operations on Downstream Flooding	Complete
3.30	Osprey Nesting Survey	Complete
3.31	Black-crowned Night Heron Nesting Survey	Complete
3.32	Re-evaluate the Closing of the Catwalk to Recreational Fishing	Complete

Study Report Schedule for the Muddy Run Project

RSP No.	Study	Anticipated Date of Study Report Availability
3.1	Water Quality Study	April 2011
3.2	Hydrologic Study of Muddy Run Water Withdrawal and Return Characteristics	April 2011
3.3	Entrainment and Impingement at Muddy Run Project Adult American Eel Telemetry Study-Pilot Study	Complete Complete
3.4	Impacts of Muddy Run Project on Conowingo Pond Fishes	April 2011
3.5	Nearfield Effects of the Muddy Run Project on Migratory Fishes	April 2011
3.6	Muddy Run Project Effects on Migratory Fishes: Interactions with the PBAPS Thermal Plume	Complete
3.7	Transmission Line Avian Interaction Study	Complete
3.8	Study to Identify Critical Habitat Use Areas for Bald Eagle	Complete
3.9	Bog Turtle and Rough Green Snake Habitat Study	Complete
3.10	Creel Survey of Muddy Run Recreation Lake	April 2011
3.11	Recreational Inventory and Needs Assessment	Complete
3.12	Shoreline Management	Complete
3.13	Visual and Noise Assessment of the Muddy Run Project	Complete
3.14	Archaeological and Historic Cultural Resource Review and Assessment	March 2011
3.15	Osprey Nesting Survey	Complete

Attachment D-Distribution List for FERC Project No. 405 and 2355

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IN REPLY REFER TO:

April 25, 2011 Filed Electronically

Kimberly Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: Conowingo Hydroelectric Project FERC #405
Muddy Run Pumped Storage Project FERC #2355
Comments on Initial Study Reports

Dear Secretary Bose:

In response to the Initial Study reports and Revised Study Plans filed in 2011, the National Park Service offers the following comments on the Recreation Facilities Inventory and Estimated Recreation Use Report RSP 3.26 and the Interim Shoreline Management Report RSP 3.27 for the Conowingo Project and the Recreation Facilities Inventory and Estimated Recreation Use Report RSP 3.11 and Interim Shoreline Management Report RSP 3.12 for the Muddy Run Project.

<u>Local, Regional and National Initiatives in the Project Areas</u>

The Chesapeake Bay and its tributaries have been recognized by the Obama Administration as being of national significance, as per the Chesapeake Bay Protection & Restoration EO #13508, issued May 9, 2009. Amongst its requirements, the EO cites the need to increase public access to the Bay and rivers in the Chesapeake watershed. The implementation strategy includes a goal for increasing public access by 300 new sites by 2025, including the Susquehanna River.
http://executiveorder.chesapeakebay.net/default.aspx

The Commonwealth of Pennsylvania has embarked on the Conservation Landscape Initiative (CLI) to identify, connect and protect valuable recreational and land conservation opportunities and goals in an area that encompasses the Conowingo project area. To that end, numerous Federal, state and local government entities and Non-Governmental Organizations, including the Department of the Interior are working together towards the CLI's goals and the licensee is encouraged to join these efforts.
http://www.dcnr.state.pa.us/cli/lowersusquehanna/index.htm

http://www.fermatainc.com/?page_id=692

The NPS has a dedicated Chesapeake Bay Office located in Annapolis, Maryland to serve the public and the resources associated with the Chesapeake Bay and its tributaries, including the Susquehanna River, which provides roughly 50% of the freshwater received by the bay, virtually all of which flows through or over the Conowingo Dam.

Trail Systems

The Mason Dixon Trail (MDT) is a designated National Recreation Trail, administered by the NPS. The trail runs from its western terminus with the Appalachian Trail at Whiskey Springs to its eastern terminus with the Brandywine Trail in PA, after having crossed portions of Maryland and Delaware, including a section of the White Clay Creek which is a designated Wild & Scenic River. The trail runs along river right (at various points following roadways) joining the Susquehanna River near Wago Junction and Lowes Island, and continuing to below the Conowingo Dam where it crosses the river near Harve de Grace, MD. www.masondixontrail.org www.americantrails.org/nationalrecreationtrails

The Susquehanna River Water Trail is a designated National Recreation Trail, administered by the NPS. It is part of the NPS' Chesapeake Bay Gateways and Watertrails Network. However, neither RSP mentions the existence of this river length long trail and the associated guide for paddlers on this popular water trail route. The states, communities, and regional non-profit and other non-governmental organizations along the river have identified significant gaps in public access to the Susquehanna River.

Significant planning exists for the advancement of public access to the Susquehanna. The Commonwealth, led by the Pennsylvania Fish and Boat Commission, developed a *Statewide Public Fishing and Boating Access Strategy* to guide planning and development and calls for HUC8 watershed-level planning and implementation. Based on nineteen criteria, the Lower Susquehanna ranks 2nd in priority out of 52 watershed units. http://www.fish.state.pa.us/accessplan.htm

At the local government level, Comprehensive Master, Open Space and Recreation Planning efforts are underway in key River Town communities to identify opportunities for increased access to the Susquehanna. Current efforts exist in Marietta and Wrightsville Boroughs, and a joint plan is being developed in Hellam Township and Hallam Borough.

In a letter dated March 18, 2011, Pennsylvania Governor Tom Corbett expressed strong support for the establishment of the Susquehanna River Connecting trail, which would connect with the designated Captain John Smith Chesapeake National Historic Trail (NHT) www.smithtrail.net.

General Comments on Conowingo Section 3.26 and Muddy Run Section 3.11

During the ISR meetings in March, 2011, several questions were raised about the adequacy of the scope and method of the recreational studies. The consultant primarily relied on recent Form 80 data and evaluated only those facilities in the project boundaries, not taking into account any nearby facilities (existing or closed) or recreational uses associated (or previously associated) with those facilities. In most cases, the licensee's consultant simply conducted on site surveys of users (without asking for zip code) and noted numbers of users relative to perceived capacity of each site. The overall conclusion was that there are adequate recreational facilities and public access points associated with both the Muddy Run the Conowingo projects. The methodology for identifying recreational use and adequacy of existing facilities was considerably flawed. The consultants did not consider many nearby facilities, did not make any attempt to identify or contact local and regional user groups, and did not send out any mailed surveys. Many key locations were missed or not included in the evaluation, including Rock Run boat ramp for example, which until a few years ago had been a major access below the Conowingo dam, but was summarily closed by Exelon shortly after taking over the projects just a few years ago. This was a heavily used facility that provided recreational access below the dam, and its closure has undoubtedly had effects on other facilities both in and near the Conowingo and Muddy Run project areas. By limiting their analysis to the project boundaries, the licensee, and therefore the FERC, does not have a real picture of recreational use in the project areas. In many cases during eastern relicensings, licensees have evaluated as far as 25 miles from the project boundary in order to encompass local and regional recreation opportunities and needs. This is especially important because nearby access locations, both currently in use and those that have been closed, should have been evaluated in the context of the project because it affects recreational use within the project boundary. By relying on current use data (arguably flawed in the scope and methodology of collection) and future demographics only, the licensee does not get an accurate or adequate picture of future recreational demand. As such, they have not satisfied the terms of FERC's February 4, 2010 Study Plan Determination.

Comments Specific to Conowingo 405

At page 1-11 in the Revised Study Plan dated December 22, 2009, the issue associated with parking and access to the Muddy Creek Gorge at Paper Mill Road was referenced in response to the comments filed July 13, 2009 by the Mason Dixon Trail System, Inc (MDTS). Exelon's response lumped this issue with general recreational enhancements that were to be looked at in the Recreational Facilities and Needs Assessment. The RSP 3.26 does not mention this access issue and refers only to the Muddy Creek Boat Ramp on the main stem of the Susquehanna River. The access at Paper Mill Road continues to see heavy use by boaters, day hikers and users of the MDT, however, access for parking has become extremely challenging for the public due to the claim of private ownership where the road crosses Muddy Creek. Survey markers are missing and in order to have any chance at a resolution to this issue, Exelon should resurvey the area to determine where its boundary is and upon the results of that survey, determine where and how to develop or enhance parking in this area, or an alternative location to be agreed upon after consultation with the MDT. A possible alternative would be the former PADOT lot on Route 74, located a mile or so upriver from the Paper Mill Road bridge area.

There are a number of additional problem locations associated with past relocations which have been brought to the attention of Exelon officials during the past several years and in particular, during the relicensing process. These issues, which have not been discussed in the RSP's, will be addressed under separate filing by the MDTS.

Subsequent to September 11, 2001, the licensee expanded its security perimeter, forcing a relocation of a portion of the MDT away from the river between the Conowingo Visitors center and Fisherman's Park and onto roads that are narrow and particularly unsafe for pedestrians. The MDTS has identified an alternative route to the licensee, but has been met with the general response that was reiterated at the March 2011 ISR meetings: The consultant hired by the licensee was asked to evaluate the risks of keeping the restrictions in place and they used FERC's standard Dam Assessment and Vulnerability Methodology. They cited the Department of Homeland Security's concurrence with the consultant's conclusions to keep everything closed that the licensee shut down after 9/11. However, the consultant was not asked to determine if those risks are real or if the closures need to continue. Exelon made their decision based on the consultants' recommendation, but Exelon's consultant noted during the March 2011 ISR meetings that its decision could be changed. Conowingo is one of few such dams that have continued their post 9/11 restrictions. The post 9/11 security closures have also affected the extremely popular and decades long tradition of fishing from the Conowingo Dam catwalk and restricting boaters near the dam. Closing of the catwalk makes little sense; the licensee could simply station someone on-site to check users. At present there is simply a person with a bullhorn telling boaters to move back, when the real threat, if any, comes from truck traffic that crosses the dam on Route 1. Exelon spent considerable money building a new ADA fishing access below the dam on river right, although this was done in the few years before the relicensing process commenced. Both York Haven and Safe Harbor have reopened their catwalks.

General Comments for Conowingo Section 3.27 and Muddy Run Section 3.1 Pertaining to Project Lands

The Shoreline Management Reports identified abutting land uses within 500 feet of the project boundary, which is inadequate, as it does not take into account visual and auditory impacts. The entire recreation report only looked at what is in the project boundary now, there was no evaluation of current or future needs or trends in the areas abutting and nearby to the project boundary. During the ISR meetings in March, 2011, the licensee's consultant explained that they had based their conclusions on future recreational needs and trends on the United States Forest Service 50-year growth projections. Such data presents only the broadest look at trends, and the state representatives from both PA and

MD stated during these meetings that they have far more pertinent, local and regionally specific data showing significant growth pressure, but that the consultants had not contacted any of the relevant resource agencies or local and regional non-government organizations when they did their studies. In addition, the current information contained in 3.27 does not show sensitive areas, such as wetlands, trails and steep slopes. The Conservation Land Initiative referenced above should have been a major source for data in order to develop a complete picture of the need for and opportunities to protect and conserve project and adjacent lands in the project areas and within the project boundaries.

The Conowingo RSP 3.26 at page 3-1 simply referenced the existence of Exelon owned lands, including 2,500 acres located above the high water line (project lands). Similarly, the Muddy Run RSP 3.11 at page 3.0 references 1,790 acres of project lands. The RSP's should include reference to the above referenced collective efforts (CLI) at the federal, state and local level, and should evaluate opportunities for conservation and protection of lands owned by the licensee in and adjacent to the project boundary, which are not integral to project operations, but whose protection would serve many of the goals set out in the Conservation Land Initiative.

The presence of the Ferncliff Nature Preserve, which is listed in the National Registry of Natural Landmarks as a National Natural Landmark (NNL), should be noted in the RSP. In particular any potential changes in land uses or access to the Exelon owned abutting the Preserve should be identified, and evaluated in the context of protecting adjacent lands as part of the CLI.

If you have any questions or comments regarding this letter, please contact Kevin Mendik at (617) 223- 5299, or Kevin_Mendik@nps.gov

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April 27, 2011

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888 First St., N.E., Room 1A
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RE: Conowingo Hydroelectric Project
Federal Energy Regulatory Commission (FERC) Number P-405
Comments on the Applicant's Initial Study Reports (ISR)

Dear Secretary Bose:

On behalf of the Maryland Department of Environment, the Maryland Department of Natural Resources (MDNR) Power Plant Research Program (PPRP) is submitting the attached comments in response to the Applicant's Initial Study Reports (ISR) filed with the Federal Energy Regulatory Commission (FERC) on February 22, 2011. These comments are being filed in regard to the application for a new license by the Exelon Generation Company, LLC (Applicant) for the Conowingo Hydroelectric Project (Conowingo / Project), located on the Susquehanna River in Cecil and Harford Counties, Maryland and Lancaster and York Counties, Pennsylvania.

Our comments on the Applicant's ISRs are provided as an attachment to this letter. Also, we generally support the comments that will be filed by the United States Fish and Wildlife Service (USFWS), Pennsylvania Fish and Boat Commission (PFBC), Pennsylvania Department of Environmental Protection, Susquehanna River Basin Commission (SRBC), The Nature Conservancy (TNC) and American Rivers. We thank you for the opportunity to provide comments on this important milestone in the relicensing process.

Sincerely,

Shawn A. Seaman
Program Manager
Maryland Department of Natural Resources
Power Plant Research Program

Attachment: Comments on the Applicant's Initial Study Reports

COMMENTS ON INITIAL STUDY REPORTS

With a few exceptions (notably study 3.32), we are only commenting on complete Initial Study Reports (ISRs) filed by the Applicant on February 22, 2011; however, we reserve the right and intend to submit comments on the remaining studies as they are filed with the FERC and we have time to fully review and evaluate them. The study summaries included in the Applicant's February 22, 2011 filing do not provide enough information for us to provide comments at this time; therefore, we also reserve the right to request additional studies in 2011, or beyond, if any of the incomplete studies are not adequate to address the impact issues and request that all optional 2011 studies be required by FERC. The incomplete studies include:

3.1 - Seasonal and Diurnal Water Quality in Conowingo Pond and below Conowingo Dam
3.2 - Downstream Fish Passage Effectiveness Study
3.4 - American Shad Passage Study
3.9 - Biological and Engineering Studies of the East and West Fish Lifts
3.11 - Hydrologic Study of the Lower Susquehanna River
3.12 - Water Level Management (Littoral Zone and Water Level Fluctuation)
3.15 - Sediment Introduction and Transport (Sediment and Nutrient Loading)
3.16 - Instream Flow Habitat Assessment below Conowingo Dam
3.17 - Downstream EAV/SAV Study (Water Level Vegetative Cover Study)
3.25 - Creel Survey of Conowingo Pond and the Susquehanna River below Conowingo Dam
3.28 - Archaeological and Historic Cultural Resource Review and Assessment

Many of the Study Reports were to be prepared and provided to participants for review and comment at the conclusion of the first year of study, as indicated in section 9 of each of these study plans. These reports were never provided to the stakeholders and, thus, when the ISRs were filed, they did not reflect our input.

3.3 - Biological and Engineering Studies of American Eel at the Conowingo Project

This particular report was issued as an interim draft that only covered study objective 3. The applicant stated that a complete report will be issued at a later date to address the remaining study objectives (1, 2, 4, 5, 6, 7, 8 and 9).

Study Comments (objective 3 only):

- Eel sampling conducted by the Applicant occurred in the spillway area and consisted of 258 eels. However, the USFWS collection efforts in the tailrace captured approximately 24,000 elvers.

- USFWS began their effort on May 31, 2010, while the Applicant initiated its eel collection efforts more than two weeks later on June 16, 2010.

- The report concludes that an earlier start date and greater attraction flows may be needed to substantially improve eel collections in the spillway area.

- USFWS notes in *Appendix A: USFWS 2010 Eel Collection Report, Conowingo Dam* that they have been unable to determine the triggers for elver migration at the Conowingo Dam.

Recommendations for Additional Studies:

- A 2011 study was proposed by the Applicant at the March 9-11, 2011 Study Report meeting. Start-up will begin in mid-May of this year (2011) and attempts will be made to increase attraction flows. An additional substrate may be tested for the elver ramps in addition to repositioning of the Enkamat substrate.

- Flow manipulations in the area of the ramps or positioning one of the ramps where there is additional flow and the other where flows are lower and/or directing flows alternately to one ramp and then the other to determine the level of flow needed for attraction may be illustrative during these preliminary siting studies.

3.5 - Upstream Fish Passage Effectiveness Study

Study Purpose: "...to determine the fish passage efficiency of the Conowingo East Fish Lift and to identify factors that may influence efficiency on a daily or seasonal basis. If factors are identified that may adversely affect efficiency, these factors can then be addressed to the extent they relate to project operations delay...."

FERC required a number of agency recommendations, including: 1) consider operational and structural factors affecting passage; 2) not use recreational anglers to collect test shad; 3) track fish from mid-April to Aug. 1; 4) conduct weekly tracking from river mouth to Holtwood dam; 5) add two remote stations; 6) assess influence of all independent variables on fish movement; 7) determine location of all tagged fish before, during, and after changes to project operations; 8) plot hourly locations of stranded fish on plan view maps. FERC could determine that testing of certain agency-recommended project manipulations is required in 2011.

Non-Compliance with the FERC-Approved Study Plan:

- Schedule – The Initial Study Report scheduled for January 21, 2011 was not filed on time (FERC approved an extension). A "Study Report" that was "...to be prepared and provided to participants for review and comment at the conclusion of the first year of study prior to filing the report with the Initial Study Report" (pg. 3-46) was never provided to the stakeholders and, thus, when the Initial Study Report was filed, it did not reflect any input from the participants.

- Fixed-location remote monitoring sites – Monitors were installed at the sites specified in the plan; however, Station 7 monitors, which were to monitor general shad movement in the tailrace, had a detection limit only to the upstream end of Rowland Island, while the tailrace is defined as the lower tip of Rowland Island in the study plan (pg. 3-45). Thus, Station 7 did not monitor fish in the tailrace as defined in the approved study plan.

- As per the FERC Director's letter (dated Feb. 4, 2010, pg. 3), the applicant was to "...consider both operational and structural factors that may affect successful or timely passage..." and "assess the influence of all independent variables on radio-tagged fish movement and behavior"; the only analyses presented in the study report were of fishway attraction effectiveness and upstream fish passage efficiency. On pg. 22 of the report, the statement is made that "...there did not appear to be a single variable that consistently provided the best fish passage conditions or guaranteed high rates of successful upstream passage….", no analysis is included in the report to substantiate that statement in compliance with the Director's instructions. No link was made between the findings of this study (Study 3.5) and those of Study 3.6, also specified in the Director's letter.

Study Comments:

- The significant number of forays into the East Fish Lift (EFL) was not analyzed in light of the physical parameters (e.g. flow, water temperature and crowding by gizzard shad) nor was the probability of capture in the EFL assessed relative to when the lift was operating. It appears from the data that the number of tagged shad captured in the EFL was related to when the lift was operated and may be a function of lift numbers (or timing of the lift relative to when the fish was present) which are related to crowding.

- There was no statistical analysis contrasting the behavior of the American shad that were not successfully passed and those that were. There was no analysis of differences in behavior, etc. related to physical parameters of the tailrace, operation of the EFL, and/or flow.

- The factors that could possibly affect passage efficiency and passage delay were not thoroughly discussed, researched or investigated as causative factors and the lack of any analysis of fish animations results in there being no scientific credible information to substantiate the conclusions drawn.

- This study lacks citations for statements such as: "*Drop back behavior related to post-tagging stress is typical of radio tagged shad and can affect migration behavior of up to 40% of the tagged fish.*" and "*While the exact cause of this inability of all fish in the EFL to successfully pass upstream is not understood, it is symptomatic of current fish lift designs for American shad*"

- The low passage rate of American shad through the EFL demonstrates the inadequacies of this lift. Flow conditions in 2010 were within normal limits but the operation of the dam in relation to turbine flow was not discussed and could be highly correlated to attractiveness to the dam, ability to hold fish close to the dam and may influence their ability to locate the EFL because of competing flows, none of which was discussed. In addition, the problem of Diffuser A and its possible influence on fish passage (mentioned on page 23) was never addressed further.

- If the SRAFRC goal of 2 million American shad is to be met above the York Haven project, conclusions of only 45% passage efficiency (check #) through this project, directly impacts this system goal. This also must be integrated with Study 3.9 and other studies to clearly present the difficulties that the Conowingo Dam imposes on successful American shad passage.

- Based on preliminary results and the animations, the delay to American shad passage is significant. The amount of time that American shad attempt to find the EFL is very significant and alarming. This reported delay not only decreases the fish's bioenergetics, but it likely forces spawning to occur below the Conowingo Dam and in habitat that is less suitable than upriver.

Recommendations for Additional Studies:

Criteria for Modification of Approved Study [18 CFR 5.15(d)]: as indicated above, approved studies were not conducted as provided for in the approved study plan. Therefore we request the following modification of this study for 2011, or beyond, based on how it was conducted in 2010:

- Results of this study should be integrated with the results of Study 3.6 as was specified in the FERC Director's letter.
- Statistical analysis of the behavior of the monitored shad relative to potential causative factors (e.g. flow, plant operation regimes, water temperature, crowding by gizzard shad, lift frequency and number) should be included in a revised version of this report.
- Fish behavior that is illustrated in the animation provided to the stakeholders should be quantitatively analyzed to assess all relationships between the behavior of the monitored fish and plant operations, as well as all the other contributing variables.
- Citations should be incorporated into a revised version of this report to provide the basis for currently unsubstantiated comments incorporated into the text.
- The Applicant should revise and amend the report in response to the comments provided here and provide a copy of the revised report to the stakeholders for final review.

3.6 - Conowingo East Fish Lift Attraction Flows

Study Purpose: 1) review and analyze applicable data from 2000 through 2009 under the designation of historical data (if available) as it relates to Conowingo turbine and East Fish Lift (EFL) operation data; 2) analyze and report turbine on/off times, duration of turbine operation, spill data, if applicable, and water temperature, in conjunction with attraction flow velocity data and hourly fish passage data, for 2010; and 3) analyze and report 2010 Conowingo station operation and fish passage data in conjunction with the passage of radio-telemetered American shad from Conowingo RSP 3.5-Upstream Fish Passage Effectiveness Study.

FERC also stated additional field studies in 2011 could be required if agencies recommend changes in project operations.

Non-Compliance with the FERC-Approved Study Plan:

- Schedule – The Initial Study Report scheduled for January 21, 2011 was not filed on time (FERC approved an extension). A "Study Report" that was "...to be prepared and provided to participants for review and comment at the conclusion of the first year of study prior to filing the report with the Initial Study Report" (pg. 3-54) was never provided to the stakeholders and, thus, when the Initial Study Report was filed, it did not reflect any input from the participants.
- The applicant states that no comparison of hourly fish passage to spill operations was conducted because the EFL is seldom operated during spill events. However, inclusion of spill was listed as a topic to be studied in the FERC Study Plan Determination.

- The applicant states that no separate analysis of river herring (alewife and blueback) was conducted because so few herrings had occurred at the EFL during the historic period. However, this had been listed as a topic of study in the Revised Study Plan.

- There was no statistical analysis of the attraction flow data collected in 2010 with regard to how this variable relates to shad passage. However, this was listed as an area of study in the Revised Study Plan and in the FERC Study Plan Determination.

- "Fast fish" operations are described on page 2 of the report in the section entitled, "Current Operation of the Conowingo East Fish Lift Facility," but if analysis was done on this operating scenario, it is not clearly described.

Study Comments:

- Three major topics were addressed by this study. First, historical data from the years 2001 through 2009 and data from 2010 were examined to determine how generation and EFL operations (project operations) influence American shad and gizzard shad passage. Second, attraction flows were monitored in 2010 but no statistical analysis was done to relate attraction flow to shad passage. Third, upstream-migrating American shad were tagged with radio transmitters and their locations monitored to evaluate migration patterns in relation to station operations. In the analyses of both the historical data and of the 2010 data, the applicant claims there is no consistent relationship between shad passage and turbine operation/generation. The applicant concludes that "attempts to improve the upstream passage of American shad should focus on the EFL rather than instituting specific flow regimes or operational schemes that may affect tailrace conditions near and outside of the EFL."

- The statistical analysis of the data is fundamentally flawed and precludes any judgment of the soundness of the conclusions on which these analyses are based. The fundamental flaws arise because the applicant attempted to relate power generation scenarios to fish passage without taking into consideration the many other variables that could potentially influence fish passage. Crucial variables that were ignored in the analysis include: 1) year, 2) day of year, and 3) hour of day. The annual variability in the population size of migrating shad is depicted in Figure 4.1-3 and the day to day variability is depicted in Figure 4.1-3 through Figure 4.1-12. Variability within individual days is also apparent in the data sets provided by the applicant.

- The format in which the data were provided by the applicant was not amenable to independent review or analysis by stakeholders. Multiple excel spreadsheets of raw data with multiple tables per sheet would require significant organization before any review could be done. Ideally, a single large table of data that included all of the relevant variables potentially affecting fish passage as well as the fish passage data should have been provided. Presumably such a table was constructed by the applicant for the purpose of the analyses they carried out.

- A central question that the applicant needed to answer was, "is the project operation in any way related to successful shad passage *if other sources of variation affecting shad passage are taken into account.*" The applicant chose to use several separate t-tests comparing an individual generation scenario to all others for their analysis. This was a poor choice of statistical method because it is unable to partition variance to any other factors potentially influencing shad passage, namely year, Julian date, or time of day. There is a tremendous amount of variation in shad numbers among years (annual range 19,914-193-574 fish), among dates within a year, and among hours within a day. Lumping all of these data into two blocks to be compared (i.e., 1 focal scenario vs. all 291 other scenarios) results in a high amount of within-group variability ("noise"). This swamps out the differences between groups ("signal") which is what we are trying to detect. There are much more appropriate statistical approaches available to the applicant which would amplify the signal to noise ratio by taking into account these other sources of variation in shad passage.

- A set of Pearson correlations was also conducted by the applicant to explore relationships between turbine generation schemes, EFL equipment settings, water temperature, and tailrace water levels with hourly American shad and gizzard shad passage. Correlations do not establish causation but can be a useful tool in data exploration. However, this approach suffers from the same drawbacks as described for the t-tests in that many other contributing factors may have prevented detection of significant patterns. A separate issue is that insufficient information about what data were included in the correlations precludes an understanding of the results. For example, correlations are typically done between two continuous variables to answer the question, how is x related to y? However, the applicant reports correlations between shad passage and aspects of operational conditions that are not clearly defined. For example, what does it mean that a particular turbine is correlated with fish passage? Did they use the duration of operation as a continuous variable or enter on/off as a binary variable (0/1) or use some other characteristic of turbine function? The same issue is evident with many of the correlations. Without further explanation, these results cannot be interpreted.

- More information is needed in order to know whether duration of turbine operations was included in the Pearson correlations. Individual turbines are included in the correlations, but it is not clear what aspect of turbine operation is being correlated with shad passage.

- River flow as a variable is discussed as one of the operational scenarios. "Minimum flow generation occurred nearly 47% of the time." Minimum flow regimes downstream of Conowingo Dam are listed earlier in the report. Natural river flow is minimum flow under some circumstances. River flow does not appear to have been used as a continuous variable in any of the analyses.

- More information is needed to determine whether entrance gate velocity was examined in the correlation analysis. There is a variable called "gate setting" but it is not clearly defined. This was listed as a topic of study in the Revised Study Plan.

- Pg. iii – The last paragraph of the Executive Summary offers an opinion (....It appears that attempts to improve ...upstream passage....should focus on the EFL rather than instituting specific flow regimes or operational schemes.....) that is unsupported by the analyses included in the report. Opinions should not be presented as scientific conclusions.

- Table 4.2-2 – This table presents shad passage rates versus various turbine operation regimes, but does so only for 2010. It appears similar data are available for many other years; that data should also be presented in similar tables.

- Pg 12. The statement: "Historic data (2001-2009) and data from 2010.......show that the EFL is effective at attracting 73% of the American shad in the tailrace....." The statement implies that the historical data support the 73% figure, when, in fact, the 73% figure is solely from the telemetry study done in 2010. Neither the historical data nor any analyses presented in the report provide an indication of what is the EFL attraction percentage of upstream migrating shad.

- Pg 13. The final paragraph of the conclusion section presents the opinion of the authors that future efforts to improve passage should focus only on the EFL and not on plant operations. This opinion is based on analyses in the report which did not adequately address the objectives of this study, as elaborated on above, and is thus an unsubstantiated conclusion.

Recommendations for additional studies:

Criteria for Modification of Approved Study [18 CFR 5.15(d)]: as indicated above, <u>approved studies were not conducted as provided for in the approved study plan</u>. Therefore we request the following modification of this study for 2011, or beyond, based on how it was conducted in 2010:

- The inadequate and inappropriate statistical analyses presented in this report should be deleted, and analyses conducted as described in the detailed comments above.
- Results of the revised analyses should be integrated with the findings of Study 3.5.
- Exelon should revise and amend the report in response to the comments provided here and provide a copy of the revised report to the stakeholders for final review.

<u>3.7 - Fish Passage Impediments Study below Conowingo Dam</u>

Study purpose: 1) determine if project operations adversely impact upstream migrations of American shad, river herrings (blueback herring and alewife), and Hickory shad; and 2) utilize the River2D model (see Conowingo Study 3.16-Instream Flow Habitat Assessment below Conowingo Dam) to ascertain if areas in the tailrace and other portions of the river below Conowingo Dam could present adverse velocity barriers under typical dam operating regimes

Non-Compliance with the FERC-Approved Study Plan:

- Schedule – The Initial Study Report scheduled for January 21, 2011 was not filed on time (FERC approved an extension). A "Study Report" that was "...to be prepared and provided to participants for review and comment at the conclusion of the first year of study prior to filing the report with the Initial Study Report" (pg. 3-57, Section 3.7.9) was never provided to the agencies and, thus, when the Initial Study Report was filed, it did not reflect any input from the participants.

Study Comments:

- Exelon states "there is no evidence to suggest that extreme water velocities present a barrier to upstream migration of American shad or river herrings." However, modeling results show that at full generation (a frequent occurrence during the day during the migration period), velocities approach 8 fps in select areas in the channel between the west shoreline and Rowland Island as well as in the tailrace proper and to the east of the island (Fig. 4.2-12). Shad have a maximum burst speed of 13 fps (maintainable less than 15 sec.) and a prolonged swim speed of no longer than 200 minutes. This suggests at least a delay or fatigue factor that these fish would experience when encountering full generation flow vs. typical run-of-river flows that would occur under natural conditions. Exelon should examine the flow records when fish are moving and compare the amount of time fish experience full generation flow vs. natural river flow during the migration period (for 2010 and 2011 since that is when telemetry data are or will be available) and for average flow during the migration period.

- Pg. 8: The Applicant should provide details of their model calibration with field data or reference the study that provides this information.

- Table 4.1-4: this table needs further explanation and annotation. The column labeled average speed does not correspond to the average distance over time, so it is unclear how this was calculated. The last 4 rows in this table have no explanation for the values there.

- Fig. 3.2-1: Where is the ADCP data applicable to this figure? The Applicant should reference another study if it is contained elsewhere.

Recommendations for additional studies:

Criteria for Modification of Approved Study [18 CFR 5.15(d)]: as indicated above, <u>approved studies were not conducted as provided for in the approved study plan</u>. Therefore we request the following modification of this study for 2011, or beyond, based on how it was conducted in 2010:

- Examine the flow records when fish are moving and compare the amount of time fish experience full generation flow vs. natural river flow during the migration period (for 2010 and 2011 since that is when telemetry data are or will be available) and for average flow during the migration period

- Provide details of model calibration with field data or reference the study that provides this information

- Further explain and annotate Table 4.1-4

- Provide the ADCP data applicable to figure 3.2-1

<u>3.8 - Downstream Flow Ramping and Fish Stranding Study</u>

Study purpose: 1) evaluate specific locations/habitats below Conowingo Dam where stranding potential exists, catalog the sites evaluated, and document the numbers, species affected, and their condition; 2) describe Project operations during the survey periods and the effects on water levels both near-field (i.e., tailrace-spillway) and far-field (i.e., flow attenuation); and 3) relate stranding potential and stranding consequences to the impacted fish populations.

FERC required additional study details, including surveys as soon as possible after peaking; recording number and condition of stranded fish; and photographic documentation.

Non-Compliance with the FERC-Approved Study Plan:

- Schedule – The Initial Study Report scheduled for January 21, 2011 was not filed on time (FERC approved an extension). A "Study Report" that was "…to be prepared and provided to the MDNR, PFBC, NOAA Fisheries, and the USFWS electronically for review and comment at the conclusion of the first year of study prior to filing the report with the Initial Study Report" (pg. 3-65, Section 3.8.9) was never provided to the agencies and, thus, when the Initial Study Report was filed, it did not reflect any input from the participants.

Study Comments:

- The Applicant reported on 12 stranding surveys conducted 4 times each in the spring, summer, and fall of 2010. They concluded that the stranding potential was highest in summer but that only 1% of fish observed were dead. They thus concluded that the consequences of this stranding were negligible. In spring, suffocation and desiccation appeared responsible for most fishes found dead, while in fall the principle consequence of stranding of adult fish is death by predation. Bald eagles and great blue herons are the primary predators with the primary prey species being gizzard shad and other resident species. Photo documentation is sparse in the report and should be better documented.

- The most obvious problem with this study is the infrequent site visits (n = 12) and the timing of the searches (well after first light). Although a biologist noted fish predation by birds and at times it was significant, there were no quantifiable estimates. During the initial study report meeting when we discussed this study, the contractor did note that predation of fish by birds was observed. Stranding of fish increases predation by animals and birds and also stresses the fish through confinement and exposure to degraded water quality. The mortality estimates presented in the tables are minimal only because of long-term effects of stranding and loss of feeding and reproductive potential.

- The graphs provided with the study clearly show the dramatic rise and fall of water levels associated with Conowingo Dam generation, but on sampled days it does not present the worse-case scenario. Although only immediate observations were made concerning the fish (dead or alive), the potential to impact a higher percentage of the fish trapped in pools was evident, therefore the 900 fish (18%) observed dead is a minimum value because of the fish totally removed through predation and the continued stress througb water quality degradation and predation.

- Hydraulic conditions described in the report are not worse-case-scenarios. Page 7 of the report gives ranges for the dewatering of a 2.4 feet to 6.0 feet drop, which is a significant biological difference in habitat for fish. However, this difference was not evaluated based on the estimated potential stranding area and the relationship between difference in water depth and visual observations.

- During the spring surveys when adult American shad will likely be encountered in the tailrace, 108 fish were observed stranded on 4 days and 46 (43%) were observed dead. This results in an average of 27 American shad per event and typically there are at least two peak / minimum flow events per day; this would result in 3,780 (27x2 = 54 x 70 days [if this is extrapolated for the entire American shad run estimated to be 70 days]) American shad stranded and resulting in a minimum of 1,625 stranding mortalities. This results in a significant impact on American shad restoration efforts in the tailrace.

- It also appears that dead/alive status was not noted in the Tables for many important species and no explanation was provided.

- This study did not attempt to quantify the total seasonal impacts of peaking and minimum flows on fish populations, especially river herring and American shad.

- It should be noted that no data were collected during the winter months, a time when the Applicant is permitted to "no flow" for up to 6 hours twice per day. Recreational angler reports have indicated significant stranding of walleye during this time period (Sadzinski, MD DNR personal communication).

- The report was very vague on when the last stranding event occurred prior to the search for fish. A longer delay likely leads to fewer observed fish stranded because of removals by birds, etc. The daily flow graphs were provided but when the study was conducted was not noted on these graphs.

- There was no discussion of habitat area versus stranding, although a map was provided that detailed the habitat types (Figure 2-1).

- The impact to fish populations is not clearly presented. The 1% mortality noted on page 16 only quantitatively estimates the number, but in no way estimates the total impact to fish populations. In fact, on page 16 it is stated *"Stranding of these abundant species provides abundant forage for numerous bald eagles and great blue herons when nesting and rearing young. Further, at least for carp, stranding leads to substantial spawning activity in many spillway reach pools."* This statement contradicts itself because it implies that stranding which is lethal to many fish, is beneficial to one species because it increases spawning. The alternative hypothesis is not presented – fish will spawn in unsuitable habitat, under poor spawning conditions when no alternative is available to them.

- There was no historical perspective of stranding presented in the report, including records of fish kills due to stranding and or low oxygen levels since the dam began operation.

Recommendations for additional studies:

Criteria for Modification of Approved Study [18 CFR 5.15(d)]: as indicated above, approved studies were not conducted as provided for in the approved study plan. Therefore we request the following modification of this study for 2011, or beyond, based on how it was conducted in 2010:

- Provide detailed photo documentation in a revised study report.

- Quantify the total seasonal impacts of peaking and minimum flows on fish populations, especially river herring and American shad.

- Annotate the daily flow graphs dates and times when the field studies were conducted.

- Analyze the correlation between habitat type and stranding.

- Provide a historical perspective of stranding, including records of fish kills due to stranding and or low oxygen levels since the dam began operation.

- Explain any correlations between habitat type and stranding

2011 Requested Study (3.8 Downstream Flow Ramping and Fish Stranding)

Observational and mapping studies to determine potential for stranding of American shad and river herring due to rapid decrease in flow from the project and use of operational and/or structural modifications to mitigate impacts stranding.

Goals and Objectives:

The 2010 study confirmed that plant operations at Conowingo Dam cause migratory and resident fish to become stranded in isolated pools in the Susquehanna River below Conowingo Dam. This study will provide more information on the frequency of such stranding and the occurrence and impact of fish-kills resulting from stranding. More importantly, the 2011 study will estimate the number of American shad and river herring killed during the 2011 spawning season and identify potential operational and structural modifications that might reduce stranding.

Resource Management Goals:

Minimize or eliminate fish mortality caused by stranding in isolated pools as a result of plant peaking.

Need:

During the early 1980's, fish kills were documented by Normandeau (formerly RMC) personnel on a daily basis in isolated pools in the spillpool area below Conowingo (Michael L. Hendricks, PFBC, personal communication). These pools become contiguous with the flowing river when the project is generating and become isolated when the project is in minimum flow mode. Fish enter these pools and the surrounding spillpool areas during generation, then become stranded at low flow. Predatory birds become accustomed to this daily event and gather in the spillpool area at dawn. Within the first hour of light the stranded fish are consumed and no evidence of a fish kill remains. These observations from the past were supported by the data collected in the 2010 survey. Additional fish kills were documented below Conowingo in 1965, 1976 and 1971 (Foerster and Reagan 1977; for full citations, see comment letter from Pennsylvania Fish and Boat Commission, PaFBC). These fish kills occurred in the tailrace at night and were attributed to low dissolved oxygen resulting from respiration of too many fish present in the tailrace and too little flow from the plant. Another fish kill occurred in May of 2001 resulting in the death of approximately 40,000 river herring (Luckett 2001). A definitive cause for this fish kill was never discovered. Dead fish were observed in the river at Port Deposit, covering an area from bank to bank, but no dead fish were observed in the Conowingo Tailrace and dissolved oxygen at station 643, just below the tailrace, never dipped below 5 mg/L. It is likely that these fish died when stranded in the spillpool which became cut-off from river flows due to nighttime reduction in project flows. The 2010 study supports this interpretation. The results of the 2010 study were surprising in that many American shad were stranded and more river herring were stranded than passed the fish lift. The general preference of American shad for the main channel and high flows suggested that stranding of American shad would be minimal. This was not the case in the 2010 survey. In addition the 2010 stranding study included only 4 surveys during the spring spawning season. This was not enough data to accurately describe the impact to populations of American shad and river herring. The study needs to be repeated in 2011 to:

- Estimate the number of American shad and river herring stranded and the proportion killed.
- Determine the points of exit and entry to the spillpool for American shad (radio telemetry study).
- Determine generation scenarios and diurnal patterns during which American shad enter, remain, and exit the spillpool (radio telemetry study).
- Identify potential operational and/or structural modifications that might reduce stranding.

The nexus between project operations and effects on the resource to be studied, and how the study results would inform the development of license requirements:

Conowingo Hydroelectric plant is operated in a peaking mode. When sufficient water is available, Conowingo generation fluctuates rapidly from 3,500, 5,000, 7,500, or 10,000 cfs (depending on FERC-ordered minimum flows) to 85,000 cfs, often on a daily or twice daily basis. The 2010 study showed that reduction of flow from full-generation to FERC- required minimum flow results in the creation of isolated pools which can result in fish kills. Operational or structural changes could re-connect these isolated pools and prevent such fish kills.

How the proposed study methodology is consistent with generally accepted practice in the scientific community:

This issue should be studied by a bathymetric survey, aerial or on-the-ground photography at various levels of low flows to locate such pools and determine at what flow levels they become isolated. Field observations of fish species and abundance in isolated pools would be conducted twice weekly during spring (14 surveys). This study would also suggest potential mitigating measures to prevent fish kills, such as operational modifications or structural modifications that would allow paths of egress for fish that would otherwise be trapped in pools.

Considerations of level of effort and cost involved in the proposed study, and explain why any alternative studies proposed by Exelon would not be sufficient to meet the stated information needs:

This is a simple, inexpensive study similar to the 2010 study but focusing on spring spawning season. Exelon did not propose 2011 studies to meet this need. Estimated cost for the study is moderate.

3.10 - Maryland Darter Surveys

Study purpose: to determine if Maryland darter are present in the Susquehanna River below Conowingo Dam and/or the lower riffles of Deer and Octoraro creeks.

Study Comments:

- At the outset, the methodology specifies a minimum of 10 full days of electrotrawling divided between the four sampling seasons (beginning with Fall 2010). The study report indicates that the Applicant was only able to conduct electrotrawling during January 2011 (4 days) and all of the sampling sites were several hundred yards downstream of the mouth of Deer Creek because of low water making conditions unsafe for navigation. Other methods of survey (seining, electrofishing, snorkeling) were conducted in Deer Creek and Octoraro Creek during the Fall of 2010 (4 dates during October/November).

- It is interesting to note that the Susquehanna River sites of the Maryland darter surveys only produced a single species; the tessellated darter. However, in study 3.8 (Downstream Flow Ramping and Fish Stranding Study) three species of darters were found; the greenside darter; banded darter; and tessellated darter. The sites for the official darter survey were all downstream from Rowland Island while the stranding studies were conducted upstream and to the east of Rowland Island. This may suggest that the spill pool area is better darter habitat or that darters get stranded at higher rates than other species or that the sampling method chosen for the official darter survey was not effective enough to find the other darter species or perhaps there are habitat differences between the two study areas that are more or less preferable to darters.

- The Chesapeake logperch, a rare species in Pennsylvania, was found at both the Deer Creek and Octoraro Creek sites but was not found at the Susquehanna River sites. Based on the example presented above regarding other darter species we suspect that a more intensive survey of the spill area would produce occurrences of the Chesapeake logperch.

Recommendations for additional studies:

- If an additional year of the Downstream Flow Ramping and Fish Stranding Study survey is required by FERC special attention should be paid to sampling for and collecting darter species including the Chesapeake logperch.

- Any darters that were vouchered during the stranding study should be re-checked to ensure their species identification is correct, with special attention paid towards possible misidentification of the Maryland darter and Chesapeake log perch.

3.13 - Study to Assess Tributary Access in Conowingo Pond

Study purpose: 1) identify potential blockages associated with Project operations to fish and recreational boating access into Conowingo Pond tributaries at the reservoir confluence under several commonly encountered water levels; 2) if access to fish is denied at certain water levels due to Project operations, identify those fish species most affected, when it occurs, and at what water levels; 3) develop potential mitigation options to enhance fish or recreational access if problems are encountered.

Non-Compliance with the FERC-Approved Study Plan:

- Impediments to boat access appear to be well identified as specified in the first goal of the study. However, Goal #2 is limited to a general discussion of some previous studies which were focused on anadromous species and may not fully consider use by other species. There is no discussion of Goal #3, mitigation.

Study Comments:

- Limited boat access into several large backwater tributaries was noted at a pool level of 109 due to low clearance (air draft) of railroad bridges. It is worth noting that these could be mitigated at some later date should these bridges be scheduled for replacement by the Norfolk Southern Rail Line.

- At a pool level of 106 or lower, boat access to some backwater tributaries may be restricted due to shoaling. Several ramps may be impacted at these levels as well.

- Fish access to the tributaries was assessed from previous studies which noted little evidence of use by anadromous species. It is suggested that herring and shad do not use these tributaries due to small catchment size and discharge. However, catchments smaller than these have been documented to support runs of herring across the Chesapeake region. If populations eventually rebound and numbers lifted to Conowingo Pool increase substantially then greater use of these streams could occur.

- Under normal spring conditions, operations would not impact fishes use of tributaries because most barriers are upstream natural features which exist at all levels. At a pool level of 106 or lower, shoals could prevent access to some shoreline tributaries and might also reduce use of some of the backwater tributaries. Under these conditions larger and more laterally compressed fishes such as American shad or gizzard shad might be less likely to navigate extensive shoal reaches than would smaller more fusiform fishes such as American eel or yellow perch.

- Species such as smallmouth bass and walleye are known to make upstream migrations prior to spawning in the Susquehanna and elsewhere. Several of the larger backwater tributaries may be large enough to host such migrations. The same concern for low pool levels during spring spawning periods would apply for these and other resident species.

Recommendations for additional studies:

- The Applicant should determine if restricted access is due to permanent features such as bedrock or riffles or if channels and ramp approaches are restricted due to excessive sedimentation. Unconsolidated sediments could be mitigated through dredging.

3.14 - Debris Management Study

Study purpose: 1. Analyze hydrologic conditions that initiate debris management actions; 2. Review current debris management practices to ensure that they are consistent with best management practices (BMPs); and 3. If not consistent with best management practices, assess need for additional practices to
reduce impacts to Pond and downstream users.

Study Comments:

- The Applicant's RSP stated that one purpose of this study was to "analyze hydrologic conditions that initiate debris management actions". We supported this proposed analysis in order to illustrate typical river flow "triggers" that transport a significant quantity of debris to the Project and initiate debris management actions. However, the Applicant's study failed to address this. In their study report, the Applicant simply plotted the average monthly flow versus the annual quantity of debris (see Figure 4.3-1) and concluded that the figure "suggests the lack of obvious trends from the limited data available". The methodology utilized in this study does not provide any useful information regarding hydrologic conditions that initiate debris management actions.

- The Applicant's RSP stated that a purpose of this study was to "identify and evaluate potential improvements". In addition, under *Task 2: Debris Management Assessment* of the RSP, the Applicant states: "Current debris management practices will be evaluated" and "debris management practices at other hydroelectric facilities......will be evaluated." However, it does not appear the study report has evaluated any other potential improvements. The Applicant's study report discusses: 1) current and historical debris management practices at the Project, 2) current debris management practices at the three upstream impoundments, and 3) debris management practices at select FERC relicensing projects. According to the study report, the Applicant currently utilizes two gantry cranes with grapple attachments to remove debris from the intakes, as well as floating surficial debris from in front of the dam. Previously the Applicant has used a self-propelled skimmer barge to capture floating debris; however, the device was retired in 2008. The study report also identifies several debris management practices being utilized at the other facilities; such as trash rakes, collection efforts in the impoundment, skimmer walls and mechanical skimmer boats. However, the Applicant did not evaluate whether or not these current practices could improve debris management at the Project, they only reported them.

- According to data presented by the Applicant in Tables 4.2-1 and 4.2-2, the annual quantity of debris collected at the Project is steadily decreasing over time. For example; during the five year period between 1989 and 1993, an annual average of 3,470 cubic yards of debris was collected. During the next five year period on record, between 1994 and 1998, an annual average of 1,238.8 cubic yards of debris was collected, which is about 1/3 the previous five year average. Finally, during the last five years on record, between 2006 and 2010* (*2010 data is through May), the annual average of debris collected was 712.8 cubic yards, which is about 1/5 the 1989 through 1993 average. As the Applicant noted in their study report, a referenced study determined "an average of 75,000 cubic yards of debris is passed over or through each dam annually with the quantity of debris being nearly proportional to river flow". Since the annual quantity of debris transported to the Project is nearly proportional to river flow and the United States Geological Survey (USGS) records for the Marietta gage do not show a corresponding downward trend over the same period, the Applicant is simply collecting a smaller percentage of debris each year.

Recommendations for Report Revisions:

- We ask that the FERC require a proper analysis that will identify the hydrologic conditions that initiate debris management actions, as proposed in the RSP.
- We ask that the FERC require the Applicant to evaluate other known debris management practices, as proposed in the RSP.
- Why is there a data gap between 1998 and 2006 (quantity of debris collected)?
- Why was the self-propelled skimmer barge retired in 2008? What percentage of the total debris removed was floating debris removed by the skimmer barge?
- Is there any record of the weight or volume of the debris composition? e.g, woody debris, plastic, metal, etc.
- The Applicant should explain what conditions initiate their "clamming" efforts.
- The Applicant should conduct a literature review of debris management procedures followed at facilities outside of the Susquehanna River watershed and incorporate that review in this report, as was specified in the approved study plan.
- The Applicant should revise and amend the report in response to the comments provided here and provide a copy of the revised report to the agencies for final review.

3.18 - Characterization of Downstream Aquatic Communities

Study purpose: 1) characterize resident fish abundance, size structure, condition, and reproductive success below Conowingo Dam; 2) describe the benthic macroinvertebrate communities below Conowingo Dam collected by various common collection gears; and 3) provide updated information on these communities available through 2010 studies focused on other objectives.

FERC did not require collection of new field data but stated they 'may recommend field work in 2011 if the final literature-based study report does not provide enough information on the aquatic community' to evaluate operational changes to the project

Non-Compliance with the FERC-Approved Study Plan:

- Schedule – The Initial Study Report scheduled for January 21, 2011 was not filed on time (FERC approved an extension). A "Study Report" that was "...to be prepared and provided to participants for review and comment at the conclusion of the first year of study" (pg. 3-140, Section 3.18.9, referring to task 2) was never provided to the agencies and, thus, when the Initial Study Report was filed, it did not reflect any input from the participants.

Study Comments:

- A literature-based study was conducted to provide a characterization of the current aquatic community below Conowingo Dam. This was done by summarizing various reports of studies conducted over an approximate ten-year time frame, from the early 1980's into the early 1990's. The summary consisted of listing dominant taxa found during these studies (including the percent contribution of these taxa to the total abundance), describing life history patterns and tolerance levels of these dominant taxa, and summarizing the possible contribution of the dominant taxa as fish prey based on previous fish stomach analysis.

- The study concluded that the benthic community inhabiting the area below the dam was generally comprised of facultative and relatively tolerant warm-water taxa. In general, over the 10-year time frame, the percent contribution of the dominant taxa did not change. Tbe study also concluded that since the fishery below the dam *"appears robust"*, that the benthic community must be providing a *"more than adequate food base"*. There are many concerns with a statement like this, as well as major problems with the review. The study only reviewed the percent contribution of the dominant taxa to the total. An analysis of this sort will not capture a total decline in the population, if the rates of decline in the dominant taxa are similar to each other. An additional summary of total abundance patterns and abundances of the dominant taxa would address this concern.

- A quick calculation of mean total abundance and mean abundance of the dominant taxa collected during each year studied found some interesting results. Given the inherent problems with this calculation (i.e., sampling occurred during different seasons and habitats and were averaged over various minimum flow regimes), the results nonetheless deserve some attention. Only data collected using the t-sampler was included to avoid gear collection issues. In the 7 years included in this analysis, the first two data points were averaged from data collected before (summer) and after (fall) a minimum flow was required beyond the summer timeframe. The third data point was averaged from data collected during a period where the dam was required to maintain a minimum flow during the winter period (fall-winter). The 4th and 5th data points were averaged from data collected before (fall) and after (winter) the facility was allowed to operate under an intermittent shut down during the winter period. The 6th and 7th data points were averaged from data collected before (fall) and after (winter) when the facility was allowed to operate under an unrestricted shut down regime during the winter period. A linear regression line on total abundance over this time period appeared relatively flat over the sampling timeframe; however, a decline in the final year was noted. Of the three dominant taxa found to be a significant fish prey resource, Gammarus and Cheumatopsyche remained relatively flat, while chironomid abundance appeared to decrease over the sampling period. Of the three soft bodied worm species, that were dominant taxa but have not been recorded as dominant fish prey, two (Dugesia and Manayunkia) declined over the sampling period and one (Oligochaeta) increased although the increase was mainly the result of a large number collected in the 6th study year examined. Of the three other dominant taxa in the mollusk category, two Ferissia (a gastropod) and Sphaeridae (a clam) declined and Corbicula (the introduced Asiatic clam) increased over the sampling period.

- The Applicant's treatment of the characterization of the current aquatic community below Conowingo Dam was incomplete. A summary and interpretation of abundance patterns observed during the early years of the dam operating under minimum flow requirements would have added a great deal to the characterization. A current survey of macroinvertebrates below the dam would provide vital information as to the current status of the benthic community and could be used to examine the achievement of the current flow regime requirement since its establishment in the 1980's and 1990's; this data is at least twenty years old. Changes in flow ramping, fish assemblage and water quality all likely have affected species diversity and abundance below Conowingo Dam. Since there have been significant changes in these factors, the present state of macroinvertebrates is unknown.

- The report states: *None the less, the fishery below the dam described within subsequent sections of this report appears robust, suggesting that the invertebrate populations provide a more than adequate food base. The fish also appear be in good condition (see Section 9.0) The invertebrate data collected during the later years of the tailrace studies were taken after much of the current minimum flow release schedule had become operational. Hence, it seems unlikely that the community has changed appreciably, given the water quality and habitat constraints imposed upon it by impoundment.* Page 4-11. This statement is speculation because it assumes the presence of fish in good condition and indicates there are enough macroinvertebrates to feed them. American shad do not feed significantly during their spawning run and therefore this statement does not apply to them. In addition, most adult fish prefer to consume small fish and not macroinvertebrates. This conclusion would need some references to support such a strong conclusion on data that is over 20 years old and correlating to adult fish data collected in the last few years.

- It should be noted that the EFL and West Fish Lift (WFL) likely do not catch fish in relative abundance to the tailrace, especially the resident species (as noted on page 10-2). In addition, river herring and hickory shad are present in significant numbers below Conowingo Dam and are rarely caught in the lifts, which is likely due to exclusion due to high attraction flow coming through the lifts.

- There was no mention of gear selectivity and efficiency of one gear type or survey versus another (see Table E-17). In addition, on page 10-2 killifish were abundant below Conowingo Dam but never caught in the lifts.

Recommendations for additional studies:

Criteria for Modification of Approved Study [18 CFR 5.15(d)]: as indicated above, <u>approved studies were not conducted as provided for in the approved study plan</u>. Therefore we request the following modification of this study for 2011, based on how it was conducted in 2010:

- Evaluate total abundance patterns and abundances of the dominant taxa

- Provide a summary and interpretation of abundance patterns observed during the early years of the dam operating under minimum flow requirements

- Conduct a current survey of macroinvertebrates and fish below the dam to indicate the current status of these populations since minimum flows were implemented in the late 1980's. FERC indicated they *"may recommend field work in 2011 if the final literature-based study report does not provide enough information on the aquatic community' to evaluate operational changes to the project"*. We believe that the historical data presented, which is over 20 years old, has not accurately indicted the current status of macroinvertebrate and fish populations below the dam and the operational changes that have occurred since those surveys were conducted. See our study plan request for details.

- The Applicant should revise and amend the report in response to the comments provided here and provide a copy of the revised report to the agencies for final review.

<u>3.19 - Freshwater Mussel Characterization Study below Conowingo Dam</u>

Study purpose: 1) characterize the freshwater mussel community in the Susquehanna River below Conowingo Dam; and 2) determine if plant operations at Conowingo Dam affect the mussel community in this river reach.

FERC required: 1) search of museum holdings not just near the project; 2) recording river flow during surveys; 3) deposit of voucher specimens

Non-Compliance with the FERC-Approved Study Plan:

- Voucher specimens were not deposited as required

- The survey only partially accomplishes study purpose 1 and fails to accomplish study purpose 2; details of this non-compliance are listed below.

Study Comments:

Task 1 – Search for published and unpublished mussel locality records for the study area

Comment 1: The RSP states that *"the results of searches for published and unpublished freshwater mussel locality records from the study area will identify species likely to be found in the survey area. With such information, the crew will be able to review a reference collection of shells of these species in order to better ensure reliable and consistent identification during the survey.*

However, it should be noted that all personnel conducting the survey will be experienced in mussel survey and identification and that voucher specimens of all non-state and non-Federal listed species will be collected for deposit in a museum."

The report does not indicate that reference shell material was examined by personnel conducting the survey after compiling a list of species that were likely to be found. There are serious implications for management actions from even minimal levels of misidentification (Shea et al. 2011), especially in impact assessments. Additionally, no voucher specimens have been given to MDNR, which was a condition of the PI's scientific permit. Additional terms of the permit included contacting MDNR biologists when questionable live specimens were collected for specimen verification within 24 hours. This was not done even though the PI retained mussels for 24 hours for verification by MDNR biologists during a scheduled field visit.

Task 2 – Semi-quantitative survey to inventory the mussel species present and estimate their relative abundance

Comment 1: The RSP noted that the entire 4.5 mile study area (to the downstream end of Spencer Island) be sampled. This was not done as clearly illustrated by Figure 4.2-1. Some areas representative of a small fraction of habitats (e.g around the confluence of Octoraro Creek) were disproportionately sampled while other areas (Rueben Island to Steret Island and east of Spencer Island) were not sampled at all. Throughout the study plan development period, we stressed to the PI that a single method be chosen, be clearly stated, and employed in the study because we suspected that the entire area would not be sampled. Based upon the habitat base map provided by the PI we suggested that the macrohabitat categories be used to proportionally stratify semi-quantitative sampling and were led to believe that this strategy would be used. We also noted that constrained area timed searches could be employed as noted in literature provided (Smith et al. 2001) to the PI during RSP development and through personal communication.

Comment 2: How were semi-quantitative survey locations chosen? This was not specified in the RSP or report and does not appear to have followed methods mutually agreed upon between MDNR and the PI. There appears to be large areas of suitable mussel habitat that were not surveyed and poor spatial representation throughout the project area, including an emphasis on the shoreline, upper project reaches, and around the Octoraro Creek confluence. For example, sampling did not take place east of Spencer Island or west of Steret Island though both reaches are within project area and contain areas with suitable mussel habitat with known concentrations of mussels.

Comment 3: The RSP also states that *"the greater part of the survey effort will focus on searches of deposits of miner material which favor mussel burrowing."* This was not done; lower portions of the study area contain large expanses of finer substrates, specifically the area from Robert Island downstream to Spencer Island and the channels between islands. We agree the prevailing substrate in the upper reaches of the project area are cobble, boulder, and bedrock, but a considerable amount of fine substrate exists in depositional areas and flow refugia that is patchy, but ubiquitous. The area termed *"Ruffle"* is the predominant macrohabitat as classified by Normandeau and received relatively little sampling effort, even though our personal observation indicated that suitable mussel habitat and mussels are found throughout this habitat. We communicated this finding to the PI via email prior to the survey. In addition, mid-channel islands, where gravel substrates dominate and mussels are abundant, received very little attention compared to near shore islands. There also appears to be a bias towards sampling along the left descending half of the channel. We stressed during comment periods that a clearly defined allocation of survey effort be made (e.g. habitat stratification with proportional allocation or constrained areas searches throughout the reach). The PI should be familiar with these methods and references that provide examples (see review of methods in Strayer and Smith 2003, Smith et al. 2001, Villella and Smith 2005).

Comment 4: Why were multiple search patterns used including parallel transects, perpendicular transects, and searches originating from a central point? It was stressed during comment periods that a consistent method be used. Smith et al. (2001) and Villella and Smith (2005), which are implicit throughout the RSP and were provided to the PI, clearly describe what type and how the search methods should be employed.

Comment 5: According to the RSP, *"Areas where concentrations of mussels are found will be delineated as feasible and perimeters noted with a GPS field instrument. The first 100 individuals of Maryland S1-S3 species encountered will be tagged with a shell maker before returning them to the river bottom. After the first 100 individuals, 25% will be tagged. The locations of these species will be recorded, also, for addition to the habitat GIS coverage that already has been prepared."* No figures illustrate that the perimeter of mussel concentrations were delineated or noted with a GPS. Please discuss why this was not conducted. The body of the report noted that 54 of 71 Alewife floaters were tagged, yet Table 4.2-5 indicates 68 of 71 were tagged. Please discuss this discrepancy and why all specimens were not tagged. The PI was granted authority to hold live mussels for up to 24 hours so tagging could have be done the following day if necessary. Also, no habitat maps were presented that include the locations of S1-S3 species. It is imperative that their location be reported to resource agencies and integrated into the flow modeling to assess whether or not dam operations limit mussel distribution and abundance.

Task 3 – Quantitative sampling

Comment 1: There is no indication in the RSP as to how the quantitative survey areas were chosen. The two-phase, double sampling design (Smith et al. 2001, Villella and Smith 2005) states that quantitative sampling areas should be chosen randomly. We have additional questions regarding the choice of quantitative survey areas as it was not clearly stated in the RSP despite several requests for further detail. Why and how were the specific CPUE's chosen? How was the size of the survey area determined? Why were they predominantly along the left descending bank? Why were they not chosen randomly as the survey methods (Smith et al. 2001) indicate? How were areas surveyed by divers in the semi-quantitative survey sampled by waders during the quantitative survey?

Random selection is necessary to reduce bias and it was agreed upon between Exelon, Normandeau, and MDNR that five areas would be sampled from strata representing no-low, moderate, and high CPUE and be approved by MDNR upon inspection of semi-quantitative data. This did not happen; a unilaterally decision on the location was made without allowing MDNR to review data. Further changes to site selection were made in the field. Furthermore, there appears to be investigator bias towards areas easily accessible and wadeable habitat. This would compound upon the apparent bias in the selection of semi-quantitative survey locations. A distribution analysis of the semi-quantitative results shows no locations with low CPUE were sampled; therefore the quantitatively sampled areas do not represent the full range of mussel abundance, or the range and frequency to be sampled that was agreed upon. The areas surveyed represent moderate to very high CPUE; two are within the 95th percentile of mussel CPUE. It also appears that in some cases, the location that was sampled in the semi-quantitative survey was not quantitatively surveyed. CPUE from corresponding semi-quantitative locations should also be noted on data sheets in Appendix B for clarity.

