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United States Nuclear Regulatory Commission
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NUREG-1437
Supplement 10
Second Renewal

Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Supplement 10 Second Renewal

Regarding Subsequent License Renewal for Peach Bottom Atomic Power Station Units 2 and 3

Draft Report for Comment

Office of Nuclear Reactor Regulation

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NUREG-1437
Supplement 10
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Regarding Subsequent License Renewal for Peach Bottom Atomic Power Station Units 2 and 3

Draft Report for Comment

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Proposed Action Issuance of Subsequent Renewed Facility Operating License Nos. DPR-44 and DPR-56 for Peach Bottom Atomic Power Station, Units 2 and 3 (Peach Bottom), in Delta, PA

Type of Statement Draft Supplemental Environmental Impact Statement

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ABSTRACT

The U.S. Nuclear Regulatory Commission (NRC) staff prepared this draft supplemental environmental impact statement (SEIS) as part of its environmental review of the Exelon Generation Company, LLC (Exelon) subsequent license renewal application, to renew the operating licenses for Peach Bottom Atomic Power Station Units 2 and 3 (Peach Bottom, or Peach Bottom Units 2 and 3) for an additional 20 years. This draft SEIS includes the NRC staff's preliminary evaluation of the environmental impacts of the subsequent license renewal as well as alternatives to subsequent license renewal. Alternatives to subsequent license renewal considered in this draft SEIS include: (1) a new nuclear power alternative, (2) a supercritical pulverized coal alternative, (3) a natural gas combined-cycle alternative, and (4) a combination alternative of natural gas combined-cycle, wind, solar, and purchased power. The NRC staff's preliminary recommendation is that the adverse environmental impacts of subsequent license renewal for Peach Bottom are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. The NRC staff based its recommendation on the following:

- the NRC's analysis and findings in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants"
- the environmental report submitted by Exelon
- the NRC staff's consultation with Federal, State, Tribal, and local government agencies
- the NRC staff's independent environmental review
- the NRC staff's consideration of public comments

Comments on this draft SEIS should be filed no later than 45 days after the date on which the U.S. Environmental Protection Agency (EPA) notice, stating that this draft SEIS has been filed with the EPA, is published in the *Federal Register*. Comments received after the end of the comment period will be considered if it is practical to do so, but assurance of consideration of late comments cannot be given.

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EXECUTIVE SUMMARY

Background

By letter dated July 10, 2018, Exelon Generation Company, LLC (Exelon) submitted to the U.S. Nuclear Regulatory Commission (NRC) an application requesting subsequent license renewal for the Peach Bottom Atomic Power Station Units 2 and 3 (Peach Bottom or Peach Bottom Units 2 and 3) renewed facility operating licenses (Agencywide Documents Access and Management System (ADAMS) Package Accession No. ML18193A689). Exelon subsequently supplemented its application by letters dated September 14, 2018 (ADAMS Accession No. ML18257A143) and January 23, 2019 (ADAMS Accession No. ML19023A015). The Peach Bottom Unit 2 current renewed facility operating license (DPR-44) expires at midnight on August 8, 2033; the Peach Bottom Unit 3 current renewed facility operating license (DPR-56) expires at midnight on July 2, 2034. In its application, Exelon requested license renewal for a period of 20 years beyond the dates when the current renewed facility operating licenses expire, to August 8, 2053 for Peach Bottom Unit 2 and July 10, 2054 for Peach Bottom Unit 3.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 51.20(b)(2), the renewal of a power reactor operating license requires preparation of an environmental impact statement (EIS) or a supplement to an existing EIS. In addition, 10 CFR 51.95(c), “Operating license renewal stage,” states that, in connection with the renewal of an operating license, the NRC shall prepare an EIS, which is a supplement to the Commission’s NUREG-1437, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants.”

Once the NRC officially accepted Exelon’s subsequent license renewal application for docketing, the NRC staff began the environmental review process as described in 10 CFR Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.” The environmental review begins by the NRC publishing a notice of intent in the *Federal Register* to prepare a supplemental environmental impact statement (SEIS) and to conduct environmental scoping. To prepare the Peach Bottom SEIS, the NRC staff performed the following:

- conducted a public scoping meeting on September 25, 2018, in Delta, PA
- conducted a severe accident mitigation alternatives in-office audit in Rockville, MD, from November 13 to 28, 2018, and an on-site environmental audit at Peach Bottom from November 7 to 8, 2018
- reviewed Exelon’s environmental report and compared it to NUREG-1437, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants” (the GEIS)
- consulted with Federal, State, Tribal, and local government agencies
- conducted a review of the issues following the guidance set forth in NUREG-1555, Supplement 1, Revision 1, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal,” Final Report
- considered public comments received

Proposed Action

Exelon initiated the proposed Federal action (i.e., issuance of renewed facility operating licenses) by submitting an application for subsequent license renewal of Peach Bottom. The existing Peach Bottom renewed facility operating licenses expire at midnight on August 8, 2033, for Unit 2 (DPR-44) and July 2, 2034, for Unit 3 (DPR-56). The NRC's Federal action is to decide whether to issue renewed licenses authorizing an additional 20 years of operation. If the NRC issues the renewed licenses, Peach Bottom Units 2 and 3 would be authorized to operate until August 8, 2053 and July 2, 2054, respectively.

Purpose and Need for Actions

The purpose and need for the proposed action (i.e., issuance of renewed licenses) is to provide an option that allows for power generation capability beyond the term of the current nuclear power plant operating licenses to meet future system generating needs. Energy-planning decisionmakers such as States, utility operators, and, where authorized, Federal agencies (other than the NRC) may determine these future system generating needs. The Atomic Energy Act of 1954, as amended, and the National Environmental Policy Act of 1969, as amended, require the NRC to perform a safety review and an environmental review of the proposed action. The above definition of purpose and need reflects the NRC's recognition that, unless there are findings in the safety review or in the 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 as to whether a particular nuclear power plant should continue to operate.

Environmental Impacts of License Renewal

This SEIS evaluates the potential environmental impacts of the proposed action. The NRC designates the environmental impacts from the proposed action as SMALL, MODERATE, or LARGE. NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (the GEIS) evaluates 78 environmental issues related to plant operation and classifies each issue as either a Category 1 issue (generic to all or a distinct subset of nuclear power plants) or a Category 2 issue (specific to individual power plants). Category 1 issues are those that meet all of the following criteria:

- The environmental impacts associated with the issue 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.
- A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal.
- Mitigation of adverse impacts associated with the issue is considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

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, important attributes of the resource.

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

For Category 1 issues, no additional site-specific analysis is required in this SEIS unless new and significant information is identified. Chapter 4 of this SEIS presents the process for identifying new and significant information.

Exelon and the NRC staff identified no new and significant information that has the potential to affect the conclusion in the GEIS related to Category 1 issues. This conclusion is supported by the NRC staff's review of Exelon's environmental report and other documentation relevant to the applicant's activities, the public scoping process, and the findings from the NRC staff's site audits. Therefore, the NRC staff relied upon the conclusions of the GEIS for all Category 1 issues applicable to Peach Bottom.

Category 2 issues are site-specific issues that do not meet one or more of the criteria for Category 1 issues; therefore, a SEIS must include additional site-specific review for these non-generic issues.

In this SEIS, the NRC staff evaluated Category 2 issues applicable to Peach Bottom, evaluated cumulative impacts, and considered new information regarding severe accident mitigation alternatives (SAMAs). Table ES-1 summarizes the Category 2 issues relevant to Peach Bottom and the NRC staff's findings related to those issues. If the NRC staff determined that there were no Category 2 issues applicable for a particular resource area, the findings of the GEIS, as documented in 10 CFR Part 51, Subpart A, Appendix B, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," are incorporated for that resource area.

Table ES-1 Summary of NRC Conclusions Relating to Site-Specific Impacts of Subsequent License Renewal at Peach Bottom

Resource Area	Relevant Category 2 Issues	Impacts
Surface Water	Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river	SMALL
Groundwater Resources	Groundwater use conflicts (plants that withdraw more than 100 gallons per minute)	SMALL
	Radionuclides released to groundwater	SMALL
Terrestrial Resources	Effects on terrestrial resources (non-cooling system impacts)	SMALL
	Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)	SMALL
Aquatic Resources	Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	SMALL
	Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	SMALL to MODERATE
	Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river)	SMALL

Table ES-1 Summary of NRC Conclusions Relating to Site-Specific Impacts of Subsequent License Renewal at Peach Bottom (cont.)

Resource Area	Relevant Category 2 Issues	Impacts
Special Status Species and Habitats	Threatened, endangered, and protected species, critical habitat, and Essential Fish Habitat	May affect, but is not likely to adversely affect northern long-eared bat and Indiana bat No adverse effects on Essential Fish Habitat
Historic and Cultural Resources	Historic and cultural resources	Would not adversely affect known historic properties
Human Health	Electric shock hazards	SMALL
Environmental Justice	Minority and low-income populations	No disproportionately high and adverse human health and environmental effects
Cumulative Impacts	Cumulative Impacts	See SEIS Section 4.16
Postulated Accidents	SAMA	See SEIS Appendix E

Alternatives

As part of its environmental review, the NRC is required to consider alternatives to license renewal and to evaluate the environmental impacts associated with each alternative. These alternatives can include other methods of power generation (replacement power alternatives), as well as not renewing the Peach Bottom operating licenses (the no-action alternative).

In total, the NRC staff initially considered 17 replacement power alternatives; the NRC staff later dismissed 13 of these because of technical, resource availability, or commercial limitations that currently exist and that the NRC staff believes are likely to still exist when the current Peach Bottom licenses expire.

This left four feasible and commercially viable replacement power alternatives which, in addition to the no-action alternative, the staff evaluates in depth in this report:

- new nuclear power (small modular reactors)
- supercritical pulverized coal
- natural gas combined-cycle
- combination alternative of natural gas combined-cycle, wind, solar, and purchased power

These are the 13 additional alternatives that the NRC staff considered but ultimately dismissed:

- solar power
- wind power
- biomass
- demand-side management
- hydroelectric power

- geothermal power
- wave and ocean energy
- municipal solid waste
- petroleum-fired power
- coal (integrated gasification combined-cycle)
- fuel cells
- purchased power
- delayed retirement of nearby generating facilities

The NRC staff evaluated the environmental impacts of each replacement power alternative, using the same resource areas that it used in evaluating the impacts from subsequent license renewal.

The NRC staff also evaluated any new and significant information that could alter the conclusions of the SAMA analysis that was performed previously in connection with the initial license renewal of Peach Bottom Units 2 and 3.

Preliminary Recommendation

The NRC staff's preliminary recommendation is that the adverse environmental impacts of subsequent license renewal for Peach Bottom are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. The NRC staff based its recommendation on the following:

- the analysis and findings in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants"
- the environmental report submitted by Exelon
- the NRC staff's consultation with Federal, State, Tribal, and local government agencies
- the NRC staff's independent environmental review
- the NRC staff's consideration of public comment

ABBREVIATIONS AND ACRONYMS

ac	acre(s)
ACHP	Advisory Council on Historic Preservation
ACR	Atlantic Coastal Ridge
ADAMS	Agencywide Documents Access and Management System
AEA	Atomic Energy Act of 1954 (as amended)
ALARA	as low as reasonable achievable
AMSL	Above Mean Sea Level
APE	Area of Potential Affects
AQCR	Air Quality Control Region
ASLB	Atomic Safety and Licensing Board
BLM	Bureau of Land Management
bls	below land surface
BMPs	best management practices
CAA	Clean Air Act
CCS	cooling canal system
CCW	component cooling water
CDMP	Comprehensive Master Development Plan
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
cfs	cubic foot (feet) per second
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2/MWh	carbon dioxide per megawatt hour
CO_{2eq}	carbon dioxide equivalents
COL	combined license
CVCS	chemical and volume control system
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dBA	A-weighted decibels
DOE	U.S. Department of Energy
DPS	distinct population segment
ECOS	Environmental Conservation Online System
EFH	Essential Fish Habitat
EIA	Energy Information Administration
EIS	environmental impact statement
ELF-EMF	extremely low frequency-electromagnetic field
EO	Executive Order
EPA	U.S. Environmental Protection Agency

ER	Environmental Report
ESA	Endangered Species Act of 1973, as amended
FE	Federally listed as endangered
FEIS	final environmental impact statement
fps	feet per second
FR	*Federal Register*
FRN	*Federal Register* notice
ft	foot (feet)
FT	Federally listed as threatened
ft^3	cubic foot (feet)
FWS	U.S. Fish and Wildlife Service
g	gram(s)
gal	gallon(s)
GEIS	generic environmental impact statement
GHG	Greenhouse Gases
gpd	gallon(s) per day
gpm	gallon(s) per minute
GT	gigatons
GWP	global warming potential
H_2O	water vapor
ha	hectare(s)
HAP	Hazardous Air Pollutant
HFC	hydrofluorocarbons
IPaC	Information for Planning and Conservation
IPCC	Intergovernmental Panel on Climate Change
ISFSI	independent spent fuel storage installation
kg	kilogram(s)
km	kilometer(s)
kW	kilowatt(s)
kWe	kilowatt(s) electric
L/min	liter(s) per minute
lb	pound(s)
LLRW	Low-level radioactive waste
LLW	low level waste
Lpd	liters per day
LRA	license renewal application
m	mete(s)
m/s	meter(s) per second

m^3/day	cubic meters per day
m^3/s	cubic meter(s) per second
MBTA	Migratory Bird Treaty Act
mgd	million gallons per day
mgy	million gallons per year
mi	mile(s)
min	minute(s)
MMT	million metric tons
mph	mile(s) per hour
MSA	Magnuson–Stevens Fishery Conservation and Management Act
mSv	millisievert
MT	metric ton(s)
MW	megawatt(s)
MWe	megawatt(s) electric
MWh	megawatt hour(s)
MWt	megawatt(s) thermal
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969, as amended
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGCC	natural gas combined-cycle
NHPA	National Historic Preservation Act of 1966, as amended
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service (of the National Oceanic and Atmospheric Administration)
NO_2	nitrogen dioxide
NOV	notice of violation
NO_x	nitrogen oxide(s)
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
O_3	ozone
ODCM	offsite dose calculation manual
OSHA	Occupational Safety and Health Administration
Pb	lead
PBAPS	Peach Bottom Atomic Power Station
PDEP	Pennsylvania Department of Environmental Protection
PFC	perfluorocarbons
PM	particulate matter
PM_{10}	particulate matter diameter between 2.5 and 10 micrometers
$PM_{2.5}$	particulate matter diameter of 2.5 micrometers or less

ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
PRA	probabilistic risk assessment
PSD	Prevention of Significant Deterioration
PV	photovoltaic
PWR	pressurized water reactor
RCS	reactor coolant system
REMP	radiological environmental monitoring program
ROI	region of influence
SAMA	severe accident mitigation alternative
SDWA	Safe Drinking Water Act
SEIS	supplemental environmental impact statement
SER	safety evaluation report
SF_6	sulfur hexafluoride
SIP	State implementation plan
SLRA	subsequent license renewal application
SO_2	sulfur dioxide
SPCC	Spill Prevention, Control and Countermeasure
Spp.	
SSC	structure, system, and component
Sv	sievert
TDS	total dissolved solids
U.S.	United States
UFSAR	updated final safety analysis report
USCB	U.S. Census Bureau
USCG	U.S. Coast Guard
USDOT	U.S. Department of Transportation
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
VOC	Volatile Organic Compounds
yd^3	cubic yard(s)
µg	microgram
µm	micrometer
$µg/m^3$	micrograms per cubic meter
°C	degree(s) Celsius
°F	degree(s) Fahrenheit

1 INTRODUCTION

The U.S. Nuclear Regulatory Commission's (NRC's) environmental protection regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," implement the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.). This Act is commonly referred to as NEPA. The regulations at 10 CFR Part 51 require the NRC to prepare an environmental impact statement (EIS) before making a decision on whether to issue an operating license or a renewed operating license for a nuclear power plant.

The Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.) (AEA), specifies that licenses for commercial power reactors can be granted for up to 40 years. The initial 40-year licensing period was based on economic and antitrust considerations rather than on technical limitations of the nuclear facility. NRC regulations permit these licenses to be renewed beyond the initial 40-year term for an additional period of time, limited to 20-year increments per renewal, based on the results of an assessment to determine whether the nuclear facility can continue to operate safely during the proposed period of extended operation. There are no limitations in the AEA or NRC regulations restricting the number of times a license may be renewed.

The decision to seek a renewed license rests entirely with nuclear power facility owners and typically is based on the facility's economic viability and the investment necessary to continue to meet NRC safety and environmental requirements. The NRC makes the decision to grant or deny a renewed license based on whether the applicant has demonstrated reasonable assurance that it can meet the environmental and safety requirements in the agency's regulations during the period of extended operation.

1.1 Proposed Federal Action

Exelon Generation Company, LLC (Exelon) initiated the proposed Federal action by submitting an application for subsequent license renewal for Peach Bottom Atomic Power Station, Units 2 and 3 (Peach Bottom or Peach Bottom Units 2 and 3). The current renewed licenses expire at midnight on August 8, 2033, for Unit 2 (DPR-44) and at midnight on July 2, 2034, for Unit 3 (DPR-56). The NRC's Federal action is to decide whether to issue renewed licenses for an additional 20 years.

1.2 Purpose and Need for the Proposed Federal Action

The purpose and need for the proposed Federal action (issuance of subsequent renewed licenses for Peach Bottom Units 2 and 3) is to provide an option that allows for power generation capability beyond the term of the current renewed nuclear power plant operating licenses to meet future system generating needs. Such needs may be determined by energy-planning decisionmakers such as State regulators, utility owners, and Federal agencies other than the NRC. This definition of purpose and need reflects the NRC's recognition that, unless there are findings in the NRC's safety review (required by the Atomic Energy Act) or findings in the NRC's environmental analysis (required by NEPA) that would lead the NRC to reject a subsequent license renewal application, the NRC does not have a role in energy-planning decisions as to whether a particular nuclear power plant should continue to operate.

1.3 Major Environmental Review Milestones

Exelon submitted an environmental report (Exelon 2018a) as an appendix to its Peach Bottom subsequent license renewal application (SLRA) (Exelon 2018b) on July 10, 2018. After reviewing the SLRA and environmental report, the NRC staff accepted the application for a detailed technical review on August 27, 2018 (NRC 2018f). On September 6, 2018, the NRC staff published a *Federal Register* notice of acceptability and opportunity for hearing (Volume 83 of the *Federal Register* (FR), page 45285 (83 FR 45285)). On September 10, 2018, the NRC staff published another notice in the *Federal Register* (83 FR 45692) informing members of the public of the staff's intent to conduct an environmental scoping process, thereby beginning a 30-day scoping comment period.

The NRC staff held a public scoping meeting on September 25, 2018, near the Peach Bottom site in Delta, PA, and issued a scoping meeting summary on October 18, 2018, which includes a list of meeting attendees (NRC 2018k). In July 2019, the NRC issued its "Supplemental Environmental Impact Statement Scoping Process Summary Report, for Peach Bottom Atomic Power Station, Units 2 and 3, York County, PA," which includes the comments received during the scoping process and the NRC staff's responses to those comments (NRC 2019a).

To independently verify information that Exelon provided in its environmental report, the NRC staff conducted an onsite audit at Peach Bottom in November 2018, and an in-office severe accident mitigation alternatives audit at NRC headquarters also in November 2018. In a letter dated January 31, 2019, the staff summarized the onsite audit and listed the attendees (NRC 2019b). In a letter dated February 5, 2019, the staff summarized the in-office severe accident mitigation alternatives audit and listed the attendees (NRC 2019c). During these audits, the NRC staff held meetings with plant personnel and reviewed Peach Bottom site-specific documentation.

After completing the scoping period and audits and reviewing Exelon's environmental report and related documents, the NRC staff compiled its findings in this draft supplemental environmental impact statement (SEIS). The NRC staff will make this draft SEIS available for public comment for 45 days. Based on the information gathered during this public comment period, the NRC staff will amend the draft SEIS findings, as necessary, and will then publish the final SEIS. Figure 1-1 shows the major milestones of the environmental portion of the NRC's subsequent license renewal application review process.

