APPLICANT'S ENVIRONMENTAL REPORT – OPERATING LICENSE RENEWAL STAGE – SUBSEQUENT LICENSE RENEWAL

The Second License Renewal

PEACH BOTTOM ATOMIC POWER STATION

Unit 2

License No. DPR-44

Unit 3

License No. DPR-56

Exelon Generation Company, LLC

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PUBLIC VERSION

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ACRONYMS AND ABBREVIATIONS

AC	Alternating Current
ACS	American Community Survey
ADA	Americans with Disabilities Act
ALARA	As Low As Reasonably Achievable
AFE	Areas for Further Evaluation
APE	Area of Potential Effect
AQCR	Air Quality Control Region
B&W	Babcock & Wilcox
BGEPA	Bald and Golden Eagle Protection Act
BTA	Best Technology Available
BWR	Boiling Water Reactor
C	Celsius
C.D.	Conowingo Datum
C-14	Carbon-14
CAA	Clean Air Act of 1970
CAES	Compressed Air Energy Storage
CCP	Coal Combustion Product
CDF	Core Damage Frequency
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
cm	Centimeters
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO2e	Carbon Dioxide Equivalents
CUMP	Consumptive Use Mitigation Plan
CWA	Clean Water Act
CWST	Clarified Water Storage Tank
CZMA	Coastal Zone Management Act
DAW	Dry Active Wastes
dbA	A-weighted decibels
DOE	Department of Energy
DSM	Demand-Side Management
EFH	Essential Fish Habitat
EFL	East Fish Lift
EIS	Environmental Impact Statement
EMF	Electromagnetic Field
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPU	Extended Power Uprate
ESA	Endangered Species Act
F	Fahrenheit

ACRONYMS AND ABBREVIATIONS (Cont'd)

FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FLEX	Flexible Coping Strategies
ft	Foot/Feet
GEIS	Generic Environmental Impact Statement
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System
gpd	Gallons per Day
gpm	Gallons Per Minute
GW	Gigawatts
GWh	Gigawatt Hours
HAP	Hazardous Air Pollutant
HI-SMUR	Holtec Inherently Safe Modular Underground Reactor
hr	Hour
HRSG	Heat recovery steam generators
IBI	Index of Biological Integrity
in.	Inches
IPaC	Information for Planning and Consultation
ISFSI	Independent Spent Fuel Storage Installation
km	Kilometer
kV	Kilovolt
kW	Kilowatts
kWh	Kilowatt hour
kWh/m^2/d	Kilowatt Hours per Square Meter per Day
L/min	Liters per Minute
lb/MMBtu	Pounds per Million British Thermal Units
LCPC	Lancaster County Planning Commission
LFG	Landfill Gas
m	Meters
MB	Maximum Benefit
MBTA	Migratory Bird Treaty Act
MDC	Minimum Detectable Concentration
MDE	Maryland Department of the Environment
mg/L	Milligrams per Liter
MGD	Million Gallons per Day
MMBtu	One Million British Thermal Units
MW	Megawatt
MWd/MTU	Megawatt Day per Metric Tons of Uranium
MWe	Megawatts Electric
MWt	Megawatts Thermal

ACRONYMS AND ABBREVIATIONS (Cont'd)

NAAQS	National Ambient Air Quality Standards
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NESC®	National Electric Safety Code®
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOx	Nitrogen Oxide
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPM	NuScale Power Module
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NUREG	U.S. Nuclear Regulatory Commission technical report designation
ODEC	Old Dominion Electric Cooperative
OTEC	Ocean Thermal Energy Conversion
PA DCNR	Pennsylvania Department of Conservation & Natural Resources
PADEP	Pennsylvania Department of Environmental Protection
PATs	Payments in Addition to Tax
PBAPS	Peach Bottom Atomic Power Station
pCi/kg	picoCuries per Kilogram
pCi/L	picoCuries per Liter
PECO	Philadelphia Electric Company
PennDOT	Pennsylvania Department of Transportation
PFBC	Pennsylvania Fish and Boat Commission
PGC	Pennsylvania Game Commission
PJM	PJM Interconnection
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter with aerodynamic diameters of 2.5 microns or less
PM_{10}	Particulate Matter with aerodynamic diameters of 10 microns or less
PNDI	Pennsylvania Natural Diversity Inventory
PNHP	Pennsylvania Natural Heritage Program
PSEG	Public Service Enterprise GroupPV Photovoltaic
REMP	Radiological Environmental Monitoring Program
RGPP	Radiological Groundwater Protection Program
RM	River Mile
ROI	Region of Interest
ROW	Right-of-Way
SAFSTOR	Safe Storage
SAMA	Severe Accident Mitigation Alternatives

ACRONYMS AND ABBREVIATIONS (Cont'd)

SBO	Station Blackout
SCR	Selective Catalytic Reduction
SHPO	State Historic Preservation Officer
SLR	Second License Renewal
SMOP	Synthetic Minor Operating Permit
SMR	Small Modular Reactor
SO_2	Sulfur Dioxide
SOx	Sulfur Oxides
SOP	Standard Operating Procedure
SRBC	Susquehanna River Basin Commission
TEDE	Total Effective Dose Equivalent
TRC	Total Residual Chlorine
UFSAR	Updated Final Safety Analysis Report
USACE	U.S. Army Corps of Engineers
USC	Ultra-Super Critical
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound
YCPC	York County Planning Commission
WFL	West Fish Lift

Chapter 1

Introduction

1.1 PURPOSE OF AND NEED FOR ACTION

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants in accordance with the Atomic Energy Act of 1954, as amended, and NRC implementing regulations. Exelon Generation Company, LLC (Exelon Generation) operates the Peach Bottom Atomic Power Station (PBAPS) Units 2 and 3 pursuant to NRC Operating Licenses DPR-44 and DPR-56, respectively. The Unit 2 license will expire August 8, 2033, and the Unit 3 license will expire July 2, 2034.

Exelon Generation has prepared this Environmental Report in conjunction with its application to NRC to renew the PBAPS operating licenses, as provided by the following NRC regulations:

> Title 10, Energy, Code of Federal Regulations (CFR), Part 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants, Section 54.23, Contents of Application - Environmental Information (10 CFR 54.23) and
>
> Title 10, Energy, CFR, Part 51, Environmental Protection Requirements for Domestic Licensing and Related Regulatory Functions, Section 51.53, Post-construction Environmental Reports, Subsection 51.53(c), Operating License Renewal Stage [10 CFR 51.53(c)]

NRC has defined the purpose and need for the proposed action, renewal of the operating licenses for nuclear power plants such as PBAPS, as follows:

> "The purpose and need for the proposed action (issuance of a renewed license) is to provide an option that allows for baseload power generation capability beyond the term of the current nuclear power plant operating license to meet future system generating needs. Such needs may be determined by other energy-planning decision-makers, such as State, utility, and, where authorized, Federal agencies (other than the NRC). Unless there are findings in the safety review required by the Atomic Energy Act or the NEPA [National Environmental Policy Act] environmental review that would lead the NRC to reject a license renewal application, the NRC does not have a role in the energy-planning decisions of whether a particular nuclear power plant should continue to operate." (NRC 2013a)

The renewed operating licenses would allow an additional 20 years of operation for the PBAPS units beyond their current licensed operating periods. The renewed license for PBAPS Unit 2 would expire on August 8, 2053, and the renewed license for PBAPS Unit 3 would expire on July 2, 2054.

1.2 ENVIRONMENTAL REPORT SCOPE AND METHODOLOGY

NRC regulations for domestic licensing of nuclear power plants require reviews of environmental impacts from renewing an operating license. NRC regulation 10 CFR 51.53(c) requires that an applicant for license renewal submit with its application a separate document entitled Applicant's Environmental Report - Operating License Renewal Stage. In determining what information to include in the PBAPS license renewal Applicant's Environmental Report, Exelon Generation has relied on NRC regulations and the following supporting documents that provide additional insight into the regulatory requirements:

- Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants, NUREG-1437 (1996 GEIS) (NRC 1996).
- GEIS for License Renewal of Nuclear Plants, NUREG-1437, Revision 1 (2013 GEIS) (NRC 2013a), and referenced information specific to transportation in Addendum 1 to the GEIS (NRC 1999)
- Regulatory Guide 4.2, Supplement 1, Revision 1 Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications (NRC 2013c)
- Standard Review Plans for Environmental Reviews for Nuclear Power Plants Supplement 1, Revision 1: Operating License Renewal Final Report (NUREG-1555) (NRC 2013d)

Exelon Generation has prepared Table 1.2-1 to verify conformance with regulatory requirements. Table 1.2-1 indicates the sections in the PBAPS License Renewal Environmental Report that respond to each requirement of 10 CFR 51.53(c). In addition, each responsive section is prefaced by a boxed quote of the associated regulatory language and applicable supporting document language.

TABLE 1.2-1
ENVIRONMENTAL REPORT RESPONSES TO LICENSE RENEWAL ENVIRONMENTAL REGULATORY REQUIREMENTS

Regulatory Requirement	Responsive Environmental Report Section(s)	
10 CFR 51.53(c)(1)		Entire Document
10 CFR 51.53(c)(2), Sentences 1 and 2	2.0	Proposed Action and Alternatives
10 CFR 51.53(c)(2), Sentence 3	7.0	Alternatives to the Proposed Action
	8.0	Comparison of Environmental Impact of License Renewal with the Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(1)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(2)	6.3	Unavoidable Adverse Impacts
10 CFR 51.53(c)(2) and 10 CFR	2.6	Alternatives to the Proposed Action
51.45(b)(3)	7.0	Alternatives to the Proposed Action
	8.0	Comparison of Environmental Impacts of License Renewal with the Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(4)	6.5	Short-Term Use Versus Long-Term Productivity of the Environment
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(5)	6.4	Irreversible and Irretrievable Resource Commitments
10 CFR 51.53(c)(2) and 10 CFR 51.45(c)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
	6.2	Mitigation
	7.0	Alternatives to the Proposed Action
	8.0	Comparison of Environmental Impacts of License Renewal with the Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(d)	9.0	Status of Compliance
10 CFR 51.53(c)(2) and 10 CFR 51.45(e)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
10 CFR 51.53(c)(3)(ii)(A)	4.5.1	Surface Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Make-up Water from a River)
	4.5.2.2	Groundwater Use Conflicts (Plants with Closed- Cycle Cooling Systems that Withdraw Make-up Water from a River)
	4.6.1.2	Water Use Conflicts with Terrestrial Resources (Plants with Cooling Ponds or Cooling Towers Using Make-up Water from a River)

TABLE 1.2-1 (Cont'd)
ENVIRONMENTAL REPORT RESPONSES TO LICENSE RENEWAL ENVIRONMENTAL REGULATORY REQUIREMENTS

Regulatory Requirement	Responsive Environmental Report Section(s)	
	4.6.2.3	Water Use Conflicts with Aquatic Resources (Plants with Cooling Ponds or Cooling Towers Using Make-up Water from a River)
10 CFR 51.53(c)(3)(ii)(B)	4.6.2.1	Impingement and Entrainment of Aquatic Organisms (Plants with Once-through Cooling Systems or Cooling Ponds)
	4.6.2.2	Thermal Impacts on Aquatic Organisms (Plants with Once-through Cooling Systems or Cooling Ponds)
10 CFR 51.53(c)(3)(ii)(C)	4.5.2.1	Groundwater Use Conflicts (Plants that Withdraw >100 gpm)
10 CFR 51.53(c)(3)(ii)(D)	4.5.2.3	Groundwater Quality Degradation (Plants with Cooling Ponds at Inland Sites)
10 CFR 51.53(c)(3)(ii)(E)	4.6.1.1	Effects on Terrestrial Resources (Non-cooling System Impacts)
	4.6.3	Special Status Species and Habitats
10 CFR 51.53(c)(3)(ii)(G)	4.9.1	Microbiological Hazards to the Public (Plants with Cooling Ponds or Canals or Cooling Towers that Discharge to a River)
10 CFR 51.53(c)(3)(ii)(H)	4.9.2	Electric Shock Hazards
10 CFR 51.53(c)(3)(ii)(K)	4.7	Historic and Cultural Resources
10 CFR 51.53(c)(3)(ii)(L)	4.15.2	Severe Accidents
10 CFR 51.53(c)(3)(ii)(N)	3.10	Environmental Justice
	4.10.1	Minority and Low Income Populations
10 CFR 51.53(c)(3)(ii)(O)	4.12	Cumulative Impacts
10 CFR 51.53(c)(3)(ii)(P)	4.5.2.4	Radionuclides Released to Groundwater
10 CFR 51.53(c)(3)(iii)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
	6.2	Mitigation
10 CFR 51.53(c)(3)(iv)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
	5.0	Assessment of New and Significant Information

1.3 PEACH BOTTOM ATOMIC POWER STATION LICENSEE AND OWNERSHIP

PBAPS is jointly owned (50 percent/50 percent) by Exelon Generation and PSEG Nuclear, LLC. Exelon Generation and PSEG Nuclear, LLC co-hold the Renewed Facility Operating Licenses, Nos. DPR-44 and DPR-56 for PBAPS Units 2 and 3, respectively, and Exelon Generation operates both units.

Exelon Generation Company, LLC is a Pennsylvania limited liability company which is a wholly owned subsidiary of Exelon Corporation, a corporation formed under the laws of the Commonwealth of Pennsylvania.

PSEG Nuclear, LLC was incorporated in 1999 and is based in Newark, New Jersey. It is a subsidiary of PSEG Power, LLC, which is the electricity generation and wholesale marketing subsidiary of Public Service Enterprise Group (PSEG).

Chapter 2

Proposed Action and Description of Alternatives

Peach Bottom Atomic Power Station Environmental Report – Operating License Renewal Stage

2.1 THE PROPOSED ACTION

NRC
"…The report must contain a description of the proposed action…." 10 CFR 51.53(c)(2)

Exelon Generation proposes that NRC renew the operating licenses for PBAPS Units 2 and 3 for an additional 20 years beyond the current licenses' expiration dates of August 8, 2033 for Unit 2 and July 2, 2034 for Unit 3. Renewal of the operating licenses would give Exelon Generation and the State of Pennsylvania the option of relying on PBAPS to meet future baseload power generating needs during the period of extended operation.

In addition to continuing operation and maintenance activities, nuclear power plants may conduct refurbishment activities to support extended operation during the license renewal term. Refurbishment is not anticipated for PBAPS. The relationship of refurbishment to license renewal is described in Section 2.3.

No other plant modifications to support extended operations and that could directly affect the environment or plant effluents are planned.

2.2 GENERAL PLANT INFORMATION

NRC

> **"…The report must contain a description of the proposed action, including the applicant's plans to modify the facility or its administrative control procedures…. This report must describe in detail the affected environment around the plant, the modifications directly affecting the environment or any plant effluents…." 10 CFR 51.53(c)(2)**

Exelon Generation proposes that NRC renew the operating licenses for PBAPS Units 2 and 3 for an additional 20 years beyond the current licenses' expiration dates of August 8, 2033 for Unit 2 and July 2, 2034 for Unit 3. Current operating and maintenance activities are anticipated to continue during the license renewal term; no modifications to the facility are anticipated from the proposed license renewal. Chapter 2 provides descriptions of the plant and plant effluents along with descriptions of the affected environment around the plant. Chapter 2 subsections provide information on the reactor and containment systems; fuel enrichment, burnup and storage; cooling and auxiliary water systems; station emission sources; the meteorological monitoring program; the power transmission system; radioactive waste management systems; and non-radioactive waste management systems.

General information about PBAPS is available in several documents. In 1973, the U.S. Atomic Energy Commission, the predecessor agency of NRC, prepared a Final Environmental Statement for operation of PBAPS Units 2 and 3 (AEC 1973). In 2003, the NRC published the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, *Regarding Peach Bottom Atomic Power Station, Units 2 and 3* (NUREG-1437, Supplement 10) (NRC 2003), which presented updated information on PBAPS and evaluated the environmental impacts associated with the initial period of extended operation. In 2013, the NRC published the GEIS, NUREG-1437, Revision 1, (NRC 2013a), which presented PBAPS features that NRC considered in its updated industry-wide assessment of license renewal environmental impacts. On March 24, 2014, NRC issued its *Environmental Assessment and Finding of No Significant Impact for Peach Bottom Atomic Power Station, Units 2 and 3* (NRC 2014) supporting an increase in the maximum reactor power level, and in accordance with NRC requirements, Exelon Generation maintains an Updated Final Safety Analysis Report (UFSAR) for the units (Exelon Generation 2017g). Exelon Generation has referred to each of these documents while preparing this environmental report for license renewal.

PBAPS is a two-unit nuclear generation facility located near Delta, Pennsylvania on the west bank of Conowingo Pond, an impoundment of the Susquehanna River created by the Conowingo Dam. PBAPS Units 2 and 3 are boiling water reactors (BWRs). Unit 1 was an experimental high temperature helium cooled and graphite-moderated reactor, which is being maintained in safe storage (SAFSTOR) mode.

Located adjacent to Units 2 and 3, Unit 1 operated from 1967 through October 1974 and entered SAFSTOR mode in 1978, with continued surveillance, security, and maintenance under Facility Operating [Possession Only] License No. DPR-12, but with no fuel in storage in its fuel pool. Exelon Generation intends to manage the status of Unit 1 such that its final decommissioning will coincide with the decommissioning of Units 2 and 3. However, the proposed second renewal of the Units 2 and 3 operating licenses would not change the Unit 1 possession only license, under which Unit 1 makes no direct releases of gaseous or liquid radioactive wastes. Unit 1 liquid radioactive wastes are transferred to collection tanks in the radioactive waste building located between Units 2 and 3 where they are processed through the liquid radioactive waste system for release as prescribed in the PBAPS Offsite Dose Calculation Manual. As reported annually in the Unit 1 Decommissioning Status Report (e.g., for years 2011 to 2016), Unit 1 liquid wastes average generally less than a total of 300 gallons of water containing low concentrations of tritium and no detectable gamma-emitting nuclides (Exelon Nuclear 2012a; Exelon Generation 2013c; Exelon Generation 2014c; Exelon Generation 2015d; Exelon Generation 2016e; Exelon Generation 2017d). These waste volumes, according to the PBAPS Annual Radioactive Effluent Release Reports, are a minute fraction of liquid waste volumes released from the site (Exelon Generation 2017c).

The PBAPS generation facility includes many buildings and facilities (Figure 2.2-1). Each unit has a reactor building. Shared features at the site include turbine building, diesel generator building, outer intake structure, intake pond, inner intake structure, water treatment plant, sewage treatment plant, discharge basin, discharge canal, cooling towers, and administration building. Other shared features not shown on Figure 2.2-1 include the radioactive waste building and emergency cooling tower. The site also contains a site management building, two electrical substations, meteorological stations, the main stack, and various warehouses. Figure 2.2-2 shows the site boundary.

2.2.1 Reactor and Containment Systems

PBAPS Units 2 and 3 are General Electric Type 4 boiling water reactors (BWR/4) with Mark I containment systems and a combined maximum generation capacity of 8,032 megawatts thermal (MWt) or approximately 2,600 megawatts electric (MWe) (Public Service Enterprise Group 2016), including power uprates.

The BWR/4 reactor systems at PBAPS are characterized by a reactor vessel housing a reactor core where nuclear fission of the uranium dioxide pellets creates heat; thus causing the coolant water to boil. The resultant steam and water droplets are separated by steam separators and steam dryers. The dried steam is directed to the turbines, which turn and generate electricity. After exiting the turbine, steam is cooled back to coolant water in the condenser from which it is recirculated to the preheaters and the reactor core. Off-gases are treated through the off-gas treatment system and then released through the PBAPS main stack.

The Mark I primary containment system for each unit at PBAPS is a pressure suppression system consisting of a drywell, pressure suppression chamber, vent system, isolation valves, containment cooling system, and other service equipment.

Designed to withstand an internal pressure of 62 pounds per square inch above atmospheric pressure and coupled with its engineered safety features, each Mark I containment is designed to provide adequate radiation protection for both normal operation and postulated design-basis events, such as earthquakes or loss of coolant (Exelon Generation 2001).

The reactor building acts as a secondary containment system by completely surrounding the primary containment, which, in turn, surrounds the reactor vessel. In addition, the reactor building houses refueling and reactor servicing equipment, new and spent fuel storage facilities, and other reactor safety and auxiliary systems.

The containment systems and their engineered safeguards are designed to ensure that offsite doses resulting from postulated design-basis events are well below the guidelines in 10 CFR Part 100.

2.2.2 Fuel enrichment, Burn-Up, and Storage

The following descriptions of the fuel enrichment, burn-up, and storage systems at PBAPS are taken from the UFSAR (Exelon Generation 2017g) unless otherwise referenced.

PBAPS Units 2 and 3 are licensed to operate using fuel composed of uranium-dioxide pellets enriched at 2 to 5 percent by weight of uranium-235 and contained in sealed zircaloy tubes. Average peak rod fuel burn-up for each unit will not exceed 62,000 megawatt day/metric tons of uranium (MWd/MTU).

Refueling is performed approximately every 24 months on a partial, roughly 1/3, batch basis.

The Unit 2 and Unit 3 spent fuel pools each provide 3,814 locations that are usable for storage of new fuel and spent fuel assemblies. The inventory of fuel assemblies in each pool is maintained such that enough locations are open to accommodate a full core offload at any time. However, the number of spent fuel assemblies in each fuel pool varies due to cycle specific variations in the number of fuel assemblies discharged at the end of each cycle.

Spent nuclear fuel for Units 2 and 3 is also stored onsite at the independent spent fuel storage installation (ISFSI). The ISFSI complies with the General License issued under 10 CFR Part 72, Subpart K (General License for Storage of Spent Fuel at Power Reactor Sites) and the conditions contained in the Certificate of Compliance for the cask system. Spent fuel transfers to the ISFSI began in 2000 (Exelon Generation 2016d). The current ISFSI storage pad is projected to be filled on or before year 2020. Hence, Exelon Generation expects to add ISFSI storage capacity regardless of license renewal.

2.2.3 Cooling and Auxiliary Water Systems

<u>Raw Water Treatment System</u>

PBAPS is not connected to a municipal water system and acquires raw water from the Conowingo Pond, a 3,642-hectare (9,000-acre) impoundment on the lower

Susquehanna River, as its source for potable water production. The raw water treatment system consists of skid mounted hollow fiber ultrafiltration membranes that are vendor supplied and operated. This equipment produces up to 576,000 gallons per day (gpd) of treated water for use in the makeup demineralizer system, as domestic (potable) water, and in other uses. This water is pumped to a 200,000 gallon clarified water storage tank (CWST). The domestic water system consists of four trains of ultrafiltration membranes, the CWST, two domestic water pumps, a domestic water hydro-pneumatic tank, hypo-chlorinator, and distribution piping.

Circulating Water System

Description of Current Circulating Water System Operation

The PBAPS circulating water system is an open-cycle, once-through design. Its principal components are the outer intake structure, intake basins, inner intake structure, circulating water pumps, condensers, discharge basin, helper cooling towers, discharge canal, and discharge structure (Figure 2.2-1).

Water from the Conowingo Pond is used at PBAPS to cool the condensers in a once-through heat dissipation system. Tables 2.2-1 and 2.2-2 provide daily water withdrawals by month and daily water consumption by month, respectively for the years 2012 through 2016. PBAPS is approved by the Susquehanna River Basin Commission (SRBC) to withdraw up to 2,363.620 million gallons per day (MGD) and to have consumptive water use up to 49.000 MGD (peak day) (Exelon Nuclear 2011b) and follows an approved Consumptive Use Mitigation Plan (CUMP) (SRBC 2012). The SRBC-approved consumptive use and water withdrawal levels incorporate now implemented uprates. These PBAPS consumptive use levels have also been authorized by the Federal Energy Regulatory Commission (FERC) as non-project use of project lands and waters associated with operation of the Conowingo Hydroelectric Project (FERC Order dated September 2, 2015 [152 FERC ¶ 62,142]). Six circulating water pumps (each rated at 250,000 gallons per minute [gpm]) draw water from Conowingo Pond at a total rate of approximately 1,500,000 gpm, circulate it through the two main condensers, and return it to the Conowingo Pond via a cooling water discharge pond, up to three helper cooling towers, and a discharge canal (Exelon Generation 2001).

Cooling water is withdrawn at a 148-m-long (487-ft-long) outer intake structure on the west bank of Conowingo Pond (Figure 2.2-1). The intake operates with an approach velocity of 0.75 feet (ft) per second, and a through-screen velocity of 1.21 ft per second (Exelon Generation 2015c). To remove large debris and ice chunks from the intake water flow before it reaches the traveling screens, there are trash racks on the face of the outer intake structure. Divers manually clean the trash racks when needed, and collected debris is disposed offsite at a permitted landfill (NRC 2003). An air bubbler system also operates on the inlet side of the outer screen structure to break up surface ice formation (URS Corporation 2008). About 12 meters (m; 40 ft) behind the trash racks, 24 traveling screens (12 per unit) are located in the outer intake structure. Each screen panel is 10-ft wide with 3/8-inch square mesh, and the screen panels are rotated to allow removal of debris, including fish, by a high-pressure spray back-wash system. The outer traveling water screens are normally operated automatically, but can be operated manually from local control panels. In normal (automatic) operation, rotation of the screens is activated by preset timers for a predetermined time as set by duration timers, and, additionally, by a set pressure differential across the screens (URS Corporation 2008). The wash water is returned to Conowingo Pond, and the debris from the screens is collected and disposed offsite at a permitted landfill (Exelon Corporation 2014).

In 2001, the U.S. Army Corps of Engineers (USACE), Baltimore District issued a permit to the PBAPS authorizing periodic routine maintenance dredging activities at PBAPS to remove accumulated river sediments at the north and south cooling water intake bays and the screenwell structure approach apron located in the Susquehanna River. The permit expired in 2011. No maintenance dredging activities have been performed in the Susquehanna River at PBAPS since the maintenance dredging permit expired. In accordance with Exelon Generation procedures, if in the future the Station determines based on routine inspections of the intake that such dredging operations are necessary, the USACE and the Pennsylvania Department of Environmental Protection (PADEP) will be contacted, and any necessary permits will be obtained before dredging operations take place.

After passing through the outer intake structure and travelling screens, circulating water enters the inner intake structure; a system of intake basins, screens, and pumps. A cross-connected recirculation sluice gate connects the discharge pond and the intake basin, allowing heated discharge water to flow into the basin to minimize frazil ice formation during the winter. Sediment from the circulating water settles in the intake basins, 210 m long by 60 m wide (700 ft by 200 ft), is removed as needed, and is placed in the dredging/rehandling basin, which was used in the past for deposition of dewatered dredged material (USACE Baltimore 2001). The dredging/rehandling basin is located along the Discharge Canal, just downriver of Cooling Tower A. At the far end of each intake basin, traveling screens protect the inner pump intakes, three in the south basin for Unit 2 and three in the north basin for Unit 3. Wash water is returned to Conowingo Pond and debris from the screens is collected and disposed offsite at a permitted landfill (Exelon Corporation 2014).

From the inner intake structure, the circulating water pumps deliver cooling water to the condenser tubes for the purpose of withdrawing heat from steam generated in the Units 2 and 3 reactors after that steam has exited the turbines. The temperature of the cooling water can increase as much as 25 degrees Fahrenheit (F) as it passes through the titanium condenser tubes (NRC 2014).

The accumulation of deposits and biofouling organisms in the condensers is prevented through the regular use of an on-line condenser cleaning system and dosages of chlorine. Tube cleaners consist of a hard body providing buoyancy and orientation in the tube along with a flexible element providing ballast. Injected into the pump discharge piping, tube cleaners travel through the condenser tubes removing accumulated deposits. Tube cleaners are then retrieved from the discharge pond. Chlorine dosages are optimized to minimize the concentration of Total Residual Chlorine (TRC) in the effluent, to meet applicable effluent limitations, and to reduce the possibility of adverse effects on the receiving waters. The 2014 PBAPS National Pollutant Discharge Elimination System (NPDES) permit includes Special Conditions and Requirements in Part C.IV of the permit that address use of Chemical Additives. Use of chemical additives is authorized in accordance with PADEP's Chemical Additive Standard Operating Procedure (SOP) and usage rates must be reported on Discharge Monitoring Reports. The NPDES permit limits chlorine use, under Special Conditions and Requirements in Part C.III of the permit, to no more than four hours (hr) per day per unit between June 1 and September 30, and to two hr per day between October 1 and May 31 "unless it can be demonstrated to the permitting agency that more time is required for macroinvertebrate control" (Part C.III. of the NPDES permit). Further, the NPDES permit limits the TRC concentration in the outfall to 0.20 milligrams per liter (mg/l) (instantaneous maximum). The permit requires that the residual chlorine concentration be analyzed with a method detection limit of no greater than 0.02 mg/l.

The heated cooling water from the main condenser tubes of both units is discharged into a cooling water discharge pond. The discharge pond directs the cooling water to the cooling towers and/or into the 1,430 m (4,700 ft) long discharge canal, which carries it back to Conowingo Pond.

PBAPS is equipped with three mechanical draft, cross-flow cooling towers (A, B, and C) located on a man-made berm to the east of the discharge canal. Each cooling tower is 71 ft in width by 53 ft in height by 515 ft in length and is equipped with fans and a dedicated vertical, mixed-flow intake pump, as well as drift eliminators that provide a drift loss coefficient of 0.002 percent (Exelon Generation 2015f). Environmental conditions for the use or non-use of the cooling towers are defined by NPDES Permit No. PA0009733 (see Appendix A). The NPDES permit also defines the number of cooling towers that must be used based on date and average river water temperature.

The condenser cooling water that is discharged from the plant into the discharge pond can be withdrawn from the discharge pond for cooling in the A cooling tower or distributed to the discharge canal and two additional ponds that each supply water to the B and C cooling towers. Distribution of water among the ponds and discharge canal occurs via a series of culverts and/or pipes depending on pond level and whether the cooling tower pump in a pond is in operation.

At the end of the discharge canal is the discharge structure, which controls the flow to Conowingo Pond such that the velocity of the submerged jet discharge is between 5 and 8 ft per second to enhance mixing. Adverse scouring effects have not been observed at the discharge location. The discharge structure also has a surface overflow spillway in addition to the jet discharge.

NPDES Permit No. PA0009733 (see Appendix A) authorizes releases from PBAPS to Conowingo Pond. Such releases are subject to wastewater discharge limitations specified in the permit. Among these are (1) a requirement to implement the PBAPS procedure for reducing the temperature of water in the discharge canal when such water reaches 110 degrees F and (2) a requirement to operate the cooling towers during specific times and conditions, as follows:

- One cooling tower must be placed in operation on June 15 and must operate continuously through August 31 unless a delay in commencement of the tower operation is requested and approved by PADEP;
- A second cooling tower must be placed in operation within 48 hr of an average intake temperature equal or greater than 83 degrees F. Once operation of the second tower commences, it must be maintained through August 31, unless permission to terminate the second tower operation is requested and approved by PADEP; and
- A third cooling tower must be placed in operation within 48 hr of an average intake temperature equal or greater than 86 degrees F. This third tower must remain in continuous operation for a minimum of seven days.

In addition to authorizing condenser cooling water releases, the NPDES permit authorizes releases to Conowingo Pond of other wastewater streams including equipment cooling water, emergency service water, treated sewage effluent, water treatment wastewater, settling basin waste water, auxiliary boiler blowdown, dredging/rehandling basin waste water, raw intake screen backwash, and stormwater. The NPDES permit also authorizes Exelon Generation to use chemical additives for mollusk control, disinfectant, corrosion inhibitors, raw water treatment (e.g., membrane cleaning), in accordance with the PADEP's 'Standard Operating Procedure (SOP) for Clean Water Program Chemical Additives'.

Description of Historical Circulating Water System Operation

PBAPS originally operated with three mechanical-draft "helper" cooling towers designed to accept 57 percent (876,000 gpm) of the circulating water flow. In 1977, two additional mechanical-draft cooling towers were put into service, making it possible to supplement cooling of the entire circulating water flow, if needed. In 1978, phased operation of these cooling towers was made a condition of the NPDES permit for the station and dictated by a "Real Time Management System for Thermal Discharge from Units 2 and 3" (Real Time Management System) that included a cooling tower matrix (Part C.I.G.d of 1995 NPDES permit, Table 1). This cooling tower matrix specified the number of cooling towers that PBAPS was required to operate, based on reactor power levels (MWt), the number of circulating water pumps in service, and intake (Conowingo Pond) water temperatures.

In 1997, Exelon Generation (then Philadelphia Electric Company [PECO]) sought an amendment to the NPDES permit to operate without cooling towers. This proposed change in operation was based on studies in the summer of 1996 that showed cooling tower operation could be curtailed without adversely affecting the balanced indigenous fish community of Conowingo Pond.

PADEP approved PBAPS to operate without cooling towers via a major permit amendment issued in January 1998 that removed the cooling tower matrix from the

NPDES permit on the condition that Exelon Generation (as PECO) would (1) complete a three-year (1997 through 1999) study on the effect of zero cooling tower operation and (2) ensure that two of the five cooling towers remain operational in the event that circumstances change and the “probability of adverse impacts is high” (1998 NPDES permit amendment, Part C.I.G).

Exelon Generation (as PECO) submitted a NPDES permit renewal application in January 2000 and the final report on zero cooling tower operation in February 2000. The final report confirmed earlier conclusions that zero cooling tower operation would not adversely impact aquatic communities. Exelon Generation began dismantling two of the cooling towers in early 2001, but retained the capability of diverting approximately 60 percent of the circulating water flow through the remaining three towers. PBAPS then operated without cooling towers until 2011, when cooling tower use was resumed as a component of a Clean Water Act (CWA) Section 316(a) thermal variance demonstration study for PBAPS. During that study, data were collected in 2010 with no cooling towers operating. Then, data were collected with the PBAPS cooling towers operating from June 15 through September 15 in each of three consecutive years, as follows: 2011 (one cooling tower), 2012 (two cooling towers), and 2013 (three cooling towers).

In March 2014, PBAPS submitted a final report to PADEP summarizing the results of its thermal variance demonstration study under CWA Section 316(a) (NAI and ERM 2014). The final report assessed the data collected during 2010 through 2013, concluding that a balanced indigenous community of aquatic biota exists in the Conowingo Pond and would not be affected by continued operation of PBAPS either with or without cooling towers. In addition, the final report presented a hydrothermal modeling study for the purpose of evaluating the effect on this conclusion of a proposed PBAPS extended power uprate (EPU), which was projected to increase the temperature of the circulating water system discharge to the Conowingo Pond by a maximum of 3 degrees F. The hydrothermal modeling study found that the EPU would not change the conclusions of the thermal variance demonstration study based on data collected during 2010 through 2013 (NAI and ERM 2014). Notwithstanding, PADEP issued a renewed NPDES permit (effective October 1, 2014) that granted a CWA Section 316(a) variance requiring (1) operation of the PBAPS cooling towers during specific times and conditions, as described here in the preceding subsection, and (2) performance of a post-EPU biological and thermal study (PADEP 2014a), which was in progress through 2016, and the results of which are discussed in Subsection 4.6.2.2.

Service Water System, Emergency Service Water, and High Pressure Service Water

Water from the intake basins also supplies auxiliary water systems including the Service Water System, the Emergency Service Water System, and the High Pressure Service Water System. Water from the intake basins enters the inner screen structure through eight bays (four per unit), six direct the water to six circulating water pumps (three per unit), as discussed above, while the remaining two bays (one bay per unit) have four traveling screens (two per bay) and feed six service water pumps (three per unit), as well as the Emergency Service Water and High Pressure Service Water systems. Each Service Water System pump produces 53,000 liters per minute (L/min) (14,000 gpm). Operated intermittently in compliance with NRC testing requirements, pumps for the

Emergency Service Water System supply up to 60,570 L/min (16,000 gpm) and for the High Pressure Service Water System supply up to 136,300 L/min (36,000 gpm). Debris, including fish, is removed from the screens by a high-pressure spray-wash system. As above, the wash water is returned to Conowingo Pond and debris from the screens is collected and disposed in an offsite permitted landfill (Exelon Corporation 2014).

The service water system provides cooling water for various non-safety-related PBAPS auxiliary systems and components. In addition, the service water system provides water for filling the fire protection system, water for washing the inner intake service water rotating screens, and water for the radwaste system. The service water system may be adjusted to meet service water system cooling requirements and may be powered by an emergency diesel generator to provide minimum flow requirements during a loss of offsite power. In compliance with the NPDES permit, PBAPS service water is discharged to Conowingo Pond.

Groundwater Supplied Systems

PBAPS has three closed groundwater wells (filled with concrete) and four wells providing non-potable water on demand to remote facilities. The well at the Salt Storage Facility near the North Substation, which is of unknown depth, supplies approximately 41.6 L/min (11 gpm) of water solely to an outdoor pressure washer and hose bib, which are used primarily for washing company vehicles . The well at the North Substation is 76.2 m (250 ft) deep and supplies water for a toilet and sink at the unmanned substation control house. While the pumping capacity is unknown, the North Substation well's use is like that of the well at the South Substation, which suggests a pumping capacity of no more than 19 L/m (5 gpm). The well in the Hazardous Materials Yard, occasionally used for washing hands or rinsing equipment, is 61 m (200 ft) deep and provides 22.7 L/min (6 gpm). The well in the South Substation, is 91 m (300 ft) deep and provides 3.8 L/min (1 gpm) to a toilet at the substation control house (Conestoga-Rovers & Associates 2006b).

Sumps throughout PBAPS collect intermittent groundwater seeps from springs in the cliffs behind PBAPS. The yard drain sumps are outside the reactor buildings. Sumps at each reactor building and at the low-level radioactive waste storage building collect this groundwater and discharge it to the discharge canal or to the river. The water collected in the radioactive waste storage building is monitored for activity prior to release. Discharge of sump water is governed by outfall limitations specified in the NPDES permit (Exelon Generation 2001).

2.2.4 Power Transmission System

"In-scope transmission lines" are defined in Footnote 4 to Table B-1 in Appendix B to Subpart A of 10 CFR Part 51, as follows:

> "[T]ransmission lines that connect the nuclear power plant to the substation where electricity is fed into the regional power distribution system and transmission lines that supply power to the nuclear plant from the grid."

Units 2 and 3 feed power to the 500 kilovolt (kV) transmission system through two separate substations. These 500-kV substations are connected by two tie lines, and are also interconnected with the PJM Interconnection (PJM) and PECO Energy 500-kV grid system. Each substation occupies a plot approximately 750 ft by 1,000 ft. The north substation is located about 2,000 ft northwest of Unit 3, and the south substation is about 1,600 ft south-southwest of Unit 2. The substations are of outdoor construction; consisting of the necessary circuit breakers, disconnect switches, transformers, and associated equipment for five 500-kV transmission lines, two 500-kV substation tie lines, and two 500-kV generator tie lines. The substations are unattended, and are remotely controlled from the control room of Units 2 and 3 and the Philadelphia main office.

Startup auxiliary power is provided from any of three sources that connect to 13-kV startup switchgear at the station, as described below (Exelon Generation 2017g).

1. A tap on the 220-kV Nottingham-Cooper line feeds a 220/13 kV transformer (startup and emergency auxiliary transformer no. 2), which connects to the 13-kV startup switchgear at Bus 2SU.
2. A 220-kV line to Muddy Run Station connects from the north substation through a 500/220 kV auto-transformer. Thirteen kV from the tertiary winding on the 500/220 kV auto-transformer feeds the 13/13 kV transformer (startup and emergency auxiliary regulating transformer no. 3), which connects through an onsite, mostly underground, dedicated 13-kV line to the 13-kV startup switchgear at Bus 3SU.
3. The 220-kV Peach Bottom-Newlinville line connects through a 220/13 kV transformer (startup transformer no. 343, which is co-located with the north substation) and an onsite, partially underground, dedicated 13-kV line to the 13-kV startup switchgear at Bus 343SU.

An alternate AC (alternating current) source is available in the event of a station blackout (SBO) condition, when offsite power sources and emergency diesel generator power is not available to bring Units 2 and 3 to a safe shutdown condition and maintain that status. A dedicated 34.5-kV submarine cable, powered from the 33-kV bus at Susquehanna Substation (adjacent to the Conowingo Dam), terminates at the PBAPS SBO Substation.

The two PBAPS 500-kV substations are permanent parts of the overall transmission system, and thus constitute points at which electricity is fed into the regional power distribution system. Accordingly, Exelon Generation concludes that the five offsite 500-kV transmission lines connected to the PBAPS substations and the two onsite 500-kV substation tie lines, which would remain in place and energized regardless of license renewal, are not “in-scope transmission lines” as defined by footnote 4 of Table B-1 of 10 CFR Part 51, Subpart A. Also, the three offsite sources that provide startup auxiliary power are permanent parts of the overall transmission system and are not themselves “in-scope transmission lines.” Hence, the “in-scope transmission lines” are as follows: (1) the two onsite 500-kV generator tie lines, one from the main power transformer of each unit to its onsite substation, (2) the 34.5-kV submarine cable that supplies offsite power to PBAPS in the event of SBO, (3) the onsite 220-kV line from the tap on the Nottingham-Cooper line to the 220/13 kV transformer, (4) the onsite dedicated 13-kV line that supplies startup auxiliary power to the 13-kV startup switch gear at Bus 3SU, and

(5) the onsite dedicated 13-kV line that supplies startup auxiliary power to the 13-kV startup switchgear at Bus 343SU.

Characteristics of the "in-scope transmission lines" include the following:

- The two 500-kV generator tie lines between the main plant and the PBAPS substation traverse only onsite property used for industrial purposes. Vegetation within and adjacent to the right-of-way (ROW) for these lines is managed in accordance with a PBAPS procedure designed to assure compliance with North American Electric Reliability Corporation standards for minimum vegetation clearance distance for AC voltages. Vegetation management strategies named in the procedure include annual right-of-way vegetation inspections and periodic or as-needed controls such as herbicide application, mechanical clearing, hand clearing, pruning, and/or tree removal, which are defined in an annual work plan.
- The 34.5-kV submarine cable that supplies power in the event of SBO is mostly either underwater or underground. Accordingly, induced currents caused by the offsite portion of this cable are not a hazard for members of the public.
- The 220-kV line from the tap on the Nottingham-Cooper line to the 220/13 kV transformer traverses only onsite property used for industrial purposes.
- The 13-kV line that supplies startup auxiliary power to Bus 3SU is routed mostly underground and the above-ground route traverses only onsite property used for industrial purposes.
- The 13-kV line that supplies startup auxiliary power to Bus 343SU is onsite and routed partially underground. The above-ground route traverses only onsite property used for industrial purposes.
- The onsite routes traversed by "in-scope transmission lines" are not accessible to the general public, and electrical shock hazards are controlled on the PBAPS site in accordance with applicable industrial safety standards.
- Vegetation management in the ROWs for in-scope transmission lines other than the 500-kV tie lines is the responsibility of the transmission owner, PECO (an Exelon Company). According to PECO procedures, ROW maintenance includes routine monitoring for encroachments or other clearance problems, which are addressed by periodic application of herbicides and/or mowing and trimming. In addition, all Exelon Company employees (e.g., PBAPS and PECO personnel) are responsible for reporting problems to the appropriate organizations for corrective action.

2.2.5 Radioactive Waste Management Systems

The following descriptions of the radioactive waste management systems at PBAPS are taken from the UFSAR (Exelon Generation 2017g) unless otherwise referenced.

The radioactive waste systems are designed to control the release of plant produced radioactive material to within the limits specified in 10 CFR Part 20 and 10 CFR Part 50,

Appendix I, maintaining such releases as low as reasonably achievable (ALARA). This is done by various methods such as collection, filtration, holdup for decay, dilution, and concentration. The methods employed for the controlled release of these contaminants depend primarily upon the state of the material: liquid, solid, or gaseous.

The liquid and solid radioactive wastes from both Units 2 and 3 are routed to a common radioactive waste building for collection, treatment, sampling, packaging, and shipment to an approved offsite facility for further processing, disposal, or release. Packaged solid wastes and reusable radioactive material may be temporarily stored in the radioactive waste onsite storage facility or in approved outside storage locations. The radioactive waste handling building is located between the two containment structures. Gaseous wastes are processed and routed to a common high stack for dilution and dispersion in the atmosphere.

2.2.5.1 Liquid Radioactive Waste Management System

The liquid radioactive waste system collects, treats, stores, and disposes of all normally and potentially radioactive aqueous liquid wastes from both Units 2 and 3. These wastes are collected in sumps and drain tanks at various locations throughout the plant and are then transferred to the appropriate collection tanks in the radioactive waste building for treatment, storage, and re-use, discharge, or disposal in an approved manner. Overall control of the liquid radioactive waste system is conducted from a control room in the radioactive waste building.

The liquid radioactive waste system consists of the following major subsystems (Exelon Generation 2017g):

1. Equipment drain subsystem – This subsystem collects and processes high purity (low conductivity) water from sources such as piping and equipment drains. This water is treated by filtration and demineralization. After appropriate sampling, it is returned for Station reuse through the condensate storage tanks.

2. Floor drain subsystem -- This subsystem collects and processes low purity (high conductivity) waste water mainly from the floor drain systems. These waters are treated by filtration and demineralization. After appropriate sampling, the water is handled in one of several ways based on its quality. If its quality is good enough, it may be reused through the condensate storage tanks. If reuse is not an option, it may be returned for further treatment, or it may be discharged to the environment through the circulating water discharge canal at a controlled rate if acceptable for release to the environment. If its quality is sufficiently poor that it is not practical to reuse or discharge the water, it can be processed for disposal at an approved offsite facility.

3. Chemical waste subsystem – This subsystem processes high conductivity chemical wastes, such as from laboratory drains (routine) and chemical decontamination solutions (infrequent). These wastes are of such high conductivity that treatment using ion-exchange may be precluded. Accordingly, unless detergent

decontamination solutions are present, these wastes are processed using filtration and dilution, and routed along with floor drain wastes.

4. Laundry drain subsystem – This subsystem manages liquid waste containing detergents, chemicals from the laundry drains, cask washdown, and personnel decontamination station drain water. These waters may be filtered, or they may be processed using temporary equipment configured for specific pollutants. If sampling shows a batch to be acceptable for release, laundry drain subsystem wastes can be discharged to the environment. In the unusual event that laundry drain subsystem wastes contain cleaning agents and analysis indicates high radioactive content, such wastes can be shipped offsite for disposal.

Wastes to be discharged to the environment from the liquid radioactive waste management system are pumped on a batch basis to the discharge canal at a limited rate through a single discharge line with an orifice to provide good mixing with condenser effluent circulating water and to achieve a permissible concentration of radioactivity in the effluent to Conowingo Pond. The single discharge line is provided with two flow meters in parallel (one for high flow and one for low), a radiation monitor, and a downstream shut-off valve. The shut-off valve is closed automatically if preset flow or radiation limits are exceeded. An interlock is provided to prevent the discharge of liquid waste to Conowingo Pond unless a minimum of one circulating water pump is operating. The quantity of liquid radioactive waste released to the environment from Units 2 and 3 is expected to be less than one-third of the total quantity generated.

At PBAPS, radioactive waste management equipment is selected, arranged, and shielded to permit operation, inspection, and maintenance with minimum personnel exposure. For example, tanks and processing equipment which will contain significant radiation sources are located behind shielding, and sumps, pumps, instruments, and valves are located in controlled access rooms or spaces. Processing equipment is selected and designed to require minimum maintenance.

Non-aqueous liquid radioactive wastes, such as oil contaminated with radioactivity, are collected at their source and processed to produce an acceptable waste form for further processing and disposal at an approved offsite facility. Although the State Only Operating Permit No. 67-05020 allows some oils contaminated with radioactivity to be determined acceptable for burning in the PBAPS auxiliary boilers as a waste derived fuel pursuant to State Only Operating Permit No. 67-05020, burning of waste derived fuels has not been done at PBAPS since 2008.

2.2.5.2 Gaseous Radioactive Waste Management System

The gaseous radioactive waste management system limits the inadvertent release of significant quantities of gaseous and particulate radioactive material so that resulting radiation exposures do not exceed the limits specified in 10 CFR Part 100. The gaseous radioactive waste management system consists of two subsystems: (1) the gaseous radwaste/off-gas system, which collects and delays release of non-condensable radioactive gases removed via air ejectors from the main condensers; and (2) the gland seal steam exhauster system, which processes airborne radioactive releases from other plant sources. The condenser off-gases consist of radioactive activation and fission product gases, radiolytic hydrogen and oxygen, and condenser air in-leakage. The main condenser gas removal system removes non-condensables from the condenser, and during power operation, passes them through an absorber train and high efficiency filters prior to exhausting them to a vent stack for elevated release to the environment. In addition, the gland seal steam exhauster system, which is separate from the main condenser air ejector holdup pipe/main absorber bed, includes a holdup line between the gland seal steam exhauster system and the vent stack. This holdup line allows radioactivity in the gases to decay before the gases enter the vent stack.

During startup or shutdown, when power level is below five percent and less radioactive gas is present in the main condenser, non-condensables are removed from the condenser by mechanical vacuum pump and discharged directly to the vent stack through the same hold-up discharge line as is used by the gland seal steam exhauster system. Continuous main stack monitoring provides assurance that releases are within regulatory limits. Elevated level alarms within the system equipment allow adequate time for operators to curtail releases that may exceed permissible limits.

The exhaust ventilation air from the turbine building and radwaste building is discharged to atmosphere from the ventilation stack above the reactor building roof. Another potential source of radioactive gases is the reactor building ventilation system, which serves the reactor enclosures and the common refueling area. Radiation monitors are installed in both the refueling floor exhaust duct and the reactor building exhaust system duct which serves the area below the refueling floor. If radiation is detected, the signal causes isolation of the reactor building to prevent the escape of potentially radioactive particles into the atmosphere and also actuates the standby gas treatment system. The standby gas treatment system filters reactor building exhaust air to remove radioactive material, and the filtered air is given elevated release through the main stack.

The regulations in 10 CFR 50.36a require that the quantities of principal radionuclides in effluents from nuclear power plants be reported. Regulatory Guide 1.21, Rev. 2 (NRC 2009) indicates that principal radionuclides are those having either a significant activity or a significant dose contribution. In addition, Regulatory Guide 1.21, Rev. 2 states that licensees should evaluate whether carbon-14 (C-14), a naturally occurring isotope, is a principal radionuclide for gaseous releases from their facilities. The latter guidance was added to Regulatory Guide 1.21 in 2009 because reductions in radioactive effluents from commercial nuclear power plants through ALARA programs had converged with improvements in analytical methods for measuring C-14 such that C-14 may have become a new principal radionuclide at some plants. PBAPS has reported C-14 emissions in the annual radioactive effluent release reports since 2010. The C-14 quantities are estimated using guidance from the Electric Power Research Institute (EPRI) Technical Report 1021106, “Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents”. C-14 is primarily released through the stack, with a smaller component released through plant vents (Exelon Generation 2016c).

2.2.5.3 Solid Radioactive Waste Management Systems

The solid radioactive waste management system consists of those systems and components which are used to condition and package wet and dry solid wastes so that the waste is suitable for transport and disposal. The system is not used for spent fuel storage and shipment. Temporary storage capacity for packaged solid wastes is provided by the radioactive waste onsite storage facility or in approved outside storage locations (Exelon Generation 2017g).

Different methods are used for processing and packaging solid radioactive wastes, depending primarily on the waste characteristics, as described below.

Reactor internal parts that have been removed are either stored onsite in the Lower Level Radwaste facility or shipped to an approved, offsite disposal facility. Such solid radioactive wastes are dispositioned based on radiation types and levels. Examples of these wastes are activated hardware such as fuel channels, control rod blades, and nuclear instrumentation. These internal parts are typically categorized under 10 CFR Part 61 as Class B/C wastes. Upon removal from the core, such wastes are packaged in a disposal liner and either transferred to an approved onsite storage facility or shipped offsite to an approved land disposal facility (Exelon Generation 2017g).

Dry Active Wastes (DAW) are collected in packages. Most DAW packages are loaded into a large container and shipped to an offsite processor for further volume reduction prior to disposal. DAW that do not meet the criteria for processing by the offsite processor may be packaged for direct shipment to a burial facility. Typical DAW are air filters, cleaning rags, protective tape, paper and plastic coverings, discarded contaminated clothing, tools, equipment parts, and solid laboratory wastes (Exelon Generation 2017g).

Wet solid radioactive wastes result from the processing of spent demineralizer resins (both bead and powdered) and spent filter material from the equipment drain and floor drain subsystems, and from the three (reactor, condensate, and fuel pool) water cleanup systems. Processing, which includes phase separation and dewatering, yields packaged, dewatered resins in High Integrity Containers (HICs). Condensate, radwaste, and fuel pool resins are typically Class A HICs, and reactor water cleanup resins are typically Class B HICs. Filled HICs may be temporarily stored in shielded cells provided at the radioactive waste onsite storage facility, which is designed for remote handling (Exelon Generation 2017g).

PBAPS infrequently generates small quantities of mixed waste (i.e., waste having both a hazardous component that is subject to the requirements of the Resource Conservation and Recovery Act and a radioactive component that is subject to the requirements of the Atomic Energy Act). PADEP regulates the hazardous component of the waste, and PADEP and NRC regulate the radioactive component. Mixed wastes generated consist of ignitable liquids and solvents with coatings residue created during the cleaning of equipment used to apply coatings (Exelon Generation 2014d). Examples include adhesives, sealants, coatings, chemical reagents, methyl ethyl ketone, and denatured alcohol (Exelon Generation 2017f). When generated, mixed wastes are accumulated in the DAW area within the radioactive waste building, and are managed in the manner provided under 40 CFR Part 266, Subpart N, (Exelon Generation 2014d) pending transport to a licensed offsite facility for treatment and disposal.

In addition, PBAPS is licensed to receive Classes B and C low-level wastes from the Limerick Generating Station. Currently there are no Limerick wastes stored at PBAPS. Contracts for offsite storage of both PBAPS and Limerick Classes B and C wastes have been established, and Exelon Generation has no plans to store wastes from Limerick at PBAPS in the future unless offsite storage again becomes unavailable through currently unforeseeable circumstances.

2.2.6 Non-Radioactive Waste Management Systems

Exelon Generation expects that during the license renewal term PBAPS will continue to generate types and quantities of nonradioactive wastes similar to those generated during current and past operations. The nonradioactive waste management system receives and processes nonradiological wastes including hazardous, non-hazardous, and universal wastes. Wastes are managed in accordance with applicable federal and state regulations as implemented through corporate procedures. Nonradioactive effluents from the Peach Bottom Units 2 and 3 consist of hazardous waste, non-hazardous waste, universal waste, and sanitary waste.

PBAPS is a small quantity generator of hazardous waste, with generation amounts less than 1,000 kilograms/month (2,200 pounds/month). During the years 2015 through 2017, hazardous wastes requiring offsite management totaled less than 3,000 pounds/year (1,361 kilograms/year). Such wastes were primarily wastes exhibiting the characteristics of ignitability, corrosivity, or toxicity for metals (cadmium, chromium, silver). Small amounts of spent solvents, manufactured articles containing mercury, and off-specification commercial chemical products were also disposed offsite. PBAPS has contracts with waste haulers and offsite treatment and disposal facilities to remove and dispose all hazardous wastes. Typical non-hazardous wastes requiring offsite management include waste/used oil, grease, antifreeze, adhesives, and other petroleum-based liquids. PBAPS has contracts with waste haulers and offsite treatment and disposal facilities to properly remove and dispose of non-hazardous wastes. Typically, approximately 23,300 L/yr (6,160 gallons/yr) of nonhazardous waste oil (Exelon Nuclear 2012b; Exelon Nuclear 2013; Exelon Nuclear 2014; Exelon Nuclear 2015; Exelon Nuclear 2016) is designated as residual waste for offsite disposal.

Universal wastes are sent to universal waste handlers for appropriate management in compliance with Pennsylvania (25 PAC 266b) and federal (40 CFR 273) regulations. PBAPS personnel are responsible for minimizing universal waste generation. Universal wastes are collected, stored, and disposed in a safe manner for each waste type, including batteries, pesticides, mercury-containing equipment, lamps, oil-based finishes, and photographic solutions. Stored universal waste may be accumulated for no longer than a year.

PBAPS also manages other plant wastewaters in accordance with the NPDES permit (PA0009733) issued by PADEP. Sanitary waste is sent to an onsite sewage treatment plant. The sewage treatment plant processes a volume of approximately 18,000 to

22,000 gpd, and has a design capacity of 50,000 gpd (Exelon Corporation 2014). The sewage treatment plant is an extended aeration type with sludge settling and chlorination facilities. The liquid effluents from the sewage treatment plant are discharged to the circulating water discharge canal, which eventually discharges in Conowingo Pond (NRC 2003).

TABLE 2.2-1
PBAPS AVERAGE AND PEAK DAILY WATER WITHDRAWALS BY MONTH FROM CONOWINGO POND (2012 – 2016) (MGD)

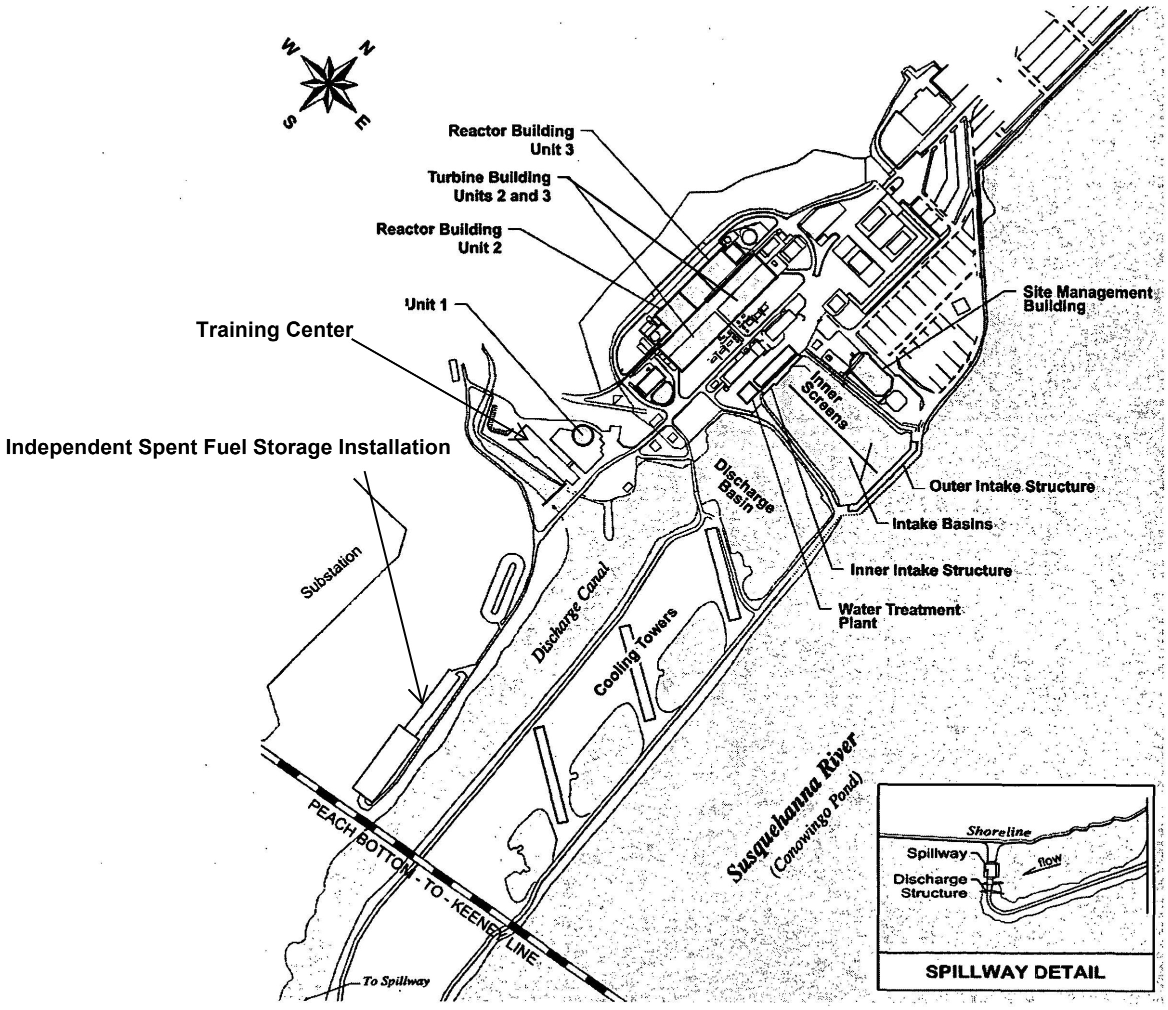
	2012[1]		2013[1]		2014[1]		2015[1]		2016[1]	
	Average	Peak Day	Average	Peak Day	Average	Peak Day	Average	Peak Day	Average	Peak Day
January	1,580.2	1,880.6	1,861.4	2,125.9	1,657.3	2,241.8	2,188.2	2,241.5	1,969.8	2,242.9
February	1,540.6	1,881.9	2,166.8	2,243.5	1,536.6	1,780.5	2,127.3	2,243.8	2,087.0	2,243.6
March	1,928.3	2,243.1	2,241.0	2,242.7	2,056.1	2,243.5	2,056.9	2,242.8	2,236.6	2,242.9
April	2,241.8	2,243.1	2,234.2	2,242.3	2,240.9	2,242.6	2,230.6	2,242.9	2,232.5	2,244.8
May	2,237.0	2,244.8	2,232.4	2,246.2	2,222.7	2,263.8	2,228.3	2,243.6	2,234.1	2,243.0
June	2,241.7	2,248.0	2,258.8	2,269.9	2,259.6	2,266.2	2,246.9	2,284.5	2,260.9	2,285.8
July	2,267.2	2,282.5	2,270.7	2,283.4	2,261.3	2,264.6	2,281.7	2,285.0	2,267.0	2,284.2
August	2,281.5	2,283.6	2,274.5	2,286.1	2,263.9	2,281.3	2,278.0	2,286.2	2,282.7	2,287.4
September	1,589.7	2,285.8	1,556.3	2,285.9	2,277.3	2,282.6	1,980.5	2,281.7	2,272.4	2,286.7
October	1,772.1	2,262.7	1,587.8	2,234.9	1,858.4	2,264.6	1,591.6	2,241.9	2,004.6	2,284.0
November	2,241.8	2,259.3	2,235.5	2,242.1	1,321.5	1,857.9	2,239.0	2,247.7	1,917.5	2,242.2
December	1,580.2	1,880.6	1,861.4	2,125.9	1,657.3	2,241.8	2,188.2	2,241.5	1,969.8	2,242.9

Sources: (Exelon Generation 2013b; Exelon Generation 2014b; Exelon Generation 2015b; Exelon Generation 2016b; Exelon Generation 2017b)
[1] SRBC Docket Limits Peak Day Surface Water Withdrawal to less than 2,363.62 MGD (SRBC 2011).

TABLE 2.2-2
PBAPS AVERAGE AND PEAK DAILY WATER CONSUMPTION BY MONTH FROM CONOWINGO POND (2012 – 2016) (MGD)

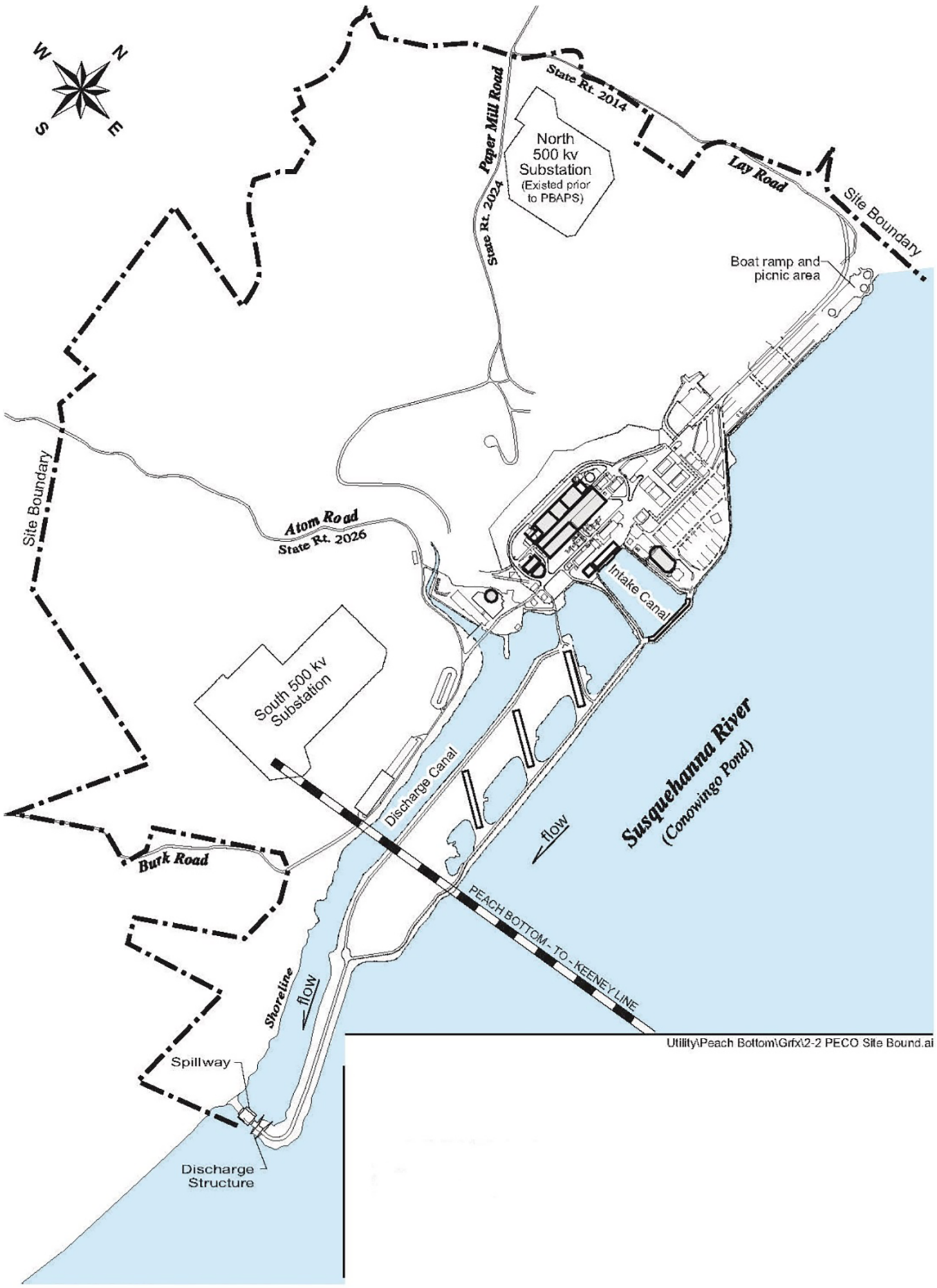
	2012[1]		2013[1]		2014[1]		2015[1]		2016[1]	
	Average	Peak Day	Average	Peak Day	Average	Peak Day	Average	Peak Day	Average	Peak Day
January	13.1	16.4	13.1	16.5	13.1	17.8	12.6	15.0	21.8	28.5
February	13.5	15.3	12.9	14.6	12.0	14.2	12.2	15.1	22.6	29.5
March	16.9	20.4	16.7	20.2	13.1	15.6	13.0	16.5	26.8	35.2
April	17.8	22.5	17.6	22.8	16.8	22.1	17.2	22.4	29.4	38.3
May	22.8	27.5	21.8	30.9	20.6	25.5	23.8	28.8	22.8	28.4
June	27.5	31.1	30.2	34.2	27.0	30.3	28.5	32.1	28.1	31.8
July	32.1	33.0	33.1	35.2	29.7	31.1	29.4	31.9	34.2	37.2
August	30.2	31.9	32.1	33.5	28.9	29.9	29.5	31.9	35.2	37.0
September	17.5	29.6	17.8	32.7	25.7	30.1	22.0	28.9	29.5	33.0
October	13.2	22.4	12.2	20.7	16.4	23.7	13.8	24.1	20.7	28.0
November	14.3	18.1	15.4	21.5	7.5	9.9	21.6	29.1	14.3	20.0
December	14.3	18.1	13.1	17.9	12.9	16.2	25.8	34.2	14.9	18.3

Sources: (Exelon Generation 2013e; Exelon Generation 2014e; Exelon Generation 2015g; Exelon Generation 2016f; Exelon Generation 2017h)
[1] SRBC Docket Limits Peak Day Consumptive Water Use to less than 49.000 MGD (SRBC 2011).



Source: (Exelon Corporation 2014)

Figure 2.2-1 PBAPS Site Map



Source: (Exelon Generation 2001)

Figure 2.2-2 Site Boundary

2.3 REFURBISHMENT ACTIVITIES

NRC

> **"The report must contain a description of… the applicant's plans to modify the facility or its administrative control procedures as described in accordance with § 54.21...This report must describe in detail…any planned refurbishment activities." 10 CFR 51.53(c)(2)**
>
> **"The environmental report must contain analyses of…refurbishment activities, if any, associated with license renewal…" 10 CFR 51.53 (c)(3)(ii)**
>
> **"…the incremental aging management activities implemented to allow operation of a nuclear power plant beyond the original 40-year license term were assumed to fall under one of two broad categories:… (2) major refurbishment actions, which usually occur infrequently and possibly only once in the life of the plant for any given item." NUREG 1437, Revision 1**

10 CFR 54.21 requires a demonstration that the effects of aging will be adequately managed so that the intended system functions will be maintained consistent with the current licensing basis throughout the period of extended operation. The PBAPS Second License Renewal (SLR) Application contains this demonstration. No physical plant alterations or modifications have been identified as necessary in connection with the PBAPS SLR Application. Accordingly, Exelon Generation has no plans for refurbishment or replacement activities at PBAPS associated with SLR. Exelon Generation has addressed refurbishment activities in this Environmental Report in accordance with NRC regulations and complementary information in the NRC GEIS for license renewal.

2.4 PROGRAMS AND ACTIVITIES FOR MANAGING THE EFFECTS OF AGING

NRC

"The report must contain a description of the proposed action, including the applicant's plans to modify … its administrative control procedures…" 10 CFR 51.53(c)(2)

Changes to power plant operations, inspections, maintenance activities, systems, and administrative control procedures designed to manage the effects of aging during the SLR term are described in Appendices A (Final Safety Analysis Report Supplement) and B (Aging Management Programs) to the PBAPS SLR Application (as required by 10 CFR Part 54). Implementing such aging management activities during the SLR term will not substantially alter previously reviewed environmental impacts from PBAPS.

2.5 EMPLOYMENT

Approximately 919 people work at PBAPS Units 2 and 3; approximately 89 contract employees and 830 permanent employees. Approximately 70 percent of PBAPS employees live in Lancaster and York counties. The remaining 30 percent is distributed across 21 other counties, with numbers ranging from 1 to 89 people. The towns of Lancaster, Red Lion, York, Delta and Quarryville have the highest numbers of employees in residence, with 9.68, 9.58, 9.14, 5.44 and 3.92 percent, respectively.

During the 18-to-20 day regularly scheduled refueling outages, staggered on a 24-month cycle for each unit, the normal plant staff is supplemented by up to 1,600 contract workers. These outage workers are either permanent residents of the region or stay in temporary housing locations assumed to be distributed similar to the locations in which permanent employees live.

As described in Section 2.4, Exelon Generation has identified no need for significant new aging management programs or major modifications to existing programs. Exelon Generation anticipates that existing "surge" capabilities for routine activities, such as outages, will enable Exelon Generation to perform the increased surveillance, monitoring, inspections, testing, trending and recordkeeping workload without increasing the PBAPS staff. Exelon Generation has not identified any refurbishment activities necessary at PBAPS. Accordingly, the current employment figures reported above are considered representative of those during the license renewal term.

2.6 ALTERNATIVES TO THE PROPOSED ACTION

Section 2.1 describes the proposed action, which is for NRC to renew the operating licenses for PBAPS Units 2 and 3 for an additional 20 years beyond the current expiration dates. Because the decision before the NRC is to renew or not renew the licenses, there is only one fundamental alternative to the proposed action: the no-action alternative. However, the no-action alternative would presumably result in a need for new baseload electrical generating capacity in the region served by PBAPS.

The no-action alternative refers to a scenario in which the NRC does not renew the PBAPS operating licenses. Unlike the proposed action of renewing the licenses, denying license renewal does not provide baseload generation capability to meet future system generating needs beyond the term of the current nuclear power plant operating licenses. Therefore, unless replacement generating capacity is provided as part of the no-action alternative, a large amount of baseload generation would no longer be available, and the alternative would not satisfy the purpose and need for the proposed action (see Section 1.1). For this reason, the no-action alternative has two components: replacing the baseload generating capacity of PBAPS and decommissioning the PBAPS Units 2 and 3.

Chapter 7 presents, in some detail, the methodology of identifying actions that could be taken to replace the baseload generation capacity of PBAPS in the region. Alternative generating technologies were evaluated to identify candidate technologies that would be capable of replacing the PBAPS generating capacity by the end of the first licensed unit's term in 2033. For purposes of this environmental report, Exelon Generation hypothesizes the following alternatives to license renewal that implement the generation replacement component of the no-action alternative.

- new natural gas generation capacity (Subsection 7.2.2.1)
- new coal generation capacity (Subsection 7.2.2.2)
- purchased power (Subsection 7.2.2.3)
- Small Modular Reactors (SMRs) generation capacity (Subsection 7.2.2.4)
- combination of wind, solar, and natural gas-fired generation capacity (Subsection 7.2.2.5)

Subsection 7.2.2.6 discusses additional alternatives that Exelon Generation has determined are not reasonable and the bases for these determinations.