Comment 2: In the report, five areas were said to be quantitatively surveyed. This number was agreed upon by the PI, Exelon and MDNR after the RSP was filed due to concerns over adequate sample size and coverage. However, according to the report one semi-quantitative survey location was chosen to represent two quantitative survey locations. As a result, only four independent quantitative survey areas were sampled.

Comment 3: According to the RSP, *"the first 100 individuals of Maryland S1-S3 species in each mussel bed will be tagged and their locations recorded with a GPS for addition to the habitat GIS coverage that already has been prepared."* The report does not indicate that Alewife floater (S3) was tagged during the quantitative survey, nor was their location recorded with a GPS. Habitat maps with this locality data were not provided.

Comment 4: Was a 1.5 mm sieve screen used as this is incredibly small? A 6 mm sieve screen is standard. It should also be noted that a benthic macroinvertebrate sieve pan was originally used because the PI did not have a standard sieve box used in mussel surveys. One was provided by MDNR.

Task 4 – Habitat parameter measurements

Comment 1: Until completion of RSP 3.16 and the integration with data from RSP 3.19, we cannot comment on this task. In light of the fact that several aspects of this study appear to be incorrectly implemented, along with inadequate spatial representation and sample size, and statements upon habitat condition and availability not based upon data, conclusions about to the effects of dam operations on freshwater mussel habitat and population cannot be supported due to a lack of valid survey data.

Comment 2: A range of substrate sizes and their corresponding classes are not provided.

Task 5 – Development of the study report

Comment 1: A report has been completed, yet numerous shortcomings, some of which are quite serious, have been identified. At this time, the task cannot be considered complete without addressing these deficiencies.

Comment 2: Discharge the day of sampling was not reported for any task.

Comment 3: In light of the fact that the quantitative sampling found nearly all the Eastern elliptio < 50 mm in excavations and that 50% of the mussels were found buried, had only an informal visual search been used, as was originally requested, how would the study results been affected (Richardson and Yokley 1996, Miller and Payne 1993)? Was the project area population, especially smaller individuals and uncommon species, adequately sampled to answer project objectives with the relatively few quantitative samples? Given the fact that only three species were detected and smaller individuals were nearly absent, we feel this clearly illustrates enough effort was not expended in quantitative sampling (Miller and Payne 1988, Smith et al. 2000).

Comment 3: The author used a reference of Eastern elliptio length at maturity from an oligotrophic Canadian Shield lake to make a statement regarding the population in a temperate, large river. Given mussel growth rates and length at age are highly variable (Lellis et al. unpublished data, Haag and Rypel 2010) why was such a comparison made? Furthermore, since this comparison was made, why were other catch-rates of Eastern elliptio from other studies not referenced to infer what could be a high catch-rate? There is considerable data available on Eastern Elliptio catch-rates (Strayer unpublished data, Lellis et al. unpublished data, Strayer and Smith 2003, Villella and Smith 2005. Similar comparisons should have been made regarding species richness, relative abundance, assemblage composition, length-frequency distributions, and population densities.

Comment 4: How does the author conclude that larger specimens were long-lived? Age at length data were not collected or referenced, although readily available, therefore the author can only speculate that an Eastern Elliptio of 170 mm was long-lived. While we would generally agree with such a statement, mussel growth rates are highly variable (Haag and Rypel 2010) and it is not uncommon for mussels to tolerate the altered environment downstream of a dam and survive for several decades even when extirpations and declines in others species took place (Layzer et al. 1993). Thus, because a handful of individuals have survived for many years, it does not mean that dam operation has no measurable or meaningful effects upon the entire mussel community.

Comment 5: Only a few semi-quantitative survey stations were within the tidal reach of the river; therefore, it is inappropriate to conclude that because densities were highest in the non-tidal reach, and subject to dam discharge, that the fauna are not affected by dam operations. In fact, the survey data and statements suggest otherwise. Mussel densities and CPUE were highest further downstream of the dam, including those approaching and some in the tidal portion of the river. Just 16% of semi-quantitative surveys took place in the lower mile of the project area. We feel that had the survey allocated more effort at the island complex and downstream of head of tide, data would further support our claims based on our personal observations of mussels in this area.

Comment 6: We agree with that the survey results that the species list is comparable to recent findings by MDNR and Dr. Tom Jones (Ashton 2009, Ashton 2010, Ashton and Devers unpublished data). However, our efforts have found one more species live, more individuals of two species, and generally higher catch-rates. In addition, because these efforts included tidally influenced reaches downstream of Spencer Island, we found the aforementioned species in greater abundance, which may indicate their upstream distribution is influenced by dam operation. We feel our data illustrate the findings of this study inadequately characterize the species richness, the relative abundance of some species, and overall population size and demographics within the project area.

Comment 7: We agree that reproduction is occurring at some unknown rate, but given <1% of the Eastern elliptio found would be considered juvenile we must conclude with current data that reproduction or survival must be very low. The absences of juveniles in other species also may suggest that host availability, reproduction, or survival to maturity may not be occurring for several reasons and limited by multiple facets of dam operation.

Comment 8: We disagree with the statement that the operation of Conowingo Dam does not affect the population of freshwater mussels downstream and there are no discernable, ecological effects. Data presented in this study clearly illustrate several discernable and significant effects upon the mussel community that can be attributed to dam operation. Several species recently collected or historically known from the Lower Susquehanna River Basin were not found in the project area (Meyer unpublished data) or were represented by single, dead valves. There is an obvious gradient of declining mussel CPUE as you move towards the dam and density is lowest near the dam. Size distributions are skewed towards older individuals even when taking into account substrate excavation, which found very few small mussels. Individuals that could be considered juveniles were not found for four of the five species collected; overall < 0.5% of the mussels found could be considered juvenile. Habitat is noted in several places as being unsuitable for mussels in the upper reaches and main channel (i.e. tailrace) of the project area because finer materials have been scoured, are easily eroded and not replaced, or water becomes stagnant and substrate covered with silt. We expect that study report 3.16 to further confirm that the aforementioned with simple and complex hydraulic variables. The conclusions about mussel abundance in relation to instream conditions were completely subjective and not based upon empirical evidence. Furthermore, nearly 20 years of peer-reviewed literature has documented direct and indirect effects of dams, including hydroelectric projects, on freshwater mussels, making such a general statement that the operations of Conowingo Dam have no effect on the freshwater mussel community within the project area improbable (Bogan 1993, Layzer et al. 1993, Blalock and Sickel 1996, Vaughn and Taylor 1997, Watters 1999, Freeman et al. 2003, Tiemann et al. 2007, Moles and Layzer 2008)

Specific comments that address the mussel study and report

1. Serious questions about the agreed upon survey design and methods in Task 2 and 3 stem from the reliance upon Maryland DNR for survey design literature, improper citation of design literature, survey implementation logistics, and even equipment. For example, the report cites methods as Strayer and Smith (2003) when in fact this reference is a review of freshwater mussel sampling methods and not a primary source. The correct citation of the survey design is Smith et al. (2001). Comments were made to the PI regarding potentially improper and questionable survey method implementation during post RSP meeting and field visits. Because no assurances were given to agencies, coupled with the reliance upon agencies for survey references and proper equipment, and observed mistakes in survey implementation, we can only assume that the PI had never before conducted a survey of such a complex design. It has become evident from communications during RSP development, after observing the semi-quantitative and quantitative survey, and during the reporting period that he was unfamiliar with a survey of such effort, the two-stage double sampling survey design itself, and standard protocols and equipment for quantitative mussel surveys despite the assurances from Exelon about the qualifications of the primary surveyor. On how many prior occasions has the PI conducted freshwater mussel surveys

using the specific methods employed? How many mussel surveys, regardless of method, have divers used in the study performed? How much experience does the dive crew have identifying mussels? Why did the PI not identify all mussels collected during Task 2 and 3? It is an accepted standard to have a single, qualified individual who holds the scientific collection permit identify mussels collected if others do not have several years' worth of experience.

2. Page 5 - According to the report timed searches were conducted at 72 locations for a total of 87.4 person-hours. This equates to 1.2 person-hours per semi-quantitative survey. This may be an insufficient level effort when trying to locate species at low density and determine species richness (Metcalfe-Smith et al. 2000) and alone cannot assess population size, density, or potential impacts (Miller and Payne 1988, Miller and Payne 1993, Obermeyer 1998, Strayer et al. 1997, Strayer and Smith 2003).

3. Pages 5 and 6 - Why are the semi-quantitative CPUE in Figure 4.2-2 and 4.2-3 presented in numerical order instead of longitudinal order (i.e. distance away from dam)? Numerical order is meaningless because the order of semi-quantitative survey locations does not proceed in a consistent direction. A single or additional figure would also be more appropriate to examine the overall CPUE regardless of survey method in relation to its true spatial location within the project area. The same could be said about the data presented in Tables 4.2-2 and 4.2-3. Measures of sample precision and error should be presented whenever noting a sample mean; either SE, CI, CV of mean CPUE for wading, diving, and overall values should be presented for each species and all mussels.

4. Page 6 - Our data suggest that Alewife floater and Eastern floater are not found in an approximately 1:1 ratio as found in the study. In fact, we rarely encountered Eastern floater throughout the past few years in both semi-quantitative and quantitative surveys. This may indicate frequent misidentifications given the PI's past questions about ways to distinguish between these two species and an underestimate of the S3 Alewife floater.

5. Page 6 - How did the author determine that CPUE >100 mussels/hour represented the "highest" catch rates? Since "high" CPUE's were only found at 8 of 72 stations (11%), this suggests that mussel abundance is low throughout most of the project area. In fact, twice as many semi-quantitative areas contained five or fewer mussels (22% of stations), which further indicate that mussels are rare or absent from a sizeable portion of available habitats. The remaining 66% of stations had CPUE < 100 mussels/hour, which would be low according to the report. Catch-rates and density from other studies of Atlantic Slope mussel communities (Lellis 2001, Villella and Smith 2005, Strayer et al. 1994, Meyer unpublished data) should have been used to determine what represents high and low CPUE instead of an arbitrary designation.

6. Page 7 - How did the author determine that habitat at locations with CPUE > 100 mussels/hour differ amongst one another and from many other locations? No data are presented that support such a statement or appeared to be collected from these locations beyond personal observation. It was also stated that the highest CPUE came from areas near islands further downstream with the exception of one site, yet islands further upstream contained the lowest CPUE. Please elaborate on this pattern as the presence of islands within the river does not appear related to CPUE, but in fact is related to distance away from dam. We feel that the data clearly illustrate a distinct cline of

increasing CPUE as you move further away from the dam, even when suitable habitat appears present. Furthermore, our CPUE data collected during July 2010 support this hypothesis.

7. Page 7 - No data are presented to state that habitat is not favorable to mussels where CPUE < 5 mussels/hour. As we interpret the author's statements, it suggests that the microhabitat is unsuitable because of dam operation at these locations, especially those further upstream near the dam or downstream of the tailrace. The lack of flow and silted substrates noted in the back channel of Mud Island suggests that minimum flow releases from the dam are insufficient to maintain flowing water over gravel substrate, specifically because the releases come from the tailrace located along the right descending bank.

8. Page 7 - Stating a range of lengths are evenly distributed when it represents predominantly very large individuals is misleading. Figure 4.2-4 does not illustrate a normal distribution or is evenly distributed, but is in fact skewed towards a population that does not represent all life stages of mussels when taking into account some reproduction likely takes place within in the project area. The author should also not speculate on age at length given no data on growth or age at length were collected or referenced. Furthermore, without indicating where in the study area juvenile mussels were found, speculating on their potential dispersal source is inappropriate.

9. Page 7 - How was < 71 mm determined to be a small Eastern Elliptio? Age at length (number of internal annuli from shell cross section) of Eastern Elliptio from Deer Creek found individuals of 70 mm in length to be 23-39 years old (Lellis et al. unpublished data), and in the Delaware River ranged from 11-34. This data from several populations within the Susquehanna and Delaware River basins suggests Eastern elliptio growth rates, maximum length, and maximum age are highly variable among populations.

10. Please comment on the semi-quantitative results in regards to search method, which illustrates a potential difference between the effectiveness of wading versus diving. The highest catch rates, except one, came from diving surveys. If more or all survey effort were put into a single search method (diving), as was stressed during the comment periods, more mussels may have been found. Data also suggest certain species were collected more effectively by diving versus wading (e.g. Yellow lampmussel). Availability of Normandeau divers should not have limited survey effort if diving was a more effective and appropriate search method. Surveys should have been postponed until they were again available or additional divers should have been contracted.

11. Page 8 - How were the results in Table 4.3.1 generated; there is no reference to a method? Standard errors are relatively large in comparison to sample means; please discuss what may have caused this. Less than 2% of the area within each quantitative survey area was sampled; does the PI feel this was sufficient effort given the abundance estimates, high measures of error, and the fact that roughly 0.03% the total project area was quantitatively surveyed? Furthermore, does the PI feel results from such a small area and sample size are appropriate make conclusions about the entire project area in light of MDNR, USFWS, and USGS data that included a greater sample size and found higher abundance and richness along with more precise density and population estimates?

12. Data collected during the project period by MDNR using similar methods, but with greater effort over a larger area using more appropriate sample sizes, dispute the findings of the study and also highlight the high level of uncertainty in this study's findings, which can be attributed to smaller sample size, improper design implementation, and potentially a lack of survey effort in areas where freshwater mussels would likely be at their highest abundance and densities in the lower reaches of the project area. Though we expended a greater amount of daily effort (person-hours), we found more individuals and more species. Our results also have lower variability, along with more precise density and population estimates. The PI was notified of this information as it became available during the study plan implementation and again prior to study report completion.

13. Several mussel species, including the state endangered Brook floater, Green floater, and Triangle floater, and in need of conservation Creeper, have been found in surveys conducted in upstream reaches of the Susquehanna River (Strayer and Fetterman 1999, Meyer pers. comm.) and were most likely historically present within the project area were not found in this survey.

We conclude that:

1. The survey only partially accomplishes Goal 1 and fails to accomplish Goal 2.

2. By not quantitatively sampling from within the full range of mussel CPUE across spatially representative locations within project area the study is limited in its ability to make conclusions about the entire mussel population and potential effects by the operation of Conowingo Dam, especially that along the right descending bank and in the lower mile of the river, which may experience different hydraulic forces and contain different habitat and species. Moreover, the apparent bias in locations of both the semi-quantitative and quantitative surveys further weakens the validity of the data.

3. Additional semi-quantitative surveys with divers for at least 1.2 and up to 2.5 person-hours per location is needed to properly characterize the mussels assemblage due to large areas of unsampled habitat within the project area, disproportionate sampling effort, and potential bias in survey locations. Specific areas to be targeted should be coordinated with resource agencies and include; east of Spencer Island, side channels between Wood and Robert islands, between Rueben and Steret islands along with Bird and Mud islands, and other areas where long distances (> 0.25 mile between survey locations) remain.

4. The sample size and area in quantitative surveys was insufficient to provide statistically acceptable levels of error in the density and population estimates, did not spatially represent the project area, were biased to the left descending bank, not randomly selected, and did not represent the range of CPUE observed. This took place despite persistent efforts by MDNR throughout the comment period and survey implementation to make the PI aware of these deficiencies. In addition, only four independent quantitative survey locations were sampled, though five were stated to be sampled.

Recommendations for additional studies:

Criteria for Modification of Approved Study [18 CFR 5.15(d)]: as indicated above, approved studies were not conducted as provided for in the approved study plan. Therefore we request the following modification of this study for 2011, based on how it was conducted in 2010:

Based on the comments and conclusions above, the study and its report are incomplete and can only be used to direct additional semi-quantitative and quantitative mussel sampling that should be carried out in 2011. There are substantial areas where semi-quantitative surveys were not conducted without justification. These areas should be surveyed in 2011; as Task 2 of the RSP noted, the entire 4.5 mile long reach would be surveyed regardless of habitat. In this task, a single, consistent sampling method (diving) and pattern must be used (line or strip transects parallel to flow). Pooled with the CPUE data from 2010, the areas to be quantitatively sampled (RSP Task 3) should then be re-evaluated and selected in direct consultation with resource agencies following the correct manor for the study design (two-phase with double sampling). The results of 2010 quantitative surveys should also be used to guide quantitative surveys in 2011, whose locations will be selected at random from the strata of catch-rates (high, medium, low to none) that represent of the range of CPUE, have appropriate numbers of quadrats to minimize sampling error, and be conducted with 50% excavation over larger expanses of mussel habitat. The number of quadrats, interval between systematic samples, and sample area should be determined by the Mussel Estimator Program based on input of preliminary data, and not determined arbitrarily, as this was a direct cause of the inadequate sampling effort that led to study deficiencies. In addition, the results of the flow modeling study (3.16) should attempt to be incorporated into the stratification so areas with varied levels of sheer stress are sampled to validate the flow model and support any future actions regarding the operation of the dam and its affects upon freshwater mussels. It is imperative this additional semi-quantitative and quantitative sampling effort must be planned and conducted with substantial input and oversight by resource agencies so that the deficiencies pointed out do not persist. Consequently, we strongly recommend that Exelon and Normandeau conduct appropriate mussel surveys using two-phase double sampling methods, in consultation with the resource agencies before and during the surveys (Smith et al. 2001, Villella and Smith 2005).

Comments on Exelon's Initial Study Report Meeting Notes Summary:
Bill hypothesized that Elliptios should be throughout Octoraro Creek because there were abundant hosts. Our alternative hypothesis is that compared to Deer Creek, the water quality of Octoraro Creek is quite poor and eel passage into Octoraro Creek has only been relatively recent, thus resulting in lower numbers of these mussels.

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3.20 - Salinity and Salt Wedge Encroachment

Study purpose: 1) determine if Project operations adversely impact downstream salinity levels; 2) determine if Project operations have the ability to change the frequency and duration of exceedances of salinity levels above drinking water standards; and 3) identify and evaluate the potential for impacts to biota from salinity changes in the lower Susquehanna River due to Project operations.

FERC required threshold EPA drinking water standard value of 0.25 ppt to be used in the evaluation.

Study Comments:

- The report is a thorough analysis of the effect of Susquehanna River flow and Conowingo project operations on salinity at the Havre de Grace water intake and in the upper Bay at a Maryland DNR monitoring site. Results indicate salinity levels are most correlated with 30- to 60-day moving averages of river flow and that short-term project operations at Conowingo have no effect on these salinity levels. This was similar to the result found by SRBC in the Conowingo Pond Management Plan. Interestingly, no correlation was found with wind speed or direction, previously reported as resulting in salinity problems at the Havre de Grace intake. No issues were found with respect to the effect of salinity on target species expected in this area; their tolerances were all well above observed salinity levels in this area.

- One minor correction: the citation to Table 4.3-1 on p. 7 should be to Table 4.6-1.

3.21 - Impact of Plant Operations on Migratory Fish Reproduction

Study Purpose: to determine if project operations impact migratory fish reproduction upstream of Conowingo Dam and Downstream in the Susquehanna River.
FERC required on-site ichthyoplankton sampling in 2011 at locations indicated in study 3.5

Non-Compliance with the FERC-Approved Study Plan:

- Schedule – The Initial Study Report scheduled for January 21, 2011 was not filed on time (FERC approved an extension). A "Study Report" that was "...to be prepared and provided to participants for review and comment at the conclusion of the first year of study" (pg. 3-159, Section 3.21.9, referring to task 2) was never provided to the agencies and, thus, when the Initial Study Report was filed, it did not reflect any input from the participants.

- The approved study plan indicates "....Hydraulic conditions and known habitat attributes of each study segment (upper Conowingo Pond and the river below Conowingo Dam) will be analyzed and compared to the published spawning requirements of the target species" (pg. 3-158). The Initial Study Report does not characterize the hydraulic conditions in Conowingo Pond, providing only a qualitative description (pg. 2, "...the upper portions of Conowingo Pond provide riverine conditions based on downstream proximity to the Holtwood Project. The majority of Conowingo Pond provides more lentic conditions with generally greater depths and lower water velocities...." Thus, the report does not provide any analysis of the habitat attributes as related to the spawning requirements of the target species. Downstream of the dam, such analyses are presumed to be presented in Study 3.16.

Study Comments:

- We disagree with the statement on p. iii of the Executive Summary that *"Hydraulic conditions of the Susquehanna River below Conowingo Dam are generally dictated by the Susquehanna River natural flow and by the operation of Safe Harbor Dam."* While water availability on a daily to weekly basis may be determined by natural river flows and releases from Safe Harbor Dam, Conowingo has the ability to and often does drastically affect downstream hydraulic conditions, changing flow from the daily minimum to its maximum hydraulic capacity of 86,000 cfs in a matter of minutes.

- On pg. 20, the statement is made that "Flows were highly episodic, often with the greatest magnitude discharge peaks occurring in April and May…" While that flow data was presented in graphs (Figure 5-1), there was no analysis done of the timing and magnitude of the ichthyoplankton collections for the various species specifically as it related to the episodic flows. While a detailed characterization of habitat availability for the species will be established in Study 3.16, in this study the empirical data should be analyzed to assess the relationship between fluctuating river flows and ichthyoplankton densities on a location-specific basis.

- On page 22 of the report, it is stated that "Based on these observations, suitable spawning habitat exists downstream of Conowingo Dam and in response to its operations, and that habitat is used annually and successfully by American shad. Given the controllable operating regimes (barring environmental anomalies) of Conowingo Dam, it is unlikely that routine operations of the Project will adversely impact American shad spawning success." However, while the initial part of this conclusion is based simply on the fact that eggs were collected in various areas below the dam, there is no analysis presented in the report to substantiate the conclusion drawn in the second sentence

- On pg 22, the statement that "…Since hickory shad appear to prefer the tributary streams, and the stock has improved, it is evident that suitable habitat is available and being successfully used for spawning in the Susquehanna River and Deer Creek tributary…" is a non sequitur. The success of hickory shad in Deer Creek says nothing about the suitability of habitat for the species in the Susquehanna River. Therefore the statement that "…..It is evident that operations of the Conowingo Project have not adversely impacted spawning of hickory shad." is unquantifiable and not substantiated by any analysis. Such analysis may not be possible since the hickory shad stock in the Susquehanna River and its tributaries has never been quantified.

- Throughout the report, conclusions are drawn that because eggs and/or larvae were captured below the dam, suitable habitat must be present. However, no statistical analyses are presented to justify such conclusions. Virtually none of the conclusions drawn in the report are substantiated by data or analyses.

- No analyses are presented in this report to achieve the purpose of the study, "to determine if project operations impact migratory fish reproduction upstream of Conowingo Dam and Downstream in the Susquehanna River"

3.22 - Shortnose and Atlantic Sturgeon Life History Studies

Study Purpose: 1. Literature review for shortnose and Atlantic sturgeon occurrence in the Susquehanna River, life history, and habitat requirements; 2. A comparison between Conowingo fish lift and any East Coast passage facilities where successful shortnose or Atlantic sturgeon upstream passage has been documented; 3. Analysis of habitat types below Conowingo Dam; 4. Documentation of sturgeon stranding below Conowingo Dam; and 5. Monitoring of the Susquehanna River for use by sturgeon.

FERC required a second array of receivers near the river mouth.

Study Comments:

- Analysis of habitat types below Conowingo Dam seems to be preliminary. In the context of the title of the study it is difficult to determine how habitat types are being analyzed. Habitat in this study appears to refer to the water column and its flow characteristics. However, an analysis of that nature should be characterized as hydraulic habitat. Nevertheless, an analysis of habitat cannot be conducted solely on hydraulic characteristics, based on the description of the study. The analysis also concludes that in general, suitable habitat is limited for all life stages of shortnose (and presumably Atlantic) although there is are no physical habitat characteristics presented in this study. It seems unlikely there is no gravel in this region given the visible habitat seen in some of the figures.

3.23 - Study to Identify Habitat Use Areas for Bald Eagle

Study Purpose: to determine the abundance levels of bald eagles, specific locations of foraging, roosting, and nesting habitat, and daily/seasonal patterns of use by migrant and nesting bald eagles within the Conowingo Project area.

Study Comments:

This study has generally followed the methodologies that were proposed except that some aspects of the study are ongoing.

- Task 1 completed during 2010; aircraft surveys were conducted to locate nesting territories and active nests; 12 breeding territories were documented of which 11 were active.

- Task 2 completed using August 2007 – February 2010 telemetry data to delineate eagle roosts.

- Task 3 is ongoing; summer ground surveys were completed (July through October) of eagle roosts (although consecutive dates per week were not surveyed). A second round of surveys was scheduled for the winter between January and March 2011. Shoreline surveys to assess overall eagle population at Conowingo are also ongoing and will be reported in the future.

3.24 - Dreissenid Mussel Monitoring Study

Study Purpose: 1) determine the presence and abundance of Dreissenid mussels, particularly zebra mussels (Dreissena polymorpha) within the Project boundary and; 2) determine potential mitigation measures to minimize the impacts of Dreissenid mussels to Project structures. FERC required the study plan to clarify that zebra mussel veligers were found in Peach Bottom intake canal in 2009.

Study Comments:

- Pg. ii, line 9: Insert "Department of Natural Resources" before "Biologists".

- Pg. ii: The second objective of this study was to "identify potential mitigation measures to minimize the impact of Dreissenid mussels to Project structures", yet there isn't any mention of potential mitigation measures in the Executive Summary.

- Pg. 2, lines 29-30: Please be more specific than "…..a few adult zebra mussels……". We believe one dead adult zebra mussel was collected at the Conowingo dam, one dead adult mussel was found at Glen Cove Marina upstream from Conowingo, and four dead adult mussels were found in Muddy Run Reservoir, even further upstream, in the fall of 2008. Is that correct? If so, please add this detail to the text on pg. 2.

- Pg. 7, line 15: Please add this sentence to this paragraph: "On August 3, 2010, MDNR biologists collected and preserved an additional three adult zebra mussels (2-alive and 1-dead) found in the lower Susquehanna below Conowingo, bringing the total number of adult zebra mussels collected downstream from the Conowingo Dam in 2010 to 14 (10-alive and 4-dead).
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- Pg. 8, line 16: What's the significance of 10,000 cfs?

- Pg. 9, lines 7-8: We don't agree that the evidence to date supports a statement that Dreissenid mussels are "….considered established………within Conowingo Pond". Only two dead adults were collected in the Conowingo Pond during the fall of 2008 and none have been collected there since. A more accurate statement is that a Dreissenid mussel population "may be established……..in the Conowingo Pool…..". Because a total of 14 adult zebra mussels were collected in 2010 in the lower Susquehanna River below Conowingo Dam, we would conclude that a population is likely established there. We also disagree with the conclusion about an "……established population of Dreissenid mussels located upstream of Conowingo Dam….." at the top of pg. 10.

- We suggest that the map of the lower Susquehanna River (last pg.) be extended to show the location of Muddy Run Reservoir, since it is mentioned on pg. 2.

<u>3.26 - Recreational Inventory and Needs Assessment</u>

Study Purpose: 1) conduct a recreation inventory in the vicinity of the Project to identify public access points within the Project boundary, 2) estimate the amount of recreational use occurring within the Project, and 3) determine what, if any, enhanced and/or new recreation facilities are needed to support the recreational use of the Conowingo Project.
FERC required a survey of fishing organizations within the project and on-site surveys at Fisherman's Park and downstream sites within the project. FERC also required re-evaluation of the restricted access line in the tailrace and an updated list of all project recreational sites beyond those in the RSP.

Study Comments:

The report for this study is based entirely on data collected between March 15, 2008 and March 14, 2009, to complete the FERC Form 80 for the Conowingo Project; consequently, the report fails to address any of FERC's requests as stated in its Study Plan Determination dated February 4, 2010. Exelon's analysis of its Form 80 data appears to be credible and supports the conclusion that the capacity of existing recreational facilities within the project boundaries will exceed projected demand through 2050; however, the study report shows no evidence that Exelon performed two of the four tasks described in its RSP:

Task 1: Literature Review and Outreach – no evidence of effort or planned effort

The study report offers no documentation of effort or methods to "conduct an internet literature search and contact readily known and identified recreational organizations and local, county, state and federal agencies to identify any commonly used formal and informal recreation access sites within the investigation" area prior to its 2008/2009 field survey of recreational use. The study report presents no evidence of a literature search or outreach conducted since the 2008/2009 recreational-use survey.

The RSP indicated that the search and outreach effort would include various birding clubs and organizations and that information from those groups would be used to supplement Exelon's existing information or birding activities in the area. The study report offers no evidence of such contact and indicates that Exelon relied entirely on its FERC Form 80 data related to birding to derive the reported estimates of birding activity at recreational facilities within the project area.

Task 2: FERC Form 80 Refined Data Analysis – completed and reported effectively

Task 3: Recreation Field Inventory of Access and Use – partially completed

The study report provides no evidence of effort to "consult with interested stakeholders prior to submitting the study report."

The study report provides no evidence of effort to "update and revise its recreation field site/facility inventory to confirm access sites identified in Task 1 and to document any additional sites that may have been overlooked, renovated, or constructed since the original inventory."

The study report offers incomplete evidence of effort to "document formal and informal access locations." No GPS coordinates are provided for any access location; however, the formal access locations are documented on a GIS map of the project. The existence of multiple informal access locations is mentioned, but no documentation of their locations is provided.

Task 4: Develop Study Report – completed, but missing significant information

The study report is missing information on methods and results of Tasks 1 and 3 as described above.

The FERC-mandated task of re-evaluating the restricted access line in the tailrace of the project was not conducted.

Other comments:

The study was vague about completing Objective 2 – Exelon assumed that since there was a vehicle parked at a particular site, it was using that site or if a counter counted a vehicle accessing a particular parking lot, it was used to extrapolate the total usage, this likely overestimates the usage for obvious reasons.

The study was based on people using the facilities and was not expanded to include non-users. In addition, the study was highly biased due to the areas surveyed, e.g. certain users took more time per area and were more frequently encountered or interviewed. It also does not include additional possible recreational areas closed to the public that could potentially be opened. These biases were never addressed in the study results.

To determine objective 3, above, recreational users and non-users would need to be interviewed. Not only were the methods to address this objective vague but no interviews were done to assess the needs of the recreational users. In short, if folks are not using the facility because they have different recreational priorities, are physically unable to access some sites or are unaware of the opportunities that exist, then they will not be interviewed by this survey. It also appears that recreational use was very low for all areas with few exceptions, even in the report when use was stated it used the word "only"(e.g. the parking lot was only at 8 percent capacity) indicating that there was significant under usage. No remedy or clarification was provided – see Table 9.3-1.

Also for Objective 3, no enhancements were discussed. Use of a facility does not mean that improvements or additions cannot be made.

The land side of Lapidum is not "unusable due to dense aquatic vegetation." It is shallow due to rapid sedimentation from the river flow. Regular dredging will help make both sides "usable." We are working with DNR's Engineering and Construction unit to begin the permitting process for dredging.

Recommended measures for additional study:

- Upgrades to Lapidum restroom (a Clivus Multrum composting system). Replace fixtures: waterless toilets/urinal and lighting; paint exterior trim; replace doors, upgrade mechanical systems.

- Construct Lapidum Contact station to provide information to anglers/boaters and other visitors. This is a main contact point for I-95 corridor visitors to the Lower Susquehanna River.

- Improve Deer Creek access points along Stafford Road. Add stone fill to pull-offs and re-grade for drainage, incorporate sustainable trails to fishing access points, repair "canoe launch" at Deer Creek and Susquehanna River confluence.

- Lower Susquehanna Heritage Greenway: Repair ~500LF section of boardwalk trail laid on top of rail road bed. Railroad ties are rotting and being shifted by water during storm events making entire boardwalk unstable. Not currently an immediate safety concern.

- Replace interpretive panels at Lapidum.

3.27 - Shoreline Management

Study Purpose: 1) conduct an inventory of Exelon real estate assets in the vicinity of the Project and identify and classify current uses; 2) identify issues and constraints that affect land management and land use; 3) review current corporate land use guidelines and policies; and 4) identify lands potentially needed (or not needed) for current and potential future project purposes. Study objectives 1 thru 3 are addressed in this report. Study objective 4 will be addressed during development of the Shoreline Management Plan (SMP).

FERC required expansion of tasks 1 and 2 to identify unique, sensitive and/or critical fish and wildlife habitat on the project shoreline.

Non-Compliance with the FERC-Approved Study Plan:

- Schedule – The Initial Study Report scheduled for January 21, 2011 was not filed on time (FERC approved an extension). A "Study Report" that was "…to be prepared and provided to participants for review and comment at the conclusion of the first year of study prior to filing the report with the Initial Study Report" (pg. 3-196, Section 3.27.9) was never provided to the agencies and, thus, when the Initial Study Report was filed, it did not reflect any input from the participants.

Study Comments:

- In the Interim Shoreline Management Report, the Applicant does not specifically point out specific unique, sensitive and/or critical fish and wildlife habitat identified along the shoreline (Project land and land within 500 feet of the Project boundary) as they had been asked to do by FERC.

- FERC approved the Applicant's RSP with certain modifications, including specifying that Tasks 1 and 2 of section 3.27.7 (methodology) should be expanded to identify unique, sensitive, and/or critical fish and wildlife habitat on the project shoreline. In the RSP, the Applicant points out that approximately 883 acres (36%) of Project lands contain Sensitive Resources, the same number and proportion that they included in the RSP. In the Interim report, they describe that the land categorized under "Class 5: Sensitive Resources" are "Project lands that contain and/or are managed or preserved for protection and enhancement of sensitive resources. Sensitive resources are defined as resources that are protected by the state, federal law, executive order. Sensitive resources also include other natural features that the Applicant considers important to the area of natural environment." Thus, unless no additional unique, sensitive, and /or critical fish and wildlife habitat was found, the lack of additional information and the consistent acreage and percentage suggests that expanded investigations and searches under Tasks 1 and 2 were not performed. Figures 3-1 through 3-6 of the Interim report do show the Project land and land within 500 feet of the Project boundary classified in the general "Sensitive Resources" category, but do not specifically indicate unique, sensitive, and/or critical fish and wildlife habitat.

3.29 - Effect of Project Operations on Downstream Flooding

Study Purpose: 1) Use a hydraulic model to estimate Water Surface Elevations (WSEs) for a full-range of flood events at Port Deposit; 2) Document the areas of inundation and flooding depths during these events; 3) Document the flow conditions during which flooding of the Port Deposit area has occurred; 4) Identify the impact of the project on downstream WSEs; and 5) Determine the operational feasibility, generation effects, and implementation costs of any procedures that might attenuate flooding conditions.

Study Comments:

- This study presents results of modeling of flood events at Port Deposit, showing the areas of inundation and depth for various size flood events, with and without the presence of the dam and various operational scenarios. Results indicate none of the alternative operating scenarios substantially changed flood levels or duration at Port Deposit.

- We agree with the report findings that any operation done at the dam will not likely reduce downstream flooding. There are no flood control dams on the river between Harrisburg and Conowingo to have any significant impacts on reducing flooding. The report evaluated flood events from the 1-year up to the 500-year storm during various alternatives of lowering the pool level and operating the flood gates to potentially reduce downstream flooding. Port Deposit located downstream begins to flood at about the 2-year storm or about 250,000 cfs.

- The maximum pool level is set at elevation 109.0. The 50 flood gates are opened to maintain elevation 109.0 during flood events. If the pool gets above elevation 109.9, flow overtops the flood gates and they cannot be lifted to avoid overtopping of the dam and US Route 1. These constraints provide only a very small amount of flood storage compared to the enormous watershed area of 27,100 square miles. In conclusion, operation of the dam has no effect on reducing flooding downstream. In fact, there are no real difference in downstream flooding between removal of the dam and regulating the dam with the lowest pool level and holding the flood waters as long as possible before gate operation.

- We recommend additional modeling alternatives, such as pool drawdown to the absolute minimum FERC elevation, to provide the maximum range of change that would be possible for the 3 management alternatives evaluated. We request further details on the hydraulic model, specifically how HEC-RAS was calibrated and confirmed with measured flood levels and whether a steady or unsteady flow model was used. We specifically want to know the range of uncertainty in flood levels expected for each of the event return intervals. Also elaborate for alternative 2 how and when the various stated pond levels were targeted within the model.

3.30 - Osprey Nesting Survey

Study Purpose: 1) conducting a review of existing literature, studies, or other data regarding known locations of osprey nests and/or frequent activity in the project area; 2) determining the presence/absence of the species in the project area; 3) verifying existing and new nesting locations of the osprey in the project area; and 4) monitoring activity levels in the project area.

Study Comments:

- Osprey nesting was investigated in the project area comprised of the Conowingo Pool and Dam areas. Proposed survey methods were followed more closely in the upper Pennsylvania portion of the study area, where osprey is a state-listed threatened species. Osprey nests were identified during field surveys on three dates within the prescribed survey period with 2 weeks between survey dates. Nest surveys in the lower part of the study area into Maryland were surveyed outside of prescribed survey period on 5 dates. Even then, the nest surveys likely adequately characterized osprey nesting in the vicinity of Conowingo Dam with 7 nests in Pennsylvania and 4 in Maryland, many of which were located on electrical transmission structures.

- Although the Study Plan referred to a second season of field study, "if necessary," the current report does not mention continuing the study.

3.31 - Black-crowned Night Heron Nesting Survey

Study Purpose: 1) conducting a review of existing literature, studies, or other data regarding known locations of heron nests and/or breeding activity in the project area; 2) determining the presence/absence of the heron in the project area; 3) verifying existing and new nesting locations of herons in the project area; and 4) monitoring heron activity levels in the project area.

Study Comments:

- Black-crowned night heron nesting was investigated in the project area comprised of the Conowingo Pool and Dam areas. Proposed methods were followed more closely in Pennsylvania, where the black-crowned night heron is state-listed as endangered. Field surveys were conducted on two dates within the proposed survey period (April 20 to May 1; although first survey date was April 19th), on dates least five days apart. Surveys in Maryland are presented as an afterthought following reports of herons at the dam. These surveys were conducted during June and well outside of the proposed survey period. No nesting herons were confirmed in either Pennsylvania or Maryland during the study. Although a second field season is referred to under Task 3 of the Study Plan, which describes reporting for the study, no mention of further field studies is mentioned in the report. Since the study is continuing for a second year, more attention should be paid to potential nesting in the lower portion of the study area that includes Maryland.

3.32 - Re-evaluate the Closing of the Catwalk to Recreational Fishing

Study Purpose: conduct a feasibility analysis to evaluate re-opening the Conowingo Project catwalk for recreational fishing by the general public.

Non-Compliance with the FERC-Approved Study Plan:

- The Applicant did not conduct a "feasibility analysis to evaluate re-opening of the Conowingo Project catwalk for recreational fishing..." We believe they conducted a vulnerability analysis and threat assessment, as the title of the report suggests, but it is unlikely they assessed the feasibility of implementing actions that would reduce threats to an acceptable level while providing access to fishermen.

- The vulnerability and threat assessment reports were not filed with FERC on or before February 22, 2011 and were thus unavailable to agencies for review

- The Applicant did not complete the recreational needs assessment of this part of the project relative to fishing access to the project area.

Recommended Actions:

- We ask that the FERC require the Applicant to file the vulnerability and threat assessment report with FERC so that it can be independently evaluated by authorized agencies

- We ask that the FERC require the Applicant to conduct a feasibility analysis, based on the vulnerability and threat assessment results, as was specified in the approved study plan.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

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April 27, 2011

Ms. Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E. Rom 1-A
Washington, D.C. 20426

RE: FERC No. 405 – 087, Conowingo Hydroelectric Project
Comments on Initial Study Reports

Dear Ms. Bose:

The U.S. Fish and Wildlife Service (Service) has reviewed the Exelon Generation Company, LLC's (Exelon or applicant) February 22, 2011 Filing of the Initial Study Reports (ISR) for the Conowingo Hydroelectric Project (Project), located on the Susquehanna River in Harford and Cecil counties, Maryland. Exelon's ISR was in response to its Proposed Study Plan (PSP) filed August 24, 2009, Revised Study Plan (RSP) filed December 22, 2009, and the February 4, 2010, Federal Energy Regulatory Commission's (Commission) issuance of a Study Plan Determination.

The Service is providing the following comments on Exelon's ISR, under the Commission's regulations, 18 C.F.R. § 5.15 (c) (4). The Service is filing its ISR comments and supporting documentation electronically, and we anticipate they will be available on the Commission's website (http://www.ferc.gov). To access these comments interested parties should go to the "eLibrary" link, and enter the docket number, P-405, to access the documents for the Conowingo Project.

GENERAL COMMENTS

Representatives of the Service attended the initial ISR meetings held by Exelon on March 9, 10, and 11, 2011 in Darlington, Maryland. At the meeting, we acknowledged the effort Exelon put into developing the ISR. However, we and other resource agencies provided a number of comments, corrections, and disagreements regarding Exelon's study reports.

In response to our oral comments Exelon has addressed some of our concerns in its ISR meeting summary. However, we are still in disagreement on some of the specifics of some studies and the need for Exelon to conduct additional analysis of data collected in 2010 and the need for additional studies in 2011. We provide the following study by study comments on Exelon's ISR using the numbering and study titles contained in the ISR for ease of cross-reference.

Changed Reporting Schedule

The Study Schedules contained in Revised Study Plan(s) filed by Exelon indicated that the ISR's would be filed with the Commission by January 21, 2011. Exelon requested and received from the Commission an extension for filing the ISR's until February 22, 2011. Exelon also noted that its February 22, 2011 filing would be incomplete as some study reports would likely require even more time to complete, and would filed over course of the following months as they were completed by Exelon. We note that even some of the reports that were filed on February 22, 2011 by Exelon were partial reports with reporting of some study tasks missing. Some we have not yet received. We have reviewed the study reports submitted with Exelon's February 22, 2011filing; however we have not had adequate time to conduct a thorough review of report materials submitted by Exelon following the February 22, 2011 deadline. We therefore, reserve the opportunity to provide comments on these later submissions as we complete our reviews. We also reserve the right to request additional studies or study modifications on those studies, and with regard to those topics, on which the reports were not timely completed.

The failure to provide study reports in a timely fashion should not be permitted to present a procedural harm to the trust resources the Service is tasked with protecting: the ISP provides for a two-year study period, with an opportunity to adjust the studies in progress, or ask for additional study, after one year. Licensees should not be permitted to short-circuit this study process and deny agencies and the public the opportunity for such requests for adjustments or additional study. To the extent that this means extension of the study period and consequent delay in the filing of a license application this is largely, in most cases, a conundrum of the applicant's own making that it should not profit from.

Lack of Consultation on Study Reports

The Revised Study Plan(s) included, in Section 9 of each study plan, a provision that the Initial Study Report was "...to be prepared and provided to participants for review and comment at the conclusion of the first year of study prior to filing the report with the Initial Study Report". We note that these *draft* study reports were not made available to the participants for review and comment prior to their being filed with the Commission as an ISR. They therefore did not reflect any review or comment by the agencies or other stakeholder participants in the Project licensing proceedings. We therefore reserve the opportunity to provide supplemental comments to those provided herein, pending any response by the applicant to reviews contained in this document.

COMMENTS ON EXELON'S INITIAL STUDY REPORTS

3.1 Seasonal and Diurnal Water Quality in Conowingo Pond and below Conowingo Dam

This study report was not submitted with Exelon's February 22, 2011 filing of the ISR. We therefore reserve the opportunity to provide comments on, or request modifications to, this study pending the completion of our review.

3.2 Downstream Fish Passage Effectiveness Study

This study report was not submitted with Exelon's February 22, 2011 filing of the ISR. We are providing some preliminary comments, however we reserve the opportunity to provide comments on this study pending the completion of our full review.

On Page 3, paragraph 4 of the report Exelon states "Researchers have found that more than 90% of fishes entrained at hydropower projects are small (<8 inches) (EPRI 1997) and that survival of small fish through turbines is high (often higher than 90%). High survival of small fish reduces the overall impact of entrainment to fish populations."

We agree that some studies show entrained fish are small, however Exelon provides no evidence that this is the case at the Project. Adult American shad and American eel will greatly exceed the 8 inch size cited here. We disagree that high survival of small fish reduces the overall impact of entrainment to fish populations. In the case of eels, there will likely be few to no eels under 8 inches moving downstream through the turbines because at this size eel behavior is to migrate upstream. Therefore, the survival of entrained adult eel that would attempt to migrate downstream past the Project will likely be very much lower than that inferred by Exelon and there will be no compensation by high entrainment survival of smaller eels.

3.3 Biological and Engineering Studies of American Eel at the Conowingo Project

Only a partial report was submitted with Exelon's February 22, 2011 filing of the ISR. We are providing some comments on the report that was provided, however we reserve the opportunity to provide additional comments on this study pending our receiving the full completion report.

We recommend that for Exelon's proposed 2011 study more of a decline angle should be placed at the upper end of the ramp crest where the ascending elvers make the "fall" into the collection container. We also recommend that the climbing substrate not extend all the way up to the apex of the ascending and descending ramp sections (i.e. a one foot section at the top with no climbing substrate). This will force the climbing elvers to swim the final section of the ascending ramp and they will not be able to use the substrate to "pull" themselves back up the descending ramp, thus avoiding capture.

We recommend increasing the volume of flow coming out of the spray bar and placing the bar directly over the apex of the ramp. The spray bar should provide an even sheet flow across the width of the ascending and descending ramps all the way to its terminus.

Exelon's study report "Estimated attraction flow volumes were 49 and 30 L/min (0.03 and 0.02 cfs) for the east and west ramps, respectively." Solomon and Beach (2004) recommend an attraction flow of 5-20 L/s. The flow at Exelon's east ramp trap is estimated at .81 L/s and the west ramp trap it is .5 L/s. The U.S. Fish and Wildlife Service trap at the Conowingo West Lift is estimated at 4.69 L/s. We recommend increasing the attraction flow at Exelon's traps to at least be equal to the effluent from the shad tanks located near the West Fish lift or 5 L/s.

We recommend using a larger collection tank at each of Exelon's traps similar to the 150 gallon tank used at the U.S. Fish and Wildlife Service trap at the Conowingo West Lift.

3.4 American Shad Passage Study

To our knowledge this study has not been conducted and no study report or update has been made available. We therefore have no comments at this time, but we reserve the opportunity to provide comments, and recommend study modifications, should Exelon provide a study report in the future.

3.5 Upstream Fish Passage Effectiveness Study

We note that the definition of "the number of fish available" provided in the study report is not consistent with the definition provided in the PSP or RSP and its use causes an inflation of the estimates of fish passage effectiveness and efficiency compared to the use of "the number of fish available" as defined in the PSP and RSP and agreed to by the agencies and the Commission. We recommend re-analysis of the data using the definition of "the number of fish available" in the PSP and RSP.

For the resource agency goal of restoring migratory fish stocks to the Susquehanna River basin, these fish must gain adequate access to river habitat upstream of the Conowingo Dam through safe, timely and effective passage through the Project area. For fish migrating upstream this will require that they: enter the Susquehanna River (all study fish accomplished this as they were all captured in the river); swim up to the Conowingo Dam, the first barrier to upstream migration (all study fish accomplished this as they were all initially captured directly downstream of the dam); locate and enter the fishway entrance (not all study fish were able to locate and enter the fishway, the ISR attributes this to the stress of capture and tagging, and potential problems with the attraction flow at the fishway entrance); be captured and crowded into the lift car, lifted up to the exit trough, and emptied into the exit trough; swim out of the exit trough and be able to swim upstream (not all study fish entered the fishway were able to accomplish this, the ISR attributes this to problems in the entrance channel and/or capture and crowding mechanism).

We agree with Exelon's conclusion that improvements must be made to upstream fish passage measures and facilities at the Project. However, we disagree with Exelon that additional study efforts and assessments should exclusively "focus on the physical elements of the EFL (e.g., Crowder Gate) and flow patterns within the EFL" as the sole consideration for improving fish passage at the Project. The study results from 2010 indicate problems with fish negotiating the tailrace and lower river section downstream of the Conowingo Dam, false attraction to the spillway where no fish lift entrance is available, and considerable delay in locating the fishway entrance and passing the project as a result of "searching" behavior in tailrace, spillway and river downstream of the project.

We recommend additional analyses of the 2010 data to assess the degree and potential cause of the searching delay, false attraction to the spillway, and the ability of fish to negotiate the lower river and tailrace up to the dam and fishway entrance. The frequency of occurrence assessments in Figures 4.4 and 4.5 offer an example of how generation could influence distribution and behavior of tagged fish during various project operations. New figures should be developed using the same generation bins in Figures 4.4 and 4.5 (plus spillage flow above station generation capacity if it occurred), however the y-axis should be the cumulative detection time (hours) for all fish detections in a particular area where telemetry monitors were deployed. There should be a separate figure developed for each of the following areas of interest: Area 1- Near field dam tailrace (group monitors for Units 1, 3, 5, 7, 8, 9, 10, and 11, plus fish entrance Gates A and C, and the frequency of occurrence bar for each generation bin should be color sub-divided for Francis units vs. Kaplan units vs. entrance gates); Area 2 - Spillway monitor; Area 3 – Rowland Island monitors; Area 4 – Spencer Island monitor; and Area 5 – Lapidum/Tomes Landing monitors. This analysis will provide for an assessment of area use for different generation scenarios.

We recommend that the 2010 animation for combined fish locations already provided by Exelon be expanded to present fish detection data for the entire 2010 study period.

Additional Radio Telemetry Study in 2011

Exelon has proposed an American shad radio telemetry study for 2011 to gather additional information on fish movement and behavior at the Project in general and in more detail in the Conowingo East Fish Lift at other areas in the spillway and river downstream of the project. Exelon prepared a study plan and circulated it to the agencies and other participants for review and comment. Following a meeting on the plan Exelon prepared an updated study plan based on the comments it received. In general we concur with the updated 2011 shad radio telemetry study plan provided it includes the additional analyses recommended above for the 2010 study.

Request for Data

We request that all data collected on fish detection and station operation be made available to us electronically as spread sheets or in database format along with the metadata regarding data collection, data verification, culling, compilation and analysis.

3.6 Conowingo East Fish Lift Attraction Flows

We have major concerns regarding the analysis conducted for this report. Exelon used a large number of t-tests to analyze the passage data and appeared to pick one project operating condition to compare to all other operation conditions. This is a poor analysis design, as it ignores differences in migratory fish run size due to years and time of operation within a year. In so doing Exelon ignores many other factors that can influence the capture and passage of migratory fish. It is therefore no wonder that Exelon did not find any "significant" differences among operating conditions. The variance in fish passage counts is huge over the data series. It appears as though the data is available to successfully partition the variance and determine how much is accounted for by a given operating condition, although not by the analysis used by Exelon in the study report.

We do not follow Exelon's reasoning behind the Pearson correlation they ran. We can see how correlating the fish passage counts with water temperature and tailrace level can be done, however we are not sure how Exelon can take the operation of a particular turbine unit and turn that into some number that can be correlated with passage counts. For example, what does the mean for Unit 11 of 0.25622 indicate? This needs to be further explained in the report.

We recommend conducting an analysis using a generalized linear model (GLM). With this analysis Exelon could use its 7 most used operation combinations as a class variable to determine which one is most effective. Other variables to include as covariates would be year (shad runs differ by year), date within a year (possibly Julian date to account for the increase and decrease in catches within a year), time of day, water temperature, and flow. We note the water temperature will likely be correlated with date, so Exelon may want to run one model with water temperature and date included, and another model with date and water temperature excluded. We recommend running this model with more than the 7 most used operation combinations; however there may not be adequate data for the range of the other covariates. At minimum, Exelon's analysis should account for differences among years, and differences among dates during the course of an annual spawning run.

We conclude that the way Exelon analyzed the data was overly simplistic and it's no wonder the analysis couldn't determine if one operation method was better than another. Exelon has the data to do a much better analysis. We recommend that the data be reanalyzed as stated above and summarized in a new report.

3.7 Fish Passage Impediments Study below Conowingo Dam

We request that the following information be added to the 2010 report. Update the radio telemetry analysis in 2011 with the results of Exelon's proposed 2011 American shad radio telemetry report. Examine the flow records when fish are moving and compare the amount of time fish experience full generation flow vs. natural river flow during the migration period (for 2010 and 2011 since that is when telemetry data are or will be available) and for average flow during the migration period. Provide details of the flow model calibration along with the field data or reference the study that provides this information. Further explain and annotate Table 4.1-4.

We also support the comments and recommendations of the Maryland Department of Natural Resources and the Pennsylvania Fish and Boat Commission regarding this study report.

3.8 Downstream Flow Ramping and Fish Stranding Study

We are concerned with the infrequent site visits (n = 12) and the timing of the imitation of the searches, well after first light. Although a consultant biologist noted fish predation by birds and that at times it was significant, there was no attempt to estimate fish loss to predation in the isolated pools and thus unavailable for observation during site visits. During the initial study report meeting when this study was discussed, the contractor did note that predation of fish by birds was observed. We note that stranding of fish in shallow pools increases the potential for predation by animals and birds and also stresses the trapped fish through confinement and exposure to degraded water quality. The mortality estimates presented in the report tables should be viewed as minimal estimates.

We also support the comments of the Maryland Department of Natural Resources and extensive comments of the Pennsylvania Fish and Boat Commission regarding this study report and the need for additional study in 2011.

3.9 Biological and Engineering Studies of the East and West Fish Lifts

This study report was not submitted with Exelon's February 22, 2011 filing of the ISR. We therefore reserve the opportunity to provide comments on, and request modifications of, this study pending the completion of our review of a study report.

3.10 Maryland Darter Surveys

We request that the original sampling plan that included winter and early spring sampling for Maryland darter, by means of electrofishing and seining in the tributary streams, be completed in the coming year. Since Exelon's consultants did not conduct creek sampling in December 2010, January, 2011, March, 2011 and April, 2011, for varying reasons, an additional winter/early spring sampling effort in the study creeks should be conducted from December, 2011 through April, 2012.

In addition, Exelon should provide the Service all original sampling data from the 2009-2010 Maryland Darter survey effort, upon which its study was designed to build upon and supplement, so that the sufficiency of sampling dates and effort can be determined.

We also support the comments of the Maryland Department of Natural Resources and Pennsylvania Fish and Boat Commission regarding this study report and the need for additional study in 2011.

3.11 Hydrologic Study of the Lower Susquehanna River

This study report was not submitted with Exelon's February 22, 2011 filing of the ISR. We therefore reserve the opportunity to provide comments on this study pending the completion of our review of a study report.

3.12 Water Level Management (Littoral Zone and Water Level Fluctuation)

This study report was not submitted with Exelon's February 22, 2011 filing of the ISR. We therefore reserve the opportunity to provide comments on this study pending the completion of our review of a study report.

3.13 Study to Assess Tributary Access in Conowingo Pond

We support the comments of the Maryland Department of Natural Resources and the Pennsylvania Fish and Boat Commission regarding this study report.

3.14 Debris Management Study

We support the comments of the Maryland Department of Natural Resources regarding this study report.

3.15 Sediment Introduction and Transport (Sediment and Nutrient Loading)

This study report was not submitted with Exelon's February 22, 2011 filing of the ISR. We therefore reserve the opportunity to provide comments on, and request modifications to, this study pending the completion of our review of a study report.

3.16 Instream Flow Habitat Assessment below Conowingo Dam

This study report was not submitted with Exelon's February 22, 2011 filing of the ISR. We therefore reserve the opportunity to provide comments on, and request modifications to, this study pending the completion of our review of a study report.

3.17 Downstream EAV/SAV Study (Water Level Vegetative Cover Study)

This study report was not submitted with Exelon's February 22, 2011 filing of the ISR. We therefore reserve the opportunity to provide comments on, and request modifications to, this study pending the completion of our review of a study report.

3.18 Characterization of Downstream Aquatic Communities

We support the comments and recommendations of the Maryland Department of Natural Resources and the Pennsylvania Fish and Boat Commission regarding this study report.

3.19 Freshwater Mussel Characterization Study below Conowingo Dam

We note that Exelon's goals for this study were to 1) Characterize the freshwater mussel community below Conowingo Dam, and 2) Determine if plant operations at Conowingo Dam affect the mussel community in this reach.

In order to assess the scientific integrity of this survey, one must first examine the stated goals. The first goal states that the "freshwater mussel community" will be characterized, indicating that only species richness will be measured. However, the study plan details methods for measuring density and abundance. It would be more appropriate to characterize freshwater mussel populations by measuring not only density and abundance of all species present but also indicators of population viability such as recruitment. In this case Goal 1 would read: Characterize freshwater mussel populations below Conowingo Dam. To determine if the operations at Conowingo Dam affect mussel populations, it is necessary to look not only at the number species that make up the community but also at the population structure and mussel distribution by species across the study area. Some species thrive in slow moving backwater while others live in riffles and runs.

Characterizing mussel species distribution through semi-quantitative surveys coupled with quantitative surveys would provide data that would help determine how operations at Conowingo Dam affect mussel populations. Therefore, Goal 2 should read: Determine if plan operations at Conowingo Dam affect mussel populations in this reach.

Methods stated in Exelon's report:

1) Search for published and unpublished mussel locality records for the study area
2) A semi-quantitative survey of the entire study area

It is unclear to us how the semi-quantitative survey sites were chosen. Although a habitat map was available it does not appear that semi-quantitative survey sites were representative of all habitat types. While habitat information is interesting, it should not be used to exempt areas within the study area from surveys. To adequately characterize the entire study area, all habitats should be sampled within established safety limits.

We note that the semi-quantitative survey sites should have been chosen randomly to represent the entire study area. Smith and Strayer (2003) details two types of sampling: Informal Sampling and Probability-Based Designs (Design-Based Inference). From the description of the methods in the ISR, it appears that the survey detailed in study 3.19 used informal sampling. Smith and Strayer (2003) write that "data collected using informal designs are of very limited use...informal sampling is most useful in preliminary surveys and for determining the presence of a mussel species at a site and should be avoided for other applications." They go on to describe several other methods of sampling that would have better characterized the freshwater mussel community below Conowingo Dam including simple random sampling, stratified sampling (sample sites could be stratified by wading and diving if cost is at issue), double sampling, two stage sampling, or distance sampling. The sampling design that most closely resembles the current method is double sampling for stratification (described on page 23 of Smith and Strayer 2003). Either a grid or transect lines should be laid over a map of the 4.5 mile long section of river and sites should be chosen randomly. If stratification is desired, it should be entirely based on cost per unit effort not on habitat. Based on the catch per unit effort at a site, quantitative survey sites should be chosen to represent high, medium, low, and 0 mussel densities.

Multiple search patterns were used in the semi-quantitative survey. We note that search methods should be standardized across all semi-quantitative survey sites. Either entire sections of the grid, transects, or 1 meter wide strips could be used.

According to the 3.19 report, quantitative surveys were conducted at 5 locations to represent the range in numbers of mussels observed during the semi-quantitative survey. This differs from the study design in which surveys were to be conducted in the areas with the highest density. It is unclear how quantitative survey locations were chosen. Methods should be described more clearly in a redraft of the report. Per comments in section 2, to best characterize the freshwater mussel community below Conowingo Dam, quantitative survey sites should be chosen to represent high, medium, low, and 0 mussel densities.

Data analysis was not clearly described. Was Dave Smith's mussel estimator program used to determine density and abundance? This was not detailed in the methods section of the report and needs to be addressed in a report redraft.

Measurement of habitat parameters should have been done where the quantitative sampling was conducted.

While no reference reach was used, there are examples in the literature of what healthy populations of freshwater mussel populations should look like. In addition, there are a number of studies of the effects of dam operations on freshwater mussels. It has been well documented that a change in operations can improve recruitment of mussels below dams. This literature should be detailed in the conclusions of a report redraft.

We also support the extensive comments and recommendations of the Maryland Department of Natural Resources on this study.

3.20 Salinity and Salt Wedge Encroachment

We support the comments and recommendations of the Maryland Department of Natural Resources on this study report.

3.21 Impact of Plant Operations on Migratory Fish Reproduction

We support the comments and recommendations of the Maryland Department of Natural Resources and the Pennsylvania Fish and Boat Commission on this study report.

3.22 Shortnose and Atlantic Sturgeon Life History Studies

On page 4, paragraph 2 of the report Exelon states: "Atlantic sturgeon abundance was high in the late 1800's and large scale commercial fisheries were created. The Delaware Bay fishery was the largest, but Chesapeake Bay supported several fisheries as well, specifically in the James, York, Rappahannock, Wicomoco / Pocomoke, Nanticoke, Choptank, Potomac, and Patuxent Rivers; apparently no landings were recorded for the upper Chesapeake Bay."

We note that it is likely that there was a sturgeon fishery in the Susquehanna River and there are historic reports of large sturgeon captured in the lower river from *The Status Review for Atlantic Sturgeon* (see excerpts below).

Status Review Pg 19: Chesapeake Bay and Tributaries (Potomac, Rappahannock, York, James, Susquehanna, Nanticoke), PA/MD/VA - Historically, Atlantic sturgeon were common throughout the Chesapeake Bay and its tributaries (Kahnle et al. 1998, Wharton 1957). There are several newspaper accounts of large sturgeon in the lower reaches of the Susquehanna River from 1765-1895, indicating that at one time, Atlantic sturgeon may have spawned there. Historically important sturgeon fisheries in Maryland occurred in the Potomac and incidental harvest of sturgeon was common in other Maryland tributaries. Several sightings were made by commercial fishermen and research biologists during 1978-1987 near the Susquehanna River mouth. Also, a deep hole (18 m) on the Susquehanna River near Perryville, MD, once supported a limited sturgeon fishery (R. St. Pierre, USFWS, personal communication). Maryland DNR personnel reported large mature female Atlantic sturgeon in the Potomac River in 1970, and in the Nanticoke River in 1972 (H. Speir, Maryland DNR, personal communication).

Status Review Page 41: "Chesapeake Bay and Tributaries (Potomac, Rappahannock, York, James, Susquehanna, Nanticoke), PA/MD/VA - Due to their upriver locations, most dams in the Chesapeake Bay have large freshwater tailways and probably did not obstruct Atlantic sturgeon spawning runs. A notable exception were four dams constructed from 1904-1932 in the Susquehanna River. Approximately 50 km of habitat were available to Atlantic sturgeon in the Susquehanna River prior to the construction of Holtwood Dam (rkm 39) in 1910. Access was further restricted in 1928 with the construction of Conowingo Dam (rkm 16) (Carricata 1997). Since 1965, fish lifts have intermittently operated at the Conowingo Dam. During years of fish lift operation, 1965-1966 and 1972 to the present, over 50 million fish representing 70 taxa, but no sturgeon, have been collected at the dam. Other major Chesapeake tributaries, including the James, York, Rappahannock, Potomac, Patuxent, Choptank, and Nanticoke Rivers were never impounded below tidal areas and should have continued to function as spawning migration corridors."