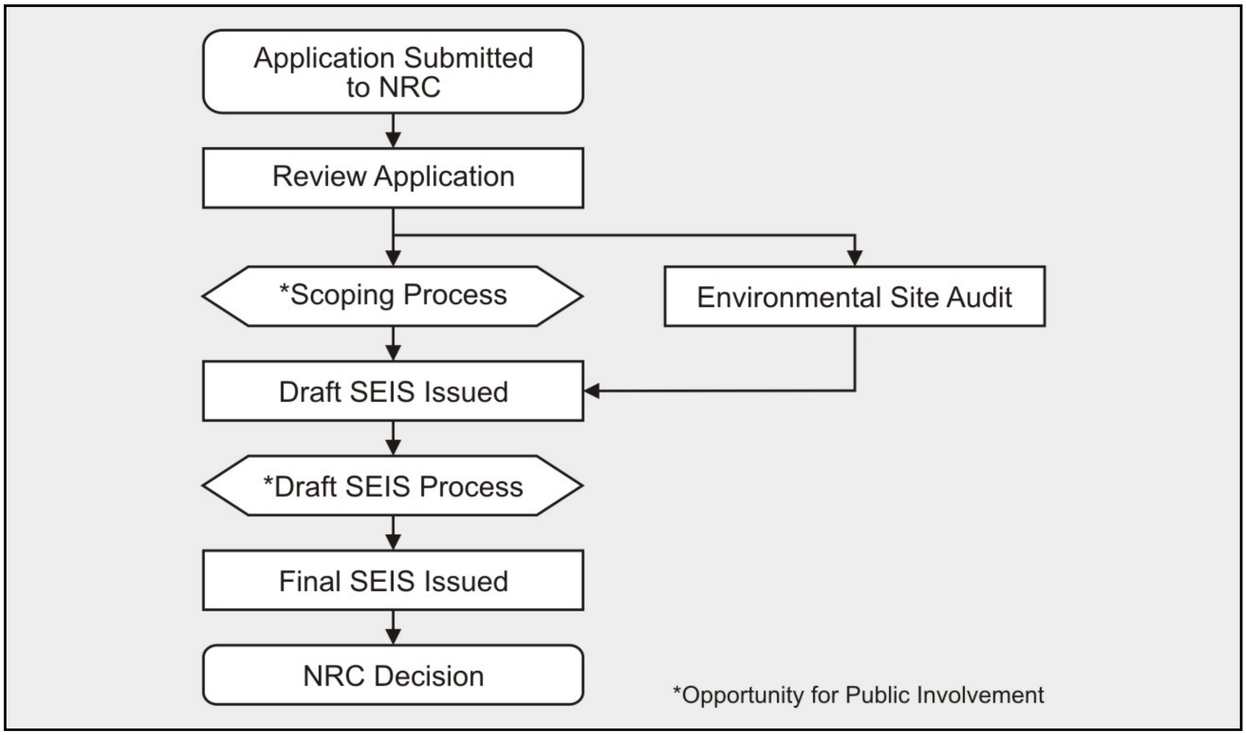


Figure 1-1 Environmental Review Process

The NRC has established a license renewal process that can be completed in a reasonable period of time and that includes clear requirements to assure safe plant operation for up to an additional 20 years of plant life. This process consists of separate environmental and safety reviews that the NRC staff conducts simultaneously and documents in two reports: (1) the SEIS documents the environmental review and (2) the safety evaluation report (SER) documents the safety review. The staff's findings in the SEIS and the SER are both factors in the NRC's decision to grant or deny the issuance of a renewed license. The NRC uses this process for both initial and subsequent license renewal.

1.4 Generic Environmental Impact Statement

To improve the efficiency of its license renewal review process, the NRC staff performed a generic assessment of the environmental impacts associated with license renewal. NUREG–1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants" (known as the GEIS) (NRC 1996, NRC 1999, NRC 2013a), documents the results of the NRC's systematic approach to evaluating the environmental consequences of renewing the licenses of individual nuclear power plants and operating them for an additional 20 years. In the GEIS, the staff analyzed in detail and resolved those environmental issues that could be resolved generically. The NRC issued the GEIS in 1996 (NRC 1996), Addendum 1 to the GEIS in 1999 (NRC 1999), and Revision 1 to the GEIS in 2013 (NRC 2013a). Unless otherwise noted, all references to the GEIS include the original 1996 GEIS, Addendum 1, and the 2013 revision. The conclusions in the GEIS apply to both initial and subsequent license renewal.

The GEIS establishes separate environmental impact issues for the NRC staff to independently evaluate. Appendix B to Subpart A of 10 CFR Part 51, "Environmental Effect of Renewing the

Operating License of a Nuclear Power Plant," provides a summary of the staff's findings in the GEIS. For each environmental issue addressed in the GEIS, the NRC staff:

- describes the activity that affects the environment
- identifies the population or resource that is affected
- assesses the nature and magnitude of the impact on the affected population or resource
- characterizes the significance of the effect for both beneficial and adverse effects
- determines whether the results of the analysis apply to all plants
- considers whether additional mitigation measures would be warranted for impacts that would have the same significance level for all plants

The NRC established its standard of significance for impacts using the Council on Environmental Quality terminology for "significant." The NRC established three levels of significance for potential impacts—SMALL, MODERATE, and LARGE—as defined below.

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, important attributes of the resource.

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

> **Significance** indicates the importance of likely environmental impacts and is determined by considering two variables: **context** and **intensity**.
>
> **Context** is the geographic, biophysical, and social context in which the effects will occur.
>
> **Intensity** refers to the severity of the impact in whatever context it occurs.

The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants (or a distinct subset of plants, as defined in the GEIS) and whether additional mitigation measures would be warranted. Issues are assigned a Category 1 (generic to all or a subset of plants) or Category 2 (site-specific) designation. As established in the GEIS, Category 1 issues are those that meet the following three criteria:

- The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants that have a specific type of cooling system or other specified plant or site characteristics.
- A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).
- 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 likely not to be sufficiently beneficial to warrant implementation.

For generic issues (Category 1), no additional site-specific evaluation is required in the SEIS unless new and significant information has been identified. Chapter 4 of this SEIS describes the process for identifying new and significant information for site-specific analysis. Site-specific issues (Category 2) are those that do not meet the three criteria of Category 1 issues; therefore, the SEIS requires additional site-specific review for these issues.

The 2013 GEIS evaluates 78 environmental issues, provides generic findings for 61 issues (subject to the consideration of any new and significant information on a site-specific basis), and concludes that a site-specific analysis is required for 17 of the 78 issues. Figure 1-2 illustrates the license renewal environmental review process. The results of the site-specific analysis are documented in the SEIS.

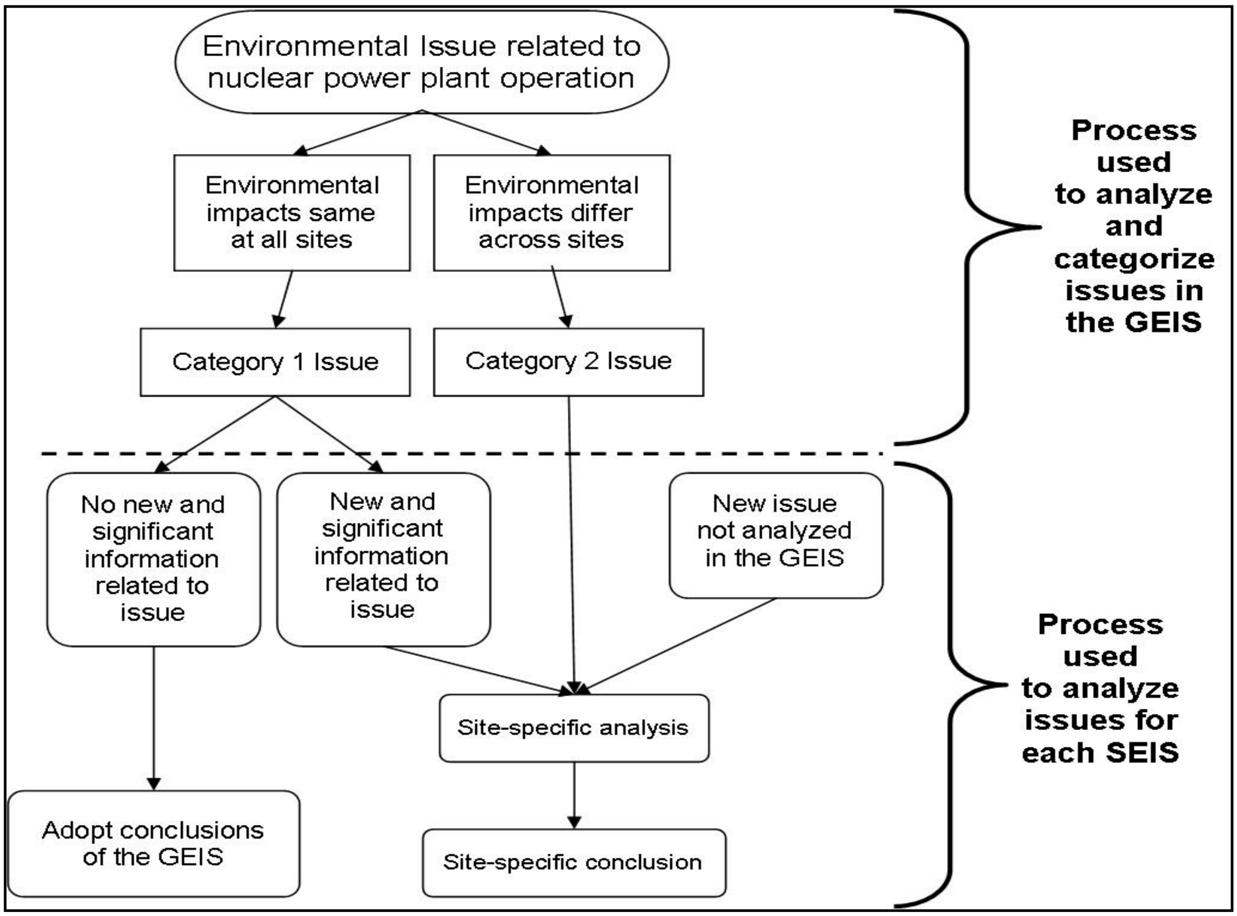


Figure 1-2 Environmental Issues Evaluated for License Renewal

1.5 Supplemental Environmental Impact Statement

This draft SEIS presents the NRC staff's preliminary analysis of the environmental effects of the continued operation of Peach Bottom through the subsequent license renewal period, alternatives to subsequent license renewal, and mitigation measures for minimizing adverse environmental impacts. Chapter 4, "Environmental Consequences and Mitigating Actions," contains an analysis and comparison of the potential environmental impacts from subsequent license renewal and alternatives to subsequent license renewal. Chapter 5, "Conclusion," presents the NRC's preliminary recommendation on whether the environmental impacts of subsequent license renewal are so great that preserving the option of subsequent license renewal would be unreasonable. The NRC staff will make its final recommendation to the

Commission on Peach Bottom subsequent license renewal in the final SEIS, which the NRC staff will issue after considering comments received on the draft SEIS during the public comment period.

In the preparation of the Peach Bottom draft SEIS, the NRC staff carried out the following activities:

- reviewed the information in Exelon's environmental report
- consulted with Federal, State, Tribal, and local government agencies
- conducted an independent environmental review, including the environmental and severe accident mitigation analysis site audits
- considered public comments

> **New and significant information**. To merit additional review, information must be both new and significant and it must bear on the proposed action or its impacts.

New information can come from many sources, including the applicant, the NRC, other agencies, or public comments. If the information reveals a new issue, the staff will first analyze the issue to determine whether it is within the scope of the license renewal environmental evaluation. If the staff determines that the new issue bears on the proposed action, the staff will then determine the significance of the issue for the plant and analyze the issue in the SEIS, as appropriate.

1.6 Decisions Supported by the SEIS

This SEIS supports the NRC's decision on whether to renew the operating licenses for Peach Bottom for an additional 20 years. The regulation at 10 CFR 51.103(a)(5) specifies the NRC's decision standard as follows:

> In making a final decision on a license renewal action pursuant to part 54 of this chapter [10 CFR], the 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 decisionmakers would be unreasonable.

There are many factors that the NRC takes into consideration when deciding whether to renew the operating license of a nuclear power plant. The analyses of environmental impacts in this SEIS will provide the NRC's decisionmaker (in this case, the Commission) with important environmental information for use in the overall decisionmaking process. Other decisions are made outside the regulatory scope of license renewal, by the NRC or other decisionmakers. These include decisions related to: (1) changes to plant cooling systems, (2) disposition of spent nuclear fuel, (3) emergency preparedness, (4) safeguards and security, (5) need for power, and (6) seismicity and flooding (NRC 2013a).

1.7 Cooperating Agencies

During the scoping process, the NRC staff identified no Federal, State, or local agencies as cooperating agencies in the preparation of the SEIS.

1.8 Consultations

The Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (ESA); the Magnuson–Stevens Fisheries Conservation and Management Act of 1996, as amended (16 U.S.C. 1801 et seq.) (MSA); and the National Historic Preservation Act of 1966, as amended (54 U.S.C. 300101 et seq.) (NHPA) require Federal agencies to consult with applicable State and Federal agencies and - Tribal governments before taking an action that may affect endangered species, fisheries, or historic and archaeological resources, respectively. The NRC staff consulted with the following agencies and Tribal governments during this environmental review:

- U.S. Fish and Wildlife Service
- National Marine Fisheries Service
- Absentee-Shawnee Tribe of Oklahoma
- Cayuga Nation
- Delaware Nation
- Delaware Tribe of Indians
- Eastern Shawnee Tribe of Oklahoma
- Oneida Indian Nation
- Oneida Nation
- Onondaga Nation
- Pennsylvania State Historic Preservation Office
- Seneca Nation of Indians
- Seneca-Cayuga Nation
- St. Regis Mohawk Tribe
- Shawnee Tribe
- Stockbridge-Munsee Community
- Tonawanda Band of Seneca
- Tuscarora Nation
- Federal Advisory Council on Historic Preservation

Appendix C, “Consultation Correspondence,” of this SEIS discusses the consultations that the NRC staff conducted in support of this environmental review.

1.9 Correspondence

During the environmental review, the NRC staff contacted Federal, State, regional, local, and Tribal governments listed in Section 1.8 above. Appendix C, “Consultation Correspondence,” of this SEIS chronologically lists all correspondence the NRC staff sent and received during its environmental review, associated with the ESA, the MSA, and the NHPA. Appendix D, “Chronology of Environmental Review Correspondence,” of this SEIS chronologically lists all other correspondence.

1.10 Status of Compliance

Exelon is responsible for complying with all NRC regulations and other applicable Federal, State, and local requirements. Appendix F of the GEIS describes some of the major applicable Federal statutes. Numerous permits and licenses are issued by Federal, State, and local authorities for activities at Peach Bottom. Appendix B of this SEIS contains further information about Exelon’s status of compliance.

1.11 Related State and Federal Activities

The NRC reviewed the possibility that activities of other Federal agencies might affect the subsequent renewal of the operating licenses for Peach Bottom. There are no Federal projects that would make it necessary for another Federal agency to become a cooperating agency in the preparation of this EIS.

The Peach Bottom site is located in York County near Delta, PA, on the west side of Conowingo Pond. The Peach Bottom site consists of approximately 769 acres (ac) (311 hectares (ha)) of land. The area surrounding Peach Bottom 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. No national parks or other Federal reserved areas have been identified within 6 miles (10 kilometers) of Peach Bottom. There are no Indian reservations within 50 miles (80 kilometers) of Peach Bottom.

Section 307(c)(3)(A) of the Coastal Zone Management Act (16 U.S.C. 1456(c)(3)(A)) requires that applicants for Federal licenses in or outside of a coastal zone who conduct activities affecting any land or water use or natural resource of that coastal zone provide a certification that the proposed activity complies with the enforceable policies of the State's coastal zone program. The Peach Bottom site is not within the Pennsylvania coastal zone and does not affect it. However, the Maryland coastal zone extends to Conowingo Pond, from which Peach Bottom Units 2 and 3 withdraw and discharge water. The Maryland Department of the Environment issued the Certification of Compliance with the Maryland Coastal Zone Management Program.

Section 401 of the Clean Water Act (33 U.S.C. 1251 et seq.) requires an applicant for a Federal license to conduct activities that may cause a discharge of pollutants into navigable waters to provide the licensing agency with a water quality certification from the State. In a letter to Exelon dated November 20, 2017 (Exelon 2018a, Appendix D), the Pennsylvania Department of Environmental Protection stated that the "current National Pollutant Discharge Elimination System permit and Section 401 certification for the Peach Bottom site remains valid and does not need to be modified for the purposes of another license renewal."

Section 102(2)(C) of NEPA requires the NRC to consult with and obtain the comments of any Federal agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in the subject matter of the SEIS. In accordance with this requirement, while preparing this SEIS, the NRC consulted with the U.S. Fish and Wildlife Service, among others. Appendix C of this SEIS provides a complete list of consultation correspondence.

2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

The U.S. Nuclear Regulatory Commission's (NRC's) decisionmaking authority in subsequent license renewal focuses on deciding whether or not to issue a subsequent renewed operating license to a nuclear power plant. The agency's implementation of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.) (NEPA), requires the NRC to consider potential alternatives to issuing a renewed operating license as well as the environmental impacts of these alternatives. Considering the environmental impacts of subsequent license renewal and comparing those impacts to the environmental impacts of alternatives allows the NRC to determine whether the environmental impacts of subsequent license renewal are so great that it would be unreasonable for the agency to preserve the option of subsequent license renewal for energy planning decisionmakers (Title 10 of the *Code of Federal Regulations* (10 CFR) 51.95(c)(4)). Ultimately, decisionmakers such as the plant operator, State, or non-NRC Federal officials will decide whether to carry out the proposed action and continue operating the plant for an additional 20 years (if the NRC renews the license) or shut down the plant and choose an alternative power generation source. Economic and environmental considerations play important roles in the decisions of these non-NRC energy planning decisionmakers.

In general, the NRC's responsibility is to ensure the safe operation of nuclear power facilities, not to formulate energy policy, promote nuclear power, or encourage or discourage the development of alternative power generation sources. The NRC does not engage in energy planning decisions, and it makes no judgment as to which energy alternatives evaluated in the supplemental environmental impact statement (SEIS) would be the best or most likely alternative to be selected in any given case.

This chapter provides (1) a description of the proposed action (i.e., subsequent renewal of the operating licenses for Peach Bottom Atomic Power Station, Units 2 and 3 (Peach Bottom or Peach Bottom Units 2 and 3)), (2) an in depth evaluation of reasonable alternatives to the proposed action (including the no action alternative), and (3) a brief description of the alternatives to the proposed action that the NRC staff considered but ultimately eliminated from in depth evaluation.

2.1 Proposed Action

As stated in Section 1.1, "Proposed Federal Action," of this SEIS, the NRC's proposed Federal action is to decide whether to issue renewed operating licenses to Peach Bottom for an additional 20 years.

Section 2.1.1 below provides a description of the expected normal power plant operations at Peach Bottom during the subsequent license renewal term. In brief, Peach Bottom is a two unit, nuclear powered, steam electric generating facility that began commercial operation in July 1974 (Unit 2) and December 1974 (Unit 3). The nuclear reactors are both General Electric boiling water reactors (BWRs) that produce a combined total of approximately 2,600 megawatts electric (MWe) (Exelon 2018a).

2.1.1 Plant Operations During the Subsequent License Renewal Term

Most plant operation activities during the subsequent license renewal term would be the same as, or similar to, those occurring during the current renewed license term. NUREG-1437, Volume 1, Revision 1, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants” (NRC 2013a) (also known as the GEIS), describes the issues that would have the same impact at all nuclear power plants (or a distinct subset of plants, as defined in the GEIS) (i.e., generic issues) as well as those issues that may have different impact levels at different nuclear power plants (i.e., site-specific issues). The impacts of generic issues are described in NUREG-1437 as Category 1 issues; those impacts are set out in NUREG-1437 and Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, and those determinations apply to each license renewal application, subject to the consideration of any new and significant information on a plant-specific basis. A second group of issues (Category 2) was identified in NUREG-1437 as having potentially different impacts at each plant, on a site-specific basis. Those issues with plant-specific impact levels need to be discussed in a plant-specific supplemental environmental impact statement (SEIS) to the GEIS, like this one.

Section 2.1.1 of the GEIS, “Plant Operations during the License Renewal Term,” describes the general types of activities that are carried out during the operation of all nuclear power plants. These general types of activities include the following:

- reactor operation
- waste management
- security
- office and clerical work
- laboratory analysis
- surveillance, monitoring, and maintenance
- refueling and other outages

As part of its subsequent license renewal application, Exelon Generation Company, LLC (Exelon) submitted an environmental report. Exelon’s environmental report states that Peach Bottom will continue to operate during the subsequent license renewal term in the same manner as it would during the current license term with the exception of additional aging management programs to address structure and component aging in accordance with 10 CFR Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants.”

2.1.2 Refurbishment and Other Activities Associated with Subsequent License Renewal

Refurbishment activities include replacement and repair of major structures, systems, and components. The major refurbishment class of activities characterized in the GEIS is intended to encompass actions that typically take place only once in the life of a nuclear plant, if at all (NRC 2013a). For example, replacement of boiling water reactor recirculation piping systems is a refurbishment activity. Refurbishment activities may have an impact on the environment beyond those that occur during normal operations and may require evaluation, depending on the type of action and the plant-specific design.

In preparation for its subsequent license renewal application, Exelon evaluated major structures, systems, and components in accordance with 10 CFR 54.21, “Contents of application—technical information,” to identify major refurbishment activities necessary for the continued operation of Peach Bottom during the proposed 20-year period of extended operation (Exelon 2018b).

Exelon states in its environmental report that refurbishment is not anticipated for Peach Bottom and that no other plant modifications to support extended operations and that could directly affect the environment or plant effluents are planned (Exelon 2018a).

2.1.3 Termination of Nuclear Power Plant Operations and Decommissioning after the Subsequent License Renewal Term

NUREG-0586, Supplement 1, Volumes 1 and 2, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors" (NRC 2002) (also known as the Decommissioning GEIS), describes the impacts of decommissioning. The majority of plant operations activities would cease with permanent reactor shutdown. However, some activities (e.g., security and oversight of spent nuclear fuel) would remain unchanged, whereas others (e.g., waste management, office and clerical work, laboratory analysis, surveillance, monitoring, and maintenance) would continue at reduced or altered levels. Systems dedicated to reactor operations would cease operations; however, if these systems are not removed from the site after permanent reactor shutdown, their physical presence may continue to impact the environment. Impacts associated with dedicated systems that remain in place or with shared systems that continue to operate at normal capacities could remain unchanged.

Decommissioning will occur whether Peach Bottom is permanently shut down at the end of its current renewed operating license term or at the end of the subsequent period of extended operation 20 years later. The license renewal GEIS concludes that license renewal would have a negligible (SMALL) effect on the impacts of terminating operations and decommissioning on all resources (NRC 2013a).