Chapter 3

Affected Environment

3.0 AFFECTED ENVIRONMENT

PBAPS is located primarily in Peach Bottom Township, York County, PA, on the west side of Conowingo Pond, formed when Conowingo Dam was constructed across the Susquehanna River. The station is approximately 18 miles upstream from the point where the river enters the Chesapeake Bay (Figure 3.0-1) and 8 miles upstream from Conowingo Dam. This location is latitude 39° 75’ 89” north and longitude 76° 26’ 92” west (latitude +39.758889 and longitude -76.269167). Originally, approximately 620 acres were acquired for the construction of PBAPS. The original property boundary was coincident with the shoreline of Conowingo Pond which roughly paralleled the county line at the time of acquisition (Figure 2.2-2). Construction of PBAPS included the placement of fill and other materials within Conowingo Pond to create additional land, the intake and discharge canals, and holding ponds. The creation of this additional land expanded the boundaries of the acreage within the PBAPS site boundary. Hence, for the purposes of this environmental review, the size of the affected environment within the site, as shown in Figure 2.2-2, is assumed to be 769.44 acres, which includes the original acreage as well as the created land and water features. PBAPS is a two-unit nuclear generation facility. Each unit has a reactor building. Shared features at the site include turbine building, diesel generator building, outer intake structure, intake pond, inner intake structure, water treatment plant, sewage treatment plant, radioactive waste building, emergency cooling tower, discharge basin, discharge canal, cooling towers, meteorological stations, main stack, and administration building. The site also contains a site management building, various warehouses, an ISFSI, a training center, the retired PBAPS Unit 1 (a prototype high-temperature, gas-cooled reactor now maintained in SAFSTOR mode) (Figure 2.2-1), two electrical substations, a public boat ramp and picnic area (Figure 2.2-2).

No major metropolitan areas occur within 6 miles of PBAPS (Figure 3.0-2). The site is 19 miles southwest of Lancaster, PA, 30 miles southeast of York, PA, and 38 miles north of Baltimore, MD (Figure 3.0-1). The area within 6 miles of the site includes parts of York and Lancaster Counties in Pennsylvania and sections of Harford and Cecil Counties in Maryland (Figure 3.0-2). The area around PBAPS is predominantly rural, characterized by farmland and woods. (Exelon Generation 2001)

The terrain on either side of Conowingo Pond is steeply hilly. Immediately behind PBAPS is a rock cliff that was created when a hill was cut away to site the Station. It rises to an elevation of about 300 ft above the river (Exelon Generation 2001). Section 2.2 describes key features of PBAPS.

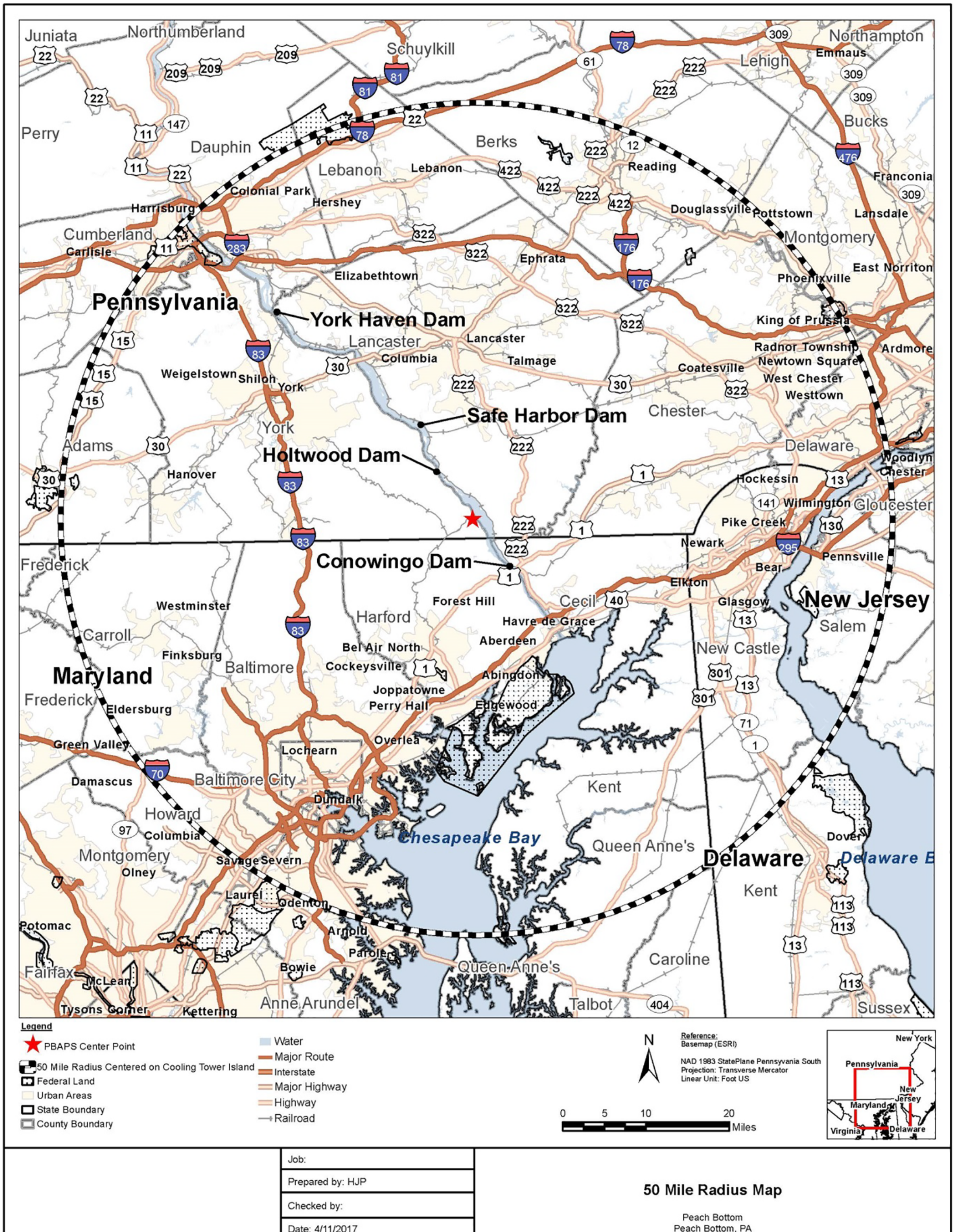


Figure 3.0-1 50-Mile Radius Map

Figure 3.0-2 6-Mile Radius Map

3.1 LAND USE AND VISUAL RESOURCES

3.1.1 Offsite Land Use

Land use within a 10-kilometers (km; 6-mile) radius of the PBAPS Station is primarily forested and agricultural, with mixed forest, cropland or pastures bordering the facility to the west, south, and north. To the east is Conowingo Pond, with more forested areas and cropland farther east. Figure 3.1-1 shows the land cover within a 6-mile radius of PBAPS. Table 3.1-1 shows land cover in the 10-km (6-mile) region based on data downloaded from the National Land Cover Database 2011 (USGS 2011).

The Conowingo Dam includes a run-of-the-river hydroelectric power plant located approximately 8 miles southeast of PBAPS and forms the lower boundary of Conowingo Pond. The Muddy Run Pumped Storage Facility is located approximately 5 miles north-northeast of PBAPS along Conowingo Pond. The Holtwood Dam is approximately 6 miles north of PBAPS and marks the upper reach of Conowingo Pond (Exelon Generation 2001). These facilities would be considered industrial land uses, which all rely upon and influence water levels in Conowingo Pond.

The SRBC approved a management plan for Conowingo Pond in 2006 (SRBC 2006). Although Conowingo Pond is managed in part with federal oversight, it is not considered a national park or reserved area. Susquehannock State Park is located approximately 2.5 miles north of PBAPS in Lancaster County. The Fishing Creek Nature Preserve is located approximately 5 miles north (Google Earth 2016b). Additional parks in the area are described in Subsection 3.8.3. Susquehannock State Park offers scenic overviews of Conowingo Pond, hiking trails, horseback riding trails, camping, and picnic areas (PA DCNR 2014). The Fishing Creek Nature Preserve is divided into two sections, north and south. The north portion is managed as a buffer for Fishing Creek. Hiking, fishing, and bow and arrow hunting are allowed (Lancaster Conservancy 2016a). Fishing Creek Nature Preserve South has two parking areas and a single gravel trail along Fishing Creek (Lancaster Conservancy 2016b).

PECO, an electric and natural gas utility subsidiary of Exelon Corporation, manages two protection areas near overhead transmission corridors in Lancaster County that contain an uncommon geological feature known as serpentine barren. These areas are known as “Goat Hill” and “Rock Springs Natural Area.” Vegetation on both sites is managed to promote unusual plant communities. PECO works cooperatively with Pennsylvania Department of Conservation and Natural Resources (PA DCNR) to manage the Goat Hill site, which is a Public Wild Plant Sanctuary. Both of these managed areas are within 10 miles of PBAPS.

The following sections look specifically at land use in York and Lancaster counties.

York County

York County is situated in south-central Pennsylvania. The County is bordered by Adams and Cumberland Counties to the west and north respectively and the Susquehanna River and Lancaster County to the east. Northeast of the River lies Dauphin County and the southern border is the Mason-Dixon line which forms the border with Maryland and its northernmost counties of Carroll, Baltimore and Harford. York County is approximately 911 square miles or 583,040 acres (YCPC 2008).

York County is rich in natural features. Almost 35 percent of its total land area is forested. York County is also home to many other natural areas, including parks and caves. The section of the Susquehanna River that borders York County extends 54 miles and includes four lakes formed from impounding dams. Over 100 streams have been identified in the county. Over half the county is comprised of prime agricultural soils which permit the agricultural industry to flourish. Because of its favorable soils and climatic conditions, York County has in the past excelled as an agricultural area (YCPC 2008).

York County contains 72 municipalities. The city of York functions as the county seat (YCPC 2008). The structure of government in Pennsylvania does not facilitate a unified approach to growth management because local municipalities have the primary authority and responsibility for land development, subdivisions, and zoning. As a result, zoning regulations vary from municipality to municipality, with some being much more restrictive than others (YCPC 2009).

As discussed in detail in Subsection 3.8.1, the population of York County has grown at faster rates than that of the Commonwealth of Pennsylvania as a whole, a trend that is predicted to continue. Decades of population growth coupled with fragmented land development practices have caused significant amounts of land to be converted to residential, commercial, and industrial uses. Once characterized by farmlands, villages and small boroughs, the landscape of York County shows the effects of urban and suburban sprawl, loss of agricultural lands and environmental degradation. The loss of agricultural and open space resources irrevocably alters the visual and aesthetic appeal of the landscape, thereby threatening the very distinctions that contribute to the quality of life in York County (YCPC 2008).

The amount of land in farms has been steadily decreasing since 1960. In 1960 there were 408,200 acres of farmland in York County, comprising 70.0 percent of County land (YCPC 2011). By 2012, land in farms totaled 262,062 acres or 44.95 percent of county land (USDA 2012c). Over 52 years, a total of 146,138 acres of farmland representing 25 percent of county land was lost.

Preservation of farmland is a priority for York County. In 1992, the County's Comprehensive Plan was adopted. Its basic land use premise was to promote development within proposed growth areas in order to preserve important open space, farmland, and natural resources and to encourage efficiency in the provision and extension of public services and facilities. An update to the Plan, completed in 2008, concluded that 76.9 percent of the proposed dwelling units were proposed within growth areas (YCPC 2009).

Lancaster County

Lancaster County is situated in south-east Pennsylvania, approximately 40 miles west of Philadelphia. The county is bounded by six adjacent counties: Berks County to the northeast, Chester County to the east, Cecil County (Maryland) to the south, York

County to the west, and Dauphin and Lebanon Counties to the northwest. It is approximately 950 square miles or 608,000 acres in size (LCPC 2006).

Lancaster County is rich in natural resources. A majority of the soils in Lancaster County is prime farmland or soils of statewide importance. These soils provide the basis for the County's agricultural industry and rural way of life. While much of Lancaster County's native forested cover has been cleared for agriculture or for urban development, significant areas of woodland remain. Forested lands are concentrated in the northern and northeastern parts of the County and along the Susquehanna River as well as streams and waterways throughout the County. Some of these forested areas have been preserved as public parks and open spaces that provide recreational opportunities for residents and visitors. A large forested belt along the boundary with Lebanon County is a state gameland (LCPC 2006).

Lancaster County's predominant land use is agriculture. In 2006, 63 percent of the county was in agricultural use. Approximately 24,000 acres (6.2 percent) of agricultural land were located inside designated growth areas while 359,000 acres (93.8 percent) of agricultural land were located outside of designated growth areas. As of 2006, 67,000 acres of farmland had been preserved through permanent easements by the Lancaster County Agricultural Preserve Board and Lancaster Farmland Trust (LCPC 2006). Between 2007 and 2012, land in farm use in Lancaster County increased to 439,481 from 425,336 acres, representing a 3.3 percent increase. In 2012, land in farms constituted 72.8 percent of the county (USDA 2012c).

Lancaster County's land use patterns and growth management policies influence and are influenced by those of adjacent counties. Berks and Chester counties have experienced significant population growth which impacts growth in Lancaster County. The transportation corridor consisting of PA 283, U.S. 30, and U.S. 222 has been the focal point of development in Lancaster County in the past and it is expected that future growth will be concentrated in the municipalities adjacent to this corridor (LCPC 2006).

Lack of a coordinated approach to growth and land development, and rapid population growth contributed to sprawl and the loss of important resources and rural character. Lancaster County contains 62 municipalities (Lancaster County 2016). The structure of government in Pennsylvania does not facilitate a coordinated approach to growth management because local municipalities have the primary authority and responsibility for land development, subdivisions, and zoning. As discussed in detail in Subsection 3.8.1, the population of Lancaster County has grown at faster rates than that of the Commonwealth of Pennsylvania as a whole, a trend that is predicted to continue. As a result, the preservation of farmland is a priority for Lancaster County. The County's growth management plan is guided by smart growth principles. A plan update directed that 85 percent of new development occur in growth areas in order to preserve the rural nature of the county (LCPC 2006).

3.1.2 Onsite Land Use

The PBAPS site consists of 769.44 acres (Figure 3.1-1). The PBAPS generation facility includes many buildings and facilities as described in Section 3.0 (also see Figures 2.2-1 and 2.2-2).

Land use onsite in the undeveloped areas includes deciduous forest, open water, cultivated crops, and barren land. Table 3.1-2 shows the amount of onsite acreage in various land use categories based on data downloaded from the National Land Cover Database 2011 (USGS 2011).

3.1.3 Visual Resources

The terrain on either side of Conowingo Pond is steeply hilly. Immediately behind PBAPS is a rock cliff that was created when a hill was cut away to site the Station (Exelon Generation 2001). It rises to an elevation of about 300 ft above the river. Overall, the area surrounding PBAPS is rural and agricultural with single lane roads and forested areas. Residences are sparse and generally associated with agricultural fields or are in small clusters at road intersections.

The active portions of the PBAPS facility are somewhat visible from Conowingo Pond and the surrounding area located to the east. The largest structures onsite are the Units 2 and 3 reactor buildings, which are rectangular and less than 300 ft high. However, as the hill is taller than the units (300 ft high) (NRC 2003), the plant is minimized visually. Additional structures visible from the east include transmission towers and lines, parking areas, and the Unit 1 reactor building, which is round and smaller than the other two reactor buildings (Photo 3.1-1). Additional man-made features onsite include the 500-ft main stack, and the two substations (north and south) located at the top of the cliff west of the reactor buildings. Only the main stack is visible from the areas to the west of the cliff, the units themselves are not visible. The units are only visible from Conowingo Pond and from residences along the shore (NRC 2003). The remainder of the property is either undeveloped or maintained as green space under the transmission lines. PBAPS is visible at night due to exterior night lighting. One cooling tower is required to be operational from June 15th through August 31st. A second tower must be placed in operation if the water temperature reaches 83 degrees F. Once placed in operation this tower must remain operational until August 31st. A third cooling tower must be placed in operation if the water temperature reaches 86 degrees F and remain operational for a minimum of seven days. During the rest of the year, when cooling towers are not operational, no plumes would be present (NRC 2003).

TABLE 3.1-1
LAND COVER WITHIN A 6-MILE RADIUS OF PBAPS AND THE PERCENTAGE OF THE TOTAL ACREAGE

Land Use/Land Cover Type	6-Mile Radius Acreage	Percent of Total (%)
Deciduous Forest	22,771.88	31.46
Cultivated Crops	17,463.10	24.13
Hay/Pasture	13,235.35	18.29
Open Water	8,309.64	11.48
Developed, Open Space	4,820.51	6.66
Shrub/Scrub	1,812.93	2.50
Mixed Forest	1,397.64	1.93
Evergreen Forest	700.57	0.97
Developed, Low Intensity	576.70	0.80
Woody Wetlands	434.40	0.60
Emergent Herbaceous Wetlands	333.93	0.46
Developed, Medium Intensity	172.79	0.24
Herbaceous	155.76	0.22
Barren Land	118.48	0.16
Developed, High Intensity	77.88	0.11
Total	72,381.56	100.00

Source: Land cover data from USGS 2011 (as shown in Figure 3.1-1).

TABLE 3.1-2
LAND COVER WITHIN THE PBAPS PROPERTY BOUNDARY

Land Use/Land Cover Type	Site Acreage	Percent of Total (%)
Deciduous Forest	327.69	42.59
Open Water	113.41	14.74
Cultivated Crops	60.08	7.81
Barren Land	57.40	7.46
Shrub/Scrub	51.28	6.66
Developed, High Intensity	51.24	6.66
Developed, Open Space	38.94	5.06
Mixed Forest	28.16	3.66
Developed, Medium Intensity	25.73	3.34
Developed, Low Intensity	11.41	1.48
Woody Wetlands	2.33	0.30
Herbaceous	1.77	0.23
Total	769.44	100.00

Source: Land cover data from USGS 2011 (as shown in Figure 3.1-1).

Figure 3.1-1 6-Mile Radius PBAPS Land Use/Land Cover Map

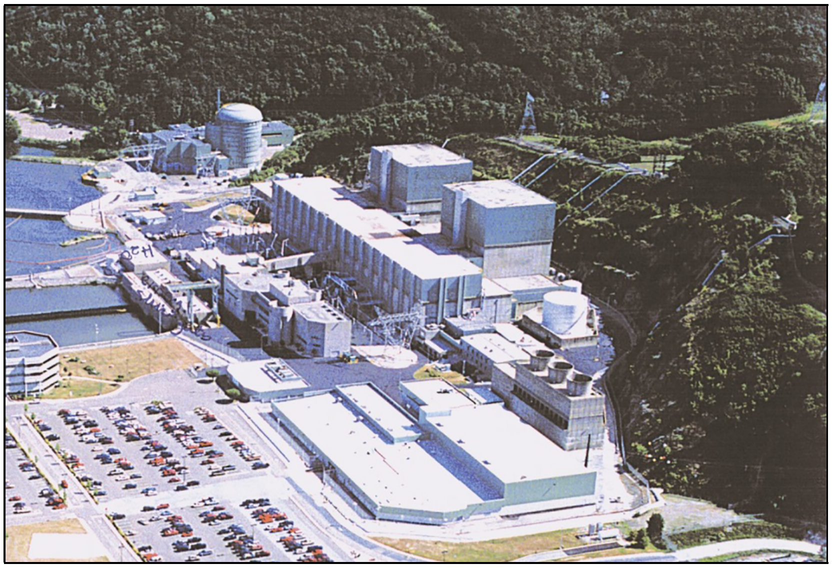


Photo 3.1-1. PBAPS Facility Buildings (Exelon Generation 2001)

Views from the east would be the most imposing as the scale of the plant is more obvious from water level. From the west, the PBAPS facility is not highly visible. Although the plant contrasts as an industrial feature in an otherwise rural setting, it is not a jarringly dominant feature from most views due to its recessed position (Photo 3.1-2).

Photo 3.1-2. View of PBAPS from the Eastern Shore of Conowingo Pond

3.2 METEOROLOGY AND AIR QUALITY

PBAPS is located partly in Peach Bottom Township, York County, partly in Drumore Township, Lancaster County, and partly in Fulton Township, Lancaster County, in southeastern Pennsylvania. It is located about 38 miles north-northeast of Baltimore, Maryland and 63 miles west-southwest of Philadelphia, Pennsylvania.

The Köppen-Geiger climate classification of the area is Cfa, which is characterized by a hot moderate climate that has year-round rainfall with no dry season, and hot summers. Meteorological records for southeastern Pennsylvania are available for the Harrisburg-Middletown area, located approximately 40 miles north of the Peach Bottom site. For the 76 year period of record ending in 2016, average temperatures ranged from -1.1 degrees Celsius (C; 30.1 degrees F) in January to 24.2 degrees C (75.6 degrees F) in July (National Centers for Environmental Information 2017). The data from this area indicate that lowest precipitation amounts for the year generally last for about a month or two, typically in January or February. The average annual precipitation for the 76-year period of record ending in 2016 was 104.8 centimeters (cm; 41.25 inches [in.]). Normal monthly precipitation ranges from 6.6 cm (2.60 in.) in the dry season (i.e., February) to 9.9 cm (3.90 in.) in the July wet season (Northeast Regional Climate Center 2016).

Thunderstorms occur on average between 20 to 30 days per year (NOAA 2016b). During the period June through August, the daily occurrence of thunderstorms is about 5 to 7 days per month. The particular 1-degree square surrounding the site has been affected by tornadoes 69 times during the period 1950 through 2003 (Ramsdell and Rishel 2007). The probability of a tornado striking the site is expected to be about 1 in 2,600 years.

Onsite monitoring of meteorological data has been conducted since the licensing of Unit 1 in 1959. The meteorological monitoring program was upgraded in 1983 to conform to the requirements of then-proposed Regulatory Guide 1.23, Rev. 1 (Exelon Generation 2017g). The following descriptions of the current meteorological monitoring program at PBAPS are taken from the UFSAR unless otherwise referenced.

The PBAPS site is equipped with an instrumented meteorological tower, Tower No. 2, and two satellite wind instruments, the Hill Pole and the River Tower, all of which have been operating long enough to provide a good understanding (i.e., representative database) of the wind patterns and stability at any elevation of interest in design and operation of the facility. Tower No. 2 is located on the bluff north and west of Units 2 and 3. Wind speed and direction are measured at Tower No. 2 at 33 ft, 75 ft, and 320 ft. Ambient temperature is measured at 33 ft. Differential temperatures, referenced to 33 ft, are measured at 150 ft and 316 ft. Precipitation is measured at approximately 8 ft. The Hill Pole is located on the bluff behind Units 2 and 3, near the base of the off-gas stack. The Hill Pole measures wind speed and direction at 33 ft. The River Tower is located in Conowingo Pond approximately 3,500 ft from Tower No. 2 in a direction perpendicular to the western river bank. The River Tower measures wind speed and direction at 45 ft.

Data from Tower No. 2 is digitized at the base of the tower, transmitted via dedicated lines to the control room, and to an onsite computer for archive storage. The data are also recorded on strip charts at the base of the tower and in the control room. The data from the River Tower is transmitted via radio telemetry to the base of Tower No. 2 and is digitized and recorded in the same manner as Tower No. 2's data. Data from the Hill Pole is digitized and recorded in the control room only. The digitized data are available on computer terminals in the control room, the Emergency Operations Facility at Coatesville, Pennsylvania, and are available for remote interrogation by Exelon Generation, the NRC and Pennsylvania and Maryland agencies.

Recorded meteorological data are used to generate wind rose tables indicating the prevailing wind direction, wind speed, and stability classes and to estimate airborne concentrations of gaseous effluents and offsite radiation dose. Exelon Generation ensures the instruments are calibrated, and data consistency evaluations are routinely performed to ensure maximum data integrity.

Under the Clean Air Act (CAA), the U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQSs) that specify maximum concentrations for carbon monoxide (CO), particulate matter with aerodynamic diameters of 10 microns or less (PM_{10}), particulate matter with aerodynamic diameters of 2.5 microns or less ($PM_{2.5}$), ozone, sulfur dioxide (SO_2), lead, and nitrogen dioxide. Areas of the United States with air quality as good as or better than the NAAQS are designated by the EPA as “attainment areas.” Areas with air quality worse than the NAAQS are designated by the EPA as “nonattainment areas.” Areas that were designated nonattainment and subsequently re-designated as attainment after meeting the NAAQS are termed “maintenance areas.” States with maintenance areas are required to develop air quality maintenance plans as elements of their State Implementation Plans.

The Peach Bottom site is located within the South Central Pennsylvania Intrastate Air Quality Control Region (AQCR), which includes Adams, Cumberland, Dauphin, Franklin, Lancaster, Lebanon, Perry, and York counties. The South Central Pennsylvania Intrastate AQCR is designated as being in attainment for all criteria pollutants, except ozone. Lancaster County, immediately across the Susquehanna River from PBAPS, is designated as a nonattainment area for ozone and classified marginal. Nearby, the Metropolitan Philadelphia Interstate AQCR includes counties in Pennsylvania (Bucks, Chester, Delaware, Montgomery, and Philadelphia), New Jersey (Burlington, Camden, Gloucester, Mercer, and Salem), and Delaware (New Castle). The Metropolitan Philadelphia Interstate AQCR is designated as nonattainment for ozone (EPA 2016a).

The Metropolitan Baltimore Intrastate AQCR is also near PBAPS, and encompasses the following counties in Maryland: Anne Arundel, Baltimore City, Baltimore County, Carroll, Harford, and Howard. All counties in the Metropolitan Baltimore Intrastate AQCR are designated nonattainment for ozone. Anne Arundel and Baltimore Counties do not meet NAAQS for SO_2.

Regulated nonradioactive air pollutant emission sources at PBAPS include auxiliary boilers, emergency diesel generators, emergency water pumps, and the cooling towers. Emissions from these sources are regulated by the PADEP Air Pollution Control Act (25 Pa. Code Chapter 127) through the State Only Operating Air Emissions Permit No. 67-

05020 (also referred to as the Synthetic Minor Operating Permit [SMOP]). The permit was issued on October 28, 2014, and expires on October 31, 2019. The permit specifies the following sources of emissions:

- Two auxiliary boilers, designated as “A” and “B”, that are used for space heating, and to help with unit startups. These boilers have a rated capacity of 50.5 million British Thermal Units (MMBTU) per hour.
- Four diesel generators, designated as numbers 1, 2, 3, and 4, located at Units 2 and 3. These generators have rated capacities of 2,600 kilowatts (kW; 3,490 horsepower). The generators are tested at load for a period of at least 60 minutes every four weeks. An endurance test involving a 24-hr burn is conducted once every two years. The four units are on a staggered endurance test schedule, with one of the four units tested every six months.
- One emergency generator located at the Administration Building.
- One diesel-driven emergency fire water pump.
- Three emergency water pumps, designated as numbers 1, 2, and 3, used for cooling water circulation.
- Three cooling tower banks. The cooling towers emit fugitive particulate matter (PM) during operation.

In addition to the sources specified in the 2014 permit, four new sources of emissions have been added at PBAPS that were exempt from the requirement to obtain an air quality Plan Approval to Construct and Install because their nitrogen oxide (NOx) emissions meet the exemption criteria specified in 25 Pa. Code §127.14(a)(8). Exelon Generation has notified PADEP of its intention to request incorporation of these sources into existing Permit No. 67-05020 at the time of its next required renewal, which will occur during 2019. In the meantime, data related to their emissions are being reported to PADEP in the PBAPS Annual Reports of Operating Hours and Fuel Usage. These sources include:

- One additional emergency water pump, designated as number 4.
- Three emergency generators at the Diverse and Flexible Coping Strategies (FLEX) Building, designated as numbers 1, 2, and 3.

Compliance with the emissions limits specified in Section C.VII.13 of the permit is based on the facility’s total actual emissions over a 12-month rolling average. The limits include:

- 100 tons/year of sulfur oxides (SOx)
- 100 tons/year of NOx
- 100 tons/year of CO
- 100 tons/year of PM_{10}
- 100 tons/year of $PM_{2.5}$

- 50 tons/year of volatile organic compounds (VOCs)
- 10 tons/year of any individual hazardous air pollutant (HAP)
- 25 tons/year of total combined HAPs
- 100,000 tons/year of greenhouse gas (GHG) emissions, expressed as carbon dioxide equivalents (CO2e)

Appendix A of the SMOP renewal application in 2013 presented calculations of operational restrictions (operating hours and fuel usage) which would achieve these emissions limits, and would maintain the status of the facility as a synthetic minor source not subject to a Title V Operating Permit (Exelon Generation 2013d). As specified in Section C.V.10 of the permit, compliance with the emissions limits is demonstrated through reporting of the operating hours and fuel usage amounts for the various sources, and showing that these fall within the operating limits calculated in Appendix A of the permit renewal application. The potential emissions associated with those operating limits are shown in Table 3.2-1.

The calculation of GHG emissions, based on the operating limits discussed above, demonstrate that the emissions sources at PBAPS would result in a maximum of 29,705 tons per year of combined GHGs, or 29.7 percent of the emissions limit, if all sources were operated at their maximum allowable fuel usage and hours. In addition to this plant-specific estimate, Exelon Generation has adopted a procedure to assist its parent company, Exelon Corporation, in complying with the EPA’s Greenhouse Gas Reporting program and the International Standards Organization 14064 Greenhouse Gases—Part 1 specification. In accordance with the procedure, estimated emissions from potential direct and indirect GHG sources are collected and submitted to a central corporate database for use in quantifying site-wide GHG emissions. GHG data for mobile sources are not compiled or reported, except those under corporate control (fleet vehicles). Within Exelon Generation, GHG emissions from fleet vehicles are tracked through fleet fuel usage. The data are tracked for the Exelon Generation fleet rather than individual facilities. Therefore, no information on emissions from vehicles specific to PBAPS is readily available. As no refurbishment activities associated with license renewal are planned, no vehicle emissions are attributable to such activities.

The CAA, as amended, established Mandatory Class I Federal Areas where visibility is an important issue. No Class I areas exist within 100 km (62 miles) of the PBAPS site (NPS 2016).

TABLE 3.2-1
PBAPS POTENTIAL AIR EMISSIONS

Pollutant	Major Source Threshold Limit per SMOP 67-05020 (tons/year)	Potential Emission[1] (tons/year)	Potential Emissions[1] as Percent of Major Source Threshold Limit
CO	100	22.9[2]	22.9%
Lead	100	0.00163[2]	0.0%
NOx	100	99.7[2]	99.7%
PM_{10}	100	7.6[2]	7.6%
$PM_{2.5}$	100	6.5[2]	6.5%
SO_2	100	9.5[2]	9.5%
VOC	50	2.5[2]	5.0%
Individual HAPs	10	<10[3]	<100%[2]
Total HAPs	25	<25[3]	<100%[2]
CO2e	100,000	29,705.3[4]	29.7%

[1] Potential emissions if all sources are operated at their maximum allowable fuel usage and hours.
[2] SMOP No. 67-05020 Renewal Application, Appendix A, Table A-1 (Exelon Generation 2013d).
[3] Per Section E.VII, PBAPS is an area source of HAPs. An area source is a source that is not a major source, and therefore does not have the potential to emit 10 tons/year of any individual HAP, or 25 tons per year total HAPs. (PADEP 2014c)
[4] SMOP No. 67-05020 Renewal Application, Appendix A, Table A-2 (Exelon Generation 2013d).

3.3 NOISE

Noise at PBAPS is generated by the various onsite equipment including the pumps, turbines, diesel generators, switchyard equipment, transformers, cooling towers, and loudspeakers. The largest amount of noise is intermittent and is due to operation of the auxiliary boilers. The PBAPS Final Environmental Statement - Operating License states that noise levels from the mechanical draft cooling towers and 500-kV transformers are typically on the order of 65 to 75 A-weighted decibels (dbA) at 100 ft from the base of a tower or transformer (equivalent to a noisy city street). Therefore, this noise could possibly be heard by boaters on Conowingo Pond; however it is unlikely that it would be heard by residents of homes in the vicinity of the facility. The closest residences are over 0.5 miles away to the west of PBAPS, and the eastern bank of Conowingo Pond is approximately 1.5 miles across open water from the plant (Google Earth 2016a). Furthermore, due to the hillside and body of water surrounding the plant, noise levels are dampened. In addition, there are no hospitals or schools in the area, and no complaints about noise are known to have been received at the site.

Neither York County nor Lancaster County has regulations or guidelines for environmental noise. Also, Pennsylvania has no noise ordinances that apply specifically to electricity generating facilities or to general industrial facilities (State of Pennsylvania 2016).

Although onsite noise is monitored for personnel safety, no noise surveys have been conducted in offsite areas.

3.4 GEOLOGIC ENVIRONMENT

3.4.1 Geology

The PBAPS site lies within the Piedmont Upland Section of the Piedmont Physiographic Province of the Appalachian Highlands. The hills in the upland section are capped by Cambrian quartzites and Precambrian crystalline rock. The valleys are underlain by limestone and calcareous shales. More specifically, PBAPS is located within the outcrop zone of the Peters Creek schist (Exelon Generation 2017g).

The upper geologic layers of the PBAPS site consist of residual soils derived by weathering of the underlying schist. These soils are compact and consist of sandy silt and silty sand with gravel. The underlying Peters Creek schist is a greenish-gray to white chlorite schist interbedded with seams and bands of quartzite that range up to 6 ft in thickness. The upper zone of the bedrock formation has been weathered to a friable material containing ribs of relatively unweathered rock. There is a transitional zone between the overlying residual soil and the highly weathered rock. The layer of severe weathering ranges in thickness from less than 10 ft to more than 60 ft. During construction of PBAPS, the relatively fresh rock surface was encountered at depths ranging from about 15 ft below original grade near the Susquehanna River, to greater than 80 ft below grade in the western portion of the site. Figure 3.4-1 shows a geological cross section of the site, including the original ground surface and the exposed surface following excavation during facility construction (Exelon Generation 2017g).

The closest significant geological structure is the Peach Bottom Syncline, located approximately 1 mile south of the site. This feature is a narrow, elongated, tightly folded syncline approximately 16 miles long, and with an average width of 1/2 mile. The Peach Bottom slate forms the core of the syncline, and is in fault contact with the Peters Creek schist for a distance of 9 miles. The closest approach of this faulting to the site is about 1 mile to the south. The fault has been inactive for at least 140 million years (Exelon Generation 2017g).

In the site area, the Peters Creek schist is characterized by thin lenticular bedding and strong flow cleavage resulting, in a well-developed schistosity. The unit is exposed in a major cut on the western side of the site, where the hillside was cut back to make room for the facility. Recent mapping of the schist exposed in this cut indicates that, along the long face of the cut near Units 2 and 3, the predominant strike of the schistosity is to the northeast, and the dip is steep (60 to 70 degrees) to the southeast (Exelon Generation 2017g).

The PA DCNR maintains an interactive map showing the locations of geologic hazards such as closed depressions, sinkholes, and epicenters of earthquakes which occurred from 1724 to 2003 (PA DCNR 2016a). None of these features are located within 5 miles of PBAPS. Additional discussion of seismic hazards is presented in Subsection 3.4.3. Mapping of the Conowingo Pond shoreline in association with the New License Application for the Conowingo Pond Hydroelectric Project classified the erosion potential of the shoreline at PBAPS as “minimal to none”, indicating that the shoreline was either predominantly bedrock outcrops, or industrial and engineered structures (Exelon Generation 2012b).

The geotechnical setting at PBAPS is reviewed when a new structure is constructed, and studies are performed, if needed. For example, reviews were done prior to the construction of the FLEX building. No previously unknown geologic hazards have been identified since initial plant construction.

3.4.2 Soils

Figure 3.4-2 shows the soil map of the PBAPS property, and Table 3.4-1 shows the characteristics of the soils. York County and the PBAPS site are located in the Piedmont Physiographic Province. The topography is generally rolling and undulating hills, with a few large flat valleys. Over 100 types of soil have been identified in York County (USDA 2003). According to information on the Natural Resources Conservation Service (NRCS) web-based soil mapper, the main soil components at PBAPS are Mt. Airy and Manor (MOB, MOC, MOD, MOE and MRF – depending on slope) soils and Glenelg Channery loam (GbB and GbC – depending on silt content) (NRCS 2016b).

Mt. Airy Manor soils are categorized according to slope. MOB soils are sloped from 3 to 8 percent. These soils are moderately deep, somewhat excessively drained Mt. Airy channery silt loam and very deep, somewhat excessively drained Manor channery loam. These soils are mapped together as they generally coexist and are found on ridgetops. Fractured schist bedrock is usually found between 32 and 60 in. deep. The slopes range from 3 to 8 percent for MOB soils to 25 to 60 percent for MRF soils (USDA 2003). The MRF soils are highly erodible, the MOD and MOE slopes are moderately erodible, and the MOB and MOC slopes are slightly erodible (NRCS 2016a).

Glenelg Channery loam (GbB) is sloped at 3 to 8 percent and is deep, well-drained soil found on ridgetops. The surface layer is about 8 in. thick and at approximately 50 in., weathered, fractured mica schist bedrock is encountered. These soils are generally used for agriculture and pasture. Glenelg Channery silt loam is sloped from 8 to 15 percent and is also found on ridgetops and side slopes. It is otherwise similar to the GbB soil unit (USDA 2003). Both of these soil types are slightly erodible (NRCS 2016a).

During construction, most of the material for required backfilling operations was obtained from the higher portions of the site. All soil backfill and other fill which is utilized for structural support was compacted to a density of at least 95 percent of the maximum density obtainable by the American Association of State Highway Officials Method of Compaction (T-180). Around the circulating water pipes and adjacent to deep walls, imported backfill was used (Exelon Generation 2017g).

3.4.3 Seismic Setting

Regional Seismic Setting

The zone of major earthquake activity closest to the site is the St. Lawrence River Valley Region, about 350 miles to the northwest. The St. Lawrence River Valley is a major rift valley formed of a downfaulted graben structure. The tectonic development of the St.

Lawrence River Valley is completely dissimilar to the tectonic development of the Piedmont. The major earthquakes of the St. Lawrence River Valley (shocks in 1663 and 1925 with maximum intensities as great as IX or X) had their epicenters near Quebec, over 550 miles northeast of PBAPS. These earthquakes were felt over the entire eastern section of Canada and the United States and probably had an intensity of about IV in the PBAPS vicinity. (Exelon Generation 2017g)

Most of the earthquake activity in Pennsylvania and the surrounding area occurs in the Piedmont in the southeastern part of the state, in an area designated as the Lancaster Seismic Zone (Crone and Wheeler 2000). The trend of earthquake epicenters in the region is generally parallel to the trend of geologic structure in the Piedmont, which is northeast to southwest. This trend extends from near York, northeastward through Lancaster County approximately 20 miles north of the PBAPS site, and continues into Berks County and Lehigh County. A summary of earthquake epicenter locations in Pennsylvania lists 26 earthquakes in Lancaster County since 1752, most with magnitudes ranging from 2.0 to 4.1. Lancaster is the county with the greatest number of earthquakes listed, with the second highest being eight earthquakes recorded in Berks County. Most of the activity is associated with known faults or other geologic features. Although the number of earthquakes is greatest in this area of Pennsylvania, there are no known earthquakes with a magnitude greater than 4.7 in this area (PA DCNR 2007).

The largest known earthquake in the Lancaster Seismic Zone occurred on January 16, 1994. That earthquake, with an epicenter in Cacoosing Valley located approximately 40 miles northeast of the PBAPS site, had a magnitude of 4.6, and intensity of VI-VII. An evaluation of the Lancaster Seismic Zone did not identify any seismically active fault or fault zone, and no evidence for Quaternary faulting aside from the known earthquakes (Crone and Wheeler 2000).

The largest Pennsylvania earthquake recorded occurred on September 25, 1998, and had a measured magnitude of 5.2 on the Richter scale near Jamestown (PA DCNR 2016c). The earthquake epicenter was in western Pennsylvania 4 miles north of Greenville, and approximately 5 miles southeast of Pymatuning Reservoir. The epicenter’s distance from the PBAPS site was approximately 245 miles (PA DCNR 2016a).

Although no major earthquakes have had epicenters closer than about 350 miles to the site, many earthquakes of low to moderate intensity have originated in the region surrounding the site. The largest earthquakes reported in the area had epicentral intensities of VII. Of the two Intensity VII shocks recorded, the closest occurred in October, 1871 near Wilmington, DE about 40 miles east of the site, causing some minor damage near its epicenter. The other Intensity VII shock was recorded about 100 miles from the site near Wilkes-Barre, PA in February, 1954 (Exelon Generation 2017g).

Local Seismic Setting

Figure 3.4-3 shows a map of earthquake epicenters within 50 miles of PBAPS through 2017. Five significant earthquakes have been recorded within a radius of 50 miles of the site. One was of Intensity VII; two shocks had intensities of VI; and two were recorded with maximum intensities of V. The significant earthquakes closest to the site occurred in southeast Pennsylvania on March 8, 1889 about 25 miles northeast of the site (Intensity V), and in Harford County, Maryland in March, 1883 some 20 miles southwest of the site (Intensity IV-V). The 1889 earthquake was felt in an area of about 4,000 square miles but did no significant damage. The series of 1883 Harford County earthquakes were local shocks causing no structural damage. The three other shocks originated about 35 to 40 miles from the site. The largest of these originated near Wilmington, Delaware on October 5, 1871 and probably was felt in the vicinity of the site. The magnitude of this shock is estimated at about 5 or slightly higher on the Richter Scale. Although several of the aforementioned shocks probably were felt in the locality of the site, no damaging effects were experienced. The ground motion at the site expected from a shock similar to any of the historical shocks would not cause damage to reasonably well-built structures including the Seismic Class 1 structures and equipment at the site. Seismic Class 1 structures and equipment are those whose failure could increase the severity of the design basis accident, cause release of radioactivity in excess of 10 CFR Part 100 limits, or those essential for safe shutdown and removal of decay heat following a loss of coolant accident (Exelon Generation 2017g).

Seismic Hazards

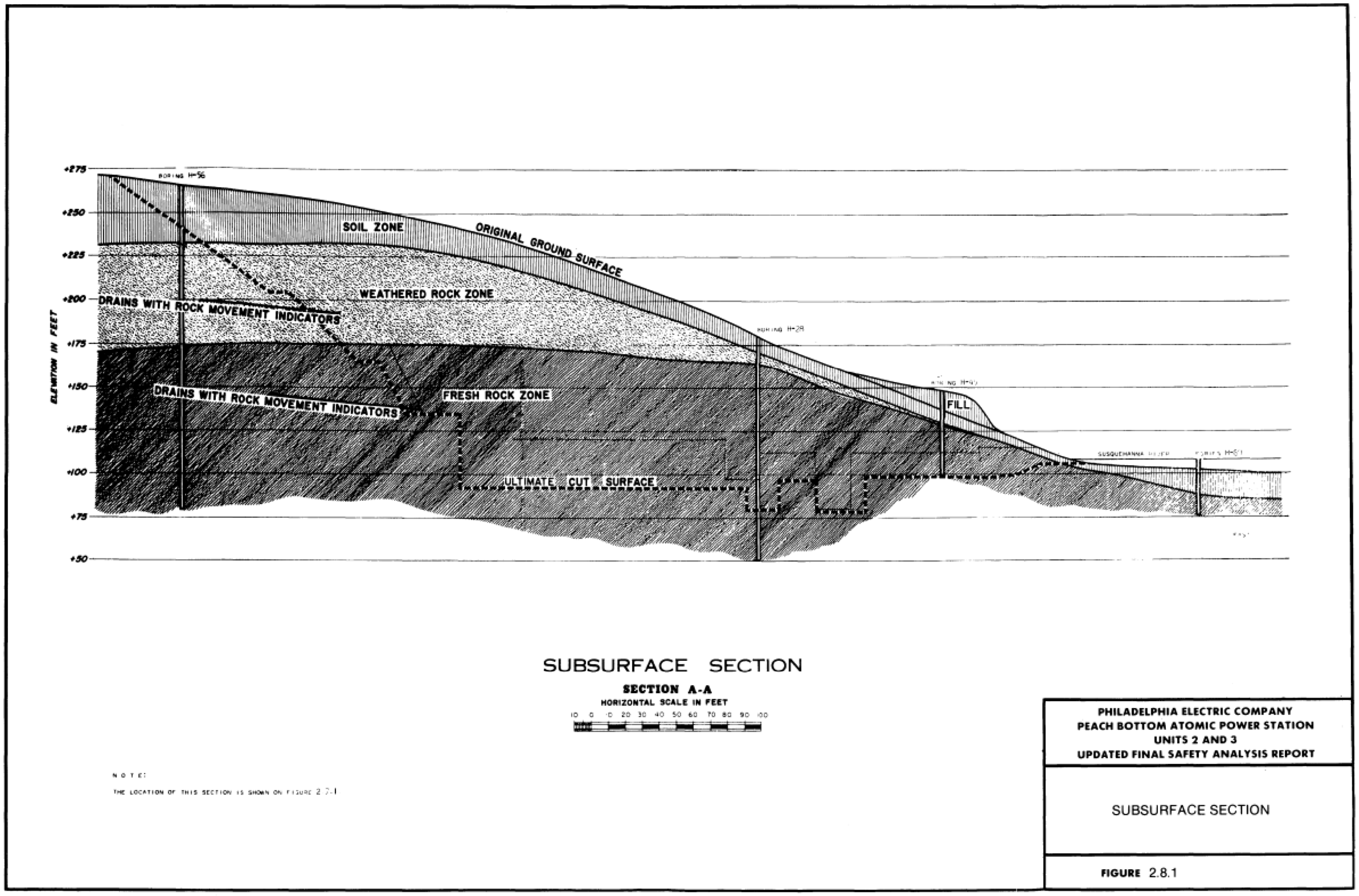
Figure 3.4-4 presents a seismic hazard map within 50 miles of PBAPS. As shown in Figure 3.4-4, PBAPS is in a region that has a 2 percent probability of exceeding a peak ground acceleration between 0.1 to 0.14 g (fraction of standard gravity) in 50 years (once in 2,500 years) (USGS 2014). No earthquake epicenter has been reported within 8 km (5 miles) of the site.

Crone and Wheeler (2000) categorize faults which have been active in the Quaternary as Class A (geologic evidence demonstrates the existence of a Quaternary fault of tectonic origin) or Class B (geologic evidence demonstrates the existence of a fault or suggests Quaternary deformation). The Lancaster Seismic Zone is classified as Class C, meaning that geologic evidence is insufficient to demonstrate the existence of tectonic fault, or that there is Quaternary slip or deformation associated with the feature. The closest feature assigned to either Class A or Class B is the Central Virginia Seismic Zone, a Class A feature located approximately 160 miles southwest of the PBAPS site (Crone and Wheeler 2000).

TABLE 3.4-1
AGRICULTURAL SOIL CHARACTERIZATION DETAILS

Map Designation[1]	Soil Series	USDA Soil Texture Classification	Prime Farmland	Farmland of Statewide Importance	Erosion Potential
Cm	Codorus	silt loam	Yes	No	Slight
GbB	Glenelg 3 to 8% slope	channery loam	Yes	No	Slight
GbC	Glenelg 8 to 15% slope	Silt loam	No	Yes	Slight
MOB	Mt. Airy and Manor soils,3 to 8% slopes	Cannery silt loam and channery loam	Yes	No	Slight
MOC	Mt. Airy and Manor soils, 8 to 15% slopes	Cannery silt loam and channery loam	No	Yes	Slight
MOD	Mt. Airy and Manor soils, 15 to 25% slopes	Cannery silt loam and channery loam	No	No	Moderate
MOE	Mt. Airy and Manor soils, 25 to 35% slopes	Cannery silt loam and channery loam	No	No	Moderate
MRF	Mt. Airy and Manor soils, 25 to 60% slopes	Cannery silt loam and channery loam Extremely stony	No	No	Severe

Source: (NRCS 2016b)
[1] See Figure 3.4-2



Source: (Exelon Generation 2017g)

Figure 3.4-1 Geological Cross Section of the PBAPS Site

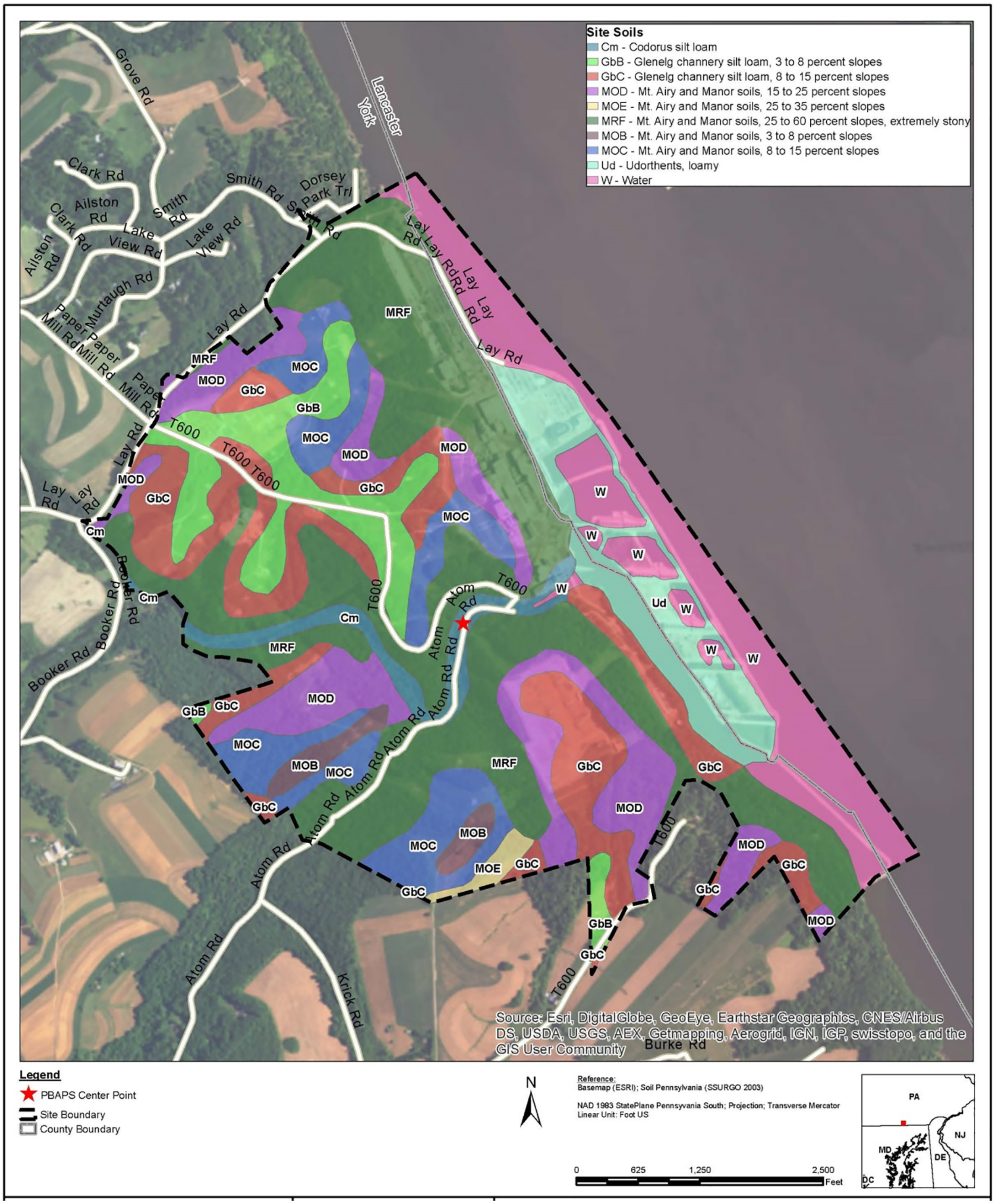


Figure 3.4-2 PBAPS Soil Map

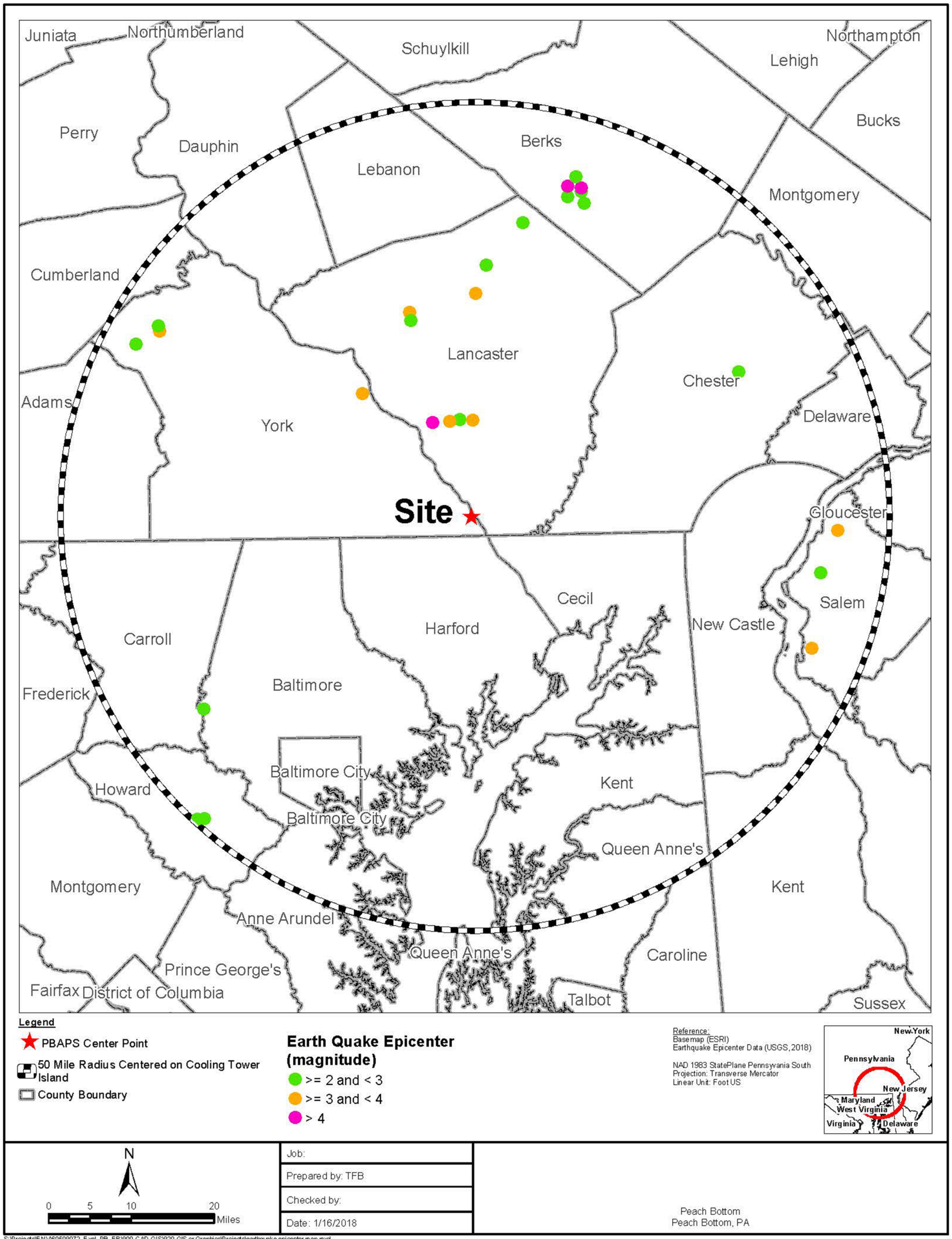


Figure 3.4-3 Earthquake Epicenters within 50 Miles of PBAPS

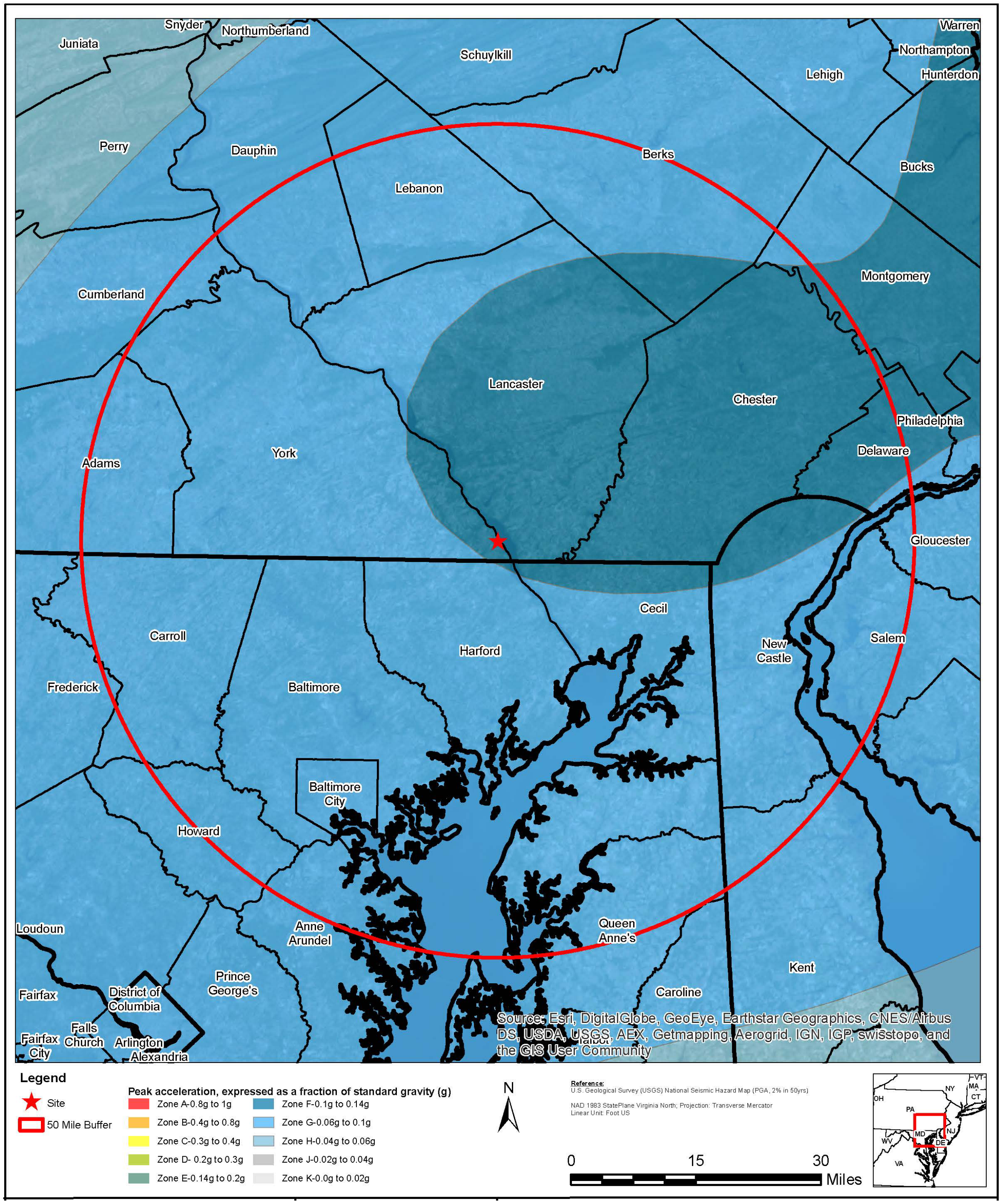


Figure 3.4-4 Seismic Hazard Map within 50 Miles of PBAPS

3.5 WATER RESOURCES

3.5.1 Surface Water Resources

3.5.1.1 Surface Water Hydrology

PBAPS is located on Conowingo Pond, at approximately River Mile (RM) 17 of the Susquehanna River. The Susquehanna River flows south more than 420 miles from its source, Lake Otsego in south-central New York, to Havre de Grace, Maryland, where it empties into the Chesapeake Bay. It drains an area of about 27,500 square miles and supplies more than half the freshwater inflow to the Bay (Exelon Generation 2001). River flow and water quality in the lower Susquehanna River are directly influenced by flood-control dams on tributaries and larger hydroelectric dams (York Haven [RM 45], Safe Harbor [RM 32], Holtwood [RM 24], and Conowingo [RM 10]) on the main stem of the lower river (Figure 3.0-1).

Conowingo Pond is located within the Lower Susquehanna River Subbasin. The Lower Susquehanna River Subbasin drains a mixture of both rural and urban land comprising 5,809 square miles of central Pennsylvania and northern Maryland, from Sunbury, Pennsylvania to the mouth in Havre de Grace, Maryland) (SRBC 2017). The Lower Susquehanna River Subbasin includes the urban areas of Harrisburg, York, and Lancaster, Pennsylvania, and more than a million acres of agricultural land spread throughout much of the subbasin (PFBC 2011).

The upstream U.S. Geological Survey (USGS) gauging station on the Susquehanna River closest to PBAPS is located at Marietta, Pennsylvania, approximately 27 miles upstream.

The hydrology of the Susquehanna River varies throughout its length (PFBC 2011). PBAPS withdraws water from and discharges water to the western shore of the Conowingo Pond of the Susquehanna River at RM 17 (NAI and ERM 2014). Base flow conditions of Conowingo Pond are the result of power production activities at the Holtwood and Conowingo dams, and to a lesser extent, Muddy Run Pumped Storage Facility (PFBC 2011). Releases from these projects are episodic and tied to times of peak power generation need (PFBC 2011). Conowingo Pond has a required pool elevation of 101.2 ft to support various usages. Its normal fluctuation varies between 101.2 and 110.2 ft National Geodetic Vertical Datum (NGVD) 1929 (PFBC 2011).

Due to the hydrological connection between the PBAPS discharge canal and the river, the Federal Emergency Management Agency (FEMA) map for the Township of Peach Bottom (FEMA 2015) indicates the 100-year floodplain (Zone AE) extends into the facility and creates a backwater effect at the mouth of the unnamed tributary discharging into the PBAPS discharge canal near Atom Road. Although the 100-year floodplain extends into the facility, PBAPS has a ground elevation of 116 ft above sea level and is hardened against floods. PBAPS has a certified maximum permissible flood threshold of 26.5 ft above the Susquehanna River elevation and can safely shut down through normal operational methods if flood waters rise to this level. In addition, PBAPS protects underground and ground-level equipment through multiple methods including water-tight doors and specially engineered flood barriers preventing water intrusion into vital plant equipment located below maximum flood elevation (Exelon Nuclear 2011a).

In response to the recommendations of the NRC's Fukushima Task Force, Exelon Generation reevaluated the flood causing mechanisms for PBAPS. The reevaluation verified that flooding would have no effect on safety-related systems, structures, and components (Exelon Generation 2015e).

Total and consumptive water use from the Conowingo Pond for PBAPS operations is managed through the CUMP (URS Corporation 2012), under which mitigation is triggered based on flow rates at the USGS gaging station at Marietta. The average annual flow from the Susquehanna River into Conowingo Pond at the Marietta gaging station is approximately 39,500 cubic feet per second (cfs). The lowest seven-day average flow occurring every 10 years (the 7Q10 flow rate) at the Marietta gaging station is 3,785 cfs (Exelon Generation 2015c).

Conowingo Pond is the largest impoundment in the Susquehanna River, formed as a result of construction in 1928 of the Conowingo Dam, a run-of-river hydroelectric generating facility, at RM 10 (SRBC 2015). It extends 14 miles upstream from the Conowingo Dam to the Holtwood Dam, with average width of approximately 1 mile (NAI and GSE 2011) and covering a surface area of 9,000 acres (SRBC 2015). PBAPS is located on the west bank of the reservoir between approximately RM 17.4 and RM 18. The Muddy Run Pumped Storage facility lies on the east bank of Conowingo Pond, approximately 5 miles north of PBAPS.

The design storage capacity of the Conowingo Pond is 310,000 acre-ft (NAI and ERM 2014). The average depth is 20 ft, the maximum depth being approximately 90 ft in the vicinity of Conowingo Dam (NAI and GSE 2012e). An analysis of a bathymetric survey of Conowingo Pond conducted in 2014 estimates the total volume of water in the Pond to be 162,062 acre-ft.

The existing FERC license for the Conowingo Dam permits water levels in the Pond to fluctuate by as much as 9 ft (between elevations 101.2 and 110.2 ft NGVD 1929). However, the current operating regime for maintaining minimum river flow below Conowingo Dam limits actual fluctuation to minimize impacts to PBAPS and the Muddy Run Pumped Storage Facility (Muddy Run) and to accommodate FERC-required summer recreation levels. Normal pool elevation is 109.2 ft NGVD. The maximum PBAPS operational drawdown elevation is 99.2 ft NGVD and for Muddy Run it is 104.7 ft NGVD (Exelon Generation 2012c).

Flood elevations in Conowingo Pond are dependent on the discharge capacity of Conowingo Dam. The Probable Maximum Flood, which combines a flood flow of 1,750,000 cfs with a postulated failure of Holtwood Dam and wind-generated waves, would result in a maximum water level at the plant of +132.0 above Conowingo Datum (C.D.). The critical equipment, systems, and structures of the plant are situated at elevation +135 C.D. (Exelon Generation 2017g).

3.5.1.2 Surface Water Use

3.5.1.2.1 Plant Surface Water Use

The SRBC is a federal-interstate compact commission created by the Susquehanna River Basin Compact between the federal government and the states of Pennsylvania, New York, and Maryland. The mission of the SRBC, which is defined in the Compact, is to enhance public welfare through comprehensive planning, water supply allocation, and management of the water resources of the Susquehanna River Basin. The SRBC manages the water resources of the Susquehanna River Basin Watershed under comprehensive planning principles through its own programs and by coordinating the efforts of the three states and the federal government. The SRBC serves as a forum to provide coordinated management, promote communication among the members, and resolve water resource issues and controversies within the basin.

Water use by PBAPS is discussed in Subsection 2.2.3. SRBC Docket 20061209-1 (Docket), approved December 5, 2006 and modified June 23, 2011, authorizes PBAPS to withdraw up to 2,363.620 MGD from Conowingo Pond and to consume up to 49.000 MGD (Appendix B; SRBC 2011). As part of the SRBC Docket and CUMP review, the SRBC determined that PBAPS water consumption was protective of instream flows and receiving waters of the Chesapeake Bay and PBAPS consumptive water use did not impact the basin's water resources. Staff determined that the approval met the SRBC's water mitigation requirements as per SRBC regulations 18 CFR §806.22(b) and was approved for inclusion in the SRBC's comprehensive plan for the water resources of the Susquehanna River Basin.

The PBAPS water use levels have also been authorized by the FERC as non-project use of project lands and waters associated with operation of the Conowingo Hydroelectric Project (FERC Order dated September 2, 2015 [152 FERC ¶ 62,142]). Consumptive water use at PBAPS consists of two key components, including: evaporation and drift in the helper cooling towers when the towers are in operation; and in-stream evaporation from Conowingo Pond due to the additional thermal loading from the plant.

The SRBC Docket requires PBAPS to provide consumptive use mitigation during low flow conditions in the Susquehanna River through releases from Conowingo Pond or other SRBC approved sources (SRBC 2011). Consumptive use is monitored, and mitigation implemented, through the CUMP (URS Corporation 2012). The plan calls for the release of 220 cfs (70 cfs of consumptive use and 150 cfs of flows not accounted for at the Marietta gauge station) from Conowingo Pond via leakage through Conowingo Dam. PBAPS submits quarterly reports on daily withdrawal and consumptive water use to the SRBC as required under 18 CFR. § 806.30(b). See Subsection 2.2.3 for tables providing monthly total and average water withdrawals and consumptive use for the reporting years 2012 through 2016. Consumptive uses during August through October are significantly less than the allowed 49.000 MGD. PBAPS also provides an annual report to both SRBC and FERC that summarizes the dates when consumptive use mitigation thresholds were reached, and mitigation was required. Mitigation thresholds are 5,000 cfs from August 1 to September 14, and then 3,500 cfs from September 15 to October 31. These thresholds were not exceeded in the reporting years 2012 through 2015 (Exelon Generation 2013a; Exelon Generation 2014a; Exelon Generation 2015a; Exelon Generation 2016a). During 2016, the CUMP mitigation thresholds were reached for September 12, 13, and 14. Accordingly, for those dates, Conowingo Dam provided 220 cfs to the Susquehanna River on behalf of PBAPS via dam leakage that was not used to meet Conowingo minimum flow requirements (Exelon Generation 2017a).

The Conowingo Pond is also the source of potable water for the station. Raw water is drawn from the Susquehanna River via the intake canal and is treated in a 576,000 gpd-capacity package plant to produce potable and demineralized water. Current treated water usage is 288,000 to 360,000 gpd. No potable water shortages have been experienced, even during planned outages when the onsite population increases.

3.5.1.2.2 Offsite Surface Water Use

Surface water in Conowingo Pond is used for power generation in hydroelectric facilities, and for municipal water supplies. Conowingo Pond is formed by Conowingo Dam, which releases water from the Pond to generate power (SRBC 2006). In addition to PBAPS, there are four surface water users in Conowingo Pond.

The Muddy Run Pumped Storage facility typically withdraws water from the Conowingo Pond at night and releases water to the Pond to generate power during daytime periods of peak electric demand. The flow rate, water elevation, and total water storage in Conowingo Pond at any given time is a function of upstream flow and precipitation, as well as the status of operations at Conowingo Dam and Muddy Run.

The York Energy Center has a permitted withdrawal allowance of 12.62 million gpd (19.5 cfs) from a location approximately eight miles upstream of the Conowingo Dam. The water is used as cooling water for the 1,100 MWe generation facility (Exelon Generation 2012b).

The City of Baltimore is approved by the SRBC to withdraw 250 million gpd (387 cfs) from Conowingo Pond. In addition, the City of Baltimore plans to increase withdrawals by 30 MGD or up to 280 MGD by 2025 (SRBC 2008). This source of water is primarily used only during major drought periods or under emergency operating conditions (Exelon Generation 2012b).

The City of Chester withdraws water from an intake located approximately seven miles upstream of Conowingo Dam. The Chester Water Authority may withdraw up to 30 million gpd from Conowingo Pond (SRBC 2006).

3.5.1.3 Surface Water Quality

3.5.1.3.1 Regional Surface Water Quality

The limit of tidal influence in the Susquehanna River is downstream of Conowingo Dam in Maryland, near the mouth of Deer Creek at RM 6 (Webb and Heidel 1970). Thus, the intake is in a freshwater waterbody. The CWA authorizes the NPDES permit program to control water pollution by regulating point sources that discharge pollutants into waters of the United States. The PADEP is authorized by the EPA to administer NPDES permitting rules within the Commonwealth of Pennsylvania (Commonwealth of Pennsylvania and EPA Region III 1991). Within PADEP, the Office of Water Programs, Bureau of Clean Water administers NPDES permits (PADEP 2017a). The requirements for NPDES permits are detailed in Pennsylvania Code, Title 25, Chapter 92a (Pennsylvania Code Online 2017).

Nonpoint source pollution contributors such as mining, agricultural and urban sources are the largest contributors of pollutants to the Susquehanna River basin (PFBC 2011). Storm water flowing over impervious surfaces in urbanized areas also picks up contaminants and debris that have been deposited during dry periods and deposits them in the river system (PFBC 2011). Developed areas of the watershed contribute about 20 percent of the nitrogen load and 12 percent of the phosphorus load to the upper Chesapeake Bay (PFBC 2011). The final 69 miles of river receives upstream inputs from over 27,000 square miles of various land uses and over 4 million residents from three states (SRBC 2015).

Water quality parameters within the four Susquehanna River impoundments located downstream of RM 44 are nearly identical (SRBC 2015). Water temperatures in Conowingo Pond are lowest in the winter (32 degrees F to 40 degrees F), increase in spring (45 degrees F to 65 degrees F) to seasonal highs in summer (80 degrees F to 86 degrees F) and decline in the fall (40 degrees F to 70 degrees F) (Exelon Generation 2012b). Temperatures throughout the water column in the upper, shallower areas of the Pond remain relatively well mixed throughout the year and surface to bottom temperature differences are usually less than 1 degree F (NAI 2000). Environmental monitoring data since 1966 have never recorded any substantial thermal stratification in Conowingo Pond and the limited thermal stratification observed breaks down during periods of heavy rain and high winds (NAI and ERM 2014).

Dissolved oxygen levels in Conowingo Pond are typically highest in the winter (12 to 15 mg/L), decline through the spring, are lowest in the summer (5 to 7 mg/L) and then increase through the fall (Exelon Generation 2012b). Dissolved oxygen typically remains relatively well mixed throughout most of the year, but variations with depth do occur in summer, especially in the lower Pond's deeper waters and surface to bottom dissolved oxgyen differences of up to 5 mg/L may occur (NAI 2000). Significant dissolved oxygen stratification rarely occurs during other months or in the Pond's shallower locations (NAI 2000). However, when water temperatures exceed 75 degrees F in the summer and flows are less than 12,000 cfs, dissolved oxygen stratification can occur, particularly in deeper areas of lower Conowingo Pond (NAI and ERM 2014). Monitoring of dissolved oxygen was conducted at three locations in June through September, 2016, in order to determine whether the thermal discharge reduces dissolved oxygen concentrations to levels that would present a barrier to fish migration past PBAPS. The monitoring was conducted during a period of low flow and high temperature, and included one location upstream and two locations downstream of the facility. Dissolved oxygen concentrations were similar at all three stations during the monitoring period. Approximately 98 percent of the measurements were above the instantaneous criterion of 5.0 mg/L, and all measurements were above or equal to the 7-day mean criterion of 5.5 mg/L. The monitoring indicated that dissolved oxygen levels are sufficient to support fish migration past the facility (NAI and ERM 2017).

Measurements in Conowingo Pond between April and October 2010 varied in the ranges of 1.2 to 146.5 Nephelometric Turbidity Units for turbidity and 7.0 to 8.9 for pH (Exelon Generation 2012b).

Conowingo Pond is the last in a series of reservoirs on the Lower Susquehanna River. Upstream of Conowingo Pond are Lake Aldred formed by Holtwood Dam and Lake Clarke formed by Safe Harbor Dam. The USACE has developed a conceptual model for the system whereby all reservoirs have reached a state of dynamic equilibrium such that there is no net storage of the sediment entering the reservoir system in the long-term (years to decades). Rather, sediment-storage is a short-term cyclical concept. Temporary sediment-storage capacity is created by episodic high flow net scour which is then lost during low flow sediment deposition (USACE and Maryland DNR 2015).