On page 39, paragraph 2of the report Exelon states "The objective of this study was to monitor the Susquehanna River for sonic transmitter tagged sturgeons at large in the system that could potentially use habitats in the Susquehanna River."

We note that it is not appropriate to determine sturgeon use of the Susquehanna River by attempting ONLY to monitor for sonic sturgeon tagged in other systems. Shortnose sturgeons are not likely to move between estuaries, even if movement through the C&D Canal has been documented. Because there is thought to be shortnose sturgeon spawning in the Potomac River, it is also possible there is a spawning population of shortnose sturgeon in the Susquehanna River. Even if those fish are genetically similar to the Delaware River stock, it does not mean that the Chesapeake Bay tributaries do not support spawning. Sturgeon captures in the Susquehanna River are limited in recent years likely due to lack of fishing effort. Most shortnose sturgeon captures reported through the Maryland Reward Program for Sturgeon in the Susquehanna River were reported by commercial catfish fishermen, who stopped fishing several years ago. Without any commercial fishing effort or scientific sampling effort in the Susquehanna River, it is not an accurate assessment to assume that no (or very few) sturgeon occur in the river below Conowingo Dam.

We support the comments and recommendations of the Maryland Department of Natural Resources and the Pennsylvania Fish and Boat Commission on this study report.

3.23 Study to Identify Critical Habitat Use Areas for Bald Eagle

We support the comments and recommendations of the Maryland Department of Natural Resources on this study report.

3.24 Zebra Mussel Monitoring Study

We support the comments and recommendations of the Maryland Department of Natural Resources on this study report.

3.25 Creel Survey of Conowingo Pond and the Susquehanna River below Conowingo Dam

This study report was not submitted with Exelon's February 22, 2011 filing of the ISR. We therefore reserve the opportunity to provide comments on, and request modifications to, this study pending the completion of our review of a study report.

3.26 Recreational Inventory and Needs Assessment

We support the comments and recommendations of the Maryland Department of Natural Resources and the Pennsylvania Fish and Boat Commission on this study report.

3.27 Shoreline Management

We support the comments and recommendations of the Maryland Department of Natural Resources on this study report.

3.28 Archaeological and Historic Cultural Resource Review and Assessment

This study report was not submitted with Exelon's February 22, 2011 filing of the ISR. We therefore reserve the opportunity to provide comments on, and request modifications to, this study pending the completion of our review of a study report.

3.29 Effect of Project Operations on Downstream Flooding

We support the comments and recommendations of the Maryland Department of Natural Resources on this study report.

3.30 Osprey Nesting Survey

We support the comments and recommendations of the Maryland Department of Natural Resources on this study report.

3.31 Black-crowned Night Heron Nesting Survey

We support the comments and recommendations of the Maryland Department of Natural Resources on this study report.

3.32 Re-evaluate the Closing of the Catwalk to Recreational Fishing

We support the comments and recommendations of the Maryland Department of Natural Resources on this study report.

In Conclusion

The Service appreciates the opportunity to provide comments on the completed studies. While we also provide preliminary comments on those studies completed late or incomplete, the Commission should expect additional comments and recommendations as reports are finalized. While the Service is aware that this is not as tidy as is contemplated by the ISP, and may pose difficulties in scheduling for the Applicant and the Commission, this difficulty was not of the Service's making, and the Service's interest should not be the ones to suffer thereby. We look forward to continuing to work on the ongoing licensing process for this project.

If you have any questions regarding our comments, please contact Larry Miller of the Mid Atlantic Fisheries Resource Office (717-705-7838 or Larry_M_Miller@fws.gov).

Sincerely,

Lawrence M. Miller
Project Leader
Mid-Atlantic Fishery Resources Office

CERTIFICATE OF SERVICE

Pursuant to Rule 2010 of the Commission's Rules of Practice and Procedure, I hereby certify that I have this day caused the U.S. Fish and Wildlife Service Comments on the Revised Study Plans for the Cononwingo Hydroelectric Project Relicensing Proceeding to be served upon each person designated on the official service list compiled by the Secretary for proceeding FERC No. 405 – 087.

Dated at Harrisburg, PA this 27th day of April, 2011.

Lawrence M. Miller
Project Leader
Mid-Atlantic Fishery Resource Office

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
WATERSHED MANAGEMENT PROGRAM

May 10, 2011

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

Re: Conowingo Hydroelectric Project, FERC Project No. 405 Comments on 2010 Study Reports

Dear Secretary Bose:

The Pennsylvania Department of Environmental Protection appreciates the opportunity to provide comments to FERC on Exelon's Conowingo Hydroelectric Dam relicensing study reports for work performed in 2010 and for those reports that were submitted to FERC for public comment as of February 22, 2011. The FERC ILP process schedule included a deadline of January 21, 2011 for the submission of all reports for studies to be performed in 2010. On January 20, 2011, Exelon filed a request with FERC for an extension of that deadline until February 22, 2011. FERC granted the extension.

During March 9-11, 2011, Exelon hosted a three-day meeting in Darlington, MD to present overviews of the study reports and summaries. DEP staff attended those meetings to ask questions and provide feedback to Exelon on the individual study reports.

At that meeting, FERC's Emily Carter responded to questions about Exelon's delayed filing of the reports and the remaining unfiled, uncompleted reports. She stated that that those study reports not received by FERC as of the February 22, 2011 extended deadline would be open for public comment under the second year schedule. We understand that we will have until 2012 to file comments on late, presently unfiled or incomplete studies. However, she also stated that comments on the studies could be filed at <u>any</u> time. Based on Ms. Carter's statements, we reserve the right to submit comments on the remaining studies as they are filed and we have time to review and evaluate them. This includes possible recommendations for additional studies in 2011 and beyond if the missing and late study reports are not adequate to address the impact issues.

By this letter, the Pennsylvania Department of Environmental Protection supports and incorporates the comments of the Pennsylvania Fish and Boat Commission, the Susquehanna River Basin Commission, the Maryland Department of Natural Resources, and the U.S. Fish and Wildlife Service.

We look forward to continuing to work with FERC on the relicensing of the dams on the lower Susquehanna River. Thank you for the opportunity to comment.

Sincerely,

James S. Spontak

James S. Spontak, Manager
Watershed Management Program
PA DEP, Southcentral Region

JSS/MDP/lmt

A. Karen Hill, Esq.
Vice President
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Via Electronic Filing

May 27, 2011

Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Re: Conowingo Hydroelectric Project, FERC Project No. 405
Response to Agency Comments on the Initial Study Report and Meeting

Dear Secretary Bose:

In accordance with Title 18 Code of Federal Regulations (18 C.F.R.), Section 5.15 (c)(5) of the regulations of the Federal Energy Regulatory Commission (Commission or FERC), Exelon Corporation, on behalf of its wholly-owned subsidiary, Exelon Generation Company, LLC (Exelon), encloses for filing this response to comments on Exelon's Initial Study Report (ISR) and ISR meeting summary for the relicensing of the Conowingo Hydroelectric Project (Conowingo Project), FERC Project No. 405. The current license for the Conowingo Project expires on September 1, 2014.

On February 22, 2011, Exelon filed its ISR with the Commission as required by Section 5.15(c)(1) of the Commission's regulations. The ISR provided the information and data gathered by Exelon to date, as well as a detailed description of Exelon"s progress in carrying out the Commission-approved study plan for the relicensing of the Project. The ISR meeting was held on March 9-11, 2011, and Exelon subsequently filed its meeting summary on March 28, 2011. On April 27, 2011, several resource agencies and public groups (stakeholders) filed written comments on the ISR and ISR meeting, including Commission staff, American Rivers, the Lower Susquehanna Riverkeeper (Riverkeeper), the Maryland Department of Natural Resources (MDNR), the National Park Service (NPS), the Nature Conservancy, the Pennsylvania Department of Environmental Protection (PADEP), the Pennsylvania Fish and Boat Commission (PFBC), the Susquehanna River Basin Commission (SRBC) and the United States Fish and Wildlife Service (USFWS).

In this response, Exelon addresses stakeholder requests for clarification as well as additional information or analysis for study reports submitted as part of the ISR. In addition, Exelon responds to stakeholders requests for additional studies or modifications to the FERC-approved study plan (see Attachment A). Exelon will address stakeholders" various interpretations of the study results in the License Application.

Exelon is filing this document with the Commission electronically. To access the document on the Commission's website (http://www.ferc.gov), go to the "eLibrary" link, and enter the docket number, P-405. Exelon is also making the document available for download at its corporate website. To access the document here, navigate to http://www.exeloncorp.com/powerplants/conowingo/relicensing/Pages/overview.aspx.

In addition to this electronic filing with the Commission, paper copies of the document are also available upon request to Colleen Hicks (610-765-6791). Finally, Exelon is making available to the public the document at the Visitor‟s Center at Muddy Run Recreation Park in Holtwood, Pennsylvania, and the Darlington Public Library in Darlington, Maryland, during regular business hours.

Exelon appreciates the work and involvement of Commission Staff, resource agencies, local governments, and members of the public in the development and work completed to date. If you have any questions regarding the above, please do not hesitate to contact Colleen Hicks. Thank you for your assistance in this matter.

Respectfully submitted,

Colleen E. Hicks

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Enclosure: Attachment A-Response to Agency Comments
Attachment B-Distribution List
Attachment C- Responses to Agency Comments on Conowingo 3.19-Freshwater Mussel Characterization Study
Attachment D-Resumes of Mussel Surveyors

3.1 Seasonal and Diurnal Water Quality in Conowingo Pond and Below Conowingo Dam

SRBC and the Nature Conservancy submitted comments on the Seasonal and Diurnal Water Quality in Conowingo Pond and Below Conowingo Dam (RSP 3.1) initial study report.

SRBC Comment 1:
"Exelon concludes in the study report that the discrete monitoring demonstrates that Station 643 is adequately representative of DO concentrations in the turbine boils; however, this conclusion is supported by an assessment of daily averaged data, not discrete hourly measurements."

Exelon Response:
The conclusion that Station 643 is representative of turbine boils was based on analysis of both hourly and average DO measurements within the context of the 2010 FERC approved study plan and MD State water quality standards. All hourly data were provided either in tabular or graphical form (Figure 4-27) and then separately in Appendix B of the initial study report for further analysis if needed. Additionally, conclusions were supplemented by the 2010 seasonal data collected at three transects downstream of Conowingo Dam and knowledge of the historical data.

Figure 4-25 in the initial study report provides the distribution of 635 discrete hourly DO measurements obtained from operating turbine boils during the 2010 study, as pre-specified by the FERC in the RSP. This figure was provided for rapid assessment of DO in the discharged water over multiple operational scenarios. Figure 4-27 shows the comparison of discrete hourly DO measurements of each turbine boil with that of Station 643 DO.

Table 4-5 of the initial study report shows the dates of hourly DO and water temperature measurements. Pages 13 and 14 of the initial study report describe the duration of operating turbines and various combinations of turbines. Figure 4-7 portrays these data in a graphical form and gives readers a perspective on the number of observations available for any analysis so desired. Since small turbines were operating on sampled dates, most measurements occurred in discharge boils of those turbines.

Of importance, however, is the use of average values to show compliance with the seasonal MD State water quality standards cited on initial study report page 20. They are either based on 7- day (February 1 through May 31) or 30 -day (June 1 through January 31) averaging period. These standards were met on a daily basis both in the turbine discharge boils as well as at Station 643.

SRBC Comment 2:
"Moreover, a uniform lag of one hour was used to account for travel time from the turbine outlets to Station 643, but it is highly unlikely that the travel time is uniform under the full range of operations from peaking to minimum releases. Regardless, reliance on Station 643 for monitoring DO concentrations is problematic from the standpoint of an extensive lag in observing potentially fatal occurrences of non-attaining DO concentrations, which were observed in the hourly monitoring data."

Exelon Response:
Historical observations made over a wide range of dam discharges suggest that a one hour lag is sufficient for this analysis. To the best of our knowledge, no fatal occurrences of DO were recorded in turbine discharge boils, at Station 643, or at the three transects downstream of the dam on sampled dates.

SRBC Comment 3:

"A final determination cannot be made from summarized results and averaged data. The importance of non-attaining DO concentrations in certain turbine boils can only be determined through an evaluation of discrete data points."

Exelon Response:
See Exelon Response to SRBC Comment 1 above.

Nature Conservancy Comment 1:
"Further, due to the spatial heterogeneity of the downstream channel and effect of turbine operations on downstream conditions, we believe that sub-daily variation of dissolved oxygen (DO) that may have consequences for downstream biota is masked by summarizing results as daily averages. Thus the ISR shows that the objectives of Study 3.1 cannot be met with the approved study methodology."

Exelon Response:
See Exelon Response to SRBC Comments 1 above.

Nature Conservancy Comment 2:
"We recommend the following modifications to the approved study as necessary to meet the study objectives. We recommend that additional monitoring of the turbine boils be completed to determine if there is potential bias of Station 643 and to characterize DO conditions under various flow, temperature, and operating conditions during late summer and fall months. This information is necessary to help Maryland Department of Environment issue the requisite water quality certification for this project."

Exelon Response:
Sampling of turbine discharge boils was carried out according to the FERC pre-specified scheme and dates and was dependent on which turbine or combinations of turbines were operating on those dates. In turn, the operational times of turbine(s) was dependent on minimum flow requirements, incoming river flows, Conowingo Pond level management, and power demand at the time. Exelon believes that the 2010 water quality study as conducted met the required objectives. See Exelon Responses to SRBC Comments 1-3 above.

Nature Conservancy Comment 3:
"In reviewing the study summary and Initial Study Report for Study 3.1, we made the following observations that support continued sampling at the turbine boils: Station 643 is on the west shore of the river, closer to the aerated Francis turbines (1-7) and furthest from the non-aerated Kaplan turbines (8-11). Figure 4.27 illustrates that the hourly samples taken at Station 643 are consistently higher than the hourly measurements taken at the individual boils. The report concludes that Station 643 is representative of DO conditions at the individual boils, but does not provide any statistical analysis to support this conclusion."

Exelon Response:
Turbine boil sampling dates for 2010 were selected by FERC and were followed exactly by Exelon in conducting the turbine boil monitoring. In addition, Exelon collected data along downstream transects that provide additional information regarding DO conditions beyond the immediate discharge zone. Exelon disagrees with the statement that hourly DO measurements at Station 643 are "consistently" higher than those taken in the individual turbine boil. Figure 4-33 clearly demonstrates that this is not the case. As shown, 33% of the time (85 of 255 hourly observations) there was no difference between the turbine boil DO value and that measured at Station 643. 72% of the time (184 of 255 hourly measurements) the difference between Station 643 and turbine boil DO was within + 0.5 mg/L. More importantly, Figure 4.33 demonstrates clearly that Station 643 is not biased toward measuring DO concentrations that are higher than those being discharged in the turbine boils. In fact, the distribution of

the differences between measurements made at Station 643 and the turbine boils is almost uniformly distributed around zero. This clearly demonstrates that there is no consistent bias in Station 643 measuring DO concentrations that are higher than being discharged from the turbines.

Nature Conservancy Comment 4:
"Further, emphasizing daily average DO masks diurnal variation observed in the samples."

Exelon Response:
Diurnal variations in DO at Station 643, due to natural processes of photosynthesis and respiration, were discussed in the initial study report and are common features in temperate water bodies. See also Exelon Responses to SRBC comments 1-3 above.

Nature Conservancy Comment 5:
"The Kaplan turbine boils were proportionately under sampled (87 out of a total of 635 total hourly observations, representing only 14% of observations). We acknowledge that the Kaplan turbines are operated less frequently during low flow conditions and therefore there may have been fewer opportunities to sample dissolved oxygen. For this reason, we do not believe the 2010 study period provides an adequate representation of typical operating conditions as they relate to DO concentrations. For example, according to Table 4.3, during 2010, only 11 hourly samples were taken on Unit 11. Six of 11 hourly DO samples (54%) were below 5 mg/L; hourly DO was below 5.0 mg/L on two of the three days at Unit 11."

Exelon Response:
Sampling scheme and dates for turbine boil(s) DO measurements in 2010 were pre-specified in the FERC study plan determination. The study plan determination specified that DO of all operating turbine boils be measured hourly between 0600 and 1800 hours. DO of operating turbine boils was sampled accordingly. Thus, if a given turbine operated for 1 hour on a sampled date, only one DO measurement could be obtained on that day. An opportunity to sample large turbine boils at low summer flows (less than 10,000 cfs), particularly for any length of time, is low due primarily to minimum flow requirements, inflows, Conowingo Pond level management, and emergency power demand. For example, if the incoming river flows are less than or equal to 5,000 cfs with no power emergency there is essentially zero probability of operation of Kaplan turbines.

Nature Conservancy Comment 6:
"Based on the data presented in Appendix B-1, observed DO concentrations downstream exhibit diurnal variation and vary spatially across the channel from west to east. Additional monitoring at the turbine boils is needed to determine whether there are potential DO barriers in the channel downstream of the project, including near the east fish lift."

Exelon Response:
Exelon does not agree that additional turbine boil sampling is necessary. Turbine boil sampling dates for 2010 were selected by FERC in its study plan determination and were follow exactly by Exelon in conducting the turbine boil monitoring. In addition, Exelon collected data along downstream transects, that provide additional information regarding DO conditions beyond the immediate discharge zone. There was no indication in any of the DO data collected in the tailwater area of DO concentrations sufficiently low and extending into the area of the east fish lift to suggest that a DO barrier of any type forms, even under extreme conditions of low flow, warm water temperatures, Kaplan unit operation and Conowingo Pond DO stratification. Moreover, DO concentrations during the fish migration season, when the fish lift is operating were all well above standards.

Nature Conservancy Comment 7:

"In order to conclude that the downstream temperature and DO conditions in 2010 are representative of typical operations, OEP Staff and parties would need to know how frequently various turbines are operated. This information has not been presented. Exelon did not adopt our recommendation that the PSP be amended to include development of a water quality model for the lower Susquehanna River and upper Chesapeake Bay. It provided the following explanation: "Exelon believes the Nature Conservancy study request for the development of a water quality model of the river reach below Conowingo Dam and the Upper Chesapeake Bay is not warranted, given that Exelon's use of existing water quality data can be used to adequately assess potential project operational impacts on water quality."

Exelon Response:
Exelon is not proposing any changes in operation and the water quality study, which was completed in accordance with the FERC study plan determination and adequately assesses any effects of the project on water quality.

Exelon

3.3 Biological and Engineering Studies of American Eel at the Conowingo Project

MDNR, PFBC, USFWS, and the Lower Susquehanna Riverkeeper submitted comments on the Biological and Engineering Studies of American Eel at the Conowingo Project (Objective 3) report.

MDNR and PFBC Comment 1:
Eel sampling conducted by Exelon occurred in the spillway area and consisted of 258 eels. The USFWS collection efforts in the tailrace captured approximately 24,000 elvers. USFWS began their effort on May 31, 2010; while Exelon initiated its eel collection efforts more than two weeks later on June 16, 2010. The report concludes that an earlier start and greater attraction flows may be needed to substantially improve eel collections in the spillway area. USFWS notes in Appendix A: USFWS 2010 Eel Collection Report, Conowingo Dam that they have been unable to determine the triggers for elver migration at the Conowingo Dam.

Exelon Response:
A 2011 study is proposed by Exelon. Start-up will begin in late-May/early June (flows permitting) this year. Details of the study have been discussed with resource agency personnel. The study plan has been drafted and was issued to stakeholders on May 13, 2011.

Lower Susquehanna Riverkeeper Comment 1
The timing of this study avoided the peak migration period experienced in earlier eel collections performed by the USFWS. (see Attachment A, Table 1 of this document). "The initial collections occurred for a single 48-h period each week. After a short time, however, the ramps and attraction flows were set to fish continuously, and elver collections occurred each Monday, Wednesday, and Friday throughout the study period." The initial period began on June 16, 2010. The "continuous" collections did not begin until July 12, 2010. Appendix A, Table 2 of Study Report 3.3, the USFWS 2010 EEL COLLECTION REPORT, CONOWINGO DAM TAILRACE, shows that the 2010 eel migration declined significantly after July 9. There is no explanation of why the applicant waited until after the time that eels would be expected, to begin their continuous sampling. Using the phrase "after a short time" to describe the four-week delay before continuous collection occurred shows an effort to verbally diminish the impact that the applicant's delay in collection had on their results. This follows a previous pattern by the applicant of making efforts to diminish the impact that the project has as a blockage to American eel migration in their largest former habitat in the United States.

Exelon Response:
The sampling periodicity for the elver collections was completed in accordance with the FERC approved study plan. Specifically, as stated in the study plan, *"The spillway pool collection ramps will be fished weekly through September-October once spill likely is diminished typically by early June. One 48-h period will be fished in each sampling period. This component will determine seasonal use of the spillway pool by elvers as well as contrast spatial abundance with the tailrace."* Exelon‟s voluntary decision to increase sampling frequency to occur each Monday, Wednesday, and Friday after July 12, 2010 was in response to the relatively low number of elvers collected below the spillway compared to the tailrace collection area. This change in sampling frequency protocol, which was not required in the FERC approved study plan, was a constructive effort by Exelon to improve the study quality. Exelon has acknowledged on countless occasions that passage of American eel at the Conowingo Project is a key issue in the relicensing process. Exelon has made a good faith effort to engage stakeholders in the discussion of this issue, as well as expend time and financial resources to conduct several scientifically sound studies related to both upstream and downstream passage of this important species.

3.5 Upstream Fish Passage Effectiveness Study

USFWS, MDNR, PFBC, American Rivers, and Nature Conservancy submitted comments on the Upstream Fish Passage Effectiveness (RSP 3.5) initial study report.

PFBC Comment 1 (see also USFWS, MDNR, PFBC, and American Rivers):
The licensee changed the definition of tailrace (TR) from the Revised Study Plan to the Initial Study Report. In the RSP (Section 3.5.6), the TR is defined as the area from the Dam to the lower end of Rowland Island. The ISP defines the TR as from the Dam to the upper tip of Rowland Island. Some 32 shad were detected at the lower end of Rowland Island that were not detected above Rowland Island. Under the ISP, these would be considered TR fish and would be included with the 89 other TR fish for a total of 121 fish in the TR. Passage effectiveness would then be 33%, not 44% as reported in the ISR.

Exelon Response:
In the updated study report, the tailrace area will be defined as the area from the Dam to the lower end of Rowland Island. Although the definition of the tailrace in the initial study report was admittedly different, results would not be greatly impacted by increasing the size of the tailrace from the dam to the lower tip of Rowland Island due to dropback as defined in Section 2.0 (Background) of the Conowingo 3.5 report[1]. Thirty-one of the 32 shad counted at the lower tip of Rowland Island but not included as tailrace fish were in the process of dropback/fallback. Once these fish left the lower tip of Rowland Island they never returned upstream and would not have been counted as tailrace shad even by the expanded definition. One Lapidum released shad would be added to the group of tailrace shad in the expanded definition of the tailrace. The fish moved upstream to the lower tip of Rowland Island, as described in Section 4.3.2 (Non-Tailrace Shad) of the Conowingo 3.5 initial study report. Although this fish failed to move above Rowland Island, it would be included for tailrace analysis in the expanded tailrace definition, increasing the number of shad available to the EFL from 89 to 90. Upstream fish passage efficiency would than be changed from 44.9% (40 of 89) to 44.4% (40 of 90).

[1]The term dropback (or fallback) describes the downstream movement of an upstream migrating anadromous fish after tagging; this behavior is related to the tagging process. In a literature review of anadromous shad and herring studies using radio or acoustic tags, post-tagging dropback ranged from 8.6 to 100% (Frank *et al*., 2009). The spatial-temporal parameters (e.g., how long after release did it take the fish to start moving downstream, how fast did the fish move downstream, how far did the fish move downstream) used to define dropback varied among studies, yet the majority of researchers (63.6%) included fish with dropback in their analysis as long as the fish eventually returned upstream. Drop back behavior related to post-tagging stress is typical of radio tagged shad and can affect migration behavior of up to 40% of the tagged fish. (Olney *et al*. 2006).

PFBC Comment 2:
Fifteen of 23 fish with turbine passage were believed to have achieved short-term survival, but no information about delayed mortality was presented.

Exelon Response:
Consistent with the FERC-approved study plan, mobile tracking only covered the river from the tailrace down to the I-95 Bridge and only occurred through the end of July. Exelon does not know the fate of these 15 radio tagged shad downstream of the I-95 Bridge or after the end of July.

PFBC Comment 3 (see also American Rivers):
Need travel times to assess delay in passing or not passing:

Exelon Response:
Exelon will provide these data in the updated study report.

PFBC Comment 4 (see also American Rivers):
Describe time lapse between when a fish entered via gate C and when it was detected at C gate "upper entrance channel dropper antenna."

Exelon Response:
To address this issue, as well as other related items, Exelon would like to collaborate with the resource agencies and other stakeholders in building a consensus on what variables and statistical analysis should be used to examine upstream fish passage effectiveness for Conowingo 3.5, as well as for Conowingo 3.6 (Conowingo EFL Attraction Flows), and 3.7 (Fish Passage Impediments Study below Conowingo Dam) initial study reports. The updated study report will be reissued with the agreed upon variable statistical analysis.

PFBC Comment 5 (see also American Rivers):
Describe time (range, mean median) between last detection in lower EFL and exit of fishway. (How much time did fish spend in the exit trough?)

Exelon Response:
See Exelon response to PFBC Comment 4.

PFBC Comment 6 (see also American Rivers):
Under what generation scenarios did fish move from lower Rowland Island to the Tailrace? Analysis of this data might be useful in attracting the 32 fish that were detected at lower Rowland Island but never in the TR.

Exelon Response:
See Exelon response to PFBC Comment 4.

PFBC Comment 7:
Figure 4-7 shows few EFL forays between 7 and 8 AM. Where were the fish at that time?

Exelon Response:
This information will be provided in the updated study report.

PFBC Comment 8 (see also American Rivers):
Need composite plots of fish locations in tailrace and spillpool areas at each level of generation (7/4, 7/3, 6/4, 2/0, as per appendix C).

Exelon Response:
This information will be provided in the updated study report.

PFBC Comment 9:
Need data and animation for nights. Must know where and when shad go at night and when they return to TR.

Exelon Response:
Exelon will provide this data and analysis in the updated study report.

PFBC Comment 10:

Fish animations should have date, time and place of release and date and time of passage.

Exelon Response:
Exelon will provide this data in the updated study report.

PFBC Comment 11:
Explain surprisingly large # of fish in spillpool areas (26 far-field, 7 near-field) in terms of generation.

Exelon Response:
Exelon will provide this analysis in the update study report.

PFBC Comment 12:
Which of these fish were actually in spillpool and which were in the tailrace below the retaining wall?

Exelon Response:
Exelon will provide this analysis in the updated study report.

PFBC Comment 13:
Need animations of all fish combined from April 30 to the end of the study.

Exelon Response:
Exelon will provide this data in the updated study report.

MDNR Comment 1:
This study lacks citations for statements such as: "Drop back behavior related to post-tagging stress is typical of radio tagged shad and can affect migration behavior of up to 40% of the tagged fish." and "While the exact cause of this inability of all fish in the EFL to successfully pass upstream is not understood, it is symptomatic of current fish lift designs for American shad"

Exelon Response:
See Exelon Response to PFBC Comment 1.

MDNR Comment 2:
Statistical analysis of the behavior of the monitored shad relative to potential causative factors (e.g. flow, plant operation regimes, water temperature, crowding by gizzard shad, lift frequency and number) should be included in a revised version of this report.

Exelon Response:
See Exelon response to PFBC Comment 4.

MDNR Comment 3:
Fish behavior that is illustrated in the animation provided to the stakeholders should be quantitatively analyzed to assess all relationships between the behavior of the monitored fish and plant operations, as well as all the other contributing variables.

Exelon Response:
See Exelon response to PFBC Comment 4.

USFWS Comment 1 (see also American Rivers):
We recommend additional analyses of the 2010 data to assess the degree and potential cause of the searching delay, false attraction to the spillway, and the ability of fish to negotiate the lower river and

tailrace up to the dam and fishway entrance. The frequency of occurrence assessments in Figures 4.4 and 4.5 offer an example of how generation could influence distribution and behavior of tagged fish during various project operations. New figures should be developed using the same generation bins in Figures 4.4 and 4.5 (plus spillage flow above station generation capacity if it occurred), however the y-axis should be the cumulative detection time (hours) for all fish detections in a particular area where telemetry monitors were deployed. There should be a separate figure developed for each of the following areas of interest: Area 1- Near field dam tailrace (group monitors for Units 1, 3, 5, 7, 8, 9, 10, and 11, plus fish entrance Gates A and C, and the frequency of occurrence bar for each generation bin should be color subdivided for Francis units vs. Kaplan units vs. entrance gates); Area 2 - Spillway monitor; Area 3 – Rowland Island monitors; Area 4 – Spencer Island monitor; and Area 5 – Lapidum/Tomes Landing monitors. This analysis will provide for an assessment of area use for different generation scenarios.

Exelon Response:
See Exelon response to PFBC Comment 4.

USFWS Comment 2:
We recommend that the 2010 animation for combined fish locations already provided by Exelon be expanded to present fish detection data for the entire 2010 study period.

Exelon Response:
See Exelon response to PFBC Comment 10.

3.6 Conowingo East Fish Lift Attraction Flows

American Rivers, MDNR, PFBC, and USFWS submitted comments on the Conowingo East Fish Lift Attraction Flows (RSP 3.6) initial study report.

MDNR Comment 1:
"The statistical analysis of the data is fundamentally flawed and precludes any judgment of the soundness of the conclusions on which these analyses are based. The fundamental flaws arise because the applicant attempted to relate power generation scenarios to fish passage without taking into consideration the many other variables that could potentially influence fish passage. Crucial variables that were ignored in the analysis include: 1) year, 2) day of year, and 3) hour of day. The annual variability in the population size of migrating shad is depicted in Figure 4.1-3 and the day to day variability is depicted in Figure 4.1-3 through Figure 4.1-12. Variability within individual days is also apparent in the data sets provided by the applicant.

Exelon Response:
This comment as well as several other comments all relate to the statistical analysis of the data contained in this initial study report. The PFBC, USFWS, and American Rivers have all stated similar comments in their individual report comment letters. Exelon proposes scheduling a meeting with the agencies to discuss the methods of statistical analysis and variables deemed by the agencies to be acceptable to all parties to portray the relationship between fish passage, station operation, and environmental conditions. After any additional analyses are completed, an updated study report will be reissued.

MDNR Comment 2:
The format in which the data were provided by the applicant was not amenable to independent review or analysis by stakeholders. Multiple excel spreadsheets of raw data with multiple tables per sheet would require significant organization before any review could be done. Ideally, a single large table of data that included all of the relevant variables potentially affecting fish passage as well as the fish passage data should have been provided. Presumably such a table was constructed by the applicant for the purpose of the analyses they carried out.

Exelon Response:
As part of the process where Exelon and the agencies meet and decide on the input variables and method of analysis, we will discuss the specifics of format presentation for raw data.

MDNR Comment 3:
A central question that the applicant needed to answer was, "is the project operation in any way related to successful shad passage if other sources of variation affecting shad passage are taken into account." The applicant chose to use several separate t-tests comparing an individual generation scenario to all others for their analysis. This was a poor choice of statistical method because it is unable to partition variance to any other factors potentially influencing shad passage, namely year, Julian date, or time of day. There is a tremendous amount of variation in shad numbers among years (annual range 19,914-193-574 fish), among dates within a year, and among hours within a day. Lumping all of these data into two blocks to be compared (i.e., 1 focal scenario vs. all 291 other scenarios) results in a high amount of within-group variability ("noise"). This swamps out the differences between groups ("signal") which is what we are trying to detect. There are much more appropriate statistical approaches available to the applicant which would amplify the signal to noise ratio by taking into account these other sources of variation in shad passage.

Exelon Response:

See response to MDNR Comment 1.

MDNR Comment 4:
A set of Pearson correlations was also conducted by the applicant to explore relationships between turbine generation schemes, EFL equipment settings, water temperature, and tailrace water levels with hourly American shad and gizzard shad passage. Correlations do not establish causation but can be a useful tool in data exploration. However, this approach suffers from the same drawbacks as described for the t-tests in that many other contributing factors may have prevented detection of significant patterns. A separate issue is that insufficient information about what data were included in the correlations precludes an understanding of the results. For example, correlations are typically done between two continuous variables to answer the question, how is x related to y? However, the applicant reports correlations between shad passage and aspects of operational conditions that are not clearly defined. For example, what does it mean that a particular turbine is correlated with fish passage? Did they use the duration of operation as a continuous variable or enter on/off as a binary variable (0/1) or use some other characteristic of turbine function? The same issue is evident with many of the correlations. Without further explanation, these results cannot be interpreted.

Exelon Response:
See response to MDNR Comment 1.

MDNR Comment 5:
More information is needed in order to know whether duration of turbine operations was included in the Pearson correlations. Individual turbines are included in the correlations, but it is not clear what aspect of turbine operation is being correlated with shad passage.

Exelon Response:
See response to MDNR Comment 1.

MDNR Comment 6:
River flow as a variable is discussed as one of the operational scenarios. "Minimum flow generation occurred nearly 47% of the time." Minimum flow regimes downstream of Conowingo Dam are listed earlier in the report. Natural river flow is minimum flow under some circumstances. River flow does not appear to have been used as a continuous variable in any of the analyses

Exelon Response:
River flow is not the appropriate variable to use as it relates to fish passage at a particular hydro station. We attempt to maximize American shad passage at the EFL at all station discharges. Since the capacity of the Conowingo station may be less than or greater than the actual river flow at a given time, the EFL operation is dictated by station discharge and not actual river flow. The sentence "Minimum flow generation occurred nearly 47% of the time." means that the station was discharging the lowest amount of water allowed under the current license.

MDNR Comment 7:
More information is needed to determine whether entrance gate velocity was examined in the correlation analysis. There is a variable called "gate setting" but it is not clearly defined. This was listed as a topic of study in the Revised Study Plan.

Exelon Response:
See response to MDNR Comment 1. The term "gate setting" refers to the opening of the entrance gate that is currently in use. The entrance gate gauges located in the EFL control room read in "percent open". For example, when an entrance gate is closed (full up position), the gauge reads "0" and when the gate is

open halfway, the gauge reads 50%. The entrance gate setting is adjusted according to the tailrace level which corresponds to specific turbine discharge scenarios.

MDNR Comment 8:
Table 4.2-2 – This table presents shad passage rates versus various turbine operation regimes, but does so only for 2010. It appears similar data are available for many other years; that data should also be presented in similar tables.

Exelon Response:
Exelon agrees that the data are available to produce similar tables for other years, and will be provided in the updated study report. Note that this table focuses solely on the peak American shad passage periods in 2010 which occurred during two 7-day periods; one in late April and the other in mid-May.

MDNR Comment 9:
Pg 12. The statement: "Historic data (2001-2009) and data from 2010…….show that the EFL is effective at attracting 73% of the American shad in the tailrace….." The statement implies that the historical data support the 73% figure, when, in fact, the 73% figure is solely from the telemetry study done in 2010. Neither the historical data nor any analyses presented in the report provide an indication of what is the EFL attraction percentage of upstream migrating shad

Exelon Response:
Comment noted. The 73% figure relates only to the 2010 radio-tagged American shad that were detected in the EFL. We will address this item in the updated study report.

MDNR Comment 10:
Pg 13. The final paragraph of the conclusion section presents the opinion of the authors that future efforts to improve passage should focus only on the EFL and not on plant operations. This opinion is based on analyses in the report which did not adequately address the objectives of this study, as elaborated on above, and is thus an unsubstantiated conclusion.

Exelon Response:
See response to MDNR Comment 1.

MDNR Comment 12:
The inadequate and inappropriate statistical analyses presented in this report should be deleted, and analyses conducted as described in the detailed comments above. Results of the revised analyses should be integrated with the findings of Study 3.5. Exelon should revise and amend the report in response to the comments provided here and provide a copy of the revised report to the stakeholders for final review.

Exelon Response:
See response to MDNR Comment 1.

3.7 Fish Passage Impediments Study

American Rivers, Maryland DNR, PAFBC, USFWS and Commission staff submitted comments on the fish passage impediments below Conowingo Dam study (RSP 3.7) study report.

FERC Comment 1:
"A two-dimensional hydraulic model (River2D) was developed to ascertain if areas in the tailrace and other portions of the river below Conowingo dam could present adverse velocity barriers under typical dam operation regimes. In the report, there is no explanation for initial and boundary conditions and model parameters of River2D. Please provide the information in detail. For the calibration of the River2D, we assume that the measured ADCP data were compared with the River2D simulation results. In the final study report, please clarify and provide figures and/or tables for the model calibration."

Exelon Response:
This information has been provided by Exelon in the Conowingo 3.16 Instream Flow Habitat Assessment below Conowingo Dam initial study report.

MDNR Comment 1:
"Exelon states "there is no evidence to suggest that extreme water velocities present a barrier to upstream migration of American shad or river herrings." However, modeling results show that at full generation (a frequent occurrence during the day during the migration period), velocities approach 8 fps in select areas in the channel between the west shoreline and Rowland Island as well as in the tailrace proper and to the east of the island (Fig. 4.2-12). Shad have a maximum burst speed of 13 fps (maintainable less than 15 sec.) and a prolonged swim speed of no longer than 200 minutes. This suggests at least a delay or fatigue factor that these fish would experience when encountering full generation flow vs. typical run-of-river flows that would occur under natural conditions. Exelon should examine the flow records when fish are moving and compare the amount of time fish experience full generation flow vs. natural river flow during the migration period (for 2010 and 2011 since that is when telemetry data are or will be available) and for average flow during the migration period".

Exelon Response:
Regardless of high velocities present in the areas specified by the MDNR comment, shad quite frequently migrated to the tailrace, indicating that they were not impeded. Figures are presented (Figures 4.2-2 through 4.1-8) in the initial study report that illustrate telemetered shad migration in relation to Conowingo discharge. There was no apparent relationship in movement versus flow regimes. Nevertheless, Exelon will examine the flow records when fish are moving and compare the amount of time fish experience full generation flow vs. natural river flow during the migration period and for average flow during the migration period. This analysis will be included in the updated study report.

MDNR Comment 2:
"Pg. 8: The Applicant should provide details of their model calibration with field data or reference the study that provides this information."

Exelon Response:
See Exelon Response FERC Comment 1.

MDNR Comment 3:
"Table 4.1-4: this table needs further explanation and annotation. The column labeled average speed does not correspond to the average distance over time, so it is unclear how this was calculated. The last 4 rows in this table have no explanation for the values there."

Exelon Response:
The table will be further annotated with explanations. The average speed was the average speed of individual trips and cannot be calculated with data from this table. The headings for the final five rows were inadvertently omitted and will be restored.

MDNR Comment 4:
"Fig. 3.2-1: Where is the ADCP data applicable to this figure? The Applicant should reference another study if it is contained elsewhere."

Exelon Response:
This information was provided by Exelon in the Conowingo 3.16 Instream Flow Habitat Assessment below Conowingo Dam initial study report.

PFBC Comment 1:
"Page 5, last paragraph, the use of the term "foray" here is unclear. Does this refer to forays from tidewater to the TR?"

Exelon Response:
"Foray" was used as a term for one trip upstream by a given telemetered shad from the tidewater area. It is simply used in place of "trip" and can be replaced with "trip."

PFBC Comment 2:
The report concludes that there are no barriers to fish passage in the river reach from Rowland Island to tidewater. However, the following statements in the Executive Summary contradict the report's conclusion.

"Based on model outputs for discharges of 10,000 and 40,000 cfs, there were relatively few areas within the river where velocities were greater than the burst speeds of American shad and River herring were evident; there were some isolated areas of velocities approaching, but not exceeding, six fps. American shad and river herrings exhibit burst swim speeds of at least, if not greater than, six fps. Predicted velocities for a discharge of 86,000 cfs did show more areas of higher velocities approaching as high as seven to nine fps. These highest velocities were concentrated primarily in the tailrace and both sides of Rowland Island. It is expected that if migrating fish enter these higher velocity areas, they will likely avoid overpowering velocity fields and swim around the areas."

These statements do not agree with the report's conclusion because they clearly show that burst swimming speed for shad and herring is exceeded when generation reached the upper limits of the dam's discharge. They also don't take into account that flows reach the 80,000 cfs range on at least a daily basis throughout much of the fish passage season. Likewise, these fish are constantly and repeatedly being challenged to exhibit burst speed swimming modes which under a free-flowing river would only be encountered occasionally and/or the fish would migrate to the edge of flows as they progressed upstream. The dam blocks all such movement so the fish are challenged again and again to negotiate much higher than natural flow velocities, thereby depleting their energy reserves. There is a reason why shad have a "burst" speed and a normal "swimming or cruising" speed. Burst speed was not intended to be their primary rate of swimming."

Exelon Response:
Exelon does not see a contradiction between the Executive Summary and Conclusion in the initial study report. Shad and alewife burst speeds are above 10 fps, while blueback herring was reported to be approximately 6.7 fps.

PFBC Comment 3:
Data from the shad telemetry study should be examined for evidence that the high velocities in the TR are or are not impediments.

Table 4.1-2 shows that most fish made multiple trips to the dam. This table lists the averaged data for the trips of each fish but an additional table should show the total time and trip distance traveled by each fish. Repeated, but failed attempts, of individual fish to find the fishway and pass the dam exacts a physiological toll. It is important to know the total distance and time traveled per fish in addition to their averaged time. It is also important to know the fate of whether the fish that made a greater number of trips were among those that perished on the way back down through the turbines and whether there is a relationship between the two events.

Data are listed by fish ID number. The data should be grouped in several different ways to make it easier to discern patterns in forays, swimming speed based on ambient and project influenced river flows, project discharge, time of day, day of week. We request that data be sorted in enough table outputs to show whether the day of the week and project discharge is related to swimming speed and number of forays. For example, on typical weekends, generation schedules are different (flow releases are usually less frequent and of lower volume and lesser fluctuation duration) than on weekdays when power demands are greater. If there are flow related influences on fish migration patterns towards the dam as table 4.1-4 suggest then low flow days, such as are typical of weekends, may show correlated migration activities."

Exelon Response:
The Appendix Table lists pertinent data for each migration upstream by telemetered shad. These data include date, time of day, time to reach an area and distance traveled and are sufficient to address the PFBC"s comment "..an additional table should show the total time and trip distance traveled by each fish." As for determining the fate of telemetered fish which passed upstream of the Project, Conowingo Report 3.5 should be referred to for those data. Fish IDs were the same for both reports. Exelon will look at the data in ways suggested by the PFBC to ascertain if correlations can be discerned between variables indicated by the PFBC.

USFWS Comment 1:
"We request that the following information be added to the 2010 report. Update the radio telemetry analysis in 2011 with the results of Exelon's proposed 2011 American shad radio telemetry report. Examine the flow records when fish are moving and compare the amount of time fish experience full generation flow vs. natural river flow during the migration period (for 2010 and 2011 since that is when telemetry data are or will be available) and for average flow during the migration period. Provide details of the flow model calibration along with the field data or reference the study that provides this information. Further explain and annotate Table 4.1-4.

Exelon Response:
These comments and concerns were addressed in responses to the MDNR and PFBC above.

3.8 Downstream Flow Ramping and Fish Stranding Study

MDNR, The Nature Conservancy, PFBC, and USFWS submitted comments on the Downstream Flow Ramping and Fish Stranding Study (RSP 3.8) initial study report.

USFWS Comment 1:
We are concerned with the infrequent site visits (n = 12) and the timing of the imitation of the searches, well after first light. Although a consultant biologist noted fish predation by birds and that at times it was significant, there was no attempt to estimate fish loss to predation in the isolated pools and thus unavailable for observation during site visits. During the initial study report meeting when this study was discussed, the contractor did note that predation of fish by birds was observed. We note that stranding of fish in shallow pools increases the potential for predation by animals and birds and also stresses the trapped fish through confinement and exposure to degraded water quality. The mortality estimates presented in the report tables should be viewed as minimal estimates.

Exelon Response:
The number of site visits (n-12) were agreed upon and included in the FERC study plan. In addition, the spring and summer surveys were initiated in the very early morning. In the fall, surveys were initiated during mid-morning, but this was generally right after the cessation of morning generation flows. The FERC approved study plan did not include a provision for estimating fish predation by birds.

MDNR Comment 1:
Hydraulic conditions described in the report are not worse-case-scenarios. Page 7 of the report gives ranges for the dewatering of a 2.4 feet to 6.0 feet drop, which is a significant biological difference in habitat for fish. However, this difference was not evaluated based on the estimated potential stranding area and the relationship between difference in water depth and visual observations.

Exelon Response:
The 2010 study was conducted in accordance with the FERC study plan determination.

MDNR Comment 2:
It also appears that dead/alive status was not noted in the Tables for many important species and no explanation was provided.

Exelon Response:
For Tables 4.1.2-1, 4.2.2-1, and 4.3.2-1, under the last column labeled "Dead Fish Observed", if a value is not present under the Number (No.) column, no dead fish of that particular species were observed.

MDNR Comment 3:
This study did not attempt to quantify the total seasonal impacts of peaking and minimum flows on fish populations, especially river herring and American shad.

Exelon Response:
The total number of fish present in the tailrace or the exact number of a particular species is unknown, as fish move into and out of the tailrace for several reasons. No data were collected in any relicensing study that would allow an estimate of these fish populations. In addition, this type of analysis was not part of the FERC study plan determination.

MDNR Comment 4:

It should be noted that no data were collected during the winter months, a time when the Applicant is permitted to "no flow" for up to 6 hours twice per day. Recreational angler reports have indicated significant stranding of walleye during this time period (Sadzinski, MD DNR personal communication).

Exelon Response:
The surveys were conducted as stated in the FERC approved revised study plan Task 2- Conduct field studies to identify if and when fish stranding occurs. The approved study plan did not involve conducting winter surveys. Also, the survey area is extremely rugged and was difficult to survey during optimal weather conditions which would preclude survey teams from safely studying the area in winter.

MDNR Comment 5:
The report was very vague on when the last stranding event occurred prior to the search for fish. A longer delay likely leads to fewer observed fish stranded because of removals by birds, etc. The daily flow graphs were provided but when the study was conducted was not noted on these graphs.

Exelon Response:
The daily flow graphs will be modified to signify when the individual surveys were conducted.

MDNR Comment 6:
There was no discussion of habitat area versus stranding, although a map was provided that detailed the habitat types (Figure 2-1).

Exelon Response:
The main purpose of the study as outlined in the revised study plan was to document fish stranding and locations of where the stranding occurred. Areas of fish stranding and pools were marked using GPS coordinates.

MDNR Comment 7:
The impact to fish populations is not clearly presented. The 1% mortality noted on page 16 only quantitatively estimates the number, but in no way estimates the total impact to fish populations. In fact, on page 16 it is stated "Stranding of these abundant species provides abundant forage for numerous bald eagles and great blue herons when nesting and rearing young. Further, at least for carp, stranding leads to substantial spawning activity in many spillway reach pools." This statement contradicts itself because it implies that stranding which is lethal to many fish, is beneficial to one species because it increases spawning. The alternative hypothesis is not presented– fish will spawn in unsuitable habitat, under poor spawning conditions when no alternative is available to them.

Exelon Response:
Refer to Exelon response to MDNR Comment 3. The statement relating to carp spawning is not implying that stranding is beneficial to carp spawning, but rather noting that a large amount of carp spawning activity was observed during some of the survey periods.

MDNR Comment 8:
There was no historical perspective of stranding presented in the report, including records of fish kills due to stranding and or low oxygen levels since the dam began operation.

Exelon Response:
The occurrence of some fish kills was noted and described in the PAD. This item was not part of the FERC study plan determination.

PFBC 2011 Study Recommendations (see also MDNR and Nature Conservancy 2011 Study Recommendations):
Observational and mapping studies to determine potential for stranding of American shad and river herring due to rapid decrease in flow from the project and use of operational and/or structural modifications to mitigate impacts stranding.

This issue should be studied by a bathymetric survey, aerial or on-the-ground photography at various levels of low flows to locate such pools and determine at what flow levels they become isolated. Field observations of fish species and abundance in isolated pools would be conducted twice weekly during spring (14 surveys). This study would also suggest potential mitigating measures to prevent fish kills, such as operational modifications or structural modifications that would allow paths of egress for fish that would otherwise be trapped in pools.

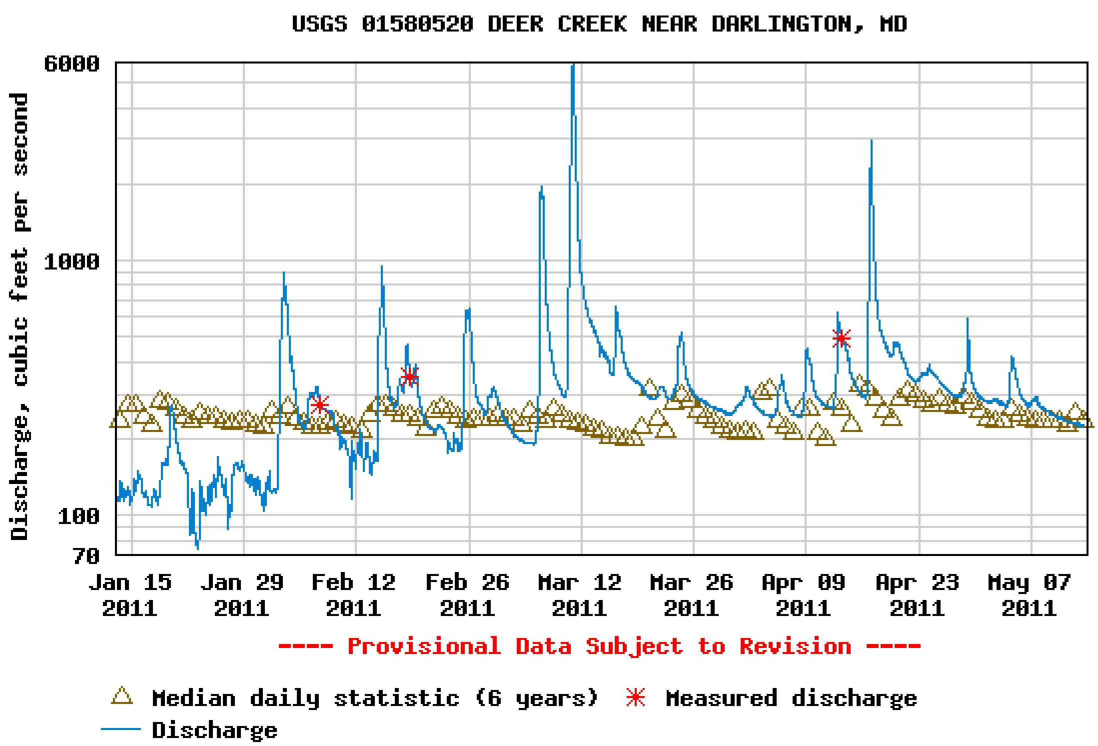
Exelon Response:
Exelon believes the spring, summer, and fall stranding studies conducted in 2010 were sufficient to determine the scope of project impacts on the stranding of American shad and river herring, as well as other species. In accordance with the FERC study plan determination, a total of 12 stranding surveys were conducted during the spring migration season, it is unclear what the additional surveys proposed would add in terms of new information. Exelon believes it would be more constructive to use the existing River2D hydraulic model, developed as part of Study 3.16 Instream Flow Habitat Assessment below Conowingo Dam, to delineate the area and locations dewatered under various minimum flow/generation flow combinations.

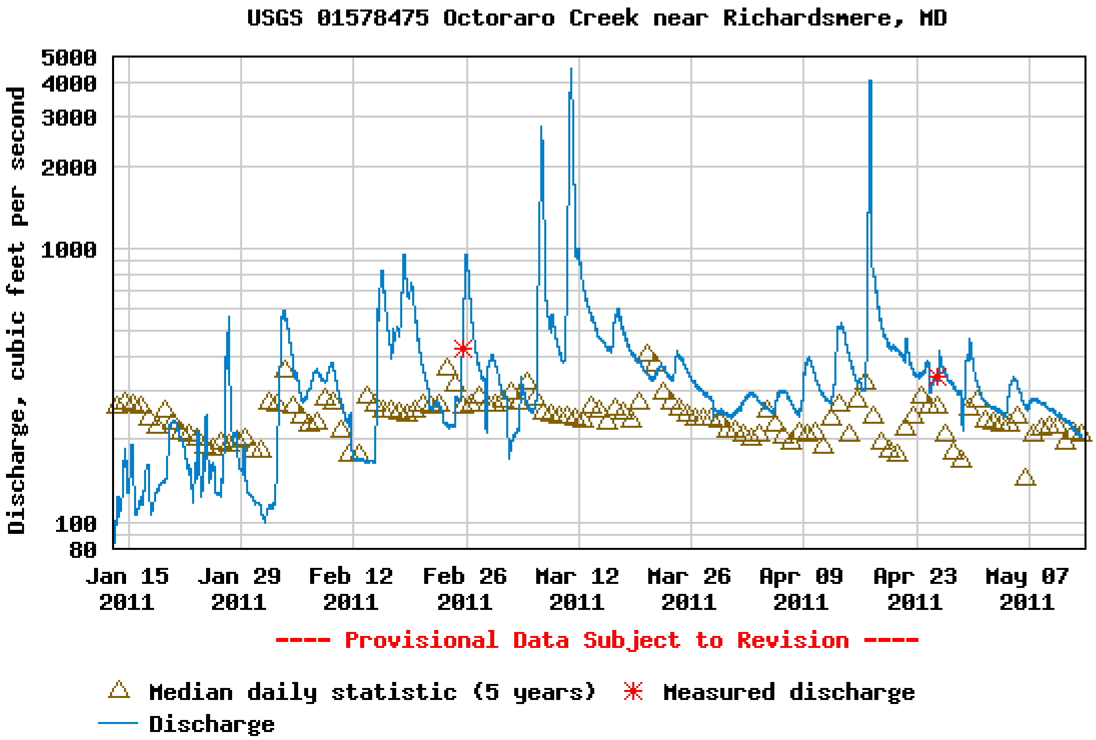
3.10 Maryland darter surveys

USFWS, MDNR, and PFBC submitted comments on the Maryland darter surveys (RSP 3.10) initial study report.

USFWS Comment 1:
"We request that the original sampling plan that included winter and early spring sampling for Maryland darter, by means of electrofishing and seining in the tributary streams, be completed in the coming year. Since Exelon's consultants did not conduct creek sampling in December 2010, January, 2011, March, 2011 and April, 2011, for varying reasons, an additional winter/early spring sampling effort in the study creeks should be conducted from December, 2011 through April, 2012."

Exelon Response:
The approved study plan stipulated the following: "Winter sampling, particularly in the river, will be flow and weather-dependent". Sampling in Deer and Octoraro creeks during winter by the combined electrofishing/seining technique was not possible due to ice in the streams (December-February) and high flows. However, sampling was conducted in the main river during January and February. Stream flows over much of the winter/spring period were unsafe and did not allow for the application of the electrofishing/seining technique. In both Deer and Octoraro creeks, effective use of the electrofishing/seining gear requires flows below 200 cfs, and preferably below 150 cfs. For most of January and February, and then constantly through mid May, flows in both streams were above 200 cfs with spikes up to 6,000 cfs (Deer Cr.) and up to nearly 5,000 cfs (Octoraro Cr.) (see streams flow history below). In 2011, sampling is scheduled to occur in the creeks via electrofishing/seining and snorkeling during the week beginning 22 May. Exelon believes the frequency and intensity of sampling conducted thus far is appropriate, and there is no need for additional sampling beyond that which has already been proposed in the approved study plan.





USFWS Comment 2:
"...Exelon should provide the Service all original sampling data from the 2009-2010 Maryland Darter survey effort, upon which its study was designed to build upon and supplement, so that the sufficiency of sampling dates and effort can be determined."

Exelon Response:
Exelon did not conduct any Maryland darter sampling prior to this survey (begun in October 2010). All data collected to date for Exelon were provided in the initial study report. USFWS may be referring to work supported by MDNR and USFWS. If available, those data will be included in the updated study report.

MDNR and PFBC Comment 1:
"It is interesting to note that the Susquehanna River sites of the Maryland darter surveys only produced a single species; the tessellated darter. However, in study 3.8 (Downstream Flow Ramping and Fish Stranding Study) three species of darters were found; the greenside darter; banded darter; and tessellated darter. The sites for the official darter survey were all downstream from Rowland Island while the stranding studies were conducted upstream and to the east of Rowland Island. This may suggest that the spill pool area is better darter habitat or that darters get stranded at higher rates than other species or that the sampling method chosen for the official darter survey was not effective enough to find the other darter species or perhaps there are habitat differences between the two study areas that are more or less preferable to darters."

Exelon Response:
That the Maryland darter survey produced one species during the winter (January) sampling in the lower river through use of only one gear type while three species were recorded in the summer/fall further upriver was not surprising. The issue is entirely gear related. Tessellated darters are more likely to be found in areas with softer (sand, silt) bottoms where the electrified benthic trawl is more effective. On

coarser substrates (e.g., uneven bedrock/boulder) where the other species are more likely to occur, the trawl can't fish as effectively right on the bottom. We anticipate the collection (or observation) of at least five darter species in the river when the combination of sampling techniques can be used. In previous work supported by MDNR, Dr. Richard Raesly has recorded five darter species in the river below the Deer Creek confluence. Access to reaches of the river near the mouths of the creek is anticipated for the spring-fall sampling periods. We will include the reach between the mouth of Octoraro Creek and Conowingo Dam if it can be accessed safely.

MDNR and PFBC Comment 2:
"The Chesapeake logperch, a rare species in Pennsylvania, was found at both the Deer Creek and Octoraro Creek sites but was not found at the Susquehanna River sites. Based on the example presented above regarding other darter species we suspect that a more intensive survey of the spill area would produce occurrences of the Chesapeake logperch."

Exelon Response:
For the same reasons explained in the response to MDNR Comment 2, we anticipate recording Chesapeake logperch in the river when the combination of planned gear types can be implemented in spring, summer, and fall 2011.

MDNR and PFBC Comment 3:
"Any darters that were vouchered during the stranding study should be re-checked to ensure their species identification is correct, with special attention paid towards possible misidentification of the Maryland darter and Chesapeake log perch."

Exelon Response:
No voucher collections were made, however the recognized expert with Maryland darter, Dr. Richard Raesly, Frostburg State University, is our lead Technical Expert and has participated in all sampling. Representative photographs will be taken during future sampling to demonstrate species identification accuracy.

3.11 Hydrologic Study of the Lower Susquehanna River

FERC and SRBC submitted comments on the Hydrologic Study of the Lower Susquehanna River (RSP 3.11) study summary.

FERC Comment 1:
"In table 2, you provided daily average low-flow statistics for US Geological Survey (USGS) gages at Marietta (No. 01578310) and Conowingo (No. 01576000). The results show that Conowingo tended to experience drier low-flow periods, although the drainage area of Conowingo is larger than that of Marietta. There is no explanation, however, for the low-flow analysis in the report. In the final study report, please provide a detailed explanation of the low-flow statistics for the Marietta and Conowingo gages."

Exelon Response:
The low-flow statistics are explained more fully in the initial study report (issued May 2011).

SRBC Comment 1:
"[Objective] 1) Describe the history of flow management practices in the lower Susquehanna River basin. This task is incomplete."

Exelon Response:
The initial study report, filed in May 2011, includes a flow management timeline and detailed list of major water users in the lower Susquehanna River.

SRBC Comment 2:
*"[**Objective] 2: Perform a statistical analysis to describe the lower Susquehanna River flow regime.** Objective 2 of the ISR Summary does not fully describe the Lower Susquehanna River Flow Regime. It only compares flow between the Marietta and Conowingo USGS gages; it does not include frequency distribution of 30-minute and daily flow levels, or fluctuations in seasonal flow."*

Exelon Response:
The initial study report submitted in May 2011 contains several statistics not shown in the study summary, including frequency distributions of 30-minute and daily flow levels. Additionally, monthly flow distribution curves and IHA-RVA analyses are shown in the initial study report, which both assess seasonal flow fluctuations.

SRBC Comment 3:
"[Objective] 3) Evaluate changes in Conowingo Project operations since a) minimum flow requirements were established (1989) and b) energy deregulation laws came into effect (1998). Only basic results are presented in the summary; a more detailed analysis of results will need to be performed upon completion of the task. The presentation of sub-daily data results is important and encouraging; however, Exelon also offers finding about annual flows and daily average metrics. SRBC staff cautions Exelon and FERC that any variations to the parameters can likely be attributed only to the varying flow patterns that were present on the Susquehanna River pre- and post-deregulation. The nature of the operation of the dam and the limited storage preclude significant alteration of daily average and annual flow characteristics."

Exelon Response:
Exelon"s initial study report (May 2011) contained more detailed analyses comparing pre and post-deregulation periods. While sub-daily flow comparisons are the best way to compare pre and post-deregulation operations, Exelon provided additional daily average and annual flow statistics in order to present a more thorough and complete context to the analysis.

The sub-objective comparing Project operations prior to and after the minimum flow requirement establishment was removed from the submitted ISR for two reasons. First, the sub-objective of comparing flow records pre and post-minimum flow was not specified in RSP 3.11. The RSP did state that the minimum flow establishment should be discussed in the flow timeline, which Exelon complied with. Secondly, the Conowingo USGS gage had no sub-daily flow data prior to 2/2/1988, providing less than one year of data on which to base pre-1989 minimum flow settlement statistics. Exelon determined that this was an inappropriate amount of data upon which to base flow comparisons, and was thus unable to assess flow regime changes following the implementation of minimum flow requirements. While a reasonable amount of daily flow data were available, a daily timestep would provide no insight to Conowingo‟s sub-daily peaking impacts or flow fluctuations.