2.2 Alternatives

As stated above, NEPA requires the NRC to consider reasonable alternatives to the proposed action of issuing subsequent renewed operating licenses for Peach Bottom. For a replacement power alternative to be reasonable, it must be both (1) commercially viable on a utility scale and operational before the reactor's operating license expires or (2) expected to become commercially viable on a utility scale and operational before the reactor's operating license expires (NRC 2013a). The NRC published the most recent GEIS revision in 2013, and it incorporated the latest information on replacement power alternatives available at that time; however, rapidly evolving technologies are likely to outpace the information in the GEIS. As such, for each supplement to the GEIS, the NRC staff must perform a site-specific analysis of replacement power alternatives that accounts for changes in technology and science since the most recent GEIS revision.

The first alternative to the proposed action of the NRC issuing subsequent renewed operating licenses for Peach Bottom is for the NRC not to issue the renewed licenses. This is called the no-action alternative. Section 2.2.1 below describes the no-action alternative. In addition to the no-action alternative, this section discusses four reasonable replacement power alternatives. These alternatives seek to replace Peach Bottom's generating capacity by meeting the region's energy needs through other means or sources. Sections 2.2.2.1 through 2.2.2.4 describe these replacement power alternatives for Peach Bottom.

2.2.1 No-Action Alternative

At some point, all operating nuclear power plants will permanently cease operations and undergo decommissioning. The no-action alternative represents a decision by the NRC not to issue renewed operating licenses to a nuclear power plant beyond the current operating license term. Under the no-action alternative, the NRC would not issue the subsequent renewed operating licenses for Peach Bottom and the units would shut down at or before the expiration of the current licenses in 2033 (Unit 2) and 2034 (Unit 3). The GEIS describes the environmental impacts that arise directly from permanent plant shutdown. The NRC expects shutdown impacts to be relatively similar whether they occur at the end of the current license term (i.e., after 60 years of operation) or at the end of a subsequent renewed license term (i.e., after 80 years of operation).

After permanent shutdown, plant operators will initiate decommissioning in accordance with 10 CFR 50.82, "Termination of license." The Decommissioning GEIS (NUREG-0586) (NRC 2002) describes the environmental impacts from decommissioning a nuclear power plant and related activities. The analysis in the Decommissioning GEIS bounds the environmental impacts of decommissioning when Exelon terminates reactor operations at Peach Bottom. Chapter 4 of the License Renewal GEIS (NUREG-1437) (NRC 2013a) and Section 4.15.2, "Terminating Plant Operations and Decommissioning," of this draft SEIS describe the incremental environmental impacts of subsequent license renewal on decommissioning activities.

Termination of operations at Peach Bottom would result in the total cessation of electrical power production by Peach Bottom Units 2 and 3. Unlike the replacement power alternatives described below in Section 2.2.2, the no-action alternative does not expressly meet the purpose and need of the proposed action, as described in Section 1.2, because the no-action alternative does not provide a means of delivering baseload power to meet future electric system needs. Assuming a need currently exists for the power generated by Peach Bottom Units 2 and 3, the no-action alternative would likely create a need for a replacement power alternative. The following section describes a wide range of replacement power alternatives, and Chapter 4 assesses their potential environmental impacts. Although the NRC's authority only extends to deciding whether to issue renewed Peach Bottom Units 2 and 3 operating licenses, the replacement power alternatives described in the following sections represent possible options for energy-planning decisionmakers if the NRC decides not to issue subsequent renewed Peach Bottom Units 2 and 3 operating licenses.

2.2.2 Replacement Power Alternatives

In evaluating alternatives to subsequent license renewal, the NRC considered energy technologies or options currently in commercial operation as well as technologies not currently in commercial operation but likely to be commercially available by the time the current Peach Bottom renewed operating licenses expire on August 8, 2033 (Unit 2) and July 2, 2034 (Unit 3).

The GEIS presents an overview of some alternative energy technologies but does not conclude which alternatives are most appropriate. Because alternative energy technologies are continually evolving in capability and cost and because regulatory structures have changed to either promote or impede the development of particular technologies, the analyses in this chapter rely on a variety of sources of information to determine which alternatives would be available and commercially viable when the current licenses expire. Exelon's environmental report provides a discussion of replacement power alternatives. In addition to the information

Exelon provided in its environmental report, the NRC staff's analyses in this chapter include updated information from the following sources:

- the U.S. Department of Energy's U.S. Energy Information Administration (EIA)
- other offices within the U.S. Department of Energy (DOE)
- the U.S. Environmental Protection Agency (EPA)
- industry sources and publications

In total, the NRC staff considered 17 replacement power alternatives to the proposed action (see text box) and eliminated 13 of these, leaving 4 reasonable replacement power alternatives for in-depth evaluation. Sections 2.2.2.1 through 2.2.2.4 contain the staff's description of these four alternatives.

The staff eliminated from in-depth evaluation those alternatives that could not provide the equivalent of Peach Bottom's current generating capacity, as those alternatives would not be able to satisfy the objective of replacing the power generated by the Peach Bottom units. Also, in some cases, the staff eliminated those alternatives whose costs or benefits could not justify inclusion in the range of reasonable alternatives. Further, the staff eliminated as unfeasible those alternatives not likely to be constructed and operational by the time the Peach Bottom licenses expire in 2033 (Unit 2) and 2034 (Unit 3). Section 2.3 of this report contains a brief discussion of each of the 13 eliminated alternatives and provides the basis for each elimination. To ensure that the alternatives considered in the SEIS are consistent with State or regional energy policies, the NRC staff reviewed energy-related statutes, regulations, and policies within the Peach Bottom region.

The evaluation of each alternative considers the environmental impacts across the following impact categories:

- land use and visual resources
- air quality and noise
- geologic environment
- surface water resources
- groundwater resources
- terrestrial resources
- aquatic resources
- historic and cultural resources
- socioeconomics
- human health
- environmental justice
- waste management

Alternatives Evaluated in Depth

- new nuclear (small modular reactors)
- supercritical pulverized coal
- natural gas combined-cycle
- combination alternative (natural gas, wind, solar, and purchased power)

Alternatives Considered but Eliminated

- solar power
- wind power
- biomass
- demand-side management
- hydroelectric power
- geothermal power
- wave and ocean energy
- municipal solid waste
- petroleum-fired power
- coal-integrated gasification combined-cycle
- fuel cells
- purchased power
- delayed retirement of other generating facilities

The GEIS assigns most site-specific issues (called Category 2 issues) a significance level of SMALL, MODERATE, or LARGE. For ecological resources subject to the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (ESA) and the Magnuson–Stevens Fishery Conservation and Management Act of 1996, as amended (16 U.S.C. Section 1801 et seq.); and historic and cultural resources subject to the National Historic Preservation Act of 1966, as amended (54 U.S.C. 300101 et seq.) (NHPA), the impact significance determination language is specific to the authorizing legislation. The order in which this SEIS presents the different alternatives does not imply increasing or decreasing level of impact; nor does the order presented imply that an energy-planning decisionmaker would be more (or less) likely to select any given alternative.

Region of Influence

If the NRC does not issue subsequent renewed licenses, procurement of replacement power for Peach Bottom Units 2 and 3 may be necessary. Peach Bottom is located near Delta, PA and is operated by Exelon, which shares joint ownership of the plant with PSEG Nuclear, LLC. Peach Bottom provides electricity through the PJM Interconnection, LLC (PJM), a regional transmission organization that coordinates the movement of wholesale electricity in 13 States across the Northeast and Midwest United States, as well as the District of Columbia (Exelon 2018a). Pennsylvania and the adjoining PJM States of Delaware, Maryland, and New Jersey constitute the region of influence (ROI) for the NRC's analysis of Peach Bottom subsequent license renewal replacement power alternatives.

In 2016, electric generators connected to the PJM had a total generating capacity of approximately 172,000 megawatts (MW). This capacity included units fueled by coal (37 percent), natural gas (36 percent), nuclear power (18 percent), hydroelectric (5 percent), and petroleum (4 percent). Lesser amounts associated with several other miscellaneous energy sources comprised the balance of generating capacity connected to the PJM (Exelon 2018a).

The electric industry provided approximately 792,000 gigawatt hours (GWh) of electricity to the PJM in 2016. This electrical production was dominated by nuclear power (36 percent), coal (32 percent), and natural gas (26 percent). Wind, hydroelectric, and solid waste energy sources collectively fueled the remaining 6 percent of this electricity (Exelon 2018a).

In the United States, natural gas generation rose from 16 percent of electricity generated in 2000 to 31 percent in 2017. Given known technological and demographic trends, the U.S. Energy Information Administration predicts that by 2050, natural gas will account for 35 percent of electricity generated in the United States (EIA 2013, EIA 2016, EIA 2018c). Electricity generated from renewable energy is expected to grow from 13 percent of total generation in 2015 to 30 percent in 2050 (EIA 2016, EIA 2018d). However, renewable energy growth within the four-State region of influence may not follow nationwide forecasts. Although each of the States within the region of influence (ROI) have enacted renewable portfolio standards mandating or targeting some level of renewable energy production by 2025, these amounts vary from 8.5 to 25 percent of total electrical generation. Additionally, there are other uncertainties that could affect forecasts. In particular, the implementation of policies aimed at reducing greenhouse gas emissions could have a direct effect on fossil fuel-based generation technologies (Power 2018, LBNL 2017).

The remainder of this section describes in depth the four reasonable replacement power alternatives to Peach Bottom subsequent license renewal. These four reasonable alternatives are as follows:

- a new nuclear alternative (Section 2.2.2.1)
- a supercritical pulverized coal alternative (Section 2.2.2.2)
- a natural gas combined-cycle alternative (Section 2.2.2.3)
- a combination alternative of natural gas combined-cycle, wind, solar photovoltaic (PV), and purchased power (Section 2.2.2.4)

Table 2-1 below summarizes key design characteristics of these four replacement power alternatives.

Table 2-1 Overview of Replacement Power Alternatives Considered In Depth

Alternative	New Nuclear (Small Modular Reactors)	Supercritical Pulverized Coal	Natural Gas Combined-Cycle	Combination (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)
Summary	Six or more modular reactor units for a total of approximately 2,400 MWe	Four 625-MWe units for a total of approximately 2,500 MWe	Five 500-MWe units for a total of approximately 2,500 MWe	Approximately 1,000 MWe from natural gas combined-cycle (two units), 1,200 MWe from wind, 200 MWe from solar PV, and 200 MWe from purchased power.
Location	Located at an existing power plant site within the four-State ROI, offsite of Peach Bottom.	Located at an existing power plant site within the four-State ROI, offsite of Peach Bottom.	Located at an existing power plant site within the four-State ROI, offsite of Peach Bottom.	Located at multiple sites distributed across the four-State ROI, offsite of Peach Bottom.
Cooling System	Closed cycle with mechanical draft cooling towers. Cooling water withdrawal—80 mgd; Consumptive water use—55 mgd (NRC 2018b).	Closed cycle with mechanical draft cooling towers. Cooling water withdrawal—66 mgd; Consumptive water use—50 mgd (NETL 2013).	Closed cycle with mechanical draft cooling towers. Cooling water withdrawal—18 mgd; Consumptive water use—14 mgd (NETL 2013).	Natural gas combined-cycle units would use closed-cycle cooling systems with mechanical draft cooling towers. Cooling water withdrawal for the natural gas units—7.3 mgd; Consumptive water use for the natural gas units—5.6 mgd (NETL 2013). No cooling system would be required for the wind and solar facilities.

Table 2-1 Overview of Replacement Power Alternatives Considered In Depth (cont.)

Alternative	New Nuclear (Small Modular Reactors)	Supercritical Pulverized Coal	Natural Gas Combined-Cycle	Combination (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)
Land Required	Approximately 220 ac (150 ha) for plant facilities (Exelon 2018a).	Approximately 4,000 ac (1,600 ha) for plant facilities and coal storage, and 480 ac (190 ha) for waste disposal (Exelon 2018a).	Approximately 250 ac (100 ha) for plant facilities. In addition, up to 10,400 ac (4,200 ha) could be needed for wells, collection stations, and associated pipelines (Exelon 2018a, NRC 1996).	Approximately 100 ac (40 ha) for the natural gas combined-cycle plant, with up to an additional 4,200 ac (1,700 ha) for wells, collection stations, and associated pipelines (Exelon 2018a, NRC 1996). Multiple wind farms would collectively require approximately 255,000 ac (103,000 ha) (NREL 2009, WAPA and FWS 2015). Solar facilities would collectively require approximately 5000 ac (2000 ha) (NRC 2013a).
Work Force	3,300 workers during peak construction and 1,500 workers during operations (NRC 2018b).	2,500 workers during peak construction and 440 workers during operations (Exelon 2018a).	800 workers during peak construction and 100 workers during operations (Exelon 2018a).	Natural gas combined-cycle, wind, and solar units would collectively require approximately 1,800 workers during peak construction and 400 workers during operations. (Exelon 2018a, NRC 2018b, DOE 2008, DOE 2011b).

2.2.2.1 New Nuclear Alternative

The NRC staff considers the construction of a new nuclear plant to be a reasonable alternative to Peach Bottom subsequent license renewal. In 2016, nuclear generation accounted for approximately 36 percent of the electricity provided to the PJM (Exelon 2018a). In addition to Peach Bottom, eight other nuclear power plants operate within the region of influence, with the nearest being Three Mile Island Unit 1, located approximately 36 miles (mi) (58 kilometers (km)) to the north.

For the new nuclear alternative, the NRC staff considered the installation of multiple small modular reactors (SMRs). Small modular reactors use water for cooling and enriched uranium for fuel in the same manner as conventional, large light-water reactors currently operating in the United States. Each small modular reactor typically generates 300 megawatts electric (MWe) or less, compared to today’s larger designs that can generate 1,000 MWe or more per reactor. However, their smaller size means that several SMRs can be bundled together in a single containment. Smaller size also means they have greater siting flexibility because they can fit in locations not large enough to accommodate a conventional nuclear reactor (NRC 2018b, DOE 2018). SMR design features include underground containment and inherent safe shutdown features, longer station blackout coping time without external intervention, and core and spent fuel pool cooling without the need for active heat removal. Small modular reactor power generating facilities are also designed to be deployed in an incremental fashion to meet the power generation needs of a service area, where generating capacity can be added in increments to match load growth projections (NRC 2018b).

The NRC established the Advanced Reactor Program in its Office of New Reactors because of considerable interest in small modular reactors, along with anticipated license applications from vendors. The NRC received the first design certification application for a small modular reactor in December 2016 (NRC 2017a). Following NRC certification, this design could potentially achieve operation on a commercial scale by 2026 (NuScale 2018). Therefore, small modular reactors could be constructed and operational by the time the current Peach Bottom licenses expire in 2033 and 2034.

For this subsequent license renewal analysis, the NRC staff assumes three co-located SMR facilities would replace Peach Bottom Units 2 and 3. The analysis is based upon a generic SMR plant design and representative construction and operating parameters derived from several commercial designs (NRC 2018l). The NRC staff further assumes that each of the SMR facilities would contain two or more modular reactor units. Together, these units would replace approximately 2,400 MWe, or 92 percent, of the approximately 2,600 MWe currently provided by Peach Bottom Units 2 and 3. The reactors would be sited at an existing or retired plant site within the region of influence to allow for the maximum use of the location's existing ancillary facilities (e.g., support buildings and transmission infrastructure).

The NRC staff assumes that the SMR facilities would use a closed-cycle cooling system with mechanical draft cooling towers. To support the plant's cooling needs, this cooling system would withdraw approximately 80 million gallons per day (mgd) (300,000 cubic meters per day (m^3/d)) of water and consume 55 mgd (210,000 m^3/d) of water (NRC 2018b).

Like Exelon, the NRC staff assumes that approximately 220 ac (89 ha) of land would be required for construction of a 2,400-MWe SMR facility (Exelon 2018a). Onsite visible structures could include cooling towers, intake and discharge structures, transmission lines, and an electrical switchyard.

2.2.2.2 Supercritical Pulverized Coal Alternative

In 2016, coal-fired generation accounted for approximately 32 percent of all electricity provided to the PJM (Monitoring Analytics 2016). Although coal has historically been the largest source of electricity in the United States, the U.S. Energy Information Administration expects natural gas generation—and potentially even renewable energy generation—to surpass coal generation by 2040 (EIA 2016). Nonetheless, currently, coal still provides the second-greatest share of electrical power to the PJM. Exelon identified in its environmental report that coal-fired plants represent a feasible, commercially available option for providing electrical generating capacity beyond Peach Bottom's current license expirations (Exelon 2018a). Therefore, the NRC staff considered supercritical coal-fired generation equipped with carbon capture and storage technology to be a reasonable alternative to Peach Bottom license renewal.

Baseload coal units have proven their reliability and can routinely sustain capacity factors as high as 85 percent. Among the technologies available, pulverized coal boilers producing supercritical steam (supercritical pulverized coal or SCPC boilers) are increasingly common for new coal-fired plants given their generally high thermal efficiencies and overall reliability. Supercritical pulverized coal facilities are more expensive than subcritical coal-fired plants to construct, but they consume less fuel per unit output, reducing environmental impacts. In a supercritical coal-fired power plant, burning coal heats pressurized water. As the supercritical steam and water mixture moves through plant pipes to a turbine generator, the pressure drops and the mixture flashes to steam. The heated steam expands across the turbine stages, which then spin and turn the generator to produce electricity. After passing through the turbine, any remaining steam is condensed back to water in the plant's condenser.

For this alternative, the NRC staff assumes four supercritical pulverized coal units would be constructed and operated to replace Peach Bottom's generating capacity. Each unit would have a capacity of approximately 735 MWe and operate using an 85 percent capacity factor, collectively replacing 96 percent of Peach Bottom's approximate generating capacity of 2,600 MWe. Similar to the new nuclear alternative (see Section 2.2.2.1), the NRC staff assumes these coal units would be located at an existing or retired plant site within the region of influence to allow for the maximum use of the location's existing ancillary facilities (e.g., support buildings and transmission infrastructure).

The NRC staff assumes that the coal units would use a closed-cycle cooling system with mechanical draft cooling towers. To support the plant's cooling needs, this cooling system would withdraw approximately 66 mgd (250,000 m^3/d) of water and consume 50 mgd (190,000 m^3/d) of water (NETL 2013). Onsite visible structures could include cooling towers, exhaust stacks, intake and discharge structures, transmission lines, coal storage, and an electrical switchyard.

The NRC staff assumes that the supercritical pulverized coal alternative would require approximately 4,500 ac (1,800 ha) of land for major permanent facilities for coal storage and waste disposal (Exelon 2018a).

2.2.2.3 Natural Gas Combined-Cycle Alternative

As discussed earlier, natural gas represents approximately 36 percent of the installed generation capacity and 26 percent of the electrical power generated in the PJM (Exelon 2018a). The NRC staff considers the construction of a natural gas combined-cycle power plant to be a reasonable alternative to Peach Bottom subsequent license renewal because natural gas is a feasible, commercially available option for providing baseload electrical generating capacity beyond the expiration of Peach Bottom's current licenses.

Baseload natural gas combined-cycle power plants (abbreviated in this section as natural gas plants) have proven their reliability and can have capacity factors as high as 87 percent (EIA 2015b). In a natural gas combined-cycle system, electricity is generated using a gas turbine that burns natural gas. A steam turbine uses the heat from gas turbine exhaust through a heat recovery steam generator to produce additional electricity. This two-cycle process has a high rate of efficiency because the natural gas combined-cycle system captures the exhaust heat that otherwise would be lost and reuses it. Like other fossil fuel-burning plants, natural gas power plants are a source of greenhouse gases, including carbon dioxide (CO_2) (NRC 2013a).

For the natural gas alternative, the NRC staff assumes that five natural gas units would be constructed and operated to replace Peach Bottom's generating capacity. Each unit would have a capacity of approximately 575 MWe and operate using an 87 percent capacity factor, collectively replacing 96 percent of Peach Bottom's approximate generating capacity of

2,600 MWe. Each unit configuration would consist of two combustion turbine generators, two heat recovery steam generators, and one steam turbine generator with mechanical draft cooling towers for heat rejection. The NRC staff assumes that the natural gas power plant will incorporate a selective catalytic reduction system to minimize the plant's nitrogen oxide emissions (NETL 2007). Natural gas would be extracted from the ground through wells, treated to remove impurities, and then blended to meet pipeline gas standards before being piped through the State's pipeline system to the Peach Bottom site. The natural gas alternative would produce waste, primarily in the form of spent catalysts used for control of nitrogen oxide emissions.

Similar to the new nuclear alternative (see Section 2.2.2.1), the NRC staff assumes that the natural gas replacement power facility would be built on an existing or retired plant site within the region of influence and would allow for the maximum use of the location's existing ancillary facilities (e.g., support buildings and transmission infrastructure).

The NRC staff assumes that the natural gas combined cycle plant would use a closed-cycle cooling system with mechanical draft cooling towers. To support the plant's cooling needs, this cooling system would withdraw approximately 18 mgd (68,000 m^3/d) of water and consume 14 mgd (53,000 m^3/d) of water (NETL 2013). Because of the high overall thermal efficiency of this type of plant, the natural gas combined-cycle alternative would require less cooling water than the Peach Bottom subsequent license renewal. Onsite visible structures could include cooling towers, exhaust stacks, intake and discharge structures, transmission lines, natural gas pipelines, and an electrical switchyard.

The NRC staff assumes that approximately 250 ac (100 ha) would be used to construct and operate the natural gas plant (Exelon 2018a). Depending on the specific site location and proximity of existing natural gas pipelines, the natural gas alternative may also require up to 10,400 ac (4,200 ha) of land for new gas wells, collection stations, and associated pipeline rights-of-way (NRC 1996).