3.5.1.3.2 Regulated Releases to Surface Water

NRC requires all nuclear power reactor licensees to demonstrate compliance with regulations limiting radiation doses to members of the public and mandating that radioactive releases contributing to such doses be ALARA (10 CFR Parts 20 and 50 and 40 CFR Part 190). In addition, 40 CFR Part 141 imposes limits on the concentrations of radionuclides, including tritium, in drinking water provided by public water supply systems. To meet these requirements, each nuclear power plant site has in place a Radiological Environmental Monitoring Program (REMP) specifying sampling frequency of environmental media, and reporting requirements. As part of the PBAPS REMP, Exelon Generation analyzes the concentrations of certain radionuclides, including tritium, in the surface water intake and the discharge canal. Results are reported in the Annual Radiological Environmental Operating Report, which also covers the Radiological Groundwater Protection Program (RGPP). In 2015, no tritium activity was detected in surface water samples (minimum detectable concentrations [MDC] ranging from 171 to 195 picoCuries per liter [pCi/L]); all results for iodine-131 were less than the MDCs ranging from 0.3 to 0.8 pCi/L; and all results for gamma-emitting nuclides in surface water samples were less than the MDCs (3 to 18 p pCi/L for most gamma emitters and 18 to 42 pCi/L for Ba-140). The REMP also includes sampling of sediment at three locations. Two locations are in Conowingo Pond at Berkin's Run and Conowingo Dam, and the third is a control location at Holtwood Dam. Naturally occurring potassium-40 was found at all locations, ranging from 10,650 to 23,720 picoCuries per kilogram (pCi/kg). The fission product cesium-137 was not detected (MDCs from 96 to 172 pCi/kg), and no other PBAPS fission or activation products were detected at MDCs ranging from 62 to 151 pCi/kg (Exelon Generation 2016d).

The Commonwealth of Pennsylvania has EPA authorization to implement the NPDES within the Commonwealth for facilities such as PBAPS. Under this program, PADEP (1) regulates thermal discharges in accordance with CWA Section 316(a) to control thermal impacts on the aquatic environment in the receiving water, and (2) implements CWA Section 316(b) requirements to ensure that the location, design, construction, and capacity of industrial cooling water intake structures reflect the best technology available (BTA) for reducing adverse environmental impacts. The PBAPS NPDES permit (PA0009733) also regulates discharges of pollutants to the Susquehanna River in outflows including process and cooling water, sanitary waste water, and storm water. Low volume wastewater discharges include discharges from the outer intake screen backwash water, the Water Treatment Wastewater Settling Basin, the Auxiliary Boiler Blowdown, the Dredging/Rehandling Basin, and the Sewage Treatment Plant. Additional regulated discharges are groundwater from the low level radwaste storage facility sump and stormwater. The NPDES permit was renewed by PADEP with an effective date of October 1, 2014 and expiration date of September 30, 2019. The permit establishes discharge limitations and monitoring requirements for specific constituents by outfall, based on the type of wastewater discharged through the respective outfall. Detailed requirements of the NPDES permit are discussed in Subsection 2.2.3, and a copy of the permit is provided in Appendix A. Offsite water users are identified in Subsection 3.5.1.2.2.

3.5.2 Groundwater Resources

3.5.2.1 Groundwater Hydrology

Conowingo Pond, adjacent to PBAPS, is in the Piedmont physiographic province. Groundwater storage and flow occurs primarily in a surficial aquifer which is found within unconsolidated overburden materials, including artificial fill, residual soil, and alluvial river sediments. The lateral extent of the overburden materials is limited to a narrow band approximately 1,000 ft wide bounded by bedrock outcrops on the west side of the property, and the Conowingo Pond to the east. The artificial fill and residual soil underlie the plant, and range in thickness from 0 to 40 ft. The alluvial sediments underlie the intake pond and Conowingo Pond, and range in thickness from 0 to 15 ft (Conestoga-Rovers & Associates 2012). There are no known deep aquifers, as groundwater is confined to fractures that become less extensive with depth. Water flow within saprolitic soils is very slow due to the soils' low porosity and relative impermeability. The soils in the vicinity of the site typically yield less than 20 gpm (AEC 1973). Groundwater flows follow surface topography, so flow in the vicinity of the Susquehanna River and Conowingo Pond is towards the river. The potentiometric surface of the overburden groundwater is shown in Figure 3.5-1, and the potentiometric surface of the bedrock groundwater is shown in Figure 3.5-2. The groundwater horizontal flow rate in the overburden is estimated for be 19 to 38 ft per year, and the flow rate in the bedrock is estimated to be 91 to 277 ft per year (Conestoga-Rovers & Associates 2012).

The groundwater levels recorded at the site ranged from about Elevation +109 ft to 250 ft C.D. The pond level is approximately Elevation +109 ft C.D. The small amount of groundwater in the region around Conowingo Pond results in wells with low yields. The median yields in 109 domestic wells within the Peters Creek Schist (the surficial geologic unit at the site) is 9 gpm, with 34 of the wells producing less than 5 gpm (Low et al. 2002). The measured permeability in the Peter's Creek Schist ranges from 0.1 ft/day in unweathered schist to 20 ft/day in highly weathered and fractured rock.

Groundwater seeps intermittently from springs in the cliffs behind PBAPS. Each reactor building and the low-level radioactive waste storage building have sumps that collect this groundwater and discharge it to the river or to the discharge canal. The yard drain sumps are outside the reactor buildings. Together the yard drain sumps discharge less than 100 gpm, which is combined with other outflows prior to release. The water collected in the radioactive waste storage building is collected and monitored for activity prior to batch releases. All three discharges are included in the NPDES permit.

3.5.2.2 Groundwater Use

Offsite Groundwater Use

There are 14 groundwater supply wells within one mile of PBAPS. These include 11 domestic wells, one unused test well, one irrigation well, and one agricultural well for livestock. The depths of the wells range from 30 to 260 ft below ground surface, and the wells yield between 5 to 60 gpm. All of the wells are upgradient of the plant (Conestoga-Rovers & Associates 2012).

Onsite Groundwater Use

As subsection 2.2.3 indicates, PBAPS has three closed groundwater wells (filled with concrete) and four wells providing non-potable water on demand to remote facilities. In the unlikely event that all four wells were pumping simultaneously, the rate of water withdrawal would be approximately 87 L/min (23 gpm). Because these wells are non-potable, they are not required to be permitted by the Commonwealth.

3.5.2.3 Groundwater Quality

Offsite Groundwater Quality

Groundwater quality in the Peter’s Creek Schist is reported to be low in dissolved solids, soft to moderately hard, and slightly acidic. The dominant cation is calcium, and the dominant anion is bicarbonate. Water quality problems in the Peter’s Creek Schist are associated with elevated iron concentrations (Taylor and Werkheiser 1984).

Onsite Groundwater Quality

Since 2006, Exelon Generation has participated in the Nuclear Energy Institute (NEI) industry initiative to protect groundwater at all of its nuclear power stations. As a part of Initiative 07-07 (NEI 07-07 "Industry Groundwater Protection Initiative - Final Guidance Document"), Exelon Generation implemented an active program to monitor for and mitigate the potential for radiological releases to groundwater at PBAPS. Under this program, which has been integrated into the PBAPS RGPP, PBAPS informs the NRC, state agencies and local officials of unintended releases of radiological materials to groundwater that meet specified reporting criteria. PBAPS also follows the principles of NEI 09-14, “Guideline for the Management of Buried Piping Integrity,” to monitor, inspect and improve buried piping and tank systems to prevent future unintended releases of radiological materials to groundwater.

PBAPS RGPP results are reported to the NRC as a component of the Annual Radiological Environmental Operating Reports. When first implemented at PBAPS, the RGPP consisted of sampling at 14 monitoring wells, as well as sampling of seven surface water locations and three groundwater seeps (Conestoga-Rovers & Associates 2012). Subsequent to investigations conducted in 2006, the PBAPS RGPP was modified to include long-term monitoring of 31 permanent groundwater monitoring wells, as well as three surface water sample locations, three groundwater seeps, two yard drain sumps, and six precipitation water sampling locations (Teledyne Brown 2016). As shown in Figure 4.5-1, permanent monitoring wells are located directly along the intake and discharge canals, between the potential tritium sources (the turbine buildings) to the west and the potential groundwater discharge area (Conowingo Pond) to the east, and thus act as sentinel wells for movement of the tritium plume towards Conowingo Pond.

As required by 10 CFR 50.75(g), PBAPS maintains records of spills involving radioactive contamination in and around the facility, equipment, and site. Additional information regarding spills and releases is reported in the RGPP reports, and in the ad-hoc reports for the 2006 and 2012 Groundwater Investigations. A summary of spill and leak information includes:

- An assignment report in the PBAPS action tracking system dated June 30, 2006, documented 33 known spills or releases having occurred between 1976 and June 28, 2006. Most of these spills were either determined to not be reportable because they were within technical specification or regulatory limits, were discharged into surface water, or were decontaminated. Spills at Units 2 and 3 in 1981, 1982, and 1983, and a release of approximately 36,000 gallons of water from the Unit 3 Condensate Storage Tank Moat in February, 1986, were the subject of further investigation following 2006.
- Starting in 2006, to fulfill the requirements of 10 CFR 50.75(g), annual assignment reports were documented in the PBAPS action tracking system listing any spills or releases having occurred during the preceding calendar year. The annual 10 CFR 50.75(g) assignment report for 2006 reported the detection of CS-137 and Co-60 on asphalt near the Administration Building.
- The annual 10 CFR 50.75(g) assignment report for 2007 noted that there were no spills or releases associated with Unit 2 or 3 during that year. However, tritium was identified in two areas in Unit 1 during the year.
- The annual 10 CFR 50.75(g) assignment report for 2008 noted that there were no spills or releases during those years. However, the report summarized the status of ongoing investigations for tritium in groundwater.
- On June 17, 2009, a valve leak was identified in the Unit 3 Condensate Storage Tank Moat. The volume and duration of the leak were unknown. The leak was determined to be the cause of elevated tritium concentrations detected in monitoring well MW-PB-04 beginning in 2007. The leak was reported to the Pennsylvania DEP's Bureau of Radiation Protection and the NRC (Conestoga-Rovers & Associates 2012). It was also summarized in the annual 10 CFR 50.75(g) assignment report for 2009.

- The annual 10 CFR 50.75(g) assignment report for 2010 documented a leak of condensate water from the hydrogen water chemistry vent line at the south end of the Unit 2 turbine building roof. The leak was non-reportable under Event Response Guidelines OP-AA-106-101-1001, as it amounted to less than 100 gallons in size.
- The annual 10 CFR 50.75(g) assignment reports for 2011, 2012, 2013, and 2014 noted that there were no spills or releases during those years.
- In April, 2015, a leak was detected in the Unit 3 Turbine Building Moisture Separator Area floor. The leak was found to be condensed steam pooled on the floor. The leak was addressed by making modifications to the floor drain (Teledyne Brown 2016).
- The annual 10 CFR 50.75(g) assignment report for 2016 did not document any spills or releases. However, it did document the identification of Cs-137 in concrete during an excavation project.

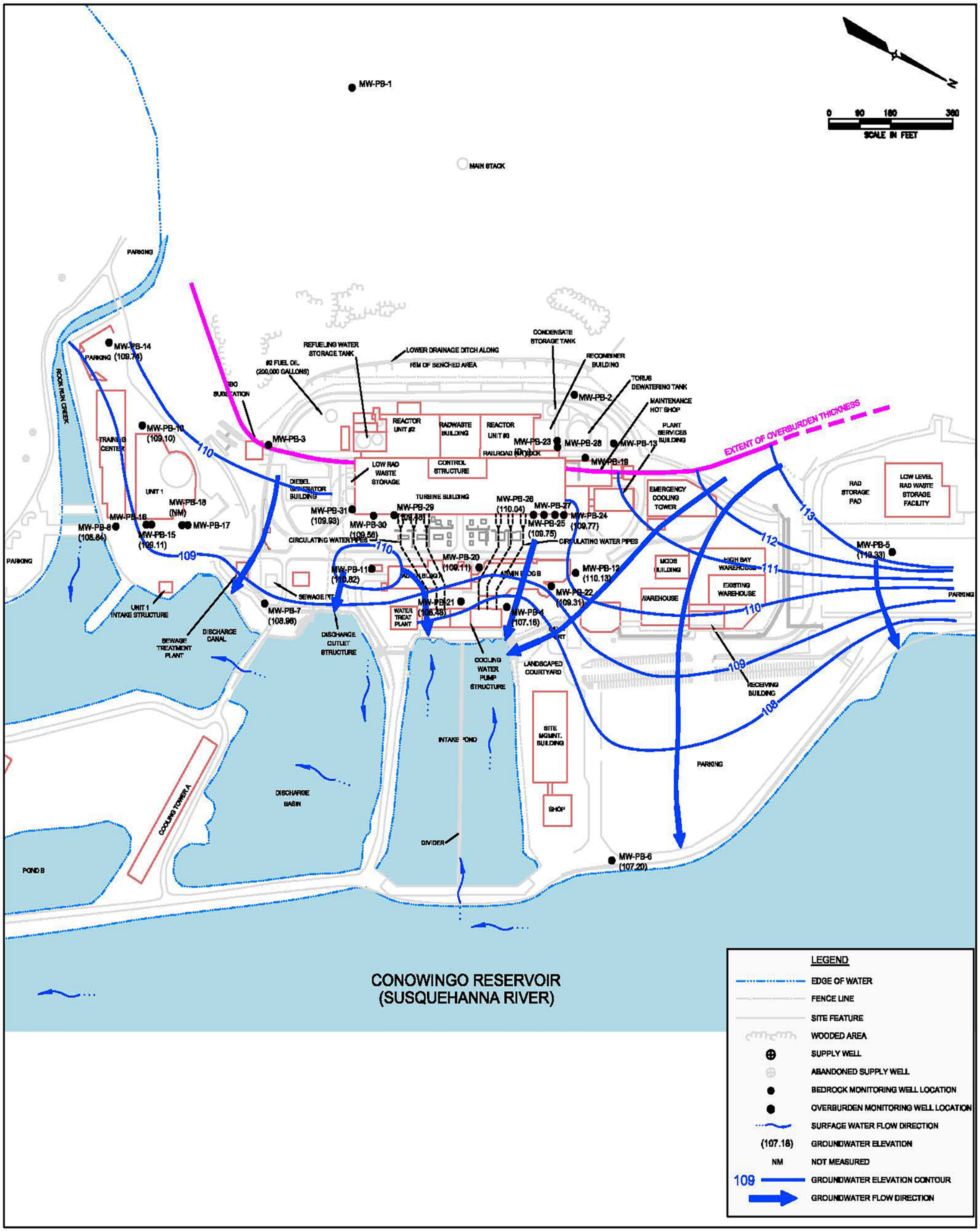
A tritium plume is present in groundwater, northeast of the Unit 3 Turbine Building. The plume extends eastward in the direction of groundwater flow, and has been documented to not extend offsite to the north or south (Teledyne Brown 2016). The wells investigating the plume range in depth from 6.5 to 105 ft (Conestoga-Rovers & Associates 2012).

The 2006 Hydrogeological Investigation Report identified three Areas for Further Evaluation (AFEs). AFE-1 was the Unit 3 Condensate Storage Tank, resulting from the 1986 release. AFE-2 was the Unit 2 and 3 Reactor and Turbine Building Areas, resulting from the 1981, 1982, and 1983 releases. AFE-3 was the Main Stack Sump, which collects condensate from off-gases. The results of the 2006 sampling concluded that tritium was not detected at concentrations greater than the EPA's drinking water standard of 20,000 pCi/L, tritium was not migrating offsite at detectable concentrations, there was no current risk from exposure to radionuclides associated with licensed plant operations, and there were no known active releases into groundwater (Conestoga-Rovers & Associates 2006).

Following the 2006 investigation, AFE-1 and AFE-3 were determined to not have any current impacts, and were not retained for further investigation. However, AFE-2 was retained, and several site-specific groundwater investigations were conducted to further evaluate conditions identified in the 2006 report, identify potential sources of the tritium plume, and evaluate potential impacts from an additional release from the Unit 3 Condensate Storage Tank in 2009. As a result of these investigations, the floor seams in the Unit 3 Turbine Building Moisture Separator Room were sealed in 2010, and the entire floor was sealed in 2011. AFE-2 remained an AFE due to elevated tritium concentrations above 20,000 pCi/L in the overburden groundwater. Tritium concentrations in the plume decreased following the mitigation activities in 2010 and 2011 (Conestoga-Rovers & Associates 2012).

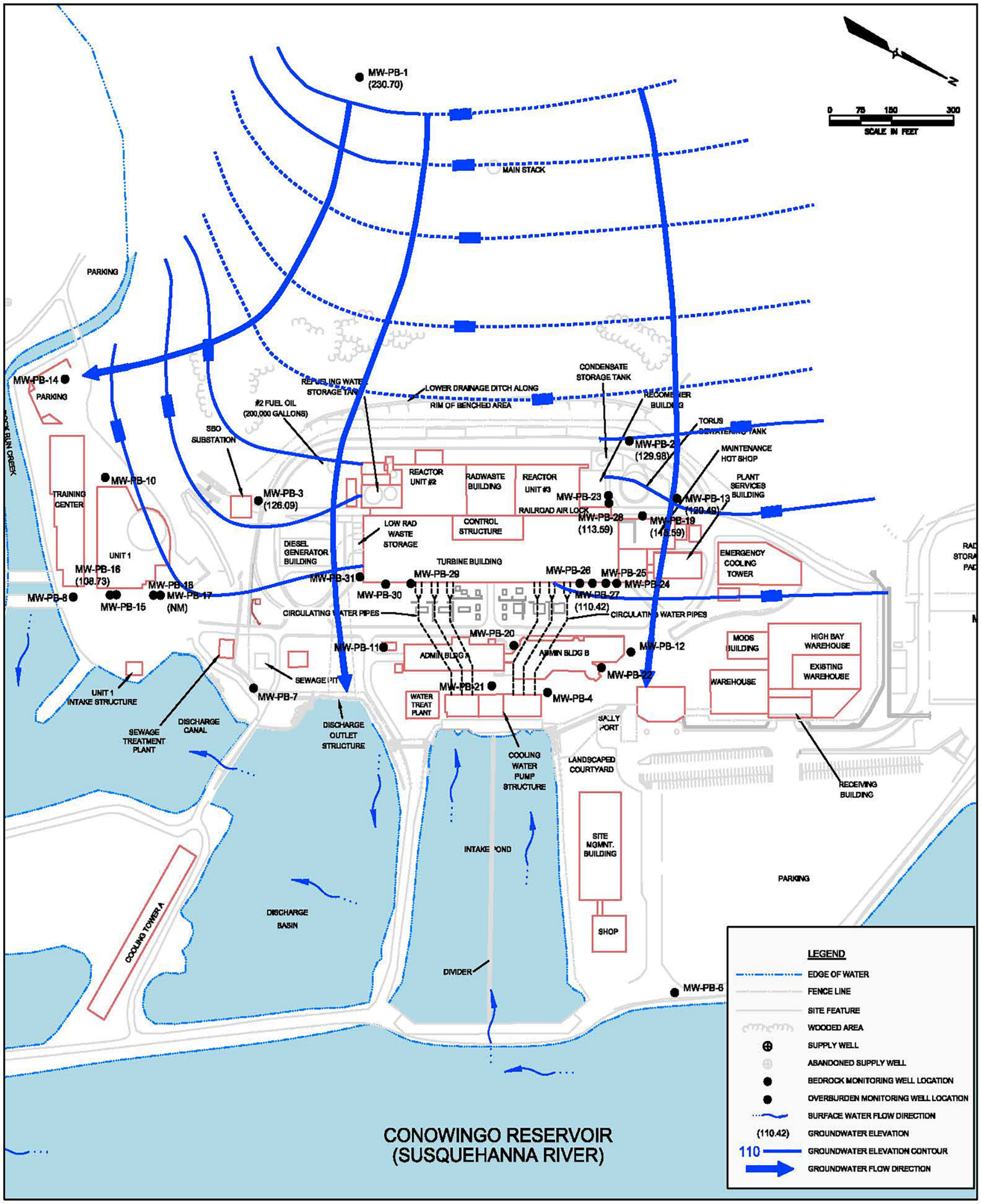
In 2015, tritium concentrations ranged from below detection limit to 37,700 pCi/L, with no tritium detected in monitoring wells located at or near the PBAPS property boundary, and the highest tritium concentrations located east of the Unit 3 Turbine Building. The tritium detected in 2015 was associated with the release from the Unit 3 Turbine Building Moisture Separator Area floor. After modifications to the drain, the wells exhibited decreasing or steady trends throughout the remainder of 2015. No tritium was detected in surface water or precipitation samples (Teledyne Brown 2016).

The trend in tritium concentrations has been decreasing or steady since the event in 2015. In 2016, the tritium concentrations ranged from 181 pCi/L to 11,000 pCi/L, all below the EPA drinking water standard and NRC reporting limit of 20,000 pCi/L. By the sampling event on November 30, 2016, the tritium concentrations measured in the wells of primary interest (MW-PB-24, 25, 26 and 27) had decreased to 246, 5,150, 345, and 892 pCi/L, respectively. Tritium was not detected in wells at or near the owner-controlled boundary, or in any surface water samples, indicating that it is not migrating off the station property at detectable concentrations (Teledyne Brown 2017).



Source: (Conestoga-Rovers & Associates 2012)

Figure 3.5-1 Potentiometric Surface of Overburden Groundwater



Source: (Conestoga-Rovers & Associates 2012)

Figure 3.5-2 Potentiometric Surface of Bedrock Groundwater

3.6 ECOLOGICAL RESOURCES

3.6.1 Aquatic Communities

This section describes the ecological resources of the aquatic communities that may be affected by the operation of PBAPS during the relicensing period. The aquatic community that would be affected by water withdrawals and discharges associated with the continued operation of PBAPS is that of Conowingo Pond. Conowingo Pond is a reservoir on the lower Susquehanna River. It is the largest impoundment on the Susquehanna River, extending 14 miles upstream from the Conowingo Dam, at RM 10, to the Holtwood Dam and covering an area of 9,000 acres (SRBC 2015).

3.6.1.1 Physical Characteristics and Water Quality of Conowingo Pond

The hydrology and water quality characteristics of Conowingo Pond are described in Subsection 3.5.1.

Environmental monitoring data since 1966 do not show substantial thermal stratification in Conowingo Pond. However, if water temperatures in the Pond exceed 75 degrees F during the summer and water flow is simultaneously less than 12,000 cfs, then dissolved oxygen stratification can occur, particularly in deeper areas of lower Conowingo Pond (near the Dam). Thermal stratification quickly breaks down during periods of heavy rain and high winds (NAI and ERM 2014). Dissolved oxygen typically remains relatively well mixed throughout most of the year, but variations with depth do occur in summer, especially in the deeper waters of the lower Pond, and surface to bottom dissolved oxygen differences of 5 mg/L or more may occur. Significant dissolved oxygen stratification rarely occurs during other months or in shallower areas of the Pond (NAI 2000).

The Susquehanna River from its origin to the MD-PA state line is designated under Title 25, Chapter 93 of the Pennsylvania Code as a warm-water fishery and migratory fishery (PFBC 2011). As a result of these designations, water quality parameters (including alkalinity, ammonia nitrogen, dissolved oxygen, total recoverable iron, osmotic pressure, pH, temperature, and TRC) are regulated and monitored as prescribed by the regulation. Additionally, the SRBC employs water quality standards for physicochemical and biological parameters in order to ensure water quality in the Susquehanna River through its Large Rivers Monitoring Program (PFBC 2011).

3.6.1.2 Community Characteristics

Habitat within the lower Conowingo Pond is mostly characteristic of a relatively still-water (lentic) system (NAI and GSE 2012c). Limited flowing-water (lotic) habitat occurs in the upper end of Conowingo Pond, below the Holtwood Dam. The reach of Conowingo Pond near PBAPS has generally greater depths and slower water velocities compared to the upstream reach. Lentic conditions result in more fine-grained, silty substrates, so the lack of riverine habitat limits available spawning habitat for species requiring sandy or cobble sediments and higher water velocities, such as the American shad (*Alosa sapidissima*) (NAI and GSE 2012c). Conowingo Pond is characterized by steep banks and few in-river features (SRBC 2015). As a result, the available shallow, shoreline habitat (10 ft or less in depth) is limited (NAI and ERM 2014). Shoreline habitat is considered important habitat for many species of fish and macroinvertebrates within Conowingo Pond. Shallow shoreline habitats compose only approximately 8.5 percent of the total area of Conowingo Pond upstream of the PBAPS discharge and only 3.8 percent of the total area downstream of the discharge (NAI and ERM 2014).

The lentic habitat of Conowingo Pond supports a fish community composed primarily of common warm-water species that are found in lakes, ponds, and reservoirs from the southeastern U.S. to Canada (NAI and ERM 2014). The fisheries community is generally dominated by representatives of the families Clupeidae, Cyprinidae, Centrarchidae, and Ictaluridae, constituting 95 percent of the fish community in Conowingo Pond (NAI and ERM 2014). Forage species are primarily clupeid and cyprinid species. The dominant clupeid taxon in Conowingo Pond, gizzard shad (*Dorosoma cepedianum*), is also the most dominant species overall. Additionally, hundreds of thousands of gizzard shad enter Conowingo Pond annually via the Conowingo Dam East Fish Lift (EFL). Approximately 96 percent of cyprinids collected in Conowingo Pond between 2010 and 2013 were from four species: spotfin shiner (*Cyprinella spiloptera*), spottail shiner (*Notropis hudsonius*), comely shiner (*N. amoenus*), and bluntnose minnow (*Pimephales notatus*).

Centrarchids, the third most abundant family in Conowingo Pond sampling, are primarily represented by bluegill (*Lepomis macrochirus*), green sunfish (*L. cyanellus*), rock bass (*Ambloplites rupestris*), and smallmouth bass (*Micropterus dolomieu)*. Channel catfish (*Ictalurus punctatus*) is one of the most abundant large-bodied species in Conowingo Pond and accounted for 12.2 percent of fish collected between 2010 and 2013 (NAI and ERM 2014).

Other families with significant representation in Conowingo Pond include Percidae (2.1 percent), represented primarily by the tessellated darter (*Etheostoma olmstedi*), Chesapeake logperch (*Percina bimaculata*), and walleye (*Sander vitreus*); Catostomidae (1.2 percent), represented primarily by the shorthead redhorse (*Moxostoma macrolepidotum*); and Fundulidae (1.1 percent), represented only by the banded killifish (*Fundulus diaphanus*) (NAI and ERM 2014).

A total of 53 species representing 13 families were collected between 2010 and 2013 in Conowingo Pond. Thirty-one species were represented by less than 100 collected individuals, and 18 species were represented by less than 10 individuals (NAI and ERM 2014). Species data are provided in Table 3.6-1. Fisheries community diversity and relative abundance were similar throughout the Conowingo Pond year round. However, avoidance occurred below the PBAPS discharge during the months of July and August, and attraction to the PBAPS discharge occurred during the winter. Fish assemblages throughout the year were consistent in thermal and non-thermal areas of Conowingo Pond and demonstrated no loss of trophic structure over the course of the study period. Additionally, habitat avoidance as a result of PBAPS operations did not occur during May and June, the peak spawning period for most Conowingo Pond fish species (NAI and ERM 2014). Electrofishing conducted by the SRBC in August 2014 also demonstrated species diversity is highest in the upper portion of Conowingo Pond below the Holtwood Dam (RM 22), where more riverine conditions exist. Diversity and catch per unit effort during August were similar in the lentic area of Conowingo Pond both above (RM 18) and below (RM 14) the PBAPS discharge (SRBC 2015).

Historically, multiple surveys (PECO 1975; NAI 2000; NAI and ERM 2014; SRBC 2015) were conducted to assess impacts from the operation of PBAPS on the aquatic community of Conowingo Pond. Changes to the aquatic community between pre-operational surveys and surveys conducted during 2010 through 2014 are limited. The only species observed to have a significant decline in abundance since preoperational studies is white crappie (*Pomoxis annularis*). Its decline is attributed to displacement due to the growth of gizzard shad populations since the 1970s. Gizzard shad likely outcompete larval and juvenile white crappie, as both species forage on the same planktonic food sources (NAI and ERM 2014).

Operation of the West Fish Lift (WFL) and EFL at the Conowingo Dam allows diadromous fish species access to Conowingo Pond (Tryninewski 2015; NAI 2015b). The WFL and EFL became operational in 1972 and 1991, respectively. Presently, the WFL is kept operational to support Pennsylvania Fish and Boat Commission (PFBC) and Atlantic States Marine Fisheries Commission biological sampling of migratory species during a 7-week period from mid-April through early June (Tryninewski 2015). However, fish collected at the WFL are returned to the Susquehanna River via the Conowingo Dam tailrace rather than being released into Conowingo Pond (Tryninewski 2015).

The EFL uses attraction flow by regulating gate bays to move migratory species upstream past Conowingo Dam during the April to June migration season (Exelon Generation 2012a). Fish entering the EFL are passed into Conowingo Pond (NAI 2015b). The most recent data available showed that between April 3 and May 31, 2015, the EFL passed 754,057 fish. Approximately 98 percent of fish passed were gizzard shad. Diadromous species passing into Conowingo Pond included American shad, blueback herring (*Alosa aestivalis*), alewife (*A. pseudoharengus*), hickory shad (*A. mediocris*), striped bass (*Morone saxatilis*), sea lamprey (*Petromyzon marinus*) and American eel (*Anguilla rostrata*) (NAI 2015b). White perch (*Morone americana*) and possibly some alewife, while anadromous in nature, may originate from escapement from Raystown Lake in Huntingdon County, Pennsylvania (Exelon Generation 2012a). Twelve species passed into Conowingo Pond via the EFL were not collected during the 2010-2013 PBAPS CWA Section 316(a) Demonstration Study (NAI and ERM 2014). Those species included the diadromous species American eel, blueback herring, hickory shad, and sea lamprey. Other non-diadromous species passed into Conowingo Pond include brook trout (*Salvelinus fontinalis*), splake trout (*Salvelinus namaycush* X *fontinalis*), rainbow trout (*Oncorhynchus mykiss*), white catfish (*Ameiurus catus*), brown bullhead (*A. nebulosus*), yellow bullhead (*A. natalis*), longnose gar (*Lepisosteus osseus*), and northern pike (*Esox lucius*) (NAI 2010b; NAI 2011b; NAI 2012b; NAI 2013c; NAI 2014b; NAI 2015b). EFL passage data between 2010 and 2015 are provided in Table 3.6-2.

Several of these migratory species are the focus of efforts to restore their populations, which have been adversely affected by historical construction of dams on the Susquehanna River. American shad and river herring (blueback herring and alewife) are the subject of a restoration program announced in 2016 (Exelon 2016). The passage of these species upstream is monitored at Conowingo Dam, as well as the three other dams upstream of PBAPS (NAI 2015b). While these species are not protected as threatened or endangered at either the state or federal level, recent data indicated that the numbers of river herring and American shad returning to spawning grounds in the Susquehanna River are at their lowest numbers since the 1980s. Collaboration between Exelon Generation and the U.S. Fish and Wildlife Service (USFWS) resulted in an agreement aiming to restore passage above all Susquehanna River dams to American shad and river herring. This will be accomplished via improvements to fish passage facilities at Conowingo Dam as well as a trap and transport effort, in which American shad and river herring collected below the Conowingo Dam are physically transported to spawning areas above the four Susquehanna River dams. The program is a long-term restoration effort that is planned to occur over a 50-year period. The agreement also included another migratory species, the American eel, which will be transported upstream until at least 2030, when a new eel passage structure is anticipated to be in place (Exelon 2016).

Conowingo Pond is a popular destination for recreational fishermen (NAI and GSE 2012a). Angler surveys conducted from March to November 2010 analyzed targeted recreational species in Conowingo Pond. The majority of fishermen surveyed targeted black bass (largemouth bass [*Micropterus salmoides*] and smallmouth bass combined), followed by catfishes, including channel and flathead catfish (*Pylodictis olivaris*). Between the spring and fall of 2010, recreational anglers caught an estimated 44,526 fish. Catches were dominated by smallmouth bass (25.7 percent), followed by channel catfish (22.0 percent), bluegill (18.2 percent), and largemouth bass (15.8 percent). An estimated 6 percent of the fish caught were harvested. Of the fish kept, 60.8 percent were channel catfish, followed by flathead catfish (19.4 percent) and common carp (*Cyprinus carpio*) (13.9 percent). Additionally, fishing tournaments are conducted in Conowingo Pond for black bass (largemouth and smallmouth bass combined) and catfish (NAI and GSE 2012a).

The benthic macroinvertebrate community was studied as part of the four-year CWA Section 316(a) Demonstration Study conducted from 2010 through 2013. Impacts to the benthic community from the thermal plume created by PBAPS during the warmest months (July and August) were determined to be localized and temporary. The benthic community demonstrated similar diversity both inside and outside of the thermal plume throughout each year. The macroinvertebrate taxa in Conowingo Pond are primarily composed of lentic species considered tolerant of water/habitat quality degradation. The most abundant taxa were chironomids and oligochaetes. Few intolerant species were collected in the Conowingo Pond. Generally, the macroinvertebrate communities in similar habitats demonstrated similar compositions and index of biological integrity (IBI) scores throughout Conowingo Pond. The IBI scores at two stations downstream of PBAPS were temporarily lower during the months of July and August in comparison to similar habitats within Conowingo Pond; however, scores soon recovered into the fall. Sites did not demonstrate any substantial reduction in community heterogeneity or trophic structure over the course of the study period (NAI and ERM 2014).

Only three freshwater mollusk taxa were collected in more than 8 years (1967-1974) of pre- and post-operational benthic monitoring conducted in support of the PBAPS CWA Section 316(a) Demonstration for initial plant licensing (PECO 1975). They included two common sphaerid genera, *Pisidium* and *Sphaerium*, and a single unionid, the paper pondshell (*Utterbackia imbecillis*). Both the sphaerids and paper pondshell are common in lakes, reservoirs, and sluggish rivers of the Midwest and Northeast. The most significant change in the Conowingo Pond mollusk community over the last several decades has been the appearance and rapid colonization since the mid-1980s of the exotic Asiatic clam (*Corbicula fluminea)*. An assessment of the mussel community below Holtwood Dam in September 2005 found little available mussel habitat in the upper portion of Conowingo Pond (Exelon Generation 2012a). Six specimens, five eastern elliptio (*Elliptio complanata*) and one yellow lampmussel (*Lampsilis cariosa*), were collected from a single sheltered location along the shoreline adjacent to the Holtwood Dam tailrace. However, other portions of the Conowingo Pond have limited mussel data. Poor mussel habitat occurs in the Conowingo Pond for most of the mussel species that are native to the Susquehanna River and are found below the Conowingo Dam (Biodrawversity, Inc. and GSE 2012).

3.6.1.3 Invasive, Non-Native Aquatic Species

Invasive, non-native aquatic species that have been found in Conowingo Pond include the Asiatic clam, zebra mussel (*Dreissena polymorpha*), rusty crayfish (*Orconectes rusticus*), and five fish species. Exelon Generation monitors for Asiatic clams and zebra mussels, as described below. PBAPS controls biofouling by these species through a program that uses biocides, which are permitted in accordance with the current NPDES permit.

The Asiatic clam has been present in Conowingo Pond since the mid-1980s (NAI and ERM 2014). Exelon Generation has conducted biomonitoring for an Asiatic clam control program in Conowingo Pond for the PBAPS since 1981. The Asiatic clam is extremely common and widespread throughout the Susquehanna River Basin. Data indicate that the Asiatic clam spawns between May and November, and early lifestages are most prevalent in Conowingo Pond in September (NAI and GSE 2012b).

The detection and subsequent monitoring of zebra mussels by Exelon Generation at PBAPS and Conowingo Dam has occurred since 1991 and continued annually through 2008 (NAI and GSE 2012b). After a 1-year lapse, the monitoring program at Conowingo Dam was initiated again in the spring of 2010. A few adult zebra mussels were found at the Conowingo Dam in the fall of 2008. PBAPS zebra mussel monitoring during 2010 from April through November collected dreissenid mussel veligers (larvae). They were collected in extremely low densities (<0.1 larvae/liter) beginning in late July and at least once monthly through early October. The peak dreissenid mussel veliger density of 0.093/L was collected during the August 18, 2010 sampling event. Although dreissenid mussels have been identified and are considered established (first observed in 2008) within Conowingo Pond, the population is believed to be either very widely distributed or at very low densities (NAI and GSE 2012b). Weekly monitoring has occurred since 2009, and the numbers of veligers collected at PBAPS increased 100 fold between 2009 and 2012. However, observed densities of settled life stages are low, and no zebra mussel infestations have occurred at any nearby water intakes or structures (Klauda et al. 2014).

The rusty crayfish was identified in Conowingo Pond in 2007 (PFBC 2011). It has been known to displace all native crayfishes and to occur in higher densities than the species it displaces (PFBC 2011). The rusty crayfish was banned from sale, barter, possession, and transportation in Pennsylvania in 2005 (PFBC 2011). Its current impacts to the Susquehanna River Basin are unknown (PFBC 2011). It is difficult to control the spread of the rusty crayfish once introduced, and the only effective control is to prevent further introductions through public education (Seitz 2013).

The PFBC, which manages Conowingo Pond fish and fisheries, considers five fish species found in Conowingo Pond as invasive or nuisance species (PFBC 2011; NAI and ERM 2014). These include common carp, mimic shiner (*Notropis volucellus*), flathead catfish, greenside darter (*Etheostoma blennioides*), and banded darter (*Etheostoma zonale*) (PFBC 2011). The presence of the mimic shiner, banded darter, and greenside darter in the Susquehanna River Basin is believed to be the result of bait-bucket introductions. Common carp were purposely stocked into the Susquehanna River in the past for recreational purposes. The long-term effects of these introductions are not yet known (PFBC 2011).

The flathead catfish was unintentionally introduced into Conowingo Pond in the early 2000s and soon became widely distributed (NAI and ERM 2014). The flathead catfish is known to be a voracious predator, and one of the greatest concerns regarding this species is its potential to negatively affect ongoing migratory fish restoration efforts (PFBC 2011). Management of the flathead catfish takes into account its negative ecological impacts but also its positive impacts via creation of a recreational fishery (Seitz 2013). Eradication of the species is likely not possible.

3.6.1.4 Special-Status Aquatic Species

Information for special status species was obtained from the Pennsylvania Natural Heritage Program's (PNHP) online Pennsylvania Natural Diversity Inventory (PNDI) database, the USWFS' online Information for Planning and Consultation (IPaC) tool, and agency correspondence.

On September 21, 2017, a PNDI receipt was obtained from the on-line PNHP website in response to a request for a Project Environmental Review for the PBAPS SLR through the PNDI Environmental Review Tool (PA DCNR 2017). The PNDI Project Environmental Review receipt included responses from four agencies regarding their primary screening determinations of the potential for special status species to be affected by the project. The responding agencies were the USFWS, Pennsylvania Game Commission (PGC), PA DCNR, and PFBC. On October 30, 2017, an updated IPaC Resource List, which provides a list of species and critical habitats under the jurisdiction of USFWS, was generated for the PBAPS (USFWS 2017c).

Aquatic species with special status designations and the potential to occur in the vicinity of and be affected by PBAPS were identified from the PNDI database search and the IPaC Resource List and are included in Table 3.6-3. The federal and state status designations shown in Table 3.6-3 are those of USFWS, PA DCNR, PGC, and PFBC.

3.6.1.4.1 Federal-Status Species

According to the USFWS, no aquatic species federally listed as threatened or endangered occur near PBAPS, and there are no critical habitats in the vicinity (USFWS 2017c). No aquatic monitoring programs within Conowingo Pond have collected a federally protected species (PECO 1975; NAI 2000; NAI 2010b; Hendricks 2011; NAI 2011b; Hendricks 2012; NAI 2012b; NAI 2013c; NAI and ERM 2014; NAI 2014b; Tryninewski 2015; NAI 2015b).

Although not identified in the PNDI report or IPaC Resource List for PBAPS site, studies and surveys have been conducted for three federally listed species below the Conowingo Dam: threatened Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), endangered shortnose sturgeon (*A. brevirostrum*), and endangered Maryland darter (*Etheostoma sellare*). The shortnose sturgeon was recorded below the tailrace of the Conowingo Dam and downstream in the Susquehanna Flats (Shortnose Sturgeon Status Review Team 2010; NAI and GSE 2012f). Shortnose sturgeon have not entered Conowingo Pond via the Conowingo Dam EFL or WFL (NAI 2010b; Hendricks 2011; NAI 2011b; Hendricks 2012; NAI 2012b; NAI 2013c; NAI 2014b; Tryninewski 2015; NAI 2015b). The Atlantic sturgeon historically occurred in the lower Susquehanna River, but no records indicate they are currently present in the lower Susquehanna River (Shortnose Sturgeon Status Review Team 2010). Restoration efforts for the Atlantic sturgeon have occurred within the Chesapeake Bay, but collection of specimens has been limited to the mid-Chesapeake Bay (Susquehanna River Anadromous Fish Restoration Cooperative 2010).

Maryland darter surveys were conducted below the Conowingo Dam (NAI and GSE 2012d). However, occurrence of the Maryland darter has not been recently documented in the lower Susquehanna River (NAI and GSE 2012d).

The American eel was petitioned for listing for federal protection in 2007 and 2015. However, the USFWS determined that the overall population of the species is stable and is neither in danger of extinction nor likely to become endangered within the foreseeable future. Therefore, listing was found not to be warranted (USFWS 2015a). American eels are known to occur in Conowingo Pond and at PBAPS and have been collected during aquatic monitoring programs (NAI 2010b; Hendricks 2012; NAI 2012b; NAI 2013c; NAI 2014b; Tryninewski 2015; NAI 2015b). As discussed in Subsection 3.6.1.2, the American eel is one of the migratory fish for which a restoration program has been established in the Susquehanna River basin under an agreement between Exelon Generation and the USFWS.

Exelon Generation submitted consultation letters to USFWS and the National Oceanic and Atmospheric Administration (NOAA) in September 2017 requesting any additional information on protected species and their habitats in the vicinity of the Site that may be affected by the PBAPS license renewal (Appendix C.1). In its response dated November 2, 2017, USFWS identified no additional protected species or habitat within its jurisdiction that would be potentially affected by PBAPS SLR (USFWS 2017d). A NOAA response letter, dated March 5, 2018, provided information on Endangered Species Act (ESA) species and Essential Fish Habitat (EFH; Appendix C.1). Two species of sturgeon, Atlantic and shortnose (*Acipenser oxyrinchus oxyrinchus and A. brevirostrum*, respectively), are listed under the ESA and are known to occur within the Susquehanna River; however, they do not occur upstream of the Conowingo Dam.

3.6.1.4.2 State-Status Species

The results of the PNDI search indicated that disturbance in and around the PBAPS site potentially could affect a state-protected aquatic species, and that further review from the PFBC is required. The PFBC identified the Chesapeake logperch, which is state-listed threatened, as the potentially affected species. This fish is listed as threatened due to impaired water quality and siltation of gravel substrates (NatureServe Explorer 2016). The Chesapeake logperch has been collected within Conowingo Pond (NAI 2010b; Hendricks 2011; NAI 2011b; Hendricks 2012; NAI 2012b; NAI 2013c; NAI and ERM 2014; NAI 2014b; Tryninewski 2015; NAI 2015b).

Relatively little is known about the Chesapeake logperch, but its habits and biology are likely similar to the common logperch (*Percina caprodes*) (NAI and ERM 2014). It is unclear whether the Chesapeake logperch spawns along the shores of Conowingo Pond or if spawning is restricted to the lower sections of the six tributary streams entering Conowingo Pond (NAI and ERM 2014). Their occurrence varies through the year, and they are most frequently collected in Conowingo Pond between August and October (NAI and ERM 2014). The distribution of the Chesapeake logperch in Conowingo Pond seems to be related to proximity to tributary streams and shallow shoreline habitat with either sand or gravel sediment present and submerged aquatic vegetation (NAI and ERM 2014).

Although it was not identified by the PNDI report and no hickory shad were collected during the 2010 to 2013 sampling events in Conowingo Pond (Table 3.6-1), the state-endangered hickory shad (*Alosa mediocris*) has been recorded entering Conowingo Pond via the EFL (NAI 2010b; NAI 2011b; NAI 2012b; NAI 2013c; NAI 2014b; NAI 2015b). Hickory shad documentation is limited to fish passage data from the Conowingo Dam EFL (NAI 2010b; NAI 2011b; NAI 2012b; NAI 2013c; NAI 2014b; NAI 2015b). A maximum of 20 hickory shad have been recorded at the EFL since 2010. Deer Creek, a Susquehanna River tributary approximately 3.5 miles below the Conowingo Dam, is the habitat used by what is regarded as the largest hickory shad spawning population in Maryland (NAI and GSE 2012c). The hickory shad spawning season typically occurs prior to that of the American shad, beginning in March and April (Maryland DNR 2018). Spawning habitat preferences of the hickory shad are not well defined but often overlap with those of the American shad. The majority of Conowingo Pond is not suitable spawning habitat for either species, and no hickory shad spawning has been documented in Conowingo Pond (NAI and GSE 2012c).

No state or federally listed mussels or invertebrates have been found in the vicinity of PBAPS or within Conowingo Pond by Exelon Generation or any research programs (PECO 1975; NAI 2006; Biodrawversity, Inc. and GSE 2012; NAI and ERM 2014). Thus, the only federally or state-listed aquatic species known to occur in Conowingo Pond are the Chesapeake logperch and hickory shad.

Exelon Generation submitted consultation letters to PFBC, PGC, and PA DCNR in September 2017 requesting additional information on any protected species and their habitats that may be affected by the PBAPS license renewal (Appendix C.1). Responses from PGC and PA DCNR (Appendix C.1) did not identify any additional species of concern. In a letter dated March 8, 2018, the PFBC expressed concern about potential PBAPS effects on the local Chesapeake logperch population in Conowingo Pond. The Chesapeake logperch is state-listed as threatened, but not federally listed. The letter indicated that PFBC intends to address its Chesapeake logperch impingement and entrainment concerns during the PBAPS NPDES permit renewal process. No additional species of concern were identified.

3.6.1.4.3 Essential Fish Habitat

EFH is waters and substrate that are necessary for spawning, breeding, feeding, or growth to maturity of fish, as identified and described for federally managed species by the National Marine Fisheries Service (NMFS) and regional fishery management councils (Magnuson-Stevens Act, 16 USC 1801 et seq.). According to the NMFS EFH Mapper, EFH has not been designated within Conowingo Pond (NOAA 2016a).

Exelon Generation submitted a consultation letter to NOAA in September 2017 requesting additional information on any protected species and their habitats that may be affected by the PBAPS license renewal. In a letter dated March 5, 2018, NOAA (1) recommended that studies and monitoring at PBAPS consider downstream effects on diadromous fish species and (2) indicated that potential downstream effects of continued PBAPS operations on Atlantic and shortnose sturgeon are unclear.

3.6.2 Terrestrial and Wetland Communities

3.6.2.1 Community Characteristics

Much of the PBAPS site is occupied by generation and maintenance facilities, laydown areas, parking lots, roads, and managed vegetation. The site is located within the Northern Piedmont ecoregion (USGS 2016) and is situated within the Piedmont physiographic province. Gently rolling hills with a few moderately steep ridges characterize this region. The primary terrestrial habitats at the site are remnants of hardwood (oak-hickory or oak-tulip tree) forest on the ridges and slopes west of the generating and support facilities. Wildlife species found in the forested portions of PBAPS are assumed to be those typically found in upland forests of southern Pennsylvania. These include a variety of amphibians (e.g., northern dusky salamander, bullfrog, leopard frog), reptiles (e.g., eastern hognose snake, copperhead, painted turtle, box turtle), songbirds (e.g., Carolina wren, wood thrush, song sparrow, rufous-sided towhee), woodpeckers (e.g., downy woodpecker, northern flicker), birds of prey (e.g., red-tailed hawk, eastern screech owl, barred owl), and mammals (e.g., gray squirrel, southern flying squirrel, striped skunk, gray fox, raccoon, white-tailed deer). Current land use adjacent to the PBAPS is a mixture of farmland (including row crops, pasture land, and old fields), woodland, and power infrastructure (substations).

A review of the USFWS Wetlands Mapper V2 (USFWS 2017e) shows that, with the exception of the cooling water discharge basins, there are no mapped wetland habitats at PBAPS. During a field visit in August 2017, five wetlands were identified at PBAPS, all of which are adjacent to the discharge canal and within the floodplain of the Susquehanna River.

3.6.2.2 Invasive/Non-Native Terrestrial Species

Invasive species are those species that are not native to a particular ecosystem and whose introduction does, or is likely to, cause economic or environmental harm or harm to human health. Non-native species are those that would not currently or historically occur in an ecosystem and are present only as a result of introduction (64 Fed. Reg. 6183-6186, "Executive Order 13112: Invasive Species," February 3, 1999).

The York County Natural Areas Inventory states that exotic plant species[1] are known to occur along stream and road edges of the Atom Road Woods site (YCPC 2004). There is no record for terrestrial invasive plant species within the PBAPS site on iMapInvasives, an online invasive species mapping website (iMapInvasives 2017). To date, the focus on invasive species has been on those dependent upon aquatic habitats. As such, there are no documented surveys available at the PBAPS site for the presence of terrestrial plant species listed on the Pennsylvania State-listed Noxious Weeds list (USDA 2016b; PA DCNR 2016b) or the Federal Noxious Weeds list (USDA 2016a).

3.6.2.3 Special-Status Terrestrial Species

Information for special status was obtained from the online PNDI database, the USWFS online IPaC tool, and agency correspondence.

On September 21, 2017, a PNDI receipt was obtained from the on-line PNHP site (PA DCNR 2017) and an updated IPaC Resource List was generated on October 30, 2017 (USFWS 2017c). The results of the draft PNDI search indicated that disturbance in and around the PBAPS site potentially could affect special-status terrestrial species and that further review from the DCNR and PFBC is required. Additional information about the project was required by the USFWS. Terrestrial animal and plant species identified from the PNDI database search, and the IPaC Resource List are listed in Table 3.6-3. The federal and state status designations shown in Table 3.6-3 are those of USFWS, PA DCNR, PGC, and PFBC.

[1] Exotic species are defined by the USDA as those species that are not native to the continent on which they are now found; by definition, they are non-native species, though not always considered invasive. An invasive species is both non-native and able to establish on many sites, grow quickly, and spread to the point of disrupting plant communities or ecosystems (USDA 2017).

3.6.2.3.1 Federal-Status Species

Both the PNDI receipt and IPaC report identified the bog turtle (*Glyptemys muhlenbergii*) as a terrestrial species known to occur in York County. Additionally, IPaC report identified the Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), and red knot (*Calidris canutus rufa*) as federally listed species known or believed to occur in York County. These species are included in Table 3.6-3, and their potential for occurrence on the site is discussed below.

In the PNDI receipt, USFWS requested additional information regarding the potential for occurrence at PBAPS of the bog turtle, which is federally listed as threatened (USFWS 2017b). The northern population is also state-listed as endangered in Pennsylvania and bog turtles are known to occur in York County, Pennsylvania. USFWS requested a bog turtle habitat (Phase 1) survey to evaluate all wetlands within 300 ft of the project area. Typical bog turtle habitats consist of spring-fed bogs or marshes with shallow surface water or saturated soils year-round, and usually interspersed with dry and wet pockets. The substrate is usually muck or peat. The dominant vegetation is low grasses and sedges (emergent wetland vegetation), often with a scrub-shrub component (Klemens 2001). The bog turtle habitat survey conducted on PBAPS in August 2017 found that none of the five wetlands on the site provide suitable habitat; therefore, the potential for occurrence of the bog turtle on the site is negligible.

The Indiana bat is a federally endangered species that hibernates in caves and mines in winter. The large winter colonies disperse in spring, and the bats migrate to summer habitats in wooded areas, where reproductive females form smaller maternity colonies. Males and non-reproductive females roost in trees but typically not in colonies. The range of the Indiana bat extends from the northeast through the east-central United States. The Indiana bat typically forages in semi-open forested habitats, forest edges, and riparian areas. Summer roosting habitat suitable for use by the Indiana bat requires dead, dying, or living trees of adequate size with sufficient exfoliating bark. Multiple roost sites may be used. Summer roosts typically are behind the bark of large, dead trees, particularly those that are in gaps in the forest canopy or along forest edges so that they receive sufficient sun exposure (USFWS 2007). Indiana bat populations are stable or decreasing throughout portions of its range due to loss of habitat and disease, in particular white-nose syndrome, a fungal disease that has caused substantial mortality in this species and other bat species (NatureServe 2015). Indiana bats are known to hibernate at 18 sites in 11 counties in Pennsylvania, none of which are in or adjoin York County, but they have been live captured in summer in York County (Butchkoski 2010).

The northern long-eared bat was federally listed by the USFWS as threatened in April 2015. It does not currently have a state listing status in Pennsylvania. The decision to list the northern long-eared bat as federally threatened was primarily due to the threat posed to the species by white-nose syndrome, which has caused substantial mortality in this species, particularly in the northeastern United States. Like the Indiana bat, the northern long-eared bat hibernates in caves and mines in winter and roosts in trees in summer. In summer, the northern long-eared bat generally roosts alone or in small colonies in cavities or beneath the bark of live or dead trees (USFWS 2015c). The northern long-eared bat hibernates deep in crevices of caves and abandoned mines; county-specific data on northern long-eared bat hibernacula are not available.

The IPaC Resource List included the red knot (*Calidris canutus rufa*) as a federally listed threatened species that could potentially be affected by PBAPS activities (USFWS 2017c). The red knot is a migratory shorebird that is found in intertidal, marine habitats (Cornell Lab of Ornithology 2017a). During their spring migration, red knots depend upon horseshoe crab eggs found in the Delaware Bay (USFWS 2015e). Although observed in-flight during migration and documented by birdwatchers in nearby Chester County, Pennsylvania and New Castle County, Delaware, USFWS records state that in Pennsylvania, the red knot is known to occur only in Erie County (Merker 2017; USFWS 2017a; Cornell Lab of Ornithology 2017b). There are no publicly available recorded observations of the red knot at PBAPS.

Although the bald eagle was delisted under the ESA in 2007, it is still protected under the Bald and Golden Eagle Protection Act (BGEPA), the Migratory Bird Treaty Act (MBTA), and the Lacey Act (USFWS 2015b). As of 2015, there were three documented, intact bald eagle nests located along the portion of Conowingo Pond near the PBAPS site. One was within the north portion of the site on a wooded slope above the river, one was on a transmission line structure in the reservoir approximately 2,500 ft offshore of the site, and the other was on a structure in the reservoir north of the site. A 1,000-ft buffer around the onsite nest would be entirely within the site boundary, while a similar buffer around the offshore nests would not cross the site boundary (USFWS 2015d).

No areas designated by the USFWS as critical habitat for endangered species exist at or in the vicinity of PBAPS (USFWS 2016a). Terrestrial animal species that are federally listed as endangered or threatened are not known to occur at PBAPS, and there are no candidates for federal listing that are likely to occur at the site.

Exelon Generation submitted a consultation letter to USFWS in September 2017 requesting additional information on any protected species and their habitats that may be affected by the PBAPS license renewal. The USFWS acknowledged in a letter dated November 2, 2017 that three bald eagle nests are located within a half mile of the PBAPS, and that they are in receipt of the signed "Bald Eagle Project Screening Form" that indicates all recommended avoidance measures will be implemented on PBAPS (USFWS 2017d). Additionally, USFWS concurred with the bog turtle habitat determination and concluded that activities associated with the relicensing will not affect the bog turtle or any other federally threatened or endangered species under their jurisdiction.

3.6.2.3.2 State-Status Species

The PNDI receipt identified four terrestrial plant species that may be affected by PBAPS activities. Of these, two have a status of "special concern species" meaning that the species' status according to PA DCNR is rare, tentatively undetermined, candidate, or otherwise of conservation concern. The other two species identified in the PNDI report are terrestrial plant species with a state listing status of threatened that have been recorded in the vicinity of PBAPS (PA DCNR 2017). According to the York County

Natural Areas Inventory (YCPC 2004), these two species occur in natural areas within, or adjacent to, the PBAPS site:

- Harbinger-of-spring (*Erigenia bulbosa*) is known to occur within the Peach Bottom Woods Site, which is in the southern portion of the PBAPS site;
- American holly (*Ilex opaca*) is known to occur within the Atom Road Woods Site, which extends into the western portion of the PBAPS site.

The lobed spleenwort (*Asplenium pinnatifidum*), which was also identified as occurring within the Atom Road Woods Site, currently has no legal status but is under review for possible future listing and is identified as a special concern species according to PA DCNR in the PNDI receipt. The PA DCNR also notes in the PNDI receipt the potential presence of an unidentified "sensitive species" of plant, which is a species identified as collectible, having economic value, or susceptible to decline as a result of visitation (PA DCNR 2017).

The osprey (*Pandion haliaetus*) until recently was state-listed as threatened; however, it was delisted 2017 (PNHP 2017). Ospreys are commonly observed at Conowingo Pond during the summer breeding season and during migration. According to a 2011 study, in 2010 four osprey nests and in 2011 five osprey nests were observed in the vicinity of the PBAPS site; one of these nests fledged three offspring in 2011 (URS Corporation and GSE 2011). In 2017, an osprey nest was located in the South Substation; coordination between PGC and Exelon Corporation (as PECO) is ongoing.

Exelon Generation submitted consultation letters to DCNR, PFBC, and PGC in September 2017, requesting additional information on any protected species and their habitats that may be affected by the PBAPS license renewal. A letter from DCNR dated September 27, 2017 determined that license renewal activities, as described in the PNDI and subsequent correspondence, are not likely to impact species or resources under their jurisdiction. In a phone call on October 3, 2017, the PGC stated that no response to Exelon Generation's consultation letter dated September 26, 2017 would be provided because PGC considers the PNDI receipt indicating that no further review is required to be sufficient. In a letter dated March 8, 2018, the PFBC expressed concern about potential PBAPS effects on the local Chesapeake logperch population in Conowingo Pond. The Chesapeake logperch is state-listed as threatened, but not federally listed. The letter indicated that PFBC intends to address its Chesapeake logperch impingement and entrainment concerns during the PBAPS NPDES permit renewal process. No additional species of concern were identified (Appendix C.1).

TABLE 3.6-1
CONOWINGO POND FISH COMMUNITY DURING 2010-2013 SAMPLING

Family	Common Name	Scientific Name	2010		2011		2012		2013		Total	
			N	%	N	%	N	%	N	%	N	%
Clupeidae	Alewife	*Alosa pseudoharengus*	0	0	1	<0.01	0	0	0	0	1	<0.01
	American shad	*Alosa sapidissima*	0	0	1	<0.01	0	0	0	0	1	<0.01
	Gizzard shad	*Dorosoma cepedianum*	5,905	47.4	10,265	40.0	8,388	24.4	3,046	16.6	27,604	30.4
Salmonidae	Brown trout	*Salmo trutta*	0	0	0	0	0	0	2	0.01	2	<0.01
Osmeridae	Rainbow smelt	*Osmerus mordax*	0	0	1	<0.01	0	0	0	0	1	<0.01
Esocidae	Muskellunge	*Esox masquinongy*	0	0	0	0	0	0	1	0.01	1	<0.01
	Tiger muskellunge	*Esox masquinongy* x *E. lucius*	0	0	0	0	1	<0.01	0	0	1	<0.01
Cyprinidae	Central stoneroller	*Campostoma anomalum*	0	0	0	0	0	0	6	0.03	6	0.01
	Rosyside dace	*Clinostomus funduloides*	0	0	0	0	8	0.02	0	0	8	0.01
	Grass carp	*Ctenopharyngodon idella*	0	0	0	0	0	0	1	0.01	1	<0.01
	Spotfin shiner	*Cyprinella spiloptera*	1,061	8.52	1,942	7.56	1,120	3.26	1,390	7.56	5,513	6.07
	Common carp	*Cyprinus carpio*	81	0.65	239	0.93	217	0.63	107	0.58	644	0.71
	Cutlips minnow	*Exoglossum maxillingua*	0	0	0	0	1	<0.01	0	0	1	<0.01
	Common shiner	*Luxilus cornutus*	0	0	7	0.03	1	<0.01	1	0.01	9	0.01
	River chub	*Nocomis micropogon*	0	0	1	<0.01	2	0.01	0	0	3	<0.01
	Golden Shiner	*Notemigonus crysoleucas*	17	0.14	15	0.06	46	0.13	20	0.11	98	0.11
	Comely Shiner	*Notropis amoenus*	155	1.24	2,456	9.56	9,373	27.3	1,953	10.6	13,937	15.3
	Spottail Shiner	*Notropis hudsonius*	100	0.80	1,031	4.01	710	2.07	746	4.06	2,587	2.85
	Swallowtail Shiner	*Notropis procne*	6	0.05	3	0.01	4	0.01	4	0.02	17	0.02
	Rosyface shiner	*Notropis rubellus*	0	0	0	0	1	<0.01	0	0	1	<0.01
	Mimic shiner	*Notropis volucellus*	0	0	25	0.10	3	0.01	2	0.01	30	0.03
	Bluntnose minnow	*Pimephales notatus*	131	1.05	545	2.12	442	1.29	1,488	8.10	2,606	2.87
	Blacknose dace	*Rhinichthys atratulus*	0	0	0	0	0	0	1	0.01	1	<0.01
	Creek chub	*Semotilus atromaculatus*	1	0.01	3	0.01	20	0.06	12	0.07	36	0.04
	Fallfish	*Semotilus corporalis*	1	0.01	35	0.14	14	0.04	4	0.02	54	0.06

TABLE 3.6-1 (Cont'd)
CONOWINGO POND FISH COMMUNITY DURING 2010-2013 SAMPLING

Family	Common Name	Scientific Name	2010		2011		2012		2013		Total	
			N	%	N	%	N	%	N	%	N	%
Catostomidae	Quillback	*Carpiodes cyprinus*	16	0.13	86	0.33	18	0.05	26	0.14	146	0.16
	White sucker	*Catostomus commersonii*	6	0.05	7	0.03	31	0.09	102	0.55	146	0.16
	Northem hogsucker	*Hypentelium nigricans*	14	0.11	27	0.11	32	0.09	10	0.05	83	0.09
	Shorthead redhorse	*Moxostoma macrolepidotum*	41	0.33	104	0.40	247	0.72	300	1.63	692	0.76
Ictaluridae	Channel catfish	*Ictalurus punctatus*	2,217	17.8	5,215	20.3	2,749	8.00	931	5.07	11,112	12.2
	Flathead catfish	*Pylodictis olivaris*	21	0.17	39	0.15	44	0.13	40	0.22	144	0.16
Belonidae	Atlantic needlefish	*Strongylura marina*	0	0	0	0	5	0.01	0	0	5	0.01
Fundulidae	Banded killifsh	*Fundulus diaphanus*	185	1.49	88	0.34	65	0.19	700	3.81	1,038	1.14
Poeciliidae	Eastern mosquitofish	*Gambusia holbrooki*	0	0	1	<0.01	0	0	0	0	1	<0.01
Moronidae	White perch	*Morone americana*	5	0.04	35	0.14	62	0.18	49	0.27	151	0.17
	Striped bass	*Morone saxatilis*	0	0	1	<0.01	1	<0.01	0	0	2	<0.01
	Hybrid striped bass	*Morone chrysops* x *M. saxatilis*	0	0	9	0.04	30	0.09	5	0.03	44	0.05
Centrarchidae	Rock bass	*Ambloplites rupestris*	154	1.24	353	1.37	303	0.88	417	2.27	1,227	1.35
	Redbreast sunfish	*Lepomis auritus*	1	0.01	8	0.03	11	0.03	13	0.07	33	0.04
	Green sunfish	*Lepomis cyanellus*	597	4.79	910	3.54	1,286	3.74	1,678	9.13	4,471	4.92
	Pumpkinseed	*Lepomis gibbosus*	2	0.02	11	0.04	10	0.03	19	0.10	42	0.05
	Bluegill	*Lepomis macrochirus*	1,120	8.99	1,395	5.43	8,140	23.7	3,246	17.7	13,901	15.3
	Smallmouth bass	*Micropterus dolomieu*	172	1.38	381	1.48	387	1.13	1,124	6.12	2,064	2.27
	Largemouth bass	*Micropterus salmoides*	61	0.49	108	0.42	148	0.43	149	0.81	466	0.51
	White crappie	*Pomoxis annularis*	2	0.02	18	0.07	12	0.03	22	0.12	54	0.06
	Black crappie	*Pomoxis nigromaculatus*	2	0.02	3	0.01	7	0.02	9	0.05	21	0.02

TABLE 3.6-1 (Cont'd)
CONOWINGO POND FISH COMMUNITY DURING 2010-2013 SAMPLING

Family	Common Name	Scientific Name	2010		2011		2012		2013		Total	
			N	%	N	%	N	%	N	%	N	%
Percidae	Greenside darter	*Etheostoma blennioides*	13	0.10	6	0.02	3	0.01	27	0.15	49	0.05
	Banded darter	*Etheostoma zonale*	5	0.04	0	0	0	0	0	0	5	0.01
	Tessellated darter	*Etheostoma olmstedi*	197	1.58	116	0.45	190	0.55	142	0.77	645	0.71
	Yellow perch	*Perca flavescens*	1	0.01	14	0.05	23	0.07	103	0.56	141	0.16
	Chesapeake logperch	*Percina bimaculata*	77	0.62	65	0.25	80	0.23	337	1.83	559	0.62
	Shield darter	*Percina peltata*	9	0.07	23	0.09	0	0	39	0.21	71	0.08
	Walleye	*Sander vitreus*	79	0.63	97	0.38	121	0.35	109	0.59	406	0.45
Total Fish Collected			**6,550**		**25,690**		**34,356**		**18,381**		**90,882**	
Number of Species Collected			**34**		**41**		**40**		**41**		**53**	

Source: (NAI and ERM 2014)

TABLE 3.6-2
FISH PASSING UPSTREAM THROUGH THE CONOWINGO DAM EFL INTO CONOWINGO POND

Species	Scientific Name	2010	2011	2012	2013	2014	2015
Sea lamprey	*Petromyzon marinus*	31	20	85	51	29	46
American eel	*Anguilla rostrata*	4	-	4	3	15	48
Longnose gar	*Lepisosteus osseus*	-	-	1	-	-	-
Blueback herring	*Alosa aestivalis*	4	17	25	7	25	3
Hickory shad	*Alosa mediocris*	-	20	-	1	2	8
Alewife	*Alosa pseudoharengus*	1	2	27	-	111	10
American shad	*Alosa sapidissima*	37,757	20,571	22,143	12,733	10,425	8,341
Gizzard shad	*Dorosoma cepedianum*	813,429	257,522	1,070,672	1,076,048	1,170,200	742,661
Rainbow trout	*Oncorhynchus mykiss*	3	2	14	6	7	4
Brown trout	*Salmo trutta*	5	2	6	8	12	6
Brook trout	*Salvelinus fontinalis*	-	-	-	1	-	-
Splake trout	*Salvelinus namaycush* x *S. fontinalis*	-	-	6	-	-	-
Rainbow smelt	*Osmerus mordax*	-	-	-	-	1	-
Northern pike	*Esox lucius*	1	-	-	-	-	-
Muskellunge	*Esox masquinongy*	1	1	3	2	4	2
Tiger muskellunge	*Esox masquinongy* x *E. lucius*	1	-	1	-	-	-
Common carp	*Cyprinus carpio*	47	253	331	180	253	457
Golden shiner	*Notemigonus crysoleucas*	2	-	1	-	1	1
Comely shiner	*Notropis amoenus*	92	-	1,051	252	-	-
Spottail shiner	*Notropis hudsonius*	12	-	1	12	1	71
Spotfin shiner	*Cyprinella spiloptera*	98	-	-	-	2	70
Quillback	*Carpiodes cyprinus*	489	167	1,523	2,725	570	162
White sucker	*Catostomus commersonii*	9	4	1	33	11	2
Shorthead redhorse	*Moxostoma macrolepidotum*	43	184	334	203	1,136	210
Atlantic needlefish	*Strongylura marina*	4	6	13	-	-	1

TABLE 3.6-2 (Cont'd)
FISH PASSING UPSTREAM THROUGH THE CONOWINGO DAM EFL INTO CONOWINGO POND

Species	Scientific Name	2010	2011	2012	2013	2014	2015
White catfish	*Ameiurus catus*	1	-	-	-	-	-
Yellow bullhead	*Ameiurus natalis*	1	-	1	-	2	-
Brown bullhead	*Ameiurus nebulosus*	1	5	203	17	105	140
Channel catfish	*Ictalurus punctatus*	4,626	10,087	12,224	1,594	9,235	1,118
Flathead catfish	*Pylodictis olivaris*	1	-	3	-	60	-
White perch	*Morone americana*	21	6	39	2	97	20
Striped bass	*Morone saxatilis*	34	21	129	200	110	407
Hybrid striped bass	*Morone chrysops x M. saxatilis*	2	-	3	-	1	11
Rock bass	*Ambloplites rupestris*	8	15	5	2	4	1
Redbreast sunfish	*Lepomis auritus*	20	-	-	2	-	-
Green sunfish	*Lepomis cyanellus*	-	-	1	-	1	-
Pumpkinseed	*Lepomis gibbosus*	6	-	3	-	2	1
Bluegill	*Lepomis macrochirus*	54	31	39	58	28	31
Smallmouth bass	*Micropterus dolomieu*	57	146	263	151	133	97
Largemouth bass	*Micropterus salmoides*	18	4	13	10	8	11
Tessellated darter	*Etheostoma olmstedi*	-	-	-	-	4	-
Yellow perch	*Perca flavescens*	2	7	21	1	3	6
Chesapeake logperch	*Percina bimaculata*	-	-	-	-	2	-
Walleye	*Sander vitreus*	378	360	722	224	150	111
Total		**857,263**	**289,453**	**1,109,911**	**1,094,526**	**1,192,750**	**754,057**

Sources: (NAI 2010b; NAI 2011b; NAI 2012b; NAI 2013c; NAI 2014b; NAI 2015b)

TABLE 3.6-3
SPECIAL-STATUS SPECIES

Scientific Name[1]	Common Name[1]	Federal Status[2]	PA State Status[2]
BIRDS			
Calidris canutus rufa	Red knot	T	-
Haliaeetus leucocephalus	Bald eagle	-	DL
MAMMALS			
Myotis septentrionalis	Northern long-eared bat	T	-
Myotis sodalis	Indiana bat	E	E
REPTILES			
Glyptemys muhlenbergii	Bog turtle	T	E
FISH			
Percina bimaculata	Chesapeake logperch	-	T
VASCULAR PLANTS			
Asplenium pinnatifidum	Lobed spleenwort	-	N
Erigenia bulbosa	Harbinger-of-spring	-	T[3]
Ilex opaca	American holly	-	T

[1] Species with federal or state special status and the potential for occurrence in the vicinity of the PBAPS site.

[2] T = Threatened; E = Endangered; DL = State delisted; N = No current legal state status, but under review for future listing; - = No status

Source for species included: (USFWS 2016b; PA DCNR 2017)

Source for current species status: (PNHP 2017)

[3] Proposed for downgrading to “special concern species”.

3.7 HISTORIC AND CULTURAL RESOURCES

The Final Environmental Impact Statement (FEIS) related to operation of PBAPS, prepared in 1973 by the AEC, stated that "no artifacts of historical or archaeological significance (were) found within the site boundary" during construction (AEC 1973). Also, in the more than 40 years of PBAPS operation since that time, none have been discovered. An archaeologist from the William Penn Museum conducted an evaluation of the site in 1972 and observed that the impoundment of the Susquehanna River in the 1920s to create Conowingo Pond flooded the floodplain and terrace areas most likely to contain cultural artifacts. Within York and Lancaster Counties in Pennsylvania and Harford County in Maryland, there are 94, 211, and 79 sites respectively, listed in the National Register of Historic Places (NRHP) (NPS 2018). Within 6 miles of PBAPS there are eight historic properties that are NRHP-listed, and another four that have been determined eligible for listing (Figure 3.7-1) as described below (Pennsylvania Historical & Museum Commission 2017a; Maryland DNR 2017a).

Historic Properties Listed in the NRHP:

1. Coulsontown Cottages Historic District, located at Ridge Road and Main Street, Delta, PA
2. Delta Historic District, located along Main Street, Delta, PA
3. Muddy Creek Bridge for the Maryland and Pennsylvania Railroad, located at Maryland and Pennsylvania RR tracks over Muddy Creek, east of Creek Ridge Road, Peach Bottom and Lower Chanceford Townships, Sunnyburn, PA
4. Scott Creek Bridge located at Maryland and Pennsylvania Railroad tracks over Scott Creek, west of Watson's Corner and south of PA, 851, Peach Bottom Township, Bryansville, PA
5. Delta Trestle Bridge for the Maryland and Pennsylvania Railroad, located east of Bunker Hill Rd., Peach Bottom Township, PA
6. Broad Creek Soapstone Quarries, Address Restricted, Whiteford, MD
7. Whiteford-Cardiff Historic District, located in parts of both Whiteford and Cardiff, MD
8. Slate Ridge School, located on Old Pylesville Road, Whiteford, MD

Historic Properties Eligible for Listing in the NRHP:

1. Pennock Mill, Drumore Township, PA
2. Lancis House, Drumore Township, PA
3. William Spencer House, Peach Bottom Township, PA
4. Sample House, Lower Chanceford Township, PA

The NRC defines the cultural resources area of potential effect (APE) for a license renewal project as:

> The NRC has determined that the APE for a license renewal action is the area at the power plant site and its immediate environs which may be impacted by post-license renewal land disturbing operation or projected refurbishment activities associated with the proposed action. The APE may extend beyond the immediate environs in those instances where post-license renewal land disturbing operations or projected refurbishment activities specifically related to license renewal of the nuclear power plant potentially have an effect on known or proposed historic sites. This determination is made irrespective of ownership or control of the lands of interest. (NUREG-1427, Rev. 1, June 2013. Sec. 3.7.1, p. 3-84).