SRBC Comment 4:
*"**[Objective] 4) Confirm the accuracy of the Conowingo USGS gage.** The effort presented in response to this task does not validate the accuracy of the Conowingo USGS gage. The project sponsor indicates that the dam was releasing (at peak times) approximately 40,000 cubic feet per second (cfs), but the USGS gage recorded values ranging from 31,800 cfs to 47,000 cfs. The downstream stage recorders were likely not capable of discerning the slight change in stage that would accompany small discharge variations in a mile-wide channel."*

Exelon Response:
As detailed in the initial study report (May 2011), Exelon assessed the gage accuracy and was not able to confirm that the gage was providing accurate flow observations. To the contrary, Exelon found that under certain flow conditions it appeared that the USGS gage may be reporting a substantial flow error. Investigations indicated that there may be individual turbines influencing the gage readings. This seems likely, as the gage is located on the downstream face of the dam immediately next to where one of the turbines discharges.

SRBC Comment 5:
*"**[Objective] 5) Develop a bathymetric map of the tailwater area below Conowingo Dam.** The map presented in the summary depicts water depth at a flow of 86,000 cfs, or full generation. More useful would be a contour map of the river bottom, or water depths depicted at seasonal minimum release flows."*

Exelon Response:
A contour map of the riverbed was created, but because of the study reach‟s irregular riverbed it was difficult to interpret. Thus, Exelon provided a map of the river bottom in the form of a thermal (colored) plot in the initial study report (May 2011).

SRBC Comment 6:
"[Objective] 6) Conduct operations modeling production runs to evaluate various operation scenarios to understand how operation changes may impact water use in the Lower Susquehanna River. As stated on page 12 of the February 4, 2010, letter from FERC to Exelon, the project sponsor was to provide a comprehensive list of operation alternatives so that potential benefits to downstream reaches of operation could be evaluated. This comprehensive list of operation alternatives was not provided in the ISR Summary, although the model was characterized as undergoing final enhancements."

Exelon Response:
The initial study report submitted in May 2011 to FERC did not contain any operations modeling production runs, though a brief model description was submitted. Exelon will submit to the stakeholders a separate stand alone reports describing the details of the operations model. The report(s) will describe

model methodology, model calibration, and a “baseline” model production run. Exelon will consult with stakeholders in designing additional model production runs based on alternative operation schemes proposed.

3.13 - Study to Assess Tributary Access in Conowingo Pond

MDNR submitted comments on the Study to Assess Tributary Access in Conowingo Pond (RSP 3.13) initial study report. These comments were endorsed by US Fish & Wildlife and partially endorsed by PA Fish and Boat Commission.

MDNR Comment 1:
"Impediments to boat access appear to be well identified as specified in the first goal of the study. However, Goal #2 is limited to a general discussion of some previous studies which were focused on anadromous species and may not fully consider use by other species. There is no discussion of Goal #3, mitigation."

Exelon Response:
Use of Conowingo tributaries by other species (other than anadromous species) was addressed in section 3.3 of the initial study report. A discussion on mitigation was not included because there is no need for mitigation at the pond elevations commonly encountered (elv.107.2-109.2 NGVD) by recreational boaters during the peak recreational periods. Potential enhancements for recreational access will be addressed in the Recreation Management Plan.

MDNR Comment 2:
The Applicant should determine if restricted access is due to permanent features such as bedrock or riffles or if channels and ramp approaches are restricted due to excessive sedimentation. Unconsolidated sediments could be mitigated through dredging.

Exelon Response:
The shoaling observed at ramp approaches in Peters Creek, Conowingo Creek and Muddy Creek is primarily due to excessive sedimentation. Refer to Conowingo RSP 3.26.

3.14 Debris Management Study

MDNR submitted comments on the Debris Management Study (RSP 3.14) initial study report.

MDNR Comment 1:
The Applicant's RSP stated that one purpose of this study was to "analyze hydrologic conditions that initiate debris management actions". We supported this proposed analysis in order to illustrate typical river flow "triggers" that transport a significant quantity of debris to the Project and initiate debris management actions. However, the Applicant's study failed to address this. In their study report, the Applicant simply plotted the average monthly flow versus the annual quantity of debris (see Figure 4.3-1) and concluded that the figure "suggests the lack of obvious trends from the limited data available". The methodology utilized in this study does not provide any useful information regarding hydrologic conditions that initiate debris management actions.

Exelon Response:
The limiting factors in the debris study analysis are data availability and quality, not methodology. The first step in analyzing hydrologic conditions initiating debris management actions is to compare hydrologic data of the Susquehanna River with quantities of debris removal. This was accomplished by plotting quantities of debris collected at Conowingo Dam versus average monthly flows of the river measured at USGS gage No. 01576000 (Susquehanna River at Marietta, PA). Figure 4.3-1 in the initial study report depicts these data. Available quantitative data of debris collected from all four hydroelectric facilities of the lower Susquehanna River are provided in the initial study report and are limited. York Haven Hydro Station reported a 1985 estimate of 5,000 cubic yards of debris entering the headrace on an annual basis and a current estimate of debris removal of up to 25 cubic yards per year (letter dated October 9, 2010; Appendix B). Safe Harbor Water Power Corporation provided annual quantities of removal at Safe Harbor Dam (letter dated August 11, 2010; Appendix B). These data are given in Table 4.4.2.2-1 of the initial study report. PPL Holtwood, LLC reported 100 to 150 tons of wood debris annually removed at Holtwood Dam (letter dated November 8, 2010; Appendix B). Current data available directly from Conowingo Dam is reported in Table 4.2-2 (2006-2009) on an annual basis. Additionally, data of annual removal quantities for 1989 through 1998, as provided in a letter to FERC from the Project dated March 24, 1999, are reported in Table 4.2-1. Available data are recorded as annual totals and therefore cannot be correlated with monthly river flow. However, it is still possible that a large-scale megascopic correspondence of annual removal quantities with river flow might be evident in the data. A review of the data found that this was not the case. Therefore, as stated in the initial study report, the data in Figure 4.3-1 "suggests the lack of obvious trends from the limited data available."

Also, an editorial note, after reviewing Table 4.2-2 and Figure 4.3-1 Exelon realized the dumpster load calculations in the Table are incorrect. They should be as follows from 2006 through 2010 (1590, 2130, 1380, 2640, 1170) and the asterisk under the table should read: Each dumpster load is approximately 30 cy, each skimmer load is approximately 12 cy. These corrections will be made in the updated study report.

MDNR Comment 2:
The Applicant's RSP stated that a purpose of this study was to "identify and evaluate potential improvements". In addition, under Task 2: Debris Management Assessment of the RSP, the Applicant states: "Current debris management practices will be evaluated" and "debris management practices at other hydroelectric facilities......will be evaluated." However, it does not appear the study report has evaluated any other potential improvements. The Applicant's study report discusses: 1) current and historical debris management practices at the Project, 2) current debris management practices at the three upstream impoundments, and 3) debris management practices at select FERC relicensing projects. According to the study report, the Applicant currently utilizes two gantry cranes with grapple attachments

to remove debris from the intakes, as well as floating surficial debris from in front of the dam. Previously the Applicant has used a self-propelled skimmer barge to capture floating debris; however, the device was retired in 2008. The study report also identifies several debris management practices being utilized at the other facilities; such as trash rakes, collection efforts in the impoundment, skimmer walls and mechanical skimmer boats. However, the Applicant did not evaluate whether or not these current practices could improve debris management at the Project, they only reported them.

Exelon Response:
The RSP states study purposes are to "review debris management practices to ensure they are consistent with best management practices" and "if not consistent with best management practices, assess need for additional practices to reduce impacts to Pond and downstream users." To establish best management practices for debris removal at similar facilities, Exelon requested information on debris management practices employed at the three upstream hydroelectric facilities (York Haven, Safe Harbor, and Holtwood) from the facility operators. Responses to Exelon"s request for information will be provided in Appendix B of the initial study report and summarized in the main text of the report in Section 4.4.

When available, debris management practices for FERC projects are readily accessible and represent current practices. Therefore, Exelon also reviewed debris management practices reported at projects that recently underwent FERC relicensing. To be relevant to the Conowingo Project, projects in the mid-Atlantic region of the country were examined (Claytor Lake Hydroelectric Project and Smith Mountain Hydroelectric Project, both in Virginia). In addition, the FERC filing of the Smith Mountain Project reported on the findings of a survey of facility operators and debris management plans filed with FERC. The debris management practices implemented at these facilities are also summarized in Section 4.4.

The review of the debris management practices of the three upstream facilities and other recent FERC relicensing projects indicates that the practices implemented at Conowingo Dam (described in Section 4.4) are similar to, and consistent with, the typical best management practices of other hydroelectric facilities. Exelon fulfilled the purpose stated above of reviewing debris management practices to ensure they are consistent with best management practices. Since Conowingo Dam practices are consistent with other facilities, it was not necessary to assess the need for additional practices.

3.15 Sediment Introduction and Transport (Sediment and Nutrient Loading)

FERC, SRBC and the Riverkeeper submitted comments on the Sediment Introduction and Transport (RSP 3.15) study summary.

FERC Comment 1:
A HEC-6 model was employed to calculate water surface and sediment bed surface profiles by computing the interaction between sediment material in the streambed and the flowing water-sediment mixture. The HEC-6 model was simulated to support the record of suspended sediment grain sizes transported past Conowingo dam and deposited in the upper Chesapeake Bay during four major storm events. In the report, however, there is no explanation for initial and boundary conditions and model parameters of the HEC-6 model. In the final study report, please provide a detailed description of this information and its calibration.

Exelon Response:
The HEC-6 model was developed and calibrated by the USGS (Hainly et al 1995)[1]. The model was hydraulically calibrated by the USGS for 1987 (calendar year) flows and closely replicated the high water profile of the 1972 Tropical Storm Agnes. Sediment transport was calibrated to estimates of monthly and annual inflows and outflows of sediment loads for calendar years 1987-89.

Inflow and outflow loads and the reservoir trap efficiencies for the calibration period were computed. According to the USGS, the model initially appeared to under-predict reservoir traps efficiencies for 1987 when compared to other models (Cohn et al 1989)[2] and empirical concentration and flow data. The USGS subsequently revised the model by having more coarse sediment enter the system. The available output data of the revised model for the three reservoir system as a whole, for the calibration year of 1987 and verification years of 1988 and 1989, is provided in Table 3.3.2.6-1 of the initial study report. Overall, the calibration data are limited, and were not available from the USGS.

The above information is described in the initial study report issued in May 2011. Exelon will also provide the HEC-6 model input data that was received from USGS in the updated study report.

[1] Hainly, R.A., L.A. Reed, H.N. Flippo, Jr., and G.J. Barton, 1995. Deposition and Simulation of Sediment Transport in the Lower Susquehanna River Reservoir System. United States Geological Survey Water-Resources Investigations Report 95-4122. 39p.

[2] Cohn, T.A., L.L. Delong, E.J. Gilroy, R.M. Hirsch, and O.K. Wells. 1989. Estimating constituent loads. Water Resources Research. 25(5):937-942.

3.18 Characterization of Downstream Aquatic Communities

MDNR and PAFBC submitted comments on the Characterization of Downstream Aquatic Communities (RSP 3.18) initial study report.

MDNR Comment 1:
The study only reviewed the percent contribution of the dominant taxa to the total. An analysis of this sort will not capture a total decline in the population, if the rates of decline in the dominant taxa are similar to each other. An additional summary of the total abundance patterns and abundances of the dominant taxa would address this concern.

Exelon Response:
A summary of the total abundance patterns and the abundances of the dominant taxa is possible for the years 1982 – 1984, where standing crop data are readily available. This information will be included in the updated study report.

MDNR Comment 2:
The applicants' treatment of the characterization of the current aquatic community below Conowingo Dam was incomplete. A summary and interpretation of abundance patterns observed during the early years of the dam operating under minimum flow requirements would have added a great deal to the characterization. A current survey of macroinvertebrates below the dam would provide vital information as to the current status of the benthic community and could be used to examine the achievement of the current flow regime requirement since its establishment in the 1980's and 1990's; this data is a least twenty years old. Changes in flow ramping, fish assemblage and water quality all likely have affected species diversity and abundance below Conowingo Dam. Since there have been significant changes in these factors, the present state of macroinvertebrates is unknown.

Exelon Response:
The FERC Study Plan Determination required Exelon to utilize existing empirical data to characterize macroinvertebrate and resident fish populations below Conowingo Dam, including assessments of reproduction, growth, and behavior. Exelon believes the data and analysis contained in the initial study report accomplish this objective. The initial study report provides an accurate list of taxa that are currently present below Conowingo Dam, as well as historical trends in taxa composition. In addition, Study 3.16-Instream Flow Habitat Assessment below Conowingo Dam analyzes the available habitat over a range of Project flows for several additional taxa identified by resource agencies. Any additional study, such as analysis of abundance patterns observed after the initiation of the current minimum flow regime, would do little to inform the development of new license conditions.

MDNR Comment 3:
It should be noted that the EFL and West Fish Lift (WFL) likely do not catch fish in relative abundance to the tailrace, especially the resident species (as noted on page 10-2). In addition, river herring and hickory shad are present in significant numbers below Conowingo Dam and are rarely caught in the lifts, which is likely due to exclusion due to high attraction flow coming through the lifts.

Exelon Response:
Some gear bias and selectivity is inherent for each of the gear types used in the analysis. It is not stated in the text that the catch of fish at the EFL and WFL are in relative abundance to the tailrace but rather the fish lift catches provide a "*baseline indicator of the dominant species in the lower Susquehanna River*. The „baseline" fish lift catches are bolstered by the additional studies utilizing other gear types (electrofishing, gill nets, ichthyoplankton, fish stranding). As stated in the introduction, (page 22) "*These*

data augment the fish lift collections in providing a more detailed spatially and temporally diverse characterization of the downstream fish populations in regards to species assemblage, condition, and habitat use. These studies included electrofishing, gillnet and ichthyoplankton sampling efforts from Conowingo Dam to the tidal zone just below Spencer Island."

MDNR Comment 4:
There was no mention of gear selectivity and efficiency of one gear type or survey versus another (see Table E-17). In addition, on page 10-2 killifish were abundant below Conowingo Dam but never caught in the lifts.

Exelon Response:
Some discussion about differences in gear types and relative effectiveness will be added, although gear targets are fairly obvious- ichthyoplankton young fish, gill nets (larger fish), electrofishing (larger and smaller fish). The purpose of including the additional studies is the potential provision of accounting for species that would otherwise not be noted by the fish lifts such as a killifish.

MDNR Comment 5:
Evaluate total abundance patterns and abundances of the dominant taxa.

Exelon Response:
Exploration of abundance patterns in the context of CPUE (i.e. normalized abundance) exists within the in the initial study report. For example, the following section is from the East Fish Lift section (page 55-56):

In all years combined (1991 to 2009), gizzard shad account for 86% of all fish collected (Table 5.3.2-2). In 1992, 2,351,351 gizzard shad were collected, the most of any species in any year (Table 5.3.2-2). In 1992, the highest CPUE for gizzard shad also occurred (3,925 fish per lift, Table 5.3.2-2). Routinely, American shad were the second most frequently collected species at the EFL. From 1991 to 2009 American shad comprised 7% of the overall catch per lift (Table 5.3.2-2). The proportional abundance of American shad CPUE at the fish lift ranged from 31% in 2000 to less than 1% in 1992 (Table 5.3.2-2). In 2001 the highest CPUE of American shad occurred (346 fish per lift, Table 5.3.2-2) and the lowest CPUE of American shad occurred in 1993 (10 fish per lift, Table 5.3.2-2). From 1991 to 2009, blueback herring comprised 4% of the overall CPUE at the EFL (Table 5.3.2-2). In 1997, 1999 and 2001 significant catches of blueback herring were made. In 2001, 510 herring per lift were collected (Table 5.3.2-2), the highest amount in any year and the second most proportionally abundant species that year after gizzard shad.

MDNR Comment 6:
Provide a summary and interpretation of abundance patterns observed during the early years of the dam operating under minimum flow requirements.

Exelon Response:
See Exelon Response to MDNR Comment 2.

MDNR Comment 7:
Conduct a current survey of macroinvertebrates and fish below the dam to indicate the current status of these populations since minimum flows were implemented in the late 1980's. FERC indicated they "may recommend field work in 2011 if the final literature-based study report does not provide enough information on the aquatic community to evaluate operational changes to the project". We believe that the historical data presented, which is over 20 years old, has not accurately indicated the current status

of macroinvertebrate and fish populations below the dam and the operational changes that have occurred since those surveys were conducted. See our study plan request for details.

Exelon Response:

The FERC Study Plan Determination required Exelon to utilize existing empirical data to characterize macroinvertebrate and resident fish populations below Conowingo Dam, including assessments of reproduction, growth, and behavior. Exelon believes the data and analysis contained in the initial study report accomplish this objective. The initial study report provides an accurate list of taxa that are currently present below Conowingo Dam, as well as historical trends in taxa composition. In addition, Study 3.16-Instream Flow Habitat Assessment below Conowingo Dam analyzes the available habitat over a range Project flows for several additional taxa identified by resource agencies. Any additional study, such as analysis of abundance patterns observed after the initiation of the current minimum flow regime, would do little to inform the development of new license conditions.

PFBC Comment 1:

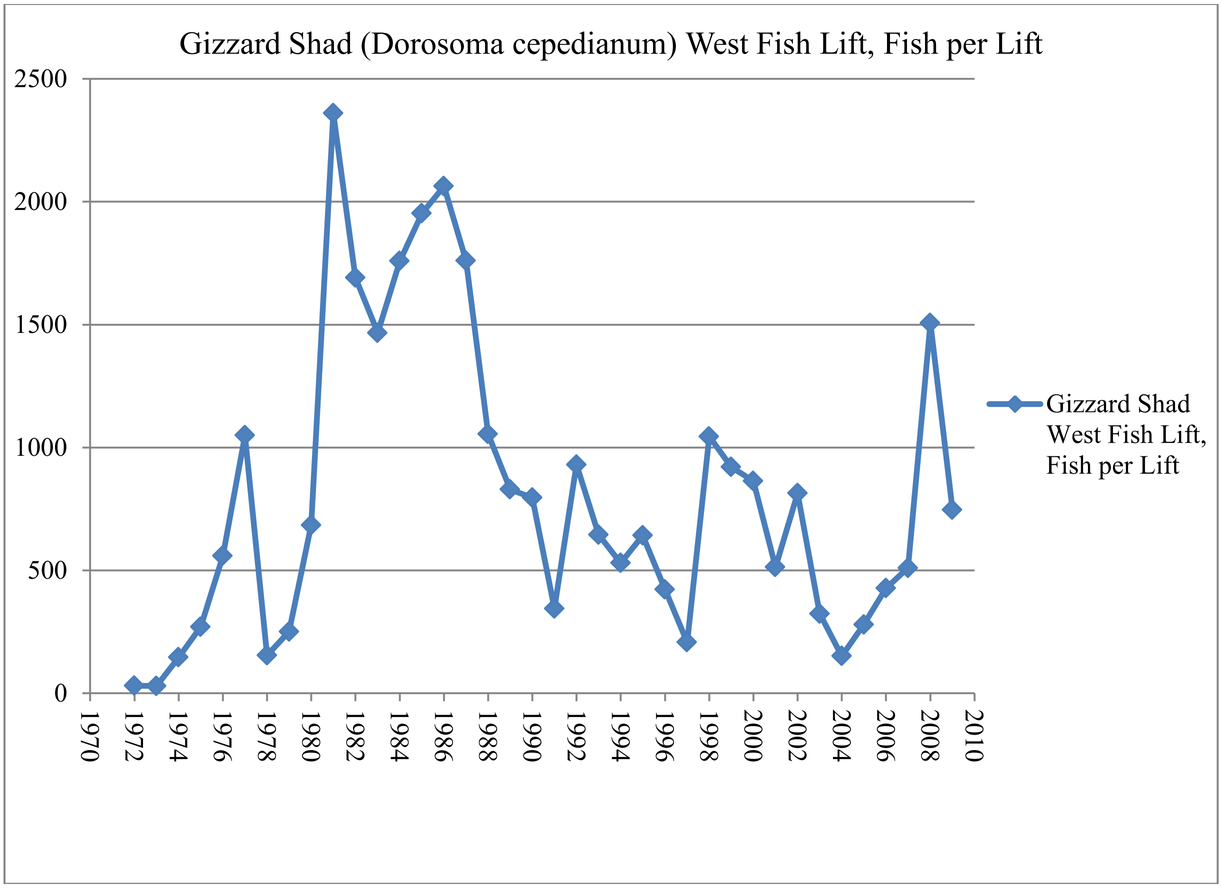
Page vi: "Smallmouth bass age and growth below Conowingo Dam were evaluated over a 4-year period from 1980 to 1983 (RMC 1985a). Mean fork length data depict a typical growth pattern. Based on mean FL attained by Age 4 (366 mm), most smallmouth bass were recruited to the harvestable population below Conowingo Dam (~305 mm TL) during their 4th year of life. Growth of smallmouth bass below Conowingo Dam was similar to or greater than that reported for several waters in PA and MD (RMC 1985a)." These data were collected in 1980 to 1983, before the explosion in gizzard shad abundance. More recent data is needed to evaluate smallmouth bass age and growth after the explosion in gizzard shad.

Exelon Response:

It‟s apparent from the data that a gizzard shad population spike occurred in the mid-70‟s. When the smallmouth bass collections for age and growth occurred, peak gizzard shad CPUEs were collected at the WFL, indicative that high gizzard shad population growth had and was occurring (i.e. samples not collected before but rather during the referenced explosion). In the executive summary (page3): "*Gizzard shad became the dominant species in 1977 and retained its dominance over the next three decades*."

Smallmouth bass exhibited a similar length weight for fish sampled in 2010 to those in the early 80‟s (Section 9, slope of length weight relationship is approximately 3% less than 80‟s collections). The similarity in length and weight relationship suggests continuity in the age and growth relationship of smallmouth bass between the two time periods.

Species	No.	CPUE	%	Rank
1972	24,849	30	10%	4
1973	45,668	30	4%	5
1974	119,672	146	7%	3
1975	139,222	271	15%	2
1976	382,275	559	33%	2
1977	742,056	1,050	63%	1
1978	55,104	154	20%	2
1979	75,553	251	38%	1
1980	275,736	684	74%	1
1981	1,156,662	2,361	85%	1
1982	1,226,374	1,692	61%	1
1983	950,252	1,466	92.4%	1



PFBC Comment 2:
Page viii: "Although several species have increased or declined in abundance, the fish species assemblage has remained moderately rich below Conowingo Dam with the same core group of species as was observed in the 1980's, and it is therefore inferred that diverse trophic interactions are supported." Such an inference is conjecture, not supported by data. The term "moderately rich" is not defined.

Exelon Response:
The data supports a finding of (pg 140) "A core assemblage consisting of gizzard shad, white perch, common carp, quillback, comely shiner, channel catfish, walleye, smallmouth and largemouth bass along with seasonal migrants like American shad, blueback herring, alewife, sea lamprey and striped bass form the primary group of inhabitants."… (pg 139) "The species assemblage of both the EFL and WFL catches, dominated by gizzard shad, channel catfish, common carp, and white perch, were similar to those observed in electrofishing, gill net, and ichthyoplankton sampling conducted below Conwowingo Dam during the 1980‟s" and establishes a nexus between the current fish lift catches and the special studies completed in the 80‟s. The dominant species were the same in all studies in the 80‟s and continue to dominate the catch in the fish lift today.

Section 7 analyzes the connection between the macro invertebrate community and the fish population (i.e. diverse trophic interaction). Although „inference‟ may be an inappropriate word, data in Section 7.1 "Fish Food Habits Below Conowingo Dam" provides evidence that diverse tropic interactions are supported. For example (page 119):

"The benthic invertebrate studies summarized in Section 4 noted which autochthonous food items (organisms originating from the sample locations) appeared most often in stomachs of some of the resident fishes below Conowingo Dam. Detailed stomach analyses of individual white perch, channel catfish and yellow perch taken by electrofishing in the tailrace below Conowingo Dam July through December 1982 and 1983 were reported by Weisberg and Janicki (1985). Small zooplankters were abundant in white perch stomachs, but caddisfly larva (Cheumatopsyche) and chironomid larva were more important on a frequency basis, with caddis larvae most important based on percent of the biomass eaten. Chironomids were most important to channel catfish numerically and on a frequency basis. However, similar to white perch, caddis larva formed most of the diet biomass. The amphipod Gammarus was the most important food of yellow perch."

As part of an Indicators of Biotic Integrity (IBI) under development by a consortium of agencies and Penn State University[3], rivers with >25 species were denoted to have „excellent‟ IBI for a large stream (i.e. > 20M). Species richness documented at the fish lifts is a good baseline indicator of the available taxa in the lower Susquehanna River. Moderately rich is an appropriate term for fish lift catches that average 40 taxa (West) and 33 taxa (East) per year relative to other rivers in PA (based on the categorization of <25 species as excellent).

As part of an IBI developed in MD[4], the calculated, „expected‟ value for the area near Conowingo would be 32 native species based on the watershed size.

*expected value species richness = m * log(watershed area in acres) + b.*
where m (slope) = 5.5701 (Eastern Piedmont)
watershed area in 17,600,000 acres (log watershed = 7.245513)
b (intercept)= -8.1135
*5.5701*7.245513+-8.1135= 32.2447301109916*

The species richness adjusted value from the IBI = observed value/expected value; in 100% of years at the East fish lift the score would be > 1.02, giving the area the highest rank of „5‟. Though, the IBI uses native species only for accounting species richness value, 36 of the species that have been collected at the fish lift are native to the lower Susquehanna[5]; accounting for only native fishes excludes many of the common game fish: largemouth & smallmouth bass, walleye, channel catfish, bluegill, pumpkinseed, etc.

By the metrics produced by PA & MD for their respective IBIs, the species richness at Susquehanna could reasonably be labeled „moderately rich‟.

[3] http://www.fish.state.pa.us/anglerboater/2010ab/vol79num4_julaug/05assess.pdf
[4] Roth, N. E., & Maryland. (2000). Refinement and validation of a fish index of biotic integrity for Maryland streams. Annapolis, Md: The Dept.
[5] (Native species list: SUSQUEHANNA RIVER MANAGEMENT PLAN Pennsylvania Fish and Boat Commission, Bureau of Fisheries, Division of Fisheries Management, 1601 Elmerton Avenue, P.O. Box 67000, Harrisburg, PA 17106-7000;
http://www.fishandboat.com/water/rivers/susquehanna/susq_plan_2011_draft.pdf) and
http://www.srbc.net/stateofsusq/documents/MDFishConservationFeatureArticle.PDF

PFBC Comment 3:
A number of figures suggest that there have been changes in the fish community since the original studies in the 1980's:

o White perch CPUE in the west fish lift is down (Figure A-15).

o Channel catfish CPUE in the west fish lift is down (Figure A-17).

o Shorthead redhorse CPUE in the west fish lift is down (Figure A-18).

o Species richness in the east fish lift is down (Figure B-2).

o Smallmouth bass CPUE in the east fish lift is down (Figure B-19).

o Channel catfish CPUE in the west fish lift is down (Figure A-17).

Exelon Response:
(From pg 139) *"Changes to the fish species assemblage were evident over the period studied"*
Some species have shown an increase in abundance (American Shad, smallmouth bass and walleye at west fish lift). The conclusion offers (pg 140) that "several species have increased or declined in abundance". Throughout the results related to each gear type (particularly the fish lifts) fluctuations in the catches of individual species are discussed.

For example (pg 53)
From 1991 to 2009, blueback herring comprised 4% of the overall CPUE at the EFL (Table 5.3.2-2). In 1997, 1999 and 2001 significant catches of blueback herring were made. In 2001, 510 herring per lift were collected (Table 5.3.2-2), the highest amount in any year and the second most proportionally abundant species that year after gizzard shad. Very few blueback herring have been collected since 2001 with none taken in 2006. Populations of blueback herring have been declining in the northeast due to a number of potential causes including habitat loss, targeted or by catch at sea via commercial fishing and increased numbers of striped bass and other types of predators (ASMFC 2009).

The information in the initial study report indicates that the available data is sufficient to provide an accurate representation of the species assemblage below Conowingo Dam.

PFBC Comment 4:
In order to truly characterize the conditions at this facility, more contemporary studies are the invertebrate communities are a necessity.

Exelon Response:
See Exelon response to MDNR Comment 7.

PFBC Comment 5:
No information more recent than the 1980s was provided on the year class abundance and reproduction success of resident fishes.

Exelon Response:
Several comparisons within the initial study report were provided between the studies of the 1980"s and the most recent fish community data. Ichthyoplankton sampling (now scheduled for 2012) will provide additional data to describe reproduction success of resident fishes.

PFBC Comment 6:
Condition factors were only presented for fish collected at the west fish lift in 2010 (Table 9.2-1). No comparison of condition factors was reported for any of the fish collections made dating back to the 1980s.

Exelon Response:
Original data do not exist (pg 78) "Because the studies were terminated following the settlement agreement, most collected data were only tabulated, processed electronically and stored on PECO"s mainframe system; these data were not analyzed or formally presented in any reports. The biological data stored on electronic media were subsequently lost." Without the original data, the requested comparisons cannot be made. Data presented in the initial study report are drawn from three progress reports and other available hard-copy data stored by Normandeau.

PFBC Comment 7:
Length weight data for 2010 was obtained from the West Fish Lift of adult fish headed upstream on spring spawning runs. Length weight data was not obtained from the 2010 summer stranded fish surveys. It is unclear during what time of year or location the fish length and weight data were obtained for the fish reported in Table 9.1-2 that were collected in the 1980s. Collecting length and weight data only from adult fish in spawning condition skews the relationship upward and may portray fish as being in better condition than actual. Length and weight data from various sizes for fish collected during a cross section of the seasons will produce a more accurate representation of fish health and condition.

Exelon Response:
Data from 1980s represent a combination of fish measured and weighed at the West Fish Lift augmented with fish taken by gill net and electrofishing at various locations in the river at all times of the year. The data do not include alewife, blueback herring or American shad, since they do not rear in the river. The intent of the length-weight regression analysis was to compare the fish from the 2010 West Fish Lift catch to historical data.

PFBC Comment 8:
Much of the data presented for this study relies on data collected from the West Fish Lift. These data need to be considered in the context of how and why the West Fish Lift was operated. It was designed to catch American shad, which are strong swimmers and can navigate higher flow velocities than many resident fishes. Also, it was operated almost exclusively only during the 6-8 week spring shad run. While resident species are collected in the WFL as evidenced by the data tables, it should not be viewed as an equal opportunity fish collecting/representative sampling device. On the contrary, smaller individuals of many resident species such as minnows, darters and many species that are not strong swimmers or don't make strong upstream movements are either under represented or not represented at all in the WFL samples. Sampling is biased towards fish that move upstream in the spring and adults and larger individuals of most species that are represented.

Exelon Response:
The „baseline" fish lift catches are bolstered by the additional studies (electrofishing, gill nets, ichthyoplankton, fish stranding) as the study states in the introduction (page 22) "*These data augment the fish lift collections in providing a more detailed spatially and temporally diverse characterization of the downstream fish populations in regards to species assemblage, condition, and habitat use. These studies included electrofishing, gillnet and ichthyoplankton sampling efforts from Conowingo Dam to the tidal zone just below Spencer Island."*

PFBC Comment 9:
Data from a reference reach above dams in the Susquehanna River is needed to compare benthic fauna.

Exelon Response:
FERC considered a similar request previously; the study plan approved by FERC does not require the comparison of the downstream aquatic community to a similar community elsewhere (i.e., a reference location). This renewed request is unlikely to add any new information that could be used for adopting reasonable PME measures. Also, see Exelon Response to MDNR Comment 7.

PFBC Comment 10:
It is common practice in environmental studies to calculate bio-assessment indices including: species richness, species evenness, Shannon's Diversity Index, Simpson's Diversity index, Berger-Parker index, Plafkin's EPT index, modified Hilsenhoff biotic index, percent dominant taxa, percent modified mayflies, family biotic index, EPT to Chironomid ratio, ratio of scraper and filtering collector functional feeding groups, percent Chironomidae, percent Tubificidae, etc. While species richness was calculated for fish collections, no other indices were calculated.

Exelon Response:
A total of three indices were either calculated or are readily discernable from the report tables. They are Richness Community, Population Density, and Percent Contribution of the Dominant Taxon. At the onset of Exelon"s review, it considered a metric analysis but opted against one. While spatial and inter-year metric comparisons can be calculated from this quantitative data set, these comparisons would not lend themselves to an accurate depiction of the community because the raw numbers for many of the rare and uncommon taxa were not available. We also considered condensing the data into an IBI determination similar to that currently in-use by MDNR for its Maryland Biological Stream Survey (MBSS). That protocol, however, is designed to address biotic integrity from much smaller first, second, and third, order streams and was not applicable. As a result of these limitations, Exelon adopted a descriptive approach that focused on the behavioral and ecological characteristics of most common taxa resident below the dam. Exelon believes its analysis is sufficient to meet the objective contained in the FERC Study Plan Determination, which was to characterize the macroinvertebrate and resident fish populations below Conowingo Dam.

PFBC Comment 11:
Length frequency tables should be provided for this fish used in the length weight relationship calculations. This will allow reviewers to evaluate whether only larger representatives for each species were included in the analyses which would tend to skew the relationships upward.

Exelon Response:
Exelon will provide length frequency tables in the updated study report.

PFBC Comment 12:
The table on length/weight relationships need to indicate by year, time of year and gear method when the data were collected.

Exelon Response:
See Exelon response to PFBC Comment 6.

PFBC Comment 13:

The report needs an opinion or rationale for the fact that many more taxa of fish than invertebrates were found during the field collections. In most warm water riverine systems the number of invertebrate taxa typically exceeds the number of fish taxa.

Exelon Response:
The characterization recorded 71 invertebrate genera identified (a 10-year time frame). When taken to the genus/species taxonomic endpoint, the count increases to 115. Were it possible to identify all individuals fully to the species level the total would be higher. From 1972 to 2009 (38 years of study) the West Fish Lift produced 72 taxa (species and hybrids) of fish from inspection of over 31.5 million individuals. As expected, there are more invertebrate species present below the dam than there are fish species. Exelon"s analysis meets the objective contained in the FERC Study Plan Determination, which required a characterization of the macroinvertebrate and resident fish populations below Conowingo Dam.

3.19 Freshwater Mussel Characterization Study

Introduction
The magnitude of the comments received is such that Exelon has provided both a generalized response as well as a point-by-point response to comments and questions raised by the reviewers (see Attachment C). FERC, American Rivers, the USFWS and MDNR submitted comments on Conowingo Study 3.19 Freshwater Mussel Characterization Study below Conowingo Dam (Conowingo 3.19).

Overview of Comments:
The comments fell into four general categories, which concerned: 1) Study Objectives (USFWS); 2) Field and Data Analysis Methods (MDNR, USFWS); 3) RSP-Specified Deliverables (MDNR) and 4) Study Conclusions (American Rivers, FERC, MDNR, USFWS).

Background:
Exelon‟s 2010 mussel survey was one of several mussel surveys that have been conducted on the lower Susquehanna River in recent years. In 2008, 2009 and 2010, the Maryland Department of Natural Resources Natural Heritage Program (Natural Heritage) sponsored semi-quantitative and quantitative mussel surveys in the lower Susquehanna River below Conowingo Dam (Ashton and Devers, unpublished data). The data was summarized in the March edition of *Ellipsaria*, reporting live and dead mussel species believed to potentially exist in the lower Susquehanna River below Conowingo Dam. Thus, several datasets exist that, when combined, may provide a diverse assessment of the lower Susquehanna River mussel community.

In Conowingo 3.19 stakeholder study comments, comparisons were made between the data collected for Conowingo 3.19, Ashton and Devers (unpublished data) and other unpublished study results. To consolidate study results, Table 1 presents the Conowingo 3.19 study results next to the Ashton and Devers (unpublished data) study results. The only difference in species composition is the 2010 Natural Heritage survey tentatively identified dead (spent) northern lance (*Elliptio fisheriana*) shells (one pair of valves). Otherwise, the species composition is identical between the Conowingo 3.19 study and the Natural Heritage surveys.

Table 1. Freshwater mussels potentially occurring in the Susquehanna River below Conowingo Dam, Maryland and recent accounts of their presence or absence. This table is adapted from Ashton and Devers (unpublished data), with addition of Exelon's mussel characterization study data and mussel common names.

Common Name	Species	Exelon 2010	MDNR's Natural Heritage Program 2008	2009	2010
triangle floater	*Alasmidonta undulata*	N[1]	N	N	N
brook floater	*Alasmidonta varicosa*	N	N	N	N
alewife floater	*Anodonta implicata*	L[2], D[3]	L, D	L, D	L, D
eastern elliptio	*Elliptio complanata*	L, D	L, D	L, D	L, D
northern lance	*Elliptio fisheriana*	N	N	N	D
yellow lampmussel	*Lampsilis cariosa*	L, D	N	N	L, D
eastern lampmussel	*Lampsilis r. radiata*	L	N	N	L, D
green floater	*Lasmigona subviridis*	N	N	N	N
tidewater mucket	*Leptodea ochracea*	D	L, D	L, D	L, D
eastern pondmussel	*Ligumia nasuta*	N	N	N	N

Common Name	Species	Exelon 2010	MDNR's Natural Heritage Program 2008	2009	2010
eastern floater	*Pyganodon cataracta*	L, D	L, D	L, D	L, D
creeper	*Strophitus undulatus*	D	N	N	D

[1] N=None collected.
[2] L=Live individuals were collected.
[3] D=Spent (empty or dead) valves were collected.

Study Objectives:
The objectives as stated in Conowingo RSP 3.19 Freshwater Mussel Characterization Study below Conowingo Dam are to:

1) Characterize the freshwater mussel community in the Susquehanna River below Conowingo Dam; and
2) Determine if plant operations at Conowingo Dam effect the mussel community in this river reach.
A brief discussion on each study objective follows.

Exelon believes that Objective 1 can be met using existing datasets. Exelon believes that the Conowingo 3.19 field data is appropriate for the purpose of characterizing the existing mussel community, particularly if it is supplemented with other mussel survey data. Thus, Exelon believes that study Objective 1 can be achieved by combining and analyzing mussel survey data from the Conowingo 3.19 study and the mussel surveys referenced in Ashton and Devers (unpublished data).

Taken at face value, Objective 2 is simply a threshold question: do plant operations effect the downstream mussel community? Exelon believes that the compendium of data available from the Conowingo 3.19 study, Ashton and Devers (unpublished data), the habitat analysis (Conowingo 3.16) and the sedimentation analysis (Conowingo 3.15) can be useful to adequately answer this question in an updated study report.

Field and Data Analysis Methods:
Generally, methodological questions fell into one of three categories as follows: a). was the field design of the semi-quantitative survey such that representative samples could be collected to characterize the mussel community below Conowingo Dam(?); b). was the field design of the quantitative surveys such that they could be used to expand and broaden the results of the semi-quantitative surveys(?); and c). was the analysis conducted sufficient to determine if Project operations were impacting the mussel community downstream of Conowingo Dam(?). Each of the questions is addressed below.

The species composition data collected in the semi-quantitative study for Conowingo 3.19 in 2010 is nearly identical to the data collected in the three years of surveys conducted in the same river reach by Natural Heritage Program (Ashton and Devers, unpublished data) as illustrated in Table 1. As such, Exelon believes that the four studies, when combined, sufficiently characterize the mussel community below Conowingo Dam. Since the species composition data is supported by four semi-quantitative studies, it is unclear how additional semi-quantitative surveys would provide any additional useful information to further characterize the mussel community below Conowingo Dam; therefore, we are not proposing additional semi-quantitative surveys in 2011 as we believe the data available sufficiently addresses Objective 1 without the use of the quantitative survey data.

The Principal Investigator‟s (PI) explanation of how and why the quantitative sampling sites were chosen is included in Attachment C. What is not clear, regardless of agreement on the methods of site selection, is how this data will be used to achieve either of the study objectives. It seems that the semi-quantitative data is adequate to achieve Objective 1 (characterization of the mussel community) and that the compendium of data (through semi-quantitative, quantitative, Ashton and Devers (unpublished data), habitat (Conowingo 3.16) and sedimentation (Conowingo 3.15) studies) is adequate to meet Objective 2 (is there a Project effect on the downstream mussel community?). This analysis will be included in an updated study report.

RSR-Specified Deliverables:
The comment letters provided by FERC, American Rivers, the USFWS and MDNR indicate deviations from the study plan after completion of the field survey and with submission of the report. These comments have been addressed in Attachment C. Exelon will issue an updated study report after consulting with the concerned stakeholders about these comments.

Study Conclusions:
Several stakeholders expressed disagreement with the conclusions Exelon drew from the analyses provided in the Conowingo 3.19 initial study report. Analysis of the mussel data and effects on the mussel community were reported in two study reports: Conowingo 3.19 and Conowingo RSP 3.16 Instream Flow Habitat Assessment below Conowingo Dam (Conowingo 3.16). Conowingo 3.16 provided spatial analyses comparing shear stress at various flows, and also analyzed mussels‟ reported shear stress tolerances throughout the river. In addition, the Conowingo 3.15 Sedimentation Report gives insights to present and historic substrate information that has relevance to Objective 2. Given the report‟s recent submission and the recent receipt of data from Ashton and Devers (unpublished data), Exelon will issue an updated study report for Conowingo 3.19, Exelon believes that a substantive discussion of conclusions is not warranted until all of the pertinent information has been provided in the revised study report, and after all mussel-related analyses have been reviewed by the stakeholders.

3.20 Salinity and Salt Wedge Encroachment

MDNR and SRBC submitted comments on the Salinity and Salt Wedge Encroachment (RSP 3.20) initial study report.

SRBC Comment 1:
"Exelon makes the determination that Project operations do not affect salinity or salt wedge encroachment based on poor correlations between Project outflow and observed salinity, but did not include a correlation assessment for 15-minute flows…SRBC staff encourages Exelon to perform a correlation analysis for the 15-minute flows, although due to extreme variability of instantaneous flows during peaking, we expect that the correlation will also be poor."

Exelon Response:
Although not clearly stated in the text, the MDNR correlations results in Table 4.3-1 were performed using 15-minute flow data[6]. Each 15-min salinity reading had a uniquely calculated moving average flow for the stated time period prior to the reported reading. For example, the 1-day moving average flow for a salinity reading on 7/29/2007 7:30[7] was calculated as the average flow observed between 7/28/2007 7:45 and 7/29/2007 7:30, while the 1-day moving average flow for a salinity reading on 7/29/2007 7:45 was calculated as the average flow between 7/28/2007 8:00 and 7/29/2007 7:45. To address SRBC"s request, correlations have been calculated for moving average time periods shorter those initially reported, including a correlation with the 15-min instantaneous flow readings (Table 1). The augmented results show that correlations become increasingly worse as the moving average time period decreases, with the instantaneous and 1-hour moving average flow values providing the worst correlation. This further supports the original conclusion that longer-term flows drive salinity levels in the river, with short-term flow variations having no noticeable salinity impacts.

SRBC Comment 2:
"Figure 4.4-4 suggests that salinity levels do begin to increase during minimum release operations, and decline when peaking resumes. With only one month of data plotted, it is not possible to make a definitive conclusion regarding the interaction between Project operations and salinity levels."

Exelon Response:
Figures 4.4-4 and 4.4-5 were intended to show salinity and flow dynamics during high-salinity periods. Each plot shows approximately one month of salinity and flow values for two years, resulting in four plots showing approximately one month of data. In addition to these plots, time series plots show Conowingo daily average flow versus MDNR 15-min salinity data (Figures 4.4-1 and 4.4-2) and Havre de Grace daily instantaneous salinity data (Figures 4.4-3), providing the longer term trends not shown in Figures 4.4-4 and 4.4-5. Collectively, these plots show the full period investigated for both salinity data sets. The long time period shown in Figure 4.4-3 makes trends somewhat difficult to depict. For better clarity, this figure is shown broken into two periods (1997-2003, 2004-2010) in Figure 1 and Figure 2.

SRBC Comment 3:
SRBC noted that "the comparison between tidal elevations and salinity were for a duration of eight days, and SRBC staff is not able to draw any conclusion from the plot presented, particularly considering that many other factors (flow variations, wind, storms) could be disproportionately influencing the salinity levels in that small timeframe."

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[6] Havre de Grace salinity observations were correlated with daily average flow data.
[7] All times are listed in 24-hour format, such that 4:00 AM is 4:00, and 4:00 PM is 16:00.

Exelon Response:
Correlations and Figure 4.3-2 showed that tidal influences normally had little to no relationship to observed salinity levels. However, there appeared to be distinct tidal influences during high salinity events that were not otherwise present. The time series shown was an example of such a situation. The figure showed salinity levels clearly rising and falling with tidal elevations for several days in a row. Yet, prior to and after the high salinity event, tidal influences appeared to have a negligible salinity influence. This pattern was also evident for other years during high salinity events that were not plotted in the initial study report, such as the additional period shown in Figure 3. Correlations were performed using the full 15-min data analysis period (2007-2010), and were not limited to the periods shown in exemplary time series plots.

SRBC Comment 4:
SRBC stated that "…when comparing flows from both the Conowingo USGS gage and the Marietta USGS gage to the salinity of the Susquehanna River downstream of the project, the project sponsor only compared the salinity of the MDNR salinity observations and not the HDG salinity observations." Later stating that "SRBC staff urges Exelon to compare salinity of the HDG observations with that of the two USGS gages in a similar format to the comparison in Figures 4.4-5 and 4.4-5 [sic]." It is assumed the comment was referring to Figures 4.4-4 and 4.4-5.

Exelon Response:
The text of Section 4.3 describes correlations that compared Havre de Grace salinity observations to Marietta and Conowingo USGS gage flows, showing rather poor correlations in both cases. While daily data time series plots were investigated, the 15-min salinity plots were generally more telling, particularly during high salinity events. Additionally, the first paragraph of Section 4.1 compares the Havre de Grace and MDNR salinity readings, showing that the 15-min (MDNR) readings typically mimicked the Havre de Grace salinity data in pattern, though not magnitude. Thus, the 15-min data provides a more detailed view of what happened in between Havre de Grace readings. Finally, more detailed flow and salinity time series plots are shown in Figure 1 and Figure 2 in response to comment 2 providing a similar comparison as in Figures 4.4-4 and 4.4-5.

SRBC Comment 5:
Finally, SRBC states that "Exelon should determine and report the timing of those measurements (i.e., whether the measurements are collected at the same time every day, and at what time of day)."

Exelon Response:
Section 3 in the initial study report states that "Beginning in 1997, the City of Havre de Grace collected instantaneous daily salinity values at the Havre de Grace water supply intake at high tide (D. Geiger, Personal Communication, 2010). Since a tidal cycle is approximately 12.5 hours, readings would occur at slightly different times in consecutive days, with various sample times covering the time of day over long terms. While the daily instantaneous readings are not as telling as the 15-min MDNR observations, since instantaneous reading are taken at high tide they should represent the most saline reading that would be observed throughout the day, as evidenced by 15-min time series plots.

Table 1: Salinity Correlations to Moving Average Flow Reciprocals (1/Moving Average Flow). This is a modified version of Table 4.3-1 from the initial study report.

Moving Average Window	MDNR salinity observations		HDG salinity observations	
	R^2	RMSE (ppt)	R^2	RMSE (ppt)
Instantaneous	0.394	0.0245		
1-hour	0.394	0.0245		
3-hour	0.397	0.0244		
6-hour	0.406	0.0242		
12-hour	0.439	0.0235		
18-hour	0.477	0.0227		
1	0.493	0.0224	0.158	0.0125
3	0.556	0.0210	0.200	0.0122
5	0.601	0.0199	0.213	0.0121
7	0.627	0.0192	0.220	0.0121
14	0.698	0.0173	0.224	0.0120
21	0.746	0.0159	0.225	0.0120
30	0.758	0.0155	0.234	0.0120
45	0.756	0.0156	0.227	0.0120
60	0.734	0.0162	0.215	0.0121

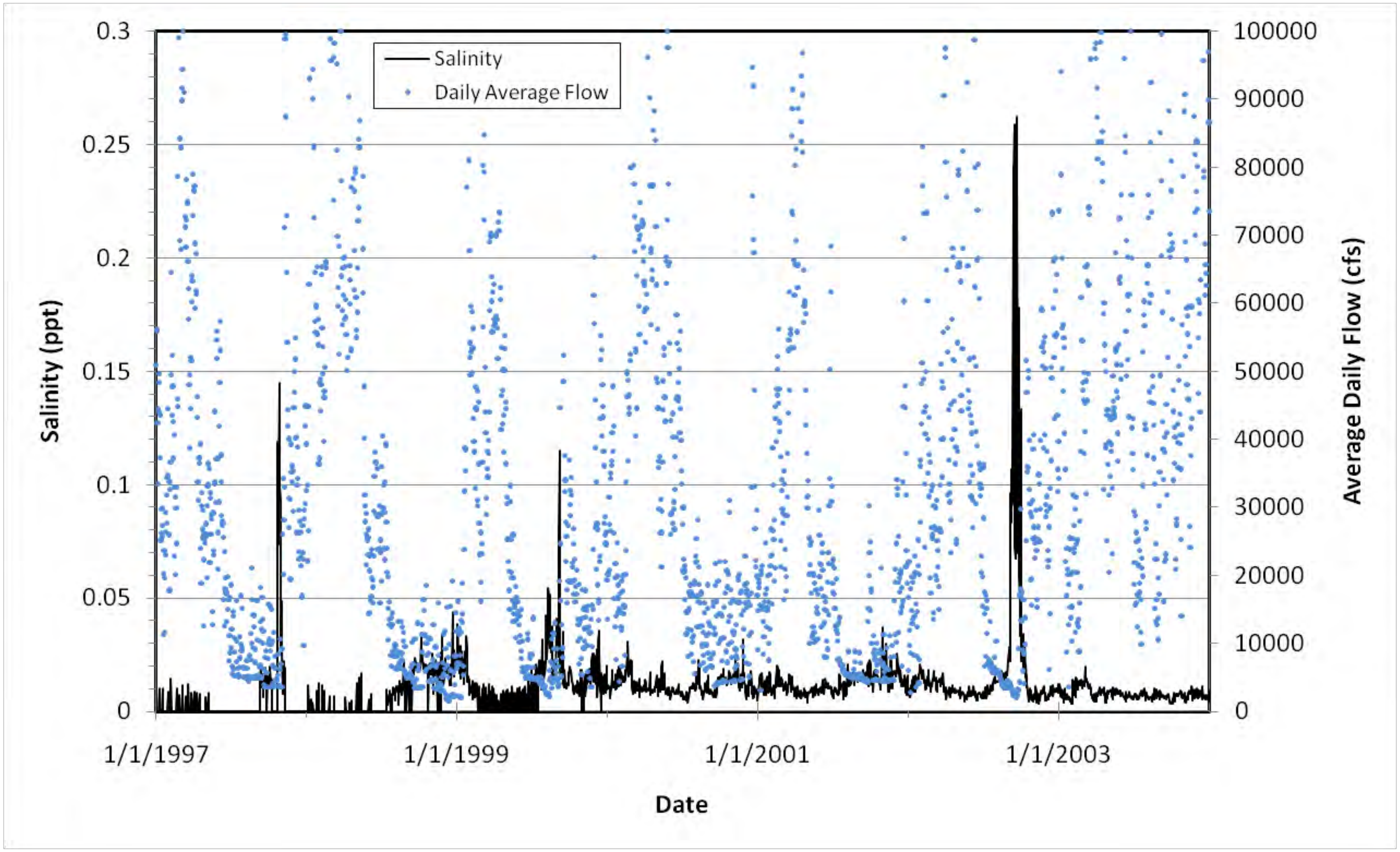

Figure 1: Time Series of HDG Salinity Observations and Conowingo USGS Gage Daily Average Flow. This is a Modified Version of Figure 4.4-3 from the initial study report.

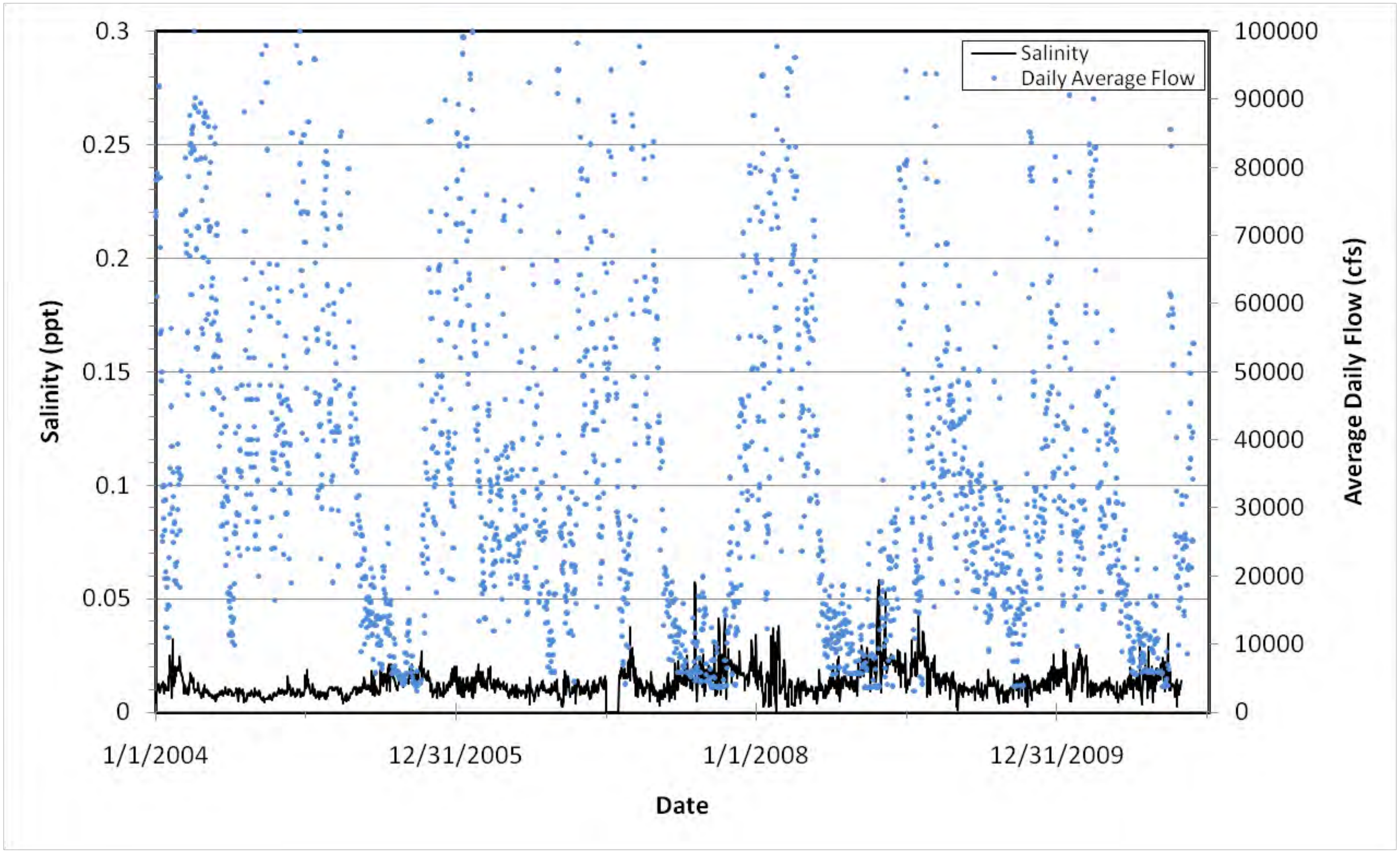

Figure 2: Time Series of HDG Salinity Observations and Conowingo USGS Gage Daily Average Flow. This is a Modified Version of Figure 4.4-3 from the initial study report.

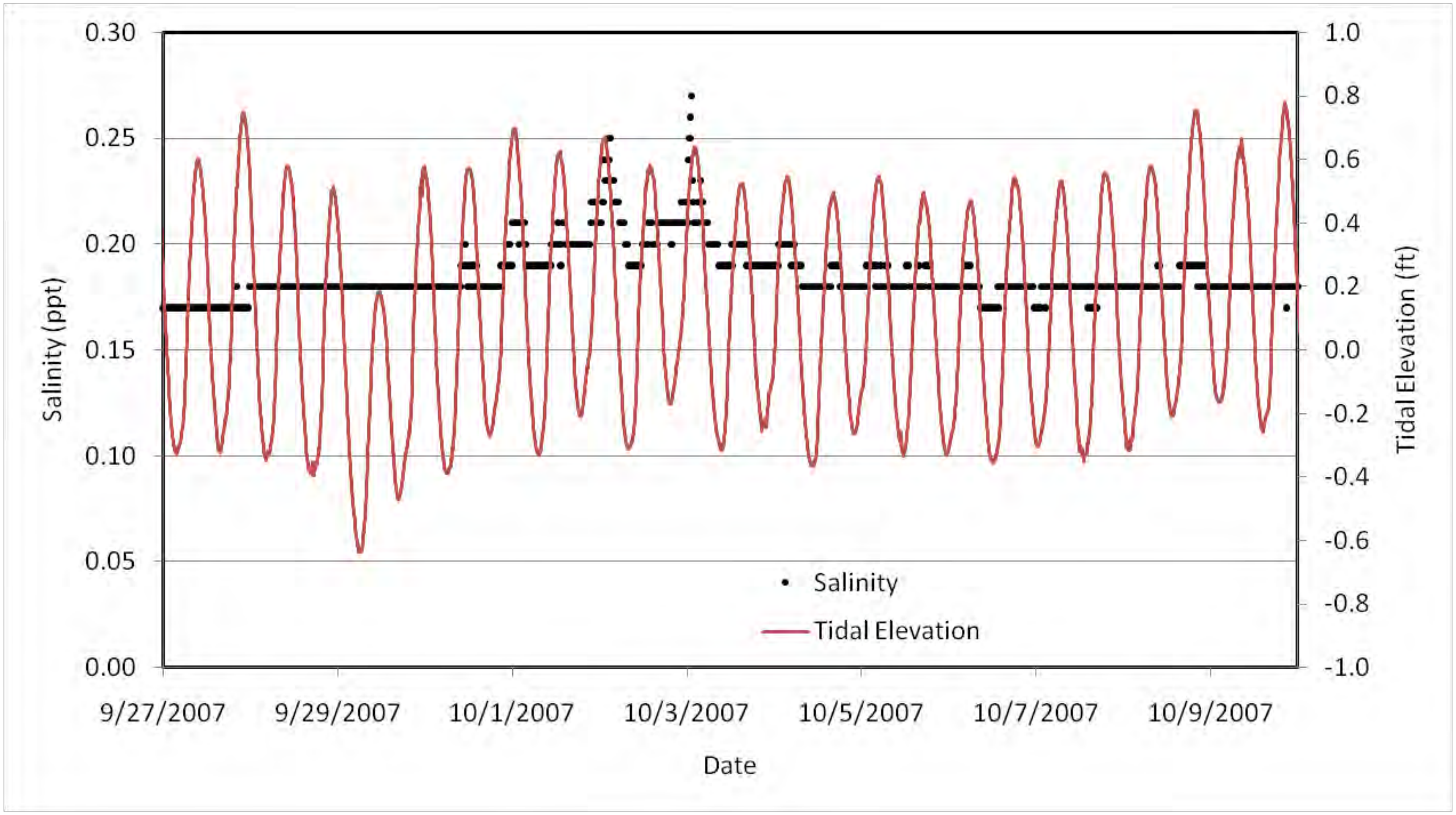

Figure 3: Tidal elevations (red line) and MDNR 15-min salinity (black dots) time series plot for the high salinity period in 2007.

3.21 Impact of Plant Operations on Migratory Fish Reproduction

MDNR and PFBC submitted comments on the Impact of Plant Operations on Migratory Fish Reproduction (RSP 3.21) initial study report.

MDNR and PFBC Comment 1:

On pg. 20, the statement is made that "Flows were highly episodic, often with the greatest magnitude discharge peaks occurring in April and May…" While that flow data was presented in graphs (Figure 5-1), there was no analysis done of the timing and magnitude of the ichthyoplankton collections for the various species specifically as it related to the episodic flows. While a detailed characterization of habitat availability for the species will be established in Study 3.16, in this study the empirical data should be analyzed to assess the relationship between fluctuating river flows and ichthyoplankton densities on a location-specific basis.

Exelon Response:

The data collected in the earlier studies referenced were not conducive to analysis of ichthyoplankton densities. A new ichthyoplankton study proposed for 2011 (delayed until 2012 due to high flows) will be designed to collect ichthyoplankton and discharge data in appropriate periodicity to address this concern.

MDNR Comment 2:

No analyses are presented in this report to achieve the purpose of the study, "to determine if project operations impact migratory fish reproduction upstream of Conowingo Dam and Downstream in the Susquehanna River"

Exelon Response:

The analysis of project operations on spawning and incubation habitat for a variety of species, including American shad, was completed as part of Study 3.16-Instream Flow Habitat Assessment below Conowingo Dam.

PFBC Comment 2:

The licensee needs to gather station generation data for the previous ichthyoplankton studies and relate egg collection, particularly for American shad, to generation status. Need a 2011 study, as per the FERC Study Plan Determination of 2/4/2010, to document hickory shad spawning areas and establish the relationship between American shad spawning and station operation. Study of existing spawning activity, as measured by ichthyoplankton samples in the mainstem river below Conowingo Dam to Port Deposit to determine if migratory fish are reproducing in this river reach and to describe the relationship between station operations and migratory fish reproduction for the 2011 study and for previous ichthyoplankton studies.

Exelon Response:

See Exelon response to MDNR and PFBC Comment 1, the ichthyoplankton study proposed by Exelon for 2011 (now 2012) (see April 2011 study plan) will address these issues. There is no need to develop a new study to examine the specific impacts to hickory shad, since this aspect will be covered in the existing study.

3.22 Shortnose and Atlantic Sturgeon Life History Studies

PFBC, MDNR, and USFWS submitted comments on the Shortnose and Atlantic Sturgeon Studies (RSP 3.22) initial study report.

PFBC Comment 1:
Additional information should be provided that results in a recommendation by the licensee as to what steps need to be taken at Conowingo dam to improve conditions for passage of shortnose sturgeon.