2.2.2.4 Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)

This alternative combines natural gas, wind, and solar replacement power generation with purchased power to meet the needs and purpose of the Peach Bottom subsequent license renewal. Natural gas, wind, and solar power generating facilities currently operate within the region of influence. For this evaluation, the NRC staff assumes that (1) a natural gas combined-cycle plant would supply 1,000 MWe, (2) wind farms would supply 1,200 MWe, (3) solar photovoltaic power plants would supply 200 MWe, and (4) 200 MWe would be purchased from other power providers. The NRC staff assumes that all components of this alternative would be located offsite of Peach Bottom but within the region of influence (i.e., Pennsylvania, Delaware, Maryland, and New Jersey). In addition, the NRC staff assumes that the natural gas component would be sited at an existing or former power plant site to maximize availability of existing infrastructure and reduce land disruption.

<u>Natural Gas Combined-Cycle Portion of the Combination Alternative</u>

The natural gas portion of the combination alternative would be generated using a natural gas combined-cycle plant located in the region of influence. The plant would be similar in function and appearance to the natural gas plant described in Section 2.2.2.3 for the natural gas-only alternative. For this analysis, the NRC assumes that the plant would consist of two natural gas units that would be constructed and operated. Each unit would have a capacity of approximately 575 MWe and operate using an 87 percent capacity factor, collectively providing an approximate net generating capacity of 1,000 MWe (EIA 2015b).

Approximately 100 ac (40 ha) of land would be used to construct and operate the natural gas plant. Depending on the specific site location and proximity of existing natural gas pipelines, the natural gas alternative may also require up to 4,200 ac (1,700 ha) of land for new gas wells, collection stations, and associated pipeline rights-of-way (NRC 1996).

The NRC staff assumes that the natural gas plant would use a closed-cycle cooling system with mechanical draft cooling towers. To support the plant's cooling needs, this system would withdraw approximately 7.3 mgd (27,000 m^3/d) of water and consume 5.6 mgd (21,000 m^3/d) of water (NETL 2013).

Wind Portion of the Combination Alternative

The NRC staff assumes that the 1,200 MWe of wind generated replacement power under this combination alternative would come from land-based wind farms located in the region of influence. The wind portion, operating at an expected capacity factor of 40 percent (Exelon 2018a), would require an installed capacity of 3,000 MWe.

The American Wind Energy Association reports a total of more than 96,000 MW of installed wind energy capacity nationwide as of December 31, 2018. Approximately 1,600 MW of this wind energy capacity has been installed across the region of influence (DOE 2019). In addition, approximately 22 gigawatts of wind generation have been proposed or are under construction in the PJM (Exelon 2018a).

The NRC staff assumes that an additional installed capacity of 3,000 MWe can be reasonably attained in the region of influence by the time the Peach Bottom licenses expire in 2033 and 2034. As is the case with other renewable energy sources, the feasibility of wind resources serving as alternative baseload power is dependent on the location (relative to expected load centers), value, accessibility, and constancy of the resource. Wind energy must be converted to electricity at or near the point where it is extracted, and there are limited energy storage opportunities available to overcome the intermittency and variability of wind resources. At the current stage of wind energy technology development, wind resources in wind power class 3 and higher are suitable for most utility-scale applications (NREL 2019). Wind power class 3 is defined as having a wind speed of 15.7 miles per hour (7.0 meters per second) and a wind density of 500 watts per square meter at 164 ft (50 m) (NREL 2019). Each state in the region of influence has wind resources meeting this power class (DOE 2019).

The average capacity of newly installed wind turbines in the United States increased from 0.71 MW in 1999 to more than 1.9 MW in 2014 (WAPA and FWS 2015, DOE 2015). Accordingly, for this analysis the NRC staff assumes the wind component would consist of approximately 1,500 turbines with a capacity of 2.0 MW each. Construction and operation of these turbines, associated access roads, and power collection and transmission systems would result in approximately 5,100 ac (2,060 ha) of temporary disturbance and 2,100 ac (850 ha) of permanent disturbance. Because wind turbines require ample spacing between one another to avoid interturbine air turbulence, the total land requirement of utility-scale wind farms is significantly larger than the disturbed land. Under this alternative, approximately 255,000 ac (103,000 ha) would be required for an installed capacity of 3,000 MWe (NREL 2009, WAPA and FWS 2015).

Wind energy's intermittency affects its viability and value as a baseload power source. However, the variability of wind-generated electricity can be tempered if the proposed wind farms were located at a large distance from one another and were operated as interconnected wind farms, an aggregate controlled from a central point. Distance between wind farms helps to ensure that multiple wind farms do not simultaneously experience the same weather conditions, and that power will likely be produced at some of the wind farms at any given time (Archer and Jacobson 2007).

Solar Portion of the Combination Alternative

The solar portion of the combination alternative would be generated using solar photovoltaic energy facilities located in the region of influence. For this analysis, the NRC staff assumes that two standalone, utility-scale solar facilities would be constructed and operated. Each facility is would have the capacity of approximately 400-MWe and would operate using a 25 percent capacity factor, collectively providing an approximate net generating capacity of 200 MWe (EIA 2018a).

Nationwide, growth in utility-scale solar photovoltaic facilities (greater than 1 MW) has resulted in an increase from 70 MW in 2008 to over 20,000 MW installed capacity in 2017 (EIA 2017). Pennsylvania, Delaware, Maryland, and New Jersey each have renewable portfolio standard requirements for the minimum proportion of electrical generation served by solar (Monitoring Analytics 2016).

Solar photovoltaic resources across the PJM range from 4.0 to 5.0 kilowatt hours per square meter per day (kWh/m^2/day) (Exelon 2018a). The feasibility of solar energy resources serving as alternative baseload power is dependent on the location, value, accessibility, and constancy of solar radiation. Solar photovoltaic power generation uses solar panels to convert solar radiation into usable electricity. Solar cells are formed into solar panels that can then be linked into photovoltaic arrays to generate electricity. The electricity generated can be stored, used directly, fed into a large electricity grid, or combined with other electricity generators as a hybrid plant. Solar photovoltaic cells can generate electricity whenever there is sunlight, regardless of whether the sun is directly or indirectly shining on the solar panels. Therefore, solar photovoltaic technologies do not need to directly face and track the sun. This capability has allowed solar photovoltaic systems to have broader geographical use than concentrating solar power (which relies on direct sun) (DOE 2011). Because the region of influence contains average solar photovoltaic resources and because solar photovoltaic technology is a commercially available option for providing electrical generating capacity, the NRC staff considers the construction and operation of solar photovoltaic facilities to be a reasonable alternative when combined with other generation sources.

Utility-scale solar facilities require large areas of land to be cleared for the solar panels. For standalone sites, solar photovoltaic facilities may require approximately 6.2 ac per megawatt (NRC 2013a). Therefore, approximately 5,000 ac (2,000 ha) would be required collectively for the two proposed solar power installations needed under this alternative. Although not all of this land would be cleared of vegetation and permanently impacted, it represents the land enclosed in the total site boundary of the solar facility (NREL 2013). Solar photovoltaic systems do not require water for cooling purposes but do require a small amount of water to clean the panels and potable water for the workforce.

Purchased Power Portion of the Combination Alternative

Under the combination alternative, purchased power could be used to replace 200 MW of the generating capacity of Peach Bottom. As discussed in Section 2.2.2, replacement power for Peach Bottom could come from anywhere within Pennsylvania or adjoining states in the PJM (i.e. the region of influence). Purchased power would likely come from the most common types of electricity generation sources within the region of influence: nuclear, coal, natural gas, wind and solar. All of these power sources are discussed as alternatives to subsequent license renewal of Peach Bottom and are identified in Sections 2.2.2.1 to 2.2.2.4. Similarly, the impacts from purchased power would depend substantially on the generation technologies used to supply the purchased power. In addition, purchased power may require new transmission lines (which may require new construction) and may also rely on older and less-efficient power plants operating at higher that current capacities or new facilities that would be constructed.

2.3 Alternatives Considered but Eliminated

The NRC staff originally considered 17 replacement power alternatives to Peach Bottom subsequent license renewal, but ultimately eliminated 13 of these from detailed study. The staff eliminated these 13 alternatives because of technical reasons, resource availability limitations, or commercial or regulatory limitations. Many of these limitations will likely still exist when the current Peach Bottom licenses expire in 2033 (Unit 2) and 2034 (Unit 3), such that these 13 alternatives are not expected to be reasonably available when needed to replace the power generated by Peach Bottom Units 2 and 3. This section describes each of the 13 eliminated alternatives as well as the reason that the NRC staff eliminated each alternative.

2.3.1 Solar Power

Solar power, including solar photovoltaic (PV) and concentrating solar power (CSP) technologies, produce power generated from sunlight. Solar photovoltaic components convert sunlight directly into electricity using solar cells made from silicon or cadmium telluride. Concentrating solar power uses heat from the sun to boil water and produce steam. The steam then drives a turbine connected to a generator to ultimately produce electricity (NREL 2014). To be considered a viable alternative, a solar alternative must replace the amount of electricity that Peach Bottom provides. Assuming a capacity factor of 25 percent (EIA 2018a), approximately 10,400 MWe of additional solar energy capacity would need to be installed in the region of influence.

Solar generators are considered an intermittent resource because their availability depends on ambient exposure to the sun, also known as solar insolation (EIA 2017). Insolation rates of solar photovoltaic resources in the region of influence are low to average and range from 4.0 to 5.0 kWh/m^2/day (Exelon 2018a; NREL 2017). In addition, although each state within the region of influence is required to include solar generation as part of its renewable portfolio standard, only 917 MWe of solar generation capacity was installed across the region of influence as of 2017 (EIA 2019a).

Considering the above factors, the NRC staff concludes that solar power energy facilities alone do not provide a reasonable alternative to Peach Bottom subsequent license renewal. However, the NRC staff does consider an alternative using solar power in combination with other power technologies and resources, as described earlier in Section 2.2.2.4.

2.3.2 Wind Power

As is the case with other renewable energy sources, the feasibility of a wind power alternative for baseload power is dependent on the location (relative to expected electricity users), value, accessibility, and constancy of the resource. Wind energy must be converted to electricity at or near the point where it is extracted, and currently there are limited energy storage opportunities available to overcome the intermittency and variability of wind resources.

To be considered a reasonable replacement power alternative to Peach Bottom subsequent license renewal, the wind power alternative must replace the amount of electricity that Peach Bottom provides. Assuming a capacity factor of 40 percent, a combination of land-based and offshore wind energy facilities in the region of influence would have to generate approximately 6,500 MWe of electricity.

The American Wind Energy Association reports a total of more than 96,000 MW of installed wind energy capacity nationwide as of December 31, 2018 (DOE 2019). Texas leads all other States in installed land-based wind energy capacity with over 23,000 MW. In 2017, land-based wind power facilities in the Peach Bottom region of influence had a total installed capacity of approximately 1,570 MWe and approximately 1 percent of the ROI’s total power was generated from these sources (EIA 2019a, EIA 2019b).

In 2016, a 30-MW project off the coast of Rhode Island become the first operating offshore wind farm in the United States (Energy Daily 2016). Although several proposed wind projects in State and Federal waters off the Atlantic coasts of Delaware, Maryland, and New Jersey and the Lake Erie coast of Pennsylvania are in the planning stages, no utility-scale offshore wind farms are currently in operation across the region of influence (EIA 2018b).

Given the amount of wind capacity necessary to replace Peach Bottom, the intermittency of the resource, and the status of wind development in the region of influence, the NRC staff finds that a wind power alternative alone—either land based, offshore, or some combination of the two—is not a reasonable alternative to Peach Bottom subsequent license renewal. However, the NRC staff does consider an alternative using wind power in combination with other power technologies and resources, as described earlier in Section 2.2.2.4.

2.3.3 Biomass Power

Biomass resources used for biomass-fired generation include agricultural residues, animal manure, wood wastes from forestry and industry, residues from food and paper industries, municipal green wastes, dedicated energy crops, and methane from landfills (IEA 2007). Using biomass-fired generation for baseload power depends on the geographic distribution, available quantities, constancy of supply, and energy content of biomass resources. For this analysis, the NRC staff assumes that biomass would be combusted for power generation in the electricity sector. Biomass is also used for space heating in residential and commercial buildings and can be converted to liquid form for use in transportation fuels.

In 2017, biomass facilities in the region of influence had a total installed capacity of approximately 930 MW, and approximately 1 percent of the ROI’s total power was generated from biomass sources (EIA 2019a, EIA 2019b).

For utility-scale biomass electricity generation, the NRC staff assumes that the technologies used for biomass conversion would be similar to the technology used in other fossil fuel plants, including the direct combustion of biomass in a boiler to produce steam (NRC 2013a). Biomass generation is generally more cost effective when co-fired with coal plants (IEA 2007). However, most biomass-fired generation plants generally only reach capacities of 50 MW, which means replacing the approximately 2,600-MWe generating capacity of Peach Bottom using only biomass would require the construction of more than 50 new, average-sized biomass facilities. Sufficiently increasing biomass-fired generation capacity by expanding existing biomass units or constructing new biomass units by the time Peach Bottom's licenses expire in 2033 and 2034, is unlikely. For this reason, the NRC staff does not consider biomass-fired generation to be a reasonable alternative to Peach Bottom subsequent license renewal.

2.3.4 Demand-Side Management

Energy conservation can include reducing energy demand through consumer behavioral changes or through altering the shape of the electricity load, and usually does not require the addition of new generating capacity. Conservation and energy efficiency programs are more broadly referred to as demand-side management.

Conservation and energy efficiency programs can be initiated by a utility, transmission operators, the State, or other load-serving entities. In general, residential electricity consumers have been responsible for the majority of peak load reductions and participation in most programs is voluntary. Therefore, the mere existence of a program does not guarantee that reductions in electricity demand will occur. The GEIS concludes that, although the energy conservation or energy efficiency potential in the United States is substantial, the NRC staff is aware of no cases where an energy efficiency or conservation program alone has been implemented expressly to replace or offset a large baseload generation station (NRC 2013a).

PJM has considered demand-side management measures as part of its resource planning efforts and has incorporated these measures into its current State and regional load projections. However, it is unlikely that additional demand-side management measures alone would be sufficient to offset the energy supply that would be lost by the shutdown of Peach Bottom (Exelon 2018a, Monitoring Analytics 2016). Therefore, the NRC staff does not consider demand-side management programs to be a reasonable alternative to Peach Bottom subsequent license renewal.

2.3.5 Hydroelectric Power

Currently, approximately 2,000 hydroelectric facilities operate in the United States. Hydroelectric technology captures flowing water and directs it to a turbine and generator to produce electricity (NRC 2013a). There are three variants of hydroelectric power: (1) run-of-the river (diversion) facilities that redirect the natural flow of a river, stream, or canal through a hydroelectric facility, (2) store-and-release facilities that block the flow of the river by using dams that cause water to accumulate in an upstream reservoir, and (3) pumped storage facilities that use electricity from other power sources to pump water to higher elevations during off-peak load periods to be released during peak load periods through the turbines to generate additional electricity.

A comprehensive survey of hydropower resources, completed in 1997, identified the region of influence as having 742 MW of potential hydroelectric capacity when adjusted for environmental, legal, and institutional constraints (Conner et. al., 1998). These constraints could include (1) scenic, cultural, historical, and geological values, (2) Federal and State land use, and (3) legal protection issues, such as wild and scenic legislation and threatened or endangered fish and wildlife legislative protection. In a separate assessment of nonpowered dams (dams that do not produce electricity), the DOE concludes that hydropower resources in the region of influence could potentially generate 763 MW of electricity (ORNL 2012). These nonpowered dams serve various purposes, such as providing water supply to inland navigation. However, hydroelectric power accounted for less than 2 percent of the region of influence's electric power production in 2017 (EIA 2019b). Although the U.S. Energy Information Administration projects that hydropower will remain a leading source of renewable generation in the United States through 2040, there is little expected growth in hydropower capacity (EIA 2013). Similarly, no new hydropower projects are being considered in the PJM region, nor is there evidence that modifications of existing hydropower facilities in the region could add sufficient hydropower capacity to replace Peach Bottom (Exelon 2018a). The potential for future construction of large hydropower facilities has diminished because of increased public concerns over flooding, habitat alteration and loss, and destruction of natural river courses (NRC 2013a).

Given the projected lack of growth in hydroelectric power production, the competing demands for water resources, and the expected public opposition to the large environmental impacts and significant changes in land use that would result from the construction of hydroelectric facilities, the NRC staff concludes that the expansion of hydroelectric power is not a reasonable alternative to Peach Bottom subsequent license renewal.

2.3.6 Geothermal Power

Geothermal technologies extract the heat contained in geologic formations to produce steam to drive a conventional steam turbine generator. Facilities producing electricity from geothermal energy have demonstrated capacity factors of 95 percent or greater, making geothermal energy a potential source of baseload electric power. However, the feasibility of geothermal power generation to provide baseload power depends on the regional quality and accessibility of geothermal resources. Utility-scale geothermal energy generation requires geothermal reservoirs with a temperature above 200 °F (93 °C). Known geothermal resources are concentrated in the Western United States, specifically Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. In general, most assessments of geothermal resources have been concentrated on these Western States (DOE 2013, USGS 2008). Geothermal resources are used in the Peach Bottom region of influence for heating and cooling purposes, but no electricity is currently being produced from geothermal resources in the region of influence (EIA 2018b). Given the low resource potential in the region of influence, the NRC staff does not consider geothermal power to be a reasonable alternative to Peach Bottom subsequent license renewal.

2.3.7 Wave and Ocean Energy

Waves, currents, and tides are often predictable and reliable, making them attractive candidates for potential renewable energy generation. Four major technologies may be suitable to harness wave energy: (1) terminator devices that range from 500 kilowatts to 2 MW, (2) attenuators, (3) point absorbers, and (4) overtopping devices (BOEM undated). Point absorbers and attenuators use floating buoys to convert wave motion into mechanical energy, driving a generator to produce electricity. Overtopping devices trap a portion of a wave at a higher elevation than the sea surface; waves then enter a tube and compress air that is used to drive a generator that produces electricity (NRC 2013a). Some of these technologies are undergoing demonstration testing at commercial scales, but none are currently used to provide baseload power (BOEM undated).

The United States' Mid-Atlantic coast is characterized by substantial amounts of wave energy arriving from the north (EPRI 2011). However, wave and ocean energy generation technologies are still in their infancy and currently lack commercial application. For these reasons, the NRC staff does not consider wave and ocean energy to be a reasonable alternative to Peach Bottom subsequent license renewal.

2.3.8 Municipal Solid Waste

Energy recovery from municipal solid waste converts nonrecyclable waste materials into usable heat, electricity, or fuel through combustion. The three types of combustion technologies include mass burning, modular systems, and refuse-derived fuel systems. Mass burning is the method used most frequently in the United States. The heat released from combustion is used to convert water to steam, which is used to drive a turbine generator to produce electricity. Ash is collected and taken to a landfill, and particulates are captured through a filtering system (EPA 2019a).

In 2018, 75 waste-to energy plants were in operation in 21 States, processing approximately 29 million tons of waste per year. These waste-to-energy plants have an aggregate capacity of approximately 2,700 MWe. Although some plants have expanded to handle additional waste and to produce more energy, no new plants have been built in the United States since 1995 (EPA 2019a). The average waste-to-energy plant produces about 50 MWe, with some reaching 77 MWe (Michaels 2010). More than 50 average-sized waste-to-energy plants would be necessary to provide the same level of output as Peach Bottom Units 2 and 3.

The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills rather than a need for energy. Given the improbability that additional stable supplies of municipal solid waste would be available to support more than 50 new facilities in the region of influence, the NRC staff does not consider municipal solid waste combustion to be a reasonable alternative to Peach Bottom subsequent license renewal.

2.3.9 Petroleum-Fired Power

Petroleum-fired electricity generation accounted for less than 1 percent of the region of influence's total electricity generation in 2017 (EIA 2019b). The variable costs and environmental impacts of petroleum-fired generation tend to be greater than those of natural gas-fired generation. The historically higher cost of oil has also resulted in a steady decline in its use for electricity generation, and the U.S. Energy Information Administration forecasts no growth in capacity using petroleum-fired power plants through 2040 (EIA 2013, EIA 2015a). Therefore, the NRC staff does not consider petroleum-fired generation to be a reasonable alternative to Peach Bottom subsequent license renewal.

2.3.10 Coal Integrated Gasification Combined Cycle

An integrated gasification combined-cycle power plant consists of coal gasification and combined-cycle power generation. Coal gasifiers convert coal into a gas (synthesis gas, also referred to as syngas), which fuels the combined-cycle power generating units. Nearly 100 percent of the nitrogen from the syngas is removed before combustion in the gas turbines and this results in lower nitrogen oxide emissions when compared to conventional coal-fired power plants (DOE 2010).

Although several smaller, integrated gasification combined-cycle power plants have been in operation since the mid-1990s, more recent large-scale projects using this technology have experienced setbacks and opposition that have hindered the technology from fully integrating into the energy market. The most significant roadblock has been the high capital cost of an integrated gasification combined-cycle power plant as compared to conventional coal-fired power plants. Both the Duke Energy Edwardsport Generation Station project in Indiana and the Kemper County integrated gasification combined-cycle project in east–central Mississippi have experienced cost and schedule overruns. The Kemper County project suspended work towards startup of the gasifier component in June 2017 (Energy Daily 2017). Other issues associated with integrated gasification combined cycle include a limited track record for reliable performance and opposition based on environmental concerns. Based upon these considerations, the NRC staff concludes that the coal integrated gasification combined-cycle technology would not provide a reasonable source of baseload power to replace Peach Bottom Units 2 and 3 by the time their current licenses expire in 2033 and 2034, respectively.