Using this definition, the APE for the PBAPS SLR is limited to land within the plant property boundary and adjacent land that might be affected by traffic, noise, or viewscape issues resulting from post-license renewal changes (See Figure 3.7-2). However, traffic, noise, and viewscape issues are not anticipated, as the SLR project does not propose any land disturbing operations or refurbishment activities.

3.7.1 Site and Regional History

The area near the PBAPS site possesses a long and varied history of human occupation, with the earliest known Native American peoples having arrived in the Lower Susquehanna Valley by at least 15,000 years ago (Custer 1996). Today, the three counties surrounding the plant contain more than 2,500 recorded historic and Native American archaeological sites, and more than 380 properties have been listed in the NRHP (Pennsylvania Historical & Museum Commission 2017b; Maryland DNR 2017b). A large number of Native American sites in this area have been identified on the terraces bordering the Susquehanna River, and near the confluences of smaller tributary streams; however, in the vicinity of Peach Bottom these landforms have been submerged beneath Conowingo Pond (created in 1928 by the construction of the Conowingo Dam) or removed entirely by subsequent transformations of the original landscape.

Historic era occupation of the Lower Susquehanna Valley dates to the early 17th century with the establishment of the first permanent European colonies in the region. Early interactions among native groups, advancing European settlers, and colonial authorities commonly resulted in the spread of withering epidemic diseases and armed conflicts that quickly uprooted traditional native societies, dislocated native groups from traditional territories, and compelled refugees to improvise new linguistically and culturally diverse communities at the margins of effective colonial control (Crosby 1976; Kent 1993; Anderson 2000; Mancall 2001; Wallace 2005). As a result of these widespread disruptions it is often difficult to associate particular locations with present-day tribal groups, or to accurately identify the occupants of a specific location at the time of European arrival. Nonetheless, with regard to the Peach Bottom area, it is known that the Native occupants of the Susquehanna River Valley at the time of European contact were the Susquehannocks, a group of allied Iroquoian-speaking tribes occupying a handful of palisaded towns and several dozen scattered villages. To the west of the

Susquehannocks lived the Shawnee; to the east were the Lenni-Lenape, or Delaware Indians, who occupied the Delaware River Valley region from southern New York to northern Delaware; and in Maryland were the Piscataway or Conoy (Kent 1993; Weslager 1996; Wallace 2005).

Caught between ever-advancing colonial settlements and the powerful Iroquois Confederacy, which sought to maintain its dominance over the fur trade, the Susquehannocks were subjugated by the Iroquois in 1675, and largely displaced from the Susquehanna River Valley by the early 1700s. With the decline of Susquehannock influence, neighboring Shawnee, Piscataway, and Iroquois tribes moved into the region, establishing a town at the mouth of Conoy Creek (near Bainbridge) in 1718 (Kent 1993; Merrell 1999; Wallace 2005). By the middle of the 18th century a series of treaties between Pennsylvania and the Iroquois Confederacy effectively ended Native occupation of the Susquehanna River valley (Wallace 2005). Displaced Delaware and Shawnee moved west to the Ohio River valley before they were resettled in Kansas, and later in Oklahoma (Weslager 1996).

There are currently no federally recognized tribes in Pennsylvania, New Jersey, Delaware, or Maryland; however, there are several state-recognized groups. Delaware recognizes the Lenape Indian Tribe of Delaware and the Nanticoke Indian Association; Maryland recognizes the Piscataway Conoy Tribe and the Piscataway Indian Nation; and, New Jersey recognizes the Nanticoke Lenni-Lenape Indians of New Jersey, the Powhatan Renape Nation, and the Ramapough Lenape Nation (Johnson 1997; Bittle 2016; National Conference of State Legislatures 2016). Pennsylvania currently affords no official state recognition to any Native American group.

3.7.2 Known Historic and Archaeological Resources

The eight sites within 6 miles of PBAPS that are currently listed in the NRHP, and the four others that are eligible to be listed in the Register are identified in Section 3.7. No previously identified historic architectural resources are located within the APE.

It is unlikely that previously undocumented archaeological resources are preserved within any portion of the APE. In part, this assessment is based on the extensive landscape modification that occurred during the construction of PBAPS. In addition, any habitable landforms that might have been contained within the APE would have been submerged beneath the waters of Conowingo Pond as a result of the construction of Conowingo Dam. The construction of that dam (1926-28) created a reservoir 1 mile wide, 14 miles long, and approximately 100 ft deep, and which covers an area of nearly 9,000 acres (Paulson and Paulson 2017). The creation of this reservoir resulted in the inundation of formerly habitable landforms immediately adjacent to the former river channel, and the effective loss of any archaeological resources that might have been contained in those grounds.

The conclusion that undocumented archaeological sites are unlikely to be contained within the APE is further supported by a Pennsylvania statewide archaeological sensitivity model analysis that indicates Native American site sensitivity correlating with proximity to upland flats, well-drained soils, spring-head locations, and floodplains along the Susquehanna River (Harris et al. 2014). Any potential floodplain soils within the

PBAPS property boundary were extensively disturbed by construction of the plant. In the vicinity of PBAPS the archaeological sensitivity model limits areas of moderate-high sensitivity to the high bluffs located adjacent to, but outside of the current APE.

The Peach Bottom property was evaluated by an archeologist in 1972, who concluded that there were no archaeological sites in the areas of Units 2 and 3. Records maintained by Exelon Generation indicate that no historic landscape, traditional cultural property, or archaeological sites have been identified at the PBAPS site since the time of its construction, and confirm that no potentially significant artifact deposits have ever been documented within the present APE (Exelon Generation 2001).

Some structures associated with PBAPS Units 1, 2 and 3 will exceed 50 years of age during the SLR term. These structures have not been evaluated to determine eligibility for listing on the NRHP. However, as is further discussed in Section 4.7, Exelon Generation has consulted with the Pennsylvania State Historic Preservation Officer (SHPO), who determined that license renewal activities will not affect these resources (Appendix C.2).

Existing Exelon Generation procedures that apply to land-disturbing activities will minimize the potential for adverse effects on previously unidentified archaeological or historic resources. If cultural or historic resources are discovered during an ongoing excavation at PBAPS, such procedures dictate that the work would be stopped, appropriate notifications would be made, a cover would be positioned to protect the exposed resources from the elements, access to the area would be controlled with barriers and/or signs, and work would not resume until authorized by Environmental personnel. Also, Environmental personnel would coordinate the salvage or disposition of any recovered resources.

FIGURE 3.7-1
WITHHELD FROM PUBLIC DISCLOSURE UNDER
10 CFR 2.390(a)(3) and 54 U.S.C. 307103

Figure 3.7-1 National Register Listed/Eligible Resources

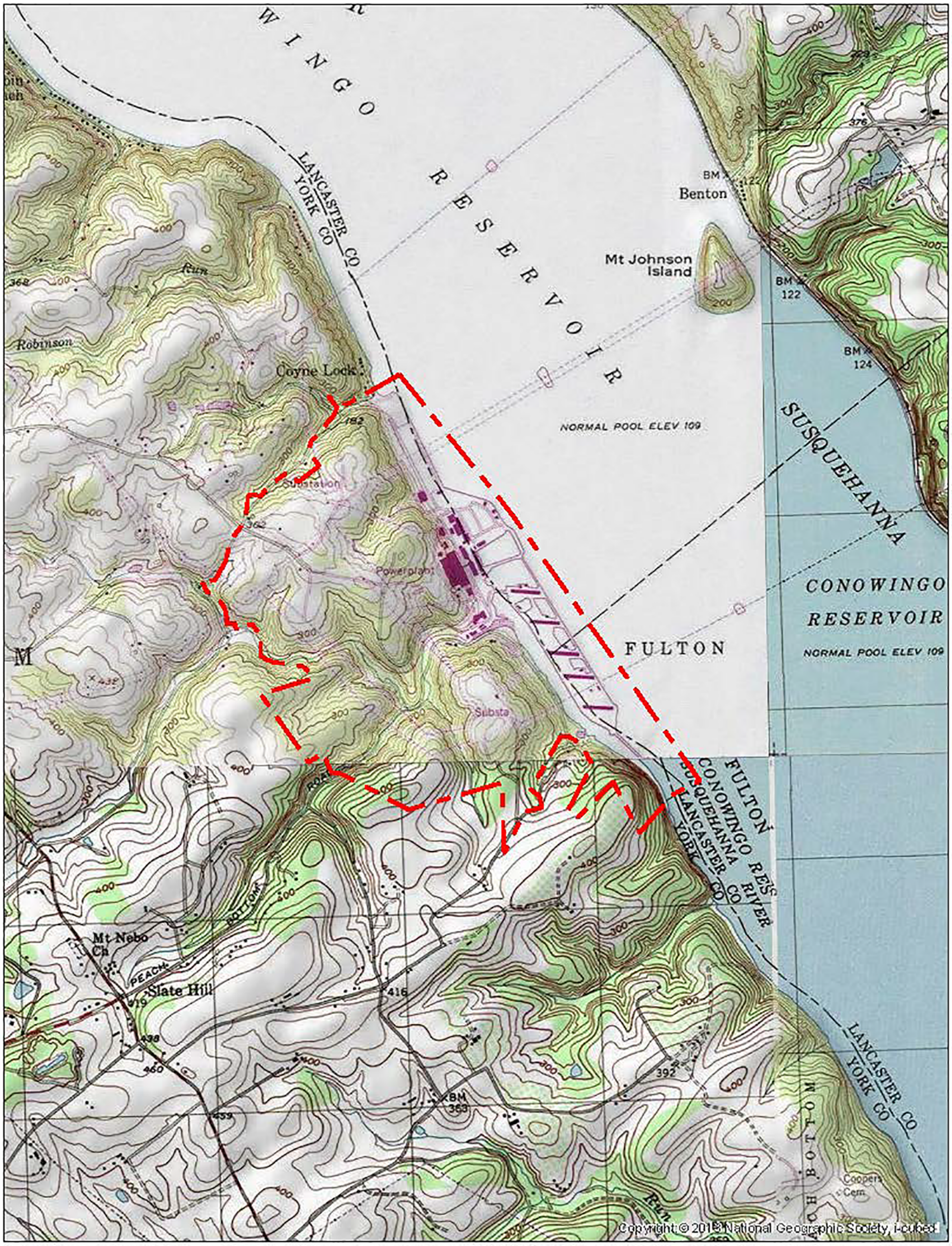


Figure 3.7-2 APE for PBAPS

3.8 SOCIOECONOMICS

As stated in the revised GEIS, the nuclear plant and the communities that support it can be described as a dynamic socioeconomic system. The communities provide the people, goods, and services needed to operate the nuclear power plant. Power plant operations, in turn, provide wages and benefits for people and dollar expenditures for goods and services. The measure of a communities' ability to support power plant operations depends on the ability of the community to respond to changing environmental, social, economic, and demographic conditions.

The socioeconomics region of influence around a nuclear power plant is defined by the counties where plant employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. Changes in nuclear power plant operations affect socioeconomic conditions in the regions surrounding them, including employment and income; population and housing; community services; and transportation (NRC 2013a).

3.8.1 Demography

Population was estimated from the PBAPS site out to 20-mile and 50-mile radii using 2010 census data and geographic information system (GIS) software (ArcView) to determine demographic characteristics in the PBAPS vicinity. There are six counties within a 20-mile radius of the site, which are included in two states: Maryland and Pennsylvania. The counties are Baltimore County, MD; Cecil County, MD; Chester County, PA; Harford County, MD; Lancaster County, PA and York County, PA (Figure 3.8-1). There are 25 counties within a 50-mile radius of the site, which are included in four states: Delaware, Maryland, New Jersey and Pennsylvania (Figure 3.8-2).

The GEIS presents a population characterization method used to evaluate the remoteness of areas in which nuclear plants are located. This method is based on two factors: "sparseness" and "proximity". Sparseness measures population density and city size within 20 miles of a site. Proximity" measures population density and city size within 50 miles of the site.

Sparseness categorizes the demographic information as follows:

	Sparseness Category	
Most sparse	1.	Less than 40 persons per square mile and no community with 25,000 or more persons within 20 miles
	2.	40 to 60 persons per square mile and no community with 25,000 or more persons within 20 miles
	3.	60 to 120 persons per square mile or less than 60 persons per square mile with at least one community with 25,000 or more persons within 20 miles
Least sparse	4.	Greater than or equal to 120 persons per square mile within 20 miles

Source: (NRC 2013a)

Proximity categorizes the demographic information as follows:

	Proximity Category	
Not in close proximity	1.	No city with 100,000 or more persons and less than 50 persons per square mile within 50 miles
	2.	No city with 100,000 or more persons and between 50 and 190 persons per square mile within 50 miles
	3.	One or more cities with 100,000 or more persons and less than 190 persons per square mile within 50 miles
In close proximity	4.	Greater than or equal to 190 persons per square mile within 50 miles

Source: (NRC 2013a)

The GEIS then uses the following matrix to rank the population category as low, medium, or high:

GEIS SPARSENESS AND PROXIMITY MATRIX

		Proximity			
		1	2	3	4
Sparseness	1	1.1	1.2	1.3	1.4
	2	2.1	2.2	2.3	2.4
	3	3.1	3.2	3.3	3.4
	4	4.1	4.2	4.3	4.4

Low Population Area | **Medium Population Area** | **High Population Area**

Exelon Generation used 2010 census data from the U.S. Census Bureau website and GIS software (ArcGIS®) to determine demographic characteristics in the PBAPS vicinity.

The Census Bureau provides updated annual projections, in addition to decennial data, for selected portions of its demographic information. Section 3.10 (Environmental Justice) of this environmental report uses Census Bureau 2010 data and 2011-2015 American Community Survey (ACS) 5 year estimates for minority and low-income population demographic information respectively.

As derived from Census Bureau 2010 information, at least 293,421 people live within 20 miles of PBAPS. Applying the GEIS sparseness measures, PBAPS site has a population density of 234 persons/mile^2 within 20 miles and falls into the least sparse category, Category 4 (having greater than or equal to 120 persons/mile^2 within 20 miles).

As estimated from Census Bureau 2010 information, at least 5,738,258 people live within 50 miles of PBAPS. This equates to a population density of 731 persons/mile^2 within 50 miles. Applying the GEIS proximity measures, PBAPS is classified as being "in close proximity" Category 4 (having greater than or equal to 190 persons/mile^2 within 50 miles).

According to the GEIS sparseness and proximity matrix, PBAPS ranks of sparseness Category 4 and proximity Category 4 result in the conclusion that PBAPS is located in a high population area.

All or parts of 25 counties are located within 50 miles of PBAPS (Figure 3.8-2). Of the counties, 10 are in Pennsylvania, 10 are in Maryland, 2 are in Delaware, and 3 are in New Jersey. The Baltimore Metropolitan Statistical area is the largest metropolitan area within 50 miles of the PBAPS site. Other sizable cities and towns within 50 miles include Reading, Harrisburg, Chester, Lancaster, and York, Pennsylvania, and Wilmington, Delaware.

York and Lancaster counties are in closest proximity to PBAPS. As described in detail in Subsection 3.8.1.1.1, approximately 69.64 percent of PBAPS employees live in York and Lancaster counties. The following discussion specifically focuses on population growth in York and Lancaster counties in relation to the Commonwealth of Pennsylvania.

Population

Table 3.8-1 shows the population from 1990 to 2015 of the Commonwealth of Pennsylvania, and Lancaster and York counties. Between 1990 and 2000, York County experienced a population growth from 339,600 (in 1990) to 381,751 (in 2000), a 12.4 percent increase over the decade, while Lancaster County grew from 422,800 (in 1990) to 470,658 (in 2000), an increase of 11.3 percent (USCB 1995; USCB 2000). Between 2000 and 2010, York County experienced a population growth from 381,751 (in 2000) to 434,972 (in 2010), a 13.9 percent increase over the decade; while Lancaster County grew from 470,658 (in 2000) to 519,445 (in 2010), a 10.4 percent increase (USCB 2000; USCB 2010b). According to the 2015 ACS, both counties continued to grow after 2010, although at a slower rate. Lancaster County's 2015 population is estimated to be 530,216, indicating a 2.1 percent growth as compared to the 2010 census. York County's 2015 population is estimated to be 439,660, indicating a 1.1 percent growth as compared to the 2010 census (USCB 2015b).

The population of both York and Lancaster counties is growing at faster rates than that of the Commonwealth of Pennsylvania as a whole. Between 1990 and 2015, the Commonwealth population grew 7.6 percent: from 11,881,643 (in 1990) to 12,779,559 (in 2015) (USCB 1995; USCB 2015b). During the same time period, Lancaster and York counties increased by 25.4 percent and 29.5 percent, respectively. Population growth is centered in the east and south central (vicinity of PBAPS) parts of the state. Pennsylvania's population growth rate is slower than U.S. growth rate of 9.7 percent for the same period. This is a long-standing trend, as Pennsylvania's decennial population growth rates have been lower than national averages dating back to the 1920's (PennDOT 2016b). The greatest relative population growth within the 50-mile radius around PBAPS between 1990 and 2000 occurred in Carroll County, Maryland, northwest of Baltimore (22.3 percent) (NRC 2003). The greatest relative population growth within the 50-mile radius around PBAPS between 2000 and 2010 occurred in Kent County, Delaware (28 percent).

As shown in Table 3.8-2, population projections based on the 2010 census predict an increase in the population of the Commonwealth of Pennsylvania to 14.1 million in 2040, up from 12.7 million in 2010. The state is projected to grow 4.1 percent from 2010 to 2020, 8.2 percent from 2010 to 2030 for an overall growth of 11.2 percent from 2010 to 2040. Almost 72 percent of the increase will be due to domestic net-migration or overseas migrants arriving from 2010 to 2040, with overseas migrants accounting for more than 85 percent of this portion of the increase. The remaining 28 percent of the increase during this period is due to natural increase (births exceeding deaths). While Pennsylvania will see an overall growth in population during this period, some counties will experience a decline in population. Thirteen of Pennsylvania's 67 counties will see an increase in population greater than 15 percent, while 35 counties will see no change or a change of 15 percent or less. A total of 19 counties will experience a decrease in population over the projection time period (The Center for Rural Pennsylvania 2014).

York County is projected to grow 5.7 percent from 2010 to 2020, and 11.2 percent from 2010 to 2030. Lancaster County is projected to grow 7.5 percent from 2010 to 2020, and 15.7 percent from 2010 to 2030. Overall, population growth of York and Lancaster counties is projected to surpass the Commonwealth of Pennsylvania's 11.2 percent growth with population increases of 14.4 and 23.3 percent from 2010 to 2040 respectively (The Center for Rural Pennsylvania 2014).

Almost 90 percent of the Commonwealth's population increase during the 2010 to 2040 period is expected to occur in predominantly urban counties, such as Lancaster and York, and the remaining 10 percent is expected to occur in predominantly rural counties. This means that the Commonwealth's population will become more urban, increasing from about 73 percent in 2010 to 74 percent in 2040. Population in rural counties will decrease from about 27 percent to about 26 percent during this same period. The southeast region of the Commonwealth, which contains six counties (Lebanon, Berks, Montgomery, Delaware, Chester and Lancaster) within a 50-mile radius of PBAPS, is expected to have the largest increase in population, gaining more than 891,000 during the 30-year period. The southcentral region, which contains four counties (Dauphin, Cumberland, York and Adams) within a 50-mile radius of PBAPS, is expected to gain more than 184,000 during this same period. Other regions of the Commonwealth are expected to have more modest gains (southwest - 127,000, northeast - 123,000, northcentral - 66,000, and northwest - 28,000) (The Center for Rural Pennsylvania 2014).

3.8.1.1 Housing and Economy

3.8.1.1.1 Housing

The larger towns near PBAPS in York County include York, 30 miles to the northwest; and Red Lion, 20 miles to the northwest. In Lancaster County, larger towns near the site are Quarryville, 10 miles to the northeast; and Lancaster, 19 miles due north. Approximately 919 people work at PBAPS Units 2 and 3 (about 89 contract employees and approximately 830 permanent employees). As depicted in Table 3.8-3, approximately 69.64 percent of PBAPS employees live in Lancaster and York counties. The remaining 30.36 percent is distributed across 21 counties, with numbers ranging from 1 to 89 people. As shown in Table 3.8-4, the towns of Lancaster, Red Lion, York, Delta and Quarryville have the highest numbers of employees in residence, with 9.68, 9.58, 9.14, 5.44 and 3.92 percent, respectively. Given the predominance of Exelon Generation employees living in York and Lancaster counties and the absence of the likelihood of significant socioeconomic effects in other locations, the focus of the analyses of housing and economy undertaken in this ER is on these two counties.

York County

With its affordability and access to the broader mega-region that spans Philadelphia, Baltimore, and Washington, DC, York County has been a strong choice for new residents and residential development over the past several years. A broad array of housing choices are offered in the County, from historic downtown lofts in the City of York, to secluded wooded properties and single-family homes in suburban areas surrounding the City, to rural farms and small historic towns in the southern and northern parts of the County. Quality of life, diverse housing stock and variety of recreational offerings has made York County a desirable location to live and for residential development (YCPC 2014).

Population growth in York County has increased steadily since 1960, changing the county's character from primarily agricultural to metropolitan. York County is part of the York-Hanover, Pennsylvania Metropolitan Statistical Area (BEA 2016f). The average growth rate has been 12.8 percent per decade for an overall increase of 82.5 percent from 1960 to 2010.

Growth is not distributed evenly, but is concentrated in four fairly distinct growth areas - the Greater York area, the Hanover area, the New Freedom/Shrewsbury area, and the spillover of the Harrisburg West Shore area into northern York County along Routes 83 and 15. Residential development in rural areas has proliferated causing sprawl and loss of farmland (YCPC 2011). Projected population growth from 2010 to 2050 in municipalities in which the highest numbers of employees reside is York (3.2 percent), Red Lion (6.6 percent) and Delta (0.5 percent). Presently, few employees (4) reside in

Peach Bottom Township. Peach Bottom's projected population growth from 2010 to 2050 is 59.6 percent (from 4,813 people to 7,683) (YCPC 2017a). In response to growth trends driven by population increases, housing has increased accordingly. Table 3.8-5 shows that the total number of housing units in York County increased by 14.0 percent between 2000 and 2010, from 156,720 to 178,671 units. York had 168,372 occupied housing units in 2010, with 75.5 percent owner occupancy and 24.5 percent renter occupancy. The total number of vacant units increased from 8,501 in 2000 (5.4 percent vacancy rate) to 10,299 (5.8 percent vacancy rate) in 2010 (Pennsylvania State Data Center 2011a). Census estimates for York County in 2015 indicated that there were 167,416 occupied housing units with a vacancy rate of 7.11 percent, or 12,821 vacant units (USCB 2015d).

Lancaster County

Population growth in Lancaster County has increased steadily since 1960, changing the county's landscape from primarily agricultural to metropolitan. Lancaster County is part of the Lancaster, Pennsylvania Metropolitan Statistical Area (BEA 2016e). The average growth rate has been 13.3 percent per decade for an overall increase of 86.6 percent from 1960 to 2010.

Projected population growth from 2010 to 2040 in municipalities in which the highest numbers of employees reside is Quarryville (37.89) and Lancaster (7.5) (LCPC 2012).

In response to the growth trends driven by population increases, housing has increased accordingly. The County offers diverse housing.

The pattern of recent development includes growth concentrations near major corridors, mostly in the northern and central regions of the County along the I-76, Route 222, Route 322, Route 283, Route 23, Lititz Pike, and Route 30 corridors. Most of the larger developments have occurred within designated Urban or Village Growth Areas, primarily in the vicinity of established growth centers near the Route 222/I-76 interchange and in the Central Lancaster Region (LCPC 2006).

The total number of housing units in Lancaster County increased 12.7 percent between 2000 and 2010 (from 179,990 to 202,952 units) (see Table 3.8-5). Lancaster had 193,602 occupied housing units in 2010, with 68.5 percent owner occupancy and 31.5 percent renter occupancy. The total number of vacant units increased from 7,430 in 2000 to 9,350 in 2010. The 2015 estimates for Lancaster County showed 195,330 occupied units, with a vacancy rate of 4.9 percent, or 10,257 units (USCB 2015c). In spite of strong demand and growth of housing units, the increasing vacancy rate indicates that single family homes were heavily overbuilt in exurban locations during the housing boom. Although the housing market is in recovery, many of those houses stand empty (Zimmerman/Volk Associates, Inc. 2013).

Existing PBAPS Effects on Housing

Exelon Generation refuels each nuclear unit on a 24-month cycle, or about one refueling outage per year for the site. During these refueling outages, site employment increases by as many as 800 to 1000 temporary workers for 30 to 40 days. Some temporary workers are from the PBAPS vicinity whereas others come into the area for temporary stays.

Table 3.8-5 provides the number of housing units and housing unit vacancies for York and Lancaster counties for 2000, 2010 and 2015. Available housing rates from 2015 (23,078 available units in York and Lancaster counties) show that the refueling outage related increase in population would not greatly impact availability. Available housing increased 44.9 percent as compared to the year 2000 when approximately 15,931 units were available in both counties combined.

3.8.1.1.2 Economy

According to the National Association of Counties, York and Lancaster counties have recovered fully from the 2008 recession on all four indicators the report tracks: unemployment, job growth, economic output and median home prices (NACo Counties Future Lab 2017).

Both Lancaster and York counties (as York-Hanover) are designated as metropolitan statistical areas, ranking 94th and 135th out of the 382 metropolitan statistical areas in the country respectively in 2015 (BEA 2016d). Between 2005 and 2015 the all industry total Gross Domestic Product (GDP) in current dollars in the York-Hanover and Lancaster PA metropolitan statistical areas grew 2.1 percent and 3.5 percent respectively. All industry total GDP for the Metropolitan Portion of the U.S. was 3.2 percent during the same period (BEA 2016c).

Both counties are located in south-central Pennsylvania, on the western edge of the highly urbanized and industrial region extending from Boston, MA, to Washington, DC. Both Counties have ready access to domestic and international markets, with a transportation network consisting of interstate highway access to major north-south and east-west routes, trucking and rail terminals, two international airports, and two international ports.

Historically, both York and Lancaster counties’ economies were deeply rooted in agriculture. While both counties have become more economically diversified, agriculture remains an important part of the economy. In 2012, York County’s agricultural production grossed $234 million, a 10 percent increase from 2007 (USDA 2012b). Lancaster County’s agricultural production grossed more than $1.47 billion in 2012, a 37.56 percent increase from 2007 (USDA 2012a).

Employment

York County

Between 2001 and 2015, York County’s economy experienced an overall growth in the number of employees and some shifting among the sectors which lead the County in economic productivity. In 2001 there were 211,517 jobs; in 2015 this total had increased to 232,528, an increase of approximately 10 percent. In 2001, the leading sectors included manufacturing, wholesale/retail, health care, and government, in that order. By 2015, the relative importance of these industries had not shifted much, but manufacturing jobs had declined by 28 percent, retail jobs had declined by 4 percent, health care jobs had increased by 40 percent and government jobs had increased by 13 percent (BEA 2016b). These changes indicate a general minor shift in overall job categories toward white-collar occupations.

Although agriculture ranks low in York County in terms of employee numbers, agricultural production contributes substantially to the County's economy and the preservation of farmland is a priority. Farmland is discussed in detail in Section 3.1.

Lancaster County

Between 2001 and 2015, overall employment in Lancaster County increased by almost 38,000 jobs, approximately 13 percent. The leading industries were manufacturing, retail, health care, and government (in that order) in 2001. By 2015, the order of importance by industry had shifted to health care, manufacturing, retail and construction. Health care jobs had increased by 53 percent, manufacturing jobs had decreased by 26 percent, retail jobs had increased by 1 percent and construction jobs had increased by 13 percent (BEA 2016a). Similar to York County, these changes show a shift towards white-collar employment and the increases in construction jobs illustrate a housing increase generated by population growth.

Unemployment

The 2015 unemployment rate for the Commonwealth of Pennsylvania was 5.1 percent. In comparison, Lancaster and York counties had 2015 unemployment rates of 4.0 and 4.6 percent, respectively (BLS 2016a; BLS 2016b).

The PBAPS thus is an important employer, but by no means the most important economic entity in York and Lancaster counties. In 2015, Exelon Generation ranked 36th on the list of York County's top 50 employers (York County Economic Alliance 2016). Exelon Generation is not on the 2015 list of top 50 employers for Lancaster County (Disability Empowerment Center 2015).

Taxes

Exelon Generation is a significant property taxpayer, paying taxes to five taxing authorities: York County, Peach Bottom Township, Lower Chanceford Township, South Eastern School District and the Red Lion School District. Tax is based on the real estate tax revenue of the taxing authorities. Table 3.8-6 lists real estate tax revenue for the taxing authorities for the years 2002 through 2016. Payments in Addition to Tax (PATs) are also paid to some of the taxing authorities.

In 2008, Exelon Generation and the taxing authorities entered into an agreement covering tax years 2008-2012. This settlement agreement included PATs to each local taxing body to mitigate the financial impact of lower assessments in recent years. This settlement provided budgetary consistency to both the local taxing bodies and to Exelon Generation. In 2012, Exelon Generation and the taxing authorities agreed to extend the 2008-2012 settlement agreement to cover tax years 2013 to 2017. Table 3.8-7 shows taxes and PATs payments to the taxing authorities from 2013 to 2016. In 2016, payments totaling $1.45 million were made for the 2015/2016 tax year.

Taxes paid by Exelon Generation benefit local communities, supporting public services such as public education, police and fire protection, road maintenance, local recreational facilities and programs, and other municipal services (Exelon Corporation 2014).

3.8.2 Transportation

As discussed in Subsection 3.8.1, the populations of York and Lancaster counties have grown at faster rates than that of the Commonwealth of Pennsylvania as a whole, a trend that is projected to continue. Both York and Lancaster counties have Metropolitan Planning Organizations that work closely with Pennsylvania Department of Transportation (PennDOT) to develop long range transportation plans for their region.

The primary transportation route through York County is Interstate 83 (I-83), which enters the county from the north and ends in downtown Baltimore (Figure 3.0-1). Over the past 20 years, PennDOT focused on maintaining the pavement and heightening and reconstructing the bridges along this corridor. Between 1983 to 2015, PennDOT spent approximately $403 million (in 2015 dollars) on projects that added pavement and additional lanes directly on I-83, as well as interchange reconfigurations, entrance and exit ramp improvements, inline bridges, overhead bridges, signage, safety improvements and Intelligent Transportation System equipment such as closed circuit cameras and variable message boards (YCPC 2016).

Pennsylvania Highway 74 (PA 74), a north-south road, is the largest capacity highway in the immediate vicinity of PBAPS. U.S. Highway 30 (US 30) is a major east-west highway that traverses the middle of Lancaster County, about 20 miles to the northwest of PBAPS.

Employees commuting to and from PBAPS typically utilize the various paved, two-lane roads in the vicinity of the plant. Immediate road access to PBAPS is via Lay Road (State Route 2104). Lay Road intersects Flintville Road (State Route 2043) approximately 2 miles from the plant. Employees may also use Flintville Road (State Route 2043), Paper Mill Road (State Route 2024, Atom Road (State Route 2026), Broad Street Extension (State Route 2045), and State Routes 74. Employees commuting from Lancaster County use State Route 372 which crosses the Susquehanna River north of PBAPS.

Flintville Road becomes Maryland State Route 623 and connects with U.S. 1 in Maryland and is used by employees commuting from the south. PennDOT does not maintain level-of-service designations for roadways in the Commonwealth. Counts determining the average number of vehicles per day are available for selected state-maintained routes. Table 3.8-8 lists roadways in the vicinity of PBAPS and the average number of vehicles per day, as determined by PennDOT.

While the PennDOT does not compute level-of-service determinations on road capacities, anecdotal evidence from local residents and Exelon Generation employees supports characterization of the area as extremely rural, and there are no traffic-related issues.

Maryland also does not compute level of service determinations on road capacities. However, the 2015 Peak Hour Congestion Map for Harford County shows that State Highway 623 is considered uncongested (Maryland DOT 2016a).

During the EPU modifications, which were completed during four refueling outages from 2012 through 2015, additional workers ranging in number from 1,600 to approximately 4,000 were onsite. Mitigation for traffic impacts was accomplished by staggering shifts and busing workers in from offsite parking areas. As no new upgrades or refurbishment activities are currently planned due to the SLR, refueling outages during the second period of extended operation should generate only the typical additional 800 to 1,000 workers. This number of additional workers has not caused impacts to transportation requiring mitigation during past refueling outages.

3.8.3 Recreation

Conowingo Pond is used for recreational fishing by residents of both Pennsylvania and Maryland (SRBC 2006). Fishery species include largemouth and smallmouth bass, channel catfish, white crappie, bluegill, and in smaller numbers, striped bass, walleye and carp. Bass tournaments are held in the open season. Additional recreational opportunities at Conowingo Pond include boating, hiking, camping, hunting, swimming, and nature observation (SRBC 2006).

Susquehannock State Park is located approximately 2.5 miles north of PBAPS in Lancaster County. The Fishing Creek Scalpy Hollow Nature Preserve is located approximately 5 miles north (Google Earth 2016b). Susquehannock Park offers scenic overviews of Conowingo Pond, hiking trails, horseback riding trails, camping, and picnic areas (PA DCNR 2014). The Fishing Creek Nature Preserve is divided into two sections, north and south. The north portion is managed as a buffer for Fishing Creek. Hiking, fishing, and bow and arrow hunting are allowed (Lancaster Conservancy 2016a). Fishing Creek Nature Preserve South has two parking areas and a single gravel trail along Fishing Creek (Lancaster Conservancy 2016b).

The Muddy Run Recreation Center and Visitor’s Center are located approximately 5 miles north of PBAPS. The recreation center provides opportunities for camping (both tent and recreational vehicle), fishing, boating (including a boat ramp and boat rental), hiking, picnicking, and there is a playground on site (Good Sam Club 2016). Wissler’s Run is located approximately 3.5 miles north of PBAPS. Visitors can ride horses, hike, fish, hunt, birdwatch, and observe wildflowers (Lancaster Conservancy 2016c). The Lock 12 Historic Area is located approximately 5 miles northwest of PBAPS on the Susquehanna River. It is a restored lock of the Susquehanna and Tidewater Canal including a restored limekiln and sawmill. Hiking and educational signage are present (PA DCNR 2014). The Lock 15 Historical Park is located approximately 4 miles northwest of PBAPS and has picnic facilities, bank fishing, historical and interpretive panels, a gravel parking lot for 25 vehicles, two restrooms (one Americans with Disabilities Act [ADA] compliant), and access to the Mason-Dixon Trail. The Muddy Creek boat launch is adjacent to the Lock 15 area to the south. It is a 20-ft wide concrete ramp with boat docks on both sides and parking. The site also includes interpretive panels and a picnic area (Support Conowingo Dam 2016). The Cold Cabin Boat Launch is located approximately 1.5 miles northeast of PBAPS. It is a kayak boat launch with a kayak rental business (Canton Kayak Club 2016). The Dorsey Park Boat Launch is located immediately adjacent to PBAPS on the north end. The launch area has two 32-ft wide hard surface boat ramps, two docks, three charcoal grills, six benches, an interpretive panel and kiosk, a large lawn area, two portable restrooms (one ADA), and a paved parking area for 25 rigs, 30 vehicles, and two ADA parking spaces (Support Conowingo Dam 2016).

The Peach Bottom Marina is located across Conowingo Pond from PBAPS. The facility has a 25-ft wide hard surface boat ramp, docking, portable restrooms, vendor-provided boat maintenance, fueling, docking services and a paved parking area with room for 33 rigs and 17 vehicles. The Peach Bottom Kayak Launch is just southeast of the marina. The Line Creek Boat Launch is located approximately 3 miles southeast of PBAPS and it is an informal carry-in launch area with minimal parking. The Broad Creek Public Landing is approximately 5 miles south of PBAPS. It has a 14-ft wide hard surface boat ramp, a small dock, and a day use area. Onsite parking is limited to four vehicles; however, an offsite parking area for 33 vehicles with trailers is available (Support Conowingo Dam 2016).

The Mason-Dixon Trail connects the Appalachian Trail with the Brandywine Trail. Within the project area, the Mason-Dixon Trail follows the west bank of the Susquehanna River from Gifford Pinchot State Park south to Havre de Grace, Maryland (mason-dixontrail.org 2016).

Pilgrim's Oak golf course is located approximately 4.5 miles northeast of PBAPS (Google Earth 2016b). It is an 18 hole course which receives Golf Digest's 4 star rating annually (Pilgrim's Oak Golf Course 2016).

TABLE 3.8-1
PENNSYLVANIA, LANCASTER AND YORK COUNTIES POPULATION: 1990-2015

Location	1990	2000	2010	2015	Percent Change 1990 - 2000	Percent Change 2000-2010	Percent Change 2010-2015	Percent Change 1990-2015
State of Pennsylvania	11,881,643	12,281,054	12,702,379	12,779,559	3.4%	3.4%	0.6%	7.6%
Lancaster County	422,822	470,658	519,445	530,216	11.3%	10.4%	2.1%	25.4%
York County	339,574	381,751	434,972	439,660	12.4%	13.9%	1.1%	29.5%

Source: (USCB 1995; USCB 2000; USCB 2010b; USCB 2015b)

TABLE 3.8-2
PENNSYLVANIA POPULATION PROJECTIONS: 2010-2040

Location	July 1, 2010 Estimate	July 1, 2020 Projection	July 1, 2030 Projection	July 1, 2040 Projection	Percent Change 2010-2020	Percent Change 2010-2030	Percent Change 2010-2040
Commonwealth of Pennsylvania	12,711,308	13,230,170	13,759,594	14,132,588	4.1%	8.2%	11.2%
Lancaster County	520,344	559,247	602,153	641,815	7.5%	15.7%	23.3%
York County	435,586	460,514	484,497	498,246	5.7%	11.2%	14.4%

Source: (The Center for Rural Pennsylvania 2014)

TABLE 3.8-3
COUNTIES WHERE WORKERS RESIDE

Number of Workers[1]	County	State	Percent of Total Workers
362	York	PA	39.39%
278	Lancaster	PA	30.25%
89	Harford	MD	9.68%
84	Chester	PA	9.14%
41	Cecil	MD	4.46%
16	New Castle	DE	1.74%
12	Baltimore	MD	1.31%
10	Delaware	PA	1.09%
7	Howard	MD	0.76%
4	Berks	MD	0.44%
3	Anne Arundel	MD	0.33%
2	Montgomery	PA	0.22%
1	Carroll	MD	0.11%
1	Centre	PA	0.11%
1	Clarion	PA	0.11%
1	Cumberland	PA	0.11%
1	Frederick	DE	0.11%
1	Gloucester	NJ	0.11%
1	Lebanon	PA	0.11%
1	Montgomery	MD	0.11%
1	Philadelphia	PA	0.11%
1	Wise	TX	0.11%
1	Grundy	IL	0.11%

[1] Workers include permanent employees and contract personnel as of October 2016.

TABLE 3.8-4
WORKER RESIDENCE BY CITY AND COUNTY

Number of Workers[1]	City	County	State	Percent of Total Workers
89	Lancaster	Lancaster	PA	9.68%
88	Red Lion	York	PA	9.58%
84	York	York	PA	9.14%
50	Delta	York	PA	5.44%
36	Quarryville	Lancaster	PA	3.92%
34	Willow Street	Lancaster	PA	3.70%
26	Bel Air	Harford	MD	2.83%
25	Felton	York	PA	2.72%
20	Airville	York	PA	2.18%
20	Oxford	Chester	PA	2.18%
19	Elkton	Cecil	MD	2.07%
18	Dallastown	York	PA	1.96%
17	Strasburg	Lancaster	PA	1.85%
16	Lincoln University	Chester	PA	1.74%
14	Pequea	Lancaster	PA	1.52%
13	Abingdon	Harford	MD	1.41%
13	West Grove	Chester	PA	1.41%
12	Holtwood	Lancaster	PA	1.31%
12	Millersville	Lancaster	PA	1.31%
12	Street	Harford	MD	1.31%
9	Brogue	York	PA	0.98%
9	Fawn Grove	York	PA	0.98%
9	Stewartstown	York	PA	0.98%
9	Windsor	York	PA	0.98%
9	Wrightsville	York	PA	0.98%
8	New Providence	Lancaster	PA	0.87%
7	Coatesville	Chester	PA	0.76%
7	Forest Hill	Howard	MD	0.76%
7	Kennett Square	Chester	PA	0.76%
7	New Park	York	PA	0.76%
7	Rising Sun	Cecil	MD	0.76%
6	Kirkwood	Lancaster	PA	0.65%
6	Lititz	Lancaster	PA	0.65%
6	North East	Cecil	MD	0.65%
5	Havre De Grace	Harford	MD	0.54%
5	Jarrettsville	Harford	MD	0.54%
5	Mount Wolf	York	PA	0.54%
5	New Freedom	York	PA	0.54%
5	Newark	New Castle	DE	0.54%
5	Pylesville	Harford	MD	0.54%
5	West Chester	Chester	PA	0.54%
5	White Hall	Harford	MD	0.54%
4	Columbia	Lancaster	PA	0.44%
4	Conestoga	Lancaster	PA	0.44%
4	Landenberg	Chester	PA	0.44%
4	Manchester	York	PA	0.44%
4	Mount Joy	Lancaster	PA	0.44%

TABLE 3.8-4 (Cont'd)
WORKER RESIDENCE BY CITY AND COUNTY

Number of Workers[1]	City	County	State	Percent of Total Workers
4	Whiteford	Harford	MD	0.44%
4	Newark	New Castle	DE	0.44%
4	Peach Bottom	Lancaster	PA	0.44%
3	Aberdeen	Harford	MD	0.33%
3	Baltimore	Baltimore	MD	0.33%
3	Conowingo	Cecil	MD	0.33%
3	Darlington	Harford	MD	0.33%
3	Edgewood	Harford	MD	0.33%
3	Fallston	Harford	MD	0.33%
3	Glen Mills	Delaware	PA	0.33%
3	Marietta	Lancaster	PA	0.33%
3	Mountville	Lancaster	PA	0.33%
3	Parkesburg	Chester	PA	0.33%
3	Shrewsbury	York	PA	0.33%
3	Washington Borough	Lancaster	PA	0.33%
3	Wilmington	New Castle	DE	0.33%
2	Aston	Delaware	PA	0.22%
2	Bear	New Castle	DE	0.22%
2	Boothwyn	Lancaster	PA	0.22%
2	Cochranville	Chester	PA	0.22%
2	Colora	Cecil	MD	0.22%
2	Dover	York	PA	0.22%
2	East Petersburg	Lancaster	PA	0.22%
2	Gap	Lancaster	PA	0.22%
2	Garnet Valley	Delaware	PA	0.22%
2	Glen Burnie	Anne Arundel	MD	0.22%
2	Havertown	Lancaster	PA	0.22%
2	Manheim	Lancaster	PA	0.22%
2	Morgantown	Berks	PA	0.22%
2	New Castle	New Castle	DE	0.22%
2	Nottingham	Chester	PA	0.22%
2	Perryville	Cecil	MD	0.22%
2	Port Deposit	Cecil	MD	0.22%
1	Akron	Lancaster	PA	0.11%
1	Annapolis	Anne Arundel	MD	0.11%
1	Avondale	Chester	PA	0.11%
1	Belcamp	Harford	MD	0.11%
1	Chester Springs	Chester	PA	0.11%
1	Clarion	Clarion	PA	0.11%
1	Cockeysville	Baltimore	MD	0.11%
1	Denver	Lancaster	PA	0.11%
1	Downingtown	Chester	PA	0.11%
1	Drumore	Lancaster	PA	0.11%
1	East Prospect	York	PA	0.11%
1	Elizabethtown	Lancaster	PA	0.11%
1	Ephrata	Lancaster	PA	0.11%
1	Etters	York	PA	0.11%

TABLE 3.8-4 (Cont'd)
WORKER RESIDENCE BY CITY AND COUNTY

Number of Workers[1]	City	County	State	Percent of Total Workers
1	Germantown	Montgomery	MD	0.11%
1	Exton	Chester	PA	0.11%
1	Finksburg	Carroll	MD	0.11%
1	Folsom	Delaware	PA	0.11%
1	Freeland	Baltimore	MD	0.11%
1	Gilbertsville	Montgomery	PA	0.11%
1	Glen Rock	York	PA	0.11%
1	Hanover	York	PA	0.11%
1	Honey Brook	Chester	PA	0.11%
1	Jonestown	Lebanon	PA	0.11%
1	Joppa	Harford	MD	0.11%
1	Kirkwood	Lancaster	PA	0.11%
1	Lancaster	Lancaster	PA	0.11%
1	Landisville	Lancaster	PA	0.11%
1	Lewisberry	York	PA	0.11%
1	Limerick	Montgomery	PA	0.11%
1	Linwood	Delaware	PA	0.11%
1	Lutherville	Baltimore	MD	0.11%
1	Mechanicsburg	Cumberland	PA	0.11%
1	Media	Delaware	PA	0.11%
1	Middletown	Frederick	DE	0.11%
1	Morris	Grundy	IL	0.11%
1	New Cumberland	York	PA	0.11%
1	Owings Mills	Baltimore	MD	0.11%
1	Paradise	Lancaster	PA	0.11%
1	Paradise	Wise	TX	0.11%
1	Parkton	Baltimore	MD	0.11%
1	Parkville	Baltimore	MD	0.11%
1	Perry Hall	Baltimore	MD	0.11%
1	Philadelphia	Philadelphia	PA	0.11%
1	Philipsburg	Centre	PA	0.11%
1	Sinking Spring	Berks	PA	0.11%
1	Sparks	Baltimore	MD	0.11%
1	Towson	Baltimore	MD	0.11%
1	Woodbury	Gloucester	NJ	0.11%
1	Wyomissing	Berks	PA	0.11%

[1] Workers include permanent employees and contract personnel.

TABLE 3.8-5
HOUSING UNITS AND HOUSING UNITS VACANT (AVAILABLE) BY COUNTY 2000, 2010 AND 2015

	2000	2010	2015	Approximate Percentage Change 2000 - 2010	Approximate Percentage Change 2010 - 2015	Approximate Percentage Change 2000 - 2015
York County						
Housing Units	156,720	178,671	180,237	14.0%	8.7%	15.0%
Occupied Units	148,219	168,372	167,416	13.6%	-0.5%	13.0%
Vacant Units	8,501	10,299	12,821	21.2%	24.5%	50.8%
Vacant Units % of Total Units	5.40%	5.80%	7.11%	.40%	1.31%	1.71%
Lancaster County						
Housing Units	179,990	202,952	205,587	12.7%	1.3%	14.2%
Occupied Units	172,560	193,602	195,330	12.2%	0.9%	13.2%
Vacant Units	7,430	9,350	10,257	25.8%	9.7%	38.0%
Vacant Units % of Total Units	4.60%	4.10%	4.99%	-0.5%	0.89%	0.39%

Source: (Pennsylvania State Data Center 2011b; USCB 2015c; USCB 2015d)

TABLE 3.8-6
LOCAL GOVERNMENT REAL ESTATE TAX REVENUE FOR PBAPS UNITS 2 AND 3

Year	York County Real Estate Tax	South Eastern School District Real Estate Tax	Peach Bottom Township Real Estate Tax	Red Lion School District	Lower Chanceford Township
2012	$110,850,508	$27,731,185	$960,398	$48,967,727	Unavailable
2013	$120,983,495	$28,288,193	$979,235	$50,100,071	Unavailable
2014	$121,948,272	$28,913,137	$1,071,752	$49,572,975	Unavailable
2015	$122,824,563	$29,603,194	$1,081,908	$50,478,733	Unavailable
2016	$139,007,358	$30,276,444	$1,196,269	$50,703,546	$166,066.40
Approximate 2016 Peach Bottom Real Estate Taxes and PAT (% of 2016 Property Tax)	**$237,000 (0.17%)**	**$1,168,800 (3.86%)**	**$36,500 (3.05%)**	**$32,600 (0.06%)**	**$1,400 (0.84%)**

TABLE 3.8-7
PROPERTY TAXES AND PATS PAID BY EXELON TO LOCAL TAXING AUTHORITIES

Tax Year (School District/ County & Township)	School District PAT	York County PAT	Peach Bottom Township PAT	Tax Paid[1]	Total Tax & PAT
2012-2013 / 2013	$800,000	$144,000	$28,570	$469,243	$1,441,813
2013-2014 / 2014	$800,000	$144,000	$28,570	$481,197	$1,453,767
2014-2015 / 2015	$800,000	$144,000	$28,570	$491,493	$1,464,063
2015-2016 / 2016	$800,000	$144,000	$28,570	$503,644	$1,476,214
2016-2017 / 2017	$800,000	$144,000	$28,570	TBD	TBD

[1] Tax is paid to York County, South Eastern School District, Peach Bottom Township, Red Lion School District, and Lower Chanceford Township.

TABLE 3.8-8
ROADWAYS IN THE PBAPS VICINITY AND AVERAGE NUMBER OF VEHICLES PER DAY

Roadway	Average Number of Vehicles Per Day – 2014/2015	Average Number of Vehicles Per Day – 2001
State Route 74 at State Route 372	6,000[1]	4,885[3]
State Route 74 at State Route 851	5,100[1]	4,239[3]
State Route 372 from State Route 74 to Bridge	4,300[1]	3,620[3]
State Route 2024 (Paper Mill Road)	750[1]	94[3]
State Route 2026 (Atom Road)	750[1]	1,307[3]
State Route 2043 (Flintville Road)	1,200[1]	1,493[3]
State Route 2045 (Broad Street Extension)	3,000[1]	2,089[3]
State Route 2104 (Lay Road)	1,800[1]	1,749[3]
(MD) State Highway 623	1,013[2]	1,275[3]

Sources:
[1] (PennDOT 2016a)
[2] (Maryland DOT 2016b)
[3] (Exelon Generation 2001)

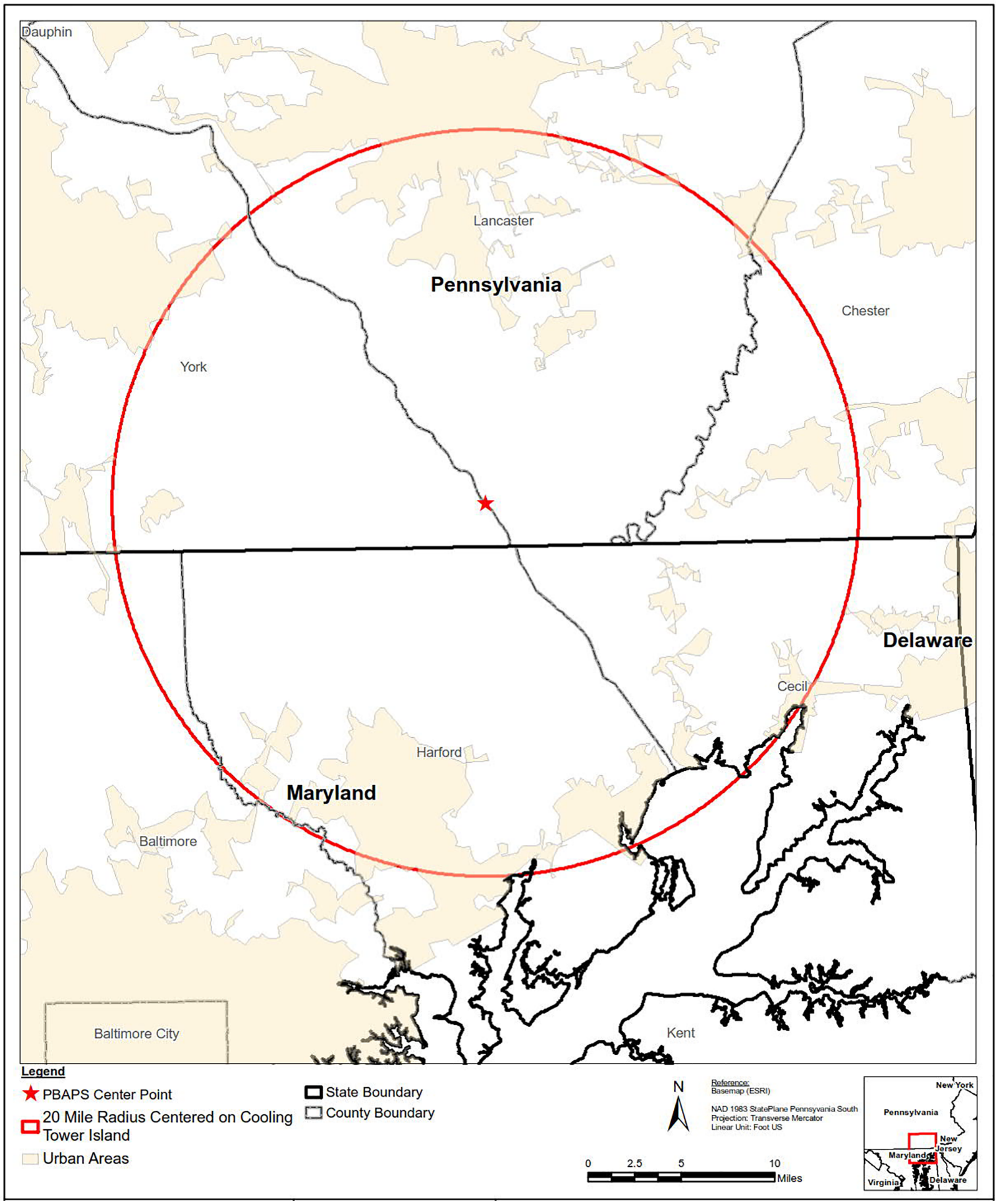


Figure 3.8-1 Counties within 20 Miles of PBAPS

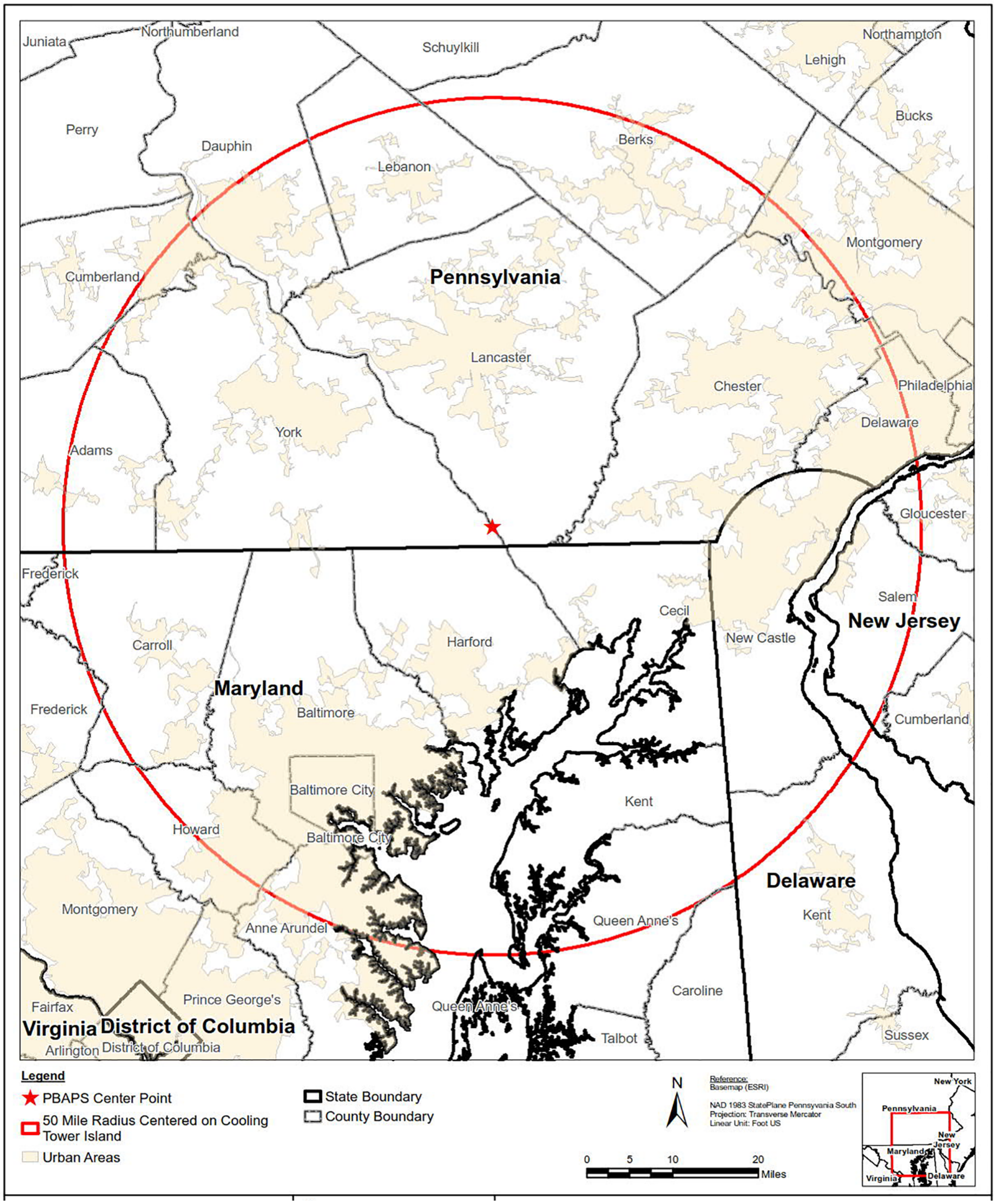


Figure 3.8-2 Counties within 50 Miles of PBAPS

3.9 HUMAN HEALTH

3.9.1 Microbiological Hazards

As discussed in Subsection 2.2.3, PBAPS continually releases cooling water from the once-through heat dissipation system to Conowingo Pond. There is public access to Conowingo Pond, including recreational fishing, boating, and vacation homes. The license renewal GEIS (NRC 2013a) discusses microbiological hazards around nuclear power plants, including background information, results of studies of microbiological hazards in cooling towers, hazards to plant workers, and hazards to members of the public. The discussion in the GEIS of specific hazards focuses on two pathogenic, thermophilic microorganisms, *Legionella* spp. and *Naegleria fowleri*, which can grow in warm waters such as those that occur at nuclear power plants in cooling towers and cooling water discharges.

Legionella bacteria, which can cause pulmonary infection and pneumonia as a result of inhalation, can be a hazard to plant workers performing maintenance in cooling towers and on condenser tubes. Plant workers cleaning condenser tubes are protected by a plant procedure that provides a standard methodology for identifying industrial hazards prior to performance of jobs. Under this procedure, possible factors that may influence safe execution of the job, including chemical and biological hazards, would be considered and appropriate worker protection measures would be designated for use during performance of the work. Exposure of members of the public to *Legionella* from PBAPS operations would not be expected because, according to the GEIS (NRC 2013a), studies at operating power plants indicate that concentrated aerosols of the bacteria would not cross the facility boundaries. Thus, there is no opportunity for *Legionella* to be sufficiently concentrated at expected exposure points to cause infection in members of the public.

Naegleria fowleri, a free-living, pathogenic amoeba that is naturally occurring in surface waters, is the cause of primary amoebic meningoencephalitis, an extremely rare disease that is usually fatal and results from nasal intake of the amoeba in water. Because it is thermophilic, *N. fowleri* can grow in heated plant effluent and become a hazard to recreational water users. A potential for exposure of recreational users may exist in Conowingo Pond in the area of the thermal plume produced by the cooling water discharge from PBAPS. Although *N. fowleri* is commonly present in warm freshwaters across the United States, infections are rare. Only 33 cases of *N. fowleri* infection involving recreational exposure to surface water were reported in the entire United States from 2006 to 2015. In Pennsylvania, reporting of cases of *N. fowleri* is not required, and the Pennsylvania Department of Health is not aware of any human *N. fowleri* infection ever occurring in the Commonwealth (Appendix C.3). The relationship between the presence of *N. fowleri* in a body of water and the occurrence of infections is unclear. The location and number of amoebae in a water body can vary over time, and there are no rapid, standardized methods for detecting and quantitating *N. fowleri* in water. For these reasons, posting of warnings is unlikely to be effective in preventing infections, (CDC 2016), and federal or state regulations requiring such measures have not been enacted.

The GEIS states that *N. fowleri* is rarely found in water cooler than 95 degrees F (35 degrees C), and infection rarely occurs at temperatures of 95 degrees F or less. However, water temperatures ranging from 95 degrees F to 106 degrees F (41 degrees C) or higher can increase its growth (NRC 2013a). As discussed in Subsection 2.2.3, a thermal study to support a CWA Section 316(a) demonstration was conducted at PBAPS from 2010 through 2013 during the warmest months, June through September. The study found that at the end of the discharge canal, the average water temperature from June 15 to September 15 was 100.2 degrees F in 2010 with no cooling towers operating (NAI and ERM 2014).

There is no public access to the discharge canal, so exposure of members of the public to thermophilic organisms could occur only in Conowingo Pond. Slightly downstream of the discharge structure in Conowingo Pond (at the two closest thermal monitoring locations, approximately 1,600 and 2,100 ft from the structure), water temperatures were approximately 6.5 to 11.5 degrees F cooler than at the end of the canal, corresponding to temperatures of 93.7 degrees F to 88.7 degrees F. Thus, during worst-case conditions in summer with no cooling towers operating, surface water temperatures were below 95 degrees F less than 1,600 ft from the discharge structure, with the warmest water in a narrow plume along the western shoreline. When one to three cooling towers were in operation, this area was further minimized (NAI and ERM 2014).

3.9.2 Electric Shock Hazards

As discussed in Subsection 2.2.4, the two PBAPS 500-kV substations are permanent parts of the overall transmission system and the points at which electricity is fed into the regional power distribution system. Accordingly, Exelon Generation concludes that the five offsite 500-kV transmission lines connected to the PBAPS substations and the two onsite 500-kV substation tie lines are not “in-scope transmission lines” as defined by footnote 4 of Table B-1 of 10 CFR Part 51, Subpart A. The “in-scope transmission lines” are as follows: (1) the two onsite 500-kV generator tie lines, one from the main power transformer of each unit to its onsite substation, (2) the 34.5-kV submarine cable that supplies offsite power to PBAPS in the event of SBO, (3) the onsite 220-kV line from the tap on the Nottingham-Cooper line to the 220/13 kV regulating transformer, (4) the onsite dedicated 13-kV line that supplies startup auxiliary power to the 13-kV startup switch gear at Bus 3SU, and (5) the onsite dedicated 13-kV line that supplies startup auxiliary power to the 13-kV startup switchgear at Bus 343SU. With the exception of the 34.5-kV submarine cable, the routes traversed by these “in-scope transmission lines” are onsite and not accessible to the general public, and electrical shock hazards are controlled on the PBAPS site in accordance with applicable industrial safety standards and plant procedures. The 34.5-kV submarine cable that supplies power in the event of SBO extends from Conowingo Dam to PBAPS. It is installed mostly underwater and underground.

3.9.3 Radiological Hazards

Some workers at PBAPS are classified as radiological workers and, depending on their work assignments, receive occupational radiation exposure. NRC regulations at 10 CFR Part 20 require that occupational radiation exposures be kept ALARA with a limit on the annual total effective dose equivalent (TEDE) for individual radiation workers of 0.05 Sieverts (5 rem) per year. Also, to assure compliance, PBAPS procedures administratively limit worker exposure to less than the NRC's regulatory limit. PBAPS is not planning to undergo refurbishment for the license renewal term, and there are no expected increases in either occupational or public radiation exposure because of license renewal. Data from NRC (NRC 2015) indicate that PBAPS occupational radiation exposures fall within the range of those for other operating BWRs.

The 3-year average (2011 to 2013) collective TEDE for PBAPS (i.e., the sum of the dose to all exposed workers) is approximately 1.96 person-Sievert (196 person-rem) per reactor. This value can be compared to the national average collective dose for all BWRs of approximately 1.3 person-Sievert (130 person-rem) for the same 3-year period (NRC 2015). Although NRC requires nuclear plants to keep collective doses ALARA, there is no regulatory limit on collective dose.

The average TEDE per PBAPS worker over this period (2011 to 2013) was 1.43 millisievert (143 millirem) compared to 1.2 millisievert (120 millirem) for all BWRs. The average TEDE per megawatt (MW) generated per year was 1.50 millisievert (150 millirem) for both PBAPS and the national average for BWRs (NRC 2015).

The PBAPS Annual Radiological Environmental Operating Reports for the years 2012 through 2016 describe the results of the REMP. The REMP includes analyses of aquatic, terrestrial, and airborne media samples, as well as ambient radiation measurements. During the five-year period, all analyses of media samples showed radioactivity at levels that were either undetectable or well within acceptable levels, and the mean ambient radiation levels were consistently at approximately 10 mR/standard month, which compares favorably with preoperational data.

3.10 ENVIRONMENTAL JUSTICE

The purpose of the environmental justice analysis is to identify and consider whether a project might cause disproportionately high and adverse human health or environmental effects on minority and low-income populations.

The NRC has performed environmental justice analyses in site-specific environmental impact statements for multiple nuclear power plant license renewals. In doing so, NRC established the use of an 80-km (50-mile) radius as the overall area that would reasonably experience potential environmental impacts for the local population. The NRC also established the state or states that have land within the 80-km (50-mile) radius of the nuclear plant seeking license renewal as the geographic area for acceptable comparative analysis. Exelon Generation has adopted this approach for identifying the PBAPS minority and low-income populations that could be impacted by activities at PBAPS.

The NRC guidance calls for use of the most recent U.S. Census Bureau decennial census data to identify minority and low-income populations. Exelon Generation used 2010 census data from the U.S. Census Bureau website to determine the percentage of the total population within the States of Delaware, Maryland, and New Jersey, and the Commonwealth of Pennsylvania for each minority category and to identify the aggregate minority populations within 50 miles of PBAPS. The 2010 Census data for race and ethnicity were compared to the ACS 5-year estimates and no significant difference was apparent. Exelon Generation used 2011-2015 ACS estimates to identify the low-income population. (The 10-year Census does not provide the necessary low-income data.) Exelon Generation used ArcView® GIS software to combine 2010 U.S. Census Bureau block group data with Environmental Systems Research Institute tract-boundary spatial data to determine the minority and low-income characteristics for the 50-mile radius around PBAPS. Exelon Generation included all block groups located wholly or partly within 50 miles of PBAPS. The 50-mile radius includes 3,967 block groups. The following sections describe the minority and low-income populations found within the 50-mile radius.

3.10.1 Minority Populations

The NRC guidance for performing environmental justice reviews defines a "minority" population as: Hispanic, Latino, or Spanish origin; American Indian or Alaskan Native; Asian; Black or African American; Native Hawaiian and Other Pacific Islander; or individuals who identified themselves on a Census form as being a member of two or more races (NRC 2013b). The guidance indicates that a minority population exists if either of the two following conditions exists:

- Exceeds 50 Percent – the minority population of an impacted area exceeds 50 percent or
- More than 20 Percent Greater – the minority population percentage of the impacted area is meaningfully greater (typically at least 20 percent) than the

minority population percentage in the geographic area chosen for comparative analysis.

Exelon Generation divided U.S. Census Bureau population numbers for each minority population within each census block group by the total population for the appropriate state to obtain the percent of the total represented by each minority. Table 3.10-1 shows the result of this calculation. Because the state percentages are low, in most cases the "more than 20 percent greater" criterion is more encompassing than the "exceeds 50 percent" criterion. For example, if 40 percent of a census block group was Hispanic, it would not contain a minority population under the "exceeds 50 percent" criterion. However, under the "more than 20 percent" criterion, such a block group in Pennsylvania would contain a minority population because a 40 percent Hispanic population exceeds the state average of 5.7 percent by more than 20 percent. Only for the aggregate minority population for Delaware, Maryland and New Jersey was the "exceeds 50 percent" criterion more encompassing.

For each of the 3,967 census block groups within 50 miles of PBAPS, Exelon Generation calculated the percent of the population in each minority category and compared the result to the corresponding threshold percent to determine whether minority populations exist. Table 3.10-1 presents the number of census tracts within each state that exceed the threshold for determining the presence of a minority population.

Based on the most encompassing criterion for each state, the most prevalent minority population is Black or African American. As shown in Table 3.10-1, Black or African American populations exist in 760 block groups: 74 in Delaware, 558 in Maryland, 6 in New Jersey, and 122 in Pennsylvania. Hispanic minority populations are the second most common and exist in 221 block groups: 23 in Delaware, 20 in Maryland, 1 in New Jersey, and 177 in Pennsylvania. Asian minority populations are found in 23 block groups: 2 in Delaware, 17 in Maryland, and 4 in Pennsylvania. No other minority populations are present in the 50-mile radius.

Figures 3.10-1 and 3.10-2 show the locations of minority populations within the 50 mile radius. Figure 3.10-1 shows the aggregate minority population block groups. The Black or African American and Hispanic minority populations tend to be concentrated in urban areas, especially in metropolitan Baltimore and Philadelphia (Figure 3.10-3).

3.10.2 Low-Income Populations

NRC guidance defines "low-income" by using U.S. Census bureau statistical poverty thresholds (NRC 2013b). The guidance indicates that a low-income population exists if either of the two following conditions exists:

- Exceeds 50 Percent – the low-income population of an impacted area exceeds 50 percent or
- More than 20 Percent Greater – the low-income population percentage of the impacted area is meaningfully greater (typically at least 20 percent) than the low-

income population percentage in the geographic area chosen for comparative analysis.

For the low-income population, the "more than 20 percent greater" criterion was the most encompassing.

Exelon Generation determined that 12 percent of Delaware, 10 percent of Maryland, 10.8 percent of New Jersey and 13.5 percent of Pennsylvania block groups are low-income based on an analysis of U.S. Census bureau, ACS 2011-2015 population estimates. Applying the NRC criteria, 469 of 3,967 census block groups contain low-income populations. Table 3.10-1 presents the numbers of census tracts within each state that exceed the threshold for determining the presence of low-income populations. The majority of block groups (235) containing low income populations are located in the Baltimore metropolitan area. The remaining block groups are located in other urban areas. Figure 3.10-3 shows the locations of the low-income populations.

3.10.3 Subsistence-Like Populations and Migrant Workers

Exelon Generation queried PBAPS staff, government organizations, and social welfare organizations to identify the existence of subpopulations near PBAPS (York and Lancaster counties) that engage in a subsistence-like lifestyle. This would include groups in which hunting, gathering, fishing, and gardening constituted a larger fraction of the subpopulations food sources than those of the general population. Several of the telephone interviewees mentioned the Amish population as a possible subsistence group. No other subpopulations were identified .

There are a number of Amish communities in the vicinity of PBAPS. Although they don't meet the definition of an environmental justice community as they are not a minority or low-income population, they were considered as part of the analysis. The Amish are known for their simple clothing, plain lifestyle, farming activities, and horse-and-buggy mode of transportation. These characteristics may be perceived by the general population as indicative of a subsistence way of life. However, about two thirds of the Amish community support themselves by working in more than 12,000 Amish-owned small businesses or non-Amish shops and factories (Kraybill et al. 2013). The Amish maintain large gardens for their own use, which may constitute a significant part of their food supply. However, they also buy many food items from traditional stores. Therefore, it was determined that they use gardening as a supplement to their food source by choice, not by necessity. The Amish hunt with guns as well as bow and arrow and often travel out of state to find the best hunting grounds. As a result of the use of gardening as a supplement to their food source, and a recreational approach to hunting, it was concluded that their lifestyle behaviors reflect a "self-sufficiency" philosophy instead of "subsistence" behavior. Other "plain-dressing communities" such as Mennonites in Lancaster and York counties have similar practices. Therefore it was concluded that no subpopulations near PBAPS engage in a subsistence-like lifestyle.

A migrant farm worker is a farm worker whose employment required travel that prevented the worker from returning to his/her permanent place of residence the same day (USDA 2014). In 2012, 46 Lancaster County farms hired a total of 162 migrant workers, and 13 York County farms hired 130 migrant workers (USDA 2014).