Exelon Response:
As described in Section 2.6 of the Initial Study Report, there are several features that may be used for comparison of the Conowingo east fish lift with other fish passage facilities that have passed shortnose sturgeon, including: river width, river discharge, fishway attraction flow / proportion of attraction flow to river discharge, and fishway entrance configuration. Of those, attraction flow volume and entrance configuration might be incorporated into designs to potentially improve the likelihood of sturgeon passage. The two considerations are necessarily linked; any entrance channel designs to facilitate sturgeon passage must allow for discharge of the higher volume of attraction flow in conjunction with existing / other entrances while maintaining appropriate velocities. Entrance design would include minimizing height above the river bottom, preferably without a standard entrance weir. Alternatively, a ramped approach to the entrance may be considered.

A feasibility and cost analysis of fishway entrance design and attraction flow enhancement will be included in the updated study report. However, any proposed measures to improve sturgeon passage will be made in the draft license application.

MDNR Comment 1:
Analysis of habitat types below Conowingo Dam seems to be preliminary. In the context of the title of the study it is difficult to determine how habitat types are being analyzed. Habitat in this study appears to refer to the water column and its flow characteristics. However, an analysis of that nature should be characterized as hydraulic habitat. Nevertheless, an analysis of habitat cannot be conducted solely on hydraulic characteristics, based on the description of the study. The analysis also concludes that in general, suitable habitat is limited for all life stages of shortnose (and presumably Atlantic) although there is are no physical habitat characteristics presented in this study. It seems unlikely there is no gravel in this region given the visible habitat seen in some of the figures.

Exelon Response:
The analysis of sturgeon habitat was completed as part of Study 3.16-Instream Flow Habitat Assessment below Conowingo Dam.

3.24 Dreissenid Mussel Monitoring Study

MDNR submitted comments on the Dreissenid Mussel Monitoring Study (RSP 3.24) initial study report.

MDNR Comment 1:
Pg. ii, line 9: Insert "Department of Natural Resources" before "Biologists.

Exelon Response:
The insert will be added to the updated study report.

MDNR Comment 2:
Pg. ii: The second objective of this study was to "identify potential mitigation measures to minimize the impact of Dreissenid mussels to Project structures", yet there isn't any mention of potential mitigation measures in the Executive Summary.

Exelon Response:
This paragraph can be added before the last paragraph in the executive summary. "The Dreissenid mussel fouling prevention/control options considered most applicable for use at Conowingo Dam are listed within the initial study report. This general list was based on "potential" use, not actual feasibility, advantages, disadvantages, costs, or comparisons with other options. The purpose of this list is to provide a general starting point for Conowingo personnel to develop an effective mussel control program."

MDNR Comment 3:
Pg. 2, lines 29-30: Please be more specific than ".....a few adult zebra mussels……". We believe one dead adult zebra mussel was collected at the Conowingo dam, one dead adult mussel was found at Glen Cove Marina upstream from Conowingo, and four dead adult mussels were found in Muddy Run Reservoir, even further upstream, in the fall of 2008. Is that correct? If so, please add this detail to the text on pg. 2.

Exelon Response:
The following sentences can be added after the sentence described above: "One dead adult zebra mussel was collected from a strainer sample at Conowingo Dam, one dead adult zebra mussel was found attached to a boat motor that was removed for winter storage at Glen Cove Marina upstream of Conowingo Dam. Also four dead adult zebra mussels (shells only) were found along shore of the Muddy Run Reservoir during a low elevation level (Figure 2-1)."

MDNR Comment 4:
Pg. 7, line 15: Please add this sentence to this paragraph: "On August 3, 2010, MDNR biologists collected and preserved an additional three adult zebra mussels (2-alive and 1-dead) found in the lower Susquehanna below Conowingo, bringing the total number of adult zebra mussels collected downstream from the Conowingo Dam in 2010 to 14 (10-alive and 4-dead).

Exelon Response:
The sentence can be added to reflect the additional collected zebra mussel specimens.

MDNR Comment 5:
Pg. 8, line 16: What's the significance of 10,000 cfs?

Exelon Response:

Exelon believes that when zebra mussels spawn in the upper Conowingo Pond, they would have the potential to settle out of the water column and attach to a substrate before passing through Conowingo Dam with river flows less than 10,000 cfs.

MDNR Comment 6:
We suggest that the map of the lower Susquehanna River (last pg.) be extended to show the location of Muddy Run Reservoir, since it is mentioned on pg. 2.

Exelon Response:
A figure will be added to the updated study report depicting the location of the Muddy Run Reservoir.

3.26 Recreational Inventory and Needs Assessment

SGHA, NPS, USFWS, MDNR, PFBC, PaDEP and M-DTS submitted comments on the Recreational Facility Inventory and Estimated Recreation Use (RSP 3.26) initial study report.

SGHA Comment 1:
"The Recreation Facility Inventory and Estimated Recreation Use Report lacks reference to the Susquehanna River Water Trail."

Exelon Response:
Exelon will include references to the Susquehanna River Water Trail and other designated water trails in the Project area in the updated study report.

NPS Comment 1:
"The methodology for identifying recreational use and adequacy of existing facilities was considerably flawed. The consultants did not consider many nearby facilities, did not make any attempt to identify or contact local and regional user groups, and did not send out any mailed surveys. Many key locations were missed or not included in the evaluation, including Rock Run boat ramp for example, which until a few years ago had been a major access below the Conowingo dam, but was summarily closed by Exelon shortly after taking over the projects just a few years ago. This was a heavily used facility that provided recreational access below the dam, and its closure has undoubtedly had effects on other facilities both in and near the Conowingo and Muddy Run project areas. By limiting their analysis to the project boundaries, the licensee, and therefore the FERC does not have a real picture of recreational use in the project areas. In many cases during eastern relicensings, licensees have evaluated as far as 25 miles from the project boundary in order to encompass local and regional recreation opportunities and needs. This is especially important because nearby access locations, both currently in use and those that have been closed, should have been evaluated in the context of the project because it affects recreational use within the project boundary. By relying on current use data (arguably flawed in the scope and methodology of collection) and future demographics only, the licensee does not get an accurate or adequate picture of future recreational demand. As such, they have not satisfied the terms of FERC's February 4, 2010 Study Plan Determination."

Exelon Response:
Exelon"s process to collect recreational use and capacity data for Project facilities is a standard methodology that has been successfully used for recreational studies at many other FERC licensed projects. Data were collected during 2008/09 in part to provide data for the 2009 filing of the FERC Form 80"s for both projects; however, the methodology was augmented beyond the typical Form 80 data needs to ensure Exelon would have a statistically valid methodology for sampling and data collection to address FERC recreational licensing requirements for both projects. Exelon followed the methodology as outlined in its study plans submitted for both projects. The Rock Run boat ramp is outside the Conowingo Project boundary and had historically been leased to individuals and operated as a commercial marina operation. The site contained marina-related maintenance buildings, private seasonal residential cottages, and several camper/RV sites directly on the bank of the river. A small ramp provided launching for small boats. Due to environmental and public safety concerns, Exelon cancelled the lease in November 2010 and oversaw the removal all structural improvements, except the boat ramp, in December 2010/January 2011. This included the marina structures, a partially demolished cottage and other cottages, camper trailers/RV"s and appurtenant structures, debris, the sub standard electrical system and all sub surface disposal systems. The site was not closed during the demolition/rehabilitation/stabilization and remains open for members of the public wishing to use the site and boat ramp. Exelon will include general information on other near-by non-project public recreational facilities in the Recreation Management Plan. Exelon provided an estimate of future recreational demand

based on growth coefficients developed as part of "Projections of Outdoor Recreation Participation to 2050" as published by the USDA Forest Service. This statistical model has been used effectively by the US Forest Service and by other FERC applicants as a reasonable methodology for assessing long term capacity potential. In addition, as a standard FERC requirement recreational use and capacity data for the projects will be updated every six years through the FERC Form 80 process. This data will be used in future years to assess the recreation use and facility capacities every six years.

NPS Comment 2:
"At page 1-11 in the Revised Study Plan dated December 22, 2009, the issue associated with parking and access to the Muddy Creek Gorge at Paper Mill Road was referenced in response to the comments filed July 13, 2009 by the Mason Dixon Trail System, Inc (MDTS). Exelon's response lumped this issue with general recreational enhancements that were to be looked at in the Recreational Facilities and Needs Assessment. The plan does not mention this access issue and refers only to the Muddy Creek Boat Ramp on the main stem of the Susquehanna River. The access at Paper Mill Road continues to see heavy use by boaters, day hikers and users of the MDT, however, access for parking has become extremely challenging for the public due to the claim of private ownership where the road crosses Muddy Creek. Survey markers are missing and in order to have any chance at a resolution to this issue, Exelon should resurvey the area to determine where its boundary is and upon the results of that survey, determine where and how to develop or enhance parking in this area, or an alternative location to be agreed upon after consultation with the MDT. A possible alternative would be the former PADOT lot on Route 74, located a mile or so upriver from the Paper Mill Road bridge area.

Exelon Response:
Exelon has recently completed a property survey of this non-project land and confirmed that Exelon does own the property. Exelon will address this issue in the Recreation Management Plan.

NPS Comment 3:
Subsequent to September 11, 2001, the licensee expanded its security perimeter, forcing a relocation of a portion of the MDT away from the river between the Conowingo Visitors center and Fisherman's Park and onto roads that are narrow and particularly unsafe for pedestrians. The MDTS has identified an alternative route to the licensee, but has been met with the general response that was reiterated at the March 2011 ISR meetings: The consultant hired by the licensee was asked to evaluate the risks of keeping the restrictions in place and they used FERC's standard Dam Assessment and Vulnerability Methodology. They cited the Department of Homeland Security's concurrence with the consultant's conclusions to keep everything closed that the licensee shut down after 9/11. However, the consultant was not asked to determine if those risks are real or if the closures need to continue. Exelon made their decision based on the consultants' recommendation, but Exelon's consultant noted during the March 2011 ISR meetings that its decision could be changed. Conowingo is one of few such dams that have continued their post 9/11 restrictions. The post 9/11 security closures have also affected the extremely popular and decades long tradition of fishing from the Conowingo Dam catwalk and restricting boaters near the dam. Closing of the catwalk makes little sense; the licensee could simply station someone on-site to check users. At present there is simply a person with a bullhorn telling boaters to move back, when the real threat if any, comes from truck traffic that crosses the dam on Route 1. Exelon spent considerable money building a new ADA fishing access below the dam on river right, although this was done in the few years before the relicensing process commenced. Both York Haven and Safe Harbor have reopened their catwalks.

Exelon Response:
Exelon will consult with MDTS regarding the potential relocation of the Mason-Dixon Trail near Conowingo Dam based on the findings specific to such a relocation contained in Exelon"s Conowingo Dam security assessments reports.

The 400 yard upstream and downstream boating exclusion area at Conowingo Dam is a State of Maryland boating regulation. This will be noted in the updated study report. Changes to the boating exclusion area should be done through proper legislative processes.

See Exelon Response regarding closure of the catwalk to the public.

PFBC Comment 1:
"The analysis of future recreational needs is flawed. Analysis of current use and future demographics is not sufficient to determine need. Potential users must be surveyed to determine if existing facilities meet their needs, as required in the FERC Study Plan Determination of 2/4/2010: "The plan proposes a literature review to identify recreational organizations that would be utilized as data sources as well as surveyed via phone. To ensure that sufficient input from the angling community is solicited, the list of entities included in the literature review phone surveys must include fishing organizations within the project because of the apparent popularity of angling." The observation that use is low does not necessarily suggest that the facility meets needs, current or future. Lack of use may be attributed to lack of specific components. For example, lack of clean, usable sanitary facilities may discourage potential users."

Exelon Response:
See Exelon Response to NPS 1 regarding methodology. Exelon has conducted a literature review to identify recreational organizations for consultation. Consultation with such organizations will be conducted in 2011 by means of local/regional consultation meetings and follow up contact as necessary. Exelon conducted a recreational user preference survey during 2010/11 and is currently compiling and analyzing the data. The results of consultations and recreational use preference surveys will be included in the Recreation Management Plan.

PFBC Comment 2:
"The FERC Study Plan Determination of 2/4/2010 requires the licensee: "To ensure recreational safety is adequately assessed in terms of current project operation, the study plan must be revised to indicate that the location of the line designated to restrict boaters from accessing the tailrace will specifically be re-evaluated as part of the study." Apparently this was not done and is not in the ISR."

Exelon Response:
See Exelon Response to NPS 3 regarding the upstream and downstream boating exclusion area at Conowingo Dam.

PFBC Comment 3:
In survey interviews, the licensee neglected to collect zip code data from users. This data is very useful in determining how far users are willing to travel to use the facilities provided. The distance traveled can be an additional measure of the quality of the facilities provided.

Exelon Response:
While Exelon agrees that zip code data is useful in determining the distance some users may be willing to travel to use facilities, it is only applicable to those users whose sole or primary destination is a Project related site, facility, or opportunity. It is not necessary to determine origination points or travel distances for the licensing of the projects. As stated above, Exelon is completing a recreation user preference survey to provide data on user opinions of existing facilities, access, opportunities, and conditions and the need for enhancements, improvements and additional facilities, access and opportunities within the Project. Additional data on the quality of and/or need for facilities will be gathered in the upcoming consultation process.

PFBC Comment 4:
"The licensee did not consider Rock Run Landing in the study because it is not in the project area. Rock Run Landing is owned by the licensee and, for many years, was leased to individuals. Facilities included space for 5-6 house trailers which served as summer homes, numerous travel trailers or motor homes, a dock with mooring for 20-30 small boats, rental boats, and a launch ramp. The users of this facility were the true "river rats" of the lower Susquehanna River and used the river for angling and hunting at a much greater frequency than most other users. Many of these individuals fished the river almost every day. At some point, the licensee terminated the leases for this property. All users have moved out and the property is no longer used. The exclusion of this property left one boat launch to be surveyed in the recreation survey (Lapidum). Since Lapidum has limited parking, additional boat launches are needed to serve the river from Conowingo Dam to Port Deposit. Rock Run Landing also provided an important safety function. Boating in the river reach from the head-of-tide to Conowingo Dam requires a small boat with little draft. These boats are not very safe in rough, wind-driven waves. The location of the Lapidum ramp is over ½ mile from the head of tide. When a strong south wind is blowing up the river, navigating from the head-of-tide to Lapidum can be very dangerous. These strong south winds can come up very quickly and create a hazard for small boat anglers fishing above the head-of-tide. Rock Run Landing provided a protected alternative for boats using the non-tidal river. Steele Island, just upstream from Rock Run Landing, provided a sheltered travel route from Conowingo Dam to a launch ramp. Thus. The loss of this ramp represents a safety hazard in addition to the loss of recreational opportunities."

Exelon Response:
See Exelon Response to NPS 1 regarding the Rock Run Landing. The ramp remains open for public use and as a shelter in unsafe boating conditions.

PFBC Comment 5:
"There is a need for additional parking and trails to provide river access on the east bank of the river from the mouth of the Octoraro Creek to Port Deposit. There is a critical need for additional parking at boat ramps that provide access to the Susquehanna River below Conowingo Dam. There is a critical need for additional parking in the vicinity of the mouth of Deer Creek and along Deer Creek. "

Exelon Response:
As stated above, Exelon is completing a recreation user preference survey to provide data on user opinions of existing facilities, access, opportunities, and conditions and the need for enhancements, improvements and additional facilities, access and opportunities within the Project. Additional data on the quality of and/or need for facilities will be gathered in the upcoming Recreation Management Plan consultation process. The results of consultations and recreational use preference surveys, and recommendations for enhancements, will be included in the updated study report.

PFBC Comment 6:
"The hours of operation need to be listed for all sites to allow a better understanding of their current use and potential. Statements such as "There was no nighttime recreation activity, as measured by camping, at the site." are made repeatedly and are misleading since no overnight camping facilities are available at most of the sites. Under 7.3 the following statement was made "No overnight camping facilities are available within the Conowingo Project". As written, one might conclude that the sites are not being used for overnight camping when in reality there is no opportunity to participate in overnight camping."

Exelon Response:
Exelon will provide hours of operation for sites with specified operating hours, and will clarify and revise language regarding overnight use within the Project. This information will be included in the Recreation Management Plan.

PFBC Comment 7:
"This report needs to be reviewed for accuracy to ensure that all of the statements about use and opportunities for use are accurate. "

Exelon Response:
Revised and final reposts will be reviewed for accuracy and consistency. Agencies have requested the study data from the submitted Recreational Use Study. This data will be made to available to all interested agencies.

PFBC Comment 8:
"Attempts need to be made to ascertain the residence or zip code location of facility users. "

Exelon Response:
See Exelon Response to PFBC 3 regarding collecting zip code information.

PFBC Comment 9:
"How often were parking areas filled to capacity?"

Exelon Response:
Exelon will review data collected for each site during 2008/09 for weekend and holiday survey days and compare use against capacity to determine how often parking areas were filled to capacity and include this information in the Recreation Management Plan.

PFBC Comment 10:
"Discussion of the Conowingo Pond boat launches does not include description of what pond levels permit use of these ramps. "

Exelon Response:
Exelon will research and investigate Conowingo Pond boat ramps to determine functionality of ramps at various pond levels and provide this information in the Recreation Management Plan.

PFBC Comment 11:
"Local groups and individuals need to be surveyed to determine recreational needs. "

Exelon Response:
See Exelon responses to PFBC 1 and 3 regarding consultation with local groups.

MDNR Comment 1:
"Limited boat access into several large backwater tributaries was noted at a pool elevation of 109 due to low clearance (air draft) of railroad bridges. It is worth noting that these could be mitigated at some later date should these bridges be scheduled for replacement by the Norfolk Southern Rail Line. At a pool elevation of 106 or lower, boat access to some backwater tributaries may be restricted due to shoaling. Several ramps may be impacted at these levels as well. The Applicant should determine if restricted access is due to permanent features such as bedrock or riffles or if channels and ramp approaches are restricted due to excessive sedimentation. Unconsolidated sediments could be mitigated through dredging."

Exelon Response:
See Exelon response to PFBC 10 regarding boat ramp data.

MDNR Comment 2:
"The study report offers no documentation of effort or methods to "conduct an internet literature search and contact readily known and identified recreational organizations and local, county, state and federal agencies to identify any commonly used formal and informal recreation access sites within the investigation" area prior to its 2008/2009 field survey of recreational use. The study report presents no evidence of a literature search or outreach conducted since the 2008/2009 recreational-use survey.

The RSP indicated that the search and outreach effort would include various birding clubs and organizations and that information from those groups would be used to supplement Exelon's existing information or birding activities in the area. The study report offers no evidence of such contact and indicates that Exelon relied entirely on its FERC Form 80 data related to birding to derive the reported estimates of birding activity at recreational facilities within the project area."

Exelon Response:
See Exelon response to PFBC 1 regarding literature research and consultation.

MDNR Comment 2:
"The study report provides no evidence of effort to "consult with interested stakeholders prior to submitting the study report." The study report provides no evidence of effort to "update and revise its recreation field site/facility inventory to confirm access sites identified in Task 1 and to document any additional sites that may have been overlooked, renovated, or constructed since the original inventory."
The study report offers incomplete evidence of effort to "document formal and informal access locations." No GPS coordinates are provided for any access location; however, the formal access locations are documented on a GIS map of the project. The existence of multiple informal access locations is mentioned, but no documentation of their locations is provided."

Exelon Response:
See Exelon response PFBC 1 regarding consultation. The recreation field site/facility inventory is updated on a regular basis to account for changes being made to various recreation facilities (i.e., Muddy Creek boat ramp improvements, Funks Pond upgrades, etc.). Project facilities will continue to be improved/upgraded by Exelon and site operators and the inventory to be revised as such changes occur and will be reflected in the Recreation Management Plan. GPS documentation of all formal and appropriate informal recreation sites will be provided in the Recreation Management Plan.

MDNR Comment 3:
"The study report is missing information on methods and results of Tasks 1 and 3 as described above. The FERC-mandated task of re-evaluating the restricted access line in the tailrace of the project was not conducted."

Exelon Response:
Exelon will provide additional information on methods and results of literature review and outreach (Task 1) and recreation field inventory (Task 3) in the Recreation Management Plan. See Exelon response 3 to NPS regarding the boating exclusion areas at Conowingo Dam.

MDNR Comment 4:
"The study was vague about completing Objective 2 – Exelon assumed that since there was a vehicle parked at a particular site, it was using that site or if a counter counted a vehicle accessing a particular parking lot, it was used to extrapolate the total usage, this likely overestimates the usage for obvious reasons.

The study was based on people using the facilities and was not expanded to include non-users. In addition, the study was highly biased due to the areas surveyed, e.g. certain users took more time per area and were more frequently encountered or interviewed. It also does not include additional possible recreational areas closed to the public that could potentially be opened. These biases were never addressed in the study results.

To determine objective 3, above, recreational users and non-users would need to be interviewed. Not only were the methods to address this objective vague but no interviews were done to assess the needs of the recreational users. In short, if folks are not using the facility because they have different recreational priorities, are physically unable to access some sites or are unaware of the opportunities that exist, then they will not be interviewed by this survey. It also appears that recreational use was very low for all areas with few exceptions, even in the report when use was stated it used the word "only" (e.g. the parking lot was only at 8 percent capacity) indicating that there was significant under usage. No remedy or clarification was provided – see Table 9.3-1."

Exelon Response:
See Exelon response to NPS 1 regarding methodology used for the recreational use study.

MDNR Comment 5:
"Also for Objective 3, no enhancements were discussed. Use of a facility does not mean that improvements or additions cannot be made."

Exelon Response:
See Exelon response to PFBC 5 regarding enhancements/improvements.

MDNR Comment 6:
"Recommended measures for additional study: Upgrades to Lapidum restroom (a Clivus Multrum composting system). Replace fixtures: waterless toilets/urinal and lighting; paint exterior trim; replace doors, upgrade mechanical systems. Construct Lapidum Contact station to provide information to anglers/boaters and other visitors. This is a main contact point for I-95 corridor visitors to the Lower Susquehanna River. Improve Deer Creek access points along Stafford Road. Add stone fill to pull-offs and re-grade for drainage, incorporate sustainable trails to fishing access points, repair "canoe launch" at Deer Creek and Susquehanna River confluence. Lower Susquehanna Heritage Greenway: Repair ~500LF section of boardwalk trail laid on top of rail road bed. Railroad ties are rotting and being shifted by water during storm events making entire boardwalk unstable. Not currently an immediate safety concern. Replace interpretive panels at Lapidum."

Exelon Response:
See Exelon response to PFBC 5 regarding enhancements/improvements.

M-DTS Comment 1:
"The Conowingo Hydroelectric Project, FERC Project No. 405: Initial Study Report failed to mention the fact the trail was on roads in the vicinity of the dam and request had been made to relocate the trail. On March 1, 2011 comments were submitted to FERC about this omission in the study report. We look forward to working with Exelon to relocate the trail to a safe route that does not impact the Dam's security."

Exelon Response:
See Exelon response to NPS 3 regarding the relocation of the Mason-Dixon Trail near Conowingo Dam.

3.27 Shoreline Management
NPS, USFWS, MDNR and PaDEP submitted comments on the Shoreline Management (RSP 3.27) initial study report.

NPS Comment 1:
"The Shoreline Management Reports identified abutting land uses within 500 feet of the project boundary, which is inadequate, as it does not take into account visual and auditory impacts. The entire recreation report only looked at what is in the project boundary now, there was no evaluation of current or future needs or trends in the areas abutting and nearby to the project boundary. During the ISR meetings in March, 2011, the licensee's consultant explained that they had based their conclusion on future recreational needs and trends on the United States Forest Service 50-year growth projections. Such data present only the broadest look at trends, and the state representatives from both PA and MD stated during these meetings that they have far more pertinent, local and regionally specific data showing significant growth pressure, but the consultants had not contacted any of the relevant resource agencies or local and regional non-government organizations when they did their studies. In addition, the current information contained in 3.27 does not show sensitive areas, such as wetlands, trails and steep slopes. The Conservation Land Initiative referenced above should have been a major source of data in order to develop a complete picture of the need for and opportunities to protect and conserve project and adjacent lands in the project areas and within the project boundaries."

Exelon Response:
Visual and auditory reviews will be conducted if it is determined, during continuing consultation, that there is an impact being created to areas located adjacent to the projects. However, Exelon has already conducted a visual and noise assessment for the Muddy Run Project (see Study 3.14), which also encompasses many areas of the Conowingo Project shoreline. Sensitive areas based on existing data and other licensing studies will be included in the shoreline management plan.

NPS Comment 2:
"The RSP's should include reference to the above referenced collective efforts (CLI) at the federal, state and local level, and should evaluate opportunities for conservation and protection of lands owned by the licensee in and adjacent to the project boundary, which are not integral to project operations, but whose protection would serve many of the goals set out in the Conservation Land Initiative."

Exelon Response:
Federal, state and local planning efforts regarding land management within the project areas will be addressed in the shoreline management plan.

NPS Comment 3:
"The presence of the Ferncliff Nature Preserve, which is listed in the National Registry of Natural Landmarks as a National Natural Landmark (NNL), should be noted in the RSP. In particular any potential changes in land uses or access to the Exelon owned abutting the Preserve should be identified, and evaluated in the context of protecting adjacent lands as part of the CLI."

Exelon Response:
The Ferncliff Nature Preserve will be noted in the sensitive resources in the shoreline management plan

MDNR Comment 1:
"In the Interim Shoreline Management Report, the Applicant does not specifically point out specific unique, sensitive and/or critical fish and wildlife habitat identified along the shoreline (Project land and land within 500 feet of the Project boundary) as they had been asked to do by FERC."

Exelon Response:
See Exelon response to NPS Comment 1regarding sensitive resources.

MDNR Comment 2:
"FERC approved the Applicant's RSP with certain modifications, including specifying that Tasks 1 and 2 of section 3.27.7 (methodology) should be expanded to identify unique, sensitive, and/or critical fish and wildlife habitat on the project shoreline. In the RSP, the Applicant points out that approximately 883 acres (36%) of Project lands contain Sensitive Resources, the same number and proportion that they included in the RSP. In the Interim report, they describe that the land categorized under "Class 5: Sensitive Resources" are "Project lands that contain and/or are managed or preserved for protection and enhancement of sensitive resources. Sensitive resources are defined as resources that are protected by the state, federal law, executive order. Sensitive resources also include other natural features that the Applicant considers important to the area of natural environment." Thus, unless no additional unique, sensitive, and /or critical fish and wildlife habitat was found, the lack of additional information and the consistent acreage and percentage suggests that expanded investigations and searches under Tasks 1 and 2 were not performed. Figures 3-1 through 3-6 of the Interim report do show the Project land and land within 500 feet of the Project boundary classified in the general "Sensitive Resources" category, but do not specifically indicate unique, sensitive, and/or critical fish and wildlife habitat."

Exelon response:
Information regarding sensitive resources is dependent upon data from other studies being conducted as part the licensing of the Project. This information was not available at the time the initial study report was submitted. Data from other licensing studies will be included in the Shoreline Management Plan.

3.29 Effect of Project Operations on Downstream Flooding

FERC and SRBC submitted comments on the Effect of Project Operations on Downstream Flooding (RSP 3.29) initial study report.

FERC Comment 1:
"For determining how project operations affect flooding levels and durations downstream of the Conowingo Project, a HEC-RAS model was developed that extends from approximately 1,350 ft downstream of Holtwood dam to the mouth of the Susquehanna River at the Chesapeake Bay. The model contains 28 cross sections from Conowingo dam to the Susquehanna River mouth; however, there is no explanation of the cross sections, model input parameters, or model calibration in the report. Please provide figures for the 28 cross sections, a table for the HEC-RAS model parameters, and figures and/or tables relating to the model calibration"

Exelon Response:
Exelon will provide the requested cross sections, model parameters and model calibration data in the updated study report.

MDNR Comment 1:
"We recommend additional modeling alternatives, such as pool drawdown to the absolute minimum FERC elevation, to provide the maximum range of change that would be possible for the 3 management alternatives evaluated."

Exelon Response:
Exelon questions the necessity of conducting an additional model run evaluating the maximum drawdown allowed by the current FERC license (101.2 ft NGVD 1929). The Peach Bottom Atomic Power Station begins experiencing cooling problems when the elevation of Conowingo Pond drops below elevation 104.2 ft, NGVD 1929. Therefore, Conowingo Pond is never drawn down below this level. Given this constraint, analyzing an alternative that entails a drawdown to the minimum FERC license elevation seems unnecessary.

MDNR Comment 2:
We request further details on the hydraulic model, specifically how HEC-RAS was calibrated and confirmed with measured flood levels and whether a steady or unsteady flow model was used. We specifically want to know the range of uncertainty in flood levels expected for each of the event return intervals.

Exelon Response:
In accordance with FERC and MDNR comments, further details on the hydraulic model calibration will be provided. To provide an estimate of model uncertainty, comparisons between modeled stages and USGS gage rating curve elevations will be provided in the updated study report.

MDNR Comment 3:
"Also elaborate for alternative 2 how and when the various stated pond levels were targeted within the model"

Exelon Response:
Pond elevations were targeted by opening or closing crest gates based on pond inflows. Since all non-regulator gates were identical, this was done by calculating crest gate capacity based on pond elevation (e.g. 10,000 cfs at a given elevation) and determining how many gates needed to be open to pass the current inflow. The intent of alternative 2 was to see if simply maintaining the pond at lower levels

throughout the storm would reduce peak outflows by reducing pond elevation (and thus outflow) at peak flows. Thus, the targeted pond level was held throughout the entire model run. In reality, this did not work as well as intended because targeting a specific elevation simply lead to more gates opening and passing the same amount of flow.

3.30: Osprey Nesting Survey

MDNR submitted comments on the Osprey Nesting Survey (RSP 3.30) initial study report.

MDNR Comment 1:
Although the Study Plan referred to a second season of field study, "if necessary," the current report does not mention continuing the study.

Exelon Response:
Exelon is conducting a second season of field study in 2011, and will issue the updated study report characterizing results both 2010 and 2011 surveys.

3.31: Black-crowned Night Heron Nesting Survey

MDNR submitted comments on the Black-crowned Night Heron Survey (RSP 3.31) initial study report.

MDNR Comment 1:

Black-crowned night heron nesting was investigated in the project area comprised of the Conowingo Pool and Dam areas. Proposed methods were followed more closely in Pennsylvania, where the black-crowned night heron is state-listed as endangered. Field surveys were conducted on two dates within the proposed survey period (April 20 to May 1; although first survey date was April 19th), on dates least five days apart. Surveys in Maryland are presented as an afterthought following reports of herons at the dam. These surveys were conducted during June and well outside of the proposed survey period. No nesting herons were confirmed in either Pennsylvania or Maryland during the study. Although a second field season is referred to under Task 3 of the Study Plan, which describes reporting for the study, no mention of further field studies is mentioned in the report. Since the study is continuing for a second year, more attention should be paid to potential nesting in the lower portion of the study area that includes Maryland.

Exelon Response:

Exelon is conducting a second season of field study in 2011, and will issue an updated study report characterizing results both 2010 and 2011 surveys. More effort will be given to indentifying potential nesting locations in the lower portion of the study area.

3.32: Re-Evaluate the Closing of the Catwalk to Recreational Fishing

Commission staff, MDNR and the Riverkeeper submitted comments on the Re-Evaluate the Closing of the Catwalk to Recreational Fishing study (RSP 3.32) initial study report.

MDNR Comment 1:
We ask that the FERC require the Applicant to file the vulnerability and threat assessment report with FERC so that it can be independently evaluated by authorized agencies.

Exelon Response:
Exelon will maintain a copy of the vulnerability and threat assessment report at the Conowingo Project, where it can be reviewed by FERC staff.

FERC Comment 1:
As evidenced from the comments received at the Initial Study Report Meeting, the Conowingo catwalk is an important resource to local fisherman and closing the catwalk has resulted in the loss of a prime fishing location along the Susquehanna River. As such, Conowingo Study 3.32 was required to re-evaluate the reasons behind the catwalk remaining closed and determine if any possible measures could be put in place to allow the catwalk to reopen. The results of this study were also meant to help inform Conowingo Study 3.26, The Recreation Inventory and Needs Assessment, and help determine whether the fishing opportunities currently available at the Conowingo Project are adequate. As currently completed, Conowingo 3.32 does not meet these goals. The study results included in the Initial Study Report indicate that only a Vulnerability and Security Assessment was completed and while this information is important, the study needs to follow-through with an assessment of the feasibility of actually reopening the catwalk.

Exelon Response:
Exelon will conduct a feasibility assessment to analyze reopening the catwalk to recreational fishing.

MDNR Comment 2:
We ask that the FERC require the Applicant to conduct a feasibility analysis, based on the vulnerability and threat assessment results, as was specified in the approved study plan.

Exelon Response:
See Exelon response to FERC comment 1.

Riverkeeper 1:
This study, or lack thereof, completed avoided the point of the study. The purpose of the study was: conduct a feasibility analysis to evaluate re-opening the Conowingo Project catwalk for recreational fishing by the general public. The original license of the Conowingo Dam gave this catwalk to the citizens who were negatively impacted by the project. The objective of this study was to determine what efforts would have to be made to allow the applicant to fulfill their requirement for being allowed to operate the project. Other catwalks on the lower Susquehanna River dams have not been closed to the public for "national security" reasons. No evidence was provided for the need of closing the catwalk, and no cost/benefit analyses were provided to show due diligence in this matter. Again, the applicant shows its disdain for the citizens that are impacted by the project.

Exelon Response:
Exelon will conduct a feasibility assessment to analyze reopening the catwalk to recreational fishing.

Attachment B-Distribution List for FERC Project No. 405

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Attachment C-Responses to Agency Comments on Conowingo 3.19-Freshwater Mussel Characterization Study

3.19 Freshwater Mussel Characterization Study

FERC, American Rivers, the USFWS, and MDNR submitted comments on the Freshwater Mussel Characterization Study below Conowingo Dam (RSP 3.19) initial study report.

FERC Comment 1:
In the February 2010 Study Plan Determination, staff recommended that Exelon deposit voucher specimens collected during sampling into a state or regional museum. The Initial Study Report states that "[s]amples of the dead shells were collected as voucher specimens for transfer to MDNR and deposit in a museum." Please specify where voucher specimens will be permanently deposited.

Exelon Response:
The voucher specimens will be permanently deposited in:

Delaware Museum of Natural History
4840 Kennett Pike
P.O. Box 3937
Wilmington, DE 19807
www.delmnh.org

FERC Comment 2:
The December 22, 2009 Revised study Plan states that "[r]epresentative individuals of each species will be photographed." Please provide diagnostic photographs for each species observed during this study.

Exelon Response:
Photographs will be provided in the updated study report.

FERC Comment 3:
You conclude in the Initial Study Report that "...any effects of the Conowingo Project operation on the downstream mussel community are not discernable and likely not ecologically significant." It is not clear that the data collected for this study support this broad conclusion, particularly without additional historic data for comparison. For instance, figures 4.2-2 and 4.2-3 of the Initial Study Report indicate more mussels per search hour in the semi-quantitative surveys with increasing distance from the dam; a similar pattern is reported for the quantitative surveys. An alternate interpretation of these data could be that Conowingo Project operation inhibits the ability of freshwater mussel populations to remain established in proximity to Conowingo dam, suggesting a project effect. However, it is understood that substrate type also influences the distribution of freshwater mussels within the project boundary. Please include a more detailed discussion of available habitat within the project boundary, and how this may influence the freshwater mussel distributions reported in this study.

Exelon Response:
FERC and several other reviewers have commented on the apparent downstream increase in the number of mussels per search hour recorded in the semi-quantitative survey. FERC has suggested in its comment that available habitat may play a role. Habitat mapping and how it was used to select the semi-quantitative survey stations is described in Exelon's Response to FERC Comment 5. Discussion of habitat in the study reach and the role that it may play in defining the mussel community in the study reach are discussed in this response.

Most of the non-tidal part of the study reach and part of the upstream end of the tidal part of the study reach is quite rugged, consisting of boulders and massive bedrock formations with strong water currents, even at relatively low flow. The only substrate materials (sand and gravel) likely to support mussels is present in small deposits located behind boulders and in low points between and on top of bedrock formations. Larger quantities of sand, gravel, and cobble are present at the confluence of Octoraro Creek and along the shoreline of islands located along the river‟s east shoreline. Bedrock and small and large boulders also are present. Secondary channels located between the islands and the river‟s east shoreline contain sand, gravel, cobble, boulder and bedrock with occasional silt deposits. River bottom in the tidal part of the study reach is dominated by bedrock and boulders at its upstream limit, with sand, gravel, and cobble present downstream. There are several islands located in the tidal part of the study reach, with shorelines containing cobbles and boulders with interstitial sand and gravel.

The non-tidal part of the study reach is a high energy environment in which water flow scours the river bottom. Water flow velocity is reduced in the non-tidal part of the study reach.

The rugged river bottom conditions that are present now may have been present for a long time. The Conowingo 3.15 Sediment Introduction and Transport Study states in its Executive Summary: "Prior to the construction of Conowingo Dam, the river in the Project area was likely very similar to the condition of the river today downstream of the dam. A natural barrier existed at the site of the dam, and flow was strong enough to inhibit sediment deposition until near the mouth of the river." Further discussion of available habitat in the study reach and how this may influence mussel distributions will be provided in the updated study report.

FERC Comment 4:
During the Initial Study Report Meeting and the follow-up conference call on the Freshwater Mussel Characterization Study (March 25, 2011), there were several questions on the experience level of the researchers conducting the field work. Please consider including each researcher's resume as an addendum to the report that supports their experience with sampling and identification of freshwater mussels, particularly species found within the Lower Susquehanna River.

Exelon Response:
Attachment D contains resumes for seven Normandeau biologists who conducted the Conowingo mussel study. Four other biologists functioned as boat operators/radiomen. Resumes for these individuals are not included because they were not responsible for mussel identification, nor for survey.

William S. Ettinger (the Principal Investigator) led the overall effort. Mr. Ettinger is an aquatic biologist with 37 years of experience conducting macroinvertebrate and other studies in fresh, estuarine, and marine environments. He has led freshwater mussel surveys since 2001, including several in the mainstem Susquehanna River, and he is competent in identification of Susquehanna River mussels. His resume is abbreviated (compared to the other resumes) in that only mussel surveys (18) and mussel habitat surveys (2) are listed. Mr. Ettinger led the wading party in the field during the semi-quantitative survey, assisted by Don Mason and Mike Mettler. Both men are competent in identification of Susquehanna River mussels. Mr. Mason has conducted at least 15 mussel surveys since 1997. Mr. Mettler has conducted 9 mussel surveys since 2001.

Alan Frizzell led the diving party in the field during the semi-quantitative survey, assisted by Erik Fel‟Dotto and Chris Baker. Each of the men is a biologist and SCUBA diver. All three men are competent in identification of Susquehanna River mussels. Mr. Frizzell has conducted at least 14 mussel surveys since 1997, Mr. Fel‟Dotto has conducted at least 12 mussel surveys since 2001, and Mr. Baker has conducted at least 8 mussel surveys since 2003. Many of them were conducted with Mr. Ettinger.

Mr. Ettinger led the quantitative survey party in the field, assisted by Mr. Mettler and Bryan Lees. Mr. Lees is an aquatic biologist with much field experience, particularly in collection of benthic macroinvertebrates, but with little experience in mussel identification. However, his inexperience in mussel identification was not a liability because Mr. Ettinger and Mr. Mettler saw and identified all mussels observed during the quantitative survey.

Reliable identification of all mussels observed was ensured in several ways. First, the species likely to be encountered in the study were identified in literature and museum search. Then, Mr. Ettinger reviewed shells of these species contained in the collections of the Delaware Museum of Natural History. Three biologists brought personal reference collections into the field for use as necessary. All of the study team reviewed the species the evening before the surveys began.

One morning during the semi-quantitative surveys, MDNR‟s Matt Ashton led a short discussion on distinguishing between eastern floater and alewife floater. Mr. Ashton offered this opportunity and the study team accepted it because it afforded an opportunity to sharpen identification skills.

During the semi-quantitative surveys, the wading party and the diving party surveyed independently. Each party was responsible for its identifications, with all three members of a party examining difficult mussels and then coming to agreement in identification. Any uncertain identifications beyond this point were discussed when the wading party and the diving party got together at the end of each day.

FERC Comment 5:
Please include a more detailed, clear discussion of how semi-quantitative and quantitative sampling locations were selected. If there were areas not sampled due to safety concerns or operation schedules, this should be explicitly discussed within the report.

Exelon Response:
Semi-quantitative Survey Station Selection
The approved Conowingo RSP states "The entire approximately 4.5 mile long study area in the Susquehanna River downstream of Conowingo Dam will be surveyed for mussels. Most of the river bottom is expected to be rocky (cobble, boulder, and bedrock), which is not preferred mussel habitat. Therefore, the survey effort will focus on search of deposits of finer material (mixed silt, sand, and gravel) which favor mussel burrowing. Nevertheless, the opportunity to find and identify mussels stranded on rocky substrate will not be ignored." It is stated up front that in the approved study plan that the surveys will focus on favorable mussel habitat. The semi-quantitative mussel survey was conducted at 72 locations selected using a habitat map of the non-tidal part of the study reach. This map, including an enlargement of the area near the confluence of Octoraro Creek, is included in this response as Figures 4.4.6-1 and 4.4.6-2. The non-tidal part of the study reach is approximately 3.5 miles in length. No habitat map was prepared for the approximately 1.0 mile long tidal part of the study reach.

Semi-quantitative survey stations were selected in the field in order to maximize the opportunity to locate and search substrate (sand, gravel, and cobble mix) most likely to support mussels. This was an important consideration because most (70%) of the non-tidal part of the study reach and part of the upstream end of the tidal part of the study reach consists of boulders and massive bedrock formations that are not preferred mussel habitat. Mussels in these river bottom conditions were likely to be encountered in small deposits of sand and gravel behind boulders and in low points in between and on top of bedrock formations, and there was concern that survey location selection randomly and *a priori* by use of a grid laid over a map might miss these isolated locations.

Despite the fact that the semi-quantitative survey stations were selected in the field, an effort was made to distribute the stations throughout the study reach and to allocate stations to all of the habitat compartments identified in Figures 4.4.6-1 and 4.4.6-2, approximately in proportion to their acreage in the study reach. How this was accomplished and the associated reasoning is described below.

The locations of these stations were the result of a decision to concentrate the survey effort where potential hydroelectric plant impacts would be expected to be the greatest, noting that habitat conditions seemed relatively uniform throughout the largest habitat compartment. The habitat compartments identified in the non-tidal part of the study reach and their total acreage and the total acreage of the tidal component of the study reach are shown in Table 1. As described two paragraphs above, the largest part of the non-tidal study reach (and the entire study reach) was habitat referred to as "ruffle" (a combination of the terms riffle and run) that is characterized as quite rugged, made up almost entirely of boulders and massive bedrock formations with strong water currents, even at relatively low river flow. This habitat compartment (P5) made up 46.2% of the total study reach. Twenty-four survey stations (33.3% of the total number of survey stations) were located in Compartment P5. Most (19) of these survey stations were located in the upstream two-thirds of Compartment P5, with five stations located in the downstream end of the compartment just upstream of the tidal/non-tidal waters boundary.

Tidal waters made up 34.3% of the study reach and 13 survey stations (18.1% of the total) were located in it (Table 1). These stations were located in the river‟s west channel, extending from west of Spencer Island upstream to near the upstream tip of Robert Island and downstream in the river‟s east channel to the downstream tip of Robert Island. No survey stations were located between Wood Island and the downstream two-thirds of Robert Island because of dense submerged aquatic vegetation in this area, which made motorboat navigation and mussel survey difficult. No survey stations were located in the river‟s east channel east of Spencer Island. This decision was based on belief that the habitat east of Spencer Island likely did not differ from the upstream habitat in the east channel or the habitat in the channel west of Spencer Island.

Habitat Compartment P5 and tidal waters made up a total of 80.5% of the study reach (Table 1). A total of 24 other compartments made up the remaining 19.5% of the study reach. Survey stations were located in 14 of them. Compartments P3 – Shallow Run and P4 – Shallow Pool, totaling 44.1 acres (2.9% of the survey reach), were the largest compartments not surveyed. These compartments, located along the river‟s west shoreline near the upstream end of the study reach, were characterized in the habitat survey as swift river current environments containing substantial bedrock and inadvisable to survey for safety reasons. It should be noted that survey results from the compartments located immediately upstream (P1 – deep run and P2 – shallow run) indicated only a total of 22 eastern elliptio (10.5 mussels per search hour) at three stations. The substrate conditions were described as 70-90% bedrock at these locations. Based on these observations, it is unlikely that Compartments P3 and P4 support many mussels. It also is unlikely that any species new to the study are present in these compartments.

Eight other habitat compartments that were not sampled totaled 4.6 acres, 0.3% of the study reach. Compartments P15 – Perched Backwater Pool, P16 – Vegetated Outcrop with Diverse Habitats, and O1 – Dry Side Channel were, in fact, terrestrial habitats that contained water only because they were submerged part of the time. The remaining five compartments (O2 through O4, O8, and O10) of shallow riffle, shallow pool, or deep pool were located at the Octoraro Creek confluence and were not surveyed because of substrate conditions (loose gravel or thick silt) unfavorable to mussels. These compartments totaled 2.7 acres.

The above discussion shows that the semi-quantitative survey station locations were selected in a planned and reasoned manner. The stations were distributed in the study reach with the largest numbers of them located in the two largest habitat compartments and the rest of them located in most of the other compartments. The compartments that were not surveyed were omitted due to safety concerns, temporary submergence, or substrate unsuitable to mussels. A total of 72 survey stations were searched for mussels in the 4.5 miles of study reach. This is an average of 16 stations per mile, or one every 330 linear feet.

Quantitative Survey Station Selection

Mussels were sampled quantitatively at five locations (stations) that were selected to represent an expected range of mussel density, based on the semi-quantitative survey results. These five locations corresponded to four particular semi-quantitative survey stations located nearby. The number of mussels observed per search hour at the four semi-quantitative survey stations was 45.7, 100.0, 234.7, and 317.5, which approximately evenly divided the range of the number of mussels observed per search hour (0 to 317.5) at the 72 semi-quantitative survey stations.

Two considerations were involved in quantitative survey station selection. First, to select locations representing the range of the number of mussels observed per search hour at the 72 semi-quantitative survey stations. Secondly, the physical conditions of the river bottom at the selected quantitative survey stations had to allow use of the sampling equipment and methodology. In other words, the river bottom substrate had to be relatively free of large boulders and bedrock that would make problematic the use of the 0.25 m^2 survey quadrat within a 15 meters by 30 meters grid established on the river bottom.

These two considerations were met by the selected quantitative stations. That most of these stations were located near the islands along the river"s east shoreline is largely based on river bottom substrate considerations. In fact, it should be noted that QS-5 was intended to be located closer to Semi-quantitative Station D-23, near the upstream end of Robert Island. However, it was necessary to move QS-5 closer to Robert Island so that it could be located in river bottom substrate in which the sampling could be conducted.

Two of the quantitative survey stations (QS-3 and QS-4) were located near Semi-quantitative Station D-26. Originally, it had been planned to locate only one quantitative survey station near an individual semi-quantitative survey station, although not stated explicitly in the study plan. However, a decision was made in the field to locate QS-4 upstream of QS-3 because it appeared that more mussels were visible on the surface of the river bottom at this location, compared to QS-3, thereby allowing an opportunity to measure mussel density in an area where mussel density was expected to be higher.

USFWS Comment 1:

It is unclear to us how the semi-quantitative survey sites were chosen. Although a habitat map was available, it does not appear that semi-quantitative survey sites were representative of all habitat types. While habitat information is interesting, it should be used to exempt areas within the study area from surveys. To adequately characterize the entire study area, all habitats should be sampled within established safety limits.

We note that the semi-quantitative survey sites should have been chosen randomly to represent the entire study area. Smith and Strayer (2003) details two types of sampling: Informal Sampling and Probability-Based Designs (Design-Based Inference). From the description of the methods in the ISR, it appears that the survey detailed in study 3.19 used informal sampling. Smith and Strayer (2003) write that "data collected using informal designs are of very limited use…informal sampling is most useful in preliminary surveys and for determining the presence of a mussel species at a site and should be avoided for other applications." They go on to describe several other methods of sampling that would have better characterized the freshwater mussel community below Conowingo Dam including simple random sampling, stratified sampling (sample sites could be stratified by wading and diving if cost is at issue), double sampling, two stage sampling, or distance sampling. The sampling design that most closely resembles the current method is double sampling for stratification (described on page 23 of Smith and Strayer 2003). Either a grid or transect lines should be laid over a map of the 4.5 mile long section of *river and sites should be chosen randomly. If stratification is desired, it should be entirely based on cost per unit effort not on habitat. Based on the catch per unit effort at a site, quantitative survey sites should be chosen to represent high, medium, low, and 0 mussel densities.*

Multiple search patterns were used in the semi-quantitative survey. We note that search methods should be standardized across all semi-quantitative survey sites. Either entire sections of the gird, transects, or 1 meter wide strips could be used.

According to the 3.19 report, quantitative surveys were conducted at 5 locations to represent the range in numbers of mussels observed during the semi-quantitative survey. This differs from the study design in which surveys were to be conducted in the areas with the highest density. It is unclear how quantitative survey locations were chosen. Methods should be described more clearly in a redraft of the report. Per comments in section 2, to best characterize the freshwater mussel community below Conowingo Dam, quantitative survey sites should be chosen to represent high, medium, low, and 0 mussel densities.
Data analysis was not clearly described. Was Dave Smith's mussel estimator program used to determine density and abundance? This was not detailed in the methods section of the report and needs to be addressed in a report redraft.

Measurement of habitat parameters should have been done where the quantitative sampling was conducted.

While no reference reach was used, there are examples in the literature of what healthy populations of freshwater mussel populations should look like. In addition, there are a number of studies of the effects of dam operations on freshwater mussels. It has been well documented that a change in operations can improve recruitment of mussels below dams. This literature should be detailed in the conclusions of a report redraft.

Exelon Response:
See Exelon Response to FERC Comment 5 and MDNR Comment 24. Habitat parameters were measured where the quantitative survey was conducted. This is indicated in Section 4.4 Habitat Parameter Measurements in the initial study report.

MDNR Comment 1:
The RSP states that "the results of searches for published and unpublished freshwater mussel locality records from the study area will identify species likely to be found in the survey area. With such information, the crew will be able to review a reference collection of shells of these species in order to better ensure reliable and consistent identification during the survey. However, it should be noted that all personnel conducting the survey will be experience in mussel survey and identification and that voucher specimens of all non-state and non-Federal listed species will be collected for deposit in a museum.

The report does not indicate that reference shell material was examined by personnel conducting the survey after compiling a list of species that were likely to be found. There are serious implications for management actions from even minimal levels of misidentification (Shea et al. 2011), especially in impact assessments. Additionally, no voucher specimens have been given to MDNR, which was a condition of the PI's scientific permit. Additional terms of the permit included contacting MDNR biologists when questionable live specimens were collected for specimen verification within 24 hours. This was not done even though the PI retained mussels for 24 hours for verification by MDNR biologists during a scheduled field visit.

Exelon Response:

Reference shell material was examined by personnel conducting the survey after compilation of a list of mussel species that were likely to be found. Exelon Response to FERC Comment 4 provides more information on assurance of proper mussel identification, including qualifications of the surveyors.

Voucher specimens will be provided to MDNR and then permanently deposited in:

Delaware Museum of Natural History
4840 Kennett Pike
P.O. Box 3937
Wilmington, DE 19807
www.delmnh.org

MDNR Comment 2:
The RSP noted that the entire 4.5 mile study area (to the downstream end of Spencer Island) be sampled. This was not done as clearly illustrated by Figure 4.2-1. Some areas representative of a small fraction of habitats (e.g. around the confluence of Octoraro Creek) were disproportionately sampled while other areas (Rueben Island to Steret Island and east of Spencer Island) were not sample at all. Throughout the study plan development period, we stressed to the PI that a single method be chosen, be clearly stated, and employed in the study because we suspected that the entire area would not be sampled. Based upon the habitat base map provided by the PI we suggested that the macrohabitat categories be used to proportionally stratify semi-quantitative sampling and were led to believe that this strategy would be used. We also noted that constrained area timed searches could be employed as noted in literature provided (Smith et al. 2001) to the PI during RSP development and through personal communication.

Exelon Response:
Although not stated in the initial study report, the semi-quantitative survey stations were proportionally stratified among the habitat compartments shown on the habitat base map. Several areas of the two largest habitat compartments contained no survey stations because the compartments were considered to be adequately surveyed elsewhere in the study reach. Exelon Response to FERC Comment 5 describes semi-quantitative survey station selection, including how the survey stations were proportionally stratified.

MDNR Comment 3:
How were semi-quantitative survey locations chosen? This was not specified in the RSP or report and does not appear to have followed methods mutually agreed upon between MDNR and the PI. There appears to be large areas of suitable mussel habitat that were not surveyed and poor spatial representation throughout the project area, including an emphasis on the shoreline, upper project reaches, and around the Octoraro Creek confluence. For example, sampling did not take place east of Spencer Island or west of Steret Island though both reaches are within project area and contain areas with suitable mussel habitat with known concentrations of mussels.

Exelon Response:
See Exelon Response to FERC Comment 5.

MDNR Comment 4:
The RSP also states that "the greater part of the survey effort will focus on searches of deposits of finer material which favor mussel burrowing." This was not done; lower portions of the study area contain large expanses of finer substrates, specifically the area from Robert Island downstream to Spencer Island and the channels between islands. We agree the prevailing substrate in the upper reaches of the project area are cobble, boulder, and bedrock, but a considerable amount of fine substrate exists in depositional areas and flow refugia that is patchy, but ubiquitous. The area terms "Ruffle" is the predominant

macrohabitat as classified by Normandeau and received relatively little sampling effort, even though our personal observation indicated that suitable mussel habitat and mussels are found throughout this habitat. We communicated this finding to the PI via email prior to the survey. In addition, mid-channel islands, where gravel substrates dominate and mussels are abundant, received very little attention compared to near shore islands. There also appears to be a bias towards sampling along the left descending half of the channel. We stressed during comment periods that a clearly defined allocation of survey effort be made (e.g., habitat stratification with proportional allocation or constrained areas searches throughout the reach). The PI should be familiar with these methods and references that provide examples (see review of methods in Strayer and Smith 2003, Smith et al. 2001, Villella and Smith 2005).

Exelon Response:
See Exelon Response to FERC Comment 5.

MDNR Comment 5:
Why were multiple search patterns used including parallel transects, perpendicular transects, and searches originating from a central point? It was stressed during comment periods that a consistent method be used. Smith et al. (2001) and Villella and Smith (2005), which are implicit throughout the RSP and were provided to the PI, clearly describe what type and how the search methods should be employed.

Exelon Response:
A variety of search patterns were used by the surveyors, including parallel transects oriented upstream, downstream, or at angles to river flow. In other instances, the surveyor"s movements were not parallel to each other, originating from a central point. These multiple search patterns were used because the rugged river bottom conditions present in much of the study reach prevented use of a uniform search pattern at many stations.

In the comment, MDNR refers to Smith, *et al.* (2001), a scientific journal article entitled "Survey protocol for assessment of endangered freshwater mussels in the Allegheny River, Pennsylvania", as guidance in search patterns to be used in semi-quantitative mussel sampling. The only guidance in Smith, *et. al.* (2001) that is apparent to the PI are statements that mussel search via snorkeling progressed in an upstream direction, whereas mussel search with SCUBA progressed in a downstream direction in the reported study. No guidance was given in regard to dealing with boulders or other river bottom obstructions.

MDNR Comment 6:
According to the RSP, "Areas where concentrations of mussels are found will be delineated as feasible and perimeters noted with a GPS field instrument. The first 100 individuals of Maryland S1-S3 species encountered will be tagged with a shell marker before returning them to the river bottom. After the first 100 individuals, 25% will be tagged. The locations of these species will be recorded, also, for addition to the habitat GIS coverage that already has been prepared." No figures illustrate that the perimeter of mussel concentrations were delineated or noted with a GPS. Please discuss why this was not conducted. The body of the report noted that 54 of 71 Alewife floaters were tagged, yet Table 4.2-5 indicates 68 of 71 were tagged. Please discuss this discrepancy and why all specimens were not tagged. The PI was granted authority to hold live mussels for up to 24 hours so tagging could have been done the following day if necessary. Also, no habitat maps were presented that include the locations of S1-S3 species. It is imperative that their location be reported to resource agencies and integrated into the flow modeling to assess whether or not dam operations limit mussel distribution and abundance.

Exelon Response:

No perimeters of mussel concentrations were delineated with a GPS field instrument because none were clearly defined. However, the locations of all semi-quantitative and quantitative survey stations were recorded via GPS-acquired coordinates.

The statement in the text of the initial study report that 54 of 71 alewife floaters were tagged is correct. Table 4.2-5 also is correct because it lists the tag numbers of 54 alewife floaters. There is a gap in the sequence of the tag numbers (036 through 049) that may confuse the reader.

Seventeen alewife floaters were not tagged because severe weather forced the study team to leave the river early one afternoon. Rather than confine the alewife floaters overnight in a dive bag and risk stressing them in the warm river water, the PI decided to return them to the river bottom to ensure their survival.

MDNR Comment 7:
There is no indication in the RSP as to how the quantitative survey areas were chose. The two-phase, double sampling design (Smith et al. 2001, Villella and Smith 2005) states that quantitative sampling areas should be chosen randomly. We have additional questions regarding the choice of quantitative survey areas as it was not clearly stated in the RSP despite several requests for further detail. Why and how were the specific CPUE's chosen? How was the size of the survey area determined? Why were they predominantly along the left descending bank? Why were they not chosen randomly as the survey methods (Smith et al. 2001) indicate? How were areas surveyed by divers in the semi-quantitative survey sampled by waders during the quantitative survey?

Random selection is necessary to reduce bias and it was agreed upon between Exelon, Normandeau, and MDNR that five areas would be sampled from strata representing no-low, moderate, and high CPUE and be approved by MDNR upon inspection of semi-quantitative data. This did not happen; a unilaterally decision on the location was made without allowing MDNR to review data. Further changes to site selection were made in the field. Furthermore, there appears to be investigator bias towards areas easily accessible and wadeable habitat. This would compound upon the apparent bias in the selection of semi-quantitative survey locations. A distribution analysis of the semi-quantitative results shows no locations with low CPUE were sampled; therefore the quantitatively sampled areas do not represent the full range of mussel abundance, or the range and frequency to be sampled that was agreed upon. The areas surveyed represent moderate to very high CPUE; two are within the 95th percentile of mussel CPUE. It also appears that in some cases, the location that was sampled in the semi-quantitative locations should also be noted on data sheets in Appendix B for clarity.

Exelon Response:
See Exelon Response to FERC Comment 5.

MDNR Comment 8:
In the report, five areas were said to be quantitatively surveyed. This number was agreed upon by the PI, Exelon and MDNR after the RSP was filed due to concerns over adequate sample size and coverage. However, according to the report one semi-quantitative survey location was chose to represent two quantitative survey locations. As a result, only four independent quantitative survey areas were sampled.

Exelon Response:
Five quantitative survey stations were established and quantitative sampling was accomplished at these locations. MDNR is correct that two quantitative survey stations were located near one semi-quantitative survey station. The reasoning for this is described in Exelon Response to FERC Comment 5.

MDNR Comment 9:

According to the RSP, "the first 100 individuals of Maryland S1-S3 species in each mussel bed will be tagged and their locations recorded with a GPS for addition to the habitat GIS coverage that already had been prepared." The report does not indicate that Alewife floater (S3) was tagged during the quantitative survey, nor was their location recorded with a GPS. Habitat maps with this locality data were not provided.

Exelon Response:
Only three alewife floater were found during the quantitative survey. They were returned live, but not tagged, to the river bottom where they were found. None were tagged because so few were found. GPS coordinates for their locations were not reported in the initial study report, but will be provided in the updated study report.

MDNR Comment 10:
Was a 1.5 mm sieve screen used as this is incredibly small? A 6 mm sieve screen is standard. It also should be noted that a benthic macroinvertebrate sieve pan was originally used because the PI did not have a standard sieve box used in mussel surveys. One was provided by MDNR.

Exelon Response:
The 1.5 mm mesh screen was not used to sieve the quantitative samples. In fact, MDNR‟s 6 mm mesh sieve box was used. MDNR offered use of this sieve box in the field and the offer was accepted, largely because MDNR‟s sieve box was lighter in construction and somewhat easier to use than Exelon‟s contractor‟s sieve box that contained the same mesh.

The study plan did not have a sieve mesh size specified in it. Therefore, Exelon‟s contractor did have a smaller mesh sieve available in the field in case MDNR requested its use in order to capture smaller mussels than would be retained on standard 6 mm mesh. However, MDNR indicated that use of 6 mm mesh was satisfactory.

MDNR Comment 11:
A range of substrate sizes and their corresponding classes are not provided.

Exelon Response:
The range of substrate sizes and their corresponding classes are:

Substrate Type	Size Class (metric)	Size Class (English
Detritus/Organic	NA	NA
Mud/soft clay	NA	NA
Silt	< 0.062 mm	< 0.00244 in
Sand	0.062 – 2 mm	0.00244 – 0.0787 in
Gravel	2 – 64 mm	0.0787 – 2.52 in
Cobble/rubble	64 – 250 mm	2.52 – 9.84 in
Boulder	250 – 4000 mm	9.84 – 157.5 in
Bedrock	NA	NA

These will also be provided in the initial study report.

MDNR Comment 12:
Discharge the day of sampling was not reported for any task.

Exelon Response:

The Semi-quantitative Survey was conducted on August 9-13, 2010 and the Quantitative Survey was conducted on August 31 and September 1-3, 2010. River discharge, as measured by the Conowingo USGS gage, was approximately 5,500 cfs during these surveys on all dates. This information will be included in the updated study report.

MDNR Comment 13:
In light of the fact that the quantitative sampling found nearly all the Eastern elliptio < 50 mm in excavations and that 50% of the mussels were found buried, had only an informal visual search been used, as was originally requested, how would the study results been affected (Richardson and Yokley 1996, Miller and Payne 1993)? Was the project area population, especially smaller individuals and uncommon species, adequately sampled to answer project objectives with the relatively few quantitative samples? Given the fact that only three species were detected and smaller individuals were nearly absent, we feel this clearly illustrates enough effort was not expended in quantitative sampling (Miller and Payne 1998, Smith et al. 2000).