2.3.11 Fuel Cells

Fuel cells oxidize fuels without combustion and therefore without the environmental side effects of combustion. Fuel cells use a fuel (e.g., hydrogen) and oxygen to create electricity through an electrochemical process. The only byproducts are heat, water, and carbon dioxide (depending on the hydrogen fuel type) (DOE 2013b). Hydrogen fuel can come from a variety of hydrocarbon resources. Natural gas is a typical hydrogen source.

Fuel cells are not economically or technologically competitive with other alternatives for electricity generation. The U.S. Energy Information Administration estimates that fuel cells may cost $7,108 per installed kilowatt (total overnight capital costs in 2012 dollars), which is high compared to other alternative technologies analyzed in this section (EIA 2013b). More importantly, fuel cell units are likely to be small (approximately 10 MW). The world's largest fuel cell facility is a 59-MWe plant that came online in South Korea in 2014 (PEI 2017). Using fuel cells to replace the power that Peach Bottom provides would be extremely costly. It would require the construction of approximately 260 average-sized units and modifications to the existing transmission system. Given the immature status and high cost of fuel cell technology, the NRC staff does not consider fuel cells to be a reasonable alternative to Peach Bottom subsequent license renewal.

2.3.12 Purchased Power

It is possible that replacement power may be purchased and imported from outside the Peach Bottom region of influence. Although purchased power would likely have little or no measurable environmental impact in the vicinity of Peach Bottom, impacts could occur where the power is generated or anywhere along the transmission route, depending on the generation technologies used to supply the purchased power (NRC 2013a).

In 2017, Exelon purchased 237 MW of firm capacity from other generation sources in the Mid-Atlantic region under several long-term contracts, the last of which is set to expire in 2032 (Exelon 2018e). However, purchased power is generally economically adverse because historically, the cost of generating power has been less than the cost of purchasing the same amount of power from a third-party supplier (NRC 2013a). Power purchase agreements also carry the inherent risk that the supplying plant will not deliver the contracted power.

Based on these considerations, the NRC staff concludes that purchased power alone does not provide a reasonable alternative to Peach Bottom subsequent license renewal. However, the NRC staff does consider an alternative using purchased power in combination with other power technologies, as described earlier in Section 2.2.2.4.

2.3.13 Delayed Retirement

Retiring a power plant ends its ability to supply electricity. Delaying the retirement of a power plant enables it to continue supplying electricity. A delayed retirement alternative would delay the retirement of generating facilities (other than Peach Bottom) within or near the region of influence.

Power plants retire for several reasons. Because generators are required to adhere to additional regulations that will require significant reductions in plant emissions, some power plant owners may opt for early retirement of older units (which often generate more pollutants and are less efficient) rather than incur the cost for compliance. Additional retirements may be driven by low competing commodity prices (such as low natural gas prices), slow growth in electricity demand, and the requirements of the EPA's Mercury and Air Toxics Standards (EIA 2015a, EPA 2015).

As noted in its environmental report, Exelon recently ceased operation of two fossil fuel plants in the region of influence that had a combined capacity of 125 MWe. Exelon also has plans to cease operation of a 636-MWe nuclear plant in the region of influence before 2020. Exelon does not consider the reactivation and/or continued operation of these plants to be viable alternatives. Further, PJM does not have the authority to require owners of generating units scheduled for retirement to keep such units in service (Exelon 2018a). Because of these conditions, the NRC staff concludes that delayed retirement does not provide a reasonable alternative to Peach Bottom subsequent license renewal.

2.4 Comparison of Alternatives

In this chapter, the NRC staff considered in depth one alternative to Peach Bottom subsequent license renewal that does not replace the plant's energy generation (the no-action alternative) and four alternatives to subsequent license renewal that may reasonably replace Peach Bottom's energy generation. These four replacement power alternatives are (1) new nuclear generation, (2) supercritical pulverized coal generation, (3) natural gas combined-cycle generation, and (4) a combination of natural gas combined-cycle generation, wind, solar, and purchased power. The environmental impacts of the proposed action and of each of the alternatives are described and assessed in Chapter 4, "Environmental Consequences and Mitigating Actions." Table 2-2 summarizes the environmental impacts of Peach Bottom subsequent license renewal and the alternatives to Peach Bottom subsequent license renewal considered in this SEIS.

The environmental impacts of the proposed action (subsequent renewal of the Peach Bottom operating licenses) would be SMALL for all impact categories except for aquatic resources. Due to thermal impacts on the aquatic organisms in the Conowingo Pond, the impact of the Peach Bottom subsequent license renewal to aquatic resources would be SMALL to MODERATE.

In comparison, each of the four reasonable replacement power alternatives have environmental impacts in at least six resource areas that are greater than the environmental impacts of the proposed action of subsequent license renewal (and one resource area, aquatic resources, that has less impacts). If the NRC adopts the no-action alternative and does not issue subsequent renewed licenses for Peach Bottom, energy-planning decisionmakers would likely implement one of the four replacement power alternatives discussed in depth in this chapter. Based on the NRC staff's review of these four replacement power alternatives, the no-action alternative, and the proposed action, the staff concludes that the environmentally preferred alternative is the proposed action of subsequent license renewal. Therefore, the NRC staff recommends that the NRC issue subsequent renewed operating licenses for Peach Bottom Units 2 and 3.

Table 2-2 Summary of Environmental Impacts of the Proposed Action and Alternatives

Impact Area (Resource)	Peach Bottom Subsequent License Renewal (Proposed Action)	No-Action Alternative	New Nuclear Alternative	Supercritical Pulverized Coal Alternative	Natural Gas Combined-Cycle Alternative	Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)
Land Use	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE
Visual Resources	SMALL	SMALL	MODERATE to LARGE	MODERATE to LARGE	SMALL to MODERATE	SMALL to LARGE
Air Quality	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Noise	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Geologic Environment	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Surface Water Resources	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Groundwater Resources	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL
Terrestrial Resources	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Aquatic Resources	SMALL to MODERATE[a]	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE
Special Status Species and Habitats	See Note[b]	See Note[c]	See Note[c]	See Note[c]	See Note[c]	See Note[c]
Historic and Cultural Resources	See Note[d]	See Note[e]	See Note[f]	See Note[f]	See Note[f]	See Note[f]
Socioeconomics	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE
Transportation	SMALL	SMALL	SMALL to LARGE	MODERATE to LARGE	SMALL to MODERATE	SMALL to LARGE
Human Health	SMALL[g]	SMALL[g]	SMALL[g]	SMALL[g]	SMALL[g]	SMALL[g]
Environmental Justice	See Note[h]	See Note[i]	See Note[j]	See Note[j]	See Note[j]	See Note[j]

Table 2-2 Summary of Environmental Impacts of the Proposed Action and Alternatives (cont.)

Impact Area (Resource)	Peach Bottom Subsequent License Renewal (Proposed Action)	No-Action Alternative	New Nuclear Alternative	Supercritical Pulverized Coal Alternative	Natural Gas Combined-Cycle Alternative	Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)
Waste Management and Pollution Prevention	SMALL[k]	SMALL[k]	SMALL [k]	MODERATE	SMALL	SMALL to MODERATE

(a) Due to thermal impacts on the aquatic organisms in the Conowingo Pond, the impact of the Peach Bottom subsequent license renewal to aquatic resources would be SMALL to MODERATE.

(b) The NRC staff concludes that the subsequent license renewal may affect but is not likely to adversely affect the northern long-eared bat *(Myotis septentrionalis)* and Indiana bat *(M. sodalis).* The subsequent license renewal would have no effect on any other Federally listed or proposed species or on designated or proposed critical habitat. The proposed license renewal would not adversely affect designated Essential Fish Habitat.

(c) The types and magnitudes of adverse impacts to species listed in the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), designated critical habitat, and Essential Fish Habitat would depend on Peach Bottom shutdown activities, the proposed alternative site, plant design and operation, as well as listed species and habitats present when the alternative is implemented. Therefore, the NRC staff cannot forecast a level of impact for this alternative.

(d) Based on *(*1) that no new ground disturbance, construction, or modifications are anticipated during the subsequent license renewal period, 2) State historic preservation office input, and 3) Exelon procedures, subsequent license renewal would not adversely affect any known historic properties (Title 36, “Parks, Forest, and Public Property,” of the *Code of Federal Regulations* 800.4(d)(1), “No Historic Properties Affected”), or historic and cultural resources.

(e) As a result of facility shutdown, land-disturbance activities or dismantlement are not anticipated as these would be conducted during decommissioning, and therefore facility shutdown would have no immediate effect on historic properties.

(f) The potential for impacts to historic and cultural resources from construction and operation of a replacement power alternative would vary greatly depending on the location of the site. The impacts on historic and cultural resources could range from will not adversely affect known historic and cultural resources to may adversely affect known historic and cultural resources.

(g) The chronic effects of electromagnetic fields on human health associated with operating nuclear power and other electricity generating plants are uncertain.

(h) There would be no disproportionately high and adverse impacts to minority and low-income populations.

(i) A reduction in tax revenue resulting from the shutdown of Peach Bottom could decrease the availability of public services in the Peach Bottom area. Minority and low-income populations dependent on these services could be disproportionately affected.

(j) Based on the analysis of human health and environmental impacts presented in this SEIS, this alternative would not likely have disproportionately high and adverse human health and environmental effects on minority and low-income populations. However, this determination would depend on site location, plant design, and operational characteristics of the new power plant, unique consumption practices and interactions with the environment of nearby populations, and the location of predominantly minority and low-income populations. Therefore, NRC staff cannot determine whether any of the replacement power alternatives would result in disproportionately high and adverse human health and environmental effects on minority and low-income populations.

(k) NUREG-2157, “Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel,” (NRC 2014b) discusses the environmental impact of spent fuel storage for the timeframe beyond the licensed life for reactor operations.

3 AFFECTED ENVIRONMENT

In conducting its environmental review of the Peach Bottom Atomic Power Station Units 2 and 3 (Peach Bottom or Peach Bottom Units 2 and 3) subsequent license renewal application, the U.S. Nuclear Regulatory Commission (NRC) first defines and describes the environment that could be affected by the subsequent license renewal. For this review, the NRC staff defines the affected environment as the environment that currently exists at and around the Peach Bottom site. Because existing conditions are at least partially the result of past construction and operations at the plant, this chapter presents the nature and impacts of these past actions as well as ongoing actions, and evaluates how, together, these actions have shaped the current environment. The effects of ongoing reactor operations at Peach Bottom have become well established as environmental conditions have adjusted to the presence of the nuclear power plant. Sections 3.2 through 3.13 describe the affected environment for each resource area. The resource discussions in this chapter include new and updated information that became available since the NRC issued the supplemental environmental impact statement (SEIS) for the initial Peach Bottom license renewal in 2003, as NUREG-1437, Supplement 10 (NRC 2003a).

3.1 Description of Nuclear Power Plant Facility and Operation

The physical presence of Peach Bottom buildings and facilities, as well as the plant's operations, are part of the environment that currently exists at and around the site. This section describes Peach Bottom buildings, certain nuclear power plant operating systems, and certain plant infrastructure, operations, and maintenance.

3.1.1 External Appearance and Setting

Peach Bottom is located near Delta, PA, in York County, approximately 38 miles (mi) (61 kilometers (km)) north of Baltimore, MD. Figure 3-1 shows the site location and features within 50 mi (80 km). The nearest city limits are Lancaster, PA, approximately 19 mi (31 km) to the north, and York, PA, approximately 30 mi (48 km) to the northwest of the site. There are no major metropolitan areas within 6 mi (10 km) of Peach Bottom. Peach Bottom is located on the west side of Conowingo Pond, an impoundment which was formed when Conowingo Dam was constructed across the Susquehanna River in 1928. Peach Bottom is approximately 18 mi (29 km) upstream from the point where the Susquehanna River enters the Chesapeake Bay and 8 mi (13 km) upstream from Conowingo Dam (NRC 2003a).

Peach Bottom Units 2 and 3 are two boiling water nuclear reactors located on approximately 769 acres (ac) (311 hectares (ha)) of Exelon Generation Company, LLC (Exelon)-owned land in York County, PA. In addition to nuclear-generating Units 2 and 3, the Peach Bottom site also houses Unit 1, which was an experimental high-temperature, helium-cooled, and graphite-moderated nuclear reactor, and is being maintained in safe storage (SAFSTOR). Information regarding SAFSTOR is described in Section 7.2.2 of NUREG-1437 (NRC 1996). There is one reactor building for Peach Bottom Unit 2 and one reactor building for Peach Bottom Unit 3. Peach Bottom Units 2 and 3 share several features including the 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 independent spent fuel storage installation (ISFSI), a training center, the retired Unit 1, two electrical substations, a public boat ramp, and a picnic area (Exelon 2018a).

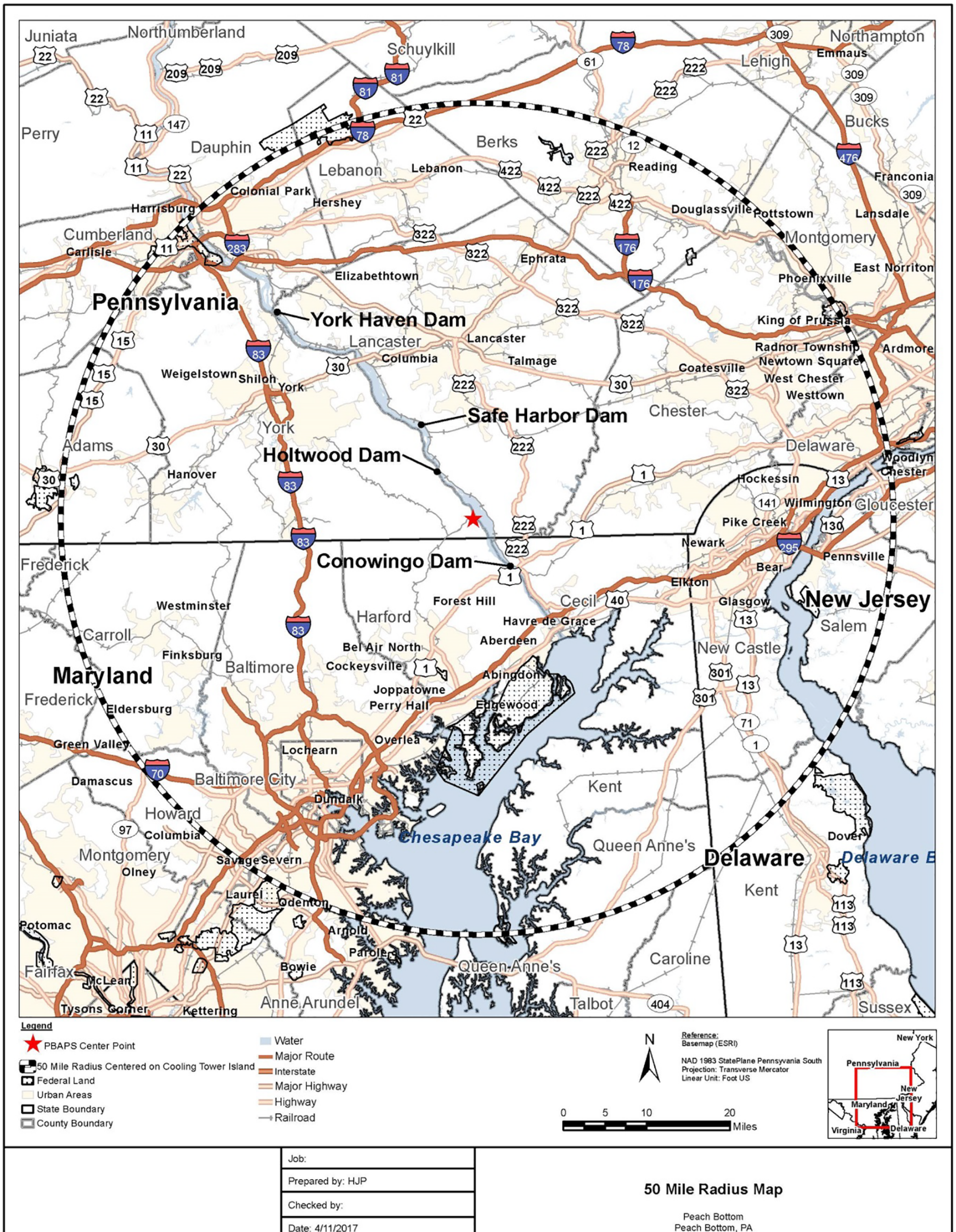


Figure 3-1 Peach Bottom 50-mi (80-km) Radius Map (Exelon 2018a)

3.1.2 Nuclear Reactor Systems

Peach Bottom Units 2 and 3 are General Electric, Type 4, boiling water reactors (BWRs) with a Mark I containment. The NRC's predecessor agency, the Atomic Energy Commission, issued the initial Peach Bottom Unit 2 facility operating license on October 25, 1973 and the initial Unit 3 operating license on July 2, 1974. Subsequently, on May 7, 2003, the NRC issued renewed facility operating licenses for Peach Bottom Units 2 and 3 authorizing an additional 20 years of operation. Peach Bottom Units 2 and 3 are each rated for a reactor core power level of 4,016 megawatts thermal (MWt) (Exelon 2018a).

3.1.3 Cooling and Auxiliary Water Systems

The Peach Bottom facility uses a combination heat dissipation system that normally operates as a once-through system, but at times also employs helper cooling towers. In boiling water reactors, steam is generated in the reactor vessel. The steam from the reactor vessel is sent to turbines, which generate electricity. From the turbines, the water is returned to the reactor vessel where it is reheated. This is called the primary loop. Excess heat in the primary loop is removed by the cooling water loop. The water in the cooling water loop does not come into physical contact with the water in the primary loop. Figure 3-2 contains a simple illustration of the cooling water loop at the Peach Bottom site.

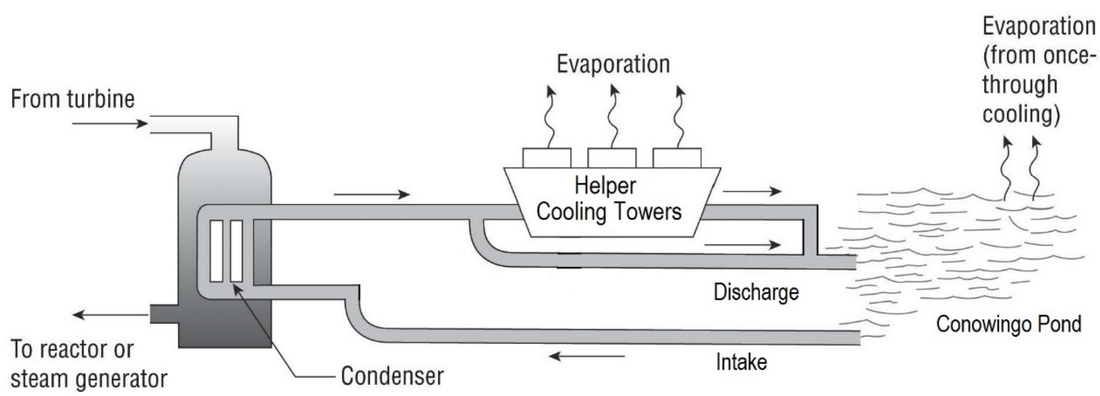


Figure 3-2 Simple Illustration of the Cooling Water Loop at the Peach Bottom Site

Individual plant systems that interact with the environment are discussed further below. Unless otherwise cited for clarity, the NRC staff drew information from either Exelon's Peach Bottom environmental report submitted as part of its subsequent license renewal application (Exelon 2018a), the NRC's 2003 SEIS (NRC 2003a), the NRC's 2014 environmental assessment for an extended power uprate (NRC 2014d), or the NRC staff's environmental site audit conducted at the Peach Bottom site in November 2018.