TABLE 3.10-1
MINORITY AND LOW-INCOME POPULATIONS WITHIN 50-MILE RADIUS

STATE/County	Total Number of Block Groups	Low-Income[1] Block Groups	Minority Block Groups[2]							
			Black or African American	American Indian or Native Alaskan	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Multiracial	Aggregate	Hispanic
Delaware	381	33	74	0	2	0	0	0	106	23
Kent	13	0	0	0	0	0	0	0	0	0
New Castle	368	33	74	0	2	0	0	0	106	23
Maryland	1,822	255	558	0	17	0	0	0	695	20
Anne Arundel	167	2	5	0	0	0	0	0	26	3
Baltimore	529	21	98	0	1	0	0	0	138	1
Baltimore City	653	215	450	0	4	0	0	0	488	14
Caroline	2	1	0	0	0	0	0	0	0	2
Carroll	101	3	1	0	0	0	0	0	0	0
Cecil	57	3	0	0	0	0	0	0	0	0
Frederick	2	0	0	0	0	0	0	0	0	0
Harford	168	7	2	0	0	0	0	0	15	0
Howard	109	1	2	0	12	0	0	0	28	0
Kent	20	2	0	0	0	0	0	0	0	0
Queen Anne	14	0	0	0	0	0	0	0	0	0
New Jersey	48	6	6	0	0	0	0	0	9	1
Cumberland	1	0	0	0	0	0	0	0	0	0
Gloucester	7	0	0	0	0	0	0	0	0	0
Salem	40	6	6	0	0	0	0	0	9	1

TABLE 3.10-1 (Cont'd)
MINORITY AND LOW-INCOME POPULATIONS WITHIN 50-MILE RADIUS

STATE/County	Total Number of Block Groups	Low-Income[1] Block Groups	Minority Block Groups[2]							
			Black or African American	American Indian or Native Alaskan	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Multiracial	Aggregate	Hispanic
Pennsylvania	1,716	175	122	0	4	0	0	0	304	177
Adams	32	0	0	0	0	0	0	0	0	0
Berks	214	43	0	0	0	0	0	0	65	65
Chester	264	12	12	0	2	0	0	0	29	18
Cumberland	66	0	1	0	1	0	0	0	2	0
Dauphin	165	24	53	0	0	0	0	0	65	11
Delaware	183	21	42	0	0	0	0	0	41	0
Lancaster	328	29	0	0	0	0	0	0	46	44
Lebanon	85	10	0	0	0	0	0	0	10	12
Montgomery	57	4	4	0	1	0	0	0	6	0
York	322	32	10	0	0	0	0	0	40	27
Total	**3,967**	**469**	**760**	**0**	**23**	**0**	**0**	**0**	**1,114**	**221**

Sources:
[1] (USCB 2015a)
[2] (USCB 2010a)

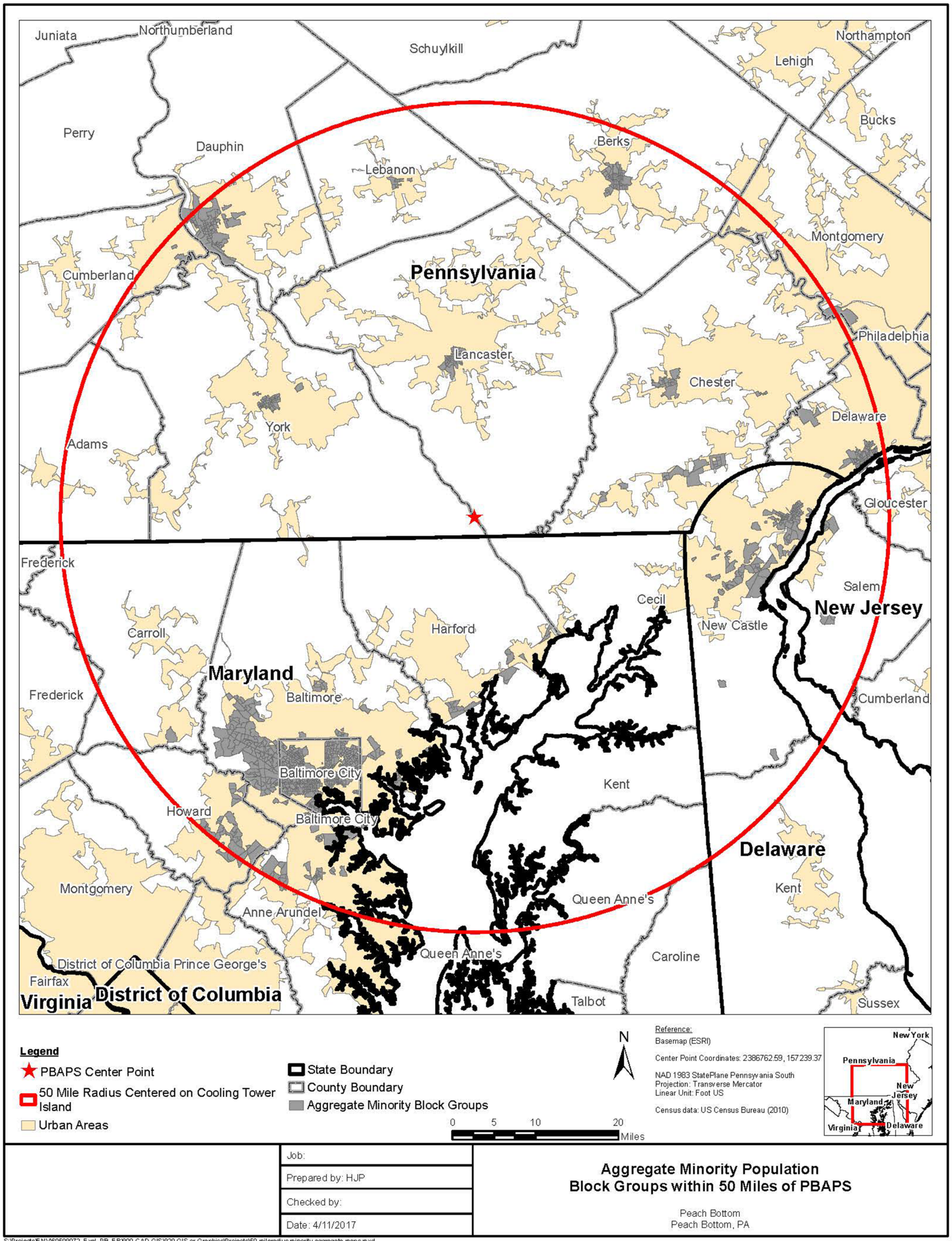


Figure 3.10-1 Aggregate Minority Population Block Groups within 50 Miles of PBAPS

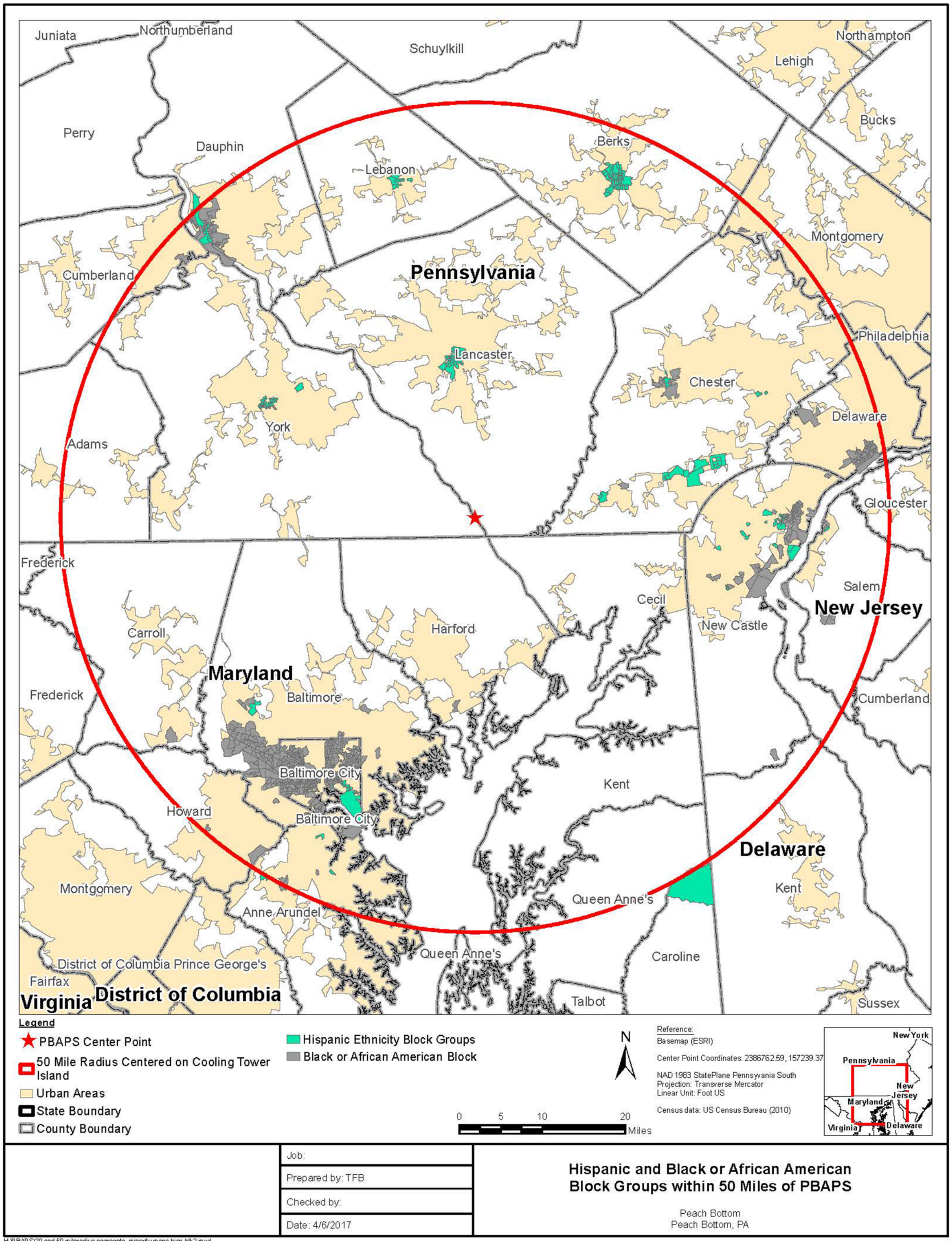


Figure 3.10-2 Hispanic and Black or African American Block Groups within 50 Miles of PBAPS

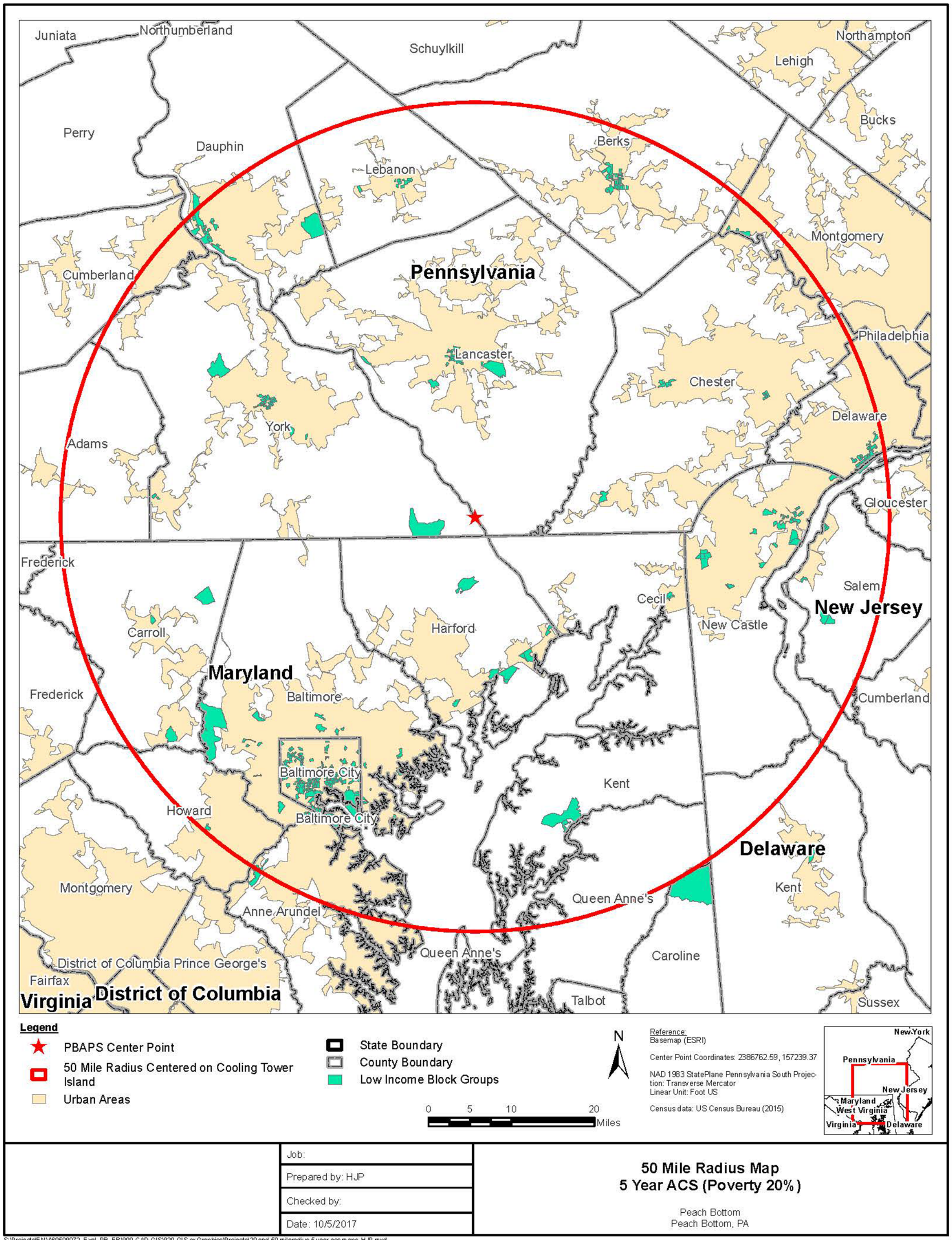


Figure 3.10-3 Low Income Block Groups within 50 Miles of PBAPS

3.11 WASTE MANAGEMENT

Subsection 2.2.5 of this Environmental Report describes the radioactive waste management systems.

Subsection 2.2.6 describes the non-radioactive waste management systems. As stated in Subsections 2.2.5 and 2.2.6, non-radioactive and radioactive wastes are all managed according to state and federal regulations, as implemented through Exelon Generation procedures.

Chapter 4

Environmental Consequences of the Proposed Action and Mitigating Actions

4.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND MITIGATING ACTIONS

NRC

"The environmental report must contain analyses of the environmental impacts of the proposed action, including the impacts of refurbishment activities, if any, associated with license renewal and the impacts of operation during the renewal term, for those issues identified as Category 2 issues in Appendix B to subpart A of this part." 10 CFR 51.53(c)(3)(ii)

"The report must contain a consideration of alternatives for reducing adverse impacts…for all Category 2 license renewal issues…." 10 CFR 51.53(c)(3)(iii)

"…The environmental report must include an analysis that considers…the environmental effects of the proposed action…and alternatives available for reducing or avoiding adverse environmental effects." 10 CFR 51.45(c) as adopted by 10 CFR 51.53(c)(3)(ii) and 10 CFR 51.53(c)(3)(iii)

The environmental report shall discuss "The impact of the proposed action on the environment. Impacts shall be discussed in proportion to their significance;" 10 CFR 51.45(b)(1) as adopted by 10 CFR 51.53(c)(2)

"The information submitted…should not be confined to information supporting the proposed action but should also include adverse information." 10 CFR 51.45(e) as adopted by 10 CFR 51.53(c)(2)

"The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." 10 CFR 51.53(c)(3)(iv)

Chapter 4 presents an assessment of the environmental consequences and potential mitigating actions associated with the renewal of the PBAPS operating licenses. Table B-1 in Appendix B to Subpart A of 10 CFR Part 51 identifies 78 issues to be evaluated in considering the impacts of license renewal. Sixty of the 78 issues are Category 1 issues. Category 1 issues are those that meet all of the following criteria:

1. The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics;
2. A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste); and
3. Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

Absent new and significant information (Chapter 5), NRC regulations do not require analyses of Category 1 issues because the NRC resolved them using the generic findings summarized in Table B-1. An applicant may reference the generic findings or GEIS analyses for Category 1 issues.

Category 2 issues are those that do not meet one or more of the criteria of Category 1, and therefore, require additional plant-specific review. Seventeen of the 78 issues were determined to be Category 2, and 1 was left uncategorized. The NRC requires plant-specific analyses of Category 2 issues.

The NRC designated the uncategorized issue (chronic effects of electromagnetic fields [EMFs]) as "NA", signifying that the categorization and impact definitions do not apply to the issue.

Exelon Generation determined that, of the 60 Category 1 issues identified in the GEIS, five do not apply to PBAPS because they apply to natural, design or operational features that do not exist at the facility. These include:

- Issue 11 - Altered salinity gradients
- Issue 24 - Groundwater quality degradation resulting from water withdrawals
- Issue 25 - Groundwater quality degradation (plants with cooling ponds in salt marshes)
- Issue 37 - Impingement and entrainment of aquatic organisms (plants with cooling towers)
- Issue 40 - Thermal impacts on aquatic organisms (plants with cooling towers)

The subsections in Chapter 4 identify the specific Category 1 issues that apply to PBAPS for each environmental resource area, and the existence of new and significant information is addressed. Also for each environmental resource area, the Category 2 issues are identified and evaluated with respect to PBAPS. For those Category 2 issues that apply to PBAPS, impacts are assessed. With the exception of historic and cultural resources and special status species, Exelon Generation has identified the significance of the impacts associated with each issue as SMALL, MODERATE, or LARGE, consistent with the NRC criteria found in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, footnote 3:

> SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.
>
> MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Consistent with the NRC guidance provided in 10 CFR Part 51, Appendix B to Subpart A, Exelon Generation has adopted the impact determinations described below for historic and cultural resources, and for federally-protected species.

The National Historic Preservation Act (NHPA) requires the NRC to consider the effects on historic properties in the vicinity of the project site and provide a reasonable opportunity for the Advisory Council on Historic Preservation to comment. If continued operation, including refurbishment, could result in adverse effects on a historic property, then the NRC must consult with the SHPO to assess mitigation. Thus, regarding historic or cultural resources, the significance of effects from license renewal, and the need for mitigation can be characterized based on a determination that (1) no historic properties are present (no effect); (2) historic properties are present, but not adversely affected (no adverse effect); or (3) historic properties are adversely affected (adverse effect) (78 FR 37281-37324; June 20, 2013). Exelon Generation has used these determinations in its conclusion of license renewal impacts to historic and cultural resources.

In complying with the ESA, NRC must consult with the USFWS if the effects of authorizing continued nuclear power plant operations, including refurbishment, would adversely affect any protected species or critical habitat for a protected species. Thus, regarding species protected under the ESA, the significance of the effects from license renewal and the need for NRC consultation with USFWS can be characterized based on a determination of whether continued nuclear power plant operations, including refurbishment, (1) would have no effect on federally-listed species, (2) are not likely to adversely affect federally-listed species, (3) are likely to adversely affect federally-listed species, or (4) are likely to jeopardize a federally-listed species or adversely modify designated critical habitat (78 FR 37281-37324; June 20, 2013). Exelon Generation has used these determinations in its conclusion of license renewal impacts to species that are federally listed, candidates for listing, or proposed for listing as threatened or endangered species.

In complying with the Magnuson-Stevens Fishery Conservation and Management Act, NRC must consult with the NMFS if the effects of authorizing continued nuclear power plant operations, including refurbishment, would adversely affect any EFH identified under the Act. Thus, regarding EFH, the significance of the effects from license renewal and the need for NRC consultation with NMFS can be characterized based on a determination of whether continued nuclear power plant operations, including refurbishment, would have (1) no adverse impact, (2) minimal adverse impact, or (3) substantial adverse impact to the essential habitat of federally managed fish populations (78 FR 37281-37324; June 20, 2013). Exelon Generation has used these determinations in its conclusion of license renewal impacts to essential habitats of federally managed fish populations.

In accordance with footnote 6 to Table B-1 in 10 CFR Part 51, Subpart A, Appendix B, the issue of chronic effects of EMFs (Issue 62), which the 2013 GEIS left uncategorized, is described without analysis in Section 4.9.

Exelon Generation adopts by reference the NRC findings of SMALL for the 55 applicable Category 1 issues because no new and significant information was found for any of them, and no further assessments of impacts associated with these Category 1 issues have been performed. Table 4.0-1 lists each applicable Category 1 issue, the corresponding NRC findings from the 2013 GEIS, and other sections in this environmental report that contain PBAPS information relevant to the issue.

TABLE 4.0-1
CATEGORY 1 ISSUES APPLICABLE TO PBAPS

CATEGORY 1 ISSUE NAME	NRC FINDING	SLR-ER SECTION
LAND USE AND VISUAL RESOURCES		
1. Onsite land use	SMALL. Changes in onsite land use from continued operations and refurbishment associated with license renewal would be a small fraction of the nuclear power plant site and would involve only land that is controlled by the licensee.	3.1.2; 4.1
2. Offsite land use	SMALL. Offsite land use would not be affected by continued operations and refurbishment associated with license renewal.	3.1.1; 4.1
3. Offsite land use in transmission line ROWs	SMALL. Use of transmission line ROWs from continued operations and refurbishment associated with license renewal would continue with no change in land use restrictions.	2.2.4; 4.1
4. Aesthetic impacts	SMALL. No important changes to the visual appearance of plant structures or transmission lines are expected from continued operations and refurbishment associated with license renewal.	3.1.3; 4.1
AIR QUALITY AND NOISE		
5. Air quality impacts (all plants)	SMALL. Air quality impacts from continued operations and refurbishment associated with license renewal are expected to be small at all plants. Emissions resulting from refurbishment activities at locations in or near air quality nonattainment or maintenance areas would be short-lived and would cease after these refurbishment activities are completed. Operating experience has shown that the scale of refurbishment activities has not resulted in exceedance of the de minimis thresholds for criteria pollutants, and best management practices including fugitive dust controls and the imposition of permit conditions in state and local air emissions permits would ensure conformance with applicable State or Tribal Implementation Plans. Emissions from emergency diesel generators and fire pumps and routine operations of boilers used for space heating would not be a concern, even for plants located in or adjacent to nonattainment areas. Impacts from cooling tower particulate emissions even under the worst-case situations have been small.	3.2; 4.2

TABLE 4.0-1 (Cont'd)
CATEGORY 1 ISSUES APPLICABLE TO PBAPS

CATEGORY 1 ISSUE NAME	NRC FINDING	SLR-ER SECTION
6. Air quality effects of transmission lines	SMALL. Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases.	2.2.4; 4.2
7. Noise impacts	SMALL. Noise levels would remain below regulatory guidelines for offsite receptors during continued operations and refurbishment associated with license renewal.	3.3; 4.3
GEOLOGY AND SOILS		
8. Geology and soils	SMALL. The effect of geologic and soil conditions on plant operations and the impact of continued operations and refurbishment activities on geology and soils would be small for all nuclear power plants and would not change appreciably during the license renewal term.	3.4; 4.4
WATER RESOURCES		
9. Surface water use and quality (non-cooling system impacts)	SMALL. Impacts are expected to be small if best management practices are employed to control soil erosion and spills. Surface water use associated with continued operations and refurbishment associated with license renewal would not increase significantly or would be reduced if refurbishment occurs during a plant outage.	2.2.3; 3.5.1; 4.5
10. Altered current patterns at intake and discharge structures	SMALL. Altered current patterns would be limited to the area in the vicinity of the intake and discharge structures. These impacts have been small at operating nuclear power plants.	2.2.3; 3.5.1; 4.5
12. Altered thermal stratification of lakes	SMALL. Effects on thermal stratification would be limited to the area in the vicinity of the intake and discharge structures. These impacts have been small at operating nuclear power plants.	2.2.3; 3.5.1.3; 4.5
13. Scouring caused by discharged cooling water	SMALL. Scouring effects would be limited to the area in the vicinity of the intake and discharge structures. These impacts have been small at operating nuclear power plants.	2.2.3; 4.5
14. Discharge of metals in cooling system effluent	SMALL. Discharges of metals have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. Discharges are monitored and controlled as part of the NPDES permit process.	2.2.3; 4.5

TABLE 4.0-1 (Cont'd)
CATEGORY 1 ISSUES APPLICABLE TO PBAPS

CATEGORY 1 ISSUE NAME	NRC FINDING	SLR-ER SECTION
15. Discharge of biocides, sanitary wastes, and minor chemical spills	SMALL. The effects of these discharges are regulated by federal and state environmental agencies. Discharges are monitored and controlled as part of the NPDES permit process. These impacts have been small at operating nuclear power plants.	2.2.3; 2.2.6; 4.5
16. Surface water use conflicts (plants with once-through cooling systems)	SMALL. These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipation systems.	3.5.1.2; 4.5
18. Effects of dredging on surface water quality	SMALL. Dredging to remove accumulated sediments in the vicinity of intake and discharge structures and to maintain barge shipping has not been found to be a problem for surface water quality. Dredging is performed under permit from the USACE, and possibly, from other state or local agencies.	2.2.3; 4.5
19. Temperature effects on sediment transport capacity	SMALL. These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem.	4.5
20. Groundwater contamination and use (non-cooling system impacts)	SMALL. Extensive dewatering is not anticipated from continued operations and refurbishment associated with license renewal. Industrial practices involving the use of solvents, hydrocarbons, heavy metals, or other chemicals, and/or the use of wastewater ponds or lagoons have the potential to contaminate site groundwater, soil, and subsoil. Contamination is subject to state or EPA regulated cleanup and monitoring programs. The application of best management practices for handling any materials produced or used during these activities would reduce impacts.	3.5.2.3; 4.5
21. Groundwater use conflicts (plants that withdraw less than 100 gpm)	SMALL. Plants that withdraw less than 100 gpm are not expected to cause any groundwater use conflicts.	3.5.2.2; 4.5
ECOLOGY (TERRESTRIAL, AQUATIC, SPECIAL STATUS SPECIES, EFH)		
29. Exposure of terrestrial organisms to radionuclides	SMALL. Doses to terrestrial organisms from continued operations and refurbishment associated with license renewal are expected to be well below exposure guidelines developed to protect these organisms.	2.2.5; 3.6.2; 4.6.1

TABLE 4.0-1 (Cont'd)
CATEGORY 1 ISSUES APPLICABLE TO PBAPS

CATEGORY 1 ISSUE NAME	NRC FINDING	SLR-ER SECTION
30. Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)	SMALL. No adverse effects to terrestrial plants or animals have been reported as a result of increased water temperatures, fogging, humidity, or reduced habitat quality. Due to the low concentrations of contaminants in cooling system effluents, uptake and accumulation of contaminants in the tissues of wildlife exposed to the contaminated water or aquatic food sources are not expected to be significant issues.	3.6.2; 4.6.1
31. Cooling tower impacts on vegetation (plants with cooling towers)	SMALL. Impacts from salt drift, icing, fogging, or increased humidity associated with cooling tower operation have the potential to affect adjacent vegetation, but these impacts have been small at operating nuclear power plants and are not expected to change over the license renewal term.	2.2.3; 3.6.2.3; 4.6.1
32. Bird collisions with plant structures and transmission lines	SMALL. Bird collisions with cooling towers and other plant structures and transmission lines occur at rates that are unlikely to affect local or migratory populations and the rates are not expected to change.	2.2.1; 2.2.4; 4.6.1
34. Transmission line ROW management impacts on terrestrial resources	SMALL. Continued ROW management during the license renewal term is expected to keep terrestrial communities in their current condition. Application of best management practices would reduce the potential for impacts.	2.2.4; 3.6.2.3.1; 4.6.1
35. EMFs on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock	SMALL. No significant impacts of EMFs on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term.	2.2.4; 4.6.1
38. Entrainment of phytoplankton and zooplankton (all plants)	SMALL. Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term.	3.6.1; 4.6.2

TABLE 4.0-1 (Cont'd)
CATEGORY 1 ISSUES APPLICABLE TO PBAPS

CATEGORY 1 ISSUE NAME	NRC FINDING	SLR-ER SECTION
41. Infrequently reported thermal impacts (all plants)	SMALL. Continued operations during the license renewal term are expected to have small thermal impacts with respect to the following: • Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem. • Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem. • Thermal discharge may have localized effects but is not expected to affect the larger geographical distribution of aquatic organisms. • Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem and is not expected to be a problem. • Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem.	2.2.3; 3.6.1; 4.6.2
42. Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication	SMALL. Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been mitigated. Low dissolved oxygen was a concern at one nuclear power plant with a once-through cooling system but has been mitigated. Eutrophication (nutrient loading) and resulting effects on chemical and biological oxygen demands have not been found to be a problem at operating nuclear power plants.	3.5.1; 4.6.2.2
43. Effects of non-radiological contaminants on aquatic organisms	SMALL. Best management practices and discharge limitations of NPDES permits are expected to minimize the potential for impacts to aquatic resources during continued operations and refurbishment associated with license renewal. Accumulation of metal contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal.	3.6.1; 4.6.2
44. Exposure of aquatic organisms to radionuclides	SMALL. Doses to aquatic organisms are expected to be well below exposure guidelines developed to protect these aquatic organisms.	2.2.5.1; 4.6.2

TABLE 4.0-1 (Cont'd)
CATEGORY 1 ISSUES APPLICABLE TO PBAPS

CATEGORY 1 ISSUE NAME	NRC FINDING	SLR-ER SECTION
45. Effects of dredging on aquatic organisms	SMALL. Dredging at nuclear power plants is expected to occur infrequently, would be of relatively short duration, and would affect relatively small areas. Dredging is performed under permit from the USACE, and possibly, from other state or local agencies.	2.2.3; 4.6.2
47. Effects on aquatic resources (non-cooling system impacts)	SMALL. Licensee application of appropriate mitigation measures is expected to result in no more than small changes to aquatic communities from their current condition.	2.2.3; 3.6.1; 4.6.2
48. Impacts of transmission line ROW management on aquatic resources	SMALL. Licensee application of best management practices to ROW maintenance is expected to result in no more than small impacts to aquatic resources.	2.2.4; 4.6.2
49. Losses from predation, parasitism, and disease among organisms exposed to sub-lethal stresses	SMALL. These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term.	3.6.1; 4.6.2
HISTORIC & CULTURAL RESOURCES		
NONE		
SOCIOECONOMICS		
52. Employment and income, recreation and tourism	SMALL. Although most nuclear plants have large numbers of employees with higher than average wages and salaries, employment, income, recreation, and tourism impacts from continued operations and refurbishment associated with license renewal are expected to be small.	3.8.1.1.2; 3.8.3; 4.8
53. Tax revenues	SMALL. Nuclear plants provide tax revenue to local jurisdictions in the form of property tax payments, payments in lieu of tax (PILOT), or tax payments on energy production. The amount of tax revenue paid during the license renewal term as a result of continued operations and refurbishment associated with license renewal is not expected to change.	3.8.1.1.2; 4.8

TABLE 4.0-1 (Cont'd)
CATEGORY 1 ISSUES APPLICABLE TO PBAPS

CATEGORY 1 ISSUE NAME	NRC FINDING	SLR-ER SECTION
54. Community services and education	SMALL. Changes resulting from continued operations and refurbishment associated with license renewal to local community and educational services would be small. With little or no change in employment at the licensee's plant, value of the power plant, payments on energy production, and PILOT payments expected during the license renewal term, community and educational services would not be affected by continued power plant operations.	3.8.1.1.2; 4.8
55. Population and housing	SMALL. Changes resulting from continued operations and refurbishment associated with license renewal to regional population and housing availability and value would be small. With little or no change in employment at the licensee's plant expected during the license renewal term, population and housing availability and values would not be affected by continued power plant operations.	3.8.1; 4.8
56. Transportation	SMALL. Changes resulting from continued operations and refurbishment associated with license renewal to traffic volumes would be small.	3.8.2; 4.8
HUMAN HEALTH (RAD AND NON-RAD HAZARDS)		
57. Radiation exposures to the public	SMALL. Radiation doses to the public from continued operations and refurbishment associated with license renewal are expected to continue at current levels, and would be well below regulatory limits.	3.9.3; 4.9
58. Radiation exposures to plant workers	SMALL. Occupational doses from continued operations and refurbishment associated with license renewal are expected to be within the range of doses experienced during the current license term, and would continue to be well below regulatory limits.	3.9.3; 4.9
59. Human health impact from chemicals	SMALL. Chemical hazards to plant workers resulting from continued operations and refurbishment associated with license renewal are expected to be minimized by the licensee implementing good industrial hygiene practices as required by permits and federal and state regulations. Chemical releases to the environment and the potential for impacts to the public are expected to be minimized by adherence to discharge limitations of NPDES and other permits.	2.2.3; 3.9.1; 4.9
61. Microbiological hazards to plant workers	SMALL. Occupational health impacts are expected to be controlled by continued application of accepted industrial hygiene practices to minimize worker exposures as required by permits and federal and state regulations.	2.2.3; 3.9.1; 4.9

TABLE 4.0-1 (Cont'd)
CATEGORY 1 ISSUES APPLICABLE TO PBAPS

CATEGORY 1 ISSUE NAME	NRC FINDING	SLR-ER SECTION
63. Physical occupational hazards	SMALL. Occupational safety and health hazards are generic to all types of electrical generating stations, including nuclear power plants, and are of small significance if the workers adhere to safety standards and use protective equipment as required by federal and state regulations.	4.9
POSTULATED ACCIDENTS		
65. Design-basis accidents	SMALL. The NRC staff has concluded that the environmental impacts of design-basis accidents are of small significance for all plants.	4.15.1
ENVIRONMENTAL JUSTICE		
NONE		
WASTE MANAGEMENT AND POLLUTION PREVENTION		
68. Low-level waste storage and disposal	SMALL. The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment would remain small during the license renewal term.	2.2.5; 4.11
69. Onsite storage of spent nuclear fuel	During the license renewal term, SMALL. The expected increase in the volume of spent nuclear fuel from an additional 20 years of operation can be safely accommodated onsite during the license renewal term with small environmental impacts through dry or pool storage at all plants. For the period after the licensed life for reactor operations, the impacts of onsite storage of spent nuclear fuel during the continued storage period are discussed in NUREG-2157 and as stated in §51.23(b), shall be deemed incorporated into this issue.	2.2.2; 4.11

TABLE 4.0-1 (Cont'd)
CATEGORY 1 ISSUES APPLICABLE TO PBAPS

CATEGORY 1 ISSUE NAME	NRC FINDING	SLR-ER SECTION
70. Offsite radiological impacts of spent nuclear fuel and high-level	For the high-level waste and spent-fuel disposal component of the fuel cycle, the EPA established a dose limit of 0.15 mSv (15 millirem) per year for the first 10,000 years and 1.0 mSv (100 millirem) per year between 10,000 years and 1 million years for offsite releases of radionuclides at the proposed repository at Yucca Mountain, Nevada. The NRC concludes that the impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the NRC has not assigned a single level of significance for the impacts of spent fuel and high level waste disposal, this issue is considered Category 1.	2.2.2; 4.11
71. Mixed-waste storage and disposal	SMALL. The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal would not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small.	2.2.5; 4.11
72. Nonradioactive waste storage and disposal	SMALL. No changes to systems that generate nonradioactive waste are anticipated during the license renewal term. Facilities and procedures are in place to ensure continued proper handling, storage, and disposal, as well as negligible exposure to toxic materials for the public and the environment at all plants.	2.2.6; 4.11
CUMULATIVE IMPACTS		
NONE		
URANIUM FUEL CYCLE		
74. Offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste	SMALL. The impacts to the public from radiological exposures have been considered by the NRC in Table S-3 of this part. Based on information in the GEIS, impacts to individuals from radioactive gaseous and liquid releases, including radon-222 and technetium-99, would remain at or below the NRC's regulatory limits.	4.13

TABLE 4.0-1 (Cont'd)
CATEGORY 1 ISSUES APPLICABLE TO PBAPS

CATEGORY 1 ISSUE NAME	NRC FINDING	SLR-ER SECTION
75. Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste	There are no regulatory limits applicable to collective doses to the general public from fuel-cycle facilities. The practice of estimating health effects on the basis of collective doses may not be meaningful. All fuel-cycle facilities are designed and operated to meet the applicable regulatory limits and standards. The NRC concludes that the collective impacts are acceptable. The NRC concludes that the impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR part 54 should be eliminated. Accordingly, while the NRC has not assigned a single level of significance for the collective impacts of the uranium fuel cycle, this issue is considered Category 1.	4.13
76. Nonradiological impacts of the uranium fuel cycle	SMALL. The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant would be small.	4.13
77. Transportation	SMALL. The impacts of transporting materials to and from uranium-fuel-cycle facilities on workers, the public, and the environment are expected to be small.	2.2.2; 4.13
TERMINATION OF PLANT OPERATIONS AND DECOMMISSIONING		
78. Termination of plant operations and decommissioning	SMALL. License renewal is expected to have a negligible effect on the impacts of terminating operations and decommissioning on all resources.	4.14

4.1 LAND USE AND VISUAL RESOURCES

The following land use and visual resources are Category 1 issues and were reviewed for new and significant information at PBAPS that could make the generic finding for a resource as described in the 2013 GEIS inapplicable:

- Issue 1 - Onsite Land Use
- Issue 2 - Offsite Land Use
- Issue 3 - Offsite Land Use in Transmission ROWs
- Issue 4 - Aesthetic Impacts

Section 3.1 describes existing onsite and offsite land use. Onsite and offsite land use changes are not anticipated during the terms of the renewed licenses. As is explained in Subsection 2.2.4, with the exception of the 34.5-kV submarine cable that supplies power from the Conowingo Dam for SBO conditions, there are no “in-scope” transmission lines in offsite ROWs. Also, the SBO line is mostly either underwater or underground, and no land use changes are expected within its route. Additionally, no new and significant information was identified regarding onsite or offsite land use. Therefore, the conclusions regarding impacts to these resources in the 2013 GEIS are considered appropriate for the PBAPS SLR, are incorporated herein by reference, and impacts to onsite and offsite land use do not need further analysis.

No refurbishment or other changes to plant structures or activities that could affect aesthetics would be associated with the license renewal for PBAPS. Additionally, no new and significant information has been identified; therefore, the conclusions regarding aesthetic impacts in the 2013 GEIS are considered appropriate for the PBAPS license renewal and further analysis is not needed.

4.2 AIR QUALITY

The following air quality resources are Category 1 issues and were reviewed for new and significant information at PBAPS that could make the generic finding for a resource as described in the 2013 GEIS inapplicable:

- Issue 5 - Air quality impacts (all plants)
- Issue 6 - Air quality effects of transmission lines

No refurbishment or changes to plant or transmission line operational activities that would change air quality effects are expected during the terms of the renewed licenses. Additionally, no new and significant information was identified. Therefore, the conclusions regarding impacts to air quality in the 2013 GEIS are considered appropriate for the PBAPS SLR, are incorporated herein by reference, and do not need further analysis. The PBAPS power transmission system is described in Subsection 2.2.4, and Section 3.2 describes air pollutant emission sources at PBAPS, as well as existing air quality in the region around PBAPS.

4.3 NOISE

The following resource is a Category 1 issue and was reviewed for new and significant information at PBAPS that could make the generic finding for the resource as described in the 2013 GEIS inapplicable:

- Issue 7 - Noise impacts

No refurbishment or changes to plant or transmission line operational activities that would change noise effects are expected during the terms of the renewed licenses. Additionally, no new and significant information was identified. Therefore, the conclusions regarding impacts from noise in the 2013 GEIS are considered appropriate for the PBAPS SLR, are incorporated herein by reference, and do not need further analysis. Section 3.3 describes the existing noise environment associated with PBAPS.

4.4 GEOLOGY AND SOILS

The following resource is a Category 1 issue and was reviewed for new and significant information at PBAPS that could make the generic finding for the resource as described in the 2013 GEIS inapplicable:

- Issue 8 - Geology and soils

No refurbishment or plant modifications are planned as a result of license renewal. The need for a geotechnical study would be evaluated if construction of new facilities or other buildings becomes necessary in the future. Additionally, no new and significant information has been identified, and changes to the existing conditions are not anticipated. Therefore, the conclusions regarding geology and soils presented in the 2013 GEIS are applicable to the PBAPS SLR terms, are incorporated herein by reference, and do not need further analysis. Section 3.4 discusses the existing geologic environment at PBAPS and the surrounding region.

4.5 WATER RESOURCES

The following are Category 1 issues related to water resources. Each was reviewed for new and significant information at PBAPS that could make the generic finding for a resource as described in the 2013 GEIS inapplicable:

- Issue 9 - Surface water use and quality (non-cooling system)
- Issue 10 - Altered current patterns at intake and discharge structures
- Issue 12 - Altered thermal stratification of lakes
- Issue 13 - Scouring caused by discharged cooling water
- Issue 14 - Discharge of metals in cooling system effluent
- Issue 15 - Discharge of biocides, sanitary wastes, and minor chemical spills
- Issue 16 - Surface water use conflicts (plants with once-through cooling systems)
- Issue 18 - Effects of dredging on surface water quality
- Issue 19 - Temperature effects on sediment transport capacity
- Issue 20 - Groundwater contamination (non-cooling system impacts)
- Issue 21 – Groundwater use conflicts (plants that withdraw less than 100 gpm)

No refurbishment or plant modifications are planned as a result of license renewal that would change effects on water resources in unanticipated ways during the terms of the renewed licenses. Additionally, no new and significant information was identified. Therefore the conclusions in the 2013 GEIS regarding impacts for these Category 1 issues are considered appropriate for the PBAPS SLR, are incorporated herein by reference, and do not need further analysis. Section 3.5 describes existing water resources in the vicinity of PBAPS.

4.5.1 Surface Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)

NRC

"If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river, an assessment of the impact of the proposed action on water availability and competing demands, the flow of the river… must be provided." 10 CFR 51.53(c)(3)(ii)(A).

"Impacts could be of small or moderate significance, depending on makeup water requirements, water availability, and competing water demands." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 17

Nuclear power plants with cooling ponds and closed-cycle cooling tower systems require makeup water to replace losses due mostly to evaporation. Although the rate of consumptive water use (chiefly evaporative losses) normally does not change over the operating life of a power plant, external circumstances and environmental conditions may change, increasing pressures on surface water supplies. For example, there may be an extended period of drought, a large population increase in the area, or an influx of industrial facilities (NRC 2013a). There could, in theory, be a change in precipitation patterns in the region. For this reason, NRC made surface water use conflicts a Category 2 issue requiring a site-specific analysis for plants utilizing cooling towers or cooling ponds and withdrawing makeup water from a river.

PBAPS does not utilize either a cooling pond or closed-cycle cooling towers that require makeup water. As discussed in Subsection 2.2.3, PBAPS operates an open-cycle, once-through circulating water system. Therefore, this issue as specified does not apply to PBAPS. However, conditions of the 2014 PBAPS NPDES permit (PA 0009733) require that during specified times and under certain circumstances as much as approximately 60 percent of the cooling water flow must be diverted through forced draft, helper (open-cycle) cooling towers for preliminary cooling prior to discharge. Consumptive use by the open-cycle system increases during times of cooling tower operation, primarily as a result of cooling tower evaporation and drift. Instream evaporation also occurs and may be reduced by cooling tower operation. Information is being provided in this section to show that use of helper (open-cycle) cooling towers by PBAPS, in accordance with the NPDES permit, does not adversely affect water availability or competing water demands.

As discussed in Subsection 2.2.3 and Subsection 3.5.1.2, water resources of the Susquehanna River Basin Watershed are managed by the SRBC. SRBC Docket No. 20061209-1, which was approved December 5, 2006 and modified June 23, 2011, authorizes PBAPS for withdrawal of up to 2,363.620 MGD from Conowingo Pond and consumptive use of up to 49.000 MGD (75.8 cfs) (SRBC 2011). This consumptive use represents approximately 0.2 percent of the 39,500 cfs average annual flow from the Susquehanna River into Conowingo Pond, as measured at the Marietta gaging station. It also represents 2 percent of the lowest seven-day average flow occurring every 10 years (the 7Q10 flow rate) of 3,785 cfs at the Marietta gaging station (Exelon Generation 2015c). This authorization was issued based on the following then-anticipated changes at PBAPS, all of which have since been implemented: (1) replacement of the low pressure turbines, (2) uprates for both units, and (3) conditions in the NPDES permit mandating operation of helper cooling towers in specified circumstances. Also, the SRBC Docket requires PBAPS to provide consumptive use mitigation during low flow conditions in the Susquehanna River through releases from Conowingo Pond or other SRBC-approved sources (SRBC 2011). Consumptive use is monitored, and mitigation implemented, through the PBAPS CUMP (URS Corporation 2012).

No refurbishment or additional plant modifications are planned in support of license renewal that would increase surface water consumptive use beyond the amounts considered by the SRBC in issuing the Docket. Since PBAPS provides consumptive use mitigation during low-flow conditions in the Susquehanna River in accordance with the SRBC Docket and will continue to comply with SRBC withdrawal and consumptive use restrictions during the life of the plant, Exelon Generation concludes that neither water availability nor competing water demands in the Conowingo Pond are adversely affected by operation of the helper (open-cycle) cooling towers. Furthermore, because PBAPS consumptive water use is restricted by SRBC to an amount that is not only well below 0.5 percent of average annual flow in the Susquehanna River, but also only approximately 2 percent of the river's 7Q10 flow rate; and because PBAPS consumptive water use represents only approximately 2 percent of total open-cycle circulating water flow, Exelon Generation concludes that operation of PBAPS Units 2 and 3 would have a SMALL impact on surface water use conflicts, and does not warrant further mitigation.

4.5.2 Groundwater Use

4.5.2.1 Groundwater Use Conflicts (Plants That Withdraw > 100 gpm)

NRC

> **"If the applicant's plant…pumps more than 100 gallons (total onsite) of groundwater per minute, an assessment of the impact of the proposed action on groundwater use must be provided." 10 CFR 51.53(c)(3)(ii)(C)**
>
> **"Plants that withdraw more than 100 gpm could cause groundwater use conflicts with nearby groundwater users.." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 22**

NRC made groundwater use conflicts a Category 2 issue because, at a withdrawal rate of more than 100 gpm, a cone of depression could extend offsite. This could deplete the groundwater supply available to offsite users, an impact that could warrant mitigation.

The issue of groundwater use conflicts at plants that pump more than 100 gpm of groundwater does not apply to PBAPS because the plant does not use more than 100 gpm of groundwater from the four wells that provide non-potable water to remote facilities, as discussed in Subsection 3.5.2.2. As Subsection 3.5.1.2.1 describes, the plant obtains all its cooling, process, and potable water from the Susquehanna River via the intake canal.

Because Exelon Generation has no plans as a result of license renewal to change operational procedures or processes that would consume groundwater, the annual average groundwater pump rates at PBAPS will not exceed 6 L/second (100 gpm) during the period of operation under the renewed licenses.

4.5.2.2 Groundwater Use Conflicts (Plants with Closed-Cycle Cooling Systems That Withdraw Makeup Water from a River)

NRC

> **"If the applicant's plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river …[t]he applicant shall…provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow." 10 CFR 51.53(3)(ii)(A)**
>
> **"Water use conflicts could result from water withdrawals from rivers during low-flow conditions, which may affect aquifer recharge. The significance of impacts would depend on makeup water requirements, water availability, and competing water demands." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 23**

The NRC made groundwater use conflicts a Category 2 issue for closed-cycle cooling systems using cooling towers and cooling ponds that withdraw makeup water from a river because consumptive use of river water could adversely affect users of the river's water, as well as aquifer recharge. This Category 2 issue addresses aquifer recharge, which is a particular concern during low-flow conditions and could result in a more severe cumulative impact to the aquifer recharge system if a river supports several to many consumptive users.

As discussed in Subsection 4.5.1, PBAPS does not utilize either a cooling pond or closed-cycle cooling towers that require makeup water. Rather, PBAPS operates an open-cycle, once-through circulating water system. Therefore, this issue as specified does not apply to PBAPS. However, conditions of the 2014 PBAPS NPDES permit (PA 0009733) require that during specified times and under certain circumstances as much as approximately 60 percent of the cooling water flow must be diverted through forced draft, helper (open-cycle) cooling towers for preliminary cooling prior to discharge. Consumptive use by the open-cycle system increases during times of cooling tower operation, primarily as a result of cooling tower evaporation and drift. Instream evaporation also occurs and may be reduced by cooling tower operation. Information is being provided in this section to show that use of helper (open-cycle) cooling towers by PBAPS in accordance with the NPDES permit does not adversely affect Susquehanna River water levels and stream flow, or the associated alluvial aquifer.

As Subsection 4.5.1 further describes, SRBC Docket No. 20061209-1 requires PBAPS to provide consumptive use mitigation during low-flow conditions in the Susquehanna River through releases from Conowingo Pond or other SRBC-approved sources (SRBC 2011). Consumptive use is monitored, and mitigation implemented, through the PBAPS CUMP (URS Corporation 2012). In addition, compared to the flow in the Susquehanna River measured at the Marietta gaging station, maximum PBAPS consumptive use allowed by the SRBC Docket represents approximately 2 percent of the 7Q10 flow, and 0.2 percent of the average annual flow. Of the total PBAPS circulating water withdrawal flow, consumptive use represents approximately 2 percent.

No refurbishment or additional plant modifications are planned to support license renewal that would increase surface water consumptive use beyond the amounts considered by the SRBC in issuing the Docket. Also, because PBAPS provides consumptive use mitigation during low-flow conditions in the Susquehanna River in accordance with the PBAPS CUMP and will continue to comply with other SRBC withdrawal and use restrictions during the life of the plant, potential impacts to Susquehanna River water levels and stream flow, as well as the associated alluvial aquifer, from PBAPS withdrawals from Conowingo Pond will be mitigated. Therefore, Exelon Generation concludes that withdrawal and consumptive use of surface water in Conowingo Pond by PBAPS Units 2 and 3 would have a SMALL impact on groundwater use conflicts, and does not warrant further mitigation.

4.5.2.3 Groundwater Quality Degradation (Plants with Cooling Ponds at Inland Sites)

NRC

"If the applicant's plant is located at an inland site and utilizes cooling ponds, an assessment of the impact of the proposed action on groundwater quality must be provided." 10 CFR 51.53(c)(3)(ii)(D)

"Inland sites with closed-cycle cooling ponds could degrade groundwater quality. The significance of the impact would depend on cooling water pond quality, site hydrogeologic conditions (including the interaction of surface water and groundwater), and the location, depth, and pump rate of water wells." 10 CFR 51, Subpart A, Appendix B, Table B 1, Issue 26.

NRC made degradation of groundwater quality a Category 2 issue because evaporation from closed-cycle cooling ponds concentrates dissolved solids in the water and settles suspended solids. In turn, seepage into the water table aquifer from the cooling pond could degrade groundwater quality. The issue of groundwater degradation from closed-cycle cooling ponds does not apply to PBAPS because the plant does not use cooling ponds. As Subsection 3.5.1.2.1 describes, PBAPS uses a once-through cooling system with helper (open-cycle) cooling towers.

4.5.2.4 Radionuclides Released to Groundwater

NRC

> **"An applicant shall assess the impact of any documented inadvertent releases of radionuclides into groundwater. The applicant shall include in its assessment a description of any groundwater protection program for the site, including a description of any monitoring wells, leak detection equipment, and procedures for the surveillance of piping and components containing radioactive liquids for which a pathway to groundwater may exist. The assessment must also include a description of any past inadvertent releases… and the projected impact to the environment during the license renewal term, including the projected transport pathways, potential receptors (e.g., aquifers, rivers, lakes, ponds, ocean) and the projected concentrations of the radionuclides." 10 CFR 51.53(c)(3)(ii)(P)**
>
> **"Leaks of radioactive liquids from plant components and pipes have occurred at numerous plants. Groundwater protection programs have been established at all operating nuclear power plants to minimize the potential impact from any inadvertent releases. The magnitude of impacts would depend on site-specific characteristics." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 27**

The NRC made the release of radionuclides to groundwater a Category 2 issue because inadvertent releases to groundwater of liquids containing radioactive materials have occurred at some nuclear power plants.

As discussed in Subsection 3.5.2.3, Exelon Generation participates in the NEI industry initiative to protect groundwater (NEI 07-07 "Industry Groundwater Protection Initiative - Final Guidance Document"). As part of that initiative, PBAPS has implemented an active program to monitor for and mitigate the potential for radiological releases to groundwater. Under this program, PBAPS informs the NRC, state agencies and local officials of unintended releases of radiological materials to groundwater which meet specified reporting criteria. PBAPS also follows the principles of the NEI 09-14, "Guideline for the Management of Underground Piping and Tank Integrity," which describes a program to monitor, inspect and improve buried piping and tank systems to prevent future unintended releases of radioactive materials to groundwater.

Exelon Generation operates a RGPP, with results reported at each of its nuclear power stations along with the Annual Radiological Environmental Operating Report for the station. The RGPP was implemented at PBAPS in 2006 with a baseline hydrogeologic investigation that included the installation and sampling of 14 monitoring wells, as well as sampling of seven surface water locations and three groundwater seeps. Since 2006, the RGPP at PBAPS has been modified to include 31 permanent monitoring wells, as well as three surface water sample locations, three groundwater seeps, two yard drain sumps, and six precipitation water sampling locations. The sampling locations and tritium concentrations in key wells as measured on November 30, 2016 are shown in Figure 4.5-1 (Teledyne Brown 2017).

A tritium plume was identified through the PBAPS RGPP sampling conducted in 2006, with tritium detected in monitoring well MW-PB-4 located north of the Unit 3 Circulating Water Pump Structure and MW-PB-12 located north of the Administration Building. Leaks within the Unit 3 Turbine Building seeped through the degraded floor seams to groundwater. The floor seams were repaired in August 2010, and the floor in the building was sealed and recoated in October 2011. The extent of the plume was delineated through the installation and sampling of additional wells. Tritium activity in wells MW-PB-24, MW-PB-25, MW-PB-26, and MW-PB-27 directly east of and adjacent to the Unit 3 Turbine Building ranged from 33,500 to 196,000 pCi/L in 2010. Tritium activity in monitoring wells MW-PB-29, MW-PB-30, and MW-PB-31 located to the east and southeast of, and adjacent to, the Unit 2 Turbine Building ranged from less than the MDC to 841 pCi/L in 2011. The tritium plume extended eastward in the direction of groundwater flow, and was documented to not extend offsite to the north or south (Teledyne Brown 2016).

Based on PBAPS RGPP annual sampling as of January 2015, tritium activity in MW-PB-25 was 8,890 pCi/L, and tritium activity in wells MW-PB-24, MW-PB-26, and MW-PB-27 ranged from less than MDC to 602 pCi/L (Teledyne Brown 2016).

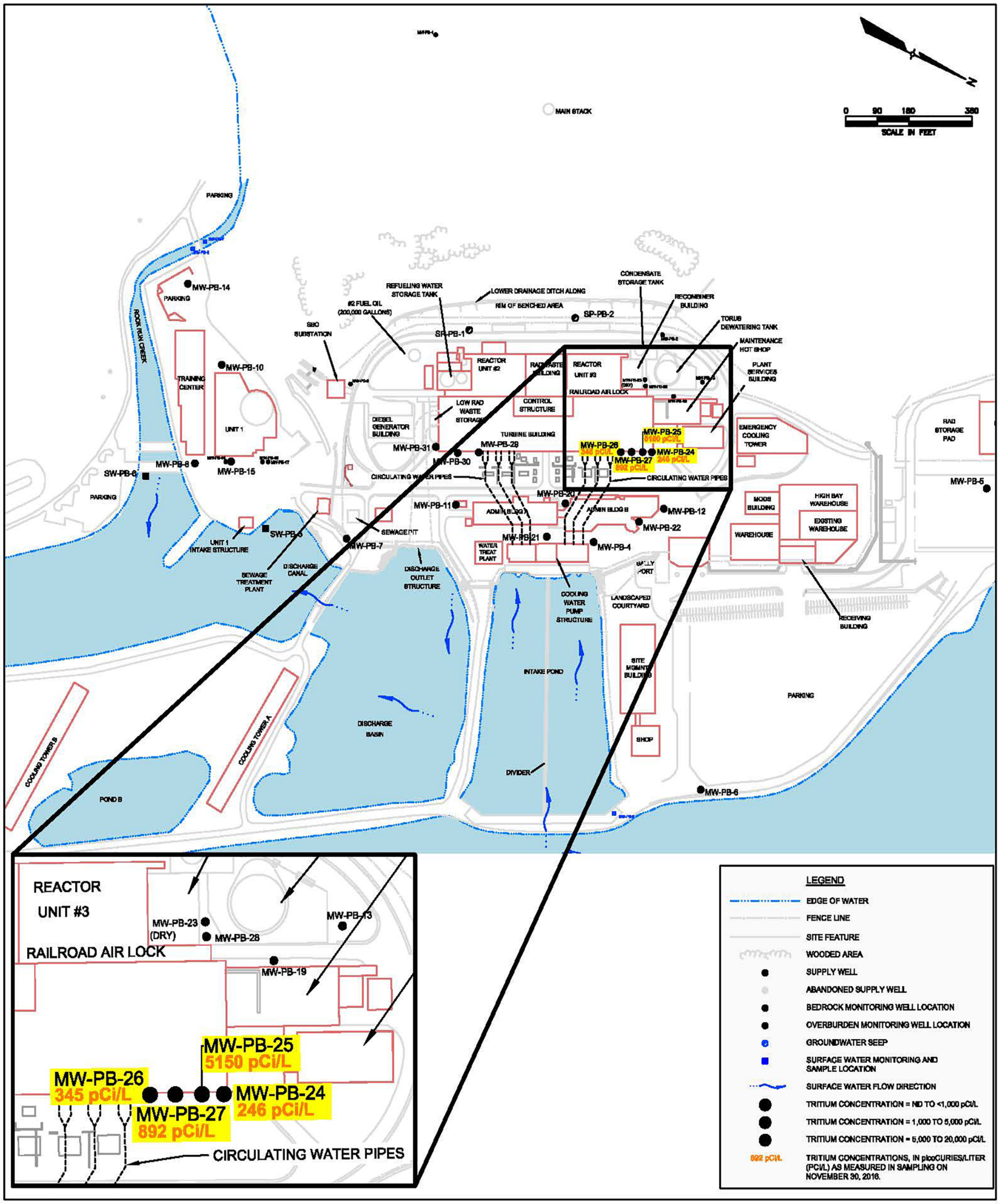
In April 2015, an inadvertent release of licensed material resulted in an increase in tritium activity in wells MW-PB-24, MW-PB-25, MW-PB-26, and MW-PB-27. In a sample obtained on April 7, 2015, tritium activity in MW-PB-25 was 37,700 pCi/L. Tritium activity in wells MW-PB-24, MW-PB-26, and MW-PB-27 ranged from 841 to 2,500 pCi/L. The elevated activity in well MW-PB-25 was confirmed in sampling conducted on April 17, 2015. Voluntary informal communications of these results were provided to the NRC, Pennsylvania Bureau of Radiation Protection, American Nuclear Insurers, and the NEI before the end of the next business day, within the time limit specified in Exelon Generation procedures (Teledyne Brown 2016).

An investigation concluded that the source of the April 2015 release was due to a raised floor drain that allowed condensed steam to pool on the Unit 3 Turbine Building Moisture Separator Area floor. After modifications to the floor drain to avoid pooling, the wells exhibited decreasing or steady trends throughout the remainder of 2015. No tritium was detected in surface water or precipitation samples (Teledyne Brown 2016).

The trend in tritium concentrations has been decreasing or steady since the event in April 2015. In 2016, the tritium concentrations ranged from 181 pCi/L to 11,000 pCi/L, all below the EPA drinking water standard and NRC reporting limit of 20,000 pCi/L. By the sampling event on November 30, 2016, the tritium concentrations measured in the wells of primary interest (MW-PB-24, 25, 26 and 27) had decreased to 246; 5,150; 345; and 892 pCi/L, respectively. Tritium was not detected in wells at or near the owner-controlled boundary, or in any surface water samples, indicating that it is not migrating off the station property at detectable concentrations (Teledyne Brown 2017).

Based on results of the RGPP monitoring, Exelon Generation concludes that the occurrence of radionuclides in the groundwater beneath PBAPS is not adversely affecting offsite groundwater because groundwater that has detectable tritium flows into the plant intake and eventually into the discharge canal, where it is diluted to negligible levels. Thus, continued operation of PBAPS would not increase the concentrations of radionuclides in offsite groundwater because the existing plume does not extend offsite, and tritium activity decreased rapidly in 2015 following corrective action to the floor drain.

In the future, PBAPS will continue implementing the principles of NEI 09-14, “Guideline for the Management of Buried Piping Integrity,” to monitor, inspect and improve buried piping and tank systems. Additionally, the RGPP will continue providing early detection if a leak should occur, which makes timely mitigation and notifications possible, when appropriate. Therefore, renewal of the PBAPS operating licenses would have a SMALL impact on groundwater contamination and further mitigation is not warranted.



Source: (Conestoga-Rovers & Associates 2012; Teledyne Brown 2017)

Figure 4.5-1 Tritium Concentrations in Groundwater on November 30, 2016

4.6 ECOLOGICAL RESOURCES

4.6.1 Terrestrial Resources

The following Category 1 issues related to terrestrial resources were reviewed for new and significant information at PBAPS to determine if such information could make inapplicable the generic finding for the issue as described in the 2013 GEIS:

- Issue 29 - Exposure of terrestrial organisms to radionuclides;
- Issue 30 - Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)
- Issue 31 - Cooling tower impacts on vegetation (plants with cooling towers)
- Issue 32 - Bird collisions with plant structures and transmission lines
- Issue 34 - Transmission line ROW management impacts on terrestrial resources
- Issue 35 - EMFs on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)

No new and significant information was identified; therefore, the conclusions regarding impacts for these Category 1 issues in the 2013 GEIS are considered appropriate for the PBAPS SLR, are incorporated herein by reference, and impacts for these Category 1 issues do not need further analysis. Subsection 3.6.2 describes terrestrial ecological resources in the vicinity of PBAPS.

4.6.1.1 Effects on Terrestrial Resources (Non-Cooling System Impacts)

NRC

The environmental report must contain an assessment of "…the impact of refurbishment, continued operations, and other license renewal related construction activities on important plant and animal habitats." 10 CFR 51.53(c)(3)(ii)(E)

"Impacts resulting from continued operations and refurbishment associated with license renewal may affect terrestrial communities. Application of best management practices would reduce the potential for impacts. The magnitude of impacts would depend on the nature of the activity, the status of the resources that could be affected, and the effectiveness of mitigation." 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 28

Non-cooling system impacts to terrestrial resources could result from refurbishment or from activities such as landscape maintenance and infrastructure upgrades. The NRC made non-cooling system impacts to terrestrial resources a Category 2 issue because the significance of impacts on terrestrial habitats and wildlife would depend on site-specific factors (NRC 2013a). Aspects of the site and project to be ascertained are: (1) the nature of refurbishment or other license renewal activities, (2) the identification of important ecological resources, and (3) the extent of impacts to terrestrial plant and animal habitats.

No refurbishment or changes to plant or transmission line operational activities that would change effects on terrestrial resources are expected to occur during operation under the renewed licenses. Wildlife and plant species on the developed parts of the PBAPS property are common species adapted to industrial sites and able to tolerate industrially generated noise and human activity. The characteristics of terrestrial communities on less developed parts of the property have been influenced by years of PBAPS operations and maintenance activities occurring in close proximity. Undeveloped areas of the plant property have been disturbed historically by activities such as logging and farming, with the possible exception of the steeper slopes where such land uses were not practicable.

Subsection 3.6.2 describes the existing terrestrial communities on the PBAPS property. No known sensitive terrestrial habitats exist within the PBAPS property boundaries, and operations and maintenance activities during the license renewal term are expected to be similar to current activities. Furthermore, existing procedures provide a process for screening proposed activities to determine if further evaluation for environmental impacts and risk is needed. Pursuant to this process, applicable environmental requirements, if any, are identified for each proposed activity, and as needed, mitigation measures are considered. As a result, current operations and maintenance have small impacts on terrestrial resources. Therefore, Exelon Generation concludes that continued operations and maintenance activities associated with non-cooling systems would have SMALL impacts on terrestrial resources and warrant no additional mitigation measures.

4.6.1.2 Water Use Conflicts with Terrestrial Resources (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)

NRC

> **"If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river, an assessment of the impact of the proposed action on water availability and competing water demands, the flow of the river, and related impacts on…riparian (terrestrial) ecological communities must be provided." 10 CFR 51.53(c)(3)(ii)(A)**
>
> **"Impacts on terrestrial resources in riparian communities affected by water use conflicts could be of moderate significance." 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 33**

This issue pertains to the effects of water use conflicts on terrestrial resources in riparian communities. It applies to nuclear power plants with cooling ponds or cooling towers, typically with high levels of consumptive use, and that use makeup water from a river. Water use conflicts with terrestrial resources in riparian communities could occur when water that supports these resources is diminished either because of droughts; increased water demand for agricultural, municipal, or industrial usage; or a combination of such factors. Because water use circumstances vary from site to site, the NRC concluded that the impact of water use conflicts with riparian communities is a site-specific, Category 2 issue (NRC 2013a).

As discussed in Subsection 4.5.1, PBAPS does not utilize either a cooling pond or closed-cycle cooling towers that require makeup water. Rather, PBAPS operates an open-cycle, once-through circulating water system. Therefore, this issue as specified does not apply to PBAPS. However, during specified times and under certain circumstances as much as approximately 60 percent of the cooling water flow must be diverted through forced draft, helper (open-cycle) cooling towers for preliminary cooling prior to discharge, which results in some consumptive use. Subsection 4.5.1 discusses the impacts to Conowingo Pond and the Susquehanna River from the station's consumptive water use. Subsection 4.5.1 explains that the SRBC manages water resources and limits water-use conflicts within the Susquehanna River Basin Watershed through comprehensive planning and coordination with three states and the federal government. The SRBC Docket for PBAPS requires the station to provide consumptive use mitigation during low-flow conditions in the Susquehanna River through releases from Conowingo Dam or other SRBC-approved sources. Because PBAPS provides this mitigation, withdrawals of surface water for the operation of PBAPS Units 2 and 3 would have a minimal impact on surface water use conflicts. Similarly, impacts to riparian ecological communities around Conowingo Pond and along the Susquehanna River would be small, if discernible, even in low-flow conditions. These communities have adapted to the normally fluctuating water levels and flow conditions of the river. As discussed in Subsection 3.6.2, wildlife species in the vicinity of the PBAPS site are those typically found in similar habitats in southern Pennsylvania. Wildlife and plant species in the site vicinity are not restricted to or dependent on the riparian communities around Conowingo Pond.

In conclusion, withdrawal of water from Conowingo Pond for PBAPS use has almost no effect on river flow or elevation. Impacts on riparian communities would be SMALL over the license renewal term and would require no mitigation measures beyond those already in place.

4.6.2 Aquatic Resources

The following Category 1 issues related to aquatic resources were reviewed for new and significant information at PBAPS to determine if such information could make inapplicable the generic finding for the issue as described in the 2013 GEIS:

- Issue 38 - Entrainment of phytoplankton and zooplankton
- Issue 41 - Infrequently reported thermal impacts
- Issue 42 - Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication
- Issue 43 - Effects of non-radiological contaminants on aquatic organisms
- Issue 44 - Exposure of aquatic organisms to radionuclides
- Issue 45 - Effects of dredging on aquatic resources

- Issue 47 - Effects on aquatic resources (non-cooling system impacts)
- Issue 48 - Impacts of transmission line ROW management on aquatic resources
- Issue 49 - Losses from predation, parasitism, and disease among organisms exposed to sub-lethal stresses

No new and significant information was identified; therefore, the conclusions regarding impacts for these Category 1 issues in the 2013 GEIS are considered appropriate for the PBAPS SLR, are incorporated herein by reference, and impacts for these Category 1 issues do not need further analysis.

Section 3.6 describes aquatic ecological resources in the vicinity of PBAPS.

4.6.2.1 Impingement and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

NRC

> **"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations…or equivalent State permits and supporting documentation. If the applicant cannot provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from…impingement and entrainment." 10 CFR 51.53(c)(3)(ii)(B)**
>
> **"The impacts of impingement and entrainment are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems, depending on cooling system withdrawal rates and volumes and the aquatic resources at the site." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 36**

The NRC made impacts to fish and shellfish from impingement and entrainment a Category 2 issue because it could not assign a single significance level to the issue for all nuclear power plant sites. The impacts of impingement and entrainment are small at many plants, but they may be moderate or large at others, depending on location, design, and capacity of the plant's cooling water intake structure.

Because Section 316(b) of the CWA requires that cooling water intake structures reflect the BTA for minimizing adverse environmental impacts (33 USC 1326), the NRC requires license renewal applicants to demonstrate the significance level of impingement and entrainment impacts by providing current CWA Section 316(b) determinations and supporting documentation, or alternatively by providing site-specific assessments of impingement and entrainment impacts.

In connection with initial licensing, the NRC issued Environmental Technical Specifications for PBAPS that required samples of impinged fishes to be collected during four 12-hr periods a week for three months at Unit 2 after its commercial operation began in June 1974. PBAPS performed the required impingement sampling for Unit 2 as well as entrainment sampling. Upon fulfillment of the condition, however, PBAPS continued impingement and entrainment sampling at Unit 2. The sampling program was extended to Unit 3 upon its start of commercial operation, and the program continued at both PBAPS units until March 1979. It was stopped because the NRC informed Exelon Generation (as PECO) in a letter dated July 26, 1978, that the studies of impingement and entrainment were being removed from the PBAPS Environmental Technical Specifications for the following reasons (RMC 1979):

(1) "The objectives of the special study have been satisfied" and the results indicated that "impingement impact is insignificant", and

(2) The objectives of the entrainment study "have been satisfied" and the "impact of entrainment is less than that suggested in the FES."

In June 1977, Exelon Generation (as PECO) submitted a CWA Section 316(b) Demonstration to the EPA in accordance with the "Special Conditions: Environmental Studies" provision of NPDES Permit PA0009733, issued December 31, 1976 and revised April 11, 1977 (PECO 1977). The CWA Section 316(b) Demonstration stated that no significant detrimental effects had occurred in the population of organisms in Conowingo Pond between the pre- and the post-operational periods of study as a result of PBAPS Units 2 and 3 operation. The CWA Section 316(b) Demonstration concluded that: "the intake structure at Peach Bottom reflects the best technology available for minimizing adverse environmental effects" (PECO 1977).

No further entrainment or impingement studies were conducted at PBAPS for the purpose of CWA Section 316(b) compliance until after the EPA's CWA Section 316(b) Phase II rule became effective on September 7, 2004 (69 FR 41576 – 41693; July 9, 2007). Even so, in most years beginning with 1982, as part of the American shad restoration program, impingement of emigrating juvenile American shad has been monitored at the PBAPS outer intake. In addition, Exelon Generation performed fish sampling in Conowingo Pond during 1996 to 1999 in support of thermal studies.

On June 10, 2005, Exelon Nuclear submitted to the PADEP a Proposal for Information Collection, as required by the CWA Section 316(b) Phase II rule (Exelon Nuclear 2005), which applies to existing electric power plants. The Proposal included impingement sampling to be performed over one 24-hr sampling event per week at each outer screenhouse over a one-year period. The CWA Section 316(b) Phase II rule did not require additional entrainment studies for PBAPS. Prior to action by PADEP on the Exelon Nuclear Proposed Information Collection, the 2nd Circuit U.S. Court of Appeals remanded the CWA Section 316(b) Phase II rule in 2007. As a result, the EPA suspended the rule and instructed state agencies to use Best Professional Judgment, in accordance with 40 CFR 125.90(b), to determine BTA for cooling water intake structures at existing power plants based on cost and benefit analyses (72 FR 37107–37109; July 9, 2007).

After the EPA suspended the CWA Section 316(b) Phase II rule, PADEP issued letters to facility owners directing them to submit information about the source water body, intake structure design and operation, an impingement mortality characterization study, and a Design and Construction Technology Plan. By letter dated December 22, 2008, Exelon Generation submitted the required information (Exelon Nuclear 2008). PADEP issued a renewed NPDES permit on November 30, 2010 (PADEP 2010), which acknowledged prior submittal of intake structure, source water body, and impingement information for PBAPS, and also established a requirement for conducting an entrainment characterization study. To address this requirement, Exelon Generation conducted entrainment sampling from March through September 2012 in accordance with an approved plan (PADEP 2011), and a report was submitted to PADEP in March 2013 (NAI 2013b).

In August 2014, the EPA published updated final regulations to implement Section 316(b) of the CWA for existing facilities (79 FR 48299; August 15, 2014). The updated rule established a list of “fragile species,” which are species that have an impingement survival rate less than 30 percent even when the BTA of modified traveling screens are in operation. The currently effective NPDES permit issued September 22, 2014 lists conditions with which PBAPS must comply during the permit’s term to meet BTA standards for the cooling water intake structure, including protection of “fragile species”. The following are the conditions that address impingement and entrainment:

A. The PBAPS cooling water intake structures must meet BTA standards for impingement mortality by employing one of the alternatives in 40 CFR §125.94(c)(1) through (c)(7). Additional measures may be required to protect federal or state threatened and endangered species and fragile species.

B. The PBAPS cooling water intake structures must meet BTA standards for entrainment which will be established by DEP on a site-specific basis after consideration of relevant factors in 40 CFR §125.98 and information in the subsequent permit application as required in §122.21(r)(9)(10)(11) (12) and (13).

The subsections below describe the results of pertinent studies conducted over the years for the purpose of compliance with CWA Section 316(b).

4.6.2.1.1 Impingement

Impingement studies conducted from 1973 through 1976 at Units 2 and 3 (URS Corporation 2008) recorded the following results. Unit 2 recorded 37 species impinged, while Unit 3 recorded 35 species impinged. Impingement was dominated by channel catfish, white crappie, and bluegill. Most impinged individuals were less than 120 millimeters in length, indicating impingement primarily occurred to juvenile and age-1 individuals. Studies indicated impingement rates for the most abundant species peaked between November and March. High impingement events were also correlated with exceptionally high river flow events (URS Corporation 2008).

Studies at PBAPS, which have been conducted during the fall of season of most years since 1982, to assess the impingement of out-migrating juvenile American shad and river herring (alewife & blueback herring) indicate that juvenile American shad in the Susquehanna River above Conowingo Dam are from two sources: natural reproduction of adult spawners and hatchery stockings of larvae (fry) produced in facilities operated by the PFBC or USFWS. In 1999, approximately 95 percent of the juveniles examined were produced in hatcheries (Susquehanna River Anadromous Fish Restoration Committee 2000).

In 1999, intake screens at PBAPS were examined three times weekly from October 18 through December 20 (23 sample dates). More than 5,000 fish were impinged, including 285 juvenile (young-of-the-year) American shad, 112 juvenile blueback herring, and 2 adult blueback herring (Susquehanna River Anadromous Fish Restoration Committee 2000).

Numbers of American shad impinged in the fall of 1999 were very small compared to the number of American shad fry and fingerlings stocked in the Susquehanna River and its tributaries during the previous summer (14,400,000 fry were stocked in May and June 1999) (Susquehanna River Anadromous Fish Restoration Committee 2000). Numbers of American shad and blueback herring impinged were very small compared to the numbers of spawning adults captured and passed at the Conowingo Dam in the spring of 1999 (69,712 American shad and 130,625 blueback herring), particularly when the reproductive potential of these species is taken into consideration (Susquehanna River Anadromous Fish Restoration Committee 2000). Depending on size, age, and condition, each American shad female produces an average of 250,000 eggs. Each blueback herring female produces an average of 80,000 eggs.