Exelon Response:
MDNR‟s comment largely questions adequacy of the quantitative survey effort in locating small mussels (e.g., ≤ 50 millimeters in shell length) as well as detecting species present in relatively small numbers. In response, it is informative to compare with Exelon‟s quantitative data, a dataset recently obtained from MDNR. MDNR emailed quantitative mussel survey data (Ashton and Devers unpublished data) obtained by MDNR, USFWS, and USGS personnel on August 3, 2010 in a gravel-cobble shoal located along the river‟s east shoreline, upstream of the VFW post on MD Route 222. This location is opposite Robert Island, approximately one-quarter mile downstream of the tidal/non-tidal waters boundary.

A total of 274 eastern elliptio were found in 396 0.25 m^2 quadrats that were sampled. Of these 274 eastern elliptio, 15 were ≤ 50 millimeters in shell length, or 5.5% of the total sample. In the Exelon quantitative sampling, a total of 110 eastern elliptio were found in 150 0.25 m^2 quadrats that were sampled. Of these 110 eastern elliptio, 8 were ≤ 50 millimeters in shell length, or 7.3% of the total sample.

In regard to adequacy to locate uncommon species, the Ashton and Devers unpublished data indicate that each of three species (eastern floater, yellow lampmussel, and eastern lampmussel) were represented by only one individual in the 396 samples. A small number (3) of one of these species (eastern floater) was identified in the 150 samples collected by Exelon. Yellow lampmussel and eastern lampmussel were not. However, because both of these species were identified in Exelon‟s semi-quantitative survey effort, they were not lost from the species list compiled for the study reach.

MDNR Comment 14:
The author used a reference of Eastern elliptio length at maturity from an oligotrophic Canadian Shield lake to make a statement regarding the population in a temperate, large river. Given mussel growth rates and length at age are highly variable (Lellis et al. unpublished data, Haag and Rypel 2010) why was such a comparison made? Furthermore, since this comparison was made, why were other catch-rates of Eastern elliptio from other studies not referenced to infer what could be a high catch-rate? There is considerable data available on Eastern Elliptio catchrates (Strayer unpublished data, Lellis et al. unpublished data, Strayer and Smith 2003, Villella and Smith 2005). Similar comparisons should have been made regarding species richness, relative abundance, assemblage composition, length-frequency distributions, and population densities.

Exelon Response:
As part of the updated study report development, Exelon will work with the stakeholders to determine if there are relevant studies from other rivers for comparison and to procure such data, if applicable.

MDNR Comment 15:

Serious questions about the agreed upon survey design and methods in Task 2 and 3 stem from the reliance upon Maryland DNR for survey design literature, improper citation of design literature, survey implementation logistics, and even equipment. For example, the report cites methods as Strayer and Smith (2003) when in fact this reference is a review of freshwater mussel sampling methods and not a primary source. The correct citation of the survey design is Smith et al. (2001). Comments were made to the PI regarding potentially improper and questionable survey method implementation during post RSP meeting and field visits. Because no assurances were given to agencies, coupled with the reliance upon agencies for survey references and proper equipment, and observed mistakes in survey implementation, we can only assume that the PI had never before conducted a survey of such a complex design. It has become evident from communications during RSP development, after observing the semi-quantitative and quantitative survey, and during the reporting period that he was unfamiliar with a survey of such effort, the two-stage double sampling survey design itself, and standard protocols and equipment for quantitative mussel surveys despite the assurances from Exelon about the qualifications of the primary surveyor. On how many prior occasions has the PI conducted freshwater mussel surveys using the specific methods employed? How many mussel surveys, regardless of method, have divers used in the study performed? How much experience does the dive crew have identifying mussels? Why did the PI not identify all mussels collected during Task 2 and 3? It is an accepted standard to have a single, qualified individual who holds the scientific collection permit identify mussels collected if others do not have several years' worth of experience.

Exelon Response:

See Exelon Response to FERC Comment 4, and MDNR Comment 10.

MDNR"s comment states that the initial study report improperly cited mussel survey design literature when Strayer and Smith (2003) was included, stating that this publication is "a review of freshwater mussel sampling methods and not a primary source". While it may be that Strayer and Smith (2003) is not a primary source, the publication"s title is *A Guide to Sampling Freshwater Mussel Populations* and it contains much detail on various survey designs, including the systematic sampling with multiple random starts design employed in the quantitative mussel survey.

MDNR Comment 16:

Page 5 - According to the report timed searches were conducted at 72 locations for a total of 87.4 person-hours. This equates to 1.2 person-hours per semi-quantitative survey. This may be an insufficient level effort when trying to locate species at low density and determine species richness (Metcalfe-Smith et al. 2000) and alone cannot assess population size, density, or potential impacts (Miller and Payne 1988, Miller and Payne 1993, Obermeyer 1998, Strayer et al. 1997, Strayer and Smith 2003).

Exelon Response:

The mean of 1.2 search hours per semi-quantitative survey station is recognized as a small number. Nevertheless, it is not considered an insufficient level of effort in a study reach that contains a large area of rugged river bottom where mussels were found only in isolated small patches of sand and gravel deposited behind boulders and in low points in between and on top of bedrock formations. In other instances, survey stations were located in small habitat compartments located near the confluence of Octoraro Creek or in small isolated pools located between islands and the river"s east shoreline. A measure of the sufficiency of the search time is the great similarity in the number and identity of mussel species recorded in Exelon"s study and by MDNR and Dr. Tom Jones in 2008-2010 as discussed in the initial study report"s Section 5.1.

MDNR Comment 17:

Pages 5 and 6 - Why are the semi-quantitative CPUE in Figure 4.2-2 and 4.2-3 presented in numerical order instead of longitudinal order (i.e. distance away from dam)? Numerical order is meaningless because the order of semi-quantitative survey locations does not proceed in a consistent direction. A single or additional figure would also be more appropriate to examine the overall CPUE regardless of survey method in relation to its true spatial location within the project area. The same could be said about the data presented in Tables 4.2-2 and 4.2-3. Measures of sample precision and error should be presented whenever noting a sample mean; either SE, CI, CV of mean CPUE for wading, diving, and overall values should be presented for each species and all mussels.

Exelon Response:
In retrospect, it may have been better to list the semi-quantitative survey stations in downstream longitudinal order in the appropriate tables and figures. An additional figure relating the numbers of mussels observed per search hour to spatial location in the study reach would aid in interpretation of the data. It also is agreed that measures of sample precision and error should have been provided with all computed means. The revisions will be made in the updated study report.

MDNR Comment 18:
Page 6 - Our data suggest that Alewife floater and Eastern floater are not found in an approximately 1:1 ratio as found in the study. In fact, we rarely encountered Eastern floater throughout the past few years in both semi-quantitative and quantitative surveys. This may indicate frequent misidentifications given the PI's past questions about ways to distinguish between these two species and an underestimate of the S3 Alewife floater.

Exelon Response:
Alewife floater and eastern floater can be difficult to distinguish. However, the PI is confident in identification of these two species. Compared to other semi-quantitative survey stations, larger numbers of eastern floater were found at the following stations – W-6 (8 individuals), W-15 (8), D-2 (8), D-23 (5), and W-14 (4). Most of these stations were located along the shoreline of islands where habitat conditions known to favor eastern floater may occur (sand or muddy substrates in slow-moving water).

Questions from the PI on ways to distinguish alewife floater and eastern floater may have been misinterpreted. One morning during the semi-quantitative survey, MDNR‟s Matt Ashton led a short discussion on distinguishing between the two species. Mr. Ashton offered this opportunity and the study team accepted it because it was offered an opportunity to sharpen identification skills.

MDNR Comment 19:
Page 6 - How did the author determine that CPUE >100 mussels/hour represented the "highest" catch rates? Since "high" CPUE's were only found at 8 of 72 stations (11%), this suggests that mussel abundance is low throughout most of the project area. In fact, twice as many semiquantitative areas contained five or fewer mussels (22% of stations), which further indicate that mussels are rare or absent from a sizeable portion of available habitats. The remaining 66% of stations had CPUE < 100 mussels/hour, which would be low according to the report. Catch-rates and density from other studies of Atlantic Slope mussel communities (Lellis 2001, Villella and Smith 2005, Strayer et al. 1994, Meyer unpublished data) should have been used to determine what represents high and low CPUE instead of an arbitrary designation.

Exelon Response:
The PI‟s intent was to identify those CPUEs that were the highest obtained in the semi-quantitative survey and, in fact, CPUEs > 100 mussels per hour were the highest observed. In retrospect, it may have been advisable to compare study values with CPUEs available elsewhere. However, Lellis (2001) and Meyer unpublished data are not readily available to the PI and perhaps to others.

MDNR Comment 20:
Page 7 - How did the author determine that habitat at locations with CPUE > 100 mussels/hour differ amongst one another and from many other locations? No data are presented that support such a statement or appeared to be collected from these locations beyond personal observation. It was also stated that the highest CPUE came from areas near islands further downstream with the exception of one site, yet islands further upstream contained the lowest CPUE. Please elaborate on this pattern as the presence of islands within the river does not appear related to CPUE, but in fact is related to distance away from dam. We feel that the data clearly illustrate a distinct cline of increasing CPUE as you move further away from the dam, even when suitable habitat appears present. Furthermore, our CPUE data collected during July 2010 support this hypothesis.

Exelon Response:
See Exelon Response to FERC Comment 3.

MDNR Comment 21:
Page 7 - Stating a range of lengths are evenly distributed when it represents predominantly very large individuals is misleading. Figure 4.2-4 does not illustrate a normal distribution or is evenly distributed, but is in fact skewed towards a population that does not represent all life stages of mussels when taking into account some reproduction likely takes place within in the project area. The author should also not speculate on age at length given no data on growth or age at length were collected or referenced. Furthermore, without indicating where in the study area juvenile mussels were found, speculating on their potential dispersal source is inappropriate.

Exelon Response:
The statements in the initial study report that "the alewife floater were relatively large (80-137 mm) and evenly distributed along the range of sizes", that "most of the eastern floater were in nearly the same range (80-135 mm) and evenly distributed with exception of the higher end where a total of twelve 110 and 155 mm individuals were observed", and "the yellow lampmussel were very evenly distributed from 63 to 108 mm" clearly apply only to the shell length size ranges that are enumerated. These statements do not refer to mussels smaller or larger than the size ranges enumerated. Clarifications will be provided in the revised study report.

No statement was made in the initial study report that Figure 4.2-4 illustrates a normal distribution, nor that there is an even distribution of mussels across shell length. Neither page 7 nor the entire Section 4.2 Semi-Quantitative Mussel Survey in the initial study report contains any speculation on age at length of any of the mussels found.

MDNR Comment 22:
Page 7 - How was < 71 mm determined to be a small Eastern Elliptio? Age at length (number of internal annuli from shell cross section) of Eastern Elliptio from Deer Creek found individuals of 70 mm in length to be 23-39 years old (Lellis et al. unpublished data), and in the Delaware River ranged from 11-34. This data from several populations within the Susquehanna and Delaware River basins suggests Eastern elliptio growth rates, maximum length, and maximum age are highly variable among populations.

Exelon Response:
An eastern elliptio <71 mm in shell length is a small mussel when the others are measured in the range of 71 to 170 mm in shell length. It is understood that eastern elliptio growth rates, maximum length, and maximum age are variable among populations.

MDNR Comment 23:

Please comment on the semi-quantitative results in regards to search method, which illustrates a potential difference between the effectiveness of wading versus diving. The highest catch rates, except one, came from diving surveys. If more or all survey effort were put into a single search method (diving), as was stressed during the comment periods, more mussels may have been found. Data also suggest certain species were collected more effectively by diving versus wading (e.g. Yellow lampmussel). Availability of Normandeau divers should not have limited survey effort if diving was a more effective and appropriate search method. Surveys should have been postponed until they were again available or additional divers should have been contracted.

Exelon Response:
MDNR assumes that all surveys conducted by the diving team employed SCUBA gear. In fact, this was not the case. SCUBA gear was employed in water depths generally in excess of 4 feet. In shallower depths, the diving team used snorkels. It should be noted that it is stated in the initial study report that the diving team used SCUBA gear at survey locations in deeper water and masks and snorkels where depth permitted. Furthermore, the semi-quantitative survey results are listed by wading team stations and diving team stations in Tables 4.2-2 and 4.2-3, respectively, not by the gear employed.

Use of both snorkel and SCUBA gear in the same survey is commonplace. MDNR often refers to Smith et al. (2001), a scientific journal article entitled "Survey protocol for assessment of endangered freshwater mussels in the Allegheny River, Pennsylvania", as guidance in proper conduct of mussel surveys. Both snorkel and SCUBA gear were used in the reported survey.

MDNR Comment 24:
Page 8 - How were the results in Table 4.3.1 generated; there is no reference to a method? Standard errors are relatively large in comparison to sample means; please discuss what may have caused this. Less than 2% of the area within each quantitative survey area was sampled; does the PI feel this was sufficient effort given the abundance estimates, high measures of error, and the fact that roughly 0.03% the total project area was quantitatively surveyed? Furthermore, does the PI feel results from such a small area and sample size are appropriate make conclusions about the entire project area in light of MDNR, USFWS, and USGS data that included a greater sample size and found higher abundance and richness along with more precise density and population estimates?

Exelon Response:
The statistical analysis of the quantitative data was conducted using the USGS Mussel Estimation Program, available at http://www.lsc.usgs.gov/aeb/2068/index.asp. It is believed that this program is widely used in analysis of quantitative mussel survey data.

It is informative to compare with Exelon"s quantitative data, a dataset recently obtained from MDNR. MDNR emailed quantitative mussel survey data (Ashton and Devers unpublished data) obtained by MDNR, USFWS, and USGS personnel on August 3, 2010 in a gravel-cobble shoal located along the river"s east shoreline, upstream of the VFW post on MD Route 222. This location is opposite Robert Island, approximately one-quarter mile downstream of the tidal/non-tidal waters boundary. Ashton and Devers unpublished data and the Exelon quantitative data collected in 2010 are listed in Table 2. Both sets of data are quite similar. MDNR"s total mussel density estimate (2.95 $\pm$ 0.23 mussels per meter^2) is within the range shown for Exelon"s five quantitative stations (2.13 $\pm$ 0.58 to 4.27 $\pm$ 1.18 mussels per meter^2). Five species were identified in the MDNR samples, whereas only three species were identified in Exelon"s samples. However, the same species (eastern elliptio and alewife floater) were the most abundant species in both sets of samples and in nearly the same relative abundance. The third species (eastern floater) identified in Exelon"s samples also was identified in MDNR"s samples. In addition, single individuals of two other species (yellow lampmussel and eastern lampmussel) were identified in

MDNR‟s samples, likely a result of the greater number of samples collected by MDNR (396), compared to Exelon (150).

Standard error often is expressed as a percent of the estimated sample mean, a statistic known as the coefficient of variation, or CV. The smaller the percentage, the more precise the estimated mean. CVs computed for total mussels and for eastern elliptio, only, at each of Exelon‟s five quantitative survey stations, ranged from 8.5% to 27.6% and 5.8% to 27.8%, respectively. CVs computed for total mussels and for eastern elliptio, only, in Ashton and Devers unpublished data were 7.8% and 7.6%.

In its comments, MDNR often refers to Smith, *et al.* (2001), a scientific journal article entitled "Survey protocol for assessment of endangered freshwater mussels in the Allegheny River, Pennsylvania", as guidance in proper conduct of quantitative mussel sampling. This article reports that CVs for the four species found in greatest density (a total of 88.9% of all mussels found) in quantitative sampling ranged from 13.6 to 23.1%, an interval very similar to that reported for the quantitative sampling in the initial study report.

MDNR Comment 25:
Data collected during the project period by MDNR using similar methods, but with greater effort over a larger area using more appropriate sample sizes, dispute the findings of the study and also highlight the high level of uncertainty in this study's findings, which can be attributed to smaller sample size, improper design implementation, and potentially a lack of survey effort in areas where freshwater mussels would likely be at their highest abundance and densities in the lower reaches of the project area. Though we expended a greater amount of daily effort (personhours), we found more individuals and more species. Our results also have lower variability, along with more precise density and population estimates. The PI was notified of this information as it became available during the study plan implementation and again prior to study report completion.

Exelon Response:
See Exelon Response to MDNR Comment 24.

MDNR Comment 26:
Several mussel species, including the state endangered Brook floater, Green floater, and Triangle floater, and in need of conservation Creeper, have been found in surveys conducted in upstream reaches of the Susquehanna River (Strayer and Fetterman 1999, Meyer pers. comm.) and were most likely historically present within the project area were not found in this survey.

Exelon Response:
No live individuals of any of the species listed in MDNR‟s comment were found in Exelon‟s mussel study. However, one dead (empty) shell of the creeper was found and this was reported in the initial study report. No dead (empty) shells of the other three species were found.

None of the four species were reported in the initial study report as found, either in terms of live individuals or dead (empty) shells, by MDNR and Dr. Tom Jones in 2008-2010. However, Ashton (2011) reported collection of dead (empty) shell(s) of the creeper in 2010.

MDNR Comment 27:
We conclude that: 1. The survey only partially accomplishes Goal 1 and fails to accomplish Goal 2.
2. By not quantitatively sampling from within the full range of mussel CPUE across spatially representative locations within project area the study is limited in its ability to make conclusions about the entire mussel population and potential effects by the operation of Conowingo Dam, especially that along the right descending bank and in the lower mile of the river, which may experience different

hydraulic forces and contain different habitat and species. Moreover, the apparent bias in locations of both the semi-quantitative and quantitative surveys further weakens the validity of the data. 3. Additional semi-quantitative surveys with divers for at least 1.2 and up to 2.5 person-hours per location is needed to properly characterize the mussels assemblage due to large areas of unsampled habitat within the project area, disproportionate sampling effort, and potential bias in survey locations. Specific areas to be targeted should be coordinated with resource agencies and include; east of Spencer Island, side channels between Wood and Robert islands, between Rueben and Steret islands along with Bird and Mud islands, and other areas where long distances (> 0.25 mile between survey locations) remain. 4. The sample size and area in quantitative surveys was insufficient to provide statistically acceptable levels of error in the density and population estimates, did not spatially represent the project area, were biased to the left descending bank, not randomly selected, and did not represent the range of CPUE observed. This took place despite persistent efforts by MDNR throughout the comment period and survey implementation to make the PI aware of these deficiencies. In addition, only four independent quantitative survey locations were sampled, though five were stated to be sampled.

Exelon Response:
See Exelon‟s Response under Section 3.19 Freshwater Mussel Characterization Study.

MDNR Comment 28:
Criteria for Modification of Approved Study [18 CFR 5.15(d)]: as indicated above, approved studies were not conducted as provided for in the approved study plan. Therefore we request the following modification of this study for 2011, based on how it was conducted in 2010:

Based on the comments and conclusions above, the study and its report are incomplete and can only be used to direct additional semi-quantitative and quantitative mussel sampling that should be carried out in 2011. There are substantial areas where semi-quantitative surveys were not conducted without justification. These areas should be surveyed in 2011; as Task 2 of the RSP noted, the entire 4.5 mile long reach would be surveyed regardless of habitat. In this task, a single, consistent sampling method (diving) and pattern must be used (line or strip transects parallel to flow). Pooled with the CPUE data from 2010, the areas to be quantitatively sampled (RSP Task 3) should then be re-evaluated and selected in direct consultation with resource agencies following the correct manor for the study design (two-phase with double sampling). The results of 2010 quantitative surveys should also be used to guide quantitative surveys in 2011, whose locations will be selected at random from the strata of catch-rates (high, medium, low to none) that represent of the range of CPUE, have appropriate numbers of quadrats to minimize sampling error, and be conducted with 50% excavation over larger expanses of mussel habitat. The number of quadrats, interval between systematic samples, and sample area should be determined by the Mussel Estimator Program based on input of preliminary data, and not determined arbitrarily, as this was a direct cause of the inadequate sampling effort that led to study deficiencies. In addition, the results of the flow modeling study (3.16) should attempt to be incorporated into the stratification so areas with varied levels of sheer stress are sampled to validate the flow model and support any future actions regarding the operation of the dam and its affects upon freshwater mussels. It is imperative this additional semi-quantitative and quantitative sampling effort must be planned and conducted with substantial input and oversight by resource agencies so that the deficiencies pointed out do not persist. Consequently, we strongly recommend that Exelon and Normandeau conduct appropriate mussel surveys using two-phase double sampling methods, in consultation with the resource agencies before and during the surveys (Smith et al. 2001, Villella and Smith 2005).

Exelon Response:
See Exelon‟s Response under Section 3.19 Freshwater Mussel Characterization Study.

REFERENCES

Ashton, M. 2011. Results from ongoing freshwater mussels surveys in the Susquehanna River and the first collection of *Dreissena polymorpha* below Conowingo Dam, Maryland. Ellipsaria 13(1): 15-16.

Ashton, M. and J. Devers. Unpublished data describing quantitative freshwater mussel sampling conducted in the Susquehanna River downstream of Conowingo Dam on August 3, 2010.

Smith, D.R., R.F. Villella, and D.P. Lemarie. 2001. Survey protocol for assessment of endangered freshwater mussels in the Allegheny River, Pennsylvania. Journal of the North American Benthological Society 20: 118-132.

Strayer, D.L. and D.R. Smith. 2003. A guide to sampling freshwater mussel populations. American Fisheries Society, Monograph 8, Bethesda, MD. 103 pp.

Villella, R.V. and D.R. Smith. 2005. Two-phase sampling to estimate river-wide populations of freshwater mussels. Journal of the North American Benthological Society 24: 357-368.

Table 1. Number of Semi-Quantitative Mussel Survey Stations by Habitat Compartment[1].

Habitat Compartment and Symbol	Study Reach Total Acres	Study Reach Percent Composition	Survey Stations Total	Survey Stations Percent Composition
P1 - Deep Run	24.8	1.6	2	2.8
P2 - Shallow Run	17.7	1.2	1	1.4
P3 - Shallow Run	28.5	1.9	0	0.0
P4 - Shallow Pool	15.6	1.0	0	0.0
P5 - Ruffle (Riffle-Run)	695.2	46.2	24	33.3
P6 - Shallow Run	32.0	2.1	4	5.6
P7 - Backwater	4.2	0.3	1	1.4
P9 - Deep Pool	70.9	4.7	6	8.3
P10 - Shallow Pool	37.9	2.5	3	4.2
P11 - Deep Pool	25.0	1.7	4	5.6
P12 - Side Channel	9.1	0.6	1	1.4
P13 - Side Channel	3.8	0.3	2	2.8
P14 - Side Channel	7.1	0.5	4	5.6
P15 - Perched Backwater Pool[2]	0.3	0.0	0	0.0
P16 - Vegetated Outcrop with Diverse Habitats[2]	1.4	0.1	0	0.0
O1 - Dry Side Channel[2]	0.2	0.0	0	0.0
O2 - Shallow Riffle	0.2	0.0	0	0.0
O3 - Shallow Riffle	0.2	0.0	0	0.0
O4 - Shallow Riffle	1.2	0.1	0	0.0
O5 - Shallow Riffle	0.4	0.0	1	1.4
O6 - Shallow Pool	2.9	0.2	3	4.2
O7 - Shallow Riffle	0.3	0.0	1	1.4
O8 - Shallow Pool	0.4	0.0	0	0.0
O9 - Interconnected Shallow Pools	8.3	0.6	2	2.8
O10 - Deep Pool	0.7	0.0	0	0.0
Tidal waters	516.0	34.3	13	18.1
Total	1504.2	100.0	72	100.0

[1] This compilation is for the entire 4.5 miles-long study reach. Note that Habitat Compartments P1 through O10 are located in non-tidal waters and that component habitat compartments in tidal waters were not determined. The non-tidal reach is approximately 3.5 miles in length, whereas the non-tidal reach is approximately 1.0 mile in length.

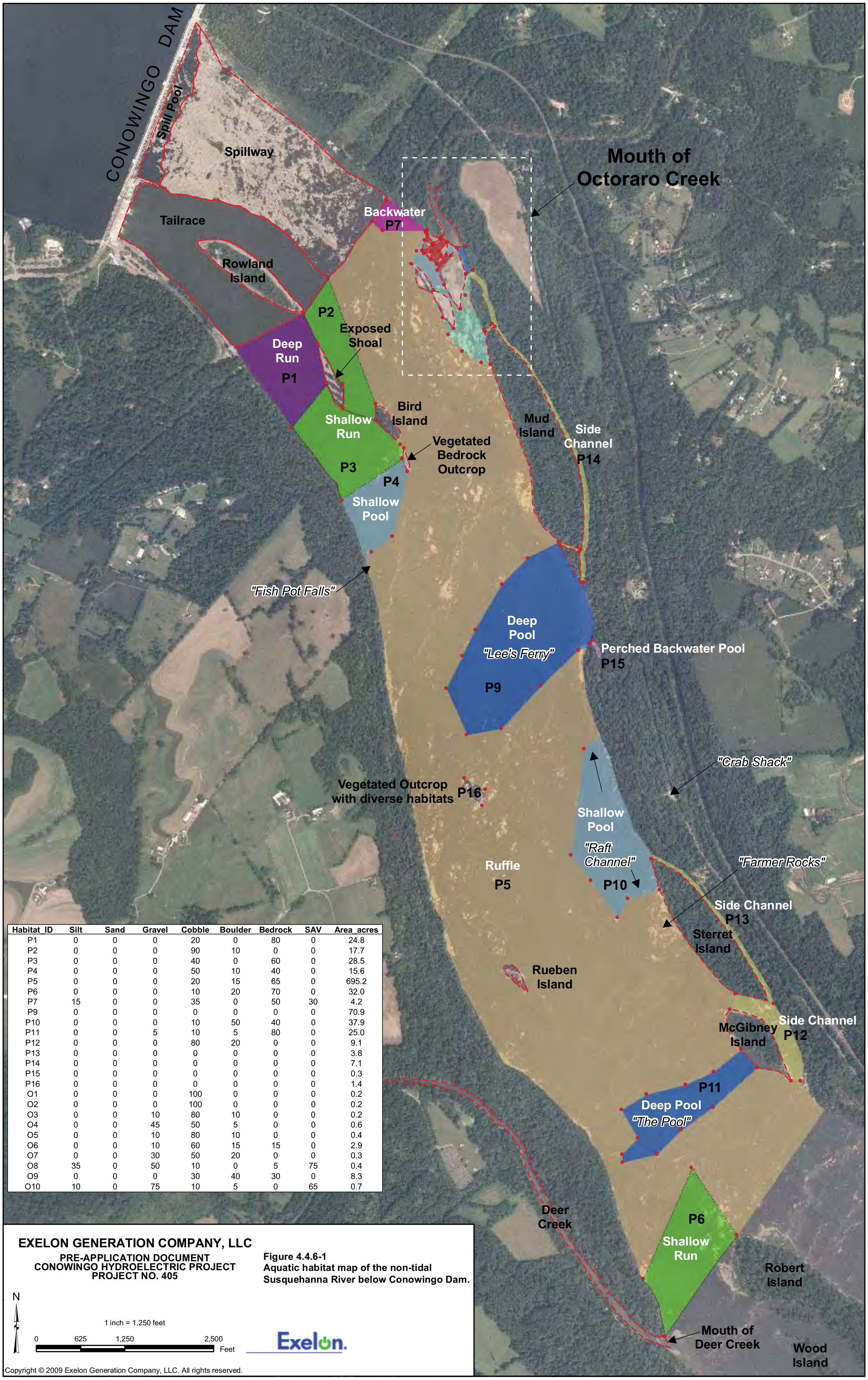
[2] Habitat Compartments P15, P16, and O1 are, in fact, terrestrial habitats that sometimes are submerged.

Table 2. Quantitative mussel survey data, including MDNR[1] data.

Exelon				MDNR		
Quantitative Station	Species	Density[2]	CV (%)	Species	Density[2]	CV (%)
QS-1	eastern elliptio	2.00 ± 0.46	23.0	eastern elliptio	2.77 ± 0.21	7.6
	alewife floater	0.13 ± 0.13	100.0	alewife floater	0.15 ± 0.03	20.0
	Total	2.13 ± 0.58	27.2	eastern floater	0.01	
				yellow lampmussel	0.01	
QS-2	eastern elliptio	1.73 ± 0.26	15.0	eastern lampmussel	0.01	
	alewife floater	0.13 ± 0.13	100.0	Total	2.95 ± 0.23	7.8
	eastern floater	0.27 ± 0.13	48.1			
	Total	2.13 ± 0.26	12.2			
QS-3	eastern elliptio	4.00 ± 0.23	5.8			
	eastern floater	0.13 ± 0.13	100.0			
	Total	4.13 ± 0.35	8.5			
QS-4	eastern elliptio	4.13 ± 1.15	27.8			
	alewife floater	0.13 ± 0.13	100.0			
	Total	4.27 ± 1.18	27.6			
QS-5	eastern elliptio	2.80 ± 0.61	21.8			
	Total	2.80 ± 0.61	21.8			
Total Number of Samples		150 (30 at each station)			396	
Total Number of Species		3			5	
Total Number of Individuals:						
eastern elliptio		110 (94.8%)			274 (93.8%)	
alewife floater		3 (2.6%)			15 (5.1%)	
eastern floater		3 (2.6%)			1 (0.4%)	
yellow lampmussel		-			1 (0.4%)	
eastern lampmussel		-			1 (0.4%)	
Total		116			292	

[1] These data received by email from Matt Ashton (MDNR) on May 11, 2011. They are taken from a Power Point entitled "Susquehanna River 2010". The data were collected by MDNR, USFWS, and USGS personnel and are Ashton and Devers unpublished data.

[2] Mean number per meter2 of river bottom ± 1 standard error.

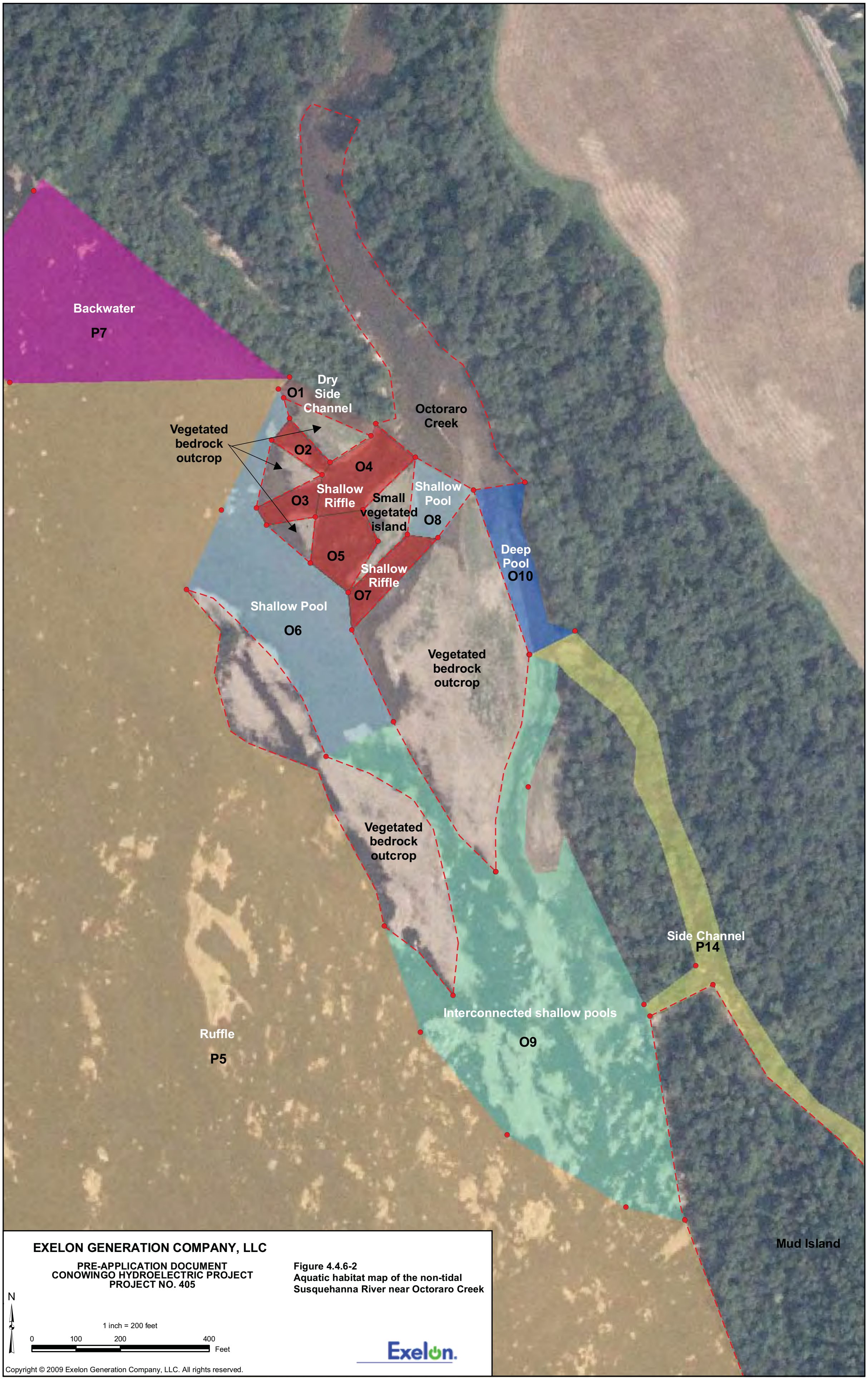


Habitat_ID	Silt	Sand	Gravel	Cobble	Boulder	Bedrock	SAV	Area_acres
P1	0	0	0	20	0	80	0	24.8
P2	0	0	0	90	10	0	0	17.7
P3	0	0	0	40	0	60	0	28.5
P4	0	0	0	50	10	40	0	15.6
P5	0	0	0	20	15	65	0	695.2
P6	0	0	0	10	20	70	0	32.0
P7	15	0	0	35	0	50	30	4.2
P9	0	0	0	0	0	0	0	70.9
P10	0	0	0	10	50	40	0	37.9
P11	0	0	5	10	5	80	0	25.0
P12	0	0	0	80	20	0	0	9.1
P13	0	0	0	0	0	0	0	3.8
P14	0	0	0	0	0	0	0	7.1
P15	0	0	0	0	0	0	0	0.3
P16	0	0	0	0	0	0	0	1.4
O1	0	0	0	100	0	0	0	0.2
O2	0	0	0	100	0	0	0	0.2
O3	0	0	10	80	10	0	0	0.2
O4	0	0	45	50	5	0	0	0.6
O5	0	0	10	80	10	0	0	0.4
O6	0	0	10	60	15	15	0	2.9
O7	0	0	30	50	20	0	0	0.3
O8	35	0	50	10	0	5	75	0.4
O9	0	0	0	30	40	30	0	8.3
O10	10	0	75	10	5	0	65	0.7

EXELON GENERATION COMPANY, LLC

PRE-APPLICATION DOCUMENT
CONOWINGO HYDROELECTRIC PROJECT
PROJECT NO. 405

Figure 4.4.6-1
Aquatic habitat map of the non-tidal Susquehanna River below Conowingo Dam.



EXELON GENERATION COMPANY, LLC

PRE-APPLICATION DOCUMENT
CONOWINGO HYDROELECTRIC PROJECT
PROJECT NO. 405

Figure 4.4.6-2
Aquatic habitat map of the non-tidal Susquehanna River near Octoraro Creek

Exelon.

x:\GISMaps\project_maps\pad\conowingo\Figure 4.4.6-2 (Aquatic Habitat Mapping).mxd 3/9/2009 2:31:06 PM

Attachment D-Resumes of Mussel Surveyors

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

WILLIAM S. ETTINGER

Branch Office Manager
Principal Aquatic Ecologist

Mr. Ettinger manages Normandeau's Lewes, DE office. His education and expertise are in aquatic, estuarine, and marine ecology, specializing in macroinvertebrates, physical habitat, hydrology, and water quality. He has wide experience in diverse areas of natural resource impact assessments and is currently responsible for evaluation of effects of acid mine drainage, dredging, industrial effluents, water diversion, and power plant operations on aquatic biota, particularly benthic macroinvertebrates. His experience includes freshwater mussel surveys (including federal and state-listed species), bathymetric data acquisition in several states, characterization of river bottom substrates using side-scan sonar, and survey of aquatic resources in support of waterfront redevelopment permitting.

EDUCATION

M.S.	1974, Entomology, Pennsylvania State University
B.S.	1972, Fundamental Sciences, Lehigh University

PROFESSIONAL EXPERIENCE

1983-Present	Normandeau Associates
1979-1983	Skelly and Loy
1974-1979	Ichthyological Associates, Inc.

PROFESSIONAL AFFILIATIONS

American Entomological Society
American Fisheries Society
Freshwater Mollusk Conservation Society
North American Benthological Society
Pennsylvania Academy of Science

SELECTED PROJECT EXPERIENCE

Exelon Energy, Inc. (2010-Present) – Survey of freshwater mussels in the Susquehanna River downstream of Conowingo Dam in Maryland in support of hydroelectric relicensing. This effort included semi-quantitative survey in a 4.5-mile river reach, followed by quantitative sampling in five selected areas within that reach. Search methodology included use of SCUBA in deeper water. Project Manager/Principal Investigator.

Environmental Solutions and Innovations, Inc. (2010) –Survey for dwarf wedgemussel and other mussels in the footprint of a proposed pipeline crossing of the upper Delaware River. Biologist.

Hunt Engineers, Architects & Land Surveyors, Inc. (2010) – Survey of freshwater mussels in the Chemung River at the Madison Avenue Bridge in Elmira, NY. The bridge project involved placement of scour protection around the piers. Project Manager/Principal Investigator.

Fisher Associates (2010) – Survey of freshwater mussels in the Chemung River at the Centerway Arch Bridge in Corning, NY. Part of the bridge project involved concrete repairs to the piers. Project Manager/Principal Investigator.

Aqua Pennsylvania, Inc. (2010) – Survey of freshwater mussels downstream of a lowhead dam in the Shenango River in Sharon, PA. The dam project involved repair of general deficiencies. Project Manager/Principal Investigator.

National Park Service (2009) – Survey of freshwater mussels and submerged aquatic vegetation at the Chesapeake and Ohio Canal National Historical Park in Pool 4 of the Potomac River. The project involved repair to an historic retaining wall along the river's one shoreline. Project Manager/Principal Investigator.

Matrix New World Engineering (2009) – Survey for dwarf wedgemussel (*Alasmidonta heterodon*) habitat in an unnamed tributary to the Paulins Kill, near Sparta, NJ. Project Manager/Principal Investigator.

Kleinschmidt Associates, Inc. (2008) – Survey for dwarf wedgemussel (*Alasmidonta heterodon*) habitat in Yards Creek, tributary to the Paulins Kill, near Blairstown, NJ, in support of hydroelectric relicensing. Project Manager/Principal Investigator.

AREVA NP, Inc. (2007) – Preliminary survey of mussels present in the Susquehanna River at Berwick, PA. This survey was conducted as part of electric utility intake and discharge structure siting. Principal Investigator.

Gannett Fleming, Inc. (2004-2008) – Survey of the fish and mussels present in the Susquehanna River at Wilkes-Barre, PA. This river reach would be affected by proposed construction of an inflatable dam. Project Manager/Principal Investigator

PPL Resources, Inc. (2006-2010) – Assessment of fly ash spill impacts to the mussel and periphyton communities in the Delaware River at Martins Creek Generating Station. The survey included search for mussels in shallow wadeable habitats and in deep pools with SCUBA at locations upstream and downstream of the fly ash entry point. Principal Investigator.

Hunt Engineers, Architects, & Land Surveyors, Inc. (2006) – Survey of freshwater mussels present in the Susquehanna River at Oneonta, NY. This survey was conducted on short notice in order to support NYSDOT's emergency stabilization of a riverbank below NYS Route 23. Water depth required use of SCUBA. Project Manager/Principal Investigator.

Kleinschmidt Associates, Inc. (2005) – Survey of mussels present in the Susquehanna River at Holtwood Dam as part of a hydroelectric relicensing effort. This survey was conducted in the impoundment (Lake Aldred) upstream of the dam and in the tailrace and free-flowing river downstream. Principal Investigator.

Skelly and Loy, Inc. (2003-2005) – Survey of freshwater mussels in the Susquehanna River in the vicinity of planned construction of a sewer force main river crossing. The effort was focused on search for two state species of concern, the green floater (*Lasmigona subviridis*) and the yellow lampmussel (*Lampsilis cariosa*) and, subsequently, relocation of these species from the project area. Because of waters in excess of 5 feet depth, SCUBA was required. Project Manager/Principal Investigator.

McFarland-Johnson, Inc. (2003) – Survey of freshwater mussels in the Chenango River in the vicinity of the I-81/NYS Route 17 interchange project in Binghamton, NY. The effort was focused on search for the NYS threatened species, the green floater (*Lasmigona subviridis*), and one federal species of concern, the yellow lampmussel (*Lampsilis cariosa*). Because of varied physical conditions, SCUBA as well as snorkeling was required. Project Manager/Principal Investigator.

STV, Inc. (2004-2010) – Survey of freshwater mussels and characterization of the fish community present in the Delaware River at the I-95 Bridge, West Trenton, NJ. Water depth required use of SCUBA. In addition, Section 7 Consultation on the federally-listed shortnose sturgeon. Project Manager/Principal Investigator.

Amy S. Greene Environmental Consultants, Inc. (2003) – Survey of freshwater mussels at several highway bridge crossings over the Paulins Kill and Wall Kill Rivers in Sussex County, New Jersey. The target species included the federally- and state-listed dwarf wedgemussel (*Alasmidonta heterodon*) and the state-listed triangle floater (*Alasmidonta undulata*). Project Manager/Principal Investigator.

Amy S. Greene Environmental Consultants, Inc. (2003) – Survey of freshwater mussels in the Raritan River at Raritan, Manville, and Somerville, New Jersey. Five prospective impact areas from sanitary sewer construction were searched, primarily for the state endangered species, the brook floater (*Alasmidonta varicosa*). Project Manager/Principal Investigator.

C&S Engineers, Inc. (2001) – Survey of a marina and the nearby Niagara River for three Federally-listed endangered mussel species – the clubshell (*Pleurobema clava*), the pink mucket (*Lampsilis abrupta*), and the fat pocketbook (*Potamilus capax*). The effort involved search by SCUBA divers as well as wading. Project Manager/Principal Investigator.

Allegheny Energy (2000) – Survey of mussels present in portions of Pools 4 and 5 of the Potomac River near Hagerstown, MD. This effort confirmed the presence of a state-listed endangered species (green floater – *Lasmigona subviridis*), which had not been observed for over 20 years. Principal Investigator.

SPECIAL TRAINING

Attended 1991 and 1992 Workshops on Freshwater Bivalves of Pennsylvania, presented by Dr. Arthur E. Bogan at the Carnegie Museum of Natural History, Pittsburgh, PA.

Attended 2008 workshop entitled Freshwater Mussels: Problems, Resources, and Taxonomy, presented by Dr. Arthur E. Bogan at the 2008 Association of Mid-Atlantic Aquatic Biologists meeting at Cacapon State Park, Berkeley Springs, WV, 2-3 April 2008.

Attended 2011 workshop entitled Identification and Taxonomy of Mussels, presented by Dr. Arthur E. Bogan at the 2011 Association of Mid-Atlantic Aquatic Biologists meeting at Cacapon State Park, Berkeley Springs, WV, 7-8 April 2011.

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

DONALD P. MASON

Aquatic Ecologist

Mr. Mason has over 25 years' experience assessing the effects of habitat alteration on aquatic ecosystems. His specialties include evaluating the effects of hazardous substances, hydropower, and commercial development on fish and benthic macroinvertebrate communities. Mr. Mason has conducted and managed studies using freshwater macroinvertebrates as pollution indicators, assessed the impacts of road and highway construction on aquatic communities, and searched for rare, threatened, or endangered mussels and other aquatic species.

EDUCATION

M.S.	1982, Entomology, University of New Hampshire
B.A.	1976, Biology, Plymouth State College

PROFESSIONAL EXPERIENCE

1985-Present	Normandeau Associates
1983-1985	Battelle New England Marine Research Laboratory
1982-1983	Normandeau Associates
1982	Charles T. Main, Inc.

PROFESSIONAL AFFILIATIONS

North American Benthological Society
New England Association of Environmental Biologists
Freshwater Mollusk Conservation Society

SELECTED PROJECT EXPERIENCE

Delaware River Joint Toll Bridge Commission (2010-Present) – Delaware River (PA/NJ) Scour Remediation Mussel Survey; Led a team of SCUBA divers to search for Rare, Threatened and Endangered (RTE) freshwater mussels near bridges that were scheduled for scour remediation. Since scour remediation efforts may adversely affect freshwater mussels near the rehabilitated piers, state-listed RTE mussel species were relocated to suitable habitat outside of the areas of impact. Responsible for obtaining and collecting permits; conducting the mussel search; relocating listed species to unaffected areas; and submitting reports to the PA Fish and Boat Commission and to the NJ Department of Environmental Protection, all on an expedited two month schedule.

Environmental Solutions and Innovations, Inc. (2010) – Delaware River Dwarf Wedgemussel Survey (PA/NJ); Provided technical expertise for a dwarf wedgemussel (*Alasmidonta heterodon*) survey for a proposed pipeline crossing over the Delaware River. The client was required by Pennsylvania Fish and Boat Commission and the U.S. Fish and Wildlife Service New Jersey Field Office to have a certified dwarf wedgemussel surveyor on the survey crew. Responsible for providing certified dwarf wedgemussel surveyor expertise.

Exelon (2010) – Susquehanna River Mussel Survey (MD); Provided freshwater mussel survey expertise for a survey downstream of Conowingo Dam on the Susquehanna River for the Conowingo Hydroelectric Relicensing Project. Field Biologist.

Florida Power and Light (2008-Present) – Fort Halifax Dam Removal Fish and Mussel Relocation Project (ME); Led a crew of 20 staff and volunteers to search for yellow lampmussel (*Lampsilis cariosa*) and tidewater mucket (*Leptodea ochracea*) as the Fort Halifax Dam was removed and the upstream impoundment was dewatered. Both of these species are threatened in the State of Maine. A total of 10,221 threatened mussels were relocated with less than one percent mortality. Project Manager.

Massena Electric Department (2007-2010) – Grasse River Benthic Macroinvertebrate and Mussel Survey (NY); Conducted seasonal benthic macroinvertebrate sampling throughout the Grasse River from Louisville to Massena, NY using kick nets (qualitative) and Ponar grabs (quantitative). Also, worked with SCUBA divers to qualitatively and quantitatively survey freshwater mussels (Unionidae) throughout the Grasse River during 2007, 2008, and 2009. A total of nine mussel species were identified. Technical Director.

PPL Resources, Inc. (2006) – Assessment of fly ash spill impacts to the mussel and periphyton communities in the Delaware River at Martins Creek Generating Station. The survey included search for mussels in shallow wadeable habitats and in deep pools with SCUBA at locations upstream and downstream of the fly ash entry point. Field Biologist.

Secor International Incorporated (2005-2006) - Baseline Investigation of the Little Mississinewa River (IN); Sediment in the Little Mississinewa River, Randolph County, IN is contaminated with PCBs from a former electrical manufacturer. Sediments at several locations along seven miles of the river will be dredged and replaced with clean material as remediation. Fish tissue and benthic macroinvertebrate community data were collected to establish baseline conditions prior to remediation. Principal Investigator.

South Shore Tri-Town Development Corporation (2001-Present) - Tri-Town Wildlife Surveys; This site, located on the former South Weymouth Naval Air Station property (MA), has areas contaminated with petrochemicals and demolition debris. Sampled the west branch of French's Stream to search for three species included on the Massachusetts Natural Heritage and Endangered Species Program list, the Mystic Valley Amphipod (*Crangonyx aberrans*), the Spatterdock (or Spring Blue) Darner (*Aeshna mutata*), and the Mocha Emerald (*Somatochlora linearis*). Specimens of the Mystic Valley Amphipod were collected on site, however neither of the dragonflies was found. Responsible for data collection and report preparation. Principal Investigator.

Beazer Homes Corp. (2006) - Andover Junction Brook Habitat Assessment and Mussel Survey (NJ); Assessed the aquatic habitat and conducted a freshwater mussel survey along 3,000 feet of streambed in Andover Junction Brook and an unnamed tributary stream, both located on a proposed planned unit development property in Andover Borough, NJ. This study was conducted to determine the species composition and relative abundance of the on-site mussel community and to determine whether Dwarf Wedge Mussel (*Alasmidonta heterodon*), a freshwater mussel included on the Federal List of Endangered Species, was present on the property. Project Manager.

Fryeburg Aquifer Resource Committee. (2006) - Baseline Investigation of Aquatic Biota in Wards Brook and Lovewell Pond (ME); Potential impacts associated with proposed additional water withdrawals from the Wards Brook aquifer, for commercial bottling, on the ecology of Wards Brook and Lovewell Pond was studied. Two of the primary ecological concerns addressed in this study included 1) the paucity of baseline information on the aquatic biota (fish, mussels, invertebrates) in Wards Brook and Lovewell Pond and, 2) impacts of groundwater withdrawal on these biota and water quality. Principal Investigator.

Upper Peninsula Power Company (2004) – Assessment of the Silver Lake Dam Breach on Downstream Mussel Fauna (MI); Led a crew of six investigators to assess the effects of the Silver Lake Dam breach on downstream mussel fauna. The survey was conducted along 32 miles of the river from Silver Lake to the river mouth at Lake Superior and included assessments of mussel habitat quality, species composition, and population density. A total of five mussel species were found throughout the study area, including cylindrical papershell (*Anodontoides ferussacianus*), giant floater (*Pyganodon grandis*), fatmucket (*Lampsilis siliquoidea*), eastern elliptio (*Elliptio complanata*), and white heelsplitter (*Lasmigona complanata*). Project Manager.

Vanasse Hangen Brustlin, Inc. (2003-2004) - Missisquoi Bay Bridge Project, Lake Champlain (VT) Freshwater Mussel Survey and Relocation; Surveyed and relocated Vermont state-listed threatened and endangered freshwater mussels that would potentially be impacted during construction of a bridge to replace the Route 78 causeway/bridge. A total of 418 mussels, including two Vermont state-listed endangered species, the Fragile Papershell (*Leptodea fragilis*) and the Pink Heelsplitter (*Potamilus alatus*), and one state-listed threatened species, the Giant Floater (*Pyganodon grandis*), were relocated using SCUBA divers to areas outside of the influence of construction activities. Responsible for leading the field crew and report preparation. Program Manager.

Vanasse Hangen Brustlin, Inc. (2000-2004) - Missisquoi Bay Bridge Project, Lake Champlain (VT); This multi-faceted study included studies on the movements of the state threatened spiny-soft shell turtle (*Trionyx spiniferus*) using radiotelemetry, a fish habitat and creel survey, and a state-listed freshwater mussel survey and relocation (see above) in relation to an existing causeway and a proposed new bridge. Responsible for data collection and report preparation. Crew Leader/Program Manager.

Public Service Company of New Hampshire (2003) - Merrimack River (NH) Brook Floater Survey; Surveyed 24 river miles using SCUBA divers, to search for populations of Brook Floater mussels (*Alasmidonta varicosa*), a NH state-listed endangered species. This study was conducted to evaluate the susceptibility of this species to impacts associated with hydroelectric generation and was the most extensive survey ever conducted for this species in the New Hampshire portion of the Merrimack River. This survey established several new records on the extent and location of brook floater populations in the Merrimack River. Responsible for leading the field crew and preparing the final report. Project Manager.

City of Manchester (CT) (1994, 1996, 1998) - A bioassessment of the fish and benthic macroinvertebrate communities in the Hockanum River was conducted as part of the discharge permit application for the Manchester, CT Sanitary Landfill and sewage treatment plant. Benthic communities were sampled using artificial substrate (rock basket) samples and kick samples, then analyzed separately using EPA's Rapid Bioassessment Protocol level 3 (RBP III). Fish data were analyzed using RBP level 5. Responsible for data collection, analysis, and report preparation. Aquatic Communities Technical Director.

Dexter Corporation (CT) (1997) - Surveyed 300 ft of streambed in Stony Brook (CT), near an aqueduct proposed for reconstruction, to look for Dwarf Wedge Mussels (*Alasmidonta heterodon*). *A. heterodon* is a federally listed endangered species that is sensitive to sedimentation and would have been adversely affected by construction activities. Responsible for conducting the field survey and report preparation. Project Manager.

New Hampshire DOT (1997) - Supervised a dive team that searched a section of the Johns River (NH), crossed by a bridge proposed for reconstruction, to look for Dwarf Wedge Mussels (*Alasmidonta heterodon*). *A. heterodon* is a federally listed endangered species which would have been adversely affected by construction activities. Responsible for project management, field data collection, and report preparation. Project Manager.

Smith College (1997) - Paradise Pond (MA) Dredging Mitigation Project; Worked closely with the client as well as State and Federal regulatory personnel to develop mitigation plans to alleviate impacts of dredging operations on a downstream population of Dwarf Wedge Mussel (*Alasmidonta heterodon*), a federally-listed endangered species. Technical Director.

City of Brockton (MA) (1997) - Supervised a dive team that surveyed the shoreline of Silver Lake, MA in search of two freshwater mussels included in the Massachusetts list of species of special concern, Eastern Pond Mussel (*Ligumia nasuta*) and Tidewater Mucket (*Leptodea ochracea*). Responsible for supervising the field crew and report preparation. Project Manager.

Northeast Maritime (1997) - Conducted a freshwater mussel search and evaluated mussel habitats in several streams that would be crossed by a gas pipeline in central Maine. The main purpose of this study was to identify habitats and populations of state and Federally listed rare, threatened, and endangered mussel species, primarily Dwarf Wedge Mussel (*Alasmidonta heterodon*), Brook Floater Mussel (*A. varicosa*), Yellow Lamp Mussel (*Lampsilis cariosa*) and Tidewater Mucket (*Leptodea ochracea*). Project Biologist.

SE Technologies, Inc. (1997) - Collected benthic macroinvertebrate data using EPA's Rapid Bioassessment Protocols level 2 (RBP II) and conducted an endangered aquatic species search near a closed electroplating facility to determine whether groundwater or surface runoff from the site was adversely affecting the aquatic biological community in Fivemile River (CT). Responsible for data collection, analysis, and report preparation. Project Manager.

SPECIAL TRAINING

OSHA 40-Hour Safety Certification

OSHA 8-Hour Safety Certification Refresher (Current)

Rapid Bioassessment Protocols (RBP)

Hazardous Material Supervisors Training (OSHA 29 CFR 1910.120)

First Aid and CPR

Habitat Evaluation Procedures (HEP)

SELECTED PRESENTATIONS

Mason, D.P. Survey for the Presence of Dwarf Wedge Mussels (*Alasmidonta heterodon*) in the Paulins Kill River, NJ. Presented to the 24th Annual Meeting of the New England Association of Environmental Biologists, March 2000, Jackson, NH.

Mason, D.P. and W.E. Hearn. Effects of fluctuating flows on benthic communities. Presented to the 37th Annual Meeting of the North American Benthological Society, May 1989, Guelph, Ontario, Canada.

Mason, D.P., S.L. Radke, K.T. Tracewski, and P.C. Johnson. Eclosion of gypsy moth (Lepidoptera: Lymantriidae) egg masses held under constant conditions as a function of sampling date. Presented to the 52nd Annual Meeting of the Eastern Branch of the Entomological Society of America, September 1980, Baltimore, MD.

SELECTED PEER-REVIEWED ARTICLES AND PUBLICATIONS

Haney, J.F., T.R. Beaulieu, R.P. Berry, D.P. Mason, C.R. Miner, E.S. McLean, K.L. Price, M.A. Trout, R.A. Vinton, and S.J. Weiss. 1983. Light intensity and relative light change as factors regulating stream drift. Archiv fur Hydrobiologie 97(1):73-88.

Mason, D.P. 1982. Physical and hydrochemical effects on stream insect communities in the White Mountain National Forest of New Hampshire. M.S. Thesis, University of New Hampshire, Durham, New Hampshire. 106 pp.

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

MICHAEL K. METTLER

Environmental Scientist

EDUCATION

B.S. 1996, Marine Science, Kutztown University

PROFESSIONAL EXPERIENCE

1996-Present	Normandeau Associates
1994-1996	Kutztown University, Housing and Residence Life Office

PROFESSIONAL AFFILIATIONS

Society of American Military Engineers (SAME)

Mr. Mettler has a wide range of training and experience in environmental sampling and measurement. He has operated echosounders, side-scan sonar, and global positioning system (GPS) equipment in bathymetric and sediment surveys of the Ohio River and other waters. In addition, Mr. Mettler collects groundwater and surface water, sediment, and soil samples for laboratory analysis.

Mr. Mettler has extensive biological sampling experience. He has surveyed fish communities using electrofishing, seining, and ichthyoplankton netting techniques and collected benthic macroinvertebrate samples with sediment grab samplers, box samplers, and kick nets. Mr. Mettler also has conducted surveys for endangered freshwater mussels.

SELECTED PROJECT EXPERIENCE

Exelon Energy, Inc. (2010-Present) – Survey of freshwater mussels in the Susquehanna River downstream of Conowingo Dam in Maryland in support of hydroelectric relicensing. This effort included semi-quantitative survey in a 4.5-mile river reach, followed by quantitative sampling in five selected areas within that reach. Search methodology included use of SCUBA in deeper water. Field Biologist

Monsanto/Conestoga-Rovers & Associates Inc. (2004 and 2008-Present) – Collect fish for a tissue contaminant study along 70 miles of the Kanawha River located in southern West Virginia. The fish were captured with an assortment of sampling techniques to include electrofishing, gill nets, and trot lines. All samples are collected and delivered to the client for processing and shipment to a subcontract laboratory. Field Biologist

Monsanto/Conestoga-Rovers & Associates (2007-Present) - Phase I of the Kanawha River EE/CA Work Plan required Normandeau to collect sediment from a 14-mile section of the Kanawha River. The Work Plan required the collection of 53 surficial sediment samples and 49 sediment cores using a submersible vibracore to a sediment depth of 10 feet. Phase II of the Kanawha River EE/CA Work Plan required Normandeau to collect 10 cores from the Kanawha River to a maximum sediment depth of 10 feet to be used as confirmatory samples. Field Crew Lead

Exelon Nuclear (2006-Present) – Assist with groundwater initiative for four Exelon nuclear facilities located in PA and NJ. Responsibilities include field oversight for the four mid-Atlantic facilities for the collection of ground and surface water samples. Task Manager

Exelon Nuclear (2005-Present) – Assist with program to monitor marine fish populations in the water supply and discharge canal at a coastal NJ nuclear electric generating facility during scheduled and unscheduled power outage events. The program requires surveying fish populations and determining their stress levels using underwater viewing cameras and fish collection surveys. Field Biologist

Anonymous Client (2001 - Present) – Assists with fish ichthyoplankton (IP) tow sampling on a 42-ft. trawler for an IP study on the Hudson River. Also conducted box trap studies and otter trawls. Field Technician

Waste Management, Inc. Landfills (1998-Present) - Environmental technician responsible for collecting groundwater, surface water, and leachate samples and monitoring methane levels of groundwater wells and landfill boundaries. Field Biologist

Hunt Engineers, Architects & Land Surveyors, Inc. (2010) – Survey of freshwater mussels in the Chemung River at the Madison Avenue Bridge in Elmira, NY. The bridge project involved placement of scour protection around the piers. Field Biologist

Fisher Associates (2010) – Survey of freshwater mussels in the Chemung River at the Centerway Arch Bridge in Corning, NY. Part of the bridge project involved concrete repairs to the piers. Field Biologist

Aqua Pennsylvania, Inc. (2010) – Survey of freshwater mussels downstream of a lowhead dam in the Shenango River in Sharon, PA. The dam project involved repair of general deficiencies. Field Biologist

National Park Service (2009) – Survey of freshwater mussels and submerged aquatic vegetation at the Chesapeake and Ohio Canal National Historical Park in Pool 4 of the Potomac River. The project involved repair to an historic retaining wall along the river's one shoreline. Field Biologist

U.S. EPA/Weston Solutions, Inc. (2009) - Under an EPA Region II RST Contract, Weston was tasked to investigate sediment in a portion of the Delaware River that runs behind the Roebling Steel Site in Florence, Burlington County, New Jersey. The work performed by Normandeau under the scope of work included the furnishing of all labor, equipment, materials, and other facilities and incidentals necessary to conduct vibracore borings at fifty-one (51) locations. Sample locations were subject to tidal influence. Field Team Lead

Independent Construction Materials (2008) - Conducted a hydrographic/bathymetric survey utilizing synchronized fathometer and DGPS mapping equipment in a flooded gravel quarry in Morgantown, PA. As part of the contract deliverables, we were able to supply the client a bathymetric contour map of the quarry within two days of completing the field survey. PM/Field Team Lead/Instrument Operator

AREVA NP, Inc. (2007) – Preliminary survey of mussels present in the Susquehanna River at Berwick, PA. This survey was conducted as part of electric utility intake and discharge structure siting. Field Biologist

Exelon Power (2005 - 2007) - Responsible for conducting fish entrainment and impingement sampling studies at five electric power facilities located in Pennsylvania and New Jersey, one nuclear and four fossil fuels facilities. Field Biologist.