3.1.3.1 Cooling Water Loop

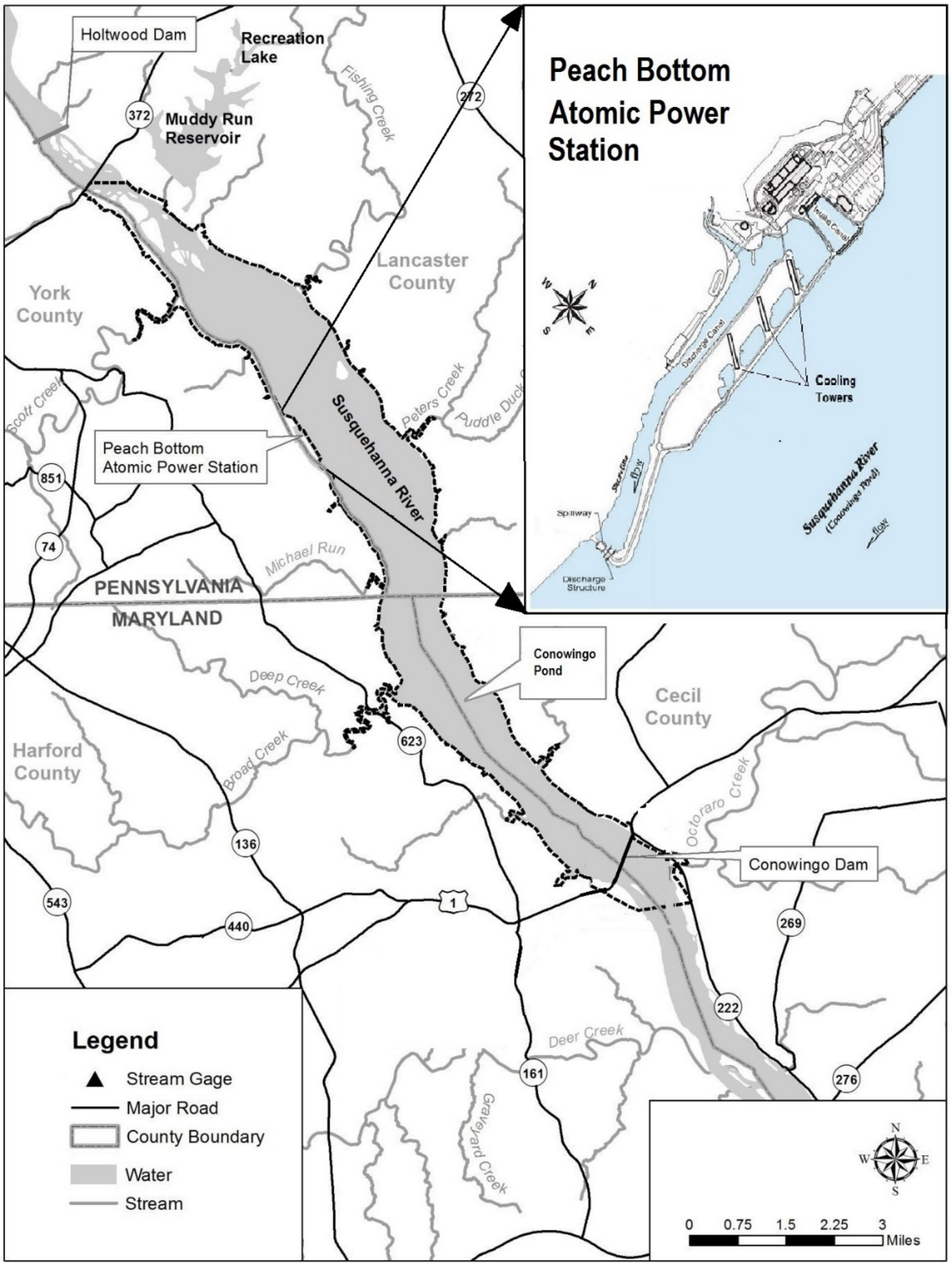
Water for the cooling water loop is withdrawn from Conowingo Pond, which is a 9,000-ac (3,600-ha) reservoir on the lower Susquehanna River (Figure 3-3). Water withdrawn from Conowingo Pond passes through a series of intake structures before it is sent to condensers that are used to transfer heat from the water in the primary loop to the water in the cooling water loop. As the water passes through the condensers, the temperature of the cooling water loop can increase by as much as 25 ºF (14 ºC). From the condensers, the now-heated water moves through a series of discharge structures before it flows back into Conowingo Pond via the discharge canal.

The principal components of the cooling water loop are: (1) the outer intake structure, (2) intake basins, (3) inner intake structures, (4) condensers, (5) helper cooling towers, (6) the discharge canal, and (7) the discharge structure (Figures 3-3 and 3-4).

At the beginning of the cooling water loop, water from Conowingo Pond flows into the outer intake structure. The outer intake (or screenwell) structure is 487-feet (ft) (148-meters (m)) long and lies along the west bank of Conowingo Pond, parallel to the long axis of the reservoir. The outer intake structure operates with an approach velocity of 0.75 feet per second (fps) (0.23 meters per second (mps)), and a through-screen velocity of 1.21 fps (0.37 mps).

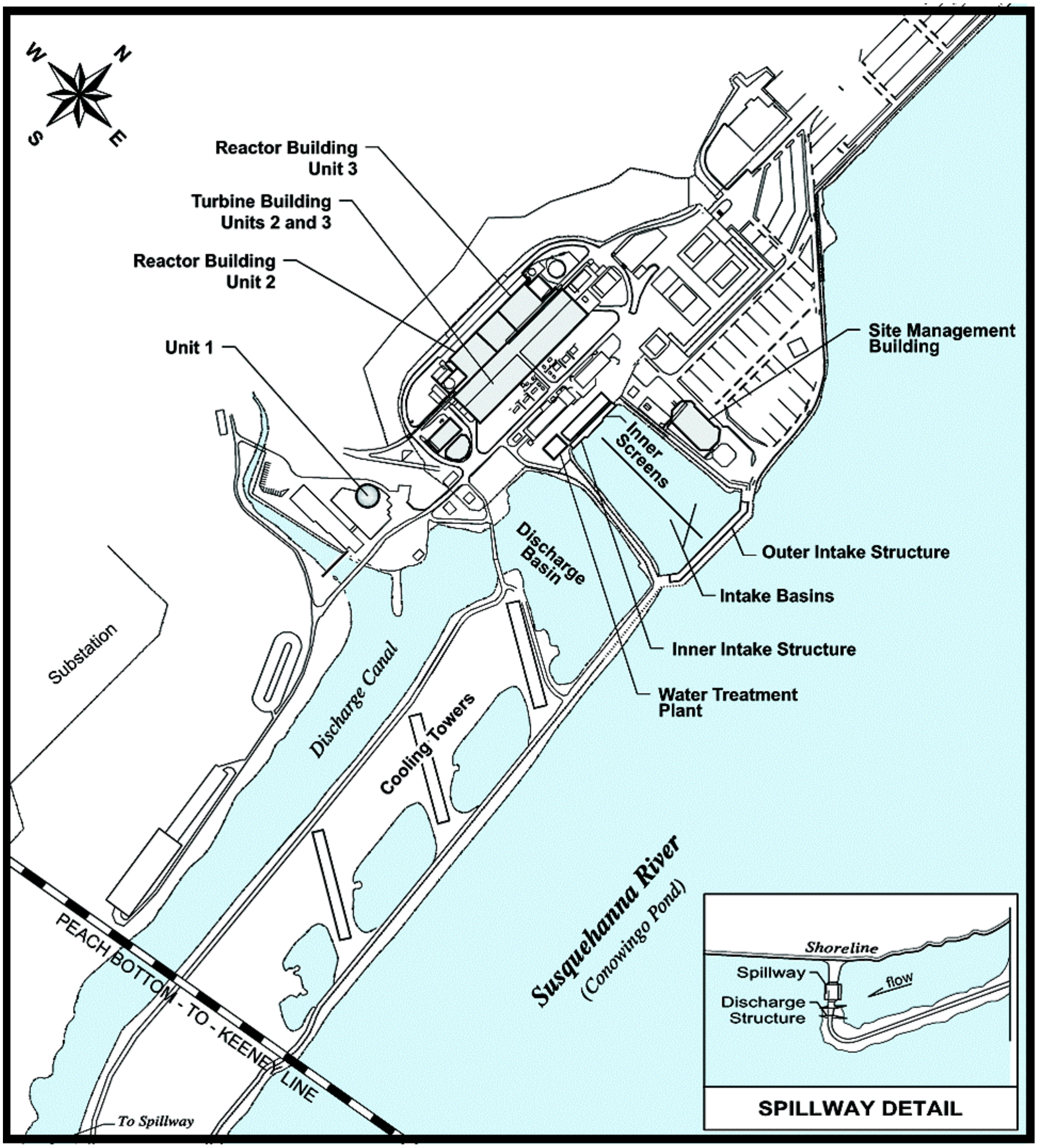
At the outer intake structure, trash racks protect 32 outer intake openings and prevent large floating debris and ice floes from reaching 24 traveling screens. The trash racks are cleaned, and the collected debris is disposed of at a permitted offsite landfill. During the winter months, an air bubbler system also operates on the inlet side of the outer screen structure to break up surface ice formation.

Located about 40 ft (12 m) behind the trash racks, traveling screens prevent fish and small debris from entering the system. Each screen panel is 10-ft (3-m) wide with a 3/8-in (1-cm) square mesh. The screens operate automatically but can also be operated manually. The screens are rotated and washed every 24 hours, but sooner if a pressure differential across the screens is detected. Trash and debris caught in the screens is sent to a permitted offsite landfill.



Source: Modified from FERC 2015 and Exelon 2018a

Figure 3-3 Conowingo Pond and Peach Bottom Site



Source: From NRC 2003a

Figure 3-4 Location of the Principal Components of the Cooling-Water Loop

From the outer intake structure, the water enters two intake basins. Each basin is 700-ft (201-m) long and 200-ft (60-m) wide. Water moves through the two intake basins and into the inner intake structure. The inner intake structure contains six circulating water pump intakes. The pump intakes are protected by traveling screens made of 3/8-in (1-cm) mesh. The traveling screens for the inner pump intakes are washed every 24 hours or when there is a pressure differential between the sides of the screen. Trash and debris caught in the screens of the outer intake structure is removed and disposed in an offsite landfill.

The six circulating water pumps, each rated at 250,000 gallons per minute (gpm) (950 m^3/min), withdraw water from the inner intake structure at a total rate of 1.5 million gpm (5,700 m^3/min). The pumps send the water to the condensers, where heat is transferred to the circulating water. Chlorine and a condenser cleaning system prevent the accumulation in the condensers of deposits and biofouling organisms. From the condensers, the now-heated water flows into a discharge basin, which is approximately 700-ft (210-m) long and 400-ft (120-m) wide. From the discharge basin, the heated cooling water flows directly into a 4700-ft (1430-m) long discharge canal.

At different times of the year, some of the water in the discharge basin may be diverted through helper cooling towers. The helper cooling towers function to lower the temperature of water by evaporating a fraction of the water that is diverted through them. The purpose of these cooling towers is to cool water from the cooling water loop before the water discharges to Conowingo Pond.

Water that has been cooled by the helper cooling towers flows into the discharge canal. There it mixes with the water that was not diverted through the cooling towers. This lowers the temperature of the water that is flowing in the discharge canal. The helper cooling towers are not used continuously throughout the year. They are operated at times and under environmental conditions as specified in Exelon's National Pollutant Discharge Elimination System permit for the Peach Bottom site.

At the end of the discharge canal, there is a submerged jet discharge structure that is used to enhance mixing of water discharged from the Peach Bottom site with the water in Conowingo Pond. The discharge velocity from the submerged jet structure to Conowingo Pond is between 5 and 8 fps (1.5 and 2.4 mps). Adverse scouring effects in Conowingo Pond have not been observed at the discharge location.

3.1.3.2 Cooling Water Loop Dredging and Sediment Removal Activities

As needed, dredging or sediment removal is conducted in front of the outer intake structure so that the rate of water flow through the intake structure remains at acceptable levels. In 2001, the U.S. Army Corps of Engineers, Baltimore District issued a permit to Peach Bottom that authorized dredging activities to remove accumulated river sediments. The permit expired in 2011 and Exelon has not performed dredging activities since. If Exelon needs to conduct dredging operations in the future, it would need to obtain any necessary permits.

As previously described, after passing through the outer intake structure, the water enters two intake basins. As the water moves through these basins, sediment suspended in the water can settle onto the bottom of the basins. Sediment in these basins is removed as needed and placed in an onsite dredging/rehandling basin. A permit is not needed to remove the sediment in the intake basins.

3.1.3.3 Auxiliary Water Systems

The Peach Bottom facility is not connected to a municipal water system and acquires all of its potable water from Conowingo Pond. A small fraction of the water from the inner intake structure is treated at a package plant onsite for use as potable water. Sanitary wastewater is treated onsite and discharged to Conowingo Pond via the discharge canal.

Water from the inner intake structure also supplies auxiliary water to service water systems. The service water systems provide the following:

- cooling water for various nonsafety-related auxiliary systems and components
- water for filling the fire protection system
- water for washing the inner intake service water rotating screens
- water for the radioactive waste (radwaste) system

In compliance with its National Pollutant Discharge Elimination System permit, Exelon discharges service water to Conowingo Pond via the discharge canal.

3.1.4 Radioactive Waste Management Systems

As a result of normal operations, equipment repairs and replacements, and normal maintenance activities, nuclear power plants routinely generate both radioactive and nonradioactive waste. Nonradioactive waste includes hazardous and nonhazardous waste. There is also a class of waste—called mixed waste—that is both radioactive and hazardous. This section describes the systems that Exelon uses to manage (i.e., treat, store, and dispose of) these wastes. This section also discusses other waste minimization and pollution prevention measures that nuclear power plants commonly employ.

The NRC licenses all nuclear plants with the expectation that they will release radioactive material to both the air and water during normal operations. However, NRC regulations require that gaseous and liquid radioactive releases from nuclear power plants meet radiation dose-based limits specified in Title 10 of *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection Against Radiation," and the as low as is reasonably achievable (ALARA) criteria in 10 CFR Part 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents." In other words, the NRC places regulatory limits on the radiation dose that members of the public can receive from a nuclear power plant's radioactive effluents. For this reason, all nuclear power plants use radioactive waste management systems to control and monitor radioactive wastes.

Peach Bottom uses the waste disposal system to collect and process radioactive materials contained in liquid, gaseous, and solid waste produced as a byproduct of plant operations. The waste disposal system assures that the dose to members of the public from radioactive effluents is reduced to levels that are ALARA in accordance with NRC's regulations.

General Design Criterion (GDC) 64 of Appendix A to 10 CFR Part 50 requires a nuclear power plant to monitor the environment for radioactive releases from normal operations. To accomplish this Exelon has a radiological environmental monitoring program (REMP) to assess the radiological impact, if any, to the public and the environment from radioactive effluents released during operations at Peach Bottom. The REMP is discussed in Section 3.1.4.5.

Nuclear power plant licenses are required, by 10 CFR 50.36a, to include technical specifications that keep releases of radioactive materials as low as is reasonably achievable. The technical specifications require Exelon to maintain an Offsite Dose Calculation Manual (ODCM) that contains the methods and parameters for calculating offsite doses resulting from liquid and gaseous radioactive effluents. These methods ensure that radioactive material discharges from Peach Bottom meet NRC and U.S. Environmental Protection Agency (EPA) regulatory dose standards. The Offsite Dose Calculation Manual also contains the requirements for the REMP (Exelon 2018d).

3.1.4.1 Radioactive Liquid Waste Management

Exelon uses waste management systems to collect, analyze, and process radioactive liquids produced at Peach Bottom. These systems reduce radioactive liquids before they are released to the environment. The Peach Bottom Units 2 and 3 liquid waste disposal system meets the design objectives of 10 CFR Part 50, Appendix I, and controls the processing, disposal, and release of radioactive liquid wastes.

The liquid waste disposal system consists of the equipment drain subsystem, the floor drain subsystem, the chemical waste subsystem, and the laundry drain subsystem. The equipment drain subsystem collects liquids from piping and equipment drains, removes radionuclides via filtration and demineralization, and returns the water for reuse after sampling via condensate storage tanks. The floor drain subsystem collects liquids from the floor drains, removes radionuclides via filtration and demineralization, and, based on quality, either (1) returns the water for reuse via the condensate storage tanks, (2) returns the water through the system for further treatment before reuse, or (3) discharges the water to the environment as a monitored release. If water quality is too poor for those methods, it is processed for disposal at an offsite facility. The chemical waste subsystem collects chemical decontamination solutions and liquids from the laboratory floor drains, processes the liquids through filtration and dilution, and routes them through the floor drain subsystem for ultimate treatment and disposal. The laundry drain subsystem collects liquids from the laundry drains, cask washdown, and personnel decontamination station drains; processes the liquids via filtration; and, depending on chemical and radiological content, releases the liquids to the environment after sampling or processes the liquids for offsite shipment and disposal (Exelon 2018a).

Exelon's use of these radioactive waste systems and the procedural requirements in the Offsite Dose Calculation Manual assures the NRC that the dose from radioactive liquid effluents at Peach Bottom complies with NRC and EPA regulatory dose standards.

Exelon calculates dose estimates for members of the public using radioactive liquid and gaseous effluent release data and atmospheric and aquatic transport models. Peach Bottom Unit 2 and Unit 3 share the liquid waste treatment system. Generally, Exelon allocates all liquid releases on a 50/50 basis to each unit. Peach Bottom's annual radioactive effluent release reports contain a detailed presentation of the radioactive liquid effluents released from Peach Bottom and the resultant calculated doses. The NRC staff reviewed 5 years of radioactive effluent release data from 2013 through 2017 (Exelon 2014b, 2015c, 2016b, 2017f, 2018f). A 5-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance that can affect the generation of radioactive effluents. The NRC staff compared the data against NRC dose limits and looked for indications of adverse trends (i.e., increasing dose levels) over the period spanning from 2013 through 2017. Since the radioactive liquid effluents are released from common areas shared by both Unit 2 and Unit 3, the resultant calculated doses presented are divided in half to evaluate compliance with the Appendix I to 10 CFR Part 50 dose criteria. The following summarizes the calculated doses from radioactive liquid effluents released from Peach Bottom Units 2 and 3 during 2017:

Peach Bottom Unit 2 in 2017

- The total-body dose to an offsite member of the public from Peach Bottom Unit 2 radioactive effluents was 3.06×10^{-6} millirem (mrem) (3.06×10^{-8} millisievert (mSv)), which is well below the 3 mrem (0.03 mSv) dose criterion in Section II.A of Appendix I to 10 CFR Part 50.
- The maximum organ dose (liver) to an offsite member of the public from Peach Bottom Unit 2 radioactive effluents was 3.50×10^{-6} mrem (3.50×10^{-8} millisievert (mSv)), which is well below the 10 mrem (0.1 mSv) dose criterion in Section II.A of Appendix I to 10 CFR Part 50.

Peach Bottom Unit 3 in 2017

- The total-body dose to an offsite member of the public from Peach Bottom Unit 3 radioactive effluents was 3.06×10^{-6} millirem (mrem) (3.06×10^{-8} millisievert (mSv)), which is well below the 3 mrem (0.03 mSv) dose criterion in Section II.A of Appendix I to 10 CFR Part 50.
- The maximum organ dose (liver) to an offsite member of the public from Peach Bottom Unit 3 radioactive effluents was 3.50×10^{-6} mrem (3.50×10^{-8} millisievert (mSv)), well below the 10 mrem (0.1 mSv) dose criterion in Appendix I, Sec II, paragraph A to 10 CFR Part 50.

The NRC staff's review of Exelon's radioactive liquid effluent control program shows that the applicant maintained radiation doses to members of the public that were within NRC's and EPA's radiation protection standards as contained in Appendix I to 10 CFR Part 50, 10 CFR Part 20, and Title 40, "*Protection of Environment*," of the *Code of Federal Regulations* (40 CFR) Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations." The NRC staff observed no adverse trends in the dose levels.

Routine plant refueling and maintenance activities at Peach Bottom will continue during the subsequent license renewal term. Based on Exelon's past performance in operating a radioactive waste system at Peach Bottom that maintains ALARA doses from radioactive liquid effluents, the NRC staff expects Exelon will maintain similar performance during the subsequent license renewal term.

3.1.4.2 Radioactive Gaseous Waste Management

The gaseous radioactive waste management system collects and processes the gaseous radioactive wastes generated at Peach Bottom. The gaseous waste management system consists of the gaseous radwaste/off-gas subsystem and the gland seal steam exhauster subsystem. The gaseous radwaste/off-gas subsystem collects and delays release of noncondensable radioactive gases removed via air ejectors from the main condensers while the gland seal steam exhauster system processes airborne radioactive releases from all other plant sources. Radioactive gases traveling through these subsystems are filtered, sent through adsorber beds for capture, and held up to allow time for decay. These waste gases are monitored for radioactivity and released to the atmosphere through a shared vent stack located above the reactor building roof. Another potential source of gaseous radioactive waste is from the reactor building ventilation system, which serves the reactor enclosures and common refueling area. This system is monitored, and if radiation is detected in the exhaust gases, it is routed through a standby gas treatment system and released through the shared vent stack once properly treated (Exelon 2018a).

Exelon's use of this gaseous radioactive waste system and adherence to the procedural requirements in the Offsite Dose Calculation Manual ensure that the dose from radioactive gaseous effluents complies with NRC and EPA regulatory dose standards.

Exelon calculates dose estimates for members of the public using radioactive gaseous effluent release data and atmospheric and aquatic transport models. Unit 2 and Unit 3 share the gaseous waste treatment system, and generally Exelon allocates all gaseous releases on a 50/50 basis to each unit. Peach Bottom's annual radioactive effluent release reports contain a detailed presentation of the radioactive gaseous effluents released from Peach Bottom and the resultant calculated doses. The NRC staff reviewed 5 years of radioactive effluent release data from 2013 through 2017 (Exelon 2014b, 2015c, 2016b, 2017f, 2018f). A 5-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant—such as refueling outages, routine operation, and maintenance—that can affect the generation of radioactive effluents. The NRC staff compared the data against NRC dose limits and looked for indications of adverse trends (i.e., increasing dose levels) over the period of 2013 through 2017. Since the radioactive gaseous effluents are released from a common vent stack shared by both Unit 2 and Unit 3, the resultant calculated doses presented in the effluent release are divided in half to evaluate compliance with the Appendix I to 10 CFR Part 50 dose criteria. The following summarizes the calculated doses from radioactive gaseous effluents released from Peach Bottom during 2017:

Peach Bottom Unit 2 in 2017

- The air dose at the site boundary from gamma radiation in gaseous effluents from Peach Bottom Unit 2 was 1.10×10^{-1} millirad (mrad) (1.10×10^{-3} milligray), which is well below the 10 mrad (0.1 milligray) dose criterion in Section II.B.1 of Appendix I to 10 CFR Part 50.
- The air dose at the site boundary from beta radiation in gaseous effluents from Peach Bottom Unit 2 was 7.50×10^{-2} millirad (mrad) (7.50×10^{-4} milligray) dose, which is well below the 20 mrad (0.2 milligray) dose criterion in Section II.B.1 of Appendix I to 10 CFR Part 50.
- The dose to an organ (bone) from radioactive iodine, radioactive particulates, and carbon from Peach Bottom Unit 2 was 2.95×10^{-1} mrem (5.90×10^{-3} mSv), which is below the 15 mrem (0.15 mSv) dose criterion in Section II.C of Appendix I to 10 CFR Part 50.