Based on 1999 studies, American shad and blueback herring impingement at PBAPS represent a very small percentage of the total number of outmigrating juvenile and adult fish. These losses are not sufficiently high to adversely affect Susquehanna River shad and river herring populations and do not represent a threat to ongoing anadromous fish restoration efforts. Based on data from 1997 and 1999, 82 (1999) to 98 (1997) percent of all fish impinged at PBAPS have been gizzard shad. Because this is a fast-growing species with high reproductive potential, impingement losses would have no discernible effect on the Conowingo Pond gizzard shad population.

Additional impingement characterization studies were conducted from August 2005 through November 2006 (URS Corporation 2008). The vast majority of impingement was composed of young gizzard shad (87 percent) (URS Corporation 2008). Other considerably impinged species included bluegill (6.9 percent) and channel catfish (4.1 percent) (URS Corporation 2008). Gizzard shad impingement primarily occurred from October through December. Most impinged gizzard shad were either dead or moribund when water temperatures were less than 45 degrees F (Exelon Nuclear 2008). Other notable species impinged included walleye and American shad, which composed approximately 0.4 percent and 0.3 percent of impingement, respectively (Exelon Nuclear 2008).

Additionally, as part of a collaborative effort with the Susquehanna River American shad restoration program and PFBC, impingement samples have been collected annually during the historical American shad outmigration period in October through November (NAI 2010a; NAI 2011a; NAI 2012a; NAI 2013a; NAI 2014a; NAI 2015a). Samples collected between 2010 and 2015 were dominated overall by gizzard shad (71.8 percent) and bluegill (25.3 percent) (NAI 2010a; NAI 2011a; NAI 2012a; NAI 2013a; NAI

2014a; NAI 2015a). Other species consistently impinged in noteworthy numbers were channel catfish. Species such as alewife, white perch, green sunfish have been impinged in noteworthy numbers inconsistently (NAI 2010a; NAI 2011a; NAI 2012a; NAI 2013a; NAI 2014a; NAI 2015a).

The updated final regulations to implement Section 316(b) of the CWA for existing facilities established a list of "fragile species," which are species that have an impingement survival rate less than 30 percent even when the BTA of modified traveling screens are in operation. The impingement data from PBAPS demonstrate that the majority of impinged fish are of "fragile species." These species include gizzard shad, alewife, and American shad (URS Corporation 2008; NAI 2010a; NAI 2011a; NAI 2012a; NAI 2013a; NAI 2014a; NAI 2015a). Gizzard shad, the dominant taxa in all impingement, is also considered an invasive species and any reduction in their stock may be considered a benefit.

4.6.2.1.2 Entrainment

An entrainment characterization study was completed at PBAPS between March 8 and September 27, 2012 (NAI 2013b). The average densities over the course of the study demonstrated a clear dominance of entrainment by gizzard shad (76 percent) (NAI 2013b). Entrained gizzard shad lifestages included eggs, yolk-sac larvae, and post yolk-sac larvae (NAI 2013b). Other taxa entrained (>1 percent) included tessellated darter (7.8 percent) and banded darter (1.2 percent) (NAI 2013b). Overall, results were consistent with known fish species composition of Conowingo Pond and prior entrainment and ichthyoplankton studies.

4.6.2.1.3 Conclusions

Based on the impingement monitoring results, Exelon Generation concludes that the environmental impact from impingement over the SLR terms would be SMALL. A final decision about the need for additional measures to protect federal or state threatened and endangered species and fragile species will be made in consultation with PADEP, as indicated in the PBAPS NPDES permit, and USFWS.

The results of entrainment studies demonstrate that entrainment at PBAPS has little to no impact on the fisheries community of Conowingo Pond (NAI 2013b). For these reasons, Exelon Generation concludes that any environmental impact from entrainment of fish and shellfish in early stages over the SLR terms would be SMALL. A final decision about the need for additional measures for protecting federal or state threatened and endangered species and meeting BTA standards for entrainment will be made in consultation with PADEP, as indicated in the PBAPS NPDES permit, and USFWS.

4.6.2.2 Thermal Impacts on Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)

NRC

> **"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations and, if necessary, a 316(a) variance in accordance with 40 CFR 125, or equivalent State permits and supporting documentation. If the applicant cannot provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from thermal changes…." 10 CFR 51.53(c)(3)(ii)(B)**
>
> **"Most of the effects associated with thermal discharges are localized and not expected to affect overall stability of populations or resources. The magnitude of impacts, however, would depend on site-specific thermal plume characteristics and the nature of aquatic resources in the area." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 39**

The NRC made impacts on fish and shellfish from thermal discharges a Category 2 issue, because the significance of impacts at a given plant depends on cooling system design, plant operating characteristics, configuration of the thermal plume (both horizontal [surface area] and vertical [depth]), and characteristics of the potentially affected aquatic resources. Thermal impacts may, therefore, be small, moderate, or large, depending on site-specific circumstances. As a general rule, plants with once-through cooling systems produce greater thermal impacts than plants with recirculating, closed-cycle cooling systems, but other factors may come into play, such as the use of helper cooling towers, bathymetry of the receiving stream or the presence/absence of rare or sensitive aquatic species.

Information to be ascertained includes: (1) whether the cooling system is once-through or closed-cycle, (2) whether the facility meets state water quality standards and effluent limits with respect to temperature, and (3), if it does not, evidence of a CWA Section 316(a) thermal variance or equivalent state documentation.

Section 316(a) of the CWA establishes a process whereby a thermal effluent discharger can demonstrate that thermal discharge limitations are more stringent than necessary (to ensure the protection and propagation of balanced, indigenous populations of fish and wildlife in and on the receiving waters) and get regulatory-agency approval of facility-specific thermal discharge limits (33 USC 1326).

As indicated in Subsection 2.2.3, PBAPS operates an open-cycle, once-through circulating water system equipped with forced draft, helper (open-cycle) cooling towers. Thermal discharges are regulated by NPDES Permit No. PA0009733 (see Appendix A), which authorizes releases from PBAPS to Conowingo Pond. The PBAPS NPDES permit grants a CWA Section 316(a) variance requiring operation of the PBAPS cooling towers during specific times and conditions, as well as performance of a post-EPU biological and thermal study, which was in progress through 2016 (NAI and ERM 2017).

The current PBAPS CWA Section 316(a) variance was based in part on results of a CWA Section 316(a) demonstration study conducted between 2010 and 2013 (NAI and ERM 2014). The study evaluated impacts to the water quality, fisheries community, and benthic macroinvertebrate community of Conowingo Pond. The demonstration study showed that each cooling tower cooled discharge water by an additional 1.6 degrees F (NAI and ERM 2014). Operation of cooling towers reduced water temperatures within Conowingo Pond within 1.2 miles of the discharge along the western shoreline (NAI and ERM 2014). Shallow shoreline habitats, which are important for multiple fish and invertebrate species, primarily occur upstream of the PBAPS discharge (NAI and ERM 2014). As a result, only 3.8 percent of Conowingo Pond's shallow shoreline habitat could be possibly affected by the thermal effluent from the PBAPS discharge (NAI and ERM 2014).

The benthic macroinvertebrate community showed similar compositions and relative abundance throughout the demonstration study in Conowingo Pond (NAI and ERM 2014). Only two stations had any observed impact, observed in the form of lower IBI scores, in the discharge area (NAI and ERM 2014). The three thermally influenced stations farthest downstream from the discharge canal had no observed impact. The two stations impacted demonstrated low IBI scores only during July and August, and demonstrated recovery afterward (NAI and ERM 2014).

Fisheries community surveys demonstrated similar results as the macroinvertebrate survey in Conowingo Pond (NAI and ERM 2014). Fish demonstrated habitat avoidance in July and August at three sampling stations located near the end of the PBAPS discharge canal (NAI and ERM 2014). However, avoidance was temporary and abundances were similar to other similar habitats in Conowingo Pond in September (NAI and ERM 2014). Most importantly, little to no habitat avoidance occurs in May and June, when most fish species in Conowingo Pond enter their peak spawning periods (NAI and ERM 2014).

The post-EPU thermal and biological monitoring study performed in 2016 (NAI and ERM 2017) found that cooling tower operation as specified in the current NPDES permit effectively mitigates the additional heat discharged as a result of the EPU. At the biological monitoring stations, water temperatures were generally consistent with the pre-EPU observations, dissolved oxygen concentrations were protective of the aquatic community, and dissolved oxygen concentrations would not prevent fish migration past the PBAPS facility. The measurable spatial and temporal effects of the thermal plume on the biota of Conowingo Pond were similar to those observed during pre-EPU sampling; that is, the patterns of fish avoidance and declines in benthos diversity were related to high water temperatures and similar to those observed during pre-EPU monitoring. The stations with measurable impacts were in the same areas where similar observations were made pre-EPU, along the west shore within approximately 0.6 mile of the PBAPS discharge canal. Overall, a balanced indigenous community of fish and benthic macroinvertebrates continues to exist in Conowingo Pond following the EPU. Thermal discharges from PBAPS comply with applicable NPDES permit conditions, affect a very small area of Conowingo Pond along the west shore near the discharge, and do not create a barrier to upstream or downstream fish movement patterns.

Additionally, the current NPDES permit, which is provided in Appendix A to this environmental report, contains mitigation measures to be used from June 15 through the end of August each year if temperature-critical levels are exceeded, or if drought or hot weather begins to impact pond temperatures. Further, Exelon Generation advised PADEP in a letter dated August 18, 2017 that it will implement the following supplemental average intake temperature basis conditions for cooling tower operation from the end of August through September 30th each year (all based on 48-hour averages) until the next renewed NPDES permit is issued:

1. One tower will operate continuously through September 30, if temperature is equal to or greater than 81 degrees F. If temperature lowers to 81 degrees F, the one remaining operational tower may be secured.
2. A second tower will continue operation or commence operation within 48 hours of average intake temperatures being equal to or greater than 83 degrees F. When intake temperature is less than 83 degrees F, operation of the second cooling tower will cease.
3. A third cooling tower will operate conditionally in accordance with the language in the current NPDES Permit (Exelon Generation 2017i).

Based on results of the PBAPS CWA Section 316(a) variance study and the post-EPU biological and thermal study (as described above) Exelon Generation concludes that thermal discharges from PBAPS are consistent with state water quality standards and will result in SMALL impacts to aquatic organisms in Conowingo Pond. Therefore, no additional mitigation is needed.

4.6.2.3 Water Use Conflicts with Aquatic Resources (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)

NRC

"If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river, an assessment of the impact of the proposed action on water availability and competing water demands, the flow of the river, and related impacts on stream (aquatic)… ecological communities must be provided." 10 CFR 51.53(c)(3)(ii)(A)

"Impacts on aquatic resources in stream communities affected by water use conflicts could be of moderate significance in some situations." 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 46

Surface water use conflicts may occur when plants withdraw water from rivers experiencing reduced flows, whether the reduction in flow is caused by drought or as the result of increased use of the surface water by additional agricultural, municipal, or industrial users. Reduced river flows associated with climate or increased water use could in turn affect the quantity and quality of stream habitat that is available to aquatic communities. Because the extent of surface water use conflicts varies from location to location, as do the potential impacts arising from these conflicts, the NRC concluded that the impact of water use conflicts on aquatic communities could not be determined generically (NRC 2013a). The impact of surface water use conflicts on stream communities is therefore a plant-specific Category 2 issue.

As discussed in Subsection 2.2.3, PBAPS operates as an open-cycle, once-through circulating water system with three helper cooling towers that do not require makeup water. The NPDES permit defines the number of cooling towers that must be used based on date and average river water temperature. With all three cooling towers operating, approximately 60 percent of the PBAPS circulating water flow passes through them. PBAPS is located on Conowingo Pond, a reservoir on the Susquehanna River with an annual flow rate less than 3.15×10^{12} cubic feet.

Because the helper towers do not require makeup water, this issue as specified does not apply to PBAPS. Nevertheless, consumptive water use at PBAPS includes evaporation through the power generation and cooling systems, including evaporation in the helper cooling towers when the towers are in operation, and evaporation of water withdrawn from Conowingo Pond due to the thermal loading from water discharged from the facility. This consumptive use represents approximately 0.2 percent of the 39,500 cfs average annual flow from the Susquehanna River into Conowingo Pond, as measured at the Marietta gaging station. It also represents only 2 percent of the 7Q10 flow of 3,785 cfs at the Marietta gaging station (Exelon Generation 2015c). The effect on the water elevation would be indiscernible given daily fluctuations of as much as 25 percent of the Pond's volume due to operation of the Muddy Run Pumped Storage Facility and the managed nature of the Pond because of Conowingo Dam operation (Subsection 3.5.1.1).

As discussed in regard to riparian community impacts in Subsection 4.6.1.2, impacts to aquatic ecological communities in Conowingo Pond and the Susquehanna River would be small, if discernible, even in low-flow conditions because of the controls placed on water elevation in Conowingo Pond. These communities have adapted to the normally fluctuating water levels and flow conditions of the river. Any incremental change attributable to PBAPS cooling tower operation would be SMALL. Because impacts are not demonstrable, Exelon Generation also concludes that further mitigation would be unwarranted.

4.6.3 Special Status Species and Habitats

NRC

> **"All license renewal applicants shall assess the impact of refurbishment, continued operations, and other license-renewal-related construction activities on important plant and animal habitats. Additionally, the applicant shall assess the impact of the proposed action on threatened and endangered species in accordance with Federal laws protecting wildlife, including but not limited to, the Endangered Species Act, and essential fish habitat in accordance with the Magnuson-Stevens Fishery Conservation and Management Act." 10 CFR 51.53(c)(3)(ii)(E)**
>
> **"The magnitude of impacts on threatened, endangered, and protected species, critical habitat, and essential fish habitat would depend on the occurrence of listed species and habitats and the effects of power plant systems on them. Consultation with appropriate agencies would be needed to determine whether special status species or habitats are present and whether they would be adversely affected by continued operations and refurbishment associated with license renewal." 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 50**

The NRC made impacts to threatened and endangered species a Category 2 issue because the status of these species is subject to change, and a site-specific assessment is required to determine whether any identified species could be affected by refurbishment activities or continued plant operations during the renewal period. In addition, compliance with the ESA requires consultation with appropriate federal agencies to determine whether threatened or endangered species are present and whether they would be adversely affected by the continued operation of the nuclear plant, or refurbishment of facilities, during the license renewal term.

Exelon Generation submitted consultation letters to the following agencies requesting information on any protected species and their habitats that may be affected by the license renewal:

- USFWS;
- PFBC;
- PA DCNR;
- PGC; and
- NOAA.

The results of a September 21, 2017 PNDI search (PA DCNR 2017) indicating that several threatened and endangered species have the potential to occur in the vicinity of the site was included with each consultation letter, along with additional information describing proposed SLR activities. All agency response letters are provided in Appendix C.1.

The USFWS acknowledged in a letter dated November 2, 2017, that three bald eagle nests are located within a half mile of the PBAPS and that they are in receipt of the signed "Bald Eagle Project Screening Form" that indicates all recommended avoidance measures will be implemented (USFWS 2017d). Additionally, USFWS concurred with the bog turtle habitat determination and concluded that activities associated with the relicensing will not affect the bog turtle or any other federally threatened or endangered species under their jurisdiction.

A letter from PFBC, dated March 8, 2018, did not identify any additional species of concern beyond the Chesapeake logperch that was listed on the PNDI receipt (PA DCNR 2017). PFBC's letter discussed the potential impacts of continued PBAPS operation on the Chesapeake logperch and stated their intention to use the NPDES permit renewal process to address their concerns regarding Chesapeake logperch impingement and entrainment.

A letter from PA DCNR, dated September 27, 2017, stated that license renewal activities, as described in the PNDI and subsequent correspondence, are not likely to impact species or resources under their jurisdiction. In a phone call on October 3, 2017, the PGC stated that they would not send a separate letter in response to Exelon Generation's consultation letter dated September 26, 2017. The PGC considered the response provided on the PNDI receipt indicating "no further review required" to be sufficient.

The NRC requires applicants seeking to renew operating licenses of nuclear plants that could affect coastal resources to evaluate potential impacts of license renewal on marine and estuarine fish species for which EFH has been identified. No EFH or Federally Managed Fisheries Species occur in the vicinity of PBAPS (NOAA 2016a). Additionally, PBAPS is not listed in the GEIS as one of the 17 nuclear plants for which EFH "may be a consideration" (NRC 2013a). In a letter dated March 5, 2018, NOAA (1) recommended that studies and monitoring at PBAPS consider downstream effects on diadromous fish species and (2) indicated that potential downstream effects of continued PBAPS operations on Atlantic and shortnose sturgeon are unclear.

Four special status species managed under the Atlantic Herring Fishery Management Plan developed by the New England Fishery Management Council occur in Conowingo Pond: alewife, American shad, blueback herring, and hickory shad. While these species are not targeted in commercial fisheries, their incidental catch within the Atlantic herring fishery is managed under the Atlantic Herring Fishery Management Plan. Additionally, the Atlantic States Marine Fisheries Commission manages six species that occur in Conowingo Pond: alewife, American eel, American shad, blueback herring, hickory shad, and striped bass. Multiple managed species are found in the Chesapeake Bay. There are catfish and blue crab fisheries within the Chesapeake Bay Watershed; however, these are state-managed fisheries, rather than federally managed.

Most federally managed commercial species do not occur within Conowingo Pond. The primary prey/forage of the commercial fisheries species occurring within the Chesapeake Bay, Susquehanna River, and Conowingo Pond are marine and therefore, not likely to be affected by the continued operations of PBAPS. The diets of federally managed species that are found in Conowingo Pond include zooplankton or benthic invertebrates, which are abundant throughout the Chesapeake Bay Watershed. The primary prey of striped bass, Atlantic menhaden, is not available to fish migrating into Conowingo Pond. However, this species currently exists in the Pond and presumably forages on other abundant clupeids.

Section 3.6 discusses ecological habitats, terrestrial and aquatic species, and special status species (i.e., species federally or state-listed as threatened, endangered, or of special concern) that occur or may occur at PBAPS. Exelon Generation has no plans to conduct refurbishment or construction at PBAPS in support of license renewal. Therefore, there would be no refurbishment- or construction-related impacts to special status species, and no analysis of refurbishment-related impacts is needed.

As discussed in Subsection 3.6.2.3.1, according to the IPaC Resource List, the USFWS considers four federally listed species to potentially occur in the vicinity of PBAPS if suitable habitats are present: Indiana bat, northern long-eared bat, bog turtle, and red knot (USFWS 2017c). Both species of bat roost in trees in summer and could potentially occur in forested areas of the site. The bog turtle utilizes spring-fed bogs and marshes as habitat, but suitable habitat was not observed during an August 2017 bog turtle habitat survey on PBAPS. While the red knot may be observed in the vicinity of PBAPS during its migration, suitable habitat does not exist on or near the site. Operations and maintenance activities during the license renewal term are expected to be similar to current activities, and additional facilities would not be constructed. Exelon Generation is not aware of any PBAPS activities to be conducted during the license renewal term that would adversely impact these federally listed species, or any others, that may occur at the site. In addition, there are no critical habitats for these or other federally listed species in the vicinity of PBAPS (USFWS 2016b) that would be affected by its continued operation.

Two state-listed plants (harbinger-of-spring and American holly) occur in natural areas on or adjacent to the site. Operations and maintenance activities during the license renewal term are expected to be similar to current activities, and additional facilities would not be constructed. Exelon Generation is not aware of any PBAPS activities conducted during the license renewal term that would adversely impact these terrestrial, state-listed species, or any others, that may occur at the site.

As discussed in Subsection 3.6.1.4.2, the Chesapeake logperch is a state-listed threatened fish species that has been found in Conowingo Pond. Chesapeake logperch impingement has been recorded to occur at PBAPS (URS Corporation 2008; NAI 2010a; NAI 2011a; NAI 2012a; NAI 2013a; NAI 2014a; NAI 2015a). However, impingement of this species is not common and never constitutes greater than 0.05 percent of sampled impingement (URS Corporation 2008; NAI 2010a; NAI 2011a; NAI 2012a; NAI 2013a; NAI 2014a; NAI 2015a). No entrainment of Chesapeake logperch was recorded at PBAPS through 2012 (NAI 2013b). During 2016, four individual Chesapeake logperch larvae were reported to the PFBC as collected in entrainment abundance sampling that is ongoing pursuant to the CWA Section 316(b) requirements in NPDES Permit PA0009733. Also, on July 23, 2014, PADEP issued a Water Quality Certification pursuant to Section 401 of the CWA for the PBAPS EPU Project that provides, among other things, that PBAPS will make annual compensatory mitigation payments to the PFBC for use in implementing habitat/sediment improvement projects in the

Susquehanna River (PADEP 2014b). A final decision about the need for additional measures to protect special status aquatic species, including the Chesapeake logperch, will be made in consultation with PADEP and USFWS in the context of the next PBAPS NPDES permit renewal proceeding, which must be initiated during March 2019. In a letter dated March 8, 2018, the PFBC expressed concern about potential PBAPS effects on the local Chesapeake logperch population in Conowingo Pond. The letter indicated that PFBC intends to address its Chesapeake logperch impingement and entrainment concerns during the PBAPS NPDES permit renewal process. Accordingly, Exelon Generation concludes that future mitigation measures, as determined through the NPDES permit renewal process, will control impingement and entrainment of Chesapeake logperch such that impacts during the license renewal term would be UNLIKELY TO ADVERSELY AFFECT this species, and further mitigation would be unwarranted.

Additionally, the thermal discharge affects a relatively small area of Conowingo Pond near the western shoreline downstream of the discharge canal. The Chesapeake logperch is a benthic-dwelling species. Effects on the benthic invertebrate community from the thermal plume have been found to be localized, temporary (only during the warmest months), and limited to a small proportion of the available, shallow, shoreline habitat within Conowingo Pond (NAI and ERM 2014). Similarly, effects on benthic habitat that potentially could be used by the Chesapeake logperch would be localized and temporary, and the fish could avoid the small area of affected habitat, further minimizing any potential for adverse effects. Thus, Exelon Generation concludes that the impact of the thermal discharge on Chesapeake logperch during the license renewal term would be UNLIKELY TO ADVERSELY AFFECT this species, and no additional mitigation measures are warranted.

Operations and maintenance activities during the license renewal term are expected to be similar to current activities. Furthermore, existing procedures require consideration of impacts to threatened and endangered species and their habitat as part of the planning process for work at the plant site. As a result, operations and maintenance have minimal impacts on threatened and endangered species. Therefore, Exelon Generation concludes that the impact of continued operations and maintenance activities resulting from license renewal would be UNLIKELY TO ADVERSELY AFFECT threatened and endangered species, and no additional mitigation measures are warranted.

In addition to special status species, other important species in the vicinity of the PBAPS site include migratory fish (e.g., the American eel, American shad, blueback herring, and alewife), the bald eagle, and other migratory birds. As discussed in Subsections 3.6.1.2 and 3.6.1.4.1, restoration programs have been established for migratory fish in the Susquehanna River under agreements between Exelon Generation and the USFWS. Although these species may experience mortality as a result of entrainment and impingement at the cooling water intake, physical barriers to migration and loss of habitat are considered to have greater impacts on their populations, and these restoration programs are expected to increase migratory fish populations in the Susquehanna River basin over time.

As discussed in Subsection 3.6.2.3.1, the bald eagle is protected under the BGEPA and the MBTA. As of 2015, the USFWS had documented three bald eagle nests along the portion of Conowingo Pond near the PBAPS site, one of which was within the north portion of the site on a wooded slope above the river, and two of which were on transmission line structures in the reservoir. A 1,000-ft buffer around the onsite nest would be entirely within the site boundary, while a similar buffer around the offshore nests would not cross the site boundary (USFWS 2015d). The PBAPS facility was in operation when these nests were constructed, indicating that bald eagles were tolerant of the presence of the facility and not disturbed by its operation. Given that operations and maintenance activities during the license renewal term are expected to be similar to current activities and additional facilities would not be constructed, Exelon Generation is not aware of any PBAPS activities during the license renewal term that would adversely impact bald eagles or their nests on and near the site.

Other birds protected under the MBTA include those identified in Subsection 3.6.2.1 and essentially all other native birds that inhabit the vicinity of the PBAPS site (with the exception of the bobwhite, ruffed grouse, and wild turkey). As discussed in Subsection 3.6.2.3.2, nests of the recently state-delisted osprey have been recorded on and in the vicinity of the PBAPS site. The PBAPS facility was in operation when these nests were constructed and used, indicating that ospreys were tolerant of the presence of the facility and not disturbed by its operation. The USFWS IPaC Trust Resources Report for the area of the site contains a list of migratory "birds of conservation concern" that potentially could occur in the area during breeding season, wintering season, or year-round (USFWS 2016b). The list includes 22 species in addition to the bald eagle that the USFWS has identified as priorities for conservation. As discussed above for the bald eagle, operations and maintenance activities during the license renewal term are expected to be similar to current activities, and additional facilities would not be constructed. Accordingly, Exelon Generation is not aware of any PBAPS activities during the license renewal term that would adversely impact migratory birds under the MBTA.

Considering all information in this section, Exelon Generation concludes that the proposed action is unlikely to adversely affect any threatened or endangered species and will have no effect on any designated critical habitat. Exelon Generation also concludes that the proposed action would have NO EFFECT on critical habitat or EFH, making further mitigation unwarranted.

4.7 HISTORIC AND CULTURAL RESOURCES

NRC

"All applicants shall identify any potentially affected historic or archeological properties and assess whether any of these properties will be affected by future plant operations and any planned future refurbishment activities in accordance with the National Historic Preservation Act." 10 CFR 51.53(c)(3)(ii)(K)

"Continued operations and refurbishment associated with license renewal are expected to have no more than small impacts on historic and cultural resources located onsite and in the transmission line ROW because most impacts could be mitigated by avoiding those resources. The National Historic Preservation Act (NHPA) requires the Federal agency to consult with the State Historic Preservation Officer (SHPO) and appropriate Native American Tribes to determine the potential effects on historic properties and mitigation, if necessary." 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 51

The NRC made impacts to historic and cultural resources a Category 2 issue (Issue 51). Determinations of impacts to historic and cultural resources are site-specific in nature and the NHPA mandates that impacts must be taken into account, which is typically accomplished through consultation with the SHPO (NRC 2013a).

There are no known historic or archaeological resources at the Peach Bottom site, and as described in Section 3.7, no known archaeological sites of significance were disturbed during PBAPS's construction in the 1970s. The structures within the APE that would exceed 50 years of age, which is the federal and state benchmark for consideration as a potential historic resource, during the term of the renewed Units 2 and 3 licenses are associated with PBAPS Unit 1, Unit 2, and Unit 3. These structures have been neither evaluated to determine eligibility for listing on the NRHP nor documented in the collections of the Historic American Buildings Survey / Historic American Engineering Record. However, Unit 1 entered SAFSTOR mode in 1978, with continued surveillance, security, and maintenance under Facility Operating [Possession Only] License No. DPR-12. As such, appropriate consideration will be given to the historic significance of the Unit 1 structures at the time of Unit 1 decommissioning. Because the PBAPS SLR project for Units 2 and 3 involves no construction or other land disturbing activities, and there will be no refurbishment activities, the SLR project will have no effect on Unit 1, Unit 2, or Unit 3 structures.

As indicated in Section 3.7.1, there are currently no federal- or state-recognized Native American tribes or groups in Pennsylvania. Exelon Generation initiated communication with the Pennsylvania SHPO by letter dated September 27, 2017. The letter expressed a desire to assess the effects of PBAPS SLR on historic properties, as required by the NRC of applicants for operating license renewal. Exelon Generation requested state concurrence with a determination that the license renewal process would have "...no effect on any historic or archaeological properties."

The Pennsylvania SHPO wrote on October 25, 2017, that it had reviewed the undertaking in accordance with Section 106 of the NHPA. The letter noted that, while there may be historic buildings, structures, and/or archaeological resources located in or near the project area, the proposed SLR would have no effect on these resources (Pennsylvania State Historic Preservation Office 2017).

Exelon Generation does not plan any land-disturbing refurbishment activities, and no refurbishment-related impacts are therefore anticipated. In addition, no known archaeological or historic sites of significance have been identified. Therefore, continued operation of the Peach Bottom facility is projected to have no impact on archaeological or historic resources. Furthermore, proposed changes to the PBAPS plant configuration are subject to a screening process to determine whether the actual or potential environmental impacts of the proposed change are either bounded by the station's environmental basis or can be avoided using practical, available alternatives. If neither of these circumstances were to exist with respect to a land-disturbing activity, then consultation would be initiated with the SHPO to determine what measures would be needed to minimize and mitigate the impacts. Any measures resulting from consultation with the SHPO would be incorporated into the work plan for the land-disturbing activity.

Because (1) past operations have not affected any historic or cultural resource, (2) Exelon Generation has procedures to protect undiscovered resources from future potential impacts, and (3) the Pennsylvania SHPO voiced no concerns about continued operation of the PBAPS facility (see Appendix C.2), Exelon Generation concludes that although historic structures are present, such structures, as well as any undiscovered cultural resources would be NOT ADVERSELY AFFECTED by renewal of the PBAPS operating licenses and no additional mitigation is warranted.

4.8 SOCIOECONOMICS

The following socioeconomic resource areas are Category 1 issues and were reviewed for new and significant information at PBAPS that could make the generic finding for a resource as described in the 2013 GEIS inapplicable:

- Issue 52 - Employment, income, recreation and tourism
- Issue 53 - Tax revenues
- Issue 54 - Community service and education
- Issue 55 - Population and housing
- Issue 56 - Transportation

No refurbishment or plant modifications are planned as a result of license renewal. Additionally, no new and significant information was identified. Therefore, the conclusions regarding impacts to socioeconomics in the 2013 GEIS are considered appropriate for the PBAPS SLR, are incorporated herein by reference, and impacts to socioeconomic topics do not need further analysis. Section 3.8 discusses the socioeconomics of the region.

4.9 HUMAN HEALTH

The following Category 1 issues related to human health were reviewed for new and significant information at PBAPS that could make inapplicable the generic finding for a resource as described in the 2013 GEIS:

- Issue 57 - Radiation exposures to the public
- Issue 58 - Radiation exposures to plant workers
- Issue 59 - Human health impact from chemicals
- Issue 61 - Microbiological hazards to plant workers
- Issue 63 - Physical occupational hazards

Section 3.9 describes human health in the vicinity of PBAPS. No new and significant information was identified, therefore the conclusions regarding impacts for these Category 1 issues in the 2013 GEIS are considered appropriate for the PBAPS SLR, are incorporated herein by reference, and impacts for these Category 1 issues do not need further analysis.

The following issue related to human health was not categorized in the 2013 GEIS:

- Issue 62 - Chronic effects of EMFs

NRC determined that the chronic effects of EMFs associated with nuclear plants and associated transmission lines are uncertain. In Subsection 4.9.1.1.4 of the 2013 GEIS, NRC states that because the scientific evidence is inconclusive, the chronic health effects of EMF are uncertain, and no generic impact level can be assigned. NRC will continue to monitor research on the potential carcinogenicity of EMFs, as well as other potential EMF effects. If NRC finds that appropriate federal health agencies have reached a consensus on the potential human health effects from EMF exposure, NRC will revise the GEIS to include the new information and will determine how to categorize and evaluate this issue for future license renewal applications (NRC 2013a). Thus, impacts for this issue cannot currently be predicted given the limitations and inconsistency of the evidence available.

4.9.1 Microbiological Hazards to the Public (Plants with Cooling Ponds or Canals or Cooling Towers that Discharge to a River)

NRC

> **"If the applicant's plant uses a cooling pond, lake, or canal or discharges into a river, an assessment of the impact of the proposed action on public health from thermophilic organisms in the affected water must be provided." 10 CFR 51.53(c)(3)(ii)(G)**
>
> **"These organisms are not expected to be a problem at most operating plants except possibly at plants using cooling ponds, lakes, or canals, or that discharge into rivers. Impacts would depend on site-specific characteristics." 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 60**

The NRC designated impacts to public health from microbiological hazards a Category 2 issue, requiring plant-specific analysis, because the magnitude of the potential public health impacts associated with thermal enhancement of such organisms' habitats, particularly those of *Naegleria fowleri (N. fowleri)*, could not be determined generically. NRC requires [10 CFR 51.53(c)(3)(ii)(G)] an assessment of the potential impact of thermophilic organisms in receiving waters on public health if a nuclear power plant uses a cooling pond, cooling lake, or cooling canal or discharges to a river. This issue is applicable to PBAPS because the Station ultimately discharges heated water to Conowingo Pond and the Susquehanna River. Also, there is public access to Conowingo Pond, including recreational fishing, boating, and vacation homes. *N. fowleri*, which is the pathogenic species of the free-living *Naegleria* amoebae, appears to be the microorganism most likely to have a potential to pose a public health hazard resulting from the operation of nuclear power plants (NRC 2013a).

PBAPS Units 2 and 3 use a once-through cooling water system that withdraws from and discharges to Conowingo Pond. Three mechanical draft ("helper") cooling towers supply additional cooling capacity in summer months. Discharge limits and monitoring requirements for PBAPS Units 2 and 3 are set forth in NPDES Permit No. PA0009733.

In NUREG-1437, Supplement 10, Subsection 4.1.5, "Microbiological Organisms (Public Health)," the NRC staff concluded that the potential effects of microbiological organisms on human health on or in the vicinity of the site due to the operation of the PBAPS cooling water discharge to the aquatic environment are SMALL. As discussed in Subsection 2.2.3 of this environmental report, the PBAPS NPDES permit limits the temperature of the water at the end of the discharge canal to 110 degrees F, even in late summer. This maximum temperature in the discharge canal is within the range of temperatures known to be conducive to the survival and growth of the thermophilic pathogen *Naegleria fowleri*. The continuing disinfection of the sewage effluent from PBAPS reduces the possibility that the effluent could act as a source for introducing microbes into the thermal discharge to Conowingo Pond (NRC 2014).

While exposure of the public to *N. fowleri* is possible in the mixing zone in Conowingo Pond below the discharge structure, the probability of such exposure is very low due to several factors: (1) As discussed in Subsection 3.9.1, there is no public access to the discharge canal. Also, a thermal study conducted during June to September each year from 2010 through 2013 to support a CWA Section 316(a) demonstration (NAI and ERM 2014) found that, with no cooling towers operating (2010), average surface water temperatures at locations 1,600 and 2,100 ft downstream of the discharge structure were approximately 93.7 and 88.7 degrees F, respectively, with the warmest water in a narrow plume along the western shoreline. In comparison, the GEIS states that *N. fowleri* is rarely found and infection rarely occurs at water temperatures of 95 degrees F or less. Data from other years of the CWA Section 316(a) Demonstration show that, with cooling towers in operation, the area in which average surface water temperature exceeds 95 degrees F during the summer is even smaller. (2) The area of the discharge mixing zone in which daily high temperatures exceed 95 degrees F in summer is very small compared to the size of Conowingo Pond. (3) *N. fowleri* infection occurs through the nose, and activities that could result in immersion and nasal exposure, such as swimming and water skiing, are unlikely to occur in the discharge mixing zone, which has a steep shoreline and no residential or recreational facilities to attract recreators; thus, the probability of exposure and infection is extremely low.

Based on the thermal characteristics of Conowingo Pond, described in Subsection 3.5.1.3.1, and of the PBAPS discharge, described in Subsection 3.9.1, ongoing operation of the facility is not expected to stimulate growth and reproduction of pathogenic microbiological organisms in Conowingo Pond. Under certain circumstances, pathogenic microbiological organisms might be present in the immediate area of the discharge outfall, but they would not be expected to occur in sufficient concentrations to pose a threat to downstream water users. Many of these pathogenic microbes are ubiquitous in nature and are usually not a problem.

Groups at higher risk may include infants, the elderly, and immunologically compromised persons (NRC 2013a). The relationship between the presence of *N. fowleri* in a water body and the occurrence of infections in such people remains unclear, but the risk of infection is very low (CDC 2016).

By letter dated September 27, 2017, Exelon Generation requested input from PADEP for use in assessing potential health effects at the PBAPS discharge location from *N. fowleri* in the Susquehanna River. In a response dated November 13, 2017, PADEP's Southcentral Region Clean Water staff reported having no relevant data. Exelon Generation then contacted the Pennsylvania Department of Health by phone on November 28, 2017. A Public Health Physician replied that the Department has no record of a case of human *N. fowleri* infection ever occurring in Pennsylvania.

Operations of PBAPS Units 2 and 3 and their cooling systems are not expected to change substantially over the license renewal term, and there is no reason to believe that discharge temperatures will increase or that disinfection will be discontinued. As previously discussed, compliance with the current NPDES permit will continue to protect against high temperatures in the PBAPS discharge mixing zone that might result in human health impacts from microbiological organisms (NRC 2014). Thus, Exelon Generation concludes that the impact of the proposed action on public health from thermophilic organisms in Conowingo Pond is SMALL, and further mitigation beyond the existing limitations on discharge temperatures into Conowingo Pond and the requirement for sewage treatment is not warranted.

4.9.2 Electric Shock Hazards

NRC

The environmental report must contain an assessment of the impact of the proposed action on the potential shock hazard from transmission lines "...[i]f the applicant's transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the National Electric Safety Code for preventing electric shock from induced currents…" 10 CFR 51.53(c)(3)(ii)(H)

"Electrical shock potential is of small significance for transmission lines that are operated in adherence with the National Electrical Safety Code (NESC). Without a review of conformance with NESC criteria of each nuclear power plant's in-scope transmission lines, it is not possible to determine the significance of the electrical shock potential." 10 CFR Part 51, Subpart A, Table B 1, Issue 64

NRC made impacts of electric shock from transmission lines a Category 2 issue because, without a review of conformance by each plant's in-scope transmission lines with the induced-current criteria of the National Electrical Safety Code® (NESC®), NRC could not determine the significance of the electrical shock potential (NRC 2013a). Footnote 4 to Table B-1 in Appendix B to 10 CFR Part 51, Subpart A clarifies the applicability of this issue as follows: "This issue applies only to the in-scope portion of electric power transmission lines, which are defined as transmission lines that connect the nuclear power plant to the substation where electricity is fed into the regional power distribution system and transmission lines that supply power to the nuclear plant from the grid." The NRC adopted this clarification in 2013, recognizing that in most cases lines originating at the power plant substations would remain in place and be energized regardless of whether the subject nuclear power plant license was renewed or not, and therefore would not be impacted by a license renewal decision (78 FR 37282; June 20, 2013). As a result, the in-scope transmission lines evaluated in this environmental report differ from those evaluated in Exelon Generation's 2001 application to the NRC for the first PBAPS license renewal. Subsection 2.2.4 identifies the currently in-scope PBAPS transmission lines as follows: (1) the two onsite 500-kV generator tie lines, one from the main power transformer of each unit to its onsite substation, (2) the 34.5-kV submarine cable that supplies offsite power to PBAPS in the event of SBO, (3) the onsite 220-kV line from the tap on the Nottingham-Cooper line to the 220/13 kV transformer, (4) the onsite dedicated 13-kV line that supplies startup auxiliary power to the 13-kV startup switch gear at Bus 3SU, and (5) the onsite dedicated 13-kV line that supplies startup auxiliary power to the 13-kV startup switchgear at Bus 343SU.

Characteristics of the "in-scope transmission lines" are described in Subsection 2.2.4. As indicated there, the in-scope transmission lines are located within the PBAPS site (with the exception of the 34.5-kV submarine cable) and are not accessible to the general public. The electric shock hazards associated with these lines are controlled in accordance with applicable industrial safety standards.

The 34.5-kV submarine cable from Conowingo Dam to PBAPS is installed mainly underwater and underground. Submarine and underground electric transmission cables are insulated and shielded so that electric fields are confined within the cable. However, magnetic fields surround the conductor and can extend outside the cable, resulting in a potential for induced electric currents in the vicinity of the cable. Submarine and underground transmission lines produce smaller magnetic fields than aboveground lines because their conductors are closer together, which causes the associated magnetic fields to partially cancel each other out. Magnetic fields are strongest near the conductor and diminish very quickly with distance (Public Service Commission of Wisconsin 2011). Thus, because the 34.5-kV submarine cable is submersed at the bottom of Conowingo Pond or buried underground, the potential for members of the public to come into sufficiently close proximity to the cable to experience a shock from induced current is negligible. Accordingly, induced currents, if any, caused by the offsite portion of this cable are not a hazard to members of the public. Thus, Exelon Generation concludes that the potential electric shock hazards from in-scope transmission lines at PBAPS are SMALL, and no additional mitigation is warranted.

4.10 ENVIRONMENTAL JUSTICE

4.10.1 Minority and Low Income Populations

NRC

"Applicants shall provide information on the general demographic composition of minority and low-income populations and communities (by race and ethnicity) residing in the immediate vicinity of the plant that could be affected by the renewal of the plant's operating license, including any planned refurbishment activities, and ongoing and future plant operations." 10 CFR 51.53(c)(3)(ii)(N)

"Impacts to minority and low-income populations and subsistence consumption resulting from continued operations and refurbishment associated with license renewal will be addressed in plant-specific reviews. See NRC Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (69 FR 52040; August 24, 2004)." 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 67

The NRC designated impacts to minority and low-income populations a Category 2 issue, requiring plant-specific analysis, because the magnitude of the potential impacts could not be determined generically. NRC requires an assessment of the potential impacts on minority and low-income populations, including populations engaged in subsistence-like living, from continued operation of the Station and any planned refurbishment activities. PBAPS has no plans for refurbishment.

A presidential Executive Order (12898) directs all federal agencies to consider in their programs, policies, and activities any "disproportionately high and adverse human health or environmental effects" on minority or low-income populations.

The other sections in Chapter 4 evaluate the impacts of continued operation of PBAPS on the environment, including the population within an 80-km (50-mile) radius. All activities associated with the continued operation have been determined to have SMALL or non-adverse impacts during the license renewal term. Therefore, high or adverse impacts to the general human population would not occur. Section 3.10 identifies the locations of minority and low-income populations as defined by the NRC Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues (NRC 2013a). Section 3.10 also describes the search for subsistence-like populations near PBAPS, of which none were found.

The figures accompanying Section 3.10 show the locations of minority and low-income populations within 80 km (50 mile) of PBAPS. None of those locations, when considered in the context of impact pathways described in Chapter 4, is expected to be disproportionately impacted. Each location is sufficiently distant from PBAPS to not present a focal point of impacts that would be disproportionate compared to other locations.

Hence, Exelon Generation concludes that disproportionately high and adverse impacts to minority and low-income populations will not occur. Therefore, impacts to such populations would be SMALL, and no mitigation is warranted.

4.11 WASTE MANAGEMENT

The following waste management areas are Category 1 issues and were reviewed for new and significant information at PBAPS that could make the generic finding for a resource as described in the 2013 GEIS and NUREG-2157, *Generic Environmental Impact Statement for Continued Storage of Spent Fuel (2014)*, inapplicable:

- Issue 68 - Low-level waste storage and disposal
- Issue 69 - Onsite storage of spent nuclear fuel
- Issue 70 - Offsite radiological impacts of spent nuclear fuel and high-level waste disposal
- Issue 71 - Mixed waste storage and disposal
- Issue 72 - Non-radioactive waste storage and disposal

No refurbishment or changes to plant operational activities that would change waste management effects are expected during the period of extended operation under the renewed licenses. Additionally, no new and significant information was identified. Therefore, the conclusions regarding impacts to waste management in the 2013 GEIS and NUREG-2157 are considered appropriate for the PBAPS SLR, are incorporated by reference, and do not need further analysis. Subsection 2.2.2 discussed spent fuel characteristics and storage. Subsection 2.2.5 describes radioactive wastes other than spent fuel that are generated during plant operations. Subsection 2.2.6 describes the non-radioactive wastes generated during plant operations. The assessment of PBAPS uranium fuel is discussed in Section 4.13.

4.12 CUMULATIVE IMPACTS

NRC

"Applicants shall provide information about past, present, and reasonably foreseeable future actions occurring in the vicinity of the nuclear plant that may result in a cumulative effect." 10 CFR 51.53(c)(3)(ii)(O)

"Cumulative impacts of continued operations and refurbishment associated with license renewal must be considered on a plant-specific basis. Impacts would depend on regional resource characteristics, the resource-specific impacts of license renewal, and the cumulative significance of other factors affecting the resource." 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 73

This section considers the contribution of continued operation of PBAPS to potential regional environmental cumulative impacts (Category 2 Issue 73). It assesses the potential significance of PBAPS impacts in relation to other known or reasonably foreseeable projects. A cumulative impact is defined in the Council on Environmental Quality (CEQ) regulations (40 CFR 1508.7) as an "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions."

Projects which could contribute to cumulative impacts with respect to PBAPS include transportation projects and plans, additional industrial development (including power production), large residential developments, and water resources projects. Resource areas that may be affected by these projects are discussed below.

In this section, past, present, and reasonably foreseeable future actions that are federally authorized or funded and take place in the vicinity of PBAPS are identified and possible cumulative effects are discussed. For the purposes of this analysis, past and present actions include actions that have been publicly announced before submittal to the NRC of the PBAPS SLR Application. Reasonably foreseeable future actions are those that are ongoing (and will continue into the future), are funded for future implementation, or are included in firm, near-term publicly available plans covering the operating periods of the renewed PBAPS licenses. The geographic area affected by cumulative impacts depends on the resource being considered (NRC 2013a). Past, present, and reasonably foreseeable actions may include individually minor, but collectively significant, actions occurring over a period of time (NRC 2013a).

The 80-km (50-mile) radius applied to PBAPS for the impact evaluation of severe accidents, air quality, and radiological health impacts to the public intersects the 80-km (50-mile) radii of three other nuclear power plants: Salem/Hope Creek (approximately 43 miles southeast), Three Mile Island (approximately 33 miles northwest), and Limerick (approximately 47 miles northeast). All of these are within 80 km (50 mile) of PBAPS (Google Earth 2017; NEI 2017a).

The Lower Susquehanna River Watershed has 85 (EPA 2016b) NPDES-permitted facilities, including PBAPS, the Conowingo hydroelectric power plant, and the Muddy Run pumped storage generating plant. The latter three facilities all withdraw water from Conowingo Pond. Table 4.12-1 presents a list of existing electricity generating plants and their capacities in York and Lancaster Counties.

Both the York County (2011) and Lancaster County (2006) comprehensive plans identify specified growth areas where development is encouraged; a high value is placed on retaining open space and agricultural areas (LCPC 2006; YCPC 2011). The populations of these two counties also appear to be growing relatively rapidly, which could eventually result in increased development pressure.

Before June 29, 2017, 24 transportation projects were under construction in York County and nine additional projects were anticipated (PennDOT 2017d). None of these projects are located near PBAPS. In Lancaster County, there were 37 active Department of Transportation construction projects and one anticipated project (PennDOT 2017b). Of these projects, the closest in Lancaster County is a rapid Fishing River Bridge replacement project located across Conowingo Pond from PBAPS. It is estimated that it will be completed in October 2018 (PennDOT 2017a). The closest project in York County is the Norman Wood Bridge construction project, which is slated for completion in June 2018, and is located 5 miles north-northeast in relation to PBAPS (PennDOT 2017c). None of these transportation projects are likely to contribute to cumulative impacts with respect to PBAPS due to their relatively short construction schedules, distance from the facility, and relative size.

The York County Planning Commission maintains a GIS website which tracks residential and commercial building permits. Based on a database query submitted June 29, 2017, none of these known developments are near PBAPS, nor do they have the potential to contribute to cumulative impacts (YCPC 2017b). Lancaster County does not maintain a similar GIS website; desktop research did not result in identification of any information regarding major residential or industrial development projects in Lancaster County.

The Old Dominion Electric Cooperative (ODEC) is constructing a natural gas-fired power plant in Cecil County, Maryland, approximately 6.5 miles southeast of PBAPS. The facility will generate approximately 1,000 MW (ODEC 2017a). It is estimated that the construction will be complete by the summer of 2017 (ODEC 2017b). In addition, Calpine Mid-Merit, LLC is constructing Block 2 at the York Energy Center. Block 2 is expected to increase the Center’s generation of baseload electricity by 830 MW beginning in 2018. The plant will employ dual-fueled, combined cycle technology using natural gas and diesel (Calpine 2018).

Sonoco is in the process of constructing a new pipeline, 80 percent of which will follow an existing line, from Ohio to Delaware County, Pennsylvania. The pipeline, which is scheduled to be completed in 2018, will bring natural gas from Ohio and Pittsburg to Delaware County, Pennsylvania, and will cross both York and Lancaster Counties (PADEP 2017d). There is another proposed pipeline which would traverse the vicinity of PBAPS. The proposed Atlantic Sunrise Pipeline would also traverse York and Lancaster Counties (Williams 2015). This pipeline is an expansion of the existing Transco pipeline and would transfer natural gas from the producing regions of northeastern Pennsylvania to markets in the Mid-Atlantic (Williams 2017a). Construction began in March 2017; however, as of June 2017, some permits had not been obtained in Pennsylvania and citizens of Lancaster County were petitioning PADEP to deny the permits (LancasterOnline 2017; Williams 2017b).

Eurofins Lancaster Laboratory is expanding their Lancaster County facility, adding 350 jobs. Construction of the expansion would also add temporary employment to the area (PA.GOV 2017).

The incremental contribution of PBAPS operation to the cumulative impacts on resource areas is discussed below.

4.12.1 Land Use and Visual Resources

As discussed in Section 4.1, as PBAPS will not be making any changes to the facility and has no plans for new construction, license renewal will have a SMALL impact on land use and visual resources during the license renewal term. Therefore, the incremental contribution to cumulative impacts to land use or visual resources would also be SMALL.

4.12.2 Meteorology and Air Quality

The PBAPS site is located within the South Central Pennsylvania Intrastate AQCR. The counties in the AQCR are Adams County, Cumberland County, Dauphin County, Franklin County, Lancaster County, Lebanon County, Perry County, and York County (40 CFR 81.105). The AQCR is designated as being in attainment for all criteria pollutants, except ozone. Lancaster County, immediately across the Susquehanna River from PBAPS, is designated as a nonattainment area for ozone and classified marginal. Nearby, the Metropolitan Philadelphia Interstate AQCR includes counties in Pennsylvania (Bucks, Chester, Delaware, Montgomery, and Philadelphia), New Jersey (Burlington, Camden, Gloucester, Mercer, and Salem), and Delaware (New Castle). The Metropolitan Philadelphia Interstate AQCR is designated as nonattainment for ozone (EPA 2016a). The only local projects that could contribute with PBAPS to air quality impacts are the ODEC natural gas-fired plant and the York Energy Center Block 2; however, as all facilities must be permitted through the same state system, cumulative impacts would be assessed by the state during the permitting process. Therefore, any potential negative impacts to air quality would be identified and mitigated. Therefore, the incremental contribution to cumulative impacts to air quality associated with the continued operation of PBAPS would be SMALL.

As noted in Section 4.2, no refurbishment or other construction projects are planned at PBAPS. Therefore, no changes to existing air quality conditions would occur due to continued operations at PBAPS and the incremental contribution to cumulative impacts of license renewal to the region’s air quality would be SMALL.

4.12.3 Noise

Although the numerous regional transportation projects introduced above would contribute to noise in the project area, these projects would be temporary in nature and would not cause any significant impacts. The construction and operation of the ODEC power plant is 6.5 miles southeast from PBAPS and would not be noticeable at this distance. Similarly, construction and operation of the York Energy Center Block 2, located approximately 2.6 miles southwest from PBAPS, would have no noticeable cumulative noise effects in areas near the PBAPS site. As noted in Section 4.3, no refurbishment or other construction projects are planned at PBAPS and license renewal would have a SMALL impact on noise in the area. Therefore, no changes to existing noise conditions would occur due to continued operations at PBAPS and, the incremental contribution to cumulative impacts to noise associated with the continued operation of PBAPS would be SMALL.

4.12.4 Geology and Soils

As noted in Section 4.4, no changes to existing conditions with respect to geology and soils are anticipated during the license renewal term. Therefore, the incremental contribution to cumulative impacts to the region's geology or soils associated with the continued operation of PBAPS would be SMALL.

4.12.5 Water Resources

4.12.5.1 Surface Water Use

As described in Subsection 4.5.1, impacts from the PBAPS license renewal on surface water use would be SMALL, and would not warrant mitigation. This determination was arrived at by considering effects from existing water users with intakes on Conowingo Pond, and overall planning efforts for the Lower Susquehanna River. According to the 2006 Conowingo Pond Management Plan, water in the reservoir is used for electric generation and public water supply. Conowingo Dam, Muddy Run, and PBAPS all consume water in the pond. Public water supply withdrawals include the Chester Water Authority, the City of Baltimore, Harford County and the City of Havre de Grace. Increasing upstream consumption has concerned the SRBC due to potentially low water levels in the pond (SRBC 2006). The SRBC is responsible for managing the water resources of Conowingo Pond and the Lower Susquehanna River Basin. The Comprehensive Plan is cumulative in that it includes all current uses of surface water. It also incorporates predicted projects and plans, which could impact water use. As this management plan is cumulative, PBAPS is already subject to the SRBC's regulations, and additional potential water uses would also be managed to minimize any impacts associated with over-use. SRBC Docket for PBAPS, which is discussed in Subsection 4.5.1, provides for mitigation of water use impacts during periods of low flow in the Susquehanna River. None of the proposed or in-progress projects in the vicinity would impact water use beyond the capacity of the SRBC to regulate it. Accordingly, and because the result presented in Subsection 4.5.1 is based on a cumulative analysis, PBAPS's incremental contribution to cumulative surface water use would be SMALL.

4.12.5.2 Groundwater Use

As described in Subsection 2.2.3, PBAPS uses less than 378 L/min (100 gpm) of groundwater and thus, does not create an offsite cone of depression. The closest public water supply well is approximately 10 km (6 miles) northwest of the site. As discussed in Subsection 4.5.2.2, consumptive surface water use by PBAPS has no effect on groundwater levels in the alluvial aquifer because the net consumptive use of the river is less than 5 percent of historic minimum average flow (1500 cfs), and 0.2 percent of mean average flow (38,370 cfs). PBAPS groundwater withdrawals also have no effect on the river water level or the alluvial aquifer because groundwater use is lower than 100 gpm (Subsection 4.5.2.1). Additionally, none of the proposed or in-progress projects in the vicinity would impact groundwater use. Consequently, PBAPS's incremental contribution to cumulative groundwater use would be SMALL.

4.12.5.3 Groundwater Quality

As discussed in Subsection 4.5.2.3, the impact of license renewal on groundwater quality would be SMALL and would not warrant mitigation. There would be no seepage from the cooling pond as PBAPS does not have a cooling pond. Additionally, there is no contact with the alluvial aquifer, further minimizing possible impacts to groundwater quality. None of the proposed or in-progress projects in the vicinity would impact groundwater quality. Therefore, the incremental contribution of continued operation of PBAPS to cumulative impacts to groundwater quality would be SMALL.

4.12.6 Ecological Resources

4.12.6.1 Terrestrial Resources

As described in Subsection 4.6.1.1, the impacts of the PBAPS license renewal on terrestrial resources would be SMALL and would not warrant mitigation. Wildlife and plant species on the developed parts of the PBAPS property are common species adapted to industrial sites and able to tolerate relatively high levels of noise and human activity. The characteristics of terrestrial communities on less developed property outside the protected area reflect the communities' adaptations to the activities at PBAPS, which are not expected to change during the license renewal term. As PBAPS does not have any plans for construction of new facilities, continued operations would not contribute to cumulative impacts, as PBAPS would not be impacting terrestrial resources.

Subsection 3.5.1.2.1 explains that the SRBC manages water resources and limits water-use conflicts within the Susquehanna River Basin Watershed through comprehensive planning and coordination with three states and the federal government. The SRBC Docket for PBAPS requires the station to provide consumptive use mitigation during low-flow conditions in the Susquehanna River through releases from Conowingo Dam or other SRBC-approved sources. Hence, the contribution to cumulative impacts on terrestrial resources in riparian communities from extending operation of PBAPS for the 20-year renewal term would be SMALL because (1) the withdrawal of Conowingo Pond water by PBAPS has almost no effect on river flow or level during normal or higher flows, (2) SRBC Docket for PBAPS would mitigate potential impacts from consumptive cooling water withdrawals during drought conditions, and (3) PBAPS groundwater use has no impact on the alluvial aquifer.

Based on the information provided above, Exelon Generation concludes that the incremental contribution of the continued operation of PBAPS to cumulative impacts on terrestrial resources would be SMALL.

4.12.6.2 Aquatic Resources

As described in Subsection 4.6.2, the impacts of the PBAPS license renewal on aquatic resources from thermal effects, entrainment, impingement, or water use conflicts would be SMALL and would not warrant mitigation.

Subsection 3.5.1.3 describes existing water quality in the Susquehanna River. Such existing water quality reflects the cumulative effect of pollutants from existing dischargers that could potentially affect aquatic resources, most of which (including PBAPS), are subject to controls imposed through NPDES permits. The NRC has determined that non-cooling system surface water quality impacts from nuclear plants are SMALL for all plants (10 CFR 51.53).

The current NPDES permit (No. PA0009733) for PBAPS requires the facility to comply with BTA standards that limit impingement and entrainment mortality from operation of the cooling water intake. Almost 30 years of fisheries monitoring in the Susquehanna River (Conowingo Pond) has shown no significant impacts related to the operation of the PBAPS intake, in addition to the intakes of other surface water users of the pond (described in Subsection 4.12.5). Ongoing compliance with NPDES permit conditions will ensure that such impacts will continue to be minimized by employing BTA for intake structures; therefore, the impacts of impingement and entrainment over the license renewal term would be SMALL and would not warrant additional mitigation.

PBAPS's thermal discharges comply with applicable NPDES permit conditions, affect a very small area of Conowingo Pond, and do not create a barrier to upstream and downstream fish movement patterns. Additionally, the current NPDES permit contains mitigation measures to be used if temperature critical levels are exceeded, or if drought or hot weather begins to impact pond temperatures. The existing NPDES discharges to Conowingo Pond are regulated by PADEP, and any new discharges to the basin would also be regulated by PADEP, thereby minimizing potential cumulative thermal impacts to aquatic resources across the entire basin. Because thermal discharges from PBAPS are expected to remain at existing levels throughout the term of the extended license, thermal impacts to aquatic organisms over the renewed license term would continue to be SMALL and would not warrant additional mitigation.

Based on the information provided above, Exelon Generation concludes that the incremental contribution of the continued operation of PBAPS to cumulative impacts on aquatic resources would be SMALL.

4.12.6.3 Special Status Species and Habitats

Table 3.6-3 lists the endangered or threatened species identified from the PNHP online PNDI database, the USFWS online IPaC tool, agency correspondence, and institutional knowledge. No federally listed aquatic species have been collected in Conowingo Pond. The federally listed Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), endangered shortnose sturgeon (*Acipenser brevirostrum*), and Maryland darter (*Etheostoma sellare*) have been collected below the Conowingo Dam. The state-listed Chesapeake logperch has been collected within Conowingo Pond, and the state-listed hickory shad (*Alosa mediocris*) has been recorded entering Conowingo Pond via the EFL.

USFWS IPaC identified four federally listed terrestrial animal species known or believed to occur in York County: Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), bog turtle (*Glyptemys muhlenbergii*), and red knot (*Calidris canutus* rufa). Although the bald eagle was delisted under the ESA list in 2007, it is still protected under the BGEPA, the MBTA, and the Lacey Act (USFWS 2015b). As of 2011, there were 11 known bald eagle nests located along the Susquehanna River from the Holtwood Dam downstream to the river's confluence with Chesapeake Bay (Exelon Generation 2012a).

The PNDI also identified two terrestrial plant species with state-listed status of threatened as having recorded occurrences in the vicinity of PBAPS: Harbinger-of-spring (*Erigenia bulbosa*) and American holly (*Ilex opaca*). The lobed spleenwort (*Asplenium pinnatifidum*), which was also identified as occurring within the Atom Road Woods Site (YCPC 2004), currently has no legal status but is under review for possible future listing.

Subsection 4.6.3 addresses potential impacts to special-status species and concludes that it is unlikely that any activities at PBAPS would adversely impact any of the species known to exist on or near the project site. Exelon Generation has no plans to conduct refurbishment or construction at PBAPS in support of license renewal. Accordingly, there would be no impacts to special status species from such activities. Also, Exelon Generation is not aware of any PBAPS activities during the license renewal period that would adversely impact special-status species that may occur at or near the site. Operations and maintenance activities during the license renewal term are expected to be similar to current activities, and existing procedures consider impacts to threatened and endangered species and their habitats as part of operations and maintenance planning. Any major construction projects in the vicinity that might contribute to cumulative impacts to special status species would be regulated separately by the USFWS and the PA DCNR. Therefore, these impacts would also be minimal.

Based on the information provided above, Exelon Generation concludes that the incremental contribution of the continued operation of PBAPS on the cumulative impacts to any special status species would be SMALL.

4.12.7 Historic and Archaeological Resources

As discussed in Section 4.7, no refurbishment activities or construction of license renewal-related facilities are planned at PBAPS to support license renewal. PBAPS has procedures to protect previously unknown historic or cultural resources that may be discovered on the site during the license renewal term. Also, SLR will have no effect on historic structures associated with Units 1, 2, and 3, and appropriate consideration will be given to the historic significance of any such onsite structures at the time of decommissioning. Hence, Exelon Generation concludes that PBAPS's continued operation would not contribute to cumulative adverse impacts on historic and cultural resources.

4.12.8 Socioeconomics

Section 2.5 on employment at PBAPS, Section 3.8 on socioeconomic conditions of York and Lancaster Counties, and Section 3.10 on minority and low-income populations within an 80-km (50-mile) radius of the plant provide background information pertinent to cumulative socioeconomic impacts. Site-specific socioeconomic impacts were not evaluated for PBAPS in this environmental report because the NRC has already generically concluded (NRC 2013a) that potentially adverse socioeconomic impacts from the continued operation of any nuclear plant would be SMALL and do not require plant-specific analyses. PBAPS's impacts to minority and low-income populations were evaluated in Section 4.10.

Continued operation of PBAPS during the license renewal term would have no impact on socioeconomic conditions in the region beyond those already experienced. Because Exelon Generation has no plans to significantly alter the number of workers during the license renewal term, overall expenditures and employment levels at the PBAPS would remain relatively constant and would not increase the demand for permanent housing or public services. Therefore, changes to population or tax-related land use impacts from PBAPS are not expected. Although the population of both counties continues to grow, the York and Lancaster County Comprehensive Plans identified no major future development plans that would affect land use, housing, taxes, education or public services in the vicinity of PBAPS. Therefore, the incremental contribution of the continued operation of PBAPS during the license renewal term to socioeconomics would be SMALL.

4.12.9 Human Health

4.12.9.1 Non-Radiological Health Impacts

Non-radiological health impacts potentially could include local impacts from fugitive dust and vehicle emissions, occupational injuries, noise, and vehicle accidents during the transport of materials or commuting. However, PBAPS license renewal, which would not involve construction or refurbishment, would not be a source of fugitive dust or construction noise. Site-specific impacts from vehicle emissions, occupational injuries, noise from operations, and traffic and transportation were not evaluated in this environmental report because such impacts already have been determined by NRC to be SMALL for all nuclear plant sites. Therefore, Exelon Generation concludes that PBAPS's license renewal contribution to cumulative, non-radiological, health impacts would be SMALL.

The potential for effects on human health from exposure to microbiological pathogens was considered in Subsection 4.9.1. Based on the characteristics of the thermophilic pathogen *Naegleria fowleri* and the thermal characteristics of the cooling water discharge and the mixing zone in Conowingo Pond near the facility, ongoing operation of PBAPS is not expected to promote the growth of this organism in Conowingo Pond or the exposure and infection of people using the reservoir. Effects from microbiological organisms have not been observed during past PBAPS operations, license renewal will not change thermal characteristics of the cumulative discharge to

Conowingo Pond, and compliance with NPDES permit thermal discharge limits will continue to control the potential for impacts on human health from microbiological organisms in Conowingo Pond (NRC 2014). Consequently, Subsection 4.9.1 concluded that the potential effects of microbiological organisms on human health from the operation of the PBAPS cooling water discharge over the license renewal term would be SMALL on and in the vicinity of the station. The area which could be affected by cumulative impacts of thermophilic pathogens on human health includes the portion of Conowingo Pond within the mixing zone of the PBAPS cooling water discharge. Calpine Mid Merit, LLC has a NPDES permit for discharging of cooling tower blowdown from the York Energy Center (PADEP 2017b). This discharge would also be regulated by PADEP and therefore, thermal discharge limits on both plants could be adjusted if thermal impacts caused Conowingo Pond to become a more favorable environment for *Naegleria fowleri* development. Exelon Generation is aware of no other existing or reasonably foreseeable facilities with thermal discharges to Conowingo Pond that would affect this area. Therefore, Exelon Generation concludes that incremental contribution of PBAPS license renewal to cumulative impacts on human health due to the growth of microbiological pathogens in Conowingo Pond would be SMALL.

The potential for effects on human health from exposure to electric shock hazards was considered in Subsection 4.9.2. The only in-scope, offsite, transmission line identified in Subsection 4.9.2 is the 34.5-kV submarine cable from Conowingo Dam to PBAPS, which provides offsite power during SBO events. All other in-scope transmission lines are located entirely on the PBAPS property, which is not accessible to members of the public. The 34.5-kV cable is submersed at the bottom of Conowingo Pond or buried underground for most of its length. Accordingly, due to its relatively low voltage and inaccessibility, the 34.5-kV submarine cable has little potential to create an induced current shock hazard for members of the public. Also, because of its location, it does not interact cumulatively with electric fields from other transmission lines. Thus, Exelon Generation concludes that the incremental contribution from PBAPS in-scope transmission lines to cumulative human health impacts from electric shock hazards would be SMALL.

4.12.9.2 Radiological Health Impacts

Radiological dose limits for protection of the public and workers have been developed by EPA and NRC to ensure that the cumulative impacts of acute and long-term exposure to radiation and radioactive material are SMALL regardless of the source or sources. Operation of PBAPS during the license renewal term will comply with these dose limits, which are codified in 40 CFR Part 190, 10 CFR Part 20 and 10 CFR Part 50, Appendix I. For the purpose of this cumulative analysis, the area within a 50-mile radius of PBAPS was included. As discussed above, three other nuclear power facilities are located within a 50-mile radius: Salem/Hope Creek (43 miles southeast), Three Mile Island (33 miles northwest), and Limerick (47 miles northeast). These facilities also are required to comply with the radiation dose limits established by EPA and NRC. Therefore, Exelon Generation concludes that the incremental contribution of continued operation of PBAPS to cumulative radiation doses and associated health impacts to workers and the public from all sources would be SMALL.

4.12.10 Environmental Justice

As noted in Section 4.10, there would be no disproportionately high and adverse health or environmental impacts from PBAPS to minority or low-income populations in the region. Hence, Exelon Generation concludes that the incremental contribution of the continued operation of PBAPS to the cumulative environmental justice conditions in the region would be SMALL during the license renewal term.

4.12.11 Waste Management

As stated in Section 4.11, no refurbishment or changes to plant operational activities that would affect waste management are expected as a result of SLR. Additionally, no new and significant information was identified. Therefore, PBAPS's incremental contribution to changes in the cumulative waste management conditions in the region would be SMALL during the license renewal term.

TABLE 4.12-1
ELECTRICAL GENERATION FACILITIES IN YORK AND LANCASTER COUNTIES

Power Plant	Average Capacity (MW)
York County	
Brunner Island	1,411
Brunner Island IC	7.4
P.H. Glatfelter Company - Pennsylvania	89.3
Peach Bottom	2,576
Tolna	50
Turnkey Project - GlaxoSmith	1.5
York Cogeneration	56.6
York County Resource Recovery Center	29.5
York Energy Center (Delta Power Project)	545
York Haven	10
Lancaster County	
Lancaster Dart Container Corp	10.4
Frey Farm Landfill	3.2
Holtwood Hydroelectric Plant	249
Honey Brook Generating Station (Granger)	3.2
Keystone Solar Project	5
Lancaster County Resource Recovery	32.4
Martin Limestone Solar Array Plant	1
Muddy Run Pumped Storage Facility	1,070
Safe Harbor	417.5
Turkey Point Wind Project (Frey Farm Wind)	3.2
Zook Generating Station (L&S Sweetners [sic])	3.2

Source: (Pennsylvania Public Utility Commission 2016)

4.13 URANIUM FUEL CYCLE

The following Category 1 issues related to the uranium fuel cycle were identified in the 2013 GEIS:

- Issue 74 - Offsite radiological impacts— individual impacts from other than the disposal of spent fuel and high-level waste
- Issue 75 - Offsite radiological impacts— collective impacts from other than the disposal of spent fuel and high-level waste
- Issue 76 - Non-radiological impacts of the uranium fuel cycle
- Issue 77 - Transportation

No new and significant information was identified; therefore, the conclusions regarding impacts to the uranium fuel cycle in the 2013 GEIS are considered appropriate for the PBAPS SLR, are incorporated herein by reference, and do not need further analysis.

4.14 TERMINATION OF NUCLEAR PLANT OPERATIONS AND DECOMMISSIONING

The following Category 1 issue was identified in the 2013 GEIS:

- Issue 78 - Termination of plant operations and decommissioning

No new and significant information was identified; therefore, the conclusions in the GEIS regarding impacts due to termination of nuclear plant operations and decommissioning are considered appropriate for the PBAPS SLR, are incorporated herein by reference, and do not need further analysis.

4.15 POSTULATED ACCIDENTS

4.15.1 Design-basis Accidents

The 2013 GEIS defines postulated accidents to include the following Category 1 issue:

- Issue 65 - Design-basis accidents

No new and significant information was identified regarding impacts from design-basis accidents. Therefore, the conclusions in the 2013 GEIS are considered appropriate for the PBAPS SLR, are incorporated herein by reference, and do not need further analysis.

4.15.2 Severe Accidents

NRC

"If the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment, a consideration of alternatives to mitigate severe accidents must be provided." 10 CFR 51.53(c)(3)(ii)(L)

"The probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives." 10 CFR Part 51, Subpart A, Appendix B, Table B-1, Issue 66.

The 2013 GEIS concluded that the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents would be small for all plants. The 2013 GEIS further concluded that applicants for license renewal of plants that have not already had a Severe Accident Mitigation Alternatives (SAMA) analysis considered by the NRC as part of an Environmental Impact Statement (EIS), supplement to an EIS, or an Environmental Assessment, must perform a SAMA analysis for license renewal. The site-specific nature of the SAMA analysis, when one is required, resulted in the categorization of severe accidents as a Category 2 issue. Notwithstanding, the NRC has ruled that, when a plant qualifies for the exception in 10 CFR 51.53(c)(3)(ii)(L) from the requirement to consider SAMAs, the exception operates to designate this Category 2 issue as the "functional equivalent" of a Category 1 issue (Exelon Generation Company, LLC (Limerick Generating Station, Units 1 and 2), CLI-13-07, 78 NRC 199, 211 (2013)). In the context of its SLR, PBAPS qualifies for this exception. Accordingly, in a manner similar to the treatment of other Category 1 issues, Exelon Generation conducted a review for new and significant information related to the following generic conclusions in the 2013 GEIS concerning this issue.

1. The probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are small for all plants.

2. License renewal environmental reports for plants for which SAMAs have been previously considered need not consider SAMAs.

4.15.2.1 Probability-Weighted Consequences of Severe Accidents Are Small

The assessment process for new and significant information related to the first conclusion mentioned in Subsection 4.15.2 included: (1) interviews with Exelon Generation subject matter experts on the validity of the conclusions in the 1996 and 2013 GEISs as they relate to PBAPS, and (2) review of documents related to predicted impacts of severe accidents at PBAPS. Consideration was given to developments in plant operation and accident analysis that could have changed the assumptions made concerning severe accident consequences after SAMAs were previously evaluated by the NRC for PBAPS in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Supplement 10 Regarding Peach Bottom Atomic Power Station, Units 2 and 3* (NRC 2003). Developments in the following areas were included: new internal events information; external events; new source term information; power uprates; higher fuel burnup; and other considerations including population increase and risk-beneficial plant changes implemented in response to recommendations from the Fukushima Daiichi Near Term Task Force.

No new and significant information was identified. Core damage frequencies (CDFs) from internal events have followed a decreasing trend at both PBAPS units since the previous SAMA analysis was performed in 2003 (NRC 2003). Calculated fire and seismic CDFs for each PBAPS unit are lower than the internal events mean value CDF for all BWRs used in the 1996 GEIS to estimate probability-weighted, offsite consequences from airborne, surface water, and groundwater pathways. Estimated population increase is within the range determined by the NRC in the 2013 GEIS to be not significant. Also, changes have been implemented at the site in response to Fukushima Daiichi Near Term Task Force recommendations and other plant-specific programs that are “risk-beneficial” but not credited in PBAPS PRA models. Therefore, the NRC conclusion in the 1996 and 2013 GEISs that “the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to groundwater, and societal and economic impacts from severe accidents are small” is considered appropriate for the PBAPS SLR, is incorporated herein by reference, and no further analysis is needed.

4.15.2.2 Consideration of SAMAs Is Not Required For PBAPS

Because Exelon Generation performed and submitted a SAMA analysis as part of a 40-to-60-year license renewal application for PBAPS (Exelon Generation 2001), consistent with the second conclusion mentioned in Subsection 4.15.2, it is not required to submit a SAMA analysis as part of any subsequent license renewal application. Instead, the environmental report must contain any new and significant information pertinent to the previous SAMA analysis of which the applicant is aware.

The assessment process used by Exelon Generation in its review for new and significant information related to the second conclusion was developed by the NEI on behalf of industry and has been reviewed by the NRC staff. It is referred to herein as “the NEI model approach,” and it provides a multi-stage assessment process for determining whether or not there is any “new and significant” information relevant to a previous SAMA analysis. If information that is both new and significant is determined to exist, an updated SAMA assessment would follow.