PPL Resources, Inc. (2006-2010) – Assessment of fly ash spill impacts to the mussel and periphyton communities in the Delaware River at Martins Creek Generating Station. The survey included search for mussels in shallow wadeable habitats and in deep pools with SCUBA at locations upstream and downstream of the fly ash entry point. Field Biologist

CDM Federal/Hopewell (2006) - Work performed by Normandeau under this work assignment for CDM included the furnishing of all labor, equipment, materials and other facilities and incidentals necessary for the collection of 20 deep water samples from a lake and a pond in an abandoned gravel pit; measure bathymetry of the gravel pit; and measure thermal gradients of the two impoundments. Field Team Lead/Instrument Operator

Gannett Fleming, Inc. (2004-2008) – Survey of the fish and mussels present in the Susquehanna River at Wilkes-Barre, PA. This river reach would be affected by proposed construction of an inflatable dam. Field Biologist

Viacom (2004) – Normandeau Associates was contracted to conduct fish and crayfish sampling from three locations in Stout's Creek near Bloomington, Indiana. Sampling was conducted to obtain fish tissue samples from three locations near Bennett's Dump, and crayfish samples from one location. Fish were collected using a pram electrofishing unit. Field Team Leader

Pennsylvania Power & Light (2004) – Conducted a hydrographic/bathymetric survey utilizing synchronized fathometer and DGPS mapping equipment along several miles of the Susquehanna River in York County PA. Collected sub-centimeter horizontal positions and vertical elevations point data using an RTK GPS unit. Field Team Lead/Instrument Operator

Cummings/Riter (2004) – Collected sediment and soil samples from the Shenango River adjacent to a Superfund Site located in Sharon, PA. The project required collecting multiple sediment cores from 72 coring locations. Sample cores were collected using a submersible vibracore mounted on a work barge, S/S hand augers, and impact corer. Field Supervisor

C&S Engineers, Inc. (2001) – Survey of a marina and the nearby Niagara River for three Federally-listed endangered mussel species – the clubshell (Pleurobema clava), the pink mucket (Lampsilis abrupta), and the fat pocketbook (Potamilus capax). The effort involved search by SCUBA divers as well as wading. Field Biologist

U.S. Army Corps of Engineers, Huntington District (2001) – Operated echosounder and linked differential GPS to obtain bathymetric data in 110 miles of the Ohio River. Instrument and boat operator

U.S. Army Corps of Engineers, Nashville District (2001) – Operated echosounder and linked differential GPS to obtain bathymetric data in reservoir in western North Carolina. Instrument operator

Anonymous Clients (1998-2001) - Responsible for installing and operating fish entrainment and impingement sampling equipment for several studies at two large refineries in Delaware. Conducted day and night ichthyoplankton tows. Field Biologist

U.S. Army Corps of Engineers (1999-2000) – Study of survival of Juvenile Salmon through a hydroelectric turbine using radio-telemetry. The study was conducted at McNary and Bonneville Dams on the Columbia River, in the state of Washington. Field Biologist

CH2M Hill (Texas) (1998-2000) – As a part of the Port Arthur Remediation Team working at a refinery in Southeastern Texas, I worked on a assortment of projects that included sediment sampling with vibracoring equipment, surface sediment sampling with Ponar, pore-water sampling, surface water sampling, and soil sampling using direct push rig. Assorted responsibilities included Sample Team Leader, Site Safety Coordinator, and GPS operator.

New York Department of Environmental Conservation (1999) – Stock assessment study to monitor size, age, incidence of repeat spawning, sex ratio, and species composition of Alewife and Blueback Herring spawning populations in the Hudson and Mohawk River (NY) systems. Field Biologist

U.S. Army Corps of Engineers, Huntington District (1998) - Conducted a side-scan sonar survey of bottom sediment in 100 miles of the Ohio River and the entire navigable Kanawha River (WV). Side–Scan Sonar Operator

South Carolina Electric & Gas (1998) - Study of survival of juvenile herring passing through a hydroelectric turbine at the Columbia Station located on the Conagree River. Lead Chase Boat Operator

Corning-Asahi Video Products (1996-1998) - Conducted chronic whole effluent toxicity testing using *Pimephales promelas* (fathead minnow), and *Ceriodaphnia dubia* for NPDES permit compliance monitoring. The tests were conducted according to PA DEP regulations. Lab Technician

Merck and Company (1996-1998) - Conducted chronic whole effluent toxicity testing using *Pimephales promelas* (fathead minnow), and *Ceriodaphnia dubia* for NPDES permit compliance monitoring. The tests were conducted according to PA DEP regulations. Lab Technician

U.S. Army Corps of Engineers, Pittsburgh District (1997) - Conducted a side-scan sonar survey of 86 miles of the Ohio River using a high resolution sonar linked to differential GPS. Conducted a ground-truthing survey designed to correlate sonar signature with actual grain size as determined by use of an underwater video camera and Ponar grab sampling. Side–Scan Sonar Operator

SELECTED TRAINING

OSHA 40-Hour Safety Certification

OSHA 8- Hour Safety Certification Refresher (Current)

OSHA Confined Space Entrant, Attendant, Supervisor Certification

FEMA-Public Assistance Operation 1. IS-631 Certification

FEMA-Intro to Debris Operations in FEMA's Public Assistance Program. IS-632 Certification

FEMA-Special Considerations for FEMA Public Assistance Projects. IS-600 Certification

Advanced (PADI) Scuba Diver with Night and Drift Diver specialties

PA Fish and Boat Commission Boating and Safety Training

National Safety Council/ First Aid-Level 2 with blood-borne pathogens

National Safety Council/ Adult CPR

OSHA Hazardous Waste Site Supervisor Training

ALAN FRIZZELL

Dive Operation Manager/Biologist

Mr. Frizzell is Dive Operation Manager overseeing all dive projects performed by Normandeau Associates. Coordinates dive safety, education and equipment maintenance. Professional scientific diver since 1987, logging over 4,000 dives.

Mr. Frizzell is also Biologist/Field Technician with experience in the collection of finfish, benthic macroinvertebrates, plankton, and water quality data in marine, estuarine, and freshwater habitats; microscopic and gross identification of marine flora and fauna; data processing and compilation of lobster larvae annual report; and captaining up to 42-foot boats. Mr. Frizzell also has conducted surveys for endangered freshwater mussels.

EDUCATION

B.S. 1980, Biology, minor in Chemistry, Keene State College

PROFESSIONAL EXPERIENCE

1986-Present Normandeau Associates

PROFESSIONAL AFFILIATIONS

American Academy of Underwater Sciences
Diver Alert Network

SELECTED PROJECT EXPERIENCE

Exelon Energy, Inc. (2010-Present) – Survey of freshwater mussels in the Susquehanna River downstream of Conowingo Dam in Maryland in support of hydroelectric relicensing. This effort included semi-quantitative survey in a 4.5-mile river reach, followed by quantitative sampling in five selected areas within that reach. Search methodology included use of SCUBA in deeper water. Dive Operation Manager/Biologist.

Delaware River Joint Toll Bridge Commission (2010-Present) – SCUBA survey for mussels near the piers of multiple bridges in support of environmental permitting for river scour remediation measures. Dive Operation Manager/Biologist.

Seabrook Nuclear Generating Station, NH (1999-Present) - Underwater video Inspection and Cleaning of offshore Intake Structures. On-line biofouling removal. Field Technician/ Diver.

Bowline Generating Plant Hudson River, NY (1994-Present) - Barrier net placement around intake. Dive Operation Manager.

Florida Power and Light., Seabrook Nuclear Generating Station, NH (1986-Present) - Environmental monitoring studies including off-shore and on-site samples; finfish collection using trawl, beach seine and impingement methods; ichthyoplankton collection with boat-towed hoop nets and entrainment sampling on-site; intertidal and subtidal studies of flora and fauna through non-destructive methods of transect and quadrant, destructive methods of air-lifting and artificial settling stones; *Mya* larvae collection with hoop nets; lobster larvae collection using Neuston nets and counting/identification of Stages I through V; water quality profile collections through YSI water temperature collection with onset probes and downloading information into computers; crustacean collection and measurement of green and *Cancer* crabs; *Mya arenaria* random plotting through aerial view of flats which are later sampled; underwater videotaping. Dive Operation Manager.

Massena Electric Department (2007-2009) – Grasse River Benthic Macroinvertebrate and Mussel Survey (NY); SCUBA survey of the mussels in the Grasse River from Louisville to Massena, NY. A total of 9 mussel species was identified. Dive Operations Manager/Biologist.

PPL Resources, Inc. (2006) – Assessment of fly ash spill impacts to the mussel and periphyton communities in the Delaware River at Martins Creek Generating Station. The survey included search for mussels in shallow wadeable habitats and in deep pools with SCUBA at locations upstream and downstream of the fly ash entry point. Dive Operation Manager/Biologist.

Hunt Engineers, Architects, & Land Surveyors, Inc. (2006) – Survey of freshwater mussels present in the Susquehanna River at Oneonta, NY. This survey was conducted on short notice in order to support NYSDOT's emergency stabilization of a riverbank below NYS Route 23. Water depth required use of SCUBA. Dive Operation Manager/Biologist.

Enercon: Fitzpatrick Nuclear Plant, Oswego, NY (2006) – Installation and dismantling of hydro-acoustics around intakes of the plant to monitor fish movements. Dive Operation Manager.

FPL Wyman Station, Cousin's Island, ME (2006) – Pre-construction dredge permitting. Videotaping transect of proposed dredge site using SCUBA. Dive Operation Manager.

Rowe Nuclear Plant, Rowe, MA (2006) - Decommission of power plant. SCUBA diving to collect sediment samples to be tested for PCB's and radiological contamination. Depths of 10-70 ft. Dive Operation Manager.

Quoddy Bay, Eastport ME (2006) - Eelgrass survey for proposed LNG terminal located in Quoddy Bay. Mapping of eelgrass beds using SCUBA. Benthic grab sample for polychaetes. Dive Operation Manager/Field Technician.

Haley and Aldrich Engineering, Laconia NH (2006) – Post construction monitoring of coal tar dredging and removal. Sediment samples were collected for fauna analysis. Samples were located by GPS and collected by SCUBA. Dive Operation Manager/Field Technician.

STV, Inc. (2004-2010) – Survey of freshwater mussels and characterization of the fish community present in the Delaware River at the I-95 Bridge, West Trenton, NJ. Water depth required use of SCUBA. In addition, Section 7 Consultation on the federally-listed shortnose sturgeon. Dive Operation Manager/Biologist.

Skelly and Loy, Inc. (2003-2005) – Survey of freshwater mussels in the Susquehanna River in the vicinity of planned construction of a sewer force main river crossing. The effort was focused on search for two state species of concern, the green floater (*Lasmigona subviridis*) and the yellow lampmussel (*Lampsilis cariosa*) and, subsequently, relocation of these species from the project area. Because of waters in excess of 5 feet depth, SCUBA was required. Dive Operation Manager/Biologist.

McFarland-Johnson, Inc. (2003) – Survey of freshwater mussels in the Chenango River in the vicinity of the I-81/NYS Route 17 interchange project in Binghamton, NY. The effort was focused on search for the NYS threatened species, the green floater (*Lasmigona subviridis*), and one federal species of concern, the yellow lampmussel (*Lampsilis cariosa*). Because of varied physical conditions, SCUBA as well as snorkeling was required. Dive Operation Manager/Biologist.

Nantucket Electric, Cape Cod/Nantucket, MA (2003/2006) - Impact study of the installation of an underwater power cable from Cape Cod to Nantucket. Transects of eelgrass beds and videotaping performed. Field Technician/ Diver.

Hubline. Duke Energy, Massachusetts Bay, MA (2003-2006) – Monitoring post-construction of Hubline pipeline from Salem Harbor to Weymouth Harbor. Annual analysis of scallop beds, juvenile lobsters (via suction sampling), flora and fauna development (via underwater photography) and rugosity. Dive Operation Manager/Field Biologist.

D.A. Collins, Bass River, Beverly, MA (2005) – Underwater videotaping of impacted dredge area, presence of undredged coal tar, and inspection of cloth sediment cover. Dive Operation Manager/Field Biologist.

Haley and Aldrich, Ferry Landing, Tarrytown, NY (2004-2005) – Dredging site used barrier net to exclude sturgeon and other fish from area. SCUBA was used to inspect net for proper deployment and damage. Dive Operation Manager/Field Biologist.

Merrimack River (NH) Brook Floater Survey (2003) - Surveyed 24 river miles using SCUBA divers, to search for populations of Brook Floater mussels (*Alasmidonta varicosa*), a NH state-listed endangered species. This study was conducted to evaluate the susceptibility of this species to impacts associated with hydroelectric generation and was the most extensive survey ever conducted for this species in the New Hampshire portion of the Merrimack River. This survey established several new records on the extent and location of brook floater populations in the Merrimack River. Responsible for leading the field crew and preparing the final report. Field Technician/ Diver.

Missisquoi Bay Bridge Project, Lake Champlain (VT) Freshwater Mussel Survey and Relocation (2003) - Surveyed and relocated Vermont state-listed threatened and endangered freshwater mussels that would potentially be impacted during construction of a bridge to replace the Route 78 causeway/bridge. A total of 418 mussels, including two Vermont state-listed endangered species, the Fragile Papershell (*Leptodea fragilis*) and the Pink Heelsplitter (*Potamilus alatus*), and one state-listed threatened species, the Giant Floater (*Pyganodon grandis*), were relocated using SCUBA divers to areas outside of the influence of construction activities. Field Technician/Diver.

United States Navy, McAllister Point, RI (2003) Set transects on artificial reefs to determine percent cover of flora and fauna. Took pictures of reefs. Set fish traps to get measurements of fish living on reef. Outlined eelgrass bed to determine how far the bed had moved over time. Field Technician/Diver

Duke Energy, Boston Harbor, MA (2002-2003) - Collected core samples from contaminated sediments near the Hubline pipeline. Field Technician/Diver.

Massachusetts Central Artery, Boston Harbor, MA (2002) - Monitoring of artificial reef including transects, underwater videotaping, and general visual assessments. Field Technician/Diver.

C&S Engineers, Inc. (2001) – Survey of a marina and the nearby Niagara River for three Federally-listed endangered mussel species – the clubshell (*Pleurobema clava*), the pink mucket (*Lampsilis abrupta*), and the fat pocketbook (*Potamilus capax*). The effort involved search by SCUBA divers as well as wading. Dive Operation Manager/Biologist.

Bath Iron Works, Bath (ME) (1997-2000) - Environmental studies conducted prior to and during shipyard expansion. A primary dive survey was done for subtidal sediments and identification of the flora and fauna. Monthly/Bimonthly finfish collections using various methods (trawl, beach seine, Fyke nets) targeting endangered species shortnose sturgeon (*Acipenser brevirostrum*). Dive Operation Manager/Field Biologist.

Massachusetts Coastal Zone Management (1998-1999) - Monthly/bimonthly finfish collection using trawls and beach seines in New Bedford and Gloucester Harbors. Field Leader.

Massachusetts Coastal Zone Management (1998-1999) - Quahog population study of New Bedford and Fall River Harbors. Hydraulic dredging of varied substrate to assess population. Efficiency of dredge checked by divers. Dive Operation Manager/Diver.

Quonset Point Associates, Quonset Point (RI) (1998) - Impact study of the development of Quonset Point. Visual identification and videotaping of benthic organisms and quahog population study by one meter quadrant extraction. Dive Operation Manager/Diver.

Portland (ME) Water District, Water Supply of Sebago Lake (1998) - Impact study on the effects of lowering water levels and beach erosion. Collection of sediment cores at varying depths by divers. Field Leader/Dive Operations Manager/Diver.

Johns River Dwarf Wedge Mussel Survey (NH) (1997) - Conducted a dive survey in a section of the Johns River crossed by a bridge proposed for reconstruction, to look for dwarf wedge mussels (*Alasmidonta heterodon*). *A. heterodon* is a federally listed endangered species which would have been adversely affected by construction activities. Responsible for conducting the search and locating previously identified dwarf wedge mussel beds. Dive Operation Manager/Diver.

Brocton (MA) Water Supply of Silver Lake, Pembroke (MA) (1997) - A dive survey in search of two freshwater mussel species, eastern pond mussel (*Ligumia nasuta*) and tidewater mucket (*Leptodea ochracea*) which are included in MA Natural Heritage Program's list of Species of Special Concern. Dive Operation Manager/Diver.

Northeast Maritime (ME) (1997) - Conducted a freshwater mussel search and evaluated mussel habitats in streams in central Maine, where a gas pipeline would be crossing. The study was to identify habitats and populations of all mussel, with concerns of rare, threatened, and endangered mussel species, primarily dwarf wedge mussel (*Alasmidonta heterodon*), brookfloater mussel (*A. varicosa*), tidewater mucket (*Leptodea ochracea*), and yellow lampmussel (*Lampsilis cariosa*). Field biologist.

Ransom Environmental, Troy (NH) (1997) - Quarry dive to locate and photograph submerged paint drums. Dive Operation Manager/Diver.

Coastal Water of Searsport, ME - Zostera bed location. Field Manager and Dive Operation Manager.

Boston Harbor Navigation Improvement Project - Environmental assessment for U.S. Army Corps of Engineers dredging project. Crew Leader.

Boston Harbor - Site assessment in placement of artificial reef. Dive Operation Manager.

Cogeneration Plant on Penobscot River, Bucksport, ME - Environmental assessment of a proposed cogeneration plant. Crew Leader.

Wisconsin Public Service - IFIM studies on Peshtigo River. Field Technician.

Fitzpatrick Nuclear Generating Station, Oswego, NY - Fish telemetry studies. Project Dive Supervisor.

Yankee Rowe Nuclear Generating Plant, Rowe, MA - Environmental studies. Water quality data and fisheries. Field Leader.

New York Power Authority, Verplank, NY - Fish survival studies. Field Technician/Diver.

Seabrook Station Offsite Chlorine Minimization Study, Hampton, NH - Construction and laboratory assessment. Crew Leader.

SPECIAL TRAINING

1983 – NAUI Open Water SCUBA Diver

1984 – NAUI Sport Diver

1996 - Present – Red Cross CPR certification

1987 - Present – NSC First Aid certification

1991 - Present – DAN Oxygen First Aid

2004 – Nitrox certification

ERIK FEL'DOTTO
Field Operations Manager

EDUCATION

B.S. 1983, Marine Biology, University of New England

PROFESSIONAL EXPERIENCE

1983-Present Normandeau Associates

Mr. Fel'Dotto is a Field Operations Manager, with over 25 years experience in environmental consulting. He oversees all aspects of the Seabrook Environmental Monitoring Project as well as other large field projects. He coordinates field efforts for collections of finfish, benthos, plankton, sediments and physical data in marine, estuarine and freshwater habitats, including hazardous waste sites.

Mr. Fel'Dotto has been a professional scientific diver since 1984, logging over 5,000 dives, with extensive experience in black water and high current conditions. An experienced boat operator, he captains vessels up to 42 feet. He has extensive experience in instrument navigation, precision sample location, and all types of sampling equipment deployment. He also has conducted surveys for endangered freshwater mussels.

SELECTED PROJECT EXPERIENCE

Exelon Energy, Inc. (2010-Present) – Survey of freshwater mussels in the Susquehanna River downstream of Conowingo Dam in Maryland in support of hydroelectric relicensing. This effort included semi-quantitative survey in a 4.5-mile river reach, followed by quantitative sampling in five selected areas within that reach. Search methodology included use of SCUBA in deeper water. Biologist.

Delaware River Joint Toll Bridge Commission (2010-Present) – SCUBA survey for mussels near the piers of multiple bridges in support of environmental permitting for river scour remediation measures. Biologist.

Northeast Gateway LNG (2006-Present) - Deep water port operational monitoring. Twice monthly day and night plankton sampling in Massachusetts Bay in vicinity of Stellwagen Bank. Field Operations Manager.

Seabrook Nuclear Generating Station (NH) (1999-Present) – Underwater video Inspection and Cleaning of Intake Structures. On-line biofouling removal. Field Manager.

Seabrook Nuclear Generating Station (NH) (1991-Present) – Multi-disciplinary Environmental Monitoring, including fisheries, benthos, plankton, shellfish, inter-tidal, sub-tidal, and radiological studies. Field Manager.

Calais LNG (2008-2009) - Calais ME. Subtidal surveys for shellfish included underwater video, transect surveys, and airlift suction sampling for early benthic phase lobster. Field Operations Manager.

Nine Mile Point Nuclear Generating station. Oswego, NY (2008) - Ecological survey for intake siting in Lake Ontario, underwater survey of habitat and biota. Field Operations Manager.

Massena Electric Department (2007-2009) – Grasse River Benthic Macroinvertebrate and Mussel Survey (NY); SCUBA survey of the mussels in the Grasse River from Louisville to Massena, NY. A total of 9 mussel species was identified. Biologist.

PPL Resources, Inc. (2006) – Assessment of fly ash spill impacts to the mussel and periphyton communities in the Delaware River at Martins Creek Generating Station. The survey included search for mussels in shallow wadeable habitats and in deep pools with SCUBA at locations upstream and downstream of the fly ash entry point. Biologist.

Hunt Engineers, Architects, & Land Surveyors, Inc. (2006) – Survey of freshwater mussels present in the Susquehanna River at Oneonta, NY. This survey was conducted on short notice in order to support NYSDOT's emergency stabilization of a riverbank below NYS Route 23. Water depth required use of SCUBA. Biologist.

Haley and Aldrich Engineering, Laconia NH (2006) – Post construction monitoring of coal tar dredging and removal. Sediment samples were collected for fauna analysis. Samples were located by GPS and collected by SCUBA. Field Operation Manager.

Enercon: Fitzpatrick Nuclear Plant, Oswego, NY (2006) – Installation and maintenance of hydro-acoustics arrays around intakes of the plant in Lake Ontario to monitor fish movements. Field Operations Manager.

Skelly and Loy, Inc. (2003-2005) – Survey of freshwater mussels in the Susquehanna River in the vicinity of planned construction of a sewer force main river crossing. The effort was focused on search for two state species of concern, the green floater (*Lasmigona subviridis*) and the yellow lampmussel (*Lampsilis cariosa*) and, subsequently, relocation of these species from the project area. Because of waters in excess of 5 feet depth, SCUBA was required. Biologist.

Hubline Gas Pipeline Construction (MA) (2001-2006) – Baseline and post-construction sub-tidal surveys of pipeline impact area in Massachusetts Bay. Included early benthic phase lobster, adult lobster, scallop surveys, hard substrate u/w photography, eelgrass and quahog surveys. Field Manager/Diving Supervisor.

Nantucket Electric, Cape Cod/Nantucket, MA (2003/2006) - Impact study of the installation of an underwater power cable from Cape Cod to Nantucket. Transects of eelgrass beds and videotaping performed. Dive Operations Manager.

Cook Nuclear Generating Station (Bridgman, MI) (2005) – Planned and mobilized startup of 2-year 316(b) environmental program, including in-plant impingement/entrainment studies and nearfield trawling, gillnetting, seining and plankton surveys on Lake Michigan. Field Manager.

STV, Inc. (2004-2010) – Survey of freshwater mussels and characterization of the fish community present in the Delaware River at the I-95 Bridge, West Trenton, NJ. Water depth required use of SCUBA. In addition, Section 7 Consultation on the federally-listed shortnose sturgeon. Biologist.

Tarrytown Barrier Net (Tarrytown, NY) (2004) – Designed, installed and maintained 1200'x30' barrier net to exclude sturgeon from remediation dredge area on Hudson River shoreline. Field Manager/Dive Supervisor.

McFarland-Johnson, Inc. (2003) – Survey of freshwater mussels in the Chenango River in the vicinity of the I-81/NYS Route 17 interchange project in Binghamton, NY. The effort was focused on search for the NYS threatened species, the green floater (*Lasmigona subviridis*), and one federal species of concern, the yellow lampmussel (*Lampsilis cariosa*). Because of varied physical conditions, SCUBA as well as snorkeling was required. Biologist.

Merrimack River (NH) Brook Floater Survey (2003) - Surveyed 24 river miles using SCUBA divers, to search for populations of Brook Floater mussels (*Alasmidonta varicosa*), a NH state-listed endangered species. This study was conducted to evaluate the susceptibility of this species to impacts associated with hydroelectric generation and was the most extensive survey ever conducted for this species in the New Hampshire portion of the Merrimack River. This survey established several new records on the extent and location of brook floater populations in the Merrimack River.

Nantucket Electric Eelgrass Survey (MA) (2003) – Underwater survey including video of eelgrass beds on Cape Cod and Nantucket for electric cable crossing. Field Manager.

Missiquoi Bay Endangered Species Mussel Relocation (VT) (2003) – Removal and relocation of mussels from causeway construction area. Diving Supervisor.

Hubline Gas Pipeline Construction Monitoring (MA) (2002-2003) – Water quality monitoring during pipeline construction. Day and night monitoring of multiple WQ parameters. Field Manager.

Portsmouth Naval Shipyard Interim Monitoring (ME) (2002, 2003) – Subtidal and intertidal collections of sediments and mussels for bulk chemistry analyses for monitoring remediation of hazardous waste sites. Field Supervisor.

C&S Engineers, Inc. (2001) – Survey of a marina and the nearby Niagara River for three Federally-listed endangered mussel species – the clubshell (*Pleurobema clava*), the pink mucket (*Lampsilis abrupta*), and the fat pocketbook (*Potamilus capax*). The effort involved search by SCUBA divers as well as wading. Biologist.

McAllister Point, Newport RI (2000) - Ichthyoplankton and fisheries characterization in subtidal and intertidal areas surrounding shoreline landfill. Field Manager.

Missisquoi Bay Turtle Habitat Evaluation (VT) (2000) - Under-water video survey of endangered softshell turtle habitat. Field Manager.

Seabrook Nuclear Generating Station (NH) (1999) – Offshore Intake Seal Barrier Installation. Quality control and u/w video. Field Manager.

Dworshak Reservoir Temperature Monitoring, US Army Corps of Engineers, Walla Walla District (ID) (1999) – Designed and installed static monitoring systems to hold termistor strings in position in reservoir with up to 180' water level fluctuations. Moorings remain in continuous use as of 2005. Installation Supervisor.

Massachusetts Coast Zone Management (MA) (1998-1999) – Dredged Material Management Plan. Fisheries resource characterization in MA harbors. Included finfish, quahog, and early benthic phase lobster surveys. Field Manager.

Bath Iron Works (ME) (1997-1998) - Shipyard Expansion. Environmental Impact Studies. Benthic and fisheries resource characterizations including radio-tagging and tracking of sturgeon. Field Manager.

NOAA (MA) (1997) - Eelgrass survey. Underwater video survey of eelgrass beds, coast of MA from NH to RI. Field Manager.

Boston Harbor Navigation Improvement Project (MA) (1994-1995) - Remote camera, sediment and fisheries sampling. Field Manager.

New Bedford Harbor (1994-1995) - PCB "Hot Spot" sediment sampling (MA). Field Manager.

New Bedford Harbor Long-Term Monitoring (MA) (1993-1995) - Sediment and benthos sampling. Field Manager.

Providence River Navigation Improvement Project (RI) (1994) - Remote camera and sediment sampling. Field Manager.

Boston Harbor Artificial Reef (MA) (1993-1994) - Benthic studies for placement of artificial reef. Field Manager.

Boston Harbor Vibracoring (MA) (1992) - Crew Leader.

Bucksport Baseline Environmental (1990-1991) - Survey for Cogeneration Plant (ME). Field Supervisor.

Indian Point Nuclear Generating Station (NY) (1989-1991) - Fish Return System Survival Studies. Project Dive Supervisor.

Fitzpatrick Nuclear Generating Station (NY) (1990) - Hydro-Acoustic Fish Deterrence Study. Dive Supervisor.

Hudson River Striped Bass Hatchery Evaluation (NY) (1986-1987) - Crew Leader.

Special Studies in Unsampled Areas of the Hudson River (NY) (1986-1987) - Crew Leader.

Striped Bass Gear Evaluation/Atlantic Tomcod Program (NY) (1985-1987) - Crew Leader.

Long River Ichthyoplankton and Fall Juvenile Surveys (NY) (1984-1987) - Vessel captain on night surveys Hudson River from Albany to NYC. Crew Leader.

Indian Point Nuclear Generating Station Impingement Monitoring (NY) (1985) - Crew Member.

Indian Point Nuclear Generating Station Entrainment Monitoring (NY) (1985) - Crew Member.

Seabrook Nuclear Generating Station Monitoring Studies (NH) (1984) - Crew Leader.

SPECIAL TRAINING

National Association of SCUBA Diving Schools; logged over 5,000 professional dives.

Personnel Protection and Safety Training for Hazardous Waste Site Activities (OSHA 40 hour course). 1990-Present

Red Cross Multimedia First Aid and CPR. 1983-Present

OSHA Hazardous Waste Site Supervisor Training. 1992-Present

Certified Professional Rescuer CPR, American Red Cross. 1996-Present

Certified in Oxygen First Aid in Dive Accidents, DAN. 1991-Present

CHRISTOPHER D. BAKER
Field Technician

Mr. Baker has been a professional scientific diver since 2000 and has logged over 1,000 dives. He has worked in various fisheries over the past eight years, and has spent the past five years working as a Biologist/Field Technician for Normandeau Associates. Mr. Baker has experience in the collection of finfish, benthic macroinvertebrates, plankton, and water quality data in marine, estuarine, and freshwater habitats; microscopic and gross identification of marine flora and fauna; and captaining up to 42-foot boats. He also has conducted surveys for endangered freshwater mussels.

EDUCATION

B.S.	1999, Marine and Freshwater Biology, University of New Hampshire

PROFESSIONAL EXPERIENCE

2002-Present	Normandeau Associates
2001-2002	New Hampshire Fish and Game
2000	The School for Field Studies
1999-2000	New Hampshire Fish and Game

SELECTED PROJECT EXPERIENCE

Exelon Energy, Inc. (2010-Present) – Survey of freshwater mussels in the Susquehanna River downstream of Conowingo Dam in Maryland in support of hydroelectric relicensing. This effort included semi-quantitative survey in a 4.5-mile river reach, followed by quantitative sampling in five selected areas within that reach. Search methodology included use of SCUBA in deeper water. Biologist.

Florida Power and Light, Wyman Station, Cousin's Island, ME (2006-Present) – Impingement and entrainment sampling. Field Technician.

Excelerate Energy, Northeast Gateway, Gloucester MA (2005-Present) - Ichthyoplankton collections and water quality monitoring at the proposed Northeast Gateway off-shore LNG terminal 15 miles off the coast of Gloucester, MA. Field Technician/Boat Captain.

Florida Power and Light, Seabrook Nuclear Generating Station, NH (2002-Present) - Environmental monitoring studies including off-shore and on-site samples; finfish collection using trawl, beach seine and impingement methods; ichthyoplankton collection with boat-towed hoop nets and entrainment sampling on-site; intertidal and subtidal studies of flora and fauna through non-destructive methods of transect and quadrant, destructive methods of air-lifting and artificial settling stones; *Mya* larvae collection with hoop nets; lobster larvae collection using Neuston nets and counting/identification of Stages I through V; water quality profile collections through YSI water temperature collection with onset probes and downloading information into computers; crustacean collection and measurement of green and Cancer crabs; *Mya arenaria* random plotting through aerial view of flats which are later sampled; underwater videotaping. Field Technician/Diver.

Seabrook Nuclear Generating Station, NH (2002-Present) - Underwater video inspection and cleaning of offshore intake structures. On-line biofouling removal. Field Technician/ Diver.

Bowline Generating Plant Hudson River, NY (1994-Present) - Barrier net placement around intake. Field Technician/ Diver.

Massena Electric Department (2007-2009) – Grasse River Benthic Macroinvertebrate and Mussel Survey (NY); SCUBA survey of the mussels in the Grasse River from Louisville to Massena, NY. A total of 9 mussel species was identified. Biologist.

PPL Resources, Inc. (2006) – Assessment of fly ash spill impacts to the mussel and periphyton communities in the Delaware River at Martins Creek Generating Station. The survey included search for mussels in shallow wadeable habitats and in deep pools with SCUBA at locations upstream and downstream of the fly ash entry point. Biologist.

Hunt Engineers, Architects, & Land Surveyors, Inc. (2006) – Survey of freshwater mussels present in the Susquehanna River at Oneonta, NY. This survey was conducted on short notice in order to support NYSDOT's emergency stabilization of a riverbank below NYS Route 23. Water depth required use of SCUBA. Biologist.

Massachusetts Water Resources Authority, Boston MA (2006) – Deployment of mussel cages at various depths in Massachusetts Bay, Cape Cod Bay, and Boston Harbor to assess the impacts of treatment plant effluent on shellfish. Field Technician/Boat Captain.

Enercon: Fitzpatrick Nuclear Plant, Oswego, NY (2006) – Installation and dismantling of hydro-acoustics around intakes of the plant to monitor fish movements. Field Technician/ Diver.

Florida Power and Light, Wyman Station, Cousin's Island, ME (2006) – Pre-construction dredge permitting. Videotaping transect of proposed dredge site using SCUBA. Field Technician/ Diver.

Florida Power and Light, Wyman Station, Cousin's Island, ME (2006) – Monitored water quality and turbidity levels during dredging activity. Field Technician/Boat Captain.

Entergy, Penobscot Estuary Mercury Study, ME (2006) - Collected Scallops in the Penobscot estuary to be tested for mercury levels. Field Technician/Diver.

Rowe Nuclear Plant, Rowe, MA (2006) - Decommission of power plant. SCUBA diving to collect sediment samples to be tested for PCB's and radiological contamination. Depths of 10-70 ft. Field Technician/ Diver.

Quoddy Bay, Eastport ME (2006) - Eelgrass survey for proposed LNG terminal located in Quoddy Bay. Mapping of eelgrass beds using SCUBA. Benthic grab sample for polychaetes. Used remote camera to photograph substrate in selected areas to identify the benthic community. Field Technician/ Diver.

Haley and Aldrich Engineering, Laconia NH (2006) - Post construction monitoring of coal tar dredging and removal. Sediment samples were collected for fauna analysis. Samples were located by GPS and collected by SCUBA. Field Technician/ Diver.

Duke Energy, Massachusetts Bay, MA (2003-2006) – Monitoring post-construction of Hubline pipeline from Salem Harbor to Weymouth Harbor. Annual analysis of scallop beds, juvenile lobsters (via suction sampling), flora and fauna development (via underwater photography) and rugosity. Field Technician/ Diver.

Nantucket Electric, Cape Cod/Nantucket, MA (2003/2006) - Impact study of the installation of an underwater power cable from Cape Cod to Nantucket. Transects of eelgrass beds and videotaping performed. Field Technician/ Diver.

Entergy (2005) – Hudson River Ichthyoplankton/Fall Juvenile Survey, NY; Collected juvenile fish using otter trawls and collected ichthyoplankton using tucker trawls along the Hudson River at night. Field Technician.

D.A. Collins, Bass River, Beverly, MA (2005) – Underwater videotaping of impacted dredge area, presence of undredged coal tar, and inspection of cloth sediment cover. Field Technician/ Diver.

Haley and Aldrich (2004-2005) – Ferry Landing, Tarrytown, NY; Dredging site used barrier net to exclude sturgeon and other fish from area. SCUBA was used to inspect net for proper deployment and damage. Field Technician/Diver.

Skelly and Loy, Inc. (2003-2005) – Survey of freshwater mussels in the Susquehanna River in the vicinity of planned construction of a sewer force main river crossing. The effort was focused on search for two state species of concern, the green floater (*Lasmigona subviridis*) and the yellow lampmussel (*Lampsilis cariosa*) and, subsequently, relocation of these species from the project area. Because of waters in excess of 5 feet depth, SCUBA was required. Biologist.

STV, Inc. (2004-2010) – Survey of freshwater mussels and characterization of the fish community present in the Delaware River at the I-95 Bridge, West Trenton, NJ. Water depth required use of SCUBA. In addition, Section 7 Consultation on the federally-listed shortnose sturgeon. Biologist.

Upper Peninsula Power Company, Marquette MI (2004) – Assessed damage to mussel populations after the Dead River Basin flooded in 2004. Field Technician/Diver.

Yankee Rowe, Rowe MA. (2004) - Collected core samples for the decommissioned Yankee Rowe nuclear power plant using a Geoprobe. Soils were tested for PCB's, coal tar, and radiological materials. Field Technician.

Gillette World Headquarters, Boston, MA (2004) – Conducted Ichthyoplankton entrainment surveys using intake water being drawn into the plant. Field Technician.

Quonset Point Associates, Quonset Point, RI (2002-2003) - Impact study of the development of Quonset Point. Ichthyoplankton sampling, otter trawl, beam trawl, and beach seines performed. Field Technician.

McFarland-Johnson, Inc. (2003) – Survey of freshwater mussels in the Chenango River in the vicinity of the I-81/NYS Route 17 interchange project in Binghamton, NY. The effort was focused on search for the NYS threatened species, the green floater (*Lasmigona subviridis*), and one federal species of concern, the yellow lampmussel (*Lampsilis cariosa*). Because of varied physical conditions, SCUBA as well as snorkeling was required. Biologist.

CDM, Merrimack Water Quality (2003) - Captained vessel to monitor various water quality parameters in the lower reaches of the Merrimack River. Boat Captain.

Bath Iron Works, Bath, ME (2003) – Observation of dredging activities monitoring for Atlantic and Shortnose Sturgeon taken during relief of dredged material. Field Technician.

Public Service of New Hampshire, Manchester, NH (2003) - Determined locations of threatened freshwater mussels along the shoreline of the Merrimack River in southern New Hampshire. Field Technician/Diver.

HubLine sediment core sampling (2003) - Took core samples from contaminated sediments. Field Technician/Diver

Duke Energy, Boston Harbor, MA (2003) - Monitored counts and behaviors of American lobster along the Hubline pipeline at night. Field Technician/Diver.

Vermont DOT, Swanton, VT (2003) - Collection and relocation of threatened mussels for the removal of a causeway. Field Technician/ Diver.

United States Navy, McAllister Point, RI (2003) - Set transects on artificial reefs to determine percent cover of flora and fauna. Took pictures of reefs. Set fish traps to get measurements of fish living on reef. Outlined eelgrass bed to determine how far the bed had moved over time. Field Technician/Diver.

Duke Energy, Boston Harbor, MA (2002-2003) - Captained vessels to monitor turbidity levels in water during dredging of HubLine pipeline. Boat Captain.

Quonset Point Associates, Quonset Point (RI) (2002) - Collected sediments to assess quahog populations in selected areas. Field Technician/Diver.

Duke Energy, Boston Harbor, MA (2002) Used hydraulic dredge in various substrates to assess quahog population. Efficiency of dredge checked by divers. Field Technician/ Diver.

Massachusetts Central Artery, Boston Harbor, MA (2002) - Monitoring of artificial reef including transects, underwater videotaping, and general visual assessments. Field Technician/Diver.

New Hampshire Fish and Game, Marine Fisheries Division (1999-2000, 2001-2002) - Collected data and performed computer analyses of Striped Bass and juvenile finfish populations in the coastal waters of New

Hampshire (including local rivers and bays). Maintained fish ladders in 6 local New Hampshire coastal rivers. Field Instructor.

The School for Field Studies (2000) - Facilitated a research project designed to determine the population of Bonefish on the Caicos Bank in the British West Indies. Field Instructor/Divemaster/Boat Captain.

SPECIAL TRAINING

2006-DAN oxygen first aid

2006-NSC First Aid

2006-NSC CPR

2004-Nitrox

2004-40 hour OSHA HAZWOPER

2003-New Hampshire Safe Boating Card

2000-PADI - Divemaster

1999-NAUI - Rescue diver

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

BRYAN W. LEES

Aquatic Ecologist

Mr. Lees has over 10 years experience in a wide array of aquatic ecological studies including fisheries, macroinvertebrates, and water quality. Mr. Lees' duties include sampling fish and macroinvertebrates, providing fish and macroinvertebrate identification in the field, and identification of macroinvertebrates in the laboratory. His other responsibilities include data compilation and analysis and report preparation.

EDUCATION

M.S.	2005, Wildlife and Fisheries Science, The Pennsylvania State University
B.S.	1999, Wildlife and Fisheries Science, The Pennsylvania State University
B.S.	1999, Environmental Resource Management, The Pennsylvania State University

PROFESSIONAL EXPERIENCE

2005-Present	Normandeau Associates
2003-2005	The Pennsylvania State University
2000-2003	Stroud Water Research Center
2000	Pennfield Farms Inc.
1999	Pennsylvania Fish and Boat Commission
1999	The Pennsylvania State University
1998	Envircon Associates Inc.
1997	The Pennsylvania State University

PROFESSIONAL AFFILIATIONS

American Fisheries Society
North American Benthological Society

SELECTED PROJECT EXPERIENCE

Exelon Energy, Inc. (2010-Present) – Survey of freshwater mussels in the Susquehanna River downstream of Conowingo Dam in Maryland in support of hydroelectric relicensing. This effort included semi-quantitative survey in a 4.5-mile river reach, followed by quantitative sampling in five selected areas within that reach. Search methodology included use of SCUBA in deeper water. Biologist.

AREVA NP (2008-Present) – BBNPP ER and Studies Project. Wrote Aquatic Ecological Source Reports to support the COLA Environmental Report. Authored Chapters 4, 5, and 6 of the COLA Environmental Report for Bell Bend Nuclear Power Plant, Salem Township, Luzerne County, PA. Also was lead biologist for aquatic ecological field studies required under NRC and other regulatory guidance from July 2007 through September 2010. Supported NRC site meetings, responses to NRC requests for additional information, and revisions of the COLA Environmental Report.

AREVA/UniStar Bell Bend Nuclear Power Plant (2008) - Project manager for Impingement and Entrainment Studies at PPL's Susquehanna Steam Electric Station. Wrote Impingement and Entrainment Sampling Report.

Pulte Homes of PA, LLC (2007-Present) – Assessment of construction impacts on a stream macroinvertebrate community near a large golf course/housing development in Chester County, PA. This work is a PA Department of Environmental Protection permitting requirement.

Woodard & Curran (2006–Present) - Aquatic benthic macroinvertebrate sample analysis for Pound Ridge Golf Club, Stamford (CT).

Mactec Engineering and Consulting (2006-Present) – Aquatic benthic macroinvertebrate sample analysis for Honeywell-Ironton (OH) Wetlands Assessment Study.

Exelon Power (2006-Present) – Assisted with the monitoring of aquatic conditions during reactor outages at Oyster Creek Nuclear Generating Station. During the events, field teams of biologists monitored the facilities discharge canal looking for any stressed or dying fish or marine organisms, conducted water temperature surveys, and collected target fish species for analytical and beneficial use purposes.

SAIC, William Dick Lagoon Project (2006-Present) - Assessed the benthic macroinvertebrate communities and habitat of two streams, one of which will receive discharge of treated effluent from a Superfund site.

Exelon Power (2005-Present) - The Limerick Generating Station Water Supply Modification Demonstration Project and Wadesville Mine Pool Withdrawal and Stream Flow Augmentation Demonstration Project – Data analysis, report writing, and fish and macroinvertebrate sampling.

Exelon Energy (2005-Present) – Fish and macroinvertebrate sampling in the East Branch Perkiomen Creek, part of the Point Pleasant Water Diversion Project, Bucks and Montgomery Counties, PA.

Sanofi Pasteur (2005-Present) – Ecological studies of impact of discharge from a pharmaceutical plant on Swiftwater Creek in the Pocono Mountains in northeast Pennsylvania.

Drumore Crossing, LP (2009) – Assessment of macroinvertebrate community structure in Fishing Creek in Lancaster County, PA. This effort was conducted to determine if an upgrade to Exceptional Value stream status was warranted.

Waste Management, Inc. (2009) – Assessment of macroinvertebrate community structure to determine impact of landfill leachate treatment plant discharge to the Delaware River. This effort was a Delaware River Basin Commission permitting requirement.

Independence Construction Materials, Inc. (2007-2009) – Assessment of quarry discharge impacts on the macroinvertebrate community in Octoraro Creek, Lancaster County, PA. This work was a PA Department of Environmental Protection NPDES permitting requirement.

Reliant Energy (2005-2009) – Seward Station 316(a) Study; Conducted ecological fieldwork for a thermal variance study on the Conemaugh River, PA.

Exelon Power/BBL (2005-2008) – Aquatic ecologist on a team of economists, engineers and biologists to provide 316(b) Phase II compliance services at seven fossil-fuel generating stations in PA, TX, and MA. The team provided Phase II applicability analysis, strategy recommendations, PIC documents and Compliance Demonstration Studies (CDS).

NJ Dept. of Environmental Protection (2005-2008) – Water quality and biological productivity studies in Round Valley Reservoir, Hunterdon County, NJ. Studies focused on improving the forage fishery supporting black bass and trout fisheries.

Exelon Power (2007) – Conducted fisheries studies on the Schuylkill River in support of a 316(a) thermal variance renewal for Cromby Generating Station. This work included fish collection, data analysis, and report preparation.

Mactec Engineering and Consultants (2007) – Aquatic benthic macroinvertebrate sample analysis for Nuclear Metals Superfund Site, Concord (MA) Aquatic

Geryville Materials, Inc. (2006) - Assisted in macroinvertebrate assessment related to a proposed rock quarry discharge into Hosensack Creek.

Merrill Creek Reservoir (2006) – Assisted in fisheries studies for a pumped-storage reservoir in New Jersey.

Exelon Power (2005-2006) – Impingement and entrainment sampling at four fossil-fuel generating stations in Pennsylvania.

New York City Department of Environmental Protection (2005) – Fish and macroinvertebrate survey in Schoharie Creek downstream of Gilboa Dam (NY).

Reading Site Contractors (2005) – Age and growth analysis of largemouth bass and bluegills in two ponds in Chester County, PA.

School of Forest Resources at The Pennsylvania State University (2003-2005) – Graduate Research/Teaching Assistant.

- Designed and conducted study of the relationship of macroinvertebrate and fish assemblages to watershed and riparian condition measures
- Collected, processed, and identified macroinvertebrates
- Surveyed fish communities using backpack, towboat, and boat electrofishing gear
- Used ArcGIS to determine watershed land cover, watershed area, and attributes of streams
- Instructed in Fisheries Science class highlighting collection of fish and macroinvertebrates, fish identification, fish aging using scales and otoliths, using gastric lavage to collect stomach contents, water chemistry analysis, Index of Biotic Integrity, and Rapid Bioassessment Protocol
- Supervised three undergraduate research assistants in completion of laboratory projects

Stroud Water Research Center (2000-2003) – Aquatic Entomology Staff Scientist.

- Collected aquatic macroinvertebrates from a variety of watersheds in PA, DE, NY, NC, and GA
- Processed and identified macroinvertebrates to genus and species levels, including Chironomidae
- Analyzed biological data and calculated metrics and water quality indices
- Selected stream sampling locations and coordinated field sampling activities
- Additional duties included: a) training student interns; b) leading field crews; c)conducting field and laboratory chemistry and, d) surveying larval and adult stream salamanders

Pennfield Farms Inc. (2000) – Wastewater Treatment Technician.

- Managed wastewater treatment facility
- Monitored treatment plant function and performed tasks vital to daily operations

Pennsylvania Fish and Boat Commission (1999) – Fisheries Biologist Aide.

- Collected and identified macroinvertebrates and fishes
- Participated in acid mine drainage biomonitoring, wetlands delineation, and highway construction permitting

School of Forest Resources at The Pennsylvania State University (1999) – Research Assistant.

- Sorted benthic macroinvertebrate samples
- Identified benthic macroinvertebrates

Envircon Associates Incorporated (1998) – Environmental Assistant.

- Sampled wastewater and completed water quality analysis for various constituents
- Administered mechanical and biological controls to treatment systems

School of Forest Resources at The Pennsylvania State University (1997) – Research Assistant.

- Studied the preferred substrate of darters in an artificial stream

SPECIAL TRAINING

EPT2 Taxonomic Certification

FWS-FIS2C01 Principles & Techniques of Electrofishing

OSHA 40-Hour Safety Certification

OSHA 8-Hour Safety Certification Refresher (Current)

Pennsylvania Chapter of the American Fisheries Society's Cyprinidae and Catostomidae Identification Workshop

Pennsylvania Department of Environmental Protection's Fish of the French Creek Drainage Identification Course

PA/WV Chapter of AFS Continuing Education Workshop for Mid-Atlantic Fish Identification

AMAAB Decapoda, Oligochaeta, and Plecoptera Identification Workshops

SELECTED PRESENTATIONS

Blye, R.W., P.L. Harmon, and B.W. Lees, Normandeau Associates and Kinnel, J., Veritas Economic Consulting, Matty, R., Exelon Power. 2006. Comparison of Entrainment at Adjacent Intakes on a Tidal river With and Without Large Slot-width Wedge-wire Screens: A Case for Partial Compliance with 316(b) Phase II Performance Standards for Reduction in Entrainment. UWAG EPRI meeting: Atlanta, September 6-7, 2006.

Whaley, J., J. Kinnel, and M. Bingham, Veritas Economic Consulting, R.W. R.W. Blye and B.W. Lees, Normandeau Associates. 2006. Approaches for Estimating Annual Impingement from Sample Counts. UWAG EPRI meeting: Atlanta, September 6-7, 2006.

Comparison of GIS and "on the ground" Assessments of Riparian Area Condition. Presented at North East Fish and Wildlife Conference. April 2005.

Linking riparian area condition and characteristics of fish and benthic macroinvertebrate assemblages. 135th Meeting of the American Fisheries Society, Anchorage, AK. September 2005.

From:	fredp.smith@exeloncorp.com
To:	Andrea.Danucalov@exeloncorp.com; Newell, Arthur (Bud) E. (Augusta,ME-US)
Subject:	FW: Peach Bottom Marina
Date:	Friday, July 01, 2011 8:01:02 AM

This was a comment I received during my Customer Appreciation Day, lease add it to the SMP comment cards.

From: Fred Slifer [mailto:fredslifer@gmail.com]
Sent: Monday, June 27, 2011 10:14 PM
To: Smith, Fred P.:(GenCo-Pwr)
Cc: stoudtpbm@fronteir.net; 'LEW STRETCH'; jack.thomas@comcast.net; jim.kush@verizon.net; 'marty pell'; 'Don Fatzinger'
Subject: Peach Bottom Marina

Dear Fred Smith:

It was a pleasure to meet and talk with you at the Peach Bottom Marina last Saturday, and especially to have an Exelon Representative who asked and actually seemed to listen to what the Peach Bottom locals had to say.

I understand that Exelon has engaged a Planning Consultant (TCR from Connecticut) to prepare proposals for recreation facilities on the Conowingo Pond, and I understand that there may actually be two plans under consideration for the Peach Bottom area.

As an Architect involved in planning and design for nearly 40 years, I find it very unusual that there has been no opportunity for input by community / users in advance of the planning process.
You noted there were to be three community meetings at various locations this week, but no one in the Peach Bottom area seems to have known of these meetings. Were they advertised somewhere in advance? Your office has email & mailing addresses for the Tenants around the Pond, but I know of no one who received any announcement. Unfortunately there is no way for me (& probably many others) to attend the meetings on such short, verbal notice.

Clearly this does not speak well of Exelon's planning process.

As I see the situation at the Peach Bottom Marina, the major issues are:
* 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.
* The harbor has only limited turn around space and very limited dock space for overnight or summer storage.
* Numerous other, mostly minor, issues addressed in the petition I trust you will receive soon.

I understand the two plans being explored are :
A) Constructing a new recreation area & marina on the river side of the railroad.
B) Dredging and making improvements to the existing harbor and marina.

Regarding plan A, I offer the following:
* Space availability for parking and boat trailer access seems extremely limited.
* Encouraging vehicular traffic over the railroad seems dangerous.
* Protection from sudden, violent storms would require substantial construction extending into the river.
* Eliminating the need for boats to pass under the railroad bridge would be a benefit only to a few of the higher boats, and then only at times of abnormally high water.

Regarding plan B, I offer the following:

* Dredging of the existing harbor to restore it to adequate depth for boat access during periods of very low water levels would stimulate more recreational activity and business for the marina.
* Enlarging the marina to its former, 1960's size, would allow for more dock access & boat storage and therefore stimulate more recreational activity and business for the marina.
* Concerns about what chemicals (if any) are in the silt materials needing to be dredged can be addressed when actual tests are performed. The fear of pcb's & other chemicals in the sediment may or may not be an issue. Considering the sediment is primarily runoff from farms and roadside drainage work, it would seem appropriate to deposit the dredged material back onto the farm(s). There is, in fact, a farmer who is faming Exelon property nearby and who claims he would greatly welcome more soil.

I would greatly appreciate your reading this into the record of each of your planned community meetings over the next few days, and would be most pleased to have the opportunity to explore these matters with your planning team.

Thank you,

Fred Slifer
707 Harston Lane,
Erdenheim, Pa 19038
Phone 215-840-8189
Peach Bottom Cottage 220713

Relicensing Comment Card Date: 6/28/11

Name: ______ (Optional)

Address: ______ (Optional)

Tel. #/E-Mail Address: ______ (Optional)

Locations/Issues of Interest: Paper Mill Road at Muddy Creek Bridge (Name or Reference)

Comments or Questions:

This area is a problem now on weekends. Don't even think about making it more of a problem by building recreational facilities here unless you provide 24-7 policing of the area.

* Parking
Trash
Alcohol Abuse
Etc.

Forward Letter or E-mail Comments to **Bud Newell by July 27, 2011**

TRC
14 Gabriel Drive
Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

Relicensing Comment Card Date: ______

Name: ______ (Optional)

Address: ______ (Optional)

Tel. #/E-M (Optional)

Locations (Name or Reference)

Comments or Questions:

Don't allow "public access" and "recreation" pressures to trump cottages when push comes to shove in the licensing process. If cottage use is not currently regulated as it should be, then deal with that but don't eliminate the cottages.

Forward Letter or E-mail Comments to **Bud Newell by July 27, 2011**

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Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

E::olon.

Relicensing Comment Card LOWER CHANCEFORD TWP. Date: 6/28/11

Name: DAVID GLENN CHM. BOARD OF SUPERVISORS (Optional)

Address: 295 SLAB ROAD DELTA, PA 17314 (Optional)

Tel. #/E-Mail Address: (717) 862-3538 (Optional)

Locations/Issues of Interest: PAPER MILL BRIDGE AREA (Name or Reference)

PROPOSED(?) DEVELOPMENT (PARKING LOT + PAVILLION) ALONG MUDDY CREEK

Comments or Questions:

THE TOWNSHIP IS OPPOSED TO ENCOURAGING PUBLIC ACCESS TO THIS AREA. WE ARE CONCERNED THAT ANY DEVELOPMENT THERE WOULD INCREASE THE PROBLEMS WE ALREADY HAVE – CRIME DRUGS NOISE TRASH TRESPASSING ON ADJACENT PRIVATE PROPERTY

Forward Letter or E-mail Comments to **Bud Newell** by July 27, 2011

TRC

14 Gabriel Drive

Augusta, ME 04330

anewell@trcsolutions.com

Continue Comments on Reverse Side

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el .

Relicensing Comment Card Date: 6-28-1

Name: MICHELE ANDERSON (Optional)

Address: 180 GRANE RD RED LION, PA 17356 (Optional)

Tel. #/E-Mail Address: taffy3 @mac.com (Optional)

Locations/Issues of Interest: CABIN OWNER (Name or Reference)

Comments or Questions:

NO ANSWER WHEN CALLING – ONLY VOICE MAIL. CONCERN – STILL DO NOT HAVE RETURNED CHECK FOR LAND LEASE RENT

Forward Letter or E-mail Comments to **Bud Newell** by July 27, 2011

TRC

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Augusta, ME 04330

anewell@trcsolutions.com

Continue Comments on Reverse Side

16.

Relicensing Comment Card

Date: ____________

Name: Sue Wiley (Optional)

Address: 5043 Delta RD Delta PA 17314 (Optional)

Tel. #/E-Mail Address: 717-456-7380 (Optional)

Locations/Issues of Interest: Papermill Rd Bridge (Name or Reference)

Comments or Questions:

see attachments

Forward Letter or E-mail Comments to **Bud Newell** by **July 27, 2011**

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Augusta, ME 04330

anewell@trcsolutions.com

Continue Comments on Reverse Side

To the Management Staff of Exelon:

I am aware that Exelon is being pressured by the Mason Dixon Trail Association and others to put a parking lot/pavilion along Papermill Road. If this trail is so popular, then why during the winter months are there only 3-4 cars a month and some months none. But when the warm weather hits there are numerous cars, and trespassers. My husband has lived here all his life and I've been here for the past 32 years. There was never much of a problem until the Funkhouser Quarry was closed and trespassers were being fined. The Papermill Rd area is very isolated with no houses in the area with only State Police Coverage.

I ask Exelon, do you permit overnight camping, underage drinking, drug use and legal age drinking, etc. because this is what is happening. Approximately 5 years ago the State Police had a "Drug Sting". They informed my husband and me because they wanted us to be aware of what was happening. A girl was raped before the drug sting was set up.

I ask that this team, (Bob, Fred, Andrea, Colleen) and other Exelon employees/representatives associated with this project take a Friday night, Saturday and or Sunday and walk the path. The majority of the users are not Mason Dixon Trail people. You will find beer bottles, condoms, fireworks, drug paraphernalia, syringes, camp fires, trash, etc. I believe that if you take this walk, you will agree that this is not what Exelon is in favor of.

I have a letter from the State Police referring to some of the activity in the past 3 years. Due to reporting, it was unclear about the wear bouts along Papermill. I've been told that if you want to request further information, you would need to do request thru the "Right to Know Law".

I also have a letter from the Delta Cardiff Ambulance President, explaining the challenge of rescue in the area.

As an adjourning property owner it has been a challenge to maintain the beauty of the area. I ask; before you pursue this further, take the walk.

Sue and Todd Wiley

Sue Wiley

DELTA- RDIFF Volunteer Fire Co.

Serving Since 1898

June 28, 2011

Susan Wiley
5043 Delta Road
Delta, PA. 17314

Dear Sue,

As President of the Delta Cardiff Volunteer Fire Company I write this letter concerning medical events along the Muddy Creek access at Paper Mill Road. It is difficult to track medical events at this location because we do not use an exact address for these injuries.

The Delta Cardiff Volunteer Fire Company provides Fire, Rescue and Medical response to both areas of Lower Chanceford and Peach Bottom Township in this area. Over the past 10 years numerous medical and trauma events located along the trail have occurred. These events are at times challenging due to the terrain. This causes extended periods of extrication for the sick and injured. We have used the Maryland State Police helicopter rescue basket at least once for extrication of the sick and injured.

Sincerely,

Rick Farrington
President
Delta Cardiff VFC

Box 15, Delta, Pennsylvania 17314   717-456-7133   FAX 717-456-7958

COMMONWEALTH OF PENNSYLVANIA
PENNSYLVANIA STATE POLICE
Troop H, York
110 Trooper Court
York, Pa. 17403
(717) 428-1011

June 23, 2011

Mrs.Sue Wiley
5043 Delta Road
Delta, Pa. 17314

Dear Mrs. Wiley:

The Pennsylvania State Police, York Station investigated the following Incidents at the location you requested in the past three years:

Referred to Other Agency	2
Other-Debris on Roadway	3
Vehicle Towed	9
Theft from Motor Vehicle	2
Other-See Officer	1
Assault-Harassment	1
Liquor Law-Underage Consumption	1
Traffic Accident	1

Sincerely,

Lt. Barry E. Staub

Lieutenant Barry E. Staub
Station Commander
Troop H, York

2011-05-10 01:23:29 (48 days ago)
onewetdog (152744)
as far as i know parking is ok but please be respectful that it is private property try to park all cars at the take out to keep the number of cars down at put in also a lot of local kids party back there and leave a lot of trash so if you can pick up a coup e pieces it is a beautiful river if we keep it that way we should not have problems

Re: Muddy Creek near Paper Mill Rd (Close to Susquehanna) #5

Moderator

Joined:
2006/9/9 19:16

From **Dallastown, PA**

Posts: **4233**

OFFLINE

I think you can still get two cars parked at the trailhead on Papermill within the Excelon property. The private property posted will have your car towed for upwards of $250 empoundment fees. It sucks. But I guess people still use the area. Its been a point of contention for a few years. I have fished it a few time and have seen trout and heard of some big ones caught but have personally only caught smallies there and some large chubs.

Its not so much a "rapids for kayaks" area as it is "wilder" than the rest. There is a falls that drops about 12-15" that is a landmark and above and below it is a bedrock derived series of "steps" with small falls typical of lower susquehanna larger creek systems. Still, there are fish and extremely clear water so be careful for yourhealth and stealthy in your approach.

We had a fellow TU memeber shatter an ankle there and it took him four hours to be found and another two to get air lifted out Its a very rugged area to fis alone. BE CAREFUL!

Posted on: 2009/7/20 0:58

2011-06-15 12:47:05 (11 days ago)

| is ok?

:ent

ile

h

ave been down there at least 5 times this year so far. Camping over e weekend as well as fishing and boating. have not been towed. I'm not saying anything as stopped, just saying it hasn't happened. Brad will run shuttle for you so you dont have to leave a car at the put in. Go to starrk Moon Kayaks and ask him on your way to the takeout

Exelon.

Relicensing Comment Card Date: ____________

Name: George M. Johnson ____________ (Optional)

Address: 67 Buck heights Rd ____________ (Optional)

Tel. #/E-Mail Address: 717 244 2051 mo709@yahoo.com (Optional)

Locations/Issues of Interest: ____________ (Name or Reference)

Comments or Questions:

Need Parking at Muddy Creek, Papermill Rd.

Forward Letter or E-mail Comments to **Bud Newell** by **July 27, 2011**

TRC

14 Gabriel Drive

Augusta, ME 04330

anewell@trcsolutions.com

Continue Comments on Reverse Side

Exelon.

Relicensing Comment Card Date: 6/28/11

Name: (Optional)

Address: ____________ (Optional)

Tel. #/E-Mail Address: (Optional)

Locations/Issues of Interest: LOCK 1 (Name or Reference)

Comments or Questions:

ROAD ACCESS * EROSION OF BANKS IN AREA OF LOCK #-15

Forward Letter or E-mail Comments to **Bud Newell** by **July 27, 2011**.

TRC

14 Gabriel Drive

Augusta, ME 04330

anewell@trcsolutions.com

Continue Comments on Reverse Side

elon.

Relicensing Comment Card Date: ____________

Name: ______________________________ (Optional)

Address: ______________________________ (Optional)

Tel. #/E-Mail Address: ______________________________ (Optional)

Locations/Issues of Interest: ______________________________ (Name or Reference)

Comments or Questions:
Open Area For Fishing around Pumped
Storage Area

tter or E-mail Comments to **Bud Newell by July 27, 2011**
TRC
14 Gabriel Drive
Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

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l n.

Relicensing Comment Card Date: ____________

Name: ______________________________ (Optional)

Address: ______________________________ (Optional)

Tel. #/E-Mail Address: ______________________________ (Optional)

Locations/Issues of Interest: ______________________________ (Name or Reference)

Comments or Ques io s:
Lock 15 Road Way Busted Up + Needs Repair

Forward Letter or E-mail Comments to **Bud Newell by July 27, 2011**
TRC
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Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

Exelon.