Peach Bottom Unit 3 in 2017

- The air dose at the site boundary from gamma radiation in gaseous effluents from Peach Bottom Unit 3 was 1.10×10^{-1} millirad (mrad) (1.10×10^{-3} milligray), which is well below the 10 mrad (0.1 milligray) dose criterion in Section II.B.1 of Appendix Ito 10 CFR Part 50.
- The air dose at the site boundary from beta radiation in gaseous effluents from Peach Bottom Unit 3 was 7.50×10^{-2} millirad (mrad) (7.50×10^{-4} milligray) dose, which is well below the 20 mrad (0.2 milligray) dose criterion in Section II.B.1 of Appendix I to 10 CFR Part 50.

- The dose to an organ (bone) from radioactive iodine, radioactive particulates, and carbon from Peach Bottom Unit 3 was 2.95×10^{-1} mrem (5.90×10^{-3} mSv), which is below the 15 mrem (0.15 mSv) dose criterion in Section II.C of Appendix Ito 10 CFR Part 50.

The NRC staff's review of Peach Bottom's radioactive gaseous effluent control program showed radiation doses to members of the public that were well below NRC and EPA radiation protection standards contained in Appendix I to 10 CFR Part 50, 10 CFR Part 20, and 40 CFR Part 190. NRC staff observed no adverse trends in the dose levels.

The routine plant refueling and maintenance activities at Peach Bottom will continue during the subsequent license renewal term. Exelon's past performance operating the radioactive waste system demonstrates that it is able to maintain ALARA doses from radioactive gaseous effluents. Based on this record of past performance, the NRC staff expects similar performance during the subsequent license renewal term.

3.1.4.3 Radioactive Solid Waste Management

Low-level solid radioactive wastes (LLRW) at Peach Bottom are processed, packaged, and stored for subsequent shipment and offsite burial by the solid radioactive waste management system. Solid radioactive wastes and potentially radioactive wastes include spent resin material, filter sludges, contaminated rags, clothing, and paper products, contaminated reactor internal parts, and other processing media from the liquid radwaste disposal system. The contaminated reactor internal parts are removed from the core and either stored in an approved onsite storage facility or shipped offsite for storage and disposal. The spent resin materials and filter sludges are dewatered and temporarily stored onsite before being shipped offsite for storage and disposal based on radioactivity classification. The contaminated rags, clothing, and paper products are collected and packaged onsite before being shipped offsite for storage and disposal, also based on radioactivity classification (Exelon 2018a).

Peach Bottom sends LLRW to three licensed processing and disposal sites: (1) EnergySolutions in Clive, UT, (2) EnergySolutions Bear Creek facility in Oak Ridge, TN, and (3) EnergySolutions Gallaher Road facility in Kingston, TN.

In 2017, a total of 56 LLRW shipments were made from Peach Bottom to the above listed processing and disposal sites. The total volume and radioactivity of LLRW shipped offsite in 2017 was 3.46×10^{4} cubic feet (ft^3) (9.81×10^{2} cubic meters (m^3)) and 2.79×10^{2} curies (Ci) (1.03×10^{7} megabecquerels (MBq)), respectively (Exelon 2018f). Routine plant operation, refueling outages, and maintenance activities that generate radioactive solid waste will continue during the subsequent license renewal term. Exelon will continue to generate radioactive solid waste and ship it offsite for disposal during the subsequent license renewal term (Exelon 2018a).

3.1.4.4 Radioactive Waste Storage

At Peach Bottom, low-level radioactive waste is stored temporarily onsite before being shipped offsite for treatment or disposal at licensed LLRW treatment and disposal facilities. As indicated in its environmental report and observed by NRC staff at the site audit, Peach Bottom has sufficient existing capability to temporarily store all generated LLRW onsite. No additional construction of onsite storage facilities is necessary for LLRW storage during the period of extended operation, as Exelon states it has contracts in place to ship LLRW offsite for disposal (Exelon 2018a).

Peach Bottom is also licensed to receive Class B and C LLRW from the Limerick Generating Station. Classification criteria for the different classes of waste are described in 10 CFR 61.55, "Waste classification." There are no Limerick wastes currently stored at Peach Bottom, and no current plans to do so unless offsite storage and disposal becomes unavailable in the future.

Peach Bottom Unit 2 and Unit 3 each store spent fuel in a spent fuel pool and in an onsite independent spent fuel storage installation (ISFSI). The ISFSI has a general license under 10 CFR Part 72.210. The ISFSI safely stores spent fuel onsite in licensed and approved dry cask storage containers. Exelon projects that the current ISFSI will be full on or before the year 2020 (Exelon 2018a). To accommodate storage of spent fuel through the current license terms for both Units 2 and 3 (2033 and 2034, respectively), Exelon is expanding the current ISFSI storage pad and expects to complete construction in 2019. Exelon also stated that spent fuel management beyond 2034 may be at a second onsite ISFSI pad or at an offsite facility if one becomes available. Exelon states that it has adequate space onsite to accommodate the construction of a new ISFSI pad if necessary (Exelon 2018c).

3.1.4.5 Radiological Environmental Monitoring Program

Exelon is required by its TSs to conduct a REMP to assess the radiological impact, if any, to the public and the environment from the operations at Peach Bottom.

The REMP measures the aquatic, terrestrial, and atmospheric environment for ambient radiation and radioactivity. Monitoring is conducted for the following: direct radiation, air, water, groundwater, milk, local agricultural crops, fish, and sediment. The REMP also measures background radiation (i.e., cosmic sources, global fallout, and naturally occurring radioactive material, including radon).

In addition to the REMP, Peach Bottom has an onsite groundwater protection program designed to monitor the onsite plant environment for detection of leaks from plant systems and pipes containing radioactive liquid (Exelon 2018a). Information on the groundwater protection program is contained in Section 3.5.2, "Groundwater Resources," of this SEIS.

As discussed in Section 3.5.2, spills of water containing tritium have been detected in the groundwater on the Peach Bottom site in recent years. Exelon identified that tritium was leaking from the Unit 3 reactor building and subsequently took corrective action to seal the floor to prevent future tritium leaks. A tritium plume continues to exist beneath the Peach Bottom plant complex. The plume is attributable to previous inadvertent spills and leaks from the plant. The maximum tritium concentrations in onsite groundwater monitoring wells at Peach Bottom are less than the drinking water standard of 20,000 picocuries per liter (pCi/L), and tritium is not detectable in the surface waters of Conowingo Pond. Further, tritium is not detectable in wells at or near the site property boundary. The tritium plume does not extend beyond the confines of the plant property boundary and the plume does not threaten any offsite water supply wells given the direction of groundwater flow. Additionally, Exelon's latest groundwater monitoring results show that gross alpha and gross beta concentrations are consistent with background concentrations. No strontium (i.e., strontium-89 or strontium-90) was detected in any samples, and there were no detections of plant-produced gamma-emitting radionuclides in site groundwater samples (Exelon 2018d).

The NRC staff reviewed 5 years of annual radiological environmental monitoring data from 2013 through 2017 (Exelon 2014a, 2015b, 2016a, 2017a, 2018d). A 5-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance that can affect the generation and release of radioactive effluents into the environment. The NRC staff looked for indications of adverse trends (i.e., increasing radioactivity levels) over the period of 2013 through 2017.

Based on the REMP and inadvertent release data the NRC staff finds no apparent increasing trend in concentration or pattern indicating either a new inadvertent release or persistently high tritium or other radionuclide concentrations that might indicate an ongoing inadvertent release from Peach Bottom Units 2 and 3. The groundwater monitoring program at Peach Bottom is robust and any future leaks that might occur during the license renewal period should be readily detected. The data show that Exelon monitors, characterizes, and actively remediates all spills and that there were no significant radiological impacts to the environment from operations at Peach Bottom.

3.1.5 Nonradioactive Waste Management Systems

Like any other industrial facility, nuclear power plants generate wastes that are not contaminated with either radionuclides or hazardous chemicals.

Peach Bottom has a nonradioactive waste management system to handle its nonradioactive hazardous and nonhazardous wastes. The nonradioactive waste management system receives and processes nonradiological wastes including hazardous, nonhazardous, and universal wastes. Exelon manages wastes in accordance with applicable Federal and State regulations as implemented through its corporate procedures. Listed below is a summary of the types of waste materials generated and managed at Peach Bottom.

- Hazardous Wastes: Peach Bottom is classified as a small-quantity, hazardous waste generator. The amounts of hazardous wastes generated are only a small percentage of the total wastes generated. These wastes consist of spent solvents, articles containing mercury, and off-specification commercial chemical products and paints. Peach Bottom has contracts with vendors to remove and dispose of these hazardous wastes offsite (Exelon 2018a).
- Nonhazardous Wastes: These include waste/used oil, grease, antifreeze, adhesives, and other petroleum-based liquids. Peach Bottom has contracts with vendors to remove and dispose of these nonhazardous wastes offsite (Exelon 2018a).
- Universal Wastes: These include batteries, pesticides, fluorescent lamps, oil-based finishes, and photographic solutions. Peach Bottom has contracts with universal waste vendors for proper transport and disposal of these wastes (Exelon 2018a).

Peach Bottom also manages nonradioactive plant wastewaters in accordance with the National Pollutant Discharge Elimination System (NPDES) permit (PA0009733) issued by the Pennsylvania Department of Environmental Protection. Peach Bottom sends sanitary waste to an onsite sewage treatment plant. The sewage treatment plant is an extended aeration type with sludge settling and chlorination facilities. The sewage treatment plant discharges liquid effluents to the circulating water discharge canal, which eventually discharges in Conowingo Pond (Exelon 2018a).

3.1.6 Utility and Transportation Infrastructure

The utility and transportation infrastructure at a nuclear power plant typically interfaces with the public infrastructure systems available in the region. Such public infrastructure includes utilities, such as suppliers of electricity, fuel, and water, as well as roads and railroads that provide access to the site. The following sections briefly describe the existing utility and transportation infrastructure at Peach Bottom. Unless otherwise cited, the source of the Peach Bottom site-specific information in this section is Exelon's environmental report submitted as part of its subsequent license renewal application (Exelon 2018a).

3.1.6.1 Electricity

Nuclear power plants generate electricity for other users; however, they also use their own generated electricity to operate. In the event of a malfunction or interruption of onsite nuclear power generation at Peach Bottom, the facility would depend on offsite power sources to provide power to engineered safety features and emergency equipment. If both Peach Bottom nuclear power generation and offsite power sources fail, the facility will use planned independent backup power sources.

3.1.6.2 Fuel

Under its current renewed facility operating licenses, Peach Bottom Units 2 and 3 are licensed for fuel that is slightly enriched uranium dioxide (up to 5.0 percent by weight uranium-235). Exelon operates the reactors at an equilibrium core maximum fuel discharge burnup rate of 62,000 megawatt-days per metric ton uranium (MWd/MTU). Refueling occurs approximately every 24 months on a partial, roughly one-third, batch basis (Exelon 2018a).

Peach Bottom Unit 2 and Unit 3 each have a spent fuel pool that provide a total of 3,814 locations for the storage of new and spent fuel assemblies. The inventory of fuel assemblies in each pool is required by the TSs to be maintained to allow a full core offload at any time. Spent nuclear fuel is also stored onsite in an ISFSI (see Section 3.1.4.4, "Radioactive Waste Storage," of this SEIS) (Exelon 2018a).

3.1.6.3 Water

In addition to cooling and auxiliary water (previously described in detail in Section 3.1.3), nuclear power plants require potable water for sanitary and everyday uses by personnel (e.g., drinking, showering, cleaning, laundry, toilets, and eye washes). The Peach Bottom facility is not connected to a municipal water system and acquires all its potable water from Conowingo Pond.

3.1.6.4 Transportation Systems

All nuclear power plants are served by controlled access roads. In addition to roads, many plants also have railroad connections for moving heavy equipment and other materials. The Peach Bottom site transportation network includes U.S. highways, interstate highways, multilane divided State highways, and local streets. Section 3.10.6, "Local Transportation," describes these systems in more detail.

3.1.6.5 Power Transmission Systems

For license renewal and subsequent license renewal, the NRC (2013a) considers the impacts of the continued operation of those power transmission lines that connect the nuclear power plant to the substation where it feeds electricity into the regional power distribution system. The NRC also considers the impacts of the continued operation of the transmission lines that supply outside power to the nuclear plant from the grid. The transmission lines that are in scope for the Peach Bottom subsequent license renewal environmental review are onsite and are not accessible to the general public. Section 3.11.4, "Electromagnetic Fields," describes these transmission lines in more detail. (Exelon 2018a)

3.1.7 Nuclear Power Plant Operations and Maintenance

Exelon's Peach Bottom maintenance activities include inspection, testing, and surveillance to maintain the current licensing basis of the facility and to ensure compliance with environmental and safety requirements. Various programs and activities are currently in place at Peach Bottom to maintain, inspect, and monitor the performance of facility structures, components, and systems. These programs and activities include but are not limited to (1) in-service inspections of safety-related structures, systems, and components, (2) a quality assurance program, (3) a fire protection program, and (4) monitoring of radioactive and nonradioactive water chemistry.

Additional Peach Bottom maintenance programs include those implemented to meet technical specification surveillance requirements and those implemented in response to NRC generic communications. Such additional programs include various periodic maintenance, testing, and inspection procedures necessary to manage the effects of aging on structures and components. Exelon performs certain program activities during the operation of the units and performs others during scheduled refueling outages. Reactor refueling at Peach Bottom occurs on an approximately 24-month cycle (Exelon 2018a).

3.2 Land Use and Visual Resources

Section 2.2.1, 2.2.8.3, and 2.2.8.4 of NUREG-1437, Supplement 10 (NRC 2003a), describe land use and visual resources at Peach Bottom Units 2 and 3. This information is incorporated here by reference.

3.2.1 Land Use

Peach Bottom Units 2 and 3 are located in Peach Bottom Township, York County, PA, on the west side of Conowingo Pond. The plant site is approximately 19 mi (31 km) southwest of Lancaster, PA; 30 mi (48 km) southeast of York, PA; and 38 mi (61 km) north of Baltimore, MD. York is the county seat of York County.

3.2.1.1 Onsite Land Use

Land at Peach Bottom Units 2 and 3 is zoned for industrial use. Peach Bottom Units 2 and 3 and associated structures and features occupy approximately 769 ac (311 ha) (620 ac plus 149 ac of fill and other materials within Conowingo Pond to create additional land, the intake and discharge canals, and holding ponds). Most land use onsite in the undeveloped areas includes deciduous forest, open water, cultivated crops, and barren land. The areas within the Peach Bottom boundary that have been developed to support plant operations are the largest land use category, with approximately 17 percent of the site classified as developed (Exelon 2018a).

3.2.1.2 Coastal Zone

Section 307(c)(3)(A) of the Coastal Zone Management Act (16 USC 1456(c)(3)(A)) requires that applicants for Federal licenses who conduct activities in a coastal zone provide a certification that the proposed activity complies with the enforceable policies of the State's coastal zone program. Peach Bottom Units 2 and 3, located in York County, is not within the Pennsylvania coastal zone, due to its distance (approximately 50 mi (80 km)) from the coastal zone, and does not affect the Pennsylvania coastal zone. However, the Maryland coastal zone extends to Conowingo Pond from which Peach Bottom Units 2 and 3 withdraw and discharge water. The Maryland Department of the Environment issued the Certification of Compliance with the Maryland Coastal Zone Management Program.

In response to information provided by Exelon, the Maryland Department of the Environment acknowledged on June 13, 2017, that no new construction activities will be undertaken in connection with the renewed licenses. Based on this consideration, the Maryland Department of the Environment stated that it “has no concerns with the proposed license renewal and the State's initial consistency determination would continue in effect and be applicable to the Second License Renewal Project” (Exelon 2018a).

3.2.1.3 Offsite Land Use

Overall, the area surrounding Peach Bottom 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.

No national parks or other Federal reserved areas have been identified within 6 mi (10 km) of Peach Bottom; however, two protection areas for management of rare plant species were established by Philadelphia Electric Company (PECO) in cooperation with the Maryland Nature Conservancy. The Rock Spring Powerline Natural Area is a 103-ac (42-ha) parcel approximately 7 mi (11 km) southeast of the site near Rock Springs, MD, and the Richardsmere Powerline Natural Area near Richardsmere, MD, is a 55-ac (22-ha) parcel approximately 10 mi (16 km) southeast of the Peach Bottom site.

3.2.2 Visual Resources

Peach Bottom Units 1, 2 and 3 are visible from Conowingo Pond and the surrounding area located to the east. The terrain on either side of the pond is steeply hilly. A rock cliff, created when a hill was cut away for the power plant, is located immediately behind the Peach Bottom site. The hill rises to an elevation of about 300 ft (91 m) above the river.

The Peach Bottom site can be seen from the public access boat ramp, picnic areas, and private residences along the shores of Conowingo Pond. The most visible features are the Peach Bottom Units 2 and 3 reactor buildings, which are rectangular and lower than the 300-ft (91-m) high hill behind the site. 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. Other features include the 500-ft (152-m) main stack, and the two substations (north and south) located at the top of the cliff west of the reactor buildings. Cliffs rising on the west side of Conowingo Pond, trees, and vegetation shield the main plant structures from view from the west, although the stack and meteorological tower are tall enough to be seen from public roads and rural residences.

3.3 Meteorology, Air Quality, and Noise

This section describes the meteorology, air quality, and noise environment in the vicinity of Peach Bottom.

3.3.1 Meteorology and Climatology

The climate of Pennsylvania is heavily influenced by Lake Erie to the northwest, the Appalachian Mountains that cut across the center of the State, and the Atlantic Ocean's moderating effect on the State's eastern coastal plain. Consequently, Pennsylvania spans two major climate zones. The northern half of the State is predominantly characterized by a humid continental climate dominated by tropical air masses in summer and polar air masses in winter. The southern half of the State, where Peach Bottom is located, is predominantly characterized by a humid subtropical climate dominated by relatively hotter summers, milder winters, and year-round precipitation (Frankson et al. 2017; NOAA 2013, NRC 2003a).

The NRC staff obtained climatological data from the Harrisburg International Airport (KMDT) weather station. This station is approximately 40 mi (64 km) northwest of Peach Bottom and is used to characterize the region's climate because of its relative location and long period of record. Exelon also maintains a meteorological monitoring system comprised of the Main Meteorological Tower, located on the bluff north and west of Peach Bottom Units 2 and 3, and the River Tower, located in Conowingo Pond approximately 3,500 ft (1,070 m) from the Main Meteorological Tower and perpendicular to the western river bank. The Main Meteorological Tower instrumentation measures wind speed and direction, ambient and differential temperatures, and precipitation. The River Tower instrumentation measures wind speed and direction (Exelon 2018a; Exelon 2018c).

The mean annual temperature for a 77-year period of record (1941–2017) at the KMDT station is 53.1 °F (11.7 °C), with the mean monthly temperature ranging from a low of 30.1 °F (-1.1 °C) in January to a high of 75.6 °F (24.2 °C) in July. The average annual precipitation for the same 77-year period of record at the KMDT station is 41.3 in. (105 cm), with mean monthly precipitation ranging from a low of 2.6 in. (6.6 cm) in February to a high of 4.1 in. (10.4 cm) in May. The mean annual wind speed during a 26-year period of record (1992–2017) at the KMDT station is 7.4 mph (11.9 km/h), with the prevailing wind being from the northwest (NCEI 2018).

Pennsylvania is subject to a strong seasonal cycle and is often affected by extreme events such as floods, hurricanes, heat and cold waves, droughts, severe thunderstorms, snow and ice storms, and nor'easters (Frankson et al. 2017; NOAA 2013). In the past 68 years (1950–2018), the following number of severe weather events have been reported in Lancaster County and York County, PA (NCEI 2019):

- Tornado: 32 events in Lancaster County, 28 events in York County
- Flood: 49 events in Lancaster County, 42 events in York County
- Thunderstorm Wind: 428 events in Lancaster County, 415 events in York County

3.3.2 Air Quality

Under the Clean Air Act (CAA) (42 USC 7401), the EPA has set primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50, "National Primary and Secondary Ambient Air Quality Standards") for six common criteria pollutants to protect sensitive populations and the environment: carbon monoxide, lead, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter (PM). NAAQs further categorizes particulate matter under two sizes—PM10 (diameter of 10 micrometers or less) and PM2.5 (diameter of 2.5 micrometers or less). Table 3-1 presents the NAAQS for the six criteria pollutants.

Table 3-1 Ambient Air Quality Standards

Pollutant	Averaging Time	National Standard Concentration
Carbon Monoxide (CO)	8-hour	9 ppm (primary standard)
	1-hour	35 ppm (primary standard)
Lead (Pb)	Rolling 3-month average	0.15 µg/m^3
Nitrogen Dioxide (NO_2)	1-hour	100 ppb (primary standard)
	Annual	53 ppb (primary and secondary standard)
Ozone (O_3)	8-hour	0.070 ppm (primary and secondary standard)[(a)]
Particulate matter less than 2.5 µm ($PM_{2.5}$)	Annual	12 µg/m^3 (secondary) 15 µg/m^3 (secondary)
	24-hour	35 µg/m^3 (primary and secondary standard)
Particulate matter less than 10 µm (PM_{10})	24-hour	150 µg/m^3 (primary and secondary standard)
Sulfur Dioxide (SO_2)	1-hour	75 ppb (primary standard)
	3-hour	0.5 ppm (secondary standard)

Key: ppb = parts per billion; ppm = parts per million; µg/m^3 = micrograms per cubic meter. To convert ppb to ppm, divide by 1000.

(a) Final rule signed October 1, 2015 and effective December 28, 2015. The previous (2008) ozone (O_3) standards additionally remain in effect in some areas.