The first stage of the process uses probabilistic risk assessment insights and/or risk model quantifications to estimate the percent of maximum benefit (MB) reduction associated with (1) unimplemented Phase 2 SAMAs[2] for the analyzed plant and (2) those SAMAs identified as potentially cost beneficial for other industry plants that have been determined to be applicable to the analyzed plant. Consistent with the NRC’s rulings that new and significant information is that which "presents 'a seriously different picture' of the environmental impacts … compared to the previously issued final environmental impact statement,” (NextEra Energy Seabrook, LLC (Seabrook Station, Unit 1), CLI-16-03, 83 NRC 52, 55 (2016)), the first stage examines whether such potentially cost-beneficial SAMAs might reduce severe accident risk substantially. If it can be demonstrated that none of the SAMAs being evaluated can reduce the MB by 50 percent or more, then the applicant may document the conclusion that there is no “new and significant” information relevant to the previous SAMA analysis.

In the event that any SAMAs evaluated in Stage 1 are shown to reduce the MB by 50 percent or more, Stage 2 of the NEI model approach would be used to develop an updated averted cost-risk estimate for implementing those SAMAs. Two options are provided for performing the Stage 2 assessment:

- Option 1: Perform a simplified (conservative) Level 3 model update to support the update of the averted cost-risk calculations.
- Option 2: Perform a full Level 3 model update to support the update of the averted cost-risk calculations.

In the event that refinements to the averted cost-risk calculations related to the Stage 2 assessment demonstrate that the MB reduction is less than 50 percent for all SAMAs, then the applicant may document the conclusion that there is no “new and significant” information relevant to the previous SAMA analysis.

[2] NEI 05-01a [“Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document”. Rev A. November 2005] provides a description of the Phase 1 and Phase 2 analyses. An unimplemented Phase 2 SAMA is a SAMA that was not screened in the Phase 1 process and has not been implemented at the analyzed plant/site. For PBAPS, which completed its SAMA analysis prior to the publication of NEI 05-01a, identification of the “Phase 2 SAMAs” required reperforming the original Phase 1 and Phase 2 screening processes using the NEI 05-01a, Section 6 criteria.

If the results of the Stage 2 assessment indicate that one or more SAMAs reduce the MB by 50 percent or more, then the impact of new information on those SAMAs is further assessed to determine whether it is significant. New information will be deemed "potentially significant" to the extent it results in the identification of an unimplemented SAMA that reduces the MB by 50 percent or more.

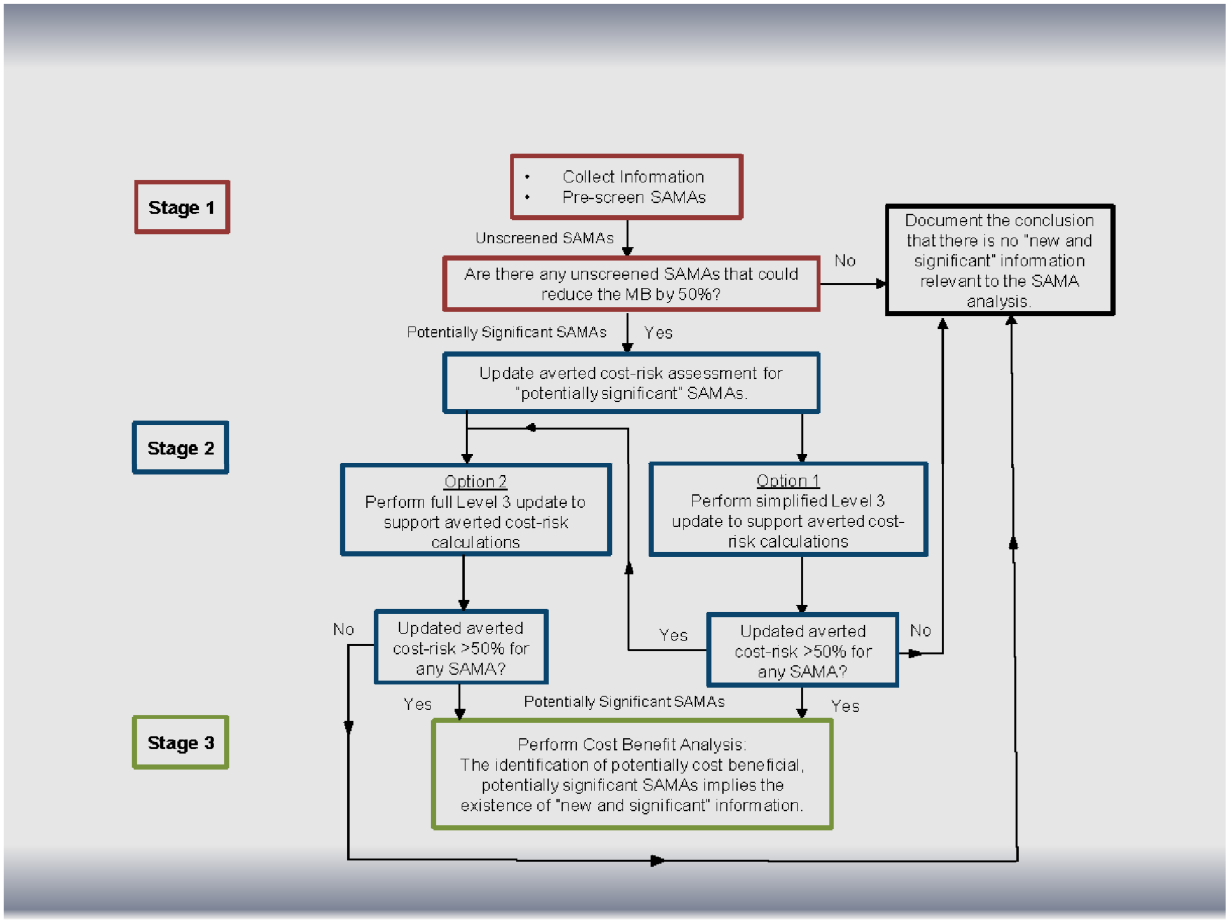
The final determination of significance will be made in the Stage 3 assessment, which consists of performing a cost-benefit analysis for unimplemented SAMAs that reduce the MB by 50 percent or more (i.e., "potentially significant" SAMAs). If such SAMAs are found to be potentially cost-beneficial, then they indicate the existence of "new and significant' information relevant to the previous SAMA analysis.

Figure 4.15-1 provides a flowchart of the 3-stage assessment process.

For PBAPS, a Stage 1 assessment was completed. A total of 180 PBAPS unimplemented Phase 2 SAMAs (30) and applicable industry SAMAs (150) were identified for Stage 1 evaluation. First, the following pre-screening criteria were applied, which reduced to 24 the number of SAMAs for which quantification of CDFs and Level 2 release category frequencies was needed:

1. Not Applicable: If a SAMA candidate does not apply to the plant design, it may be excluded from further review.
2. Already Implemented: If a SAMA candidate has already been implemented at the plant, or its benefit achieved by other means, it may be excluded from further review.
3. Combined: If a SAMA candidate is similar in nature and can be combined with another SAMA candidate to develop a more comprehensive or plant-specific SAMA candidate, only the combined SAMA candidate is retained.
4. Reclassified as a Phase 1 SAMA: If a PBAPS SAMA candidate was screened in the PBAPS 40-to-60-year Phase 2 SAMA analysis because the cost of implementation exceeded the maximum averted cost risk, the SAMA can be reclassified as a Phase 1 SAMA, which does not need further analysis.

None of the 24 SAMAs for which quantifications were performed reduced the MB for PBAPS by 50 percent or more. Therefore, it was concluded that no "new and significant" information relevant to the PBAPS SAMA analysis exists, and no further analysis is needed.



Source: (NEI 2017b)

Figure 4.15-1 SAMA "New & Significant" Assessment Flowchart

Assessment of New and Significant Information

5.0 ASSESSMENT OF NEW AND SIGNIFICANT INFORMATION

NRC

> **"The environmental report must contain any new and significant information regarding the environmental impacts of license renewal of which the applicant is aware." 10 CFR 51.53(c)(3)(iv)**

The NRC licenses operation of domestic nuclear power plants and provides for license renewal, requiring a license renewal application that includes an environmental report (10 CFR 54.23). NRC regulations, 10 CFR Part 51, prescribe the environmental report content and identify the specific analyses the applicant must perform. In an effort to streamline the environmental review, NRC has resolved most of the environmental issues generically (Category 1 issues) and requires an applicant's analysis of only the remaining site-specific issues (Category 2 issues).

While NRC regulations do not require an applicant's environmental report to contain analyses of the impacts of those Category 1 environmental issues that have been generically resolved [10 CFR 51.53(c)(3)(i)], the regulations do require that an applicant identify any new and significant information of which the applicant is aware that relates to those issues [10 CFR 51.53(c)(3)(iv)]. The purpose of this requirement is to alert NRC staff to such information, so the staff can determine whether to seek the NRC's approval to waive or suspend application of the rule with respect to the affected generic analysis. NRC has explicitly indicated, however, that an applicant is not required to perform a site-specific validation of GEIS conclusions (NUREG-1529).

Exelon Generation expects that new and significant information would include:

- Information that identifies a significant environmental issue not covered in the GEIS and consequently not codified in the regulation, or
- Information or circumstances at a site that were not considered in the GEIS analyses and that lead to an impact finding that presents a seriously different picture of the environmental impact of the proposed project in comparison with what was envisioned in the GEIS.

NRC has not provided specific criteria for evaluating whether new information or circumstances present a seriously different picture of environmental impacts than were generically resolved to be Category 1 issues, thus making them "significant." Therefore, for the purpose of its review, Exelon Generation used guidance available in CEQ regulations. NEPA authorizes CEQ to establish implementing regulations for federal agency use. NRC requires license renewal applicants to provide NRC with input, in the form of an environmental report, that NRC will use to meet NEPA requirements as they apply to license renewal (10 CFR 51.10).

CEQ guidance provides that federal agencies should prepare environmental impact statements for actions that would significantly affect the environment (40 CFR 1502.3), focus on significant environmental issues (40 CFR 1502.1), and eliminate from detailed study issues that are not significant [40 CFR 1501.7(a)(3)]. The CEQ guidance includes a lengthy definition of "significantly" that requires consideration of the context of the action and the intensity or severity of the impact(s) (40 CFR 1508.27). Exelon Generation considered that MODERATE or LARGE impacts, as defined by NRC, would be seriously different than previously envisioned impacts for Category 1 issues.

Therefore, only new information that would suggest a change from SMALL impacts to either MODERATE or LARGE impacts for an issue considered in the GEIS or an issue not considered in the GEIS with MODERATE or LARGE impacts would be considered "significant." Chapter 4 presents the NRC definitions of SMALL, MODERATE, and LARGE impacts.

As part of the preparation of this license renewal application, Exelon Generation reviewed all Category 1 issues that apply to PBAPS for new and significant information. The assessment included: (1) interviews with Exelon Generation subject matter experts on the validity of the conclusions in the GEIS as they relate to PBAPS, (2) an extensive review of documents related to environmental issues at PBAPS, the Susquehanna River and the Conowingo Pond, (3) credit for Exelon Generation environmental monitoring and reporting required by regulations and oversight of Station facilities and operations by state and federal regulatory agencies (permanent activities that would bring significant issues to Exelon Generation's attention), (4) review of documentation supporting NRC's environmental reviews under NEPA for the previous PBAPS license renewal application filed in 2001 and EPU application filed in 2012, and (5) consultation with state and federal agencies about potential PBAPS effects on resources within their specific jurisdictions.

As Section 4.15 discusses, for PBAPS, the Category 2 issue related to severe accidents (Issue 66) is the "functional equivalent" of a Category 1 issue (CLI-13-07, II.A, p. 15). Because of this, no site-specific analysis of severe accident environmental impacts or mitigation alternatives is required for PBAPS. Section 4.15 describes Exelon Generation's process for assessing new and significant information related to Issue 66 and the conclusions.

In its entirety, Exelon Generation's assessment did not identify any new and significant information regarding the PBAPS environment or operations that would (1) make any generic conclusion codified by the NRC for Category 1 issues not applicable to PBAPS, (2) alter regulatory or GEIS statements regarding Category 2 issues, or (3) suggest any other measure of license renewal environmental impact not considered in the GEIS. Table 4.0-1 lists each applicable Category 1 issue and indicates sections of this ER that contain PBAPS information relevant to the assessment for new and significant information about the issue.

Chapter 6

Summary of License Renewal Impacts and Mitigating Actions

6.1 LICENSE RENEWAL IMPACTS

Exelon Generation has reviewed the environmental impacts of renewing the PBAPS operating licenses and has concluded that all impacts would be SMALL and would not require mitigation beyond existing levels. Nevertheless, Exelon Generation acknowledges that, as described in Subsection 4.6.2.1, final decisions about the need for additional measures for protecting special status species and meeting BTA standards for impingement and entrainment will be made in consultation with PADEP, as indicated in the PBAPS NPDES permit, and USFWS.

This Environmental Report documents the basis for Exelon Generation's conclusions. Chapter 4 incorporates by reference the NRC's findings for the 55 license renewal Category 1 issues identified in Appendix B to Subpart A of 10 CFR Part 51, Table B-1 that apply to PBAPS (Table 4.0-1), all of which have impacts that are SMALL.

Chapter 4 also presents PBAPS site-specific analyses of the Category 2 issues identified in Appendix B to Subpart A of 10 CFR Part 51, Table B-1, and concludes that such issues are either not applicable or have SMALL impacts.

In accordance with Appendix B to Subpart A of 10 CFR Part 51, Table B-1, footnote 6, the uncategorized issue related to chronic health effects of EMFs is described without evaluation in Section 4.9.

For the issue of severe accidents (GEIS Issue 66), which is a Category 2 issue that is evaluated functionally as a Category 1 issue for PBAPS SLR, Chapter 4 incorporates by reference the 2013 GEIS findings that environmental impacts from severe accidents are SMALL and further consideration of SAMAs is not needed because no new and significant information has been identified.

Table 6.1-1 identifies the impacts that PBAPS SLR would have on resources associated with the Category 2 issues.

TABLE 6.1-1
ENVIRONMENTAL IMPACTS RELATED TO LICENSE RENEWAL AT PBAPS

GEIS Issue No.	Category 2 Issue	PBAPS ER Section	Environmental Impact
Surface Water Resources			
17	Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river)	4.5.1	**SMALL**
Groundwater Resources			
22	Groundwater use conflicts (plants that withdraw > 100 gpm)	4.5.2.1	**NONE.** The issue does not apply because the plant does not use more than 100 gpm of groundwater from the four wells that provide non-potable water to remote facilities
23	Groundwater use conflicts (plants with closed-cycle cooling systems that withdraw makeup water from a river)	4.5.2.2	**SMALL**
26	Groundwater quality degradation (plants with cooling ponds at inland sites)	4.5.2.3	**NONE.** The issue does not apply because PBAPS does not use cooling ponds.
27	Radionuclides released to groundwater.	4.5.2.4	**SMALL**
Ecological Resources			
28	Effects on terrestrial resources (non-cooling system impacts)	4.6.1.1	**SMALL**
33	Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)	4.6.1.2	**SMALL**
36	Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	4.6.2.1	**SMALL**
39	Thermal impacts on aquatic organisms (plants with once- through cooling systems or cooling ponds)	4.6.2.2	**SMALL**
46	Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river)	4.6.2.3	**SMALL**
50	Threatened, endangered, and protected species and EFH	4.6.3	**UNLIKELY TO ADVERSELY AFFECT THREATENED OR ENDANGERED SPECIES and NO EFFECT ON DESIGNATED CRITICAL HABITAT OR EFH**

TABLE 6.1-1 (Cont'd)
ENVIRONMENTAL IMPACTS RELATED TO LICENSE RENEWAL AT PBAPS

GEIS Issue No.	Category 2 Issue	PBAPS ER Section	Environmental Impact
Historic and Cultural Resources			
51	Historic and cultural resources	4.7	**HISTORIC PROPERTIES ARE PRESENT, BUT ARE NOT ADVERSELY AFFECTED**
Human Health			
60	Microbiological hazards to the public (plants with cooling ponds or canals or cooling towers that discharge to a river)	4.9.1	**SMALL**
64	Electric shock hazards	4.9.2	**SMALL**
Postulated Accidents			
66	Severe accidents	4.15.2	**SMALL and FURTHER CONSIDERATION OF SAMAs IS NOT NEEDED because no new and significant information has been identified**
Environmental Justice			
67	Minority and low-income populations	4.10.1	**SMALL**
Cumulative Impacts			
73	Cumulative impacts	4.12	**SMALL**

6.2 MITIGATION

NRC

"The report must contain a consideration of alternatives for reducing adverse impacts… for all Category 2 license renewal issues…" 10 CFR 51.53(c)(3)(iii)

"The environmental report must include an analysis that considers and balances…alternatives available for reducing or avoiding adverse environmental effects." 10 CFR 51.45(c) as incorporated by 10 CFR 51.53(c)(2) and 10 CFR 51.45(c)

Chapter 4 in this Environmental Report concludes that impacts of PBAPS license renewal activities would be SMALL for all Category 2 issues to which the NRC applies the levels SMALL, MODERATE or LARGE as a measure of significance. Federally listed threatened or endangered species are determined "not likely to be adversely affected" by license renewal activities. Cultural resources are determined to be "not adversely affected." Also, Chapter 4 reports that no new and significant information has been identified for any applicable Category 1 issue and adopts by reference the findings of the 2013 GEIS of SMALL impacts for such issues. Because no new and significant information has been identified for the issue of severe accidents (Issue 66), which is a Category 2 issue that for PBAPS SLR is evaluated functionally as a Category 1 issue, Chapter 4 incorporates by reference the NRC's findings in the 2013 GEIS that environmental impacts from severe accidents are SMALL and further consideration of SAMAs is not needed. Chapter 5 indicates that no new and significant issues not previously evaluated in the 2013 GEIS have been identified.

Current operations include monitoring activities that would continue during the license renewal term. Exelon Generation performs routine monitoring to ensure the safety of workers, the public, and the environment. These activities include gaseous and liquid radiological release monitoring and environmental monitoring in accordance with the PBAPS operating license technical specifications issued by the NRC, groundwater monitoring in accordance with the PBAPS RGPP, effluent monitoring in accordance with the NPDES permit issued by PADEP, and monitoring of consumptive use mitigation in accordance with the Docket issued by the SRBC. These programs ensure that the Station's emissions and effluents are within regulatory limits, and that unusual or off-normal emissions are quickly detected, thus mitigating potential impacts.

Because all impacts of PBAPS SLR are small, consideration of alternatives for achieving further mitigation should not be necessary. Nevertheless, Exelon Generation acknowledges that, as described in Subsection 4.6.2.1, final decisions about the need for additional measures for protecting special status species and meeting BTA standards for impingement and entrainment will be made in consultation with PADEP, as indicated in the PBAPS NPDES permit, and USFWS.

6.3 UNAVOIDABLE ADVERSE IMPACTS

NRC

The environmental report shall discuss any "...adverse environmental effects which cannot be avoided should the proposal be implemented;" 10 CFR 51.45(b)(2) as adopted by 10 CFR 51.53(c)(2)

This Environmental Report adopts by reference the NRC findings in the 2013 GEIS for applicable Category 1 issues, including discussions of any unavoidable adverse impacts (Table 4.0-1). Exelon Generation examined the 17 Category 2 issues identified in the 2013 GEIS to assess site-specific impacts. Exelon Generation identified the following unavoidable adverse impacts of license renewal activities:

- Solid radioactive wastes are a product of plant operations and permanent disposal is necessary.
- Disposal of nonradioactive and radioactive wastes will result in a small impact as long as the plant is in operation. Disposal procedures for these wastes are intended to reduce adverse impacts to acceptably low levels.
- Operation of PBAPS results in a very small increase in radioactivity in air and water. However, there are no increases in external radiation or air dose from the plant above measurable background, and emissions to water and groundwater result in doses well below the regulatory allowable level. Operation of PBAPS also creates a very low probability of accidental radiation exposure to PBAPS employees and inhabitants of the area.
- Operation of PBAPS results in consumptive use of surface water.
- Loss of small numbers of adult and juvenile fish impinged on traveling screens.
- Loss of small numbers of larval fish and shellfish entrained at the intake structures.

6.4 IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

NRC

The environmental report shall discuss any "...irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented." 10 CFR 51.45(b)(5) as adopted by 10 CFR 51.53(c)(2)

Continued operation of PBAPS for the license renewal term will result in irreversible and irretrievable resource commitments, including the following:

- Nuclear fuel, which is used in the reactor and is converted to radioactive waste;
- Land required to permanently disposition offsite the following: spent nuclear fuel, low- level radioactive wastes generated as a result of plant operations, and nonradioactive industrial wastes generated from normal industrial operations;
- Elemental materials that will become radioactive; and
- Materials used for the normal industrial operations of PBAPS that cannot be recovered or recycled or that are consumed or reduced to unrecoverable forms.

6.5 SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY OF THE ENVIRONMENT

NRC

The environmental report shall discuss the "...relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity;" 10 CFR 51.45(b)(4) as adopted by 10 CFR 51.53(c)(2)

The current balance between short-term use and long-term productivity at the PBAPS site was basically set once the units began operating in the 1970s. The Final EIS related to the operation (AEC 1973) evaluated the impacts of operating PBAPS. Approximately 130 acres of the Conowingo Pond was filled or enclosed within the berm surrounding the outer intake structure, discharge basin, and discharge canal. It is likely that this acreage will not be recovered. However, this represents a small percentage of the total area of the pond and does not affect the aquatic habitat in any consequential way.

As discussed in Subsection 3.5.1.2, water resources of the Susquehanna River Basin Watershed are managed by the SRBC under comprehensive planning principles through its own programs and by coordinating the efforts of three states (Pennsylvania, New York, and Maryland) and the federal government. As part of the EPU project, PBAPS submitted a request for a Docket modification to the SRBC in September 2010 to increase consumptive water use to a peak of 49.000 MGD to address operational changes resulting from the planned replacement of low pressure turbines.

Approximately 100 acres of the 769.44-acre site have been developed. After decommissioning of the nuclear facilities at the site, most environmental disturbances would cease and restoration of the natural habitat could occur. Thus, the "trade-off" between the production of electricity and changes in the local environment is reversible to some extent.

Experience with other experimental, developmental, and commercial nuclear plants has demonstrated the feasibility of decommissioning and dismantling such plants sufficiently to restore a site to its former use. The degree of dismantlement will take into account the intended new use of the site and a balance among health and safety considerations, salvage values, and environmental impacts. However, decisions on the ultimate disposition of these lands have not yet been made. Continued operation for another 20 years beyond the currently licensed term would not increase the short- term productivity impacts described here.

Chapter 7

Alternatives to the Proposed Action

Peach Bottom Atomic Power Station Environmental Report – Operating License Renewal Stage

7.0 ALTERNATIVES TO THE PROPOSED ACTION

NRC

The environmental report shall discuss "Alternatives to the proposed action…" 10 CFR 51.45(b)(3) as adopted by reference at 10 CFR 51.53(c)(2)

"The report is not required to include discussion of need for power or economic costs and benefits of...alternatives to the proposed action except insofar as such costs and benefits are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation." 10 CFR 51.53(c)(2)

"These alternatives must be commercially viable on a utility scale and operational prior to the expiration of the reactor's operating license or be expected to become commercially viable on a utility scale and operational prior to the expiration of the reactor's operating license." NUREG-1437, Revision 1, p. 2-19

"Power could be provided by a suite of alternatives and combinations of alternatives...the number of possible combinations of alternatives that could replace the generating capacity of a nuclear power plant is potentially unlimited. Based on this, the NRC has only evaluated individual alternatives rather than combinations of alternatives. However, combinations of alternatives may be considered during plant-specific license renewal reviews." NUREG-1437, Revision 1, p. 2-18

"While the potential [of conservation and energy efficiency programs] to replace a large baseload generator may exist in some locations, it is more likely that conservation and energy efficiency programs will not be evaluated in site-specific license renewal reviews as stand-alone alternatives but may play an important role in the evaluation of a combination of alternatives." NUREG-1437, Revision 1, p. 2-33

"Importing power from outside a particular region or purchasing it from a generator in the same region are possible sources of replacement power." NUREG-1437, Revision 1, p. 2-31

Chapter 7 evaluates alternatives to PBAPS license renewal. The chapter identifies actions that Exelon Generation or other energy-planning decision makers might take, and associated environmental impacts, if the NRC does not renew the PBAPS operating licenses. The chapter also addresses actions that Exelon Generation has identified, but has concluded would not be taken, and discusses the bases for determining that such actions would be unreasonable.

In considering the level of detail and analysis that it should provide for each alternative, Exelon Generation relied on the NRC decision-making standard for license renewal: "…the NRC staff, adjudicatory officers, and Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decision makers would be unreasonable" [10 CFR 51.95(c)(4)].

Exelon Generation has determined that an environmental report would support NRC decision-making as long as the document provides sufficient information to clearly indicate whether an alternative would have a smaller, comparable, or greater environmental impact than the proposed action. Providing additional detail or analysis serves no function if it only brings to light additional adverse impacts of alternatives to license renewal. This approach is consistent with regulations of the CEQ, which provide that the consideration of alternatives (including the proposed action) should enable reviewers to evaluate their comparative merits (40 CFR Parts 1500-1508). Chapter 7 provides sufficient detail about alternatives to establish the basis for necessary comparisons to the Chapter 4 discussion of impacts from the proposed action. In characterizing environmental impacts from alternatives, this section uses the same definitions of SMALL, MODERATE, and LARGE as those presented in the introduction to Chapter 4. Also, the definitions of significance measures for (1) effects on historic and cultural resources, (2) effects on threatened and endangered species, and (3) effects on essential habitat of federally managed fish populations are the same as presented in Chapter 4.

7.1 NO-ACTION ALTERNATIVE

The "no-action alternative" refers to a scenario in which the NRC does not renew the PBAPS operating licenses. Unlike the proposed action, denying license renewal does not provide a means of meeting future electric system needs. Therefore, unless replacement generating capacity is provided as part of the no-action alternative, approximately 2,600 MWe of baseload generation would no longer be available, and the alternative would not satisfy the purpose and need for the proposed action (Exelon Corporation 2016b). For this reason, the no-action alternative is defined as having two components—termination of operations, which includes replacing the generating capacity of PBAPS and decommissioning, as described below.

In 2015, PBAPS provided 19,858 gigawatt hours (GWh) of electricity in the Commonwealth of Pennsylvania (EIA 2015b). During that same period, Pennsylvania obtained approximately 37.2 percent of its power from nuclear generation (EIA 2016c). PBAPS provided approximately 25 percent of that total, representing 9.25 percent of the electricity in Pennsylvania. This power was provided to the wholesale market and was used by two million residential and business customers (Exelon Corporation 2016b). As provided in 10 CFR 51.53(c)(2), Exelon Generation has not considered in this Environmental Report the need for power from PBAPS, but instead considered alternatives for replacing power from PBAPS. Replacement options to consider include (1) building new generating capacity using energy from coal, gas, nuclear, wind, solar, other sources, or some combination of these, (2) purchasing power from the wholesale market, or (3) reducing power requirements through demand-side management (DSM). Subsections 7.2.1 and 7.2.2 describe each of these alternatives in detail, and Subsection 7.2.3 describes environmental impacts from feasible alternatives.

The 2013 GEIS defines the "No-Action" alternative as the process of terminating plant operations followed by decommissioning, which includes reducing residual radioactivity to a level that permits the release of the property for unrestricted use or restricted use. The NRC-evaluated decommissioning options include immediate decontamination and dismantlement; safe storage of the stabilized and defueled facility, followed by additional decontamination and dismantlement; and encasing radioactive contaminants in a structurally long-lived material, such as concrete, and maintaining the entombment structure with continued surveillance. Regardless of the option chosen, decommissioning must be completed within the 60-year period following permanent cessation of operations and permanent removal of fuel. Under the no-action alternative, Exelon Generation would have the option to continue operating PBAPS until the existing licenses expire in 2033 and 2034, and then terminate operations and initiate decommissioning for both units in accordance with NRC requirements.

As the 2013 GEIS notes, the NRC has generically evaluated environmental impacts from decommissioning. NRC-evaluated decommissioning impacts include those to occupational and public radiation dose, waste management, air and water quality, and ecological, economic, and socioeconomic resources. The NRC indicated in the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1* (NUREG-0586) (NRC 2002) that the environmental effects of greatest concern (i.e., radiation dose and releases to the environment) are substantially less for decommissioning than the same effects resulting from reactor operations. Exelon Generation incorporates herein by reference the NRC conclusions from the 2013 GEIS (Section 4.12.2.1) and NUREG-0586 regarding environmental impacts of decommissioning for all PBAPS units.

Exelon Generation notes that decommissioning activities and their impacts are not discriminators between the proposed action and the no-action alternative. PBAPS will have to be decommissioned regardless of the NRC decision on SLR; which would only postpone decommissioning for another 20 years. The NRC has established in the 2013 GEIS that the timing of decommissioning operations does not substantially influence the environmental impacts of decommissioning. Exelon Generation adopts by reference the NRC findings (10 CFR Part 51, Subpart A, Appendix B, Table B-1) that delaying decommissioning until after the end of the renewal term would have little effect on decommissioning environmental impacts. The discriminators between the proposed action and the no-action alternative lay in the choice of generation replacement options associated with terminating plant operations that would be part of the no action alternative in addition to decommissioning. Section 7.2 analyzes the impacts from these options.

7.2 REPLACEMENT POWER ALTERNATIVES

PBAPS has an approximate annual average net capacity of 2,600 MWe (Exelon Corporation 2016b). PBAPS generated approximately 19,900 GWh of baseload power in 2015, and 18,800 GWh of baseload power in 2014 (EIA 2015b). PBAPS is considered a baseload generation station based on its 2015 capacity factor of approximately 92.9 percent (Exelon Corporation 2016b). This baseload power is sufficient to supply the electricity used by over 2 million residential and business customers (Exelon Corporation 2016b), and would be unavailable to customers in the event the PBAPS operating licenses are not renewed.

The power consumed in Pennsylvania is not limited to electricity generated within the Commonwealth. Pennsylvania relies on electricity drawn from the PJM, a regional network that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia. One consequence of the network is that electric power consumers in Pennsylvania are not dependent on electricity generated within the Commonwealth. The current mix of power generation options within the PJM is one indicator of what Exelon Generation considers to be feasible alternatives to the PBAPS. In 2016, electric generators connected to the PJM had a total generating capacity of 171,648 MWe (PJM 2016b). This capacity included units fueled by coal (36.6 percent), natural gas (35.6 percent), nuclear (18.2 percent), hydroelectric (4.9 percent), oil (3.7 percent), wind (0.6 percent), solid waste (0.4 percent), solar (0.1 percent) (Monitoring Analytics 2016). In 2016, electricity generators provided 792,000 GWh of electricity to the PJM. The fuel sources used to produce this electricity include nuclear (36 percent), coal (32 percent), natural gas (26 percent), wind (3 percent), hydroelectric (2 percent), solid waste (1 percent) (Monitoring Analytics 2016). Oil, solar, and other renewable fuel sources account for less than one percent each (Monitoring Analytics 2016). Figure 7.2-1 and Figure 7.2-2 respectively illustrate the distribution of fuel types contributing to the 2016 installed generating capacity and the electricity production of the PJM.

Comparing the fuel types of generating capacity with the fuel types actually utilized for electricity production indicates that generating units fueled by coal and nuclear are used by PJM substantially more relative to their installed capacity than either oil-fired or gas-fired generation. This comparison reflects the relatively low fuel cost and base-load suitability for nuclear and coal-fired power plants, and the relatively higher use of gas- and oil-fired units to meet peak loads. Comparison of installed capacity and energy production for petroleum and gas-fired facilities indicates a strong preference for gas firing over oil firing, indicative of the higher cost and greater air pollutant emissions associated with oil firing. Energy production from hydroelectric sources is typically preferred from a cost standpoint over production from plants fueled by nuclear and all three fossil fuels, but hydroelectric capacity is limited and utilization can vary substantially depending on water availability.

7.2.1 Alternatives Considered

For the purposes of this Environmental Report, alternative generating technologies were evaluated to identify candidate technologies that would be capable of replacing the PBAPS total net base-load capacity of 2,600 MWe at the time the PBAPS Unit 2 and Unit 3 licenses expire in 2033 and 2034, respectively. Exelon Generation accounted for the fact that PBAPS is a base-load generator and that any reasonable alternative to PBAPS would also need to be able to generate base-load power. Exelon Generation assumed that the region of interest (ROI) within which facilities would be sited for purposes of this alternatives analysis includes the states of Delaware, Maryland, and New Jersey, and the Commonwealth of Pennsylvania, which are the states within the PJM's network that are geographically closest to PBAPS.

Also, for the purposes of the PBAPS license renewal Environmental Report, Exelon Generation has limited analysis of impacts from new generating plant technology alternatives to the technologies it deems as reasonably likely to be commercially viable on a utility scale and operational by 2033:

- Gas-fired generation (combined cycle),
- Coal-fired generation (supercritical pulverized coal combustion),
- Purchased power
- Nuclear-powered generation (SMRs), and
- Combinations of technologies.

The gas-fired technology alternative that Exelon Generation has chosen to evaluate is the combined-cycle (combustion and steam) turbine rather than the simple-cycle (combustion-only) turbine. The combined-cycle option is more efficient and economical to operate since it uses the heated exhaust of the combustion turbines to produce steam in heat recovery steam generators (HRSGs), which is then used in the steam turbines to generate additional power. The benefits of lower operating costs for the combined-cycle option outweigh its higher capital costs. Exelon Generation assumes the use of natural gas as the primary fuel in combined-cycle combustion turbines because of the economic and environmental advantages of natural gas over oil and other types of gas. Manufacturers now have large standard sizes of combined-cycle turbines that are economically attractive and suitable for high-capacity base-load operation.

The generation information presented in Figure 7.2-2, which identifies coal as the most heavily used non-nuclear generating fuel type in the PJM, supports consideration of a coal-fired alternative because, although, as a company, Exelon Generation supports reducing carbon emission, future generation capacity may come from other companies. The coal-fired technology that Exelon Generation has chosen to evaluate is ultrasupercritical (USC) pulverized coal combustion with control technologies recognized by EPA for minimizing emissions. USC combustion technology generally refers to coal plants that operate at higher pressures and temperatures (exceeding 600 degrees C) where water changes from liquid directly to superheated steam. USC coal combustion technology is reportedly cleaner and more efficient than traditional combustion technology used at normal pulverized coal plants and can reach efficiencies up to 50 percent. Carbon dioxide (CO_2) emissions from USC plants are approximately 5.2 million tons per 1000 MWe. Improvements in efficiency result in reductions in the emissions of CO_2, SO_2, NOx, mercury, particulate, and fly ash (IEA ETSAP 2010).

In December 2012, the 600-MWe (624 MWe net output) John W. Turk Jr. power plant in Fulton, Arkansas became the first coal-fired power plant to use USC technology. POWER magazine, a power industry publication, named the Turk facility its Plant of the Year for 2013 based in part for its success in “overcoming numerous legal and regulatory obstacles” (Lewis 2014). Exelon Generation assumes new coal-fired plants would be of similar size, design, and operation.

There has been continuing advancement in the technology development of SMRs. The driving forces in the development of SMRs are: meeting the need for flexible power generation for a wider range of users and applications; replacing ageing fossil fuel-fired power plants; enhancing safety performance through inherent and passive safety features; offering better economic affordability; suitability for non-electric applications; options for remote regions without established electricity grid infrastructures; and offering possibilities for synergetic energy systems that combine nuclear and alternate energy sources (IAEA 2014). A number of SMR design concepts have been developed by various domestic and foreign consortia, including designs with various coolants such as helium gas (PBMR-165), liquid sodium metal (GE-Hitachi PRISM-311, Toshiba 4S-100), lead-bismuth metal eutectic (Hyperion Gen4-25), and more conventional light water technology. The principal light water SMR design concepts include the mPower™ design by Babcock & Wilcox (B&W), the Westinghouse 225, NuScale Power design, and the Holtec Inherently Safe Modular Underground Reactor (HI-SMUR). NuScale Power is the only SMR developer to have submitted a Design Certification Application to the NRC. NuScale’s Design Certification Application was accepted for review in early 2017. Exelon Generation believes construction of SMRs may become a reasonable base-load generation alternative to license renewal for the PBAPS units, considering that the existing PBAPS operating licenses expire in 2033 and 2034.

For the purpose of comparison, Exelon Generation has crafted an alternative that combines generation alternatives to replace PBAPS’s approximate annual average net baseload generating capacity. The combination considered is wind generation combined with photovoltaic (PV) solar generation and firming capacity in the form of gas-fired combined-cycle generation. Exelon Generation assumes that this combination of generation alternatives could adequately balance the electrical output from intermittent wind and solar energy sources to allow these sources to replace PBAPS’s baseload generating capacity by 2033, which is the earlier expiration year of the two PBAPS operating licenses.

Electric industry restructuring initiatives in the ROI have been designed to promote competition in energy supply markets, which Exelon Generation believes will result in a purchasable electricity supply sufficient to replace the baseload capacity of PBAPS by 2033 without construction of new power plants. However, some transmission facility construction may be needed, which would be situation specific. The technologies that would exist to generate purchased power are unknown. Therefore, Exelon Generation assumes that the generating technologies likely would be among those described in the 2013 GEIS as replacement generation alternatives (i.e., fossil fuel-fired, renewable, and nuclear).

7.2.2 Descriptions of Alternatives

The following subsections present fossil-fuel-fired (natural gas and coal) generation capacity (Subsections 7.2.2.1 and 7.2.2.2), purchased power (Subsection 7.2.2.3), new nuclear generation capacity (Subsection 7.2.2.4), and combinations of various energy supplies, including wind and solar (Subsection 7.2.2.5) as reasonable alternatives to license renewal for supplying base-load electricity. Subsection 7.2.2.6 discusses additional alternatives that Exelon Generation has determined are not reasonable and the bases for these determinations. Table 7.2-1 summarizes the key characteristics of the alternative technologies considered to be reasonable.

Construction of a hypothetical new power station at an existing power station would be preferable to construction at a new greenfield site. This approach would minimize environmental impacts by building on previously disturbed land and by making the most use possible of existing facilities, such as transmission lines, roads and parking areas, office buildings, and components of the cooling system. However, there is insufficient area at the existing PBAPS site to construct a new nuclear, coal- or gas-fired unit of adequate capacity without impacting the ongoing operations; thus, a new plant(s) would have to be located elsewhere. Accordingly, except for the combination alternative, it is assumed that space would be found at one or more existing power plant sites other than PBAPS within the ROI in order to benefit from the existing infrastructure and minimize the environmental impact that would occur in comparison to a new greenfield location. This approach avoids overstating the environmental impacts of these alternatives in comparison to the proposed action. For the combination alternative, it is assumed that the amount of required land would dictate greenfield site development.

To compare the environmental impacts of alternative electricity supplies with PBAPS license renewal on an equal basis, Exelon Generation set the existing approximate net average annual generating capacity of PBAPS (approximately 2,600 MWe) as the approximate net electrical generating capacity that any reasonable alternative would need to supply. However, because some alternative technologies are manufactured in standard unit sizes, it was not always possible to aggregate such technologies to exactly match the PBAPS capacity. In such cases, generation capacity at or below the PBAPS net average annual generating capacity has been used to conservatively evaluate impacts in cases of new facility construction.

It must be emphasized, however, that all scenarios are hypothetical. Exelon Generation has no current plans for new facility construction to replace PBAPS.

7.2.2.1 Construct and Operate New Natural Gas-Fired Generation Capacity

For purposes of this analysis, Exelon Generation assumed development of a modern natural gas-fired combined-cycle plant with design characteristics similar to those being developed elsewhere in the PJM region, and with a net generating capacity comparable to that of PBAPS. The hypothetical plant would be composed of five pre-engineered natural gas-fired combined-cycle units producing 510 MWe each of net plant power for a total of 2,550 MWe (GE Power & Water 2015), with closed-cycle mechanical draft cooling towers. In addition, construction of two 41-cm (16 in.) diameter gas pipelines in an existing 100-ft wide ROW would likely be required as well as upgrades to existing pipelines. Table 7.2-2 presents the basic characteristics for the gas-fired alternative, and impacts are described in Subsection 7.2.3.1.

7.2.2.2 Construct and Operate New Coal-Fired Generation Capacity (USC)

For purposes of this analysis, Exelon Generation assumed construction and operation of four USC pulverized coal units, each with a net capacity of 624 MWe for a total of 2,496 MWe. The system would also be combined with closed-cycle mechanical draft cooling towers. Air quality control systems would include close-coupled overfire air for control of NOx and low–NOx burners. A selective catalytic reduction (SCR) system would be used for additional NOx control. An activated carbon injection system would be used for mercury removal. Downstream of the boiler, a spray dry absorber system with pebble lime and recycle ash for SO_2 reduction and a pulse jet fabric filter baghouse for particulate removal would be installed. Assuming that the facility is constructed at an existing fossil plant, an extension of an existing rail spur would likely be required. Table 7.2-3 presents the basic USC alternative emission control characteristics, and impacts are described in Subsection 7.2.3.2.

7.2.2.3 Purchased Power

Exelon Generation has evaluated conventional and prospective power supply options that could be reasonably implemented before the existing PBAPS licenses expire. Electric industry restructuring initiatives in the ROI have been designed to promote competition in energy supply markets by facilitating participation by non-utility suppliers. PJM has implemented market rules to appropriately anticipate and meet electricity demands in the wholesale electricity market that have resulted from restructuring. However, because retail customers in the ROI now may choose among multiple companies to supply their electricity needs, future load obligations of such companies are uncertain.

Accordingly, for the purposes of this analysis, Exelon Generation assumes that a purchasable electricity supply sufficient to replace the 2600 MWe of baseload generating capacity of PBAPS would be available by 2033 without construction of new power plants, while maintaining sufficient grid stability margins.

Electricity trading has existed between the United States and Canada or Mexico for many years, and numerous transmission ties exist. Electricity trading between the United States and Mexico has been quite small; however, electricity trading between the United States and Canada is considerably greater and involves exchanges along almost the entire border separating the countries. In 2014, 60 companies in Canada exported 58,400 GWh of electricity into the United States, making up 1.6 percent of U.S. electricity retail sales (EIA 2015a). Based on the quantity of electricity traded between the United States and Canada in the past and the available transmission infrastructure and generating capacity for continued trading, electricity trading between the United States and Canada is considered as a potentially feasible source of future electricity trading.

The technologies that would be used to generate purchased power are unknown. However, Exelon Generation assumes that the generating technologies likely would be among those described in the 2013 GEIS (i.e., fossil fuel-fired, renewable, and nuclear). For this reason, Exelon Generation is adopting by reference the 2013 GEIS descriptions of fossil fuel-fired, renewable, and nuclear alternative generating technologies to describe the generation sources that the purchased power alternative would comprise.

Exelon Generation anticipates that additional transmission infrastructure would be needed in the event purchased power must replace PBAPS capacity. From a local perspective, loss of PBAPS could require construction of new transmission lines to ensure local system stability.

Impacts of the purchased power alternative are described in Subsection 7.2.3.3.

7.2.2.4 Construct and Operate New SMR Generating Capacity

SMRs are nuclear power plants that are smaller in size (300 MWe or less) than current generation base load plants (often 1,000 MWe or more). Deployment of SMRs provides a more flexible approach to power leveling as a total long-term generation capacity can be constructed at multiple sites and the capacity can be incrementally increased over time. As indicated previously, a number of SMR design concepts have been developed by various domestic and foreign consortia, including designs with various coolants such as helium gas (PBMR-165), liquid sodium metal (GE-Hitachi PRISM-311, Toshiba 4S-100), lead-bismuth metal eutectic (Hyperion Gen4-25), and more conventional light water technology. The principal light water SMR design concepts include the mPower™ design by B&W, the Westinghouse 225, the NuScale Power design, and the HI-SMUR.

After consideration of the various designs, Exelon Generation determined that light water SMRs held a significant advantage over other emerging designs because the NRC licensing processes and procedures are much further developed for light water cooled reactors than for other designs. Because of the immaturity of the NRC licensing requirements for non-light water cooled designs, development and deployment of such a design within the next 20 years appears to be unlikely. Consequently, Exelon Generation determined that it should consider in more detail one of the proposed designs utilizing light water cooling.

NuScale Power is currently the only SMR manufacturer to have submitted a Design Certification Application to the NRC. The NuScale Power Module (NPM) is a self-contained unit that has an electrical capacity of 50 MWe (NuScale Power 2017b). Facility designs support the deployment of multiple modules at each facility. NuScale Power forecasts that the first NPM will go into operations in 2026 (NuScale Power 2017c), seven years before the existing PBAPS operating licenses expire in 2033 and 2034. Therefore, for the purposes of this alternative evaluation, Exelon Generation is assuming that four facilities, each with a cluster of twelve 50-MWe SMRs (48 modules [2,400 MWe]) could be constructed/installed at multiple sites within the ROI to replace

PBAPS's 2,600 MWe. Closed-cycle mechanical draft cooling towers would be utilized and new rail spurs or barge offloading facilities would be required to support each of the SMR sites. Table 7.2-1 presents the basic characteristics for the SMR alternative, and impacts are described in Subsection 7.2.3.4.

7.2.2.5 Combinations of Alternatives

The 2013 GEIS recognized that the number of possible combinations of alternatives that could replace the generating capacity of a nuclear power plant is potentially unlimited. Based on this, the 2013 GEIS only evaluated individual alternatives rather than combinations of alternatives, but stated that combinations of alternatives may be considered during plant-specific license renewal reviews. These alternatives must be commercially viable on a utility scale and operational prior to the expiration of the reactor's operating license or be expected to become commercially viable on a utility scale and operational prior to the expiration of the reactor's operating license. For the purpose of comparison, Exelon Generation has crafted an alternative that combines generation alternatives to replace PBAPS's approximate annual average net base-load generating capacity. The combination being considered includes wind generation combined with PV solar generation and firming capacity in the form of gas-fired combined-cycle generation. Although energy storage options such as batteries, compressed air energy storage (CAES), and pumped hydroelectric have continued to evolve, they continue to be limited by size and discharge times (batteries), geographical constraints (pumped hydroelectric and CAES) and reduction in efficiencies (University of Michigan 2016). Therefore, these energy storage options were not considered as part of the combination alternative selected by Exelon Generation.

Wind and solar generation appear to be appropriate components of this combination alternative because renewable energy sources, including wind and solar energy, are projected to be a growing source of electricity through 2040 (EIA 2016a). Additionally, PJM reports that, as of October 20, 2016, about 22 gigawatts (GW) of wind generation has been proposed or is under construction in the PJM region, and about 24 GW of solar generation has been proposed. Since most new power plants added to the U.S. electricity grid since 1990 have been gas-fired combined-cycle plants, it is also appropriate to assume that the method by which firming capacity for wind and solar power would be provided is a new gas-fired combined-cycle generation plant. Furthermore, the Energy Information Administration's Annual Energy Outlook forecasts continued growth in the use of gas-fired combined-cycle plants as a new electricity source through 2040 (EIA 2016a). Therefore, gas-fired combined-cycle electricity generation is a proven technology with demonstrated operating characteristics and well-defined resource and capital requirements.

For this combination of alternatives, Exelon Generation assumed that 1,800 MWe of PBAPS's net base-load capacity of approximately 2,600 MWe would be replaced by two land-based wind farms, with the balance (approximately 800 MWe) replaced by six PV solar facilities. However, since wind and PV solar energy are intermittent, for the purpose of this alternative, the wind farm capacity efficiency is assumed to be 53 percent (based on the U.S. Department of Energy (DOE) projected capacity factor for land-based wind energy and Wind Resources Class 7 in 2030) (DOE 2008a), while the PV solar facility capacity factor is assumed to be 16.7 percent. As a result, the total capacity assumed to be required for each wind farm is approximately 1,700 MWe for a total wind generating capacity of approximately 3,400 MWe and the total capacity assumed to be required for each of the six PV solar facilities is 800 MWe, for a total PV solar generating capacity of 4,800 MWe.

Gas-fired combined-cycle generation has been successfully used to balance intermittent renewable power and thereby maintain electrical grid system reliability. Based on the National Renewable Energy Laboratory (NREL) evaluation in its Eastern Wind Integration and Transmission Study (NREL 2010), approximately 6 percent of wind energy capability would be needed in gas-fired combined-cycle backup to support the regulation and operating reserve requirements imposed by wind energy. Assuming 3,400 MWe of land-based wind generation capability, approximately 200 MWe of gas-fired combined-cycle generation would be required as reserve capacity.

For the purposes of this evaluation, Exelon Generation has assumed that approximately 10 percent of PV solar energy capability would be needed in gas-fired combined-cycle backup. Accordingly, for 4,800 MWe of PV solar energy capability (assuming a capacity factor for solar of 16.7 percent), approximately 480 MWe of gas-fired combined-cycle generation would be required as reserve capacity.

In summary, for this combination of alternatives, Exelon Generation assumed that the PBAPS base-load capacity of approximately 2,600 MWe would be replaced by two 1,700 MWe wind farm (each with a with a minimum of 100 MWe gas-fired combined-cycle backup capacity) and six 800-MWe PV solar facilities (each with a minimum of 80 MWe gas-fired combined-cycle backup capacity). New transmission lines would also be required for this alternative. Also, for the purposes of this Environmental Report, it is assumed that, by 2033, this combination of alternatives would be a reasonable alternative to renewal of the PBAPS operating licenses. Impacts of this alternative are discussed in Subsection 7.2.3.5.

7.2.2.6 Other Alternatives Considered but Eliminated from Further Consideration

This section identifies alternatives that Exelon Generation has evaluated and determined are not reasonable for replacing PBAPS and the bases for these determinations. Exelon Generation accounted for the fact that PBAPS is a base-load generator and that any feasible alternative to PBAPS would also need to be able to generate base-load power. Except for the discussion of DSM, Exelon Generation relied heavily upon NRC's 2013 GEIS in performing this evaluation.

Demand-side Management

DSM programs consist of planning, implementing, and monitoring activities of electric utilities to encourage consumers to modify their level and pattern of electricity usage. This can reduce customers' demand for energy through conservation, efficiency, and load management so that the need for additional generation capacity is eliminated or reduced. The DSM alternative does not fulfill the stated purpose and need of the proposed action because it does not "provide an option that allows for baseload power generation capability" (NRC 2013a).

In addition, because Exelon Generation sells power into the wholesale electricity market through PJM, DSM measures are not within the Company's control or consistent with Exelon's business objectives as merchant generator to sell energy and capacity. However, PJM has instituted measures to capture energy conservation potential and load management in its resource planning. While DSM displaces need for energy, it is primarily directed at load management and tends to displace peak generation and load growth, not baseload power. Furthermore, the 2013 GEIS indicates that although energy conservation or energy efficiency potential in the United States is substantial, DSM, alone, has not been implemented to replace a baseload generation station.

In conclusion, although DSM is an important tool for meeting projected electricity demand and the impacts from the DSM alternative are generally small, DSM does not fulfill the stated purpose and need for license renewal of nuclear power plants. DSM measures are already captured in state and regional load projections and additional DSM measures would likely offset only a small fraction of the energy supply lost by the shutdown of PBAPS. For these reasons, Exelon Generation does not consider DSM to be a viable supply of replacement baseload electricity, even if considered in combination with other generation alternatives. Hence, DSM does not represent a reasonable alternative to renewal of the PBAPS operating licenses.

Hydropower

Approximately 730 MWe of utility generating capacity in the PJM region is hydroelectric (PJM 2016c). As the 2013 GEIS points out in Subsection 2.3.3.1, hydropower provided 80 percent of commercial electricity generated by all renewable alternatives in 2010 and will remain the largest renewable energy source through the year 2035. However, as of October 20, 2016, no new hydropower projects are being considered in the PJM region (PJM 2016c). Although, according to the U.S. Hydropower Resource Assessment (Idaho National Engineering and Environmental Laboratory 1998), there are no remaining sites in the PJM region that would be environmentally suitable for a large hydroelectric facility, hydroelectric generating capacity may be increased by adding or repowering turbines at existing facilities or by adding turbines to previously nonpowered dams used for flood control (EIA 2017b). Even so, in the PJM region, no evidence was found that such modifications of existing facilities could increase hydroelectric generating capacity enough to replace PBAPS.

The 1996 GEIS estimates land use of 4,142 square km (1,600 square miles) per 1,000 MWe for a new hydroelectric dam and reservoir. Based on this estimate, replacement of PBAPS generating capacity would require flooding approximately 10,765 square km (4,158 square miles), resulting in a large impact on land use. Further, operation of a hydroelectric facility would alter aquatic habitats above and below the dam, which would impact existing aquatic communities.

Exelon Generation has concluded that, due to the lack of suitable sites in the ROI for a large new hydroelectric facility and the amount of land needed (approximately 10,765 square km - 4,158 square miles), hydropower is not a reasonable alternative to PBAPS SLR.

Wind Power

Energy potential in wind is expressed by wind generation classes, ranging from one (least energetic) to seven (most energetic). Current wind technology can operate economically on Class 4 sites with the support of the federal production tax credit of 2.3 cent per kilowatt hour (kWh), while Class 3 wind regimes would require further technical development for utility scale application. Absent further Congressional action, this credit will be reduced by 60 percent by 2019 (DOE 2016a). In the PJM region, areas of highest wind energy potential (Class 5 and 6) are the outer coastal areas of New Jersey, offshore areas of Lake Erie, and the higher mountain summits of the Appalachians. PJM has reported installed wind generating capacity in the PJM region totaling over 17,000 MW as of October 20, 2016, with additional wind projects totaling approximately 22 GW proposed or under construction as of October 20, 2016. Technological improvements, including increased rotor diameter and tower height, offset by installation in lower wind resource areas, result in capacity factors averaging between 25 to 40 percent (EIA 2017c) and a few projects in wind areas where average wind speeds are more than 7.5 meters per second (i.e., Class of 5 or above) have been reported with capacity factors exceeding 50 percent (DOE 2015). Capacity factor is the ratio of actual output over a period of time to potential output if it were possible for the generating unit to operate at full nameplate capacity continuously over the same period of time. Therefore, assuming a projected capacity factor of 50 percent, approximately 5,200 MW of new wind capability in an offshore location would be required to replace the base-load generating capacity of PBAPS.

Wind turbine technology has evolved to minimize the intrinsically variable effects of meteorological processes on wind power and its integration into the grid. Successful integration of intermittent wind power into the power system involves efficient grid operating procedures including coordinated balancing areas, fast dispatch, and reliable wind forecasting. The balancing area is a predefined area within the interconnected transmission grid where generation and load are balanced while interchanges remain reliable. Dispatch is the real-time control of on-line generators. Reliable wind forecasting allows proper scheduling of operations to optimize wind power production. Grid-friendly features including low-voltage ride-through, allow turbines to stay online during low-voltage events; thus increasing system reliability. In addition, modern wind turbines feature frequency response and fast response; thus supporting a nominal system frequency of 60 hertz and fast system balancing. In conclusion, many grid-reliability issues may be mitigated by successfully integrating wind power into the power grid using modern turbines and efficient grid procedures (DOE 2015). However, due to the speculative forecasts for offshore wind generation in the PJM region, anticipated reduction of the federal production tax credit, and relatively low capacity factors in areas of lower wind speed, Exelon Generation has concluded that wind power alone is not a reasonable alternative to PBAPS SLR.

Interconnected wind farms were also considered and eliminated from further consideration. This decision was based on the fact that interconnected wind farms would have to be developed in multiple sufficiently separated regions so that they would not be affected by the same synoptic winds. In addition, the amount of added wind generation capability would have to be much greater than the nuclear generation in order to replace its capacity; considerable additional transmission capacity would have to be developed to transport the power from these multiple farms and/or maintain grid reliability; and such an alternative involving farms in multiple separated regions is beyond the control of any single merchant generator.

Solar Power

Approximately 290 MWe of utility generating capacity in the PJM region is solar. There are two primary commercial solar technologies commonly used: PV, which directly convert light to electricity and concentrating solar power, which uses heat from the sun (thermal energy) to drive utility-scale, electric turbines.

DOE's NREL reports that the PJM region receives solar insolation of 4.0 to 5.0 kWh per square meter per day (kWh/m^2/d), which is considered low to average (NREL 2016). For utility-scale development, insolation levels below 6.5 kWh/m^2/d are not considered economically viable given current technologies (BLM and DOE 2012). Solar facilities can only generate electricity when the sun is shining. Energy storage can be used to overcome the intermittent nature of solar power facilities; however, current and foreseeable storage technologies are not suited for the large-scale storage of electricity that would be needed to replace PBAPS's baseload generation.

Exelon Generation has concluded that the low to average levels of solar energy available throughout the ROI, the unavailability of suitable electricity storage technologies that could alleviate grid-reliability issues, and minimal existing solar generating capacity in the ROI, solar power, alone, is not a reasonable alternative to PBAPS SLR.

Geothermal

Geothermal energy is a developed technology for power generation. To produce electric power with geothermal energy, underground high-temperature reservoirs of steam or hot water are tapped by wells and the escaping steam rotates turbines to generate electricity. Typically, water is then returned to the ground to recharge the reservoir.

Geothermal energy can achieve average capacity factors of 92 percent and can be used for baseload power where this type of energy source is available (Geothermal Energy Association 2013). The major challenge for geothermal development lies in the area of geothermal resource mapping. Power plant development is limited to those locations where the quantity, quality, and reliability have been proven from intensive geological exploration, drilling, testing, and production. In the United States, high-temperature hydrothermal reservoirs are located in the western states, Alaska and Hawaii. Water at 360 degrees F or higher is required to generate geothermal electricity. There are no known high-temperature geothermal sites in the ROI (NREL 2017). The ROI has low to moderate temperature resources that can be tapped for direct heat or geothermal heat pumps, but electricity generation is not feasible with these resources (NREL 2007; NREL 2011).

Exelon Generation has concluded that, due to the lack of high temperature geothermal sites in the ROI, geothermal power is not a reasonable alternative to PBAPS SLR.

Tidal, Ocean Thermal, and Wave

Technologies to harness electrical power from the ocean include tidal power, ocean thermal energy, and wave power conversion. These technologies are still in the early stages of development and are not commercially available to replace a large base-load generator such as PBAPS.

Tidal power technologies extract energy from the diurnal flow of tidal currents caused by the gravitational pull of the moon. Unlike wind and wave power, tidal streams offer entirely predictable output. All coastal areas consistently experience two high tides and two low tides over a period of approximately 25 hr. However, because the lunar cycle is longer than a 24-hr day, the peak outputs differ by about an hour each day, and so tidal energy cannot be guaranteed at times of demand.

Tidal power technologies consist of tidal turbines and barrages. Tidal turbines are similar in appearance to wind turbines that are mounted on the seabed. They are designed to exploit the higher energy density, but lower velocity, of tidal flows compared to wind. Tidal barrages are similar to hydropower dams in that they are dams with gates and turbines installed along the dam. When the tides produce an adequate difference in the level of the water on opposite sides of the dam, the gates are opened and water is forced through turbines, which turns a generator. For those tidal differences to be harnessed into electricity, the difference in water height between the high and low tides must be at least 4.9 m (16 ft). There are only about 40 sites on Earth with tidal ranges of this magnitude (DOE 2013). The only sites with such tidal differences within the United States are in Maine and Alaska (California Energy Commission 2016). Therefore, tidal resources off the coast of the ROI do not provide a viable tidal energy resource.

Ocean thermal energy conversion (OTEC) technology capitalizes on the fact that the water temperatures decrease with depth. As long as the temperature between the warm surface water and the cold deep water differs by about 20 degrees C (36 degrees F), an OTEC system can produce a significant amount of power (Lewis et al. 2011). The temperature gradient off of the coast of the ROI is less than 18 degrees C (32 degrees F) and not a good resource for OTEC technology.

Wave energy conversion takes advantage of the kinetic energy in the ocean waves (which are mainly caused by interaction of wind with the surface of the ocean). Wave energy offers an irregular, oscillatory, low frequency energy source that must be converted to a 60-Hertz frequency before it can be added to the power grid (California Energy Commission 2016). Wave energy resources are best between 30 and 60 degrees latitude in both hemispheres and the potential tends to be greatest on western coasts (Lewis et al. 2011). Ocean Power Technologies, Inc. deployed its new PB3 wave energy converter off the coast of New Jersey in July of 2016 (OPT 2016). However, this device uses wave energy to charge a battery pack capable of delivering up to 8.4 kWh per day (OPT 2018), which is miniscule compared to the 62,400 megawatt-hours per day of electricity produced by PBAPS at full power.

Offshore technologies that harness the energy of ocean waves and current are in their infancy, and have not been used at utility scale. Since the late 1990s, new technologies have been introduced to harness the energy of the ocean's waves, currents, and tides. Nearly 100 companies worldwide have joined this effort but most companies struggle to deploy their first prototypes and not all can be funded from the public sector. A viable strategy to help mature the marine renewable energy industry does not exist (Buchsbaum 2017). Hence, although some technologies may be available in the future, none has yet been demonstrated to be capable of providing the electrical generating capacity needed to replace PBAPS's base-load generating capacity.

Exelon Generation believes that tidal, ocean thermal, and wave technologies have not matured sufficiently to provide a viable supply of replacement base-load electricity for PBAPS. As a result, Exelon Generation has concluded that, due to limited output capability, cost, and production limitations, these technologies are not reasonable alternatives to PBAPS SLR.

Biomass

A variety of biomass fuel types can be utilized to generate energy. These include wood, municipal solid waste, burning energy crops, converting crops to a liquid fuel such as ethanol (ethanol is primarily used as a gasoline additive), and gasifying energy crops (including wood waste, agricultural products and algae). As of 2016, biomass fuels provided approximately 5 percent of the primary energy in the United States (48 percent from biofuels (used primarily for transportation), 41 percent from wood or wood-derived biomass, and 11 percent from municipal wastes) (EIA 2017a).

As discussed in the 1996 GEIS, the use of wood waste to generate electricity is largely limited to those states with significant wood resources. It takes roughly one ton per hour of wood waste to produce one MWe of electricity. Generally, the largest wood waste power plants are 40 to 100 MWe in size. In addition, construction of a wood-fired plant would have an environmental impact that would be similar to that for a coal-fired plant, although facilities using wood waste for fuel would be built on smaller scales. Like coal-fired plants, wood waste plants require large areas for fuel storage, processing, and waste (i.e., ash) disposal. Additionally, operation of wood-fired plants has environmental impacts, including impacts on the aquatic environment and air. Wood has a low heat content that makes it unattractive for base-load applications. It is also difficult to handle and has high transportation costs. While some wood resources are available in the ROI, Exelon Generation believes that, due to the lack of an environmental advantage, low heat content, handling difficulties, and high transportation costs, wood energy cannot provide a viable supply of replacement base-load electricity for PBAPS. Hence, Exelon Generation has concluded that wood energy is not a reasonable alternative to PBAPS license renewal.

Landfill gas (LFG) and waste-to-energy are potential municipal waste energy sources. Although collecting LFG is relatively straightforward and LFG-to-energy plants can have capacity factors greater than 90 percent, the largest LFG program currently in production is producing only 50 MWe (EESI 2013). The 1996 GEIS suggests that the overall level of construction impacts from a waste-to-energy plant should be approximately the same as that for a coal-fired plant. Additionally, waste-fired plants have the same or greater operational impacts (including impacts on the aquatic environment, air, and waste disposal). Some of these impacts would be moderate, but still larger than the environmental effects of PBAPS license renewal. Exelon Generation believes that, due to the number of LFG-to-energy plants required to replace the replace 2,600 MWe of PBAPS and the high costs and lack of environmental advantages associated with other waste-to-energy plants; these two alternatives cannot provide a viable supply of replacement base-load electricity for PBAPS. Hence, Exelon Generation has concluded that LFG and waste-to-energy are not reasonable alternatives to PBAPS SLR.

Petroleum

The PJM region has several petroleum (oil)-fired power plants; however, they produced only 5 percent of the total power generated in the region in 2016 (PJM 2016a). From 2006 to 2015, utilities reduced the consumption of oil for electrical generation from a high of 82,433 barrels in 2007 to 29,545 in 2015 (EIA 2016b). Oil-fired operation is more costly than nuclear or coal-fired operation, and future increases in petroleum prices are expected to make oil-fired generation increasingly more costly. Also, construction and operation of an oil-fired plant would have significant environmental impacts. For example, Subsection 8.3.11 of the 1996 GEIS estimates that construction of a 1,000-MWe oil-fired plant would require about 48.6 hectares (120 acres). Additionally, operation of oil-fired plants would have significant environmental impacts (including impacts on the aquatic environment and air) that would be comparable to those from a coal-fired plant.

Exelon Generation has concluded that, due to the high costs and lack of obvious environmental advantage, burning oil to generate electricity is not a reasonable alternative to PBAPS SLR.

Fuel Cells

Fuel Cells electrochemically combine hydrogen and oxygen to provide electricity along with heat and water. Stationary fuel cells provide power and/or heat from fixed locations. In 2016, more than 50,000 stationary fuel cell systems were shipped worldwide providing more than 200 MW of power (DOE 2017). Large-scale stationary power system projects, providing more than 200 kW, can be connected into the grid infrastructure in a variety of public and private enterprises, including universities, hospitals, and utilities (DOE 2017). Several hundred large fuel cell systems currently operate in the United States averaging 1 MW per installation (CleanEnergy States Alliance 2010). Costs for stationary fuel cell installations range between $2,500 and $4,500 per kilowatt electricity (kWe) (CleanEnergy States Alliance 2010) with DOE targeting $1,000 kWe by 2020 (DOE 2016b). According to a conservative estimate, large stationary fuel cells generate 200 MWe in the United States today, and demand is growing in both the private and public sectors (Markowitz 2015). Although fuel cell technology and development has increased in recent years; the production capability of the largest stationary fuel cell in the United States is 14.9 MWe (EESI 2015). The DOE Fuel Cell Market Report noted that there were more than 150 MWe of actively producing or ordered fuel cell systems worldwide in 2016. Further, half of the fuel cell systems from shipped U.S. fuel cell manufacturers (75 MW) will produce power for the electric grid of South Korea (DOE 2017).

Exelon Generation believes that fuel cell technology has not matured sufficiently to provide a viable supply of replacement base-load electricity for PBAPS. As a result, Exelon Generation has concluded that, due to cost and production limitations, fuel cell technology is not a reasonable alternative to PBAPS SLR.

Large-Scale Advanced Nuclear Reactors

Increased interest in the development of large-scale advanced nuclear reactors has been expressed by members of both industry and government (DOE 2008b). Several startup companies have emerged in recent years, each with its own advanced reactor design (Freed 2014). These and other startups in the United States and Canada, who use innovative fuels and alternative coolants, have raised more than $1.3 billion in private investment (Koch 2015). Advanced reactors referred to as Generation IV reactors, include such technologies as lead-cooled fast reactors, sodium-cooled fast reactors, molten salt reactors, very high temperature reactors, gas cooled fast reactors, and supercritical water-cooled reactors (The Generation IV International Forum 2017). However, while it is claimed that some Generation IV reactor designs may achieve commercial deployment by 2030 (The Generation IV International Forum 2017), these nuclear power reactors generally lack a practical development path, significant venture capital, and an advanced regulatory approach. Therefore, the schedule for development of a prototype reactor is uncertain (Freed 2014). With this, Exelon Generation considers it unlikely that a commercially viable replacement for PBAPS using Generation IV technology could be sited, planned, licensed, constructed, and brought online by the time the existing PBAPS operating licenses expire in 2033 and 2034. For this reason, Exelon Generation does not consider large-scale advanced nuclear reactors to be a reasonable alternative to PBAPS SLR.

Delayed Retirement

As the NRC noted in the GEIS, extending the lives of existing non-nuclear generating plants beyond the time they were originally scheduled to be retired represents another potential alternative to license renewal. In the ROI, Exelon Generation has two non-nuclear (oil/gas) peaking units, Perryman 2 (51 MW) and Riverside 4 (74 MW), both of which are peaking units located in Baltimore, Maryland that retired and ceased operations in 2016 (Exelon Corporation 2016a). Exelon Generation has also agreed to permanently cease generation operation of the 636 MWe Oyster Creek Generating Station (nuclear) located in New Jersey by December 31, 2019. The combined generating capacities of Perryman 2 and Riverside 4 are not sufficient to justify pulling them out of retirement and continuing operation of Oyster Creek is not a viable alternative. Therefore, Exelon Generation does not consider the delayed retirement of internal power generating assets to be a reasonable alternative to PBAPS SLR.

Power generating utilities within the PJM region retired non-nuclear generating facilities totaling 24,155 MWe from 2011 to 2016 (Monitoring Analytics 2016). Some potential reliability issues have been forestalled through a combination of short lead-time transmission upgrades, voluntary deactivation deferrals, and implementation of a process that compensates generators that remain online beyond announced retirement dates. However, FERC has determined that PJM cannot compel the owners of units scheduled for retirement to keep such units in service (Monitoring Analytics 2010). For these reasons, Exelon Generation does not consider the delayed retirement of non-nuclear generating units that are not owned by Exelon Generation to be a reasonable alternative to PBAPS SLR.

7.2.3 Environmental Impacts

This section evaluates the environmental impacts of alternatives that Exelon Generation has determined to be reasonable alternatives to PBAPS license renewal: gas-fired generation, coal-fired generation, purchased power, new nuclear generation, and a combination of wind, solar, and gas generation.

7.2.3.1 Natural Gas-Fired Generation

NRC evaluated environmental impacts from gas-fired generation alternatives in the 2013 GEIS, focusing on combined-cycle plants. Subsection 7.2.2.1 presents Exelon Generation's reasons for defining the gas-fired generation alternative as a five-unit (510 MWe each), 2,550 MWe (total), combined-cycle plant on one or more existing fossil plant sites in the ROI. Table 7.2-2 presents the basic characteristics for the gas-fired alternative. Construction of a gas-fired unit would have impacts on land-use and could impact ecological, aesthetic, and cultural resources. Human health effects associated with air emissions would be of concern.

Air Quality

Natural gas is a relatively clean-burning fossil fuel that primarily emits NOx, a regulated pollutant, during combustion. A natural gas-fired plant would also emit small quantities of SOx [presented as SO_2][3], PM, and CO, all of which are regulated pollutants. In addition, a natural-gas-fired plant would produce CO_2, a GHG.

From emissions data (in pounds per MMBtu [lb/MMBtu]) published by EPA provided in Table 7.2-2, the emissions from five 10-MWe natural gas-fired plants with a net heat rate of 8,170 Btu/kWh (GE Power & Water 2015) and an assumed capacity factor of 87 percent are calculated to be:

- SO_2 = 245 metric tons (270 tons) per year (0.0034 lb/MMBtu)
- NOx = 9,363 metric tons (10,320 tons) per year (0.13 lb/MMBtu)

[3] For gas-fired generation, EPA assumes all sulfur in fuel is converted to SO_2 upon combustion; therefore, the terms SOx and SO_2 can be used interchangeably (EPA 2000).

- CO = 1,080 metric tons (1,191 tons) per year (0.015 lb/MMBtu)
- Filterable Particulates = 137 metric tons (151 tons) per year [all particulates are particulates with diameters of 2.5 microns or less ($PM_{2.5}$)] (0.0019 lb/MMBtu)
- CO_2 = 7,922,170 metric tons (8,732,695) per year (110 lb/MMBtu)

A new natural gas-fired combined-cycle plant would be considered a major-emitting industrial facility and would be subject to a New Source Review under the CAA. The new plant would also need to comply with the standards of performance for stationary combustion turbines set forth in Subpart KKKK of Title 40 CFR Part 60, Title IV of the CAA's reduction requirements for SOx and nitrogen oxides, as well as other air pollution and GHG emission rules.

While gas-fired turbine emissions are less than coal-fired boiler emissions, the emissions are still substantial. Exelon Generation concludes that emissions from the gas-fired alternative would noticeably alter local air quality, but would not cause or contribute to violations of NAAQS in the region. Based on these emissions, Exelon Generation believes air quality impacts would be MODERATE and the corresponding human health impacts would be SMALL to MODERATE.

Waste Management

The solid waste generated from this type of facility would be minimal. The only noteworthy operational waste would be from spent SCR used for NOx control. However, the NRC states in the 2013 GEIS that the SCR process for a 2,265 MWe plant would generate only a small amount of spent catalyst per year. Therefore, Exelon Generation concludes that gas-fired generation waste management impacts would be SMALL.

Water Resources

Both total withdrawal and consumptive cooling water requirements for combined cycle gas-fired plants are generally less than those for nuclear plants with comparable cooling systems (EPRI 2002). However, for a new gas-fired alternative plant, a closed-cycle cooling system such as mechanical draft cooling towers would be used, resulting in greater consumptive use. Impingement, entrainment, and thermal impacts to aquatic resources from make-up water withdrawals and discharges for a closed-cycle condenser cooling system to a surface water source would be smaller than the impacts of the PBAPS once-through system (with helper towers) on the Susquehanna River. If this alternative were to be sited such that the Susquehanna River would be the cooling water source, impacts on aquatic biota of the river due to cooling water withdrawals and thermal discharges likely would be offset by the concurrent shutdown of the nuclear facility. Water quality impacts due to concentration of solids in cooling tower blowdown would be higher than those associated with the once-through (with helper towers) cooling system at PBAPS. Potential impacts from the gas-fired alternative would be mitigated by compliance with permit requirements. Exelon Generation concludes that gas-fired generation impacts to aquatic resources and water quality would be SMALL.

Other Impacts

Construction of the gas-fired alternative on an existing plant site would impact the construction site and the supporting utility corridors. A new natural gas pipeline would likely be required to supply fuel for the gas turbine generators in this alternative. Exelon Generation assumes that, to the extent practicable, the pipeline would be routed along existing, previously disturbed, ROWs to minimize impacts. Two new pipelines, each approximately 41 cm (16 in.) in diameter, would require a 30.5-m-wide (100-ft-wide) corridor. This new construction may also necessitate an upgrade of the statewide pipeline network. Exelon Generation estimates that 100.8 hectares (249 acres) would be needed for a plant site, but the location on an existing industrial site would minimize impacts. Therefore, land use impacts would be SMALL. Erosion and sedimentation, fugitive dust, and construction debris impacts would be noticeable but SMALL with appropriate controls. Compliance with the ESA would minimize impacts on federally listed threatened or endangered species, and, for the purpose of this alternatives assessment, Exelon Generation assumes that the construction and operation of the gas-fired power plant would be NOT LIKELY TO ADVERSELY AFFECT such species. The loss in terrestrial habitat resulting from plant construction would be minimized by location on an existing industrial site, thus the impact to ecological resources would be SMALL. Depending on the state hosting the new gas-fired alternative, impacts to cultural resources could be possible because not all states require the protection of cultural resources on private lands. Therefore, impacts to cultural resources may be NOT PRESENT to ADVERSE EFFECT.