Relicensing Comment Card Date: ____________

Name: ______________________ (Optional)

Address: ______________________ (Optional)

Tel. #/E-Mail Address: ______________________ (Optional)

Locations/Issues of Interest: ______________________ (Name or Reference)

Comments or Questions:

Lock 15 Erosion

Forward Letter or E-mail Comments to **Bud Newell by July 27, 2011**
TRC
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Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

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n.

Relicensing Comment Card Date: June 28, 1

Name: MARY BOOMSMA Lancaster side (Optional)

Address: 144 I Stubbs Mill Rd. Peach Bottom PA 17563 (Optional)

Tel. #/~~E-Mail~~ Address: 717-548-2836 (Optional)

Locations/Issues of Interest: Historic - Old (1876) (Name or Reference)
Rail Road Station of the Lancaster, Oxford and Southern Rd.
on Peach Bottom Rd. (Fulton Township)

Comments or Questions:
This SPM meeting was very preliminary. I would like to hear more when you and FERC make more headway with the licensing. You also must protect the vultures nesting on the cliffs near Johnson Island. We all have our little agendas.

Forward Letter or E-mail Comments to **Bud Newell by July 27, 2011**
TRC
14 Gabriel Drive
Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

Exelon.

Relicensing Comment Card Date: 6/28/2011

Name: Kate Gonick, Lancaster County Conservancy (Optional)

Address: 1175 West End Ave LANC. PA 17603 (Optional)

Tel. #/E-Mail Address: kgonick@lancasterconservancy.org (Optional)

Locations/Issues of Interest: land and cultural resource preservation (Name or Reference)

Comments or Questions:
Please send me information on Section 106 process consulting party status and please contact me regarding land protection

Forward Letter or E-mail Comments to **Bud Newell** by **July 27, 2011**
TRC
14 Gabriel Drive
Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

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elon.

Relicensing Comment Card Date: 6-28-11

Name: CHARLES J. TREES III (Optional)

Address: 57 CEDAR ACRES DR LANC (Optional) PA 17602

Tel. #/E-Mail Address: (Optional)

Locations/Issues of Interest: MUDDY RUN DRAW DOWN LAKE (Name or Reference)

Comments or Questions:
ARE WE EVER GOING TO BE ABLE TO FISH IN THE DRW DOWN LAKE

Forward Letter or E-mail Comments to **Bud Newell** by **July 27, 2011**.
TRC
14 Gabriel Drive
Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

x. ò.

Relicensing Comment Card

Date: 06/28/11

Name: Susquehanna Gateway Heritage Area (Optional)

Address: 1706 LONG LEVEL RD. WRIGHTSVILLE PA 17368 (Optional)

Tel. #/E-Mail Address: 717-252-0229 jpinkerton@susquehannaheritage.org (Optional)

Locations/Issues of Interest: SUSQUEHAN W R (Name or Reference)

Comments or Questions:

THE SUSQUEHANNA RIVER WATER TR IL-LOWER SECTION (PE NSYLVANIA), A DESIGNATED NATIONAL RE REA ION TRAI , SHOULD BE INCORPORATED INTO THE STUDIES AND INVENTORIES FOR THE CONOWINGO/MUDDY RUN RE ICENSING PROJECT.

Forward Letter or E-mail Comments to **Bud Newell** by **July 27, 2011**

TRC

14 Gabriel Drive

Augusta, ME 04330

anewell@trcsolutions.com

Continue Comments on Reverse Side

Exelon.

Relicensing Comment Card Date: 6/29/2011

Name: NORMAN P STINCHCOMB (Optional)

Address: 3605 ADY ROAD STRE T MD (Optional)

Tel. #/E-Mail Address: Bonnie Stinchcomb Hotmail DOT Com (Optional)

Locations/Issues of Interest: Conowingo Dam (Name or Reference)

Comments or Questions:
Water flow what gates will be run it
let us know what gate will be run.

Forward Letter or E-mail Comments to **Bud Newell by July 27, 2011**
TRC
14 Gabriel Drive
Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

Exelon.

Relicen rd 6 29-11

Name: William tes Sr.

Address: 3586 Day Rd Darlington Md 21034

Tel. #/E-M

Locations, adding # of Generator
To Hotline between # 2 + # 5

Comments or Questions:

Forward Letter or E-mail Comments to **Bud Newell by July 27, 2011**
TRC
14 Gabriel Drive
Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

Exelon.

Relicensing Comment Card

Date: /29

Name: Peter Collins (Cabin Tenant 852 Cold Cabin) (Optional)

Address: 1745 Jumpers Ct Jarrettsville MD 21084 (Optional)

Tel. #/E-Mail Address: 410-382-2820 collinsp@zoominternet.net (Optional)

Locations/Issues of Interest: Cold Cabin Park (Name or Reference)

Comments or Questions:

Could use improvement to increase access and use. Swimmers vs. kayakers vs. boaters. Sometimes boat ramp is clogged. Increase open area by boat ramp for kayakers to put in/out. Create area in upstream end of path for swimmers. Improve parking. More picnic tables? (maybe another Eagle Scout project to improve).

Forward Letter or E-mail Comments to Bud Newell by July 27, 2011

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14 Gabriel Drive
Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

Ex lon.

Relicens'ng Comment Card

Date: 6/29/2011

Name: [redacted] Paul Magness Harford County, Park & Rec (Optional)

Address: 1809 Fallston Rd Fallston 21047 (Optional)

Tel. #/E-Mail A pmagness@harfordcountymd.gov (Optional)

Locations/Issues of Interest: (Name or Reference)

Please add me to stakeholder list

Comments or Questions:

Harford County Parks and Recreation is currently work on a County Land Preservation, Parks and Recreation Plan that will be complete in the first half of 2012

Forward Letter or E-mail Comments to Bud Newell by July 27, 2011

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14 Gabriel Drive
Augusta, ME 04330
anewell@trcsolutions.com

Continue Comments on Reverse Side

Exelon.

Relicensing Comment Card Date: 6/29/11

Name: Ben Cox - Harford County Dept. of P&R (Optional)

Address: ______ (Optional)

Tel. #/E-Mail Address: bpcox@harfordcountymd.gov (Optional)

Locations/Issues of Intere Will you be working with Harford + Cecil County Parks & Rec's? (Name or Reference)

Comments or Questions:

If yes to the above question; what are your plans?

Forward Letter or E-mail Comments to **Bud Newell by July 27, 2011**

TRC

14 Gabriel Drive

Augusta, ME 04330

anewell@trcsolutions.com

Continue Comments on Reverse Side

Exelon.

Relicensing Comment C JERE Hess Date: ______

Name: (Optional)

Address: 2507 Shureslanding Road (Optional)

Tel. #/E-Mail Address: 410-457-5277 Darlington, Md 21034

Locations/Issues of Interest: Catwalk on Dam (Na

ents or Questions:

Its over 10 yrs since you closed Catwalk Please Open

Put me on list, Please

Mailing list.

Anna Hart

Forward Letter or E-ma'l ommen t **Bud Newell by July 27, 2011**

TRC

14 Gabriel Drive

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anewell@trcsolutions.com

Continue Comments on Reverse Side

Comments from SMP meetings (some may have filed comment cards on same issues)

Muddy Run Visitors Center 6-28-11

DCNR – Is Exelon willing to discuss conservation easements and transfer of land?

Anonymous – Will MR generating reservoir be re-opened for fishing?

Lower Chanceford 6-28-11

Anonymous (2) – inappropriate/uncontrolled use occurring at Muddy Creek/Papermill Road site. Do not improve access/parking

M-D Trail – Muddy Creek trail used by others (kayaker, anglers). M-D Trail and other users pick up trash.

Port Deposit 6-29-11

Robert Hodge, County Commissioner – need development funds for expansion of park at Octoraro Creek – will Exelon assist?

Conowingo Visitors Center 6-29-11

Anonymous – can information be added to the flow phone indicating which units are generating?

Danielle Haslup, Cecil County Parks & Rec – same comment as Robert Hodge above

Anonymous – Peach Bottom Marina silting in – dredge or move marina to other side to railroad tracks

Anonymous – Will Exelon have to take back any cabins for any of their recreation plans?

From:	Ray Dewar
To:	Newell, Arthur (Bud) E. (Augusta,ME-US)
Subject:	RE: parking at Pappermill road bridge
Date:	Tuesday, July 05, 2011 3:20:05 PM

Bud,

Thank you for your quick response.

Ray

From: anewell@trcsolutions.com
To: raydewar60@hotmail.com
Date: Tue, 5 Jul 2011 15:12:45 -0400
Subject: RE: parking at Pappermill road bridge

Ray,

This issue has not been resolved to date. Ownership of the land is in dispute and Exelon is attempting to clear this up with the other party.

We are aware of the issue at this site regarding parking and vehicles being towed in the past. Exelon hopes this will be resolved in the near future.

Bud Newell
Environmental Specialist
TRC
14 Gabriel Drive
Augusta, Maine 04330

From: Ray Dewar [mailto:raydewar60@hotmail.com]
Sent: Tuesday, July 05, 2011 3:06 PM
To: Newell, Arthur (Bud) E. (Augusta,ME-US)
Subject: parking at Pappermill road bridge

Mr Newell,

Are you able to inform me if parking for Muddy creek canoers is allowed at roadside at the Pappermill road bridge?

Thank you,
Ray Dewar

July 12, 2011

Ms. Colleen Hicks
Exelon
300 Exelon Way
Kennett Square, PA 19348

Dear Ms. Hicks:

On behalf of the Cecil Bird Club, I am responding to your request for public comment on the relicensing of Conowingo Dam. We are pleased that Exelon has done so many environmental studies to show the impact of the dam on the Susquehanna River, especially the shoreline and waters south of the dam. You have ample evidence of the importance of this habitat on wildlife. For example, the reports Exelon commissioned document the success of the breeding Bald Eagle and heron populations near the dam.

You may not be aware that the dam is also an area where Bald Eagles congregate in the fall. In fact, this is the second largest concentration of Bald Eagles in the state of Maryland, with more than 150 eagles of various ages there in November-December. Birders come from all over the Mid-Atlantic region to view these eagles, and two local clubs, the Cecil Bird Club and the Delmarva Ornithological Society, regularly schedule well-attended field trips there every year. In addition, the dam is home to a pair of Peregrine Falcons, a species that is still recovering from pesticide use in the 1960s.

Birders also frequent the Shures Landing Wildflower Walk that leads from Fisherman's Park toward Susquehanna State Park. This site has breeding Prothonotary Warblers, and the shores of the river in the state park grounds are one of the few places locally where Cerulean Warblers are regularly seen during spring migration. An abundance of other songbirds may be seen downstream of the dam in all seasons, with

Maryanne Dolan
104 Milestone Road
Elkton, Maryland 21921
(410) 398-7567
Maryanne.dolan@gmail.com

waterfowl and gulls prominent during the winter. There is excellent birding on the Cecil County side as well, with Little Gulls, Bonaparte's Gulls, and Black-headed Gulls among the uncommon species that may be seen from Port Deposit.

We are fortunate to have such a fine birding site in our area, and we are grateful for the access provided by Exelon.

If you have any questions about recreational birding downstream of the dam, please call me at 410-398-7567. I invite you to attend our next Bald Eagle count on the Saturday after Thanksgiving. For more information about our field trips, please see our website: http://www.cecilbirds.org/calendar.html.

Sincerely,

Maryanne Dolan
President, Cecil Bird Club

Maryanne Dolan
104 Milestone Road
Elkton, Maryland 21921
(410) 398-7567
Maryanne.dolan@gmail.com

The Mason Dixon Trail System, Inc. has several comments about recreational access to the Exelon properties. I will comment North to South:

1. We would very much like to get the trail along the North Side of Muddy Creek and have parking access at Paper Mill road. We realize that the Wileys are contesting the ownership of the property at Paper Mill Road. We also are aware that the recent survey shows the property to belong to Exelon. This would eliminate several miles of road walking for hikers and the dangerous walk along route 74.

2. Along Muddy Creek the Kayakers could use a launch site at Paper Mill Road and a take out at the mouth of Muddy Creek. They currently have to go downriver to the lower end of Coal Cabin.

3. South of Peach Bottom to Broad Creek we are again walking on roads with increasing traffic. Any portion of that area that could be gotten into the woods would be a great recreational opportunity for the hikers. Michaels Run to Broad Creek looks on paper as though it is an area that could be very doable.

4. We are still trying to resolve a route across the property just below Conowingo Dam. This area again has the trail along Shures Landing Road which is a very unsafe road to walk along.

5. I would remind you that a meeting in August was suggested by Bud Newell so that we could take a serious look at our requests.

Ron Gray
Vice President, Mason Dixon Trail System, Inc.

From:	Andrea.Danucalov@exeloncorp.com
To:	Colleen.Hicks@exeloncorp.com; Newell, Arthur (Bud) E. (Augusta,ME-US); Campbell, William B. (Augusta,ME-US); fredp.smith@exeloncorp.com; tsullivan@gomezandsullivan.com
Subject:	FW: Shoreline Management
Date:	Thursday, July 21, 2011 8:47:41 AM

Please see email below about a request for information about the Shoreline Management Plan.

Please advise on a response.

From: Matt & Kerri Kneisley [mailto:dakota.phd@verizon.net]
Sent: Thursday, July 21, 2011 6:02 AM
To: Danucalov, Andrea H.:(GenCo-Pwr)
Subject: Fw: Shoreline Management

----- Original Message -----
From: Matt & Kerri Kneisley
To: andrea.danucaov@exeloncorp.com
Sent: Wednesday, July 20, 2011 9:43 PM
Subject: Shoreline Management

Hello my name is Matthew D. Kneisley and I would like more info on the shoreline mang. program. I have gone out on the river from Peachbottom inlet Since I was four years old and now I am fourty. I have spent alot of time hunting ducks and fishing in the river in that area. I want the chance to see what it is that your company is proposing.
Thank you
Matthew D. Kneisley

From:	Matt & Kerri Kneisley
To:	Newell, Arthur (Bud) E. (Augusta,ME-US)
Subject:	Re: Shoreline access
Date:	Tuesday, July 26, 2011 6:05:52 PM

Bud,
Thank you for updating me with the info. It was nice to see someone still cares in a big compant to respond to a average person.
Thanks
Matthew Kneisley

> ----- Original Message -----
> **From:** Newell, Arthur (Bud) E. (Augusta,ME-US)
> **To:** Matt & Kerri Kneisley
> **Sent:** Monday, July 25, 2011 9:31 AM
> **Subject:** RE: Shoreline access
>
> Hi Matt,
>
> The meetings on June 28th and 29th were to meet with interested parties to discuss Shoreline Management Plans (SMP) for the Conowingo Project and Muddy Run Project. The SMP will provide guidance to Exelon for the management of Project lands for the term of a new Federal Energy Regulatory Commission (FERC) license for the projects. The meetings primary purpose was to update people on the process and plan and to receive public input into the SMP.
>
> Over the course of the four meetings, we received comments from individuals on a number of non-SMP issues including recreation and public access. All comments were noted regardless of subject matter.
>
> We are familiar with the recreation access to the Project and the Peach Bottom Marina. We are working on various recreation reports that will be filed with the FERC application sometime next year, but to date no decisions regarding changes at any of the recreation sites or facilities have been made.
>
> Please let me know if you have any questions or need more information.
>
> Bud
>
> A.E. Newell III
> Environmental Specialist
>
> TRC Results you can rely on
>
> 14 Gabriel Drive, Augusta, Me. 04330
> T: 207.620.3831 | F: 207.621.8226 | C: 207.592.3958
>
> Follow us on LinkedIn or Twitter | www.trcsolutions.com

From: Matt & Kerri Kneisley [mailto:dakota.phd@verizon.net]
Sent: Thursday, July 21, 2011 11:19 PM
To: Newell, Arthur (Bud) E. (Augusta,ME-US)
Subject: Shoreline access

Bud,
My name is Matthew Kneisley and I have spent Thirty six years of my fourty year life on the Susquehanna river with my family. Please send me info. from the June 28-29 2011 meeting about what you are going to plan for river access and the Peachbottom marina. I have gone out to the river under those tunnels since I was a little boy. I even dragged my boat threw the mud and outside the tunnels to go duck hunting and fishing many times just to spend time on the river. We need more public access to the lower part of the river and the marina could be dregged alittle to help us get out.
I would like to know what the Exelon Corp. has in store for the up coming years.
If you have any questions please call me or e-mail me.
(717) 666-4595 anytime.
Thanks Matt

From:	Erik
To:	Newell, Arthur (Bud) E. (Augusta,ME-US)
Subject:	Re: River access
Date:	Monday, July 25, 2011 9:40:33 AM

Peachbottom marina

Sent from my iPhone

On Jul 25, 2011, at 6:33 AM, "Newell, Arthur (Bud) E. (Augusta,ME-US)" <anewell@trcsolutions.com> wrote:

Erik,

Do you have a specific site(s) or area you are concerned with?

Bud Newell

A.E. Newell III
Environmental Specialist

<image001.jpg> 14 Gabriel Drive, Augusta, Me. 04330

T: 207.620.3831 | F: 207.621.8226 | C: 207.592.3958

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From: Erik Putt [mailto:esputt@gmail.com]
Sent: Friday, July 22, 2011 11:21 PM
To: Newell, Arthur (Bud) E. (Augusta,ME-US)
Subject: River access

please do not take away our river access!

From:	Andrea.Danucalov@exeloncorp.com
To:	Campbell, William B. (Augusta,ME-US); Newell, Arthur (Bud) E. (Augusta,ME-US); Colleen.Hicks@exeloncorp.com; fredp.smith@exeloncorp.com; Robert.Judge2@exeloncorp.com; tsullivan@gomezandsullivan.com; lkhitrik@gomezandsullivan.com
Subject:	FW: River Acess
Date:	Wednesday, July 27, 2011 2:44:10 PM

Comments on SMP.

From: tsbenner92@gmail.com [mailto:tsbenner92@gmail.com]
Sent: Saturday, July 23, 2011 4:44 AM
To: Danucalov, Andrea H.:(GenCo-Pwr)
Subject: River Acess

To whom it may concern:

Please do not shut down the Peach Bottom marina. The susquehanna river is such an important part of life for many Lancaster Countians whether they are fisherman, hunters or recreational boaters. Local access is crucial to our way of life. I know how important public opinion is to Exelon and the entire nuclear world. I don't think this will sit well with the any of the community!!

Thankyou
Shawn Benner
Avid hunter, fisherman,
and recreations boater

From: robeng@comcast.net
To: Newell, Arthur (Bud) E. (Augusta,ME-US)
Subject: Re: gate at rock
Date: Monday, July 25, 2011 11:31:15 AM

---

http://www.tidalfish.com/forums/showthread.php/305003-townsends-rock-run-landing-Port-Deposit?s=74699d848afebdb26c64ff611e2d80f6

From: "Arthur Newell (Bud) E. (Augusta,ME-US)" <anewell@trcsolutions.com>
To: robeng@comcast.net
Sent: Monday, July 25, 2011 10:17:55 AM
Subject: RE: gate at rock

Bob,

I am not aware of a gate being proposed at Rock Run and am forwarding your e-mail to someone at Exelon to respond to.

Bud

A.E. Newell III
Environmental Specialist

14 Gabriel Drive, Augusta, Me. 04330
T: 207.620.3831 | F: 207.621.8226 | C: 207.592.3958

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From: robeng@comcast.net [mailto:robeng@comcast.net]
Sent: Monday, July 25, 2011 10:15 AM
To: Newell, Arthur (Bud) E. (Augusta,ME-US)
Subject: gate at rock

Dear Mr. Newell I am writing this to convey my concern about the "Improvements" at rock run landing. I read an article saying a gate would be put up thereby denying us (fisherman) access to night time fishing. The best striper fishing occurs during low light conditions. i.e. just before dawn and during and after dusk. I feel a better idea would be to allow fisherman access till 2400 hrs as striper possesion is illegal between midnight and 0500.. I"m also going to call bob judge and discuss this with him. Any help in this matter would be greatly appreciated. Sincerely, bob engle.

P-405

ORIGINAL

FILED
SECRETARY OF THE COMMISSION
2011 JUL 25 A 10:36
FEDERAL ENERGY REGULATORY COMMISSION

PEACH BOTTOM MARINA
1798 SLATE HILL ROAD
PEACH BOTTOM, PA 17563
PHONE # 717-548-2330
Email - stoudtpbm@frontiernet.net

Federal Energy Regulatory Commission
888 First St, NE
Washington, DC 20426

To whom it may concern,

With Exelon's 2014 re-license coming due, we would like to petition for changes at the Peach Bottom marina area.

The following is a list of changes that the petitioners would like to see take place. Please feel free to call or come to the marina to discuss any request that has been submitted.

Attached is a signature list for the petition.

Requested Changes:
Dredge at the marina
Resurface and re-line parking lot
Replace walkway at boat house (cement is breaking apart)
Replace docks at the marina, add more docking if possible
Markings on the bridges and perhaps lighting (solar powered) for nighttime navigation
More permanent bathroom facilities(as stated in the original plans)
Paint stripes on ramp to designate two lanes
New picnic tables
Channel markers
Replace trash receptacles

Thank you for your time

Kerry & Donna Stoudt

Kerry & Donna Stoudt
Owner

NAME	ADDRESS (OPTIONAL)
Bally Bloch	P.O. Box 191 Emmaus PA 18049
Len Stretch	631 Allentown Rd - Telford, PA 18969
Barb Bitts	224 Spring Lane Peach Bottom, PA 17563
Jeff Bers	12 Orchard Lane Conestoga Pa. 17516
Fred Oxenreider	479A Peach Btm Rd Peach Bottom PA 17563
Nancy Oxenreider	↓ ↓
Ed Davidson	PO Box 221 Peach Bottom PA 17563
Lisa Harris	27 Roberts Rd Nottingham PA 19362
Mark Harris	27 Roberts Rd Nottingham PA 19362
Mary E Davidson	P.O. Box 221 Peach Bottom PA 17563
David L. Wheatley	471 Peach Bottom Rd Peach Bottom PA 17563
Linda Stretch	631 Allentown Rd., Telford, PA 18969
Randy Roberts	912 Allentown Rd, Tylers Port PA
Dean Manna	3121 Summit Ave. Balt MD.
Nicholas Giammona	626 Prestwick Trail Bel Air MD 21014
Deborah Pannell	459 Peach Bottom Rd Peach Bottom PA
[illegible]	226 Peach Bottom 17563
Brett Long	587 Oregon Road Holtwood PA 17532
Gene Spence	630 TimberWood D. Newark, De. 19702
Dylan Spence	" "
Terry Etzweiler	310 Mountville Dr Lebanon PA 17042
[illegible]	310 Mountville Dr. Lebanon PA 17042
Christopher P. Brown	3 Barrow Ct. Towson, Md 21204
Bonnie C. Brown	3 Barrow Ct, Towson, MD 21204
Kim Cole	1259 W Princess York PA 17404
Zachary Cole	1259 West Princess St York Pa 17404
Adrienne Breining	343 Parkside Dr Macungie PA 18062
Janice Jacoby	4561 E Texas Rd Allentown PA 18103
Martha Pell	482 Peach Bottom PA
Michael D. Pell	419 Circle Drive Peach Bottom
Susan King	20 Park Rd Nottingham PA 19362
Jeff King	20 Park Rd Nottingham PA 19362
Dennis J. Haddock	1314 N. 14th St. Rdg PA 19604
Rafael Sanco	907 Tuckerton Rd Rdg Pa 19605
Chris Abbott	1239 Perry St. Rdg Pa 19604

Keith Leitch	4453 Delmar Dr Rdg. PA 19606
Susan R. Leitch	
Susan Wilming	503 HARDING AVE Rdg PA 19607
DONNA SPENCE	907 TUCKERTON RD RDG, PA 19605
Nick Peltzer	864 PENNSY RP 17584
Jason Bleh	1277 Oak Drive Macungie, PA 18062
Todd McDonald	12-A St Andrews Cir Reading PA 19607
Christine Abbott	1239 Perry St Reading PA 19604
Benny Danielle Miller	286 Hess Rd Quarryville PA 17566
[illegible]	53 Blackburn road Quarryville PA 17566
Megan Peltzer	864 Pennsy Rd. Willow St. PA. 17584
[illegible]	213 Crozerville Rd Aston PA 19014
[illegible]	2535 W Colonial Dr. Boothwyn PA 19061
[illegible] Perri	3665 Market St Aston PA 19014
Dawn [illegible]	108 Autumn Dr, Lititz PA 17543
[illegible] Yoder	341 W Lemon St, Lancaster PA 17603
Lori Uhrig	1746 State St. E. Petersburg PA 17520
Tim King	155 Hess Road Cochranville PA
Garrett Beers	466 Scotland Rd Quarryville PA
Tyler Arkatin	622 Center Rd. Quarryville PA
Tom Flynn	62 Penn Rd Voorhees, NJ 08043
Karen Flynn	62 Penn Rd Voorhees NJ 08043
David Barthelme	143 East State St. 'Quille Pa.
[illegible]	466 Scotland Rd Quarryville PA
Keith Willis	140 Scotts LN Oxford PA. 19363
Christine Tuenier	130 Scotts Ln Oxford, PA 19363
Debbie Steager	5630 Chestnut St. Old Zionsville PA
Edward W Steager	5630 Chestnut St Rd Zionsville Pa
Gary Kilbourne	116 Glenmann Dr. Landenberg, PA 19350
Thelma Grumbein	1864 Riverview N. Drumore, PA 17518
Pat McCabe	660 Hawthorne Ln Mt Joy PA 17552
[illegible] McCabe	660 HAWTHORNE LN MT JOY PA. 17552
Theodore M. Grumbein	1864 RIVERVIEW N. DRUMORE PA 17518

RANDALL LEHMAN	1105 MATAMORAS RD.
Megan Lehman	1119 Matamoras RD.
Leslie Hart	11 BeBee Lane Quarryville PA
Les Hart	" " "
James M Long	2465 Lemon Rd Rooks Pa
Debbie R Long	" " " " "
DARRYLE HUDSON	1579 SLATE HILL RD Peach Bottom Pa
[illegible]	1718 State Hill Rd Peach Bottom
Tom Kreider	1055 Stoney Hill Rd Quarryville
Joe Dynda	1 Lisd Rd Rdg Pa 19606
Chuck Roesler	628 Poplar Lane, Peach Bottom, PA
B.J. Sweeney	481 Peach Bottom Rd
Deb Roesler	622 Poplar Lane, Peach Bottom, PA
Brian Myers	2592 Robert Fulton Hwy, Peach Bottom, PA
SCOTT JENKINS	2588 ROBERT FULTON Hwy PEACH BOTTOM PA
Ernie Miller	1239 Tanning Yard Hollow Rd Peach Bottom
Andrew Musselman	172 Good Rd New Providence PA 17560
Marty Child	525 School Lane Telford PA 18969
Jeff Child	525 School Lane, Telford, PA 18969
Scott L. Leich	4453 Delmar Drive Reading, PA 19606
[illegible]	1297 Forviss Rd Peach Bottom PA 17563
[illegible]	220713 PEACH BOTTOM
[illegible]	212 Pine Bridge Ln, Lancaster, PA
[illegible]	275 Hillside Ave. Denville, NJ
Dennis A Koch	500 Forest Ln Pottsville PA
Tamara R. Koch	500 Forest Lane Pottsville Pa.
DOUG FINKBINER	22 FARMINGTON WAY NEW PROVIDENCE PA
DIANE FINKBINER	22 FARMINGTON WAY NEW PROVIDENCE PA
Sheree Libby	1653 Slate Hill Rd DRUMORE
Ron & Denny Cutler	1331 Harmony Ridge Rd. Peachbottom
[illegible] Thomas	560 OLD MARKET ST. MOUNT JOY PA 17552
Bobbi Thomas	560 Old Market St. Mt. Joy PA
Randy Hodson	1653 Slate Hill Rd Drumore
[illegible]	302 KETCH LN. PEACH BOTTOM 17563

DELTA WATERFOWL FOUNDATION

The future of waterfowl and waterfowl hunting

Transmitted Electronically

July 26, 2011

Mr. Robert Judge
Manager, External Affairs
Exelon
300 Exelon Way
Kennett Square, PA 19348-2473

Dear Robert,

On behalf of the Delta Waterfowl Foundation, our Lancaster, Pennsylvania Chapter and our members, we are writing to express our concerns over the potential reduced access to the Susquehanna River especially that reach of river served by the Peach Bottom Marina. Delta Waterfowl is an international 501 (c)(3) non profit waterfowl conservation organization which serves the twin mandates of securing the future of waterfowl through a variety of conservation initiatives as well as representing waterfowl hunters.

It has come to our attention that there have been discussions to close the Peach Bottom Marina as siltation has made access to the river from this site increasingly difficult. While we acknowledge the cost and difficulty of silt removal, we urge you to find a means of preserving the existing access or find another suitable site to serve this stretch of river. This area is an important recreational resource, providing a host of opportunities to enjoy hunting, fishing, boating and the like. The loss of the Peach Bottom Marina would force many who enjoy the river to travel long distances for river access.

Mr. Judge, we would very much appreciate the opportunity to work with you and your colleagues at Exelon to discuss a means of enhancing the existing access or to evaluate other sites that could serve as feasible alternatives to provide access to this reach of river. Please let us know how we may be engaged to look for creative solutions.

Thank you for taking the time to address this issue.

Robert-
Thank you for taking the time to consider our perspective on this issue!

Sincerely,

John L. Devney
Senior Vice President

C: Matt Kneisley, Chair, Lancaster Chapter of Delta Waterfowl

U.S. OFFICE
P.O. Box 3128 • Bismarck, ND 58502 • Office 701 222-8857 • Fax 701 224-1924 • Toll Free 1-888-987-3695 • E-mail: usa@deltawaterfowl.org

CANADA OFFICE
Unit 22 – 62 Scurfield Blvd. • Winnipeg, MB R3Y 1M5
Office 204 956-7766 • Fax 204 956-7755 • Toll Free 1-877-667-5656 • E-mail: canada@deltawaterfowl.org

www.deltawaterfowl.org

Conowingo Shoreline Management Plan

Comments of the Harford County Chapter of the Maryland Ornithological Society

July 2011

The Harford County Chapter of the Maryland Ornithological Society, known locally as the Harford Bird Club, has approximately 150 members and is vitally interested in enhancing the bird habitat along the Susquehanna River. Therefore we ask that our viewpoint be included as Exelon develops its Conowingo Shoreline Management Plan in preparation for relicensing.

The Conowingo Dam is one of the Harford Bird Club's premiere birdwatching sites. It attracts birdwatchers from throughout the Mid-Atlantic region for its bald eagle population and for many other birds who feed on fish and other aquatic life. We offer regular birdwatching trips to Conowingo not only for the bald eagles and water-habitat birds but for scores of species of woodland birds that use the river as a migratory route. Springtime along the shores of the Susquehanna is a major attraction in the region for birdwatching, which, itself, is a significant economic attribute for Harford and Cecil Counties.

The Harford Bird Club's Conservation Committee requests that the Conowingo Management Plan include, wherever possible, the conversion of impervious surfaces to pervious and to plant only indigenous (native) species of trees and shrubs. Indigenous species provide food and nesting sites for birds as well as host species for butterflies to deposit their eggs. Some indigenous species that are particularly helpful to bird and butterfly species that are decorative for public areas as well include:

Trees	**Shrubs**
Red, white and pin Oaks	Spicebush
Red maple (acer rubrum)	Elderberry
Poplar	Winged and smooth sumac (not poison sumac)
Hemlock	Sweetspire (itea virginica)
Native dogwood (pink or white)	Highbush or lowbush blueberry
Hawthorne	Golden St. John's Wort
Shubert's red Chokecherry (Prunus virginiana)	Sweet pepperbush (clethra)
American elm (Ulmus Americana – now available)	Bottlebrush buckeye (Aesculus parviflora)

We would be happy to consult further on indigenous species for our area. Feel free to contact our Conservation Chair, Deborah Bowers, at 410 692-2708 or by email at farmlandpres@gmail.com.

Thank you.

Shoreline Management Plan Consultation Meetings

Muddy Run Visitors Center, July 26 – PA Agencies

Attendees: A.Danucalov, A.Ryan, C.Hicks, F.Smith, V.McClure, T.Sullivan, L.Khitrik, D.Gonzalez, J.George, B. Campbell, B.Newell, A.Whepley, Jim Spontak (PaDEP), Andy St. John (PaDCNR), Nick Ebersole (Lancaster Conservancy), Mike Hendricks (PaFBC), Josh Tryninewsig (PaFBC), Mike Domin (Lancaster County Planning), Jonathan Pinkerton (Susquehanna Gateway Heritage Area), Linda Swank (PaGC), Lori Yeich (Pa DCNR), Kate Gonick (Lancaster Conservancy), Pam Shellenberger (York County Planning), Kevin Mendik (NPS)

Review Power Point presentation: C.Hicks

Review ISMP, Draft TOC, Constraints Maps: B.Newell

Schedule/timing: T.Sullivan

Comments/Discussions:

Andy – Is Exelon willing to discuss/consider land protection? Who is the contact person for Exelon for these discussions? Stakeholders will need deed tract information to develop "ask list".

> Colleen Hicks to be contact. Are there land conservation areas agencies are interested in?

Kate - Two approaches to determine protected lands: Exelon to determine what they are willing to consider or Exelon provide deed tract information for stakeholders to determine parcels of interest. What is project and non-project acreage?

> Maps of project and non-project lands to be developed and provided to stakeholders. Actively managed areas will be identified on maps. Approx. 2,500 acres of project land (above normal pond elevation). Do not have a figure for non-project acreage.

Kevin – Was railroad trail use (Conowingo Dam to Havre de Grace) included in recreation survey? Unimproved portion (Deer Creek to North Park) has potential for trail expansion/linkage.

> Trail from Fishermans Park to Deer Creek and McLhinney/North Park was included in survey. Data for use between Deer Creek and Lapidum provided by Susquehana State Park.

Mike – Interested in access for anglers and boaters and conservation of species, including reptiles and amphibs.

Constraint map data can be provided to interested agencies. Contact Lana, copy Bud, and indicate format needed.

Written comments to Bud by August 15th.

Conowingo Visitors Center, July 27 – MD Agencies

Attendees: A.Danucalov, A.Ryan, C.Hicks, F.Smith, T.Sullivan (by phone), D.Gonzalez, J.George, B. Campbell, B.Newell, A.Whepley, Matt Kropp (Harford County Planning), Bill Richkus (Versar/MdDNR), Kevin Mendik (NPS), Larry Miller (USFWS), Eric Sennstrom (Cecil County Planning),

Review Power Point presentation: C.Hicks

Review ISMP, Draft TOC, Constraints Maps: B.Newell

Schedule/timing: T.Sullivan

Comments/Discussions:

Kevin – Unimproved portion (Deer Creek to North Park) has potential for trail expansion/linkage.

Bill – are there any scenic/wild waters within this project?

> Bud - Deer Creek is listed in Md. and upper portion of Octoraro Creek (outside Project boundary) in Pa.

Kevin – Poor signage directing users to Rock Run Marina and boat launch is in poor condition.

Matt – Many sensitive areas noted on constraints maps from Havre De Grace to Deer Creek. Were any RTE plant surveys done?

> Tom – will look into this and provide response

Larry – USFWS requests a 100 meter vegetated buffer along entire Project boundary. This provides a sedimentation and run-off buffer. USFWS is aware that FERC's area of interest is typically 200' back from NHW.

Eric – Access to bay and tributaries are an interest to Cecil County. Also, additional development of recreation area at Octoraro Creek and extension of trail from Octoraro Creek to VFW hall on Rt. 222

> Bud – Received same comments regarding recreation area from Commissioner Hodge and Danielle Haslup (Parks & Rec) at June public meetings.

Larry – Cottage leases – how is wastewater treatment and water withdrawals addressed? Are docks part of cottage lease agreement?

> Fred – Standards developed to address size, materials, floatation for docks and uniform set of standards for cottages

Larry - MDE permitting requirements to assist with standards. Cottage standards should be addressed in SMP. Does Exelon have an enforcement/surveillance program?

Fred – inspection program from land side for land, need a coordinated effort for inspection from water.

Bill – Will recreation information included in SMP and Recreation Plan?

Bud - Will be a brief description of recreation in the SMP

Larry – Are there provisions for a water trail? Overnight campsites?

Bud - Will be addressed in the Recreation Plan.

Larry - How are people made aware of the process to portage Conwoingo Dam?

Fred – Holtwood gives Exelon contact information to paddlers, also on paddling websites. Exelon receives approx. 8-9 portages requests per year.

Larry - Add future use areas in both SMP and Recreation Plan

Constraint map data can be provided to interested agencies. Contact Lana, copy Bud, and indicate format needed.

Written comments to Bud by August 15th.

August 11, 2011

Ms. Colleen Hicks
Exelon Power
300 Exelon Way
Kennett Square, PA 19348

Dear Ms. Hicks:

On behalf of the Pennsylvania Department of Conservation and Natural Resources, Bureau of State Parks; the Pennsylvania Game Commission; Lancaster County Planning Commission; York County Planning Commission; Susquehanna Gateway Heritage Area; York County Farm and Natural Lands Trust; and the Lancaster County Conservancy, we wish to thank you for the opportunity to comment on the Conowingo and Muddy Run Shoreline Management Plans and explore opportunities for expanded protections of Exelon lands. Recently our respective public agencies and private non-profit organizations collectively met and identified an interest in the following lands inside and outside the FERC project boundary for expanded protection and conservation management:

Lancaster County:

- Muddy Run Recreation Park area
- Wissler Run Park area (including parcels abutting Susquehannock State Park)
- Fishing Creek area
- Peters Creek area
- Haines Creek area
- Peach Bottom Marina
- River Islands

York County:

- Peach Bottom parcels south of facility outside project boundary
- Dorsey Park Launch and day use area
- Muddy Creek area
- Lock 15 area
- Lock 13 area
- Lock 12 area

In order to further refine our interest, please forward a copy of the parcel deed book and page data, including specific tracts identified, to the above noted mailing address. We look forward to working with you in your efforts to expand land protection and public access to the Lower Susquehanna River Conservation Landscape.

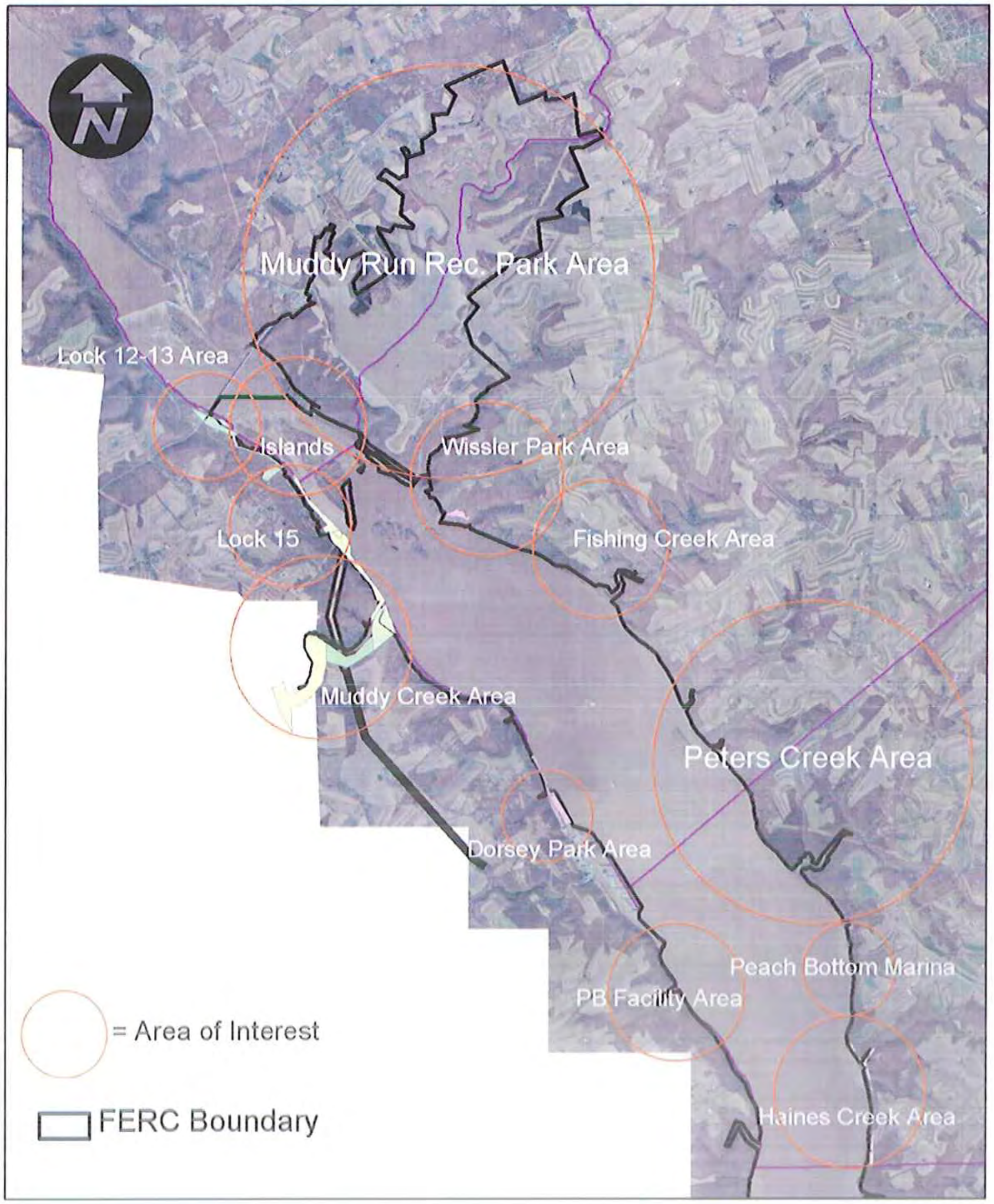
Sincerely,

John W. Norbeck
Director
Bureau of State Parks
Department of Conservation and
Natural Resources

Enclosure

cc: Bill Capouillez – Pa Game Commission
Kate Shirk-Gonick – Lancaster County Conservancy
Mark Platts - Susquehanna Gateway Heritage Area
Lori Yeich – DCNR, BRC
Andy St. John – DCNR, BSP
Pam Shellenberger – York County Planning Commission
Mike Domin – Lancaster County Planning Commission
Sean Kenny – York Co. Farm & Natural Lands Trust
Tom Sullivan – Gomez & Sullivan Engineers
Kevin Mendik - National Park Service

Exelon Lands: Areas of Interest



COMMONWEALTH OF PENNSYLVANIA
Pennsylvania Game Commission

2001 ELMERTON AVENUE
HARRISBURG, PA 17110-9797

"To manage all wild birds, mammals and their habitats for current and future generations."

ADMINISTRATIVE BUREAUS:

ADMINISTRATION....................717-787-5670
HUMAN RESOURCES..............717-787-7836
FISCAL MANAGEMENT...........717-787-7314
CONTRACTS AND PROCUREMENT....................717-787-6594
LICENSING.............................717-787-2084
OFFICE SERVICES.................717-787-2116
WILDLIFE MANAGEMENT............717-787-5529
INFORMATION & EDUCATION......717-787-6286
WILDLIFE PROTECTION.............717-783-6526
WILDLIFE HABITAT MANAGEMENT...........................717-787-6818
REAL ESTATE DIVISION..........717-787-6568
AUTOMATED TECHNOLOGY SERVICES....................................717-787-4076

www.pgc.state.pa.us

Division of Environmental Planning and Habitat Protection
717-783-5957

August 11, 2011

A.E. Newell
TRC
14 Gabriel Drive
Augusta, ME 14330

Re: Federal Energy Regulatory Commission Re-licensing of the Conowingo Hydroelectric Project on the Susquehanna River, Lancaster County, Pennsylvania

Dear Mr. Newell,

Thank you for submitting the Interim Shoreline Management Report (ISMR) RSP 3.27 for the Conowingo Hydroelectric Project to the Pennsylvania Game Commission for review. The PGC recognizes that there are several objectives of the ISMR. These objectives include completing an inventory of Exelon's real estate assets in the vicinity of the project area to identify and classify current uses; identify issues and constraints that affect land management and land use; review current corporate land use guidelines and policies; and to identify land potentially needed (or not needed) for current and future project uses.

In following those objectives, the PGC has screened this project for potential impacts to species and resources of concern under PGC responsibility, which includes birds and mammals. At this time, our review identified two state listed threatened species within the project area.

Eight state listed threatened bald eagle (*Haliaeetus leucocephalus*) nests have been identified within the project area. These nest locations are within areas currently categorized as "Class 3) Industrial/Commercial", "Class 5) Sensitive Resources"; "Class 8) Cottages", and within areas shaded with a blue hatched pattern that is believed to represent open waters of the Susquehanna River. ". In an effort to promote current and future nesting, additional coordination with the PGC will be required for any activities proposed within 1,000 feet of any bald eagle nest.

This review also identified eight state listed threatened osprey (*Pandion haliaetus*) nests located within the project area. These nest locations are within areas currently categorized as "Class 1) Project Operations", "Class 5) Sensitive Resources", "Class 6) Forest Management/Undeveloped", "Class 8) Cottages", and within areas shaded with a blue hatched pattern that is believed to represent waters of the Susquehanna River. In an effort to minimize disturbance to nesting ospreys, additional coordination with the PGC will be required for any activity proposed within 800 feet of any osprey nest.

Given the sensitive nature of these resources, the PGC has determined that both bald eagle and osprey nest locations, and their associated buffers, should be reclassified into the "Class 4)

Sensitive Resources Lands" category. According to the ISMR, this category is designated for lands to be managed for the protection and conservation of sensitive resources, specifically state listed threatened and endangered habitat protection areas. Should additional information on endangered or threatened species of birds or mammals becomes available, this areas should also be included in the "Class 4) Sensitive Resources Lands" designation.

Please be aware that this reply relates only to the ISMR and does not address any other potential concerns of the PGC regarding the re-licensing of the Conowingo Hydroelectric Project. We appreciate the opportunity to provide comments on the ISMR at this time.

Sincerely,

Olivia A. Braun

Olivia A. Braun
Environmental Planner
Division of Environmental Planning & Habitat Protection
Bureau of Wildlife Habitat Management
Phone: 717-787-4250, Extension 3128
Fax: 717-787-6957
E-mail:OBraun@pa.gov

OAB/oab

Cc: Killough
Metz
Librandi Mumma
DuBrock
Brauning
Gross
Barber

From:	Lower Susquehanna Riverkeeper
To:	Newell, Arthur (Bud) E. (Augusta,ME-US); Guy Alsentzer; ksmith@gomezandsullivan.com; al.blott@verizon.net; alexbalboa_us@yahoo.com; alex_hoar@fws.gov; Andrew Dehoff; Andy Shiels; brichkus@versar.com; bsadzinski@dnr.state.md.us; dpoe@dl.com; donnac@havredegracemd.com; Duke Pepper; esennstrom@ccgov.org; Gary Petrewski; jkludwig@harfordcountymd.gov; janet_norman@fws.gov; jrichenderfer@srbc.net; jspontak@state.pa.us; jseebach@americanrivers.org; John Seitz; jwhittak@winston.com; jkimble@shwpc.com; julie_thompson@fws.gov; julie.crocker@noaa.gov; jgantenbein@n-h-i.org; jzimmerman@tnc.org; franklin1@aol.com; mayor@portdeposit.org; kmckinne@lancasterconservancy.org; larry_m_miller@fws.gov; mbryer@tnc.org; mdephilip@tnc.org; mihendrick@state.pa.us; Paula Ballaron; pniland@harfordlandtrust.org; phil.cwiek@usace.army.mil; rbc1@psu.edu; Shawn Seaman; sschreiner@versar.com; tlibrandi@state.pa.us; mashton@dnr.state.md.us; kwhiteford@dnr.state.md.us; elynam@srbc.net; jbalay@srbc.net; don.pugh@yahoo.com; sheila_eyler@fws.gov; ian_park@fws.gov; steve_minkkinen@fws.gov; wcope@srbc.net; Tom Beauduy; rcairo@srbc.net; dladd@srbc.net; lynn.lankshear@noaa.gov; jeremmille@state.pa.us; jzhang@srbc.net; rgoodno@lancasterconservancy.org; bhare@energy.state.md.us; nprimrose@dnr.state.md.us; jessica.pruden@noaa.gov; hsachs@mde.state.md.us; deweaver@olympuspower.com; woohee.choi@ferc.gov; andrew.bernick@ferc.gov; monir.chowdhury@ferc.gov; andrew.tittler@sol.doi.gov; emily.carter@ferc.gov; john.mudre@ferc.gov; ahenning@srbc.net; agavin@srbc.net; john.smith@ferc.gov; obraun@state.pa.us; tmoberg@tnc.org; kevin_mendik@nps.gov; rockdfish@aol.com; dublinlaundry1@aol.com; bonniestinchcomb@hotmail.com; geofsmith@state.pa.us; wmelnick@state.pa.us; contact@alliancefortheebay.org; cheslock@usa.net
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Subject:	Preliminary Comments to Exelon Recreation Plan as per Public Meeting Presentation and Request for Comment Sept 15, 2011
Date:	Friday, October 07, 2011 1:11:27 PM

At the recent Exelon FERC Recreation Plan Meetings, Exelon consultant Bud Newell said he had not received my comments regarding the Shoreline Management Plan that I had sent on July 27, 2011. Those comments are repeated here, with slight modification, as they also pertain to the Recreation Plan. In addition, I am submitting comments on behalf of a former Conowingo Dam employee and long-time recreational user of the Susquehanna River and Conowingo facilities who wishes to remain anonymous.

October 7, 2011

Bud Newell
TRC Solutions

RE: Exelon Corporation Conowingo Dam Relicensing
Preliminary Comments to Shoreline Management Plan as per Public Meeting Presentation

To Whom It May Concern,

The Conowingo Dam Recreation Plan, a plan to fulfill Conowingo Dam owners' obligation to provide recreation to the public in exchange for the loss of their natural right to use the public resource of the free-flowing Susquehanna River, must consider the following public concerns.

Public Access for Recreation: Dozens of citizens have been in contact with Stewards of the Lower Susquehanna staff regarding access to the Susquehanna River for fishing. Striper fishing, possibly the highest recreational use in and directly below the Project, has been impeded by two actions taken by Exelon.

The first is the reduction of access to fishing facilities and boat launches to periods between sunrise and sunset. Every fisherman knows that the best fishing occurs in early morning, as the sky lightens before sunrise, and around and after dusk, when the light changes again. These are the times when Striped Bass feed closest to the surface and shoreline. This is particularly important for fishing the Susquehanna. Restricting access to dawn to dusk does not allow for traditional fishing schedules. Fishermen want to be out on the water before dawn, which means preparations for launch must be made prior to dawn, between 4 and 6 am. In addition, fishermen have contacted us regarding fishing after dusk. Most striper-fishing websites point to two factors that create optimum fishing: change of light (either from darkness toward day, or light into the night), and change of tides. Because the change of tides does not have a major effect in this area, the change of light is THE factor for optimum fishing. Striper fishing traditionally goes into the night. Many hard-working citizens of Maryland and Pennsylvania have to work in the mornings, and that leaves evenings and night for their recreational fishing. We request that all facilities be open from 4 a.m. until Midnight. This would still allow for "down time" to eliminate non-fishermen from abusing the areas, but would grant the needed access to optimize recreation.

As no surprise to you, the second impediment is the lack of access to the "catwalk". In 1928 this catwalk was designed and offered in exchange for the loss of traditional fishing, which impact occurs to this day as a result of Conowingo Dam. At the time of the building of the dam access was allowed 24-hours a day, and was promised for the life of the project. We believe this agreement should be honored, although we are willing to accept the "down time" of Midnight to 4 a.m., as stated above. One improvement to the catwalk can be made to reduce any negative impacts on the striped bass caught there. Ramps that would allow fishermen to slide the stripers more gently back into the river would reduce injury and mortality to the fish. Regarding Exelon's concern for broken windows due to renegade sinkers, alternatives to glass such as plexiglass could be installed.

There seems to be some idea that the new fishing pier has replaced the need for fishing from the catwalk. While no creel surveys were done by Exelon to compare catches at the new pier to historic catches at the catwalk, our anecdotal "surveys" of fishermen reveal that the species most frequently caught at the new pier is catfish. This is no substitute for striper fishing. If Exelon does not believe these anecdotes are representative of the facts, I would suggest that proper creel surveys be done by opening the catwalk for two weeks during striper season and compare catches between the pier and catwalk.

Sediment buildup behind Conowingo Dam affecting marinas: Although sediment buildup will be addressed in future comments to Exelon studies, there is a recreational component that came out of the public meetings that needs to be addressed here. During the meeting at Muddy Creek, Exelon's representative stated that it would not be logical for Exelon to be responsible for sediment buildup around marinas and the mouths of Conowingo Pool's tributaries. In fact, Exelon's Sediment Study, submitted to FERC on May 6, 2011, clearly states that prior to the building of Conowingo Dam there was enough force in the Susquehanna River that sediment was passed through directly to the Susquehanna Flats and Chesapeake Bay. This indicates that the project *is* responsible for the buildup of sediment in the above mentioned areas. To prove this fact, one needs to look no further than the tributaries above the fall line at Wrightsville into Lake Clarke. The confluences of the tributaries, above this line and below York Haven Dam, with the Susquehanna River are relatively free of sediment. Thus sediment buildup is a direct result of the Conowingo Dam and sediment removal is the responsibility of Exelon.

Letter from a Long-Time Fisherman

Dear Sir:

This letter concerns a small marina on the Susquehanna River in Port Deposit, Maryland, called Rock Run Landing.

Exelon owns the land at this location as well as most or all of the land on both sides of the river from Conowingo Hydroelectric Station down to Port Deposit (about 4 ¼ miles).

I have lived in Darlington, Maryland (about 2 miles from the dam) since the mid 1950's. I was employed by Philadelphia Electric Company (now Exelon) at Conowingo Dam for 27 years. I have rented a slip and kept a boat in the water at Rock Run Landing from 1977 through 2009 for hunting and fishing.

When I was a young man there were 5 landings on the river between the dam and Port Deposit where private boats could be kept in the water and on the shore, with boat rentals available. Four of these facilities no longer exist, mostly because Exelon has not renewed their leases, even though Exelon is obliged, because of its operating license from FERC, to allow a certain amount of access to the river for recreational use.

Exelon notified the lease holder at Rock Run Landing that their lease, which expired August 31, 2010, will not be renewed. This action has resulted in the curtailment of in-the-water slip rentals, land storage of boats and trailers, and boat rentals.

I believe that the curtailment of these recreational services at Rock Run Landing constitutes a denial of access to the river. Rock Run Landing is the last facility left that offers such services between Conowingo Dam and Havre de Grace, which is about 12 miles down river from the dam. The following are the main services that cease to exist at Rock Run Landing:

<!--[if !supportLists]-->• <!--[endif]-->Boat rentals – this location is a small natural harbor with an island nearby for protection;
<!--[if !supportLists]-->• <!--[endif]-->In-the-water slip rentals;
<!--[if !supportLists]-->• <!--[endif]-->On-land boat and trailer storage. Many boat owners prefer to leave their boats at the landing rather than tow them back and forth during the season;
<!--[if !supportLists]-->• <!--[endif]-->Tackle shop and engine repair;
<!--[if !supportLists]-->• <!--[endif]-->Launching ramp which is open 24 hours a day, 365 days a year, with no locked gate.

The state operated ramp across the river at Lapidum has 2 launching ramps and parking for about 100 trailers and vehicles. However, it is a gated facility and was recently locked for several months, including the entire spring fishing season. There was no access to the river at Lapidum during this period. There was no place to launch a boat on the west side of the river from the dam to Havre de Grace.

Until a few years ago, a guide with the appropriate license took customers fishing on the Susquehanna River from Rock Run Landing. His customers included former State Comptroller Louis Goldstein, Brooks Robinson, several Maryland DNR officials, several outdoor writers, and world-renowned anglers. I believe that Rock Run Landing and its variety of services should be allowed to remain open to people who want to enjoy the river. It is the last location left where traditional access is available.

Please inform FERC of this situation. I appreciate your consideration of this matter and look forward to hearing from you.

Thank you very much, ____________

From the Mighty Susquehanna, Michael R Helfrich
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Subject: Preliminary Comments to Shoreline Management Plan as per Public Meeting Presentation Request
Date: Wed, 27 Jul 2011 13:24:03 -0400

July 27, 2011

Bud Newell
TRC Solutions

RE: Exelon Corporation Conowingo Dam Relicensing
Preliminary Comments to Shoreline Management Plan as per Public Meeting Presentation

To Whom It May Concern,

The Shoreline Management Plan, which appears to include aspects of Exelon's requirement to provide adequate recreation to the public in exchange for the use of the public's resource, as well as Exelon's requirement to maintain water quality within and downstream of the Project area, must consider the following public concerns.

Public Access for Recreation: Dozens of citizens have been in contact with Stewards of the Lower Susquehanna staff regarding access to the Susquehanna River for fishing. Striper fishing, possibly the highest recreational use in and directly below the Project, has been impeded by two actions taken by Exelon.

The first is the reduction of access to fishing facilities and boat launches to periods between sunrise and sunset. Every fisherman knows that the best fishing occurs in early morning, as the sky lightens before sunrise, and around and after dusk, when the light changes again. These are the times when Striped Bass feed closest to the surface and shoreline. This is particularly important for fishing the Susquehanna, most of which is relatively shallow. Restricting access to dawn to dusk does not allow for traditional fishing schedules. Fishermen want to be out on the water before dawn, which means preparations for launch must be made prior to dawn, between 4 and 6 am. In addition, fishermen have contacted us regarding fishing after dusk. Most striper-fishing websites point to two factors that create optimum fishing: change of light (either from darkness toward day, or light into the night), and change of tides. Because the change of tides does not have a major effect in this area, the change of light is THE factor for optimum fishing. Striper fishing traditionally goes into the night. We request that all facilities be open from 4 a.m. until Midnight. This would still allow for "down time" to eliminate non-fishermen from abusing the areas, but would grant the needed access to optimize recreation.

As no surprise to you, the second impediment is the lack of access to the "catwalk". In 1928 this catwalk was designed and offered in exchange for the loss of traditional fishing, which impact occurs to this day as a result of Conowingo Dam. At the time of the building of the dam access was allowed 24-hours a day, and was promised for the life of the project. We believe this agreement should be honored, although we are willing to accept the "down time" of Midnight to 4 a.m., as stated above. One improvement to the catwalk can be made to reduce any negative impacts on the striped bass caught there. Ramps that would allow fishermen to slide the stripers more gently back into the river would reduce injury and mortality to the fish.

Sediment buildup behind Conowingo Dam: Although sediment buildup will be addressed in future comments to Exelon studies, there is a recreational component that came out of the public meetings that needs to be addressed here. During the meeting at Muddy Creek, Exelon's representative stated that it would not be logical for Exelon to be responsible for sediment buildup around marinas and the mouths of Conowingo Pool's tributaries. In fact, Exelon's Sediment Study, submitted to FERC on May 6, 2011, clearly states that prior to the building of Conowingo Dam there was enough force in the Susquehanna River that sediment was passed through directly to the Susquehanna Flats and Chesapeake Bay. This indicates that the project *is* responsible for the buildup of sediment in the above mentioned areas. To prove this fact, one needs to look no further than the tributaries above the fall line at Wrightsville into Lake Clarke. The confluences of the tributaries, above this line and below York Haven Dam, with the Susquehanna River are free of sediment. Thus sediment buildup is a direct result of the Conowingo Dam and sediment removal is the responsibility of Exelon.

From the Mighty Susquehanna, Michael R Helfrich
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January 2012 Draft SMP - Comment Response Summary			
Date	**Author**	**Comment**	**Exelon Response**
Undated	John Landan	Request that Exelon consider a wood and debris mitigation program under the new license	Debris management has been an on-going issue on the Lower Susquehanna River. As part of its regular operations and maintenance activities, Exelon removes and disposes of a substantial amount of river borne debris each year. Unfortunately, during times of high river flow Exelon's ability to safely and economical remove debris is hindered. Exelon believes this is not an issue that can be resolved solely by Exelon's actions.
2/9/12	Paul Rudy	Requests reopening of fishing access at the Conowingo Dam catwalk.	Exelon believes the safety and security concerns associated with public access to the dam and powerhouse outweigh providing public access for fishing. Exelon is not proposing to allow public access for fishing at the Conowingo powerhouse catwalk for the new license.
2/10/12	Gary Treadway	Requests reopening of fishing access at the Conowingo Dam catwalk.	Exelon believes the safety and security concerns associated with public access to the dam and powerhouse outweigh providing public access for fishing. Exelon is not proposing to allow public access for fishing at the Conowingo powerhouse catwalk for the new license.
2/13/12	Harford County Dept. of Planning and Zoning	Page 4-8, requests revised language to reflect latest version of the Harford County Natural Resources Element Plan	Exelon has revised language in the SMP as suggested.
2/21/12	Susquehanna River Basin Commission (SRBC)	Section 3.0, Best Management Practices (BMPs) are not included in the SMP. Requests opportunity to comment on BMPs.	BMPs are included as Appendix 1 of the SMP. Comments on the BMPs can be submitted with comments on the Draft License Application.
		Section 6.1.2, Best Management Practices (BMPs) are not included in the SMP	Section 6.1.2 has been revised to reference the applicable BMPs.
		Section 6.1.4, specifics on erosion remediation and monitoring not provided in the SMP. Requests	Exelon will revise the SMP to identify areas of concern for erosion and will reference applicable BMPs. Comments on the erosion management efforts in the SMP can be submitted with comments on

January 2012 Draft SMP - Comment Response Summary			
Date	**Author**	**Comment**	**Exelon Response**
		opportunity to comment on BMPs.	the Draft License Application.
		Section 6.1.5, Woody debris safety hazard levels are not defined in the SMP	Woody debris safety hazard levels and navigation hazards have been defined in Section 6.1.5.
		Section 8.0, will plan amendments be subject to stakeholder review and comment prior to implementation?	If an amendment is required, Exelon will provide a 30 day comment period prior to the submittal of an SMP amendment to FERC.