Exelon Generation estimates a peak construction workforce of 800; thus, socioeconomic impacts of construction would be SMALL to MODERATE and beneficial. However, Exelon Generation estimates a significantly reduced workforce of approximately 100 for gas operations, resulting in adverse socioeconomic impacts due to the loss of approximately 919 personnel responsible for operational activities at PBAPS (89 contract employees and 830 permanent employees) and the approximately 1,000 additional personnel employed during each PBAPS refueling outage. Loss of the operational and temporary refueling personnel would impact various aspects of the local community including employment, taxes, housing, offsite land use, economic structure, and public services. Exelon Generation believes these impacts would be MODERATE.

The stacks and boilers of the new gas-fired unit may add visual impacts at the existing power plant site where it is constructed; but these should be minimal because of the presence of existing plant structures and the impact on aesthetic resources would be SMALL.

7.2.3.2 Coal-Fired Generation (USC pulverized coal)

NRC evaluated environmental impacts from coal-fired generation alternatives in the 2013 GEIS. NRC concluded that construction impacts could be substantial, due in part to the large land area required (which can result in natural habitat loss) and the large workforce needed. NRC identified major adverse impacts from operations as human health concerns associated with air emissions, waste generation, and losses of aquatic biota due to cooling water withdrawals and discharges.

The coal-fired alternative that Exelon Generation has defined in Subsection 7.2.2.2 (four USC units, each with a net capacity of 624 MWe for a total of 2,496 MWe) would be located at one or more existing fossil plant sites.

Air Quality

A coal-fired plant would emit SOx[4], NOx, PM, mercury, and CO, all of which are regulated pollutants. A coal-fired plant would also emit CO_2, which is a GHG. As Subsection 7.2.2.2 indicates, Exelon Generation has assumed a plant design that would minimize air emissions through a combination of boiler technology and post combustion pollutant removal. Using data provided in Table 7.2-3, the coal-fired alternative emissions are calculated to be as follows:

- SO_2 = 3,883 metric tons (4,281 tons) per year (0.065 lb/MMBtu)
- NOx = 2,987 metric tons (3,293 tons) per year (0.05 lb/MMBtu)
- CO = 8,961 metric tons (9,878 tons) per year (0.15 lb/MMBtu)
- Filterable Particulates = 717 metric tons (790 tons) per year [all particulates are PM_{10}] (0.012 lb/MMBtu)
- Mercury = 0.10 metric tons (0.11 tons) per year (1.7E-06 lb/MMBtu)
- CO_2 = 11,774,536 metric tons (12,979,200 tons) per year (5,200,000 tons per 1000 MWe)

The description in Subsection 7.2.3.1 of air quality regulations applicable to the natural gas-fired generation alternative also applies to the coal-fired generation alternative. In addition, NRC noted in the 2013 GEIS that adverse human health effects from coal combustion have led to important federal legislation in recent years and that public health risks, such as cancer and emphysema, have been associated with coal combustion. NRC also mentioned global warming and acid rain as potential impacts. Exelon Generation concludes that federal legislation and large-scale concerns, such as global warming and acid rain, are indications of concerns about destabilizing important attributes of air resources. However, SOx emission allowances, NOx credits, low NOx burners, over-fire air, fabric filters or electrostatic precipitators, and scrubbers are mitigation measures imposed by regulation. As such, Exelon Generation concludes that the coal-fired alternative would have MODERATE impacts on air quality; the impacts would be noticeable and greater than those of the gas-fired alternative, but would not destabilize air quality in the area. The impacts on human health would likewise be MODERATE.

Waste Management

Exelon Generation concurs with the 2013 GEIS assessment that the coal-fired alternative would generate substantial solid waste. Based on the consumption of 328 tons per hour of coal at John W. Turk Jr. power plant, a 2,496 MWe of coal-fired USC

[4] For coal-fired generation, SOx includes SO_2, sulfur trioxide, and other compounds of sulfur generated by coal combustion (EPA 1998).

generation would annually consume approximately 7,194,206 metric tons (7,930,253 tons) of coal having an ash content of 5.5 percent (Peltier 2013). Coal Combustion Product (CCP) waste consists about 59 percent of ash waste and 41 percent of other non-ash waste (slag, scrubber waste, etc.) (American Coal Ash Association 2016). Approximately 396,000 metric tons (436,000 tons) per year of ash waste would be generated from the operation of four units similar to the John W. Turk Jr. power plant. About 58 percent of the ash waste, approximately 229,000 metric tons (253,000 tons) per year would be marketed for beneficial reuse. The remaining ash, approximately 166,000 metric tons per year (183,000 tons per year), would be collected and disposed of onsite, if space were available. Based on the amount of ash waste, approximately 271,000 metric tons (299,000 tons) of non-ash waste would be generated. Of this amount, about 43 percent or 117,000 metric tons (129,000 tons) would be available for beneficial reuse while approximately 155,000 metric tons (171,000 tons) would require disposal each year.

Ash and non-ash waste can be disposed in offsite landfills, or disposed in onsite landfills or surface impoundments. In 2012, approximately 80 percent of coal combustion wastes not reused were disposed in onsite disposal units. According to the EPA, disposal currently occurs at more than 310 active onsite landfills, averaging more than 120 acres in size with an average depth of over 40 ft, and at more than 735 active onsite surface impoundments, averaging more than 50 acres in size with an average depth of 20 ft (EPA 2017). Exelon Generation estimates that ash and scrubber waste disposal over a 20-year period would require approximately 120 acres per 624 MWe plant for a total of 180 hectares (480 acres). If this acreage is not available at the existing power plant site where the new coal-fired unit would be sited, offsite disposal may be necessary, which would increase disposal impacts.

Exelon Generation believes that proper siting, current waste management practices, and current waste monitoring practices would prevent waste disposal from destabilizing any resources. After closure of the waste site and revegetation, the land would be available for other uses. For these reasons, Exelon Generation believes that waste disposal for the coal-fired alternative would have MODERATE impacts; the impacts of increased waste disposal would be noticeable, but would not destabilize any important resource.

Water Resources

Cooling water requirements for coal-fired plants are similar to those for nuclear plants having similar generating capacity with comparable cooling systems (EPRI 2002). However, for a new coal-fired alternative plant, a closed cycle cooling system such as mechanical cooling towers would be used, resulting in greater consumptive use. Impingement, entrainment, and thermal impacts to aquatic resources from make-up water withdrawals and discharges for a closed-cycle condenser cooling system to a surface water source would be smaller than the impacts of the PBAPS once-through system (with helper towers) on the Susquehanna River. Water quality impacts due to concentration of solids in cooling tower blowdown would be higher than those associated with the once-through (with helper towers) cooling system at PBAPS. Impacts would be mitigated by permit requirements. Exelon Generation concludes that impacts of coal-fired generation on aquatic resources and water quality would be SMALL.

Other Impacts

Exelon Generation estimates that construction of the power block and coal storage area would affect approximately 1,619 hectares (4,000 acres) of land and associated terrestrial habitat. Because much of this construction would be on previously disturbed land, impacts to land use would be SMALL to MODERATE. Installation of a new rail spur or expansion of an existing spur may be required for coal and limestone deliveries under this alternative; however, this may not be necessary if construction occurs on an existing coal facility. As with any large construction project, some erosion and sedimentation and fugitive dust emissions could be anticipated, but would be minimized by using best management practices. Debris from clearing and grubbing could be disposed of onsite.

Loss in terrestrial habitat would also be mitigated by locating new coal plants on existing sites, thus the impact to ecological resources would be SMALL to MODERATE. Compliance with the ESA would minimize impacts on federally listed threatened or endangered species, and, for the purpose of this alternatives assessment, Exelon Generation assumes that the construction and operation of the coal-fired power plant at an existing industrial site would be NOT LIKELY TO ADVERSELY impact such species.

Depending on the state hosting the new gas-fired alternative, impacts to cultural resources could be possible because not all states require the protection of cultural resources on private lands. Therefore, impacts to cultural resources may be NOT PRESENT to ADVERSE EFFECT.

Exelon Generation estimates a peak construction work force of 2,500 people. Socioeconomic impacts from the construction workforce would be minimal, if worker relocation is not required with a site located near a large metropolitan area. Exelon Generation estimates an operational workforce of 436 people for the coal-fired alternative. This is a reduction in operating personnel compared to PBAPS's approximately 919 (89 contract employees and 830 permanent employees) personnel responsible for operational activities at PBAPS and the approximately 1,000 additional personnel employed during each PBAPS refueling outage. Loss of the operational and temporary personnel would impact various aspects of the local community including employment, taxes, housing, offsite land use, and public services, which could be significant. Thus, reduction in workforce would result in adverse socioeconomic impacts characterized as MODERATE.

Visual impacts would be consistent with the industrial nature of the site. The stacks, boilers, and rail deliveries would change the visual impact of the site to the surrounding community, but the impacts should be minimal because of the presence of existing plant structures. Thus, aesthetic impacts would be characterized as SMALL.

7.2.3.3 Purchased Power

As discussed in Subsection 7.2.2.3, Exelon Generation assumes that the generating technologies used under the purchased power alternative would be among those that NRC analyzed in the 2013 GEIS (i.e., fossil-fueled, renewable, and nuclear). Exelon Generation is also adopting by reference the NRC analysis of the environmental impacts from those technologies. Under the purchased power alternative, therefore, environmental impacts would still occur, but they are assumed to originate from existing power plants located elsewhere in the PJM region.

Impacts would occur in areas where purchased power is produced. Impact magnitude would be incremental and reflective of the overall amount of power being produced in the PJM region. Based on there being no new construction required, the impacts to aesthetics, socioeconomics, and cultural resources are anticipated to be SMALL or NO ADVERSE AFFECT. Similarly, because there would be no new construction and ongoing operations would continue in compliance with regulatory requirements that protect listed species, the use of purchased power would be NOT LIKELY TO ADVERSELY AFFECT threatened or endangered species. The impact to all other resources could be SMALL to MODERATE, depending on the type of fuel used, waste management practices, and locations of the facilities.

Exelon Generation anticipates that additional transmission infrastructure would be needed in the event purchased power is relied upon to replace PBAPS capacity. From a regional perspective, PJM's inter-connected transmission system is highly reliable. From a local perspective, loss of PBAPS capacity could require construction of new transmission lines to ensure local system stability. Impacts from the construction of new transmission lines would be minimized through BMPs and the routing of lines to avoid sensitive environments and locations. However, the development of new transmission line corridors and facilities would result in short-term impacts from construction and long-term impacts from maintenance within the corridors. Land use impacts likely would be SMALL to MODERATE, depending on the specifics of the lengths, routes, and existing land uses in the new corridor alignments. Erosion and sedimentation, fugitive dust, and construction debris impacts would be noticeable but SMALL with appropriate controls. Compliance with the ESA would minimize impacts on federally listed threatened or endangered species, and construction and operation of new transmission lines would be NOT LIKELY TO ADVERSELY AFFECT such species. There likely would be losses of terrestrial forest habitats within the new corridors, although new edge and field habitats would be created. Thus, the impact to ecological resources could be SMALL to MODERATE, depending on factors such as the extent of forest clearing required and the proportion of such habitats in the vicinity that would be affected. Depending on the state in which the new transmission line corridors are developed, impacts to cultural resources could be possible because not all states require the protection of cultural resources on private lands. Therefore, impacts to cultural resources may be NOT PRESENT to ADVERSE EFFECT.

7.2.3.4 New Nuclear Capacity - SMR

As discussed in Subsection 7.2.2.4, under the new nuclear capacity alternative, Exelon Generation assumes that forty-eight 50 MWe SMR modules would be constructed using an NRC-certified standard design. As with other alternatives, Exelon Generation has not identified locations for the new nuclear units, but assumes the new nuclear units would be sited in clusters of 12 units per site at existing power plant locations within the PJM region.

Air Quality

Air quality impacts due to the operation of clusters of 12 SMR units would be minimal. Air emissions, primarily from facility equipment (e.g., diesel generators, auxiliary boilers) and non-facility equipment (e.g., vehicular traffic), would be comparable to those associated with the continued operation of PBAPS. Overall, the impact on air quality of such emissions and the associated human health impacts are characterized as SMALL.

Waste Management

Management of radioactive and nonradioactive wastes of clusters of 12 SMR units would be similar to that associated with the continued operation of PBAPS. The overall impacts are characterized as SMALL.

Water Resources

Aggregate cooling water requirements for all 48 SMR units would be similar to those of PBAPS but would be distributed at multiple sites within the ROI. In addition, a closed cycle cooling system such as mechanical cooling towers would be used for each site. Impingement, entrainment, and thermal impacts to aquatic resources from make-up water withdrawals and discharges for these closed-cycle systems would be smaller than the impacts of the PBAPS once-through system (with helper towers) on the Susquehanna River. Water quality impacts due to concentration of solids in cooling tower blowdown would be higher than those associated with the once-through (with helper towers) cooling system at PBAPS. Depending on siting, discharges could be distributed among smaller rivers or lakes, which could result in a greater or lesser relative impact, depending on the affected water bodies. Regardless of the water source or discharge receptor, impacts would be mitigated for each nuclear site by permit requirements. Exelon Generation concludes that nuclear generation's impacts to aquatic resources and water quality would be SMALL to MODERATE.

Other Impacts

Based on NuScale's estimate of needing about 90 acres to support for 1,000 MW of generation capacity using the NuScale SMRs, Exelon Generation estimates that construction of the 12 reactor units and auxiliary facilities at four SMR sites within the ROI would affect 87 hectares (215 acres) of land and associated terrestrial habitat (NuScale Power 2017a). Because most of this construction would be on previously disturbed land, impacts would be SMALL. For the purposes of analysis, Exelon

Generation has assumed that the existing roadway infrastructure would be used for reactor vessel and other deliveries under this alternative.

Visual impacts would be consistent with the industrial nature of the sites, thus aesthetic impacts would be SMALL.

As with any large construction project, some erosion and sedimentation and fugitive dust emissions could be anticipated at each construction site, but would be minimized by using best management practices. Debris from clearing and grubbing could be disposed of onsite. Compliance with the ESA would minimize any impacts on Threatened or Endangered species, ensuring a NOT LIKELY TO ADVERSELY AFFECT impact. The NHPA mandates that impacts must be taken into account, which for NRC-licensed facilities, is typically accomplished through consultation with the SHPO, where any cultural and historic impacts of construction of the facility or transmission lines would be addressed and could be NOT PRESENT to MAY ADVERSELY AFFECT.

Exelon Generation estimates a peak construction work force of approximately 2,250 workers (assuming staggered construction among 4 sites with 12 units at each site). The surrounding communities would experience moderate demands on housing, public services, and transportation during construction. Exelon Generation estimates an operational workforce of approximately 375 people for each 12 unit (600 MWe) plant or a total work force of approximately 1,625 people. An additional temporary workforce of approximately 750 people would be required for refueling operations. It is anticipated that the surrounding communities could accommodate the long-term demands on housing, public services, and transportation of plan operations. Therefore, Exelon Generation concludes that socioeconomic impacts during construction would be SMALL TO MODERATE and during operation would be SMALL.

Exelon Generation estimates that the aggregate of other construction and operation impacts would be SMALL for new nuclear capacity using SMRs. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these other impacts, mitigation would not be warranted.

7.2.3.5 Wind Generation, PV Solar Generation and Gas-fired Combined-cycle Generation

Construction of the wind farm, solar field, and gas-fired combined-cycle plants would have relatively larger environmental impacts in comparison to PBAPS license renewal, which would involve no new construction activities.

Air Quality

When compared with fossil-fueled power generation, potential benefits of using wind and solar-generated electricity include reduction in the levels emitted into the atmosphere of CO_2, which is believed to be the major cause of global climate change (DOE 2008a). In addition, compared with fossil-fueled generation, levels emitted into the atmosphere of regulated pollutants such as nitrogen oxides, SO_2, and mercury, which can cause human health effects, would be reduced (DOE 2008a). Hence, air quality impacts from combined wind and solar generation would be minimal. Some air emissions from the gas-fired combined-cycle component of this alternative, as well as from portable diesel generators and vehicular traffic during construction and operation would be comparable to or less than those associated with natural gas-fired generation (Subsection 7.2.3.1). However, overall, pollutant emissions to air and associated air quality impacts are characterized as SMALL. The impacts on human health would likewise be SMALL.

Waste Management

Minor quantities of construction-related wastes would be generated. During operation, maintenance activities could generate dielectric fluids at the wind turbine locations and substations. Overall, non-radioactive waste produced at wind generation facilities would be minimal and associated impacts are characterized as SMALL. Radioactive wastes are not produced at wind generation facilities.

Minor quantities of construction-related wastes would be generated for PV solar facilities. Such wastes would be similar in character and quantity to wastes generated during construction of any large industrial facility (BLM and DOE 2012).

Operation of the PV solar, wind, and gas-fired components at the combined facility would produce industrial wastes, domestic wastes, and wastewaters similar to any large industrial facility. Industrial wastes would include discarded materials and equipment, and general maintenance wastes such as spent solvents, used oil and filters, oily rags, used hydraulic and transmission fluids, spent glycol-based coolants, spent battery electrolyte, and spent lead-acid batteries (BLM and DOE 2012).

While some of these wastes could be toxic, the quantities of toxic wastes are expected to be small and would be managed in accordance with applicable environmental regulations (BLM and DOE 2012). At PV facilities, high-performance solar cell materials would contain small amounts of toxic metals such as cadmium, selenium, and arsenic. Under normal conditions, these metals are secured within sealed solar panels and represent no hazard to workers or the public. When removed from service, legitimate recycling opportunities would be sought for these panels, but if such opportunities are not available, discarded solar panels containing toxic metals would be characterized, and they might need to be managed as hazardous waste (BLM and DOE 2012). On an annual basis, malfunctions or damage sustained in accidents or as a result of weather extremes may result in some panels needing to be replaced (BLM and DOE 2012).

Domestic wastes would include wastes associated with workforce support such as discarded paper, beverage containers, food scraps, cardboard, glass, and plastic containers, and other non-hazardous trash (BLM and DOE 2012).

Wastewaters would include wastes from industrial activities (spent aqueous cleaning/washing solutions, cooling system and steam cycle blowdowns, brines from water treatment, and spent glycol coolants), sanitary wastewaters from support of the workforce, and stormwater runoff from industrial areas (BLM and DOE 2012).

Overall, non-radioactive waste types and volumes produced at a combined generation facility would be comparable to or less than those associated with the continued operation of PBAPS, and associated impacts are characterized as SMALL. Radioactive wastes would not be produced at the combined generation facility.

Water Resources

No water would be consumed during construction or operation of wind generation facilities, and no water would be diverted for non-consumptive cooling use. Hence, impacts to aquatic resources would be minimal. Impacts to water quality could occur from accidental spills of petroleum lubricants and fuel, but such impacts are also expected to be minimal. Overall, impacts on aquatic resources and water quality from wind generation facilities are characterized as SMALL.

The impacts to water resources associated with the gas-fired component of the alternative would be the same as described for the gas-fired alternative in Subsection 7.2.3.1. The magnitude of the impact would be smaller than those associated with PBAPS, as the cooling water use, water quality impact, and impacts to aquatic resources from intake and discharge would be proportional to the output, which would be lower than that described for the gas-fired alternative, and thus would be SMALL.

Water use during construction of a PV solar facility would be comparable to water use during construction of any large industrial facility.

Operation of PV facilities would have minimal water consumption impacts because steam cooling is not needed. Impacts to water quality from operation of a PV facility would be less than continued operation of PBAPS. Overall, impacts on aquatic resources and water quality from PV facilities are characterized as SMALL.

Other Impacts

Land use for wind and solar facilities are high. Land use requirements for modern wind farms were studied by the NREL in 2009. They concluded that there were three different types of impacts to land use — (1) permanently disturbed, (2) temporarily disturbed, and (3) total project area (NREL 2009). The authors concluded that for total project area, based on existing wind farms, approximately 3 hectares (7.41 acres) would be required for the generation of one MWe (NREL 2009). This would result in 10,200 hectares (25,194 acres) required as total project area to generate the 3,400 MWe proposed in Subsection 7.2.2.5. Acreages of permanent and temporary disturbance are generally smaller, as turbines do not take up much physical space relative to the total project area. The NREL reported that the average permanent impact would be 0.3 hectares (0.74 acres) per MWe and the average temporary disturbance would be 1 hectare (2.47 acres) per MWe. Therefore, although 10,200 hectares (25,194 acres) would be required for the generation of 3,400 MWe, only 1,020 hectares (2,516 acres) would be permanently disturbed. However, depending on the characteristics of the plant vicinity, land use could change over the entire project area. For example, even if only 1,020 hectares (2,516) acres were necessary for physical structures, if the project were fenced, land use for the entire parcel would change to an industrial character.

NREL also completed a study on the land use requirements for solar farms. The study reported that an average for all solar technologies of 3.6 hectares (8.9 acres) was required per MWe (NREL 2013), with an average direct, permanent requirement for all solar technologies of 3 hectares (7.41 acres) per MWe. Therefore, to generate the 4,800 MWe proposed in Subsection 7.2.2.5, a total of 17,280 hectares (42,720 acres) would be required. Although only 14,400 hectares (35,568 acres) would be permanently impacted, the area would likely be fenced for safety reasons. Therefore, approximately 17,280 hectares (42,720 acres) would be necessary to generate 4,800 MWe of electricity.

The gas-fired combined cycle portion of the combined generation scenario would have similar impacts to land use as those discussed in Subsection 7.2.3.1. As in Subsection 7.2.2.5, Exelon Generation assumed that the wind portion of the combined system would require 200 MWe from one or more gas-fired plants and that the solar portion would require 480 MWe from multiple gas-fired plants. Therefore, a total of approximately 30.3 hectares (75 acres) would be required as it is likely that the wind and solar portions would not -be adjacent or near enough to share a gas-fired plant.

Using these estimated acreages, the construction of a wind, solar, and gas combination system to generate approximately 8,880 MWe of power would be 27,510 hectares (67,979 acres), assuming total project area, 3,400 MWe of wind, 4,800 MWe of solar power, and 680 MWe generated by the gas-fired plant. This would result in LARGE land-use impacts.

In addition to the large land requirements, development of land-based wind power projects may cause other direct and indirect environmental impacts that are predominately local, but can concern individuals in the affected communities and landscapes (DOE 2008a). For example, indirect impacts can include trees being removed around turbines and the presence of turbines causing some species or individuals to avoid previously viable habitats. Direct impacts can include bird and bat mortality from collisions with turbines. This is a particular worry with bats because they are relatively long-lived mammals with low reproduction rates, which means that species populations could be impacted. Within the PJM region, New Jersey has evaluated the land in its coastal zone and prepared the Large Scale Wind Turbine Siting Map, which identifies specific areas where wind turbines 61 m (200 ft) in height or taller or having a cumulative rotor swept area of greater than 372 square m (4,000 square ft) are unacceptable due to the operational impacts of the turbines on birds and bats (NJDEP 2009). Overall, the direct and indirect environmental impacts of wind energy development on terrestrial ecological resources are characterized as SMALL to MODERATE.

Much of the land area occupied by a PV solar generation facility would be cleared and maintained as an unvegetated or sparsely vegetated surface throughout the life of the facility. This would create an extensive loss of habitat for terrestrial, avian and plant communities. Adjacent plant communities could be affected by such factors as increased runoff, altered hydrology, sedimentation, reduced water quality, and erosion (BLM and DOE 2012). Overall, impacts of the PV solar facility on terrestrial ecology are characterized as LARGE.

Impacts to habitats and water quality due to the construction of a gas-fired plant are discussed in Section 7.2.3.1 and are anticipated to be SMALL if constructed on an existing industrial site.

Compliance with the ESA would minimize impacts on federally listed threatened or endangered species, and for the purpose of this alternatives assessment, Exelon Generation assumes that the construction and operation of all components of the combined generation alternative if constructed at existing industrial sites would be NOT LIKELY TO ADVERSELY AFFECT such species. However, if the large acreage required for the wind and solar portions of the project could not be located within an existing industrial area, this combined generation alternative could be LIKELY TO ADVERSELY AFFECT threatened and endangered species. As the siting of an approximately 50,000 acre facility is not likely to occur in an already existing industrial area, further study and mitigation may be necessary to minimize impacts to such species.

Depending on the state(s) hosting the components of the new combined generation alternative, impacts to cultural resources could be possible, because not all states require the protection of cultural resources on private lands. Therefore, cultural resources may be NOT PRESENT to ADVERSE EFFECT.

Visual impacts would be considerable due to the number and size of wind turbines that would be required to provide 3,400 MWe of new wind capability, and because they would be prominent from afar in the open landscape and over a large area. Thus, aesthetic impacts would be characterized as MODERATE to LARGE. Likewise, visual impacts would be considerable due to the number and size of the PV arrays together with ancillary systems that would be required to provide approximately 4,800 MWe of new solar capability. These components would be prominent in the open landscape and over a large area. Thus, aesthetic impacts would be characterized as LARGE.

Assuming that construction is staggered in time at any given location, Exelon Generation estimates a peak construction work force of 2,500 people for wind farm construction. Exelon Generation also estimates an operational workforce of 611 people once the full wind portion of the project is constructed. Similarly, assuming that construction is also staggered in time and in the vicinity of the wind farm, Exelon Generation estimates a peak construction work force for 750 people for solar farm construction; and once the full proposed capacity is constructed, an operational work force of 307 people. Additional impacts from the backup gas-fired combined-cycle plants would be similar, but smaller, to those described in Subsection 7.2.3.1. Overall, the combination alternative would result in the loss of approximately 919 (89 contract employees and 830 permanent employees) personnel responsible for operational activities at PBAPS and the approximately 1,000 additional personnel employed during each PBAPS refueling outage. Loss of the operational and temporary personnel would impact various aspects of the local community including employment, taxes, housing, offsite land use, and public services, which could be significant. However, over 3,250 temporary construction jobs and 1,018 new permanent jobs would be generated within the ROI to help compensate for this loss. Thus, the overall socioeconomic impacts would be characterized as SMALL.

Exelon Generation concludes that it is very unlikely that other environmental impacts of this or any combination of fossil-fuel-fired and renewable energy alternatives would be less than the small level of impacts associated with renewal of the PBAPS operating licenses because they would require construction activities.

TABLE 7.2-1
SUMMARY OF REPLACEMENT POWER ALTERNATIVES

	Natural Gas-Fired Generation Alternative	Coal-fired USC Alternative	Purchased Power Alternative	SMRs Nuclear Alternative	Combination Renewable and Natural gas-fired Alternative
Summary of Alternative	Five pre-engineered natural gas-fired combined-cycle units producing 510 MWe each of net plant power for a total of 2,550 MWe	Four USC units, each with a net capacity of 624 MWe for a total of 2,496 MWe	Varies based on power alternative	Forty-eight 50 MWe SMR modules for a total of 2,400 MWe	Two 1,700 MWe wind farms (each with a minimum of 100 MWe gas-fired combined-cycle backup capacity) and six 800 MWe PV solar facilities (each with a minimum of 80 MWe gas-fired combined-cycle backup capacity)
Location	Existing fossil plant sites	Existing fossil plant sites	Existing electricity generation sites within PJM region	Existing electricity generation sites within PJM region	ROI
Cooling System	Closed-cycle with mechanical draft cooling towers	Closed-cycle with mechanical draft cooling towers	Varies based on power alternative	Closed-cycle with mechanical draft cooling towers	For natural gas-fired portion, closed-cycle with mechanical draft cooling towers
Land Requirements	100.8 hectares (249 acres)	1,619 hectares (4,000 acres); 180 hectares (480 acres) for waste disposal	Varies based on power alternative	87 hectares (215 acres)	Wind farm – 10,200 hectares (25,194 acres) Solar Farm – 17,280 hectares (42,720 acres) Total Natural Gas – 30.3 hectares (75 acres)

TABLE 7.2-1 (Cont'd)
SUMMARY OF REPLACEMENT POWER ALTERNATIVES

	Natural Gas-Fired Generation Alternative	Coal-fired USC Alternative	Purchased Power Alternative	SMRs Nuclear Alternative	Combination Renewable and Natural gas-fired Alternative
Work Force	800 workers during peak construction; approximately 100 workers for gas operations	2,500 workers during peak construction; approximately 436 people for the coal-fired operations	Varies based on power alternative	2,250 workers during peak construction (assuming staggered construction of four 12-unit plants); total of approximately 1,625 for operations once full construction of all plants is complete; additional temporary workforce of 750 during periodic refueling outages	Wind farm – over 2,500 workers during construction and over 611 workers during operations. Solar farm – 750 during construction and 307 during operations Gas plants – 800 for construction and 100 during operations.

TABLE 7.2-2
GAS-FIRED ALTERNATIVE

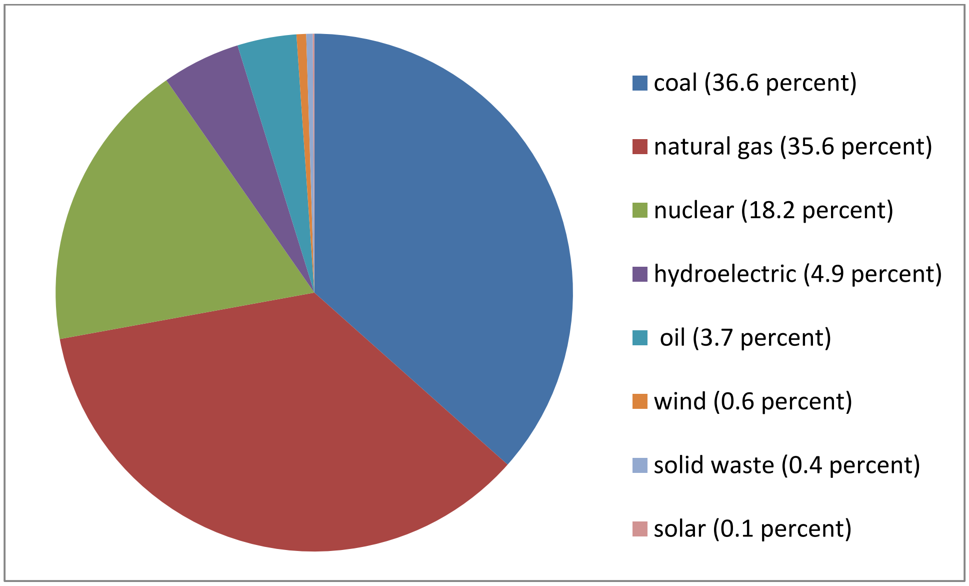
Characteristic	Basis
Plant size = 2,550 MWe consisting of five 510-MWe combined-cycle units	Manufacturer's standard size gas-fired combined cycle units (total rating approximately PBAPS's annual net mean generation capacity of 2,600 MWe)
Number of plants/combined-cycle units = 1/5	Assumed
Fuel Type = natural gas	Assumed
Fuel SO_2 emission = 0.0034 lb/million Btu	(EPA 2000)
NOx control = SCR with steam/water injection	Best available for minimizing NO_x emissions (EPA 2000)
Fuel NOx emission = 0.13 lb/million Btu	Typical for large SCR controlled gas fired units with water injection (EPA 2000)
Fuel CO emission = 0.015 lb/million Btu	Typical for large SCR controlled gas fired units. (EPA 2000)
Fuel $PM_{2.5}$ emission = 0.0019 lb/million Btu	(EPA 2000)
Fuel CO_2 emission = 110 lb/million Btu	(EPA 2000)
Heat rate = 8,170 Btu/kWh	(GE Power & Water 2015)
Capacity factor = 87 percent	Assumed based on conservative performance of modern plants (EIA 2010)

Note: The difference between "net" and "gross" is electricity consumed onsite. The HRSGs do not contribute to air emissions.

TABLE 7.2-3
COAL-FIRED ALTERNATIVE

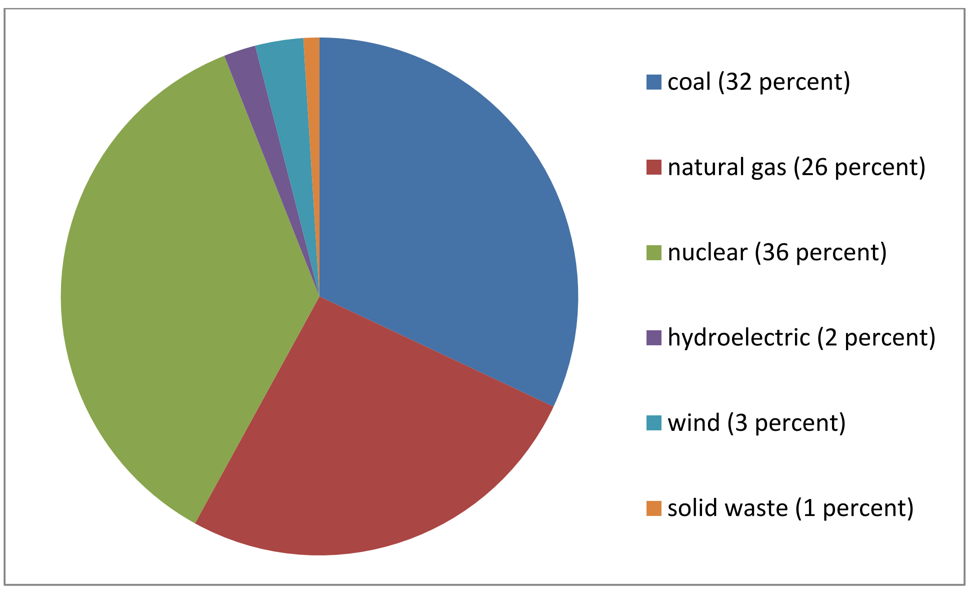
Characteristic	Basis
Plant size = 2,496 MWe consisting of four 624 MWe (net)	Assumed unit size similar to the 624 MWe John W. Turk Jr. USC power plant in Fulton, Arkansas (total rating approximately PBAPS's annual net mean generation capacity of 2,600 MWe)
Number of plants / units = 1 / 4	Assumed
Boiler type = tangentially fired, dry-bottom	Minimizes nitrogen oxides emissions (EPA 1998)
Fuel Type = sub-bituminous, pulverized coal	Assumed
Fuel heating value = 8,300 Btu/lb	John W. Turk Jr. USC power plant performance parameter (Peltier 2013)
Fuel ash content by weight = 5.5 percent	John W. Turk Jr. USC power plant performance parameter (Peltier 2013)
Fuel sulfur content by weight = 0.4 percent	John W. Turk Jr. USC power plant performance parameter (Peltier 2013)
Uncontrolled NOx emission = 0.05 lb/MMBtu	John W. Turk Jr. USC power plant performance parameter (Peltier 2013)
Uncontrolled CO emission = 0.15 lb/MMBtu	John W. Turk Jr. USC power plant performance parameter (Peltier 2013)
Uncontrolled CO_2 emission = 5,900,000 lb/1000 MWe	John W. Turk Jr. USC power plant performance parameter (Peltier 2013)
Uncontrolled SO_2 emission = 0.065 lb/MMBtu	John W. Turk Jr. USC power plant performance parameter (Peltier 2013)
Uncontrolled PM_{10} emission = 0.012 lb/MMBtu	John W. Turk Jr. USC power plant performance parameter (Peltier 2013)
Uncontrolled mercury emission = 1.7 lb/TBtu	John W. Turk Jr. USC power plant performance parameter (Peltier 2013)
Heat rate = 8,730 Btu/kWh	John W. Turk Jr. USC power plant performance parameter (Peltier 2013)
Capacity factor = 69 percent	John W. Turk Jr. USC power plant performance parameter (Peltier 2013)
NOx control=low NOx burners with over-fire air and SCR (85-95 percent reduction)	Best commercially available but not widely demonstrated for minimizing NOx emissions (EPA 1998)
Particulate control = baghouse fabric filters (up to 99.9 percent removal efficiency)	Best available for minimizing particulate emissions (EPA 1998)
SO_x control = Wet scrubber - limestone (80-95 percent removal efficiency)	Best available for minimizing SO_x emissions (EPA 1998)

Note: The difference between "net" and "gross" is electricity consumed onsite. The HRSGs do not contribute to air emissions.



Source: (Monitoring Analytics 2016)

Figure 7.2-1 PJM Regional Generating Capacity by Fuel Type 2016



Source: (Monitoring Analytics 2016)

Figure 7.2-2 PJM Regional Energy Output by Fuel Type 2016

7.3 ALTERNATIVES FOR REDUCING ADVERSE IMPACTS

10 CFR 51.53(c)(3)(iii) states that "The report must contain a consideration of alternatives for reducing adverse impacts, as required by § 51.45(c), for all Category 2 license renewal issues in Appendix B to Subpart A of this part." The review of the environmental impacts associated with the Category 2 issues required by 10 CFR 51.53(c)(3)(ii) provided in Chapter 4 identified no significant adverse effects that would warrant consideration of additional alternatives to reduce or avoid those impacts. Hence, as Section 6.2 indicates, because all impacts of PBAPS SLR are small, consideration of alternatives for achieving further mitigation should not be necessary. Nevertheless, Exelon Generation acknowledges that, as described in Subsection 4.6.2.1, final decisions about the need for additional measures for protecting special status species and meeting BTA standards for impingement and entrainment will be made in consultation with PADEP, as indicated in the PBAPS NPDES permit, and USFWS.

Chapter 8

Comparison of Environmental Impact of License Renewal with the Alternatives

8.1 COMPARISON OF ENVIRONMENTAL IMPACT OF LICENSE RENEWAL WITH THE ALTERNATIVES

NRC

"To the extent practicable, the environmental impacts of the proposal and the alternatives should be presented in comparative form;" 10 CFR 51.45(b)(3) as adopted by 51.53(c)(2)

Chapter 4 analyzes environmental impacts of the PBAPS license renewal and Chapter 7 analyzes impacts of reasonable alternatives. Table 8.1-1 summarizes environmental impacts of the proposed action (license renewal) and the reasonable alternatives, for comparison purposes. The environmental impacts compared in Table 8.1-1 are either Category 2 issues for the proposed action or are issues that the GEIS (NRC 2013a) identified as major considerations in an alternatives analysis. Therefore, although, for example, the GEIS designates air quality impacts as a Category 1 issue, Table 8.1-1 includes a comparison of air impacts from the proposed action to those of the alternatives. Table 8.1-2 provides a more detailed comparison of the alternatives.

As shown in Table 8.1-1 and Table 8.1-2, environmental impacts of the proposed action (PBAPS license renewal) to which the SMALL, MODERATE or LARGE measures of significance apply are all expected to be SMALL. For threatened and endangered species, the proposed action is not likely to adversely affect protected species, and for cultural resources, the proposed action would have no adverse effect. Exelon Generation expects that environmental impacts on specific resources from the alternative actions identified as reasonable could be SMALL to LARGE. For threatened and endangered species, the alternative actions are expected to have no effect or be not likely to adversely affect protected species, or be likely to affect protected species, depending on the siting of the plants and assumed mitigation measures. For cultural resources, the alternative actions could occur where no resource is present or in a location where an adverse effect on resources would take place.

Exelon Generation concludes that the environmental impacts of the continued operation of PBAPS, providing approximately 2,600 MWe of base-load power generation through 2053, would be smaller overall than impacts associated with any of the other reasonable alternatives that are analyzed. PBAPS's continued operation would create the same or significantly less environmental impact than the construction and operation of any other new base-load generation capacity, and therefore, there is no other preferred alternative. Additionally, PBAPS's continued operation would extend the existing significant positive economic impact on the communities near the Station. Therefore, Exelon Generation concludes that the results of this analysis support the approval of PBAPS license renewal to maintain the option of continued PBAPS operation for energy planning decision makers.

TABLE 8.1-1
IMPACTS COMPARISON SUMMARY

Impact	Proposed Action (License Renewal)	No-Action (Decom-missioning)	With Gas-Fired Generation	With Coal-Fired (USC) Generation	With Purchased Power	With SMRs	With Combined Wind Energy, PV Solar Energy, & Gas-Fired Generation
Land Use	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL	LARGE
Aesthetics	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	LARGE
Air Quality	SMALL	SMALL	MODERATE	MODERATE	SMALL to MODERATE	SMALL	SMALL
Water Resources	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL
Ecological Resources	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL	LARGE
Threatened or Endangered Species[1]	NOT LIKELY TO ADVERSELY AFFECT	Not an impact evaluated by Decom-missioning GEIS (NRC 1996)	NOT LIKELY TO ADVERSELY AFFECT	NOT LIKELY TO ADVERSELY AFFECT	NOT LIKELY TO ADVERSELY AFFECT	NOT LIKELY TO ADVERSELY AFFECT	NOT LIKELY TO ADVERSELY AFFECT to LIKELY TO ADVERSELY AFFECT
Cultural Resources[2]	NO ADVERSE EFFECT	NO ADVERSE EFFECT	NOT PRESENT to ADVERSE EFFECT	NOT PRESENT to ADVERSE EFFECT	NO ADVERSE EFFECT	NOT PRESENT to ADVERSE EFFECT	NOT PRESENT to ADVERSE EFFECT
Socioeconomics	SMALL	SMALL	MODERATE	MODERATE	SMALL	SMALL to MODERATE	SMALL
Human Health	SMALL	SMALL	SMALL to MODERATE	MODERATE	SMALL to MODERATE	SMALL	SMALL
Waste Management	SMALL	SMALL	SMALL	MODERATE	SMALL to MODERATE	SMALL	SMALL

[1] Effects on threatened or endangered species may be characterized as follows: (1) no effect, (2) not likely to affect, (3) likely to affect, (4) likely to jeopardize continued existence.

[2] Effects on historic properties may be characterized as follows: (1) no historic properties present, (2) historic properties are present, but not adversely affected, or (3) historic properties are adversely affected.

TABLE 8.1-2
IMPACTS COMPARISON DETAIL

Proposed Action (License Renewal)	No-Action (Decommissioning)	With Gas-Fired Generation	With Coal-Fired (USC) Generation	With Purchased Power	With SMRs	With Combined Wind Energy, PV Solar Energy, & Gas-Fired Generation
Renewal of PBAPS Units 2 and 3 licenses for 20 years each, followed by termination of plant operations and decommissioning	Decommissioning following expiration of current PBAPS Units 2 and 3 licenses. Adopting by reference, as bounding for PBAPS, decommissioning GEIS description (Subsection 7.1)	New construction at existing fossil plant sites (Subsection 7.2.2.1)	New construction at existing fossil plant sites (Subsection 7.2.2.2)	Adopting by reference GEIS description of alternate technologies and the NRC analysis of the environmental impacts from those technologies (Subsection 7.2.2.3)	New construction at various sites within ROI (Subsection 7.2.2.4)	Construction of wind energy turbines, solar collectors, and gas-fired firming capacity within the ROI (Subsection 7.2.2.5)
		Five pre-engineered natural gas-fired combined-cycle units producing 510 MWe each of net plant power for a total of 2,550 MWe	Four USC units, each with a net capacity of 624 MWe for a total of 2,496 MWe		Forty-eight 50 MWe SMR modules in 12 unit clusters using an NRC-certified standard design.	Two 1,700 MWe wind farms (each with a minimum of 100 MWe gas-fired combined-cycle backup capacity) and six 800 MWe PV solar facilities (each with a minimum of 80 MWe gas-fired combined-cycle backup capacity)
		Construct two 41-cm (16 in) diameter gas pipelines in an existing 100-ft wide ROW. May require upgrades to existing pipelines	Extend an existing rail spur	Construct new transmission lines to assure local transmission system stability	Construct new rail spur or extend an existing spur or barge offloading facility	Construct new transmission lines
		Construct cooling tower(s) and intake/discharge system	Construct cooling tower(s) and intake/discharge systems		Construct cooling tower(s) and intake/discharge systems	Construct cooling tower(s) and intake/discharge system(s)
		Natural gas, 8,170 Btu/kWh; 0.0034 lb SO_2/million Btu; 0.13 lb NO_x/million Btu	Pulverized sub-bituminous coal, 8,300 5.5% ash; 0.4% sulfur; 0.05 lb NO_x/MMBtu		Low-enriched uranium fuel; refueling every 18 months	Same natural gas fuel characteristics as for the Gas-Fired Generation alternative.

TABLE 8.1-2 (Cont'd)
IMPACTS COMPARISON DETAIL

Proposed Action (License Renewal)	No-Action (Decom-missioning)	With Gas-Fired Generation	With Coal-Fired (USC) Generation	With Purchased Power	With SMRs	With Combined Wind Energy, PV Solar Energy, & Gas-Fired Generation
		SCR with steam/water injection	Low NO_x burners, overfire air and SCR; activated carbon injection system for mercury removal; spray dry absorber system with pebble lime and recycle ash for SO_2 reduction; fabric fiber baghouse for particulate removal			
Approximately 919 full time employees		Approximately 100 employees (Subsection 7.2.3.1)	Approximately 436 employees (Subsection 7.2.3.2)		Approximately 375 employees (Subsection 7.2.3.4)	Over 1,018 employees (Subsection 7.2.3.5)
Land Use Impacts						
SMALL – Adopting by reference Category 1 issue findings (Table 4.0-1, Issues 1 and 2)	SMALL – Adopting by reference Category 1 issue finding (Table 4.0-1, Issue 78).	SMALL – 249 acre for facility at existing power plant sites across the ROI. Two new gas pipelines would be built within existing ROW to connect with existing gas pipeline corridor (Subsection 7.2.3.1)	SMALL to MODERATE – 4,000 acre for the power block and associated facilities at existing power plant sites across the ROI; 180 ha (480 ac) for ash and scrubber sludge disposal (Subsection 7.2.3.2)	SMALL to MODERATE – Most transmission facilities could be constructed along existing transmission ROW (Subsection 7.2.3.3). Depending on the fuel used to generate the purchased power and the location of the generating facilities, impacts would be similar to those described for the energy alternatives (Subsection 7.2.3.3)	SMALL – 233 acre required for the power block and associated facilities at existing power plant sites across the ROI (Subsection 7.2.2.4)	LARGE – Approximately 68,000 acre required for the combination alternative (Subsection 7.2.2.5)

TABLE 8.1-2 (Cont'd)
IMPACTS COMPARISON DETAIL

Proposed Action (License Renewal)	No-Action (Decom-missioning)	With Gas-Fired Generation	With Coal-Fired (USC) Generation	With Purchased Power	With SMRs	With Combined Wind Energy, PV Solar Energy, & Gas-Fired Generation
Water Resources Impacts						
SMALL – Adopting by reference Category 1 issue findings (Table 4.0-1, Issues 9, 10, 12-15, 18-21, and 24). One Category 2 surface water issue applies (Subsection 4.5.1, Issue 17) and three Category 2 groundwater issues apply (Subsection 4.5.2.2, Issue 23; Subsection 4.5.2.3, Issue 26; and Subsection 4.5.2.4, Issue 27).	SMALL – Adopting by reference Category 1 issue finding (Table 4.0-1, Issue 78).	SMALL – Construction impacts minimized by use of best management practices. Reduced cooling water demands, inherent in combined-cycle design (Subsection 7.2.3.1)	SMALL – Construction impacts minimized by use of best management practices. Operational consumptive water use impacts would be similar to PBAPS due to use of cooling towers. Volume of withdrawals from and discharges to a surface water source would be less than those of PBAPS due to closed-cycle cooling system (Subsection 7.2.3.2)	SMALL to MODERATE – Depending on the fuel used to generate the purchased power, impacts would be similar to those described for the energy alternatives (Subsection 7.2.3.3)	SMALL to MODERATE – Construction impacts minimized by use of best management practices. Operational impacts could vary based on location and size of receiving water body (Subsection 7.2.3.4)	SMALL – Construction impacts minimized by use of best management practices. Wind, PV and combined cycle gas facilities use minimal water (Subsection 7.2.3.5)
Air Quality Impacts						
SMALL – Adopting by reference Category 1 issue finding (Table 4.0-1, Issue 5).	SMALL – Adopting by reference Category 1 issue findings (Table 4.0-1, Issue 78)	MODERATE –270 tons SO_2/yr; 10,320 tons NO_x/yr; 1,191 tons CO/yr; 151 tons $PM_{2.5}$/yr; 8,732,695 tons CO_2/yr (Subsection 7.2.3.1)	MODERATE – 1,070 tons SO_2/yr; 823 tons NO_x/yr; 2,468 tons CO/yr; 198 tons $PM_{2.5}$/yr; 0.03 tons mercury/yr; 5,200,000 tons CO_2/yr (Subsection 7.2.3.2)	SMALL to MODERATE – Depending on the fuel used to generate the purchased power, impacts would be similar to those described for the energy alternatives (Subsection 7.2.3.3)	SMALL – Air emissions are primarily from non-generation equipment and diesel generators and are comparable to those associated with the continued operation of PBAPS (Subsection 7.2.3.4)	SMALL – Gas-fired combustion turbine emits air pollutants similar to gas-fired alternative, but at approximately 5% of the amounts (Subsection 7.2.3.5)

TABLE 8.1-2 (Cont'd)
IMPACTS COMPARISON DETAIL

Proposed Action (License Renewal)	No-Action (Decom-missioning)	With Gas-Fired Generation	With Coal-Fired (USC) Generation	With Purchased Power	With SMRs	With Combined Wind Energy, PV Solar Energy, & Gas-Fired Generation
Ecological Resource Impacts						
SMALL – Adopting by reference Category 1 issue findings (Table 4.0-1, Issues 29, 30, 32, 34, 35, 38, 41-45, 47, and 49). Five Category 2 issues apply (Subsection 4.6.1.1, Issue 28; Subsection 4.6.1.2, Issue 33; Subsection 4.6.2.1, Issue 36; Subsection 4.6.2.2, Issue 3; and Subsection 4.6.2.3, Issue 46)	SMALL – Adopting by reference Category 1 issue finding (Table 4.0-1, Issue 78)	SMALL – Construction of pipeline could alter the terrestrial habitat, but construction on an existing site would minimize habitat disturbances. Impacts to aquatic resources would be small. (Subsection 7.2.3.1)	SMALL to MODERATE – 4,000 acre would be required for the new power block and coal storage; 180 ha (480 ac) of the existing site could be required for ash/sludge disposal. Impacts to aquatic resources would be small. (Subsection 7.2.3.2)	SMALL to MODERATE – Depending on the fuel used to generate the purchased power, impacts would be similar to those described for the energy alternatives; the need for transmission lines could affect terrestrial and aquatic resources (Subsection 7.2.3.3)	SMALL – Construction could affect terrestrial habitats. Impacts of operations would be comparable to those associated with continued operation of PBAPS. Impacts to aquatic resources would be small. (Subsection 7.2.3.4)	LARGE – Potential for impact include habitat avoidance, and bird and bat mortality; extensive loss of habitat beneath solar collectors due to clearing, shading and loss of precipitation, and maintenance (Subsection 7.2.3.5)
Threatened and Endangered Species Impacts[1]						
NOT LIKELY TO ADVERSELY AFFECT – One Category 2 issue applies (Subsection 4.6.3, Issue 50)	Not an impact evaluated by Decommissioning GEIS (NRC 1996)	NOT LIKELY TO ADVERSELY AFFECT – Federal and state laws prohibit federal projects from destroying or adversely affecting protected species and their habitats (Subsection 7.2.3.1)	NOT LIKELY TO ADVERSELY AFFECT – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats (Subsection 7.2.3.2)	NOT LIKELY TO ADVERSELY AFFECT – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats (Subsection 7.2.3.3)	NOT LIKELY TO ADVERSELY AFFECT – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats (Subsection 7.2.3.4)	NOT LIKELY TO ADVERSELY AFFECT to LIKELY TO ADVERSELY AFFECT– Depending on the siting of the wind and solar farms. Federal and state laws prohibit destroying or adversely affecting protected species and their habitats (Subsection 7.2.3.5)

TABLE 8.1-2 (Cont'd)
IMPACTS COMPARISON DETAIL

Proposed Action (License Renewal)	No-Action (Decommissioning)	With Gas-Fired Generation	With Coal-Fired (USC) Generation	With Purchased Power	With SMRs	With Combined Wind Energy, PV Solar Energy, & Gas-Fired Generation
Human Health Impacts						
SMALL – Adopting by reference Category 1 issues (Table 4.0-1, Issues 57-59, 61, and 63). One Category 2 issue applies Microbiological hazards (Subsection 4.9.1, Issue 60)	SMALL – Adopting by reference Category 1 issue finding (Table 4.0-1, Issue 78)	SMALL TO MODERATE– Adopting by reference GEIS conclusion that some risk of cancer and emphysema exists from emissions (NRC 2013a)	MODERATE – Adopting by reference GEIS conclusion that risks such as cancer and emphysema from emissions are likely (NRC 2013a)	SMALL to MODERATE – Depending on the fuel used to generate the purchased power, impacts would be similar to those described for other energy alternatives (Subsection 7.2.3.3)	SMALL – Impacts would be comparable to continued operation of PBAPS (Subsection 7.2.3.4)	SMALL to MODERATE – Air emissions from combustion turbines (Subsection 7.2.3.5)
Socioeconomic Impacts						
SMALL– Adopting by reference Category 1 issue findings Table 4.0-1, Issues 52-56). One Category 2 issue applies – Environmental Justice (Subsection 4.10.1, Issue 67)	SMALL – Adopting by reference Category 1 issue finding (Table 4.0-1, Issue 78)	MODERATE – Small, temporary impacts due to construction and moderate impacts from loss of 919 permanent jobs at the PBAPS site could adversely affect surrounding counties (Subsection 7.2.3.1)	MODERATE – Small, temporary impacts due to construction and moderate impacts from loss of 919 permanent jobs at the PBAPS site could adversely affect surrounding counties (Subsection 7.2.3.2)	SMALL – Small impacts at the sites of the existing plants, and moderate impacts from loss of 919 permanent jobs at the PBAPS site could adversely affect surrounding counties (Subsection 7.2.3.3)	SMALL– Small, temporary impacts due to construction and moderate impacts from loss of 919 permanent jobs at the PBAPS site could adversely affect surrounding counties (Subsection 7.2.3.4)	SMALL to MODERATE – Small, temporary impacts due to construction and moderate impacts from loss of 919 permanent jobs at the PBAPS site could adversely affect surrounding counties (Subsection 7.2.3.5)

TABLE 8.1-2 (Cont'd)
IMPACTS COMPARISON DETAIL

Proposed Action (License Renewal)	No-Action (Decommissioning)	With Gas-Fired Generation	With Coal-Fired (USC) Generation	With Purchased Power	With SMRs	With Combined Wind Energy, PV Solar Energy, & Gas-Fired Generation
			Waste Management Impacts			
SMALL – Adopting by reference Category 1 issue findings (Table 4.0-1, Issues 68, 69, 71, and 72)	SMALL – Adopting by reference Category 1 issue finding (Table 4.0-1, Issue 78)	SMALL – The only noteworthy waste would be a small amount of spent catalyst from spent SCR used for NO_x control. (Subsection 7.2.3.1)	MODERATE – 295,000 tons of non-recycled coal ash and other combustion waste annually would require 180 ha (480 ac) for disposal over a 20-year period. (Subsection 7.2.2.2)	SMALL to MODERATE – Depending on the fuel used to generate the purchased power, impacts would be similar to those described for the energy alternatives (Subsection 7.2.3.3)	SMALL – Non-radioactive and radioactive wastes would be similar to those associated with the continued operation of PBAPS (Subsection 7.2.3.4)	SMALL- Waste generation in minor quantities during operation (Subsection 7.2.3.5)
			Visual/Aesthetic Impacts			
SMALL – Adopting by reference Category 1 issue finding (Table 4.0-1, Issue 4)	SMALL – Adopting by reference Category 1 issue finding (Table 4.0-1, Issue 78)	SMALL – Visual impacts would be consistent with industrial nature of selected site (Subsection 7.2.3.1)	SMALL – Visual impacts would be consistent with the industrial nature of the site (Subsection 7.2.3.2)	SMALL– Depending on the fuel used to generate the purchased power, impacts would be similar to those described for the energy alternatives (Subsection 7.2.3.3)	SMALL – Visual impacts would be comparable to those from existing PBAPS facilities (Subsection 7.2.3.4)	LARGE - Comparable to other wind and solar visual impacts (Subsection 7.2.3.5)

TABLE 8.1-2 (Cont'd)
IMPACTS COMPARISON DETAIL

Proposed Action (License Renewal)	No-Action (Decom-missioning)	With Gas-Fired Generation	With Coal-Fired (USC) Generation	With Purchased Power	With SMRs	With Combined Wind Energy, PV Solar Energy, & Gas-Fired Generation
Cultural Resources Impacts[2]						
NO ADVERSE EFFECT – One Category 2 issue applies – SHPO consultation minimizes potential for impact (Subsection 4.7, Issue 51)	NO ADVERSE EFFECT – Adopting by reference Category 1 issue finding (Table 4.0-1, Issue 78)	NOT PRESENT to ADVERSE EFFECT – some states do not have cultural resource protection regulations (Subsection 7.2.3.1)	NOT PRESENT to ADVERSE EFFECT – some states do not have cultural resource protection regulations (Subsection 7.2.3.2)	No ADVERSE EFFECT - based on no new construction.	NOT PRESENT to ADVERSE EFFECT – protection of archaeological and cultural resources would be implemented consistent with applicable state and federal requirements which must include SHPO consultation, if effects would be significant, due to NRC licensing involvement (Subsection 7.2.3.4)	NOT PRESENT to ADVERSE EFFECT – some states do not have cultural resource protection regulations (Subsection 7.2.3.5)

1 Effects on threatened or endangered species may be characterized as follows: (1) no effect, (2) not likely to adversely affect, (3) likely to adversely affect, (4) likely to jeopardize continued existence.

2 Effects on historic properties may be characterized as follows: (1) no historic properties present, (2) historic properties are present, but not adversely affected, or (3) historic properties are adversely affected .

ABREVIATIONS

SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource.
LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource. (10 CFR 51, Subpart A, Appendix B, Table B-1, Footnote 3).
ROI = region of interest = includes the states of Delaware, Maryland, and New Jersey, along with the Commonwealth of Pennsylvania, the states within PJM's network that are geographically closest to PBAPS.

Chapter 9

Status of Compliance

9.1 PROPOSED ACTION

NRC

> **"The environmental report shall list all federal permits, licenses, approvals and other entitlements which must be obtained in connection with the proposed action and shall describe the status of compliance with these requirements. The environmental report shall also include a discussion of the status of compliance with applicable environmental quality standards and requirements including, but not limited to, applicable zoning and land-use regulations, and thermal and other water pollution limitations or requirements which have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection." 10 CFR 51.45(d), as adopted by 10 CFR 51.53(c)(2)**

9.1.1 General

Table 9.1-1 lists environmental authorizations Exelon Generation has obtained for current PBAPS operations. In this context, Exelon Generation uses "authorizations" to include any permits, licenses, approvals, or other entitlements. Exelon Generation expects to continue renewing these authorizations, as appropriate, during the current license period and throughout the period of extended operation associated with renewal of the PBAPS operating licenses. Because the NRC regulatory focus is prospective, Table 9.1-1 does not include authorizations that Exelon Generation obtained for past activities that did not include continuing obligations.

Preparatory to applying for renewal of the PBAPS licenses to operate, Exelon Generation conducted an assessment to identify new and significant environmental information (Chapter 5). The assessment included interviews with subject experts, review of PBAPS environmental documentation, and communication with state and federal environmental protection agencies. Based on this assessment, Exelon Generation concludes that PBAPS is in substantive compliance with applicable environmental standards and requirements. Minor deviations from applicable standards or requirements are corrected, and notification is provided to regulatory agencies, as required. Table 9.1-2 lists additional environmental authorizations and consultations related to NRC renewal of the PBAPS licenses to operate. As indicated, Exelon Generation anticipates needing relatively few such additional authorizations and consultations. Subsections 9.1.2 through 9.1.5 discuss these items in more detail.

9.1.2 Threatened or Endangered Species

Section 7 of the ESA (16 USC 1531 et seq.) requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of species that are federally listed, or proposed for listing, as endangered or threatened. Depending on the action involved, the Act requires consultation with the USFWS, regarding effects on non-marine species, and with the NMFS, when marine species could be affected. USFWS and NMFS have issued joint procedural regulations at 50 CFR Part 402, Subpart B, that address consultation, and USFWS maintains the joint list of threatened or endangered species at 50 CFR Part 17.

Although not required of an applicant by federal law or NRC regulation, Exelon Generation has chosen to invite comment from federal and state agencies regarding potential effects that PBAPS license renewal might have on state and federally protected species.

Appendix C.1 includes copies of correspondence between Exelon Generation and agency responses. Table 9.1-3 summarizes the status of Exelon Generation's correspondence with federal and state agencies about protected species.

9.1.3 Historic Preservation

Section 106 of the NHPA requires federal agencies having the authority to license any undertaking to consider the effect of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation an opportunity to comment on the undertaking, prior to the agency issuing the license (54 USC 306108). Advisory Council regulations provide for the SHPO to have a consulting role (35 CFR 800.2). Although not required of an applicant by federal law or NRC regulation, Exelon Generation has chosen to invite comment by the Pennsylvania SHPO. Appendix C.2 includes copies of Exelon Generation's correspondence with the SHPO regarding potential effects that PBAPS license renewal might have on historic or cultural resources. Based on the Exelon Generation submittal and other information, the Pennsylvania SHPO concurred with Exelon Generation's conclusion that PBAPS SLR would have no effect on historic buildings, structures, and/or archaeological resources located in or near the project area.

9.1.4 Water Quality (401) Certification

Federal CWA Section 401 requires an applicant seeking a federal license for an activity that may result in a discharge to navigable waters to provide the federal licensing agency with a certification, or a waiver of certification, by the state where the discharge would originate. If no waiver is issued by the state, its certification must indicate that applicable state water quality standards will not be violated as a result of the discharge (33 USC 1341).

The NRC recognized in the 2013 GEIS that some NPDES-delegated states explicitly integrate their 401 certification process with NPDES permit issuance (NRC 2013a). In accordance with Section 402 of the CWA (33 USC 1342) the EPA delegated to the Commonwealth of Pennsylvania its authority to issue NPDES permits.

A published PADEP policy states that CWA Section 401 certifications have been integrated with other required permits, and that individual water quality certifications will be issued by PADEP only for activities that are not regulated by other water quality approvals or permits, such as NPDES permits (PADEP 1997). PBAPS is regulated by NPDES Permit No PA0009733, which expires September 30, 2019 (included in Appendix A). Additionally, PADEP issued a CWA Section 401 certification to PBAPS in conjunction with NRC authorization for EPU (PADEP 2014b) (included in Appendix D). In a letter dated August 16, 2017, Exelon Generation requested PADEP concurrence that the previous CWA Section 401 certification together with the existing NPDES permit would be adequate to regulate PBAPS Units 2 and 3 such that an individual water quality certification approval under CWA Section 401 for the proposed SLR would not be needed (Exelon Generation 2017e) (included in Appendix D). PADEP subsequently concurred (PADEP 2017c) (included in Appendix D).

9.1.5 Coastal Zone Management Program

Section 307 in the Coastal Zone Management Act of 1972 (CZMA) (16 USC 1451 et seq.), referred to as the "federal consistency" provision, requires that federal actions within and outside a state's coastal zone that would have reasonably foreseeable effects on any coastal use or natural resource of the coastal zone be consistent with the enforceable policies of the state's federally approved coastal management program. Federal actions include federal licensing activities, such as renewal by the NRC of a nuclear reactor license.

NOAA has promulgated implementing regulations under the CZMA requiring that an applicant for a federal license must coordinate with the state and certify in the application to the federal licensing agency that reasonably foreseeable effects on the state's coastal zone from the licensed facility would be consistent with the state's approved coastal management program. A copy of the certification must be provided to the state at the same time as to the federal licensing agency [15 CFR 930.57(a)].

"Interstate consistency" is a special circumstance that arises when:

1. A federal action will occur exclusively in one state (State B), but will have effects on the uses or resources of another state's coastal zone (State A); and
2. NOAA has approved a list of such federal actions submitted by State A (15 CFR Part 930, Subpart I).

If interstate consistency circumstances exist, State A has the option to review any proposed federal action on its approved list, and may also use the procedure in 15 CFR 930.54 to review unlisted activities.

PBAPS is not located within any Pennsylvania Coastal Zone Management area, and it has no potential to affect the Pennsylvania Coastal Zone. However, even though the plant is not located in Maryland, PBAPS operations may affect the small part of Conowingo Pond located within the Maryland Coastal Zone since the plant withdraws water from and has discharges to Conowingo Pond. Nevertheless, at this time, Maryland does not have an Interstate Consistency list approved by NOAA.

In May 2003, the NRC renewed the operating licenses for PBAPS Units 2 and 3 for an additional 20 years beyond the initial 40-year terms. By letter dated April 23, 2002, the Maryland Department of the Environment (MDE) determined this action to be consistent with the Maryland Coastal Zone Management Program. With regard to the PBAPS SLR, MDE acknowledged on June 13, 2017 that the renewed licenses will simply be extended and no new construction activities will be entailed. Based on this consideration, MDE concluded that it has no concerns with the proposed SLR and that the state's 2002 interstate consistency determination will continue in effect and be applicable to the PBAPS SLR project (Appendix E).

TABLE 9.1-1
ENVIRONMENTAL AUTHORIZATIONS FOR CURRENT PBAPS

Agency	Authority	Requirements	Number	Issue and Expiration Dates	Activity Covered
Federal and State Requirements					
NRC	Atomic Energy Act (42 USC 2011, et seq.), 10 CFR 50.10	License to operate	Renewed DPR – 44 (Unit 2)	Issued on 05/07/2003 Expires on 08/08/2033 (Unit 2)	Operation of PBAPS Unit 2
			Renewed DPR – 56 (Unit 3)	Issued on 05/07/2003 Expires on 07/02/2034 (Unit 3)	Operation of PBAPS Unit 3
PADEP	CWA (33 USC Section 1251 et seq.), Pennsylvania Clean Streams Law (35 Pennsylvania Statutes Section 691.1 et seq.), 25 Pa. Code Chapters 92a and 93	Individual Discharge Permit	PA 0009733	Issued on 09/22/2014 Effective on 10/01/2014 Expires on 09/30/2019	Effluent limits for PBAPS discharges to the Susquehanna River
EPA, PADEP	CWA Section 401 (33 USC 1341)	Certification of compliance with state water quality standards	PADEP File No. EA 67-024	Issued on 7/23/2014 (effective for duration of operation as an electric generation facility; may be suspended revoked or modified according to its terms)	Compliance with applicable state water quality standards
FERC	Federal Power Act (16 USC Section 10(a)(1))	Approval	152 FERC ¶ 62,142	Issued on September 2, 2015 Indefinite until system is modified	Non-Project consumptive use of Conowingo Reservoir water
SRBC	Susquehanna River Basin Compact (PL91-575). 18 CFR 803	Approval	Docket 20061209-1	Approved 6/23/2011; Expires on 7/3/2034	Consumptive use of Conowingo Pond water
EPA, PADEP	CAA (42 USC 7661 et seq.) Air Pollution Control Act (25 Pa. Code Chapter 127)	PA State Only Operating Permit	67-05020	Issued on 10/28/14; Expires on 10/31/19	Operation of air emission sources

TABLE 9.1-1 (Cont'd)
ENVIRONMENTAL AUTHORIZATIONS FOR CURRENT PBAPS

Agency	Authority	Requirements	Number	Issue and Expiration Dates	Activity Covered
PADEP	Storage Tank and Spill Prevention Act (Act 32) (25 Pa. Code Chapter 245) Pennsylvania	Registration /permitting	67-60412	Renewed annually	Storage Tanks located at PBAPS (gasoline, used oil, hazardous substances, unlisted materials)
PADEP	Pennsylvania Safe Drinking Water Act (35 Pennsylvania Statutes Sections 7.21.1-7.21-17)(25 Pa. Code Chapter 109)	Permit	6709503	Issued: 9/22/2011 Indefinite (valid until system is modified)	Public Water Supply
PADEP	Submerged Lands License Agreement (25 Pa. Code Chapter 105)		E67-503	Indefinite (valid until system is modified)	Occupation of Submerged Lands of the Commonwealth
PADEP	Resource Conservation and Recovery Act (42 U.S.C. 6901 et seq.), 40 CFR 262.12, 25 Pa. Code 262.12	Hazardous Waste Generator Registration	PAD00079813 2	Not applicable	Hazardous waste generation
Utah Department of Environmental Quality	U.A.C. R313-26, U.A.C. R313-19-100	Permit to Deliver Radioactive Material	0112001213	Renewed annually	Radioactive waste shipments to land disposal facility in Utah

TABLE 9.1-2
ENVIRONMENTAL AUTHORIZATIONS FOR PBAPS LICENSE RENEWAL

Agency[1]	Authority	Requirement	Remarks
NRC	Atomic Energy Act (42 USC 2011 et seq.)	License renewal	Applicant for federal license must submit an Environmental Report in support of license renewal application.
USFWS NMFS	ESA Section 7 (16 USC 1536)	Consultation	Federal agency issuing a license must consult with the USFWS and NMFS regarding federally protected species.
PADEP	CWA Section 401 (33 USC 1341)	Certification	Applicant seeking federal license for a project with discharge to state waters must obtain either state certification that proposed action would comply with applicable state water quality standards, or a waiver.
Pennsylvania Historic Preservation Office	NHPA Section 106 (54 USC 306108)	Consultation	Federal agency issuing a license must consider cultural impacts and consult with SHPO.
MDE	Federal CZMA (16 USC 1451 et seq.)	Interstate Consistency Determination	Requires an applicant to provide certification to the federal agency issuing the license that license renewal would be consistent with the federally approved state coastal zone management program for the state in whose coastal zone the project is located and other states that have included the applicant's project on a NOAA-approved interstate consistency list.

[1] No requirements related to NRC license renewal were identified for local or other agencies.

TABLE 9.1-3
STATUS OF CORRESPONDENCE WITH STATE AND FEDERAL AGENCIES ABOUT PROTECTED SPECIES

Exelon Generation Letter Date	Species of Concern	Status of Protection	Government Agency/ Response Date	Potential Effects
9/26/2017	Bog turtle	Federally listed as threatened	USFWS / 11.02.2017	No potential onsite habitat has been identified, making the presence of bog turtles at the site, as well as adverse effects on bog turtles, unlikely. USFWS concurs with this habitat determination and has concluded that SLR will have no effect on the bog turtle.
	Bald eagle	Protected under BGEPA, MBTA, and Lacey Act		Disturbance of bald eagles is unlikely because operations and maintenance activities will not change, and no construction will occur as a result of SLR. USFWS has indicated its acceptance of a signed Bald Eagle Project Screening Form indicating that all recommended eagle avoidance measures will be followed at PBAPS.
	Indiana bat	Federally listed as endangered		No adverse effects on bats are expected because operations and maintenance activities will not change, and no construction will occur as a result of SLR. USFWS has concluded that SLR will have no effect on this species.
9/26/2017	Prey of federally managed species in Chesapeake Bay	None	NOAA, NMFS, Greater Atlantic Regional Fisheries Office / 3.05.2018	Indirect adverse effects on EFH in the Chesapeake Bay are possible if impacts to prey species and water quality degradation from PBAPS operations during the license renewal term would extend downstream of Conowingo Dam. NMFS recommends that studies and monitoring consider diandromous fish species as well as water quality effects.
	Atlantic Sturgeon Shortnose sturgeon	Federally listed as threatened; Federally listed as endangered		NMFS indicates that sturgeon do not occur upstream of the Conowingo Dam, but it is unclear from the information provided whether continued PBAPS operations may have downstream effects on either listed sturgeon species.
9/26/2017	Lobed spleenwort	State Special Concern Species	PA DCNR Resources, Bureau of Forestry / 9.27.2017	No adverse effects on any species of concern are likely based on the nature of the project, the immediate location, and the agency's detailed information about the resource.
	Harbinger-of-Spring	State-listed as threatened		
	American Holly	State-listed as threatened		
	Unidentified sensitive species	State Special Concern Species		
9/26/2017	Chesapeake logperch	State-listed as threatened	PFBC, Division of Environmental Services / 3.08.2018	PFBC expressed no objection to SLR for PBAPS. Adverse effects to the state-listed threatened Chesapeake logperch population are possible from impingement and entrainment at the PBAPS intake structure in the Conowingo Pond, but PFBC intends to address this concern during the PBAPS NPDES permit renewal process.

TABLE 9.1-3 (Cont'd)
STATUS OF CORRESPONDENCE WITH STATE AND FEDERAL AGENCIES ABOUT PROTECTED SPECIES

Exelon Generation Letter Date	Species of Concern	Status of Protection	Government Agency/ Response Date	Potential Effects
9/26/2017	Osprey	State-listed as threatened	PGC / 10.02.2017 (Telephone call indicating that the PNDI receipt is the only response that PGC will issue)	No known impact.

9.2 ALTERNATIVES

NRC

> **“The discussion of alternatives in the report shall include a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements.” 10 CFR 51.45(d), as required by 10 CFR 51.53(c)(2)**

The coal, gas, purchased power, new nuclear SMRs, and combination alternatives discussed in Chapter 7 could be constructed and operated to comply with applicable environmental quality standards and requirements. Exelon Generation notes that increasingly stringent air quality protection requirements could make the construction of a large fossil-fueled power plant infeasible in many locations. Exelon Generation also notes that the EPA has revised its requirements for design and operation of cooling water intake structures at new and existing facilities (40 CFR Part 125, Subparts I and J). These requirements could necessitate construction of cooling towers and other technologies for the coal- and gas-fired and new nuclear alternatives.

Chapter 10

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