Primary standards provide public health protection, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

Source: EPA 2018c

With respect to meeting NAAQS, the EPA designates areas that meet the standards as areas of attainment and areas that do not meet the standards as areas of nonattainment. Areas for which there is insufficient data to determine attainment or nonattainment, the EPA designates as unclassifiable. Areas that once did not meet the standards but now do meet the standards, the EPA designates as maintenance areas; maintenance areas are under a 10-year monitoring plan to maintain the attainment designation status. States bear the primary responsibility for ensuring attainment and maintenance under NAAQS. Under Section 110 of the Clean Air Act (CAA) (42 U.S.C. 7401) and related provisions, States must submit, for EPA approval, State implementation plans (SIPs) that provide for the timely attainment and maintenance of NAAQS.

In Pennsylvania, air quality designations are made at the county level. For planning and maintaining ambient air quality under NAAQS, the EPA has developed air quality control regions. Air quality control regions are intrastate or interstate areas that share a common airshed. Peach Bottom is located partly in Lancaster County and partly in York County, both of which are within the EPA's South Central Pennsylvania Intrastate Air Quality Control Region (40 CFR 81.105, "South Central Pennsylvania Intrastate Air Quality Control Region"). This air quality control region consists of eight Pennsylvania counties: Adams, Cumberland, Dauphin, Franklin, Lancaster, Lebanon, Perry, and York. With respect to meeting NAAQS, EPA designates Lancaster County as unclassifiable/attainment or better than national standards for all criteria pollutants. EPA similarly designates York County as unclassifiable/attainment or better than national standards for all criteria pollutants, with the exception of sulfur dioxide, which has not yet been designated. EPA intends to designate York County with respect to the 2010 sulfur dioxide primary standard by December 31, 2020 (40 CFR Section 81.339, "Pennsylvania"). The nearest designated nonattainment area (for the 2015 (8-hour) ozone standard) is Harford County, MD, approximately 2.6 mi (4.4 km) from Peach Bottom (EPA 2019c).

Under the Clean Air Act, Title V, "Permits," requires States to develop and implement an air pollution permit program. The Pennsylvania Department of Environmental Protection regulates Peach Bottom's nonradioactive air pollutant emissions through the State Only Operating Permit No. 67-05020 (also referred to as the synthetic minor operating permit) (Exelon 2018a, PDEP 2014a). The Pennsylvania Department of Environmental Protection issued the Peach Bottom Units 2 and 3 synthetic minor operating permit in November 2014, and this permit will expire in 2019 (Exelon 2018a, PDEP 2014a). Regulated nonradioactive air pollutant emission sources at Peach Bottom Units 2 and 3 include auxiliary boilers, emergency diesel generators, emergency water pumps, and cooling towers (Exelon 2018a). Table 3-2 below lists these permitted air pollutant emission sources and their associated air permit specified conditions.

Table 3-2 Permitted Air Emission Sources at Peach Bottom Units 2 and 3

Emission Source	Air Permit Condition*
Two 50.5 MMBTU/ hour auxiliary boilers used for space heating and to help with unit startups Four emergency diesel generators located at Units 2 and 3 One emergency generator located at the Administration Building One diesel-driven emergency fire water pump Three emergency water pumps used for cooling water circulation. Three cooling tower banks.	Total collective annual emissions limited to: - 100 tons/year of SOx, NOx, CO, PM_{10}, and $PM_{2.5}$ - 50 tons/year of VOCs - 10 tons/year of any individual HAP - 25 tons/year of total combined HAPs - 100,000 tons/year of GHG emissions, expressed as CO_2e

Key: CO = carbon monoxide, CO_2e = carbon dioxide equivalent, GHG = greenhouse gas emission, HAP = hazardous air pollutant, MMBTU = million metric British Thermal Unit, NOx = nitrogen oxides, PM = particulate matter SOx = sulfur oxides, VOC = volatile organic compounds

* Compliance with eissions 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. Compliance with emissions limits is demonstrated through reporting of the operating hours and fuel usage amounts for the various sources and demonstrating that these fall within the operating limits calculated in Appendix A of the permit.

Source: Exelon 2018a, PDEP 2014a

In addition to the permitted sources listed above in Table 3-2, Exelon has identified four new sources of emissions that have been added at Peach Bottom (one emergency water pump and three Flex Building emergency generators). Exelon intends to request that these new emission sources be incorporated into Peach Bottom's synthetic minor operating permit when it is renewed in 2019 (Exelon 2018a).

Table 3-3 shows annual emissions from permitted sources at Peach Bottom Units 2 and 3. According to the 2014 National Emissions Inventory, estimated annual emissions in tons per year for York County are approximately 18,700 (sulfur dioxide), 26,800 (nitrogen oxides); 56,700 (carbon monoxide), 12,000 (particulate matter less than 10 microns), 22,000 (volatile organic compounds), and 510 (hazardous air pollutants). Similarly, estimated annual emissions in tons per year for Lancaster County are approximately 970 (sulfur dioxide), 14,100 (nitrogen oxides), 71,300 (carbon monoxide), 16,900 (particulate matter less than 10 microns), 26,800 (volatile organic compounds), and 640 (hazardous air pollutants) (EPA 2019b). The contribution of air emissions from permitted sources at Peach Bottom Units 2 and 3 constitute 0.1 percent or less of either county's total annual emissions of these pollutants. Greenhouse gas emissions from operation of Peach Bottom Units 2 and 3 are discussed in Section 4.15.3, "Greenhouse Gas Emissions and Climate Change," of this SEIS.

Table 3-3 Estimated Air Pollutant Emissions from Peach Bottom Units 2 and 3

			Emissions (tons/year)				
Year	SO_x	NO_x	CO	PM_{10}	$PM_{2.5}$	VOCs	HAPs
2013	0.92	30.6	9.98	0.99	0.68	1.16	0.37
2014	0.10	14.2	2.45	0.57	0.23	0.26	0.40
2015	0.09	15.2	3.09	0.50	0.25	0.34	0.30
2016	0.09	15.9	3.26	0.52	0.26	0.35	0.31
2017	0.09	16.5	3.38	0.54	0.26	0.36	0.32

CO = carbon monoxide, HAPs = hazardous air pollutants, NOx = nitrogen oxides, SO_2 = sulfur dioxide, PM_{10} = particulate matter less than 10 micrometers, $PM_{2.5}$ = particulate matter less than 2.5 micrometers, VOC = VOC = volatile organic compounds. To convert tons per year to metric tons per year, multiply by 0.90718.

Source: Exelon 2018c

The EPA promulgated the Regional Haze Rule to improve and protect visibility in national parks and wilderness areas by protecting them from haze, which is caused by numerous, diverse air pollutant sources located across a broad region (40 CFR 51.308–309). Specifically, 40 CFR 81 Subpart D, "Identification of Mandatory Class I Federal Areas Where Visibility Is an Important Value," lists mandatory Federal areas where visibility is an important value. The Regional Haze Rule requires States to develop implementation plans to reduce visibility impairment at Class I Federal areas.

The nearest Class 1 Federal area to Peach Bottom is the Brigantine National Wilderness Area, located approximately 100 miles (160 km) to the east. Federal land management agencies that administer Federal Class I areas consider an air pollutant source that is located greater than 31 mi (50 km) away to have negligible impacts on these areas if the total SO_2, NO_X, PM10, and sulfuric acid annual emissions from the source are less than 500 tons per year (70 FR 39104, NRR 2010). Given the distance of Peach Bottom to Class I areas and the air emissions presented in Table 3-3, there is little likelihood that ongoing activities at Peach Bottom adversely affect air quality and air quality-related values (e.g., visibility or acid deposition) in any such designated area.

3.3.3 Noise

Section 2.2.8.4 of NUREG-1437, Supplement 10, described general noise conditions at Peach Bottom Units 2 and 3 for the first renewal (NRC 2003a). This information is incorporated here by reference.

Noise from Peach Bottom Units 2 and 3 can be heard at the public access boat ramp and picnic areas immediately upstream of the plant, and from private residences along the shores of Conowingo Pond. In general, noise can be facilitated by Conowingo Pond under calm wind conditions or when the wind is blowing from Peach Bottom. Noise from Peach Bottom Units 2 and 3 is generally not an issue at sensitive noise receptors near the plant due to trees, other vegetation, and attenuation by distance. In addition, cliffs, vegetation, and trees largely screen residents living to the west from noise generated at Peach Bottom Units 2 and 3.

3.4 Geologic Environment

This section describes the geologic environment of the Peach Bottom site and vicinity, including landforms, geology, soils, and seismic setting.

3.4.1 Physiography and Geology

Peach Bottom is located within the southern portion of the Piedmont Upland Section of the Piedmont physiographic province (Exelon 2018a, Sevon 2018). The regional terrain generally consists of broad, rounded, and undulating hills and shallow valleys. Slopes generally increase in steepness along headwater drainages from the uplands and toward the Susquehanna River Valley (Sevon 1996a, 2018). Areas on either side of Conowingo Pond, where Peach Bottom is sited, are steeply hilly (NRC 2003a). Elevations range from about 380 ft Above Mean Sea Level (AMSL) (116 m AMSL) just northwest of the north substation to about 300 ft (91 m) ASML along the cliff which was formed during excavation work for the Peach Bottom main plant complex (USGS 2016). Plant grade elevation, between the turbine building and Conowingo Pond, is 116 ft (35.4 m) ASML. The normal pool elevation of Conowingo Pond is 109.2 ft (33.3 m) ASML (Exelon 2017e).

Rock types across the Piedmont Upland Section mainly include schist, gneiss, and quartzite (Sevon 1996a, 2008). These metamorphic rocks are typically overlain by regolith. Regolith includes unconsolidated surficial materials (also called overburden) such as alluvium, colluvium, weathered rock, saprolite (chemically weathered rock), soil, and/or fill material (Sevon 1996a).

Across the Peach Bottom main plant complex that includes the nuclear island, the underlying regolith variously includes backfill material, residual soils, and weathered bedrock. The residual soils consist of sandy silt and silty sand with gravel derived from weathered schist. These residual materials are underlain by a zone of saprolitic-like weathered schist consisting of friable material containing ribs of relatively unweathered rock (Exelon 2017e, 2018a).

During power plant construction, cut slopes were excavated into the regolith and into unweathered bedrock to support emplacement of major plant facilities, including the reactor, radwaste, and turbine buildings. In total, excavation work removed up to 160 ft (49 m) of residual soil materials, weathered rock, and in places, unweathered rock (Exelon 2017e). Excavated areas surrounding plant structures were generally backfilled using compacted residual soil materials taken from the higher elevations of the plant property, although some offsite fill materials were also used. Rock fill and rip-rap was obtained from weathered and fresh rock excavated from the site (Exelon 2017e, 2018a).

As a result of plant construction, the total depth of regolith and backfill overlying bedrock across the main plant complex ranges from 0 to 40 ft (0 to 12 m). Alluvial sediments underlie the intake pond (canal) area and range from 0 to 15 ft (0 to 4.6 m) (Exelon 2018a).

The bedrock that underlies the Peach Bottom site, much of Peach Bottom township, and the adjoining Conowingo Pond is a dense metamorphic rock (schist) (Exelon 2018a, GHD 2018, PADCNR 2018a, Sevon 1996b). This bedrock, mapped as the Peters Creek schist (but also known as the Peters Creek formation), is a greenish-gray to white chlorite schist interbedded with seams and bands of quartzite that are up to 6-ft (1.8-m) thick. The Peters Creek schist is exposed in the cliff face on the west side of the main plant complex. The rock exhibits well-developed schistosity, with a cleavage structure characterized by banded layering of platy minerals. The schistosity trends (strikes) generally to the northeast and the dip angle is 60 to 70 degrees to the southeast across the plant site (Exelon 2017e, 2018a). Field investigations conducted during construction indicated that neither the major nor the minor joint systems and weathered rock seams encountered were continuous or interconnected over large areas (Exelon 2017e). The Peters Creek schist is estimated to be over 2,000-ft (600-m) thick across southeastern Pennsylvania, and the rock is moderately resistant to weathering with fair cut-slope stability (Geyer and Wilshusen 1982).

Where weathered rock seams were encountered during facility construction, they were excavated and replaced with lean concrete. A lean concrete mat, up to 3-ft (0.9-m) thick, with a waterproofing membrane, was also placed on exposed bedrock to provide a barrier between the rock and the base foundation of the major power plant structures (Exelon 2017e). Thus, all major plant structures are founded on competent rock or engineered fill materials.

A notable geologic structural feature in proximity to the plant site is the Peach Bottom syncline. This tightly folded structure, and the associated fault at its axis, generally strikes in a northeast direction and runs for a total length of approximately 16 mi (26 km). 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 mi (14 km). At its closest point, the structure passes approximately 1 mi (1.6 km) south of the plant site (Exelon 2017e, Exelon 2018a, NRC 2003a). This fault and similar features in the region have healed (i.e., have filled in or recemented). Thus, this fault does not present a concern, and the fault and similar structures in the site vicinity have been inactive for at least the last 140 million years (Exelon 2017e, Exelon 2018a, NRC 2003a).

Exelon reevaluates geotechnical conditions whenever a new facility is constructed. Exelon last performed a review prior to construction of the FLEX building at Peach Bottom (completed in 2015). Exelon has not identified any previously unknown geologic hazards since initial plant construction (Exelon 2018a).

3.4.2 Soils and Economic Resources

Natural soils were significantly disturbed during Peach Bottom plant construction. As a result, soil unit mapping by the Natural Resources Conservation Service (NRCS) identifies site soils in and near the main plant complex and discharge canal areas as Udorthents, loamy. This category identifies areas where natural soils have been disturbed or removed. Elsewhere across the Peach Bottom property, the mapped soils include series, with slopes ranging from 3 to 60 percent (Exelon 2018a, NRCS 2018).

The Glenelg, Mt. Airy, and Manor soils primarily consist of channery loams and channery to very channery silt loams in the upper part of the soil profiles. Channery soils are those that contain more than 15 percent rock fragments. Some of the soils grade to sandy loams in the lower part. The soils developed from residual materials derived from weathered schist bedrock. Soil drainage ranges from moderately drained, to well drained, to excessively well-drained and soil depths generally range from moderately deep (20 to 40 in. (51 to 102 cm)) to deep (greater than 40 in. (102 cm)). Soil erosion potential generally ranges from slight to moderate in the north and south-central portions of the site, except that Mt. Airy soils along the bluffs to the north and south of the main plant complex and bordering the unnamed tributary are rated as having a severe hazard primarily due to steep slopes (NRCS 2018b).

No known rock, mineral, or energy resources of a unique or limited nature exist within the confines of the plant property. As previously noted in Section 3.4.1, onsite regolith, soils, and schist bedrock that were excavated during plant construction were stockpiled and reused for backfill and other purposes. There are no active mines or quarries within a 5-mi (8-km) radius of Peach Bottom (PADNR 2018b, YCPC 2018).

3.4.3 Seismic Setting

Probabilistic analyses performed by the U.S. Geological Survey that consider both the occurrence and intensity of earthquakes within and outside Pennsylvania indicate a relatively low seismic hazard in Pennsylvania overall (Scharnberger 2007).

Most earthquakes that have occurred within Pennsylvania have had epicenters in or near an area designated as the Lancaster Seismic Zone. This northeast to southwest trending area of elevated seismic activity begins in Lehigh County, PA and extends southwest and generally through the central portion of Berks, Lancaster, and York counties. The trend line passes approximately 20-mi (32-km) north of the Peach Bottom site (Exelon 2018a, Faill 2004, PADCNR 2018a). In summary, since 1978, a total of 26 earthquakes with a magnitude equal to or greater than 2.5 have occurred within a radius of 62 mi (100 km) of Peach Bottom (USGS 2018a). The largest was a magnitude 4.6 event on January 16, 1994, with an epicenter located about 39 mi (63 km) northeast of the site near Reading, PA. It produced light to moderate shaking near its epicenter and was likely felt south and along the Susquehanna River valley in Pennsylvania (Exelon 2018a, USGS 2018a). The nearest recorded earthquake occurred on July 16, 1978. This small earthquake had a magnitude of 3.1 with an epicenter approximately 11 mi (18 km) north of the site.

There have been no recorded earthquakes with a magnitude greater than 4.7 in southeastern Pennsylvania (Scharnberger 2007). However, the largest earthquake recorded to date within Pennsylvania's borders, known as the Pymatuning earthquake, occurred on September 25, 1998 (PADCNR 1998). It had a peak magnitude of 5.2 (regional magnitude) (Scharnberger 2007, USGS 2018a). It was centered near Jamestown, PA (Mercer County), some 240 mi (386 km) northwest of Peach Bottom (PADCNR 2018a, USGS 2018a). The earthquake produced moderate shaking (equivalent to Modified Mercalli Intensity VI) and caused only minor structural damage near the epicenter (e.g., bricks shaken from chimneys). It did produce significant hydrologic changes in springs and wells in the area of the earthquake.

It was felt throughout northern Ohio and northwestern Pennsylvania and into bordering states (PADCNR 1998).

In adjacent Maryland, the largest, instrumentally recorded earthquake was a magnitude 3.1 event near Hancock, Washington County, in 1978 (MGS 2001). This location is approximately 100 mi (160 km) west of Peach Bottom. A magnitude 6 earthquake occurring in southeastern New York or northern New Jersey could affect the easternmost counties of Pennsylvania. Historically, such events (e.g., in 1737 and 1884) have produced Modified Mercalli Intensity IV (i.e., light) shaking in eastern Pennsylvania (Scharnberger 2007). Such a level of shaking would likely result in little to no damage to structures.

The NRC's evaluation of the impact of seismic activity on a nuclear power plant is an ongoing process that is separate from the license renewal process. All nuclear power plants in the United States are designed and built to withstand strong earthquakes based on their location and nearby earthquake activity. Over time, the NRC's understanding of the seismic hazard for a given nuclear power plant may change as methods of assessing seismic hazards evolve and the scientific understanding of earthquake hazards improves (NRC 2014e, 2018h). As new seismic information becomes available, the NRC evaluates the new information to determine whether changes are needed at existing plants or to NRC regulations.

In 2012, the NRC required all licensees to re-evaluate the seismic hazards at their sites using updated seismic information and present-day regulatory guidance and methodologies (NRC 2012). The purpose of that request was to gather information to update the seismic hazards analysis to enable the NRC to determine whether individual site licenses should be modified, suspended, or revoked. On March 31, 2014, Exelon responded to this request and provided a seismic hazard and screening report for Peach Bottom (Exelon 2014c). In April 2015, the NRC staff issued its assessment of Exelon's screening report (NRC 2015f). The NRC staff concluded that Exelon appropriately conducted the screening report and that the evaluation was acceptable for addressing follow-up actions. Subsequently, in December 2014, Exelon submitted to the NRC its report describing the expedited seismic evaluation process that was undertaken for Peach Bottom. The seismic evaluation was conducted to demonstrate seismic margin through a review of plant equipment that can be relied upon to protect the reactor core following beyond design basis seismic events (Exelon 2015a). The NRC staff completed its review of the seismic evaluation in June 2015. The NRC staff concluded in part that Exelon had identified and evaluated the seismic capacity of key installed mitigating strategies equipment used for core cooling and containment functions to cope with scenarios such as loss of all alternating current power and loss of access to the ultimate heat sink to withstand a seismic event up to two times the safe shutdown earthquake. The NRC staff also concluded that Exelon's seismic evaluation provides additional assurance that supports continued plant safety while a longer-term seismic evaluation is completed to support regulatory decisionmaking (NRC 2015e).

3.5 Water Resources

This section describes surface water and groundwater resources at and around the Peach Bottom site.

3.5.1 Surface Water Resources

Surface water encompasses all water bodies that occur above the ground surface, including rivers, streams, lakes, ponds, and man-made reservoirs or impoundments.

3.5.1.1 Local and Regional Surface Water Hydrology

The Peach Bottom site is located on the west bank of Conowingo Pond and adjacent to Rock Run Creek, which discharges into Conowingo Pond. Conowingo Pond is a reservoir on the Susquehanna River formed by the Conowingo Dam. The Conowingo Pond reservoir is located between Conowingo Dam at the downstream end of the reservoir and Holtwood Dam at the upstream end of the reservoir. Conowingo Dam is located approximately 8.5-mi (13.7-km) downstream of the Peach Bottom site; Holtwood Dam is located approximately 6 mi (9.7 km) upstream of the Peach Bottom site. The Conowingo and Holtwood dams each provide hydroelectric generation (NRC 2014d).

Possessing a drainage area of 27,500 mi^2 (71,225 km^2), the Susquehanna River drains portions of western and central New York State, a large portion of Pennsylvania, and a small portion of Maryland. The river flows south more than 420 mi (676 km) from its source in south-central New York until it empties into the Chesapeake Bay in Maryland (see Figure 3-5). The Susquehanna River supplies more than half the freshwater that flows into the Chesapeake Bay (Exelon 2018a, FERC 2015). The Peach Bottom site is located at approximately river mile 17 of the Susquehanna River.

Five hydroelectric projects on the lower Susquehanna River use flow from the river and its tributaries to generate electricity (FERC 2015). On the Susquehanna River, the Conowingo Dam is the most downstream hydroelectric project (see Figure 3-3, Conowingo Pond and Peach Bottom Site). Conowingo Dam is located 10-mi (16 km) upstream from the Chesapeake Bay. By impounding the river, it creates a reservoir (Conowingo Pond) with 35 mi (56 km) of shoreline that extends 14-mi (22.5-km) upstream to the Holtwood Dam (FERC 2015, NRC 2014d). Conowingo Pond has a surface area of approximately 9,000 ac (36.4 km^2). It has a width that varies from 0.5 to 1.3 mi (0.8 to 2.1 km) and a maximum depth of 98 ft (29.9 m). In addition to supplying cooling water for Peach Bottom, Conowingo Pond also provides recreation (as a fish and wildlife resource), provides a source of water for other power generation facilities, and provides public water supplies for several communities (NRC 2014d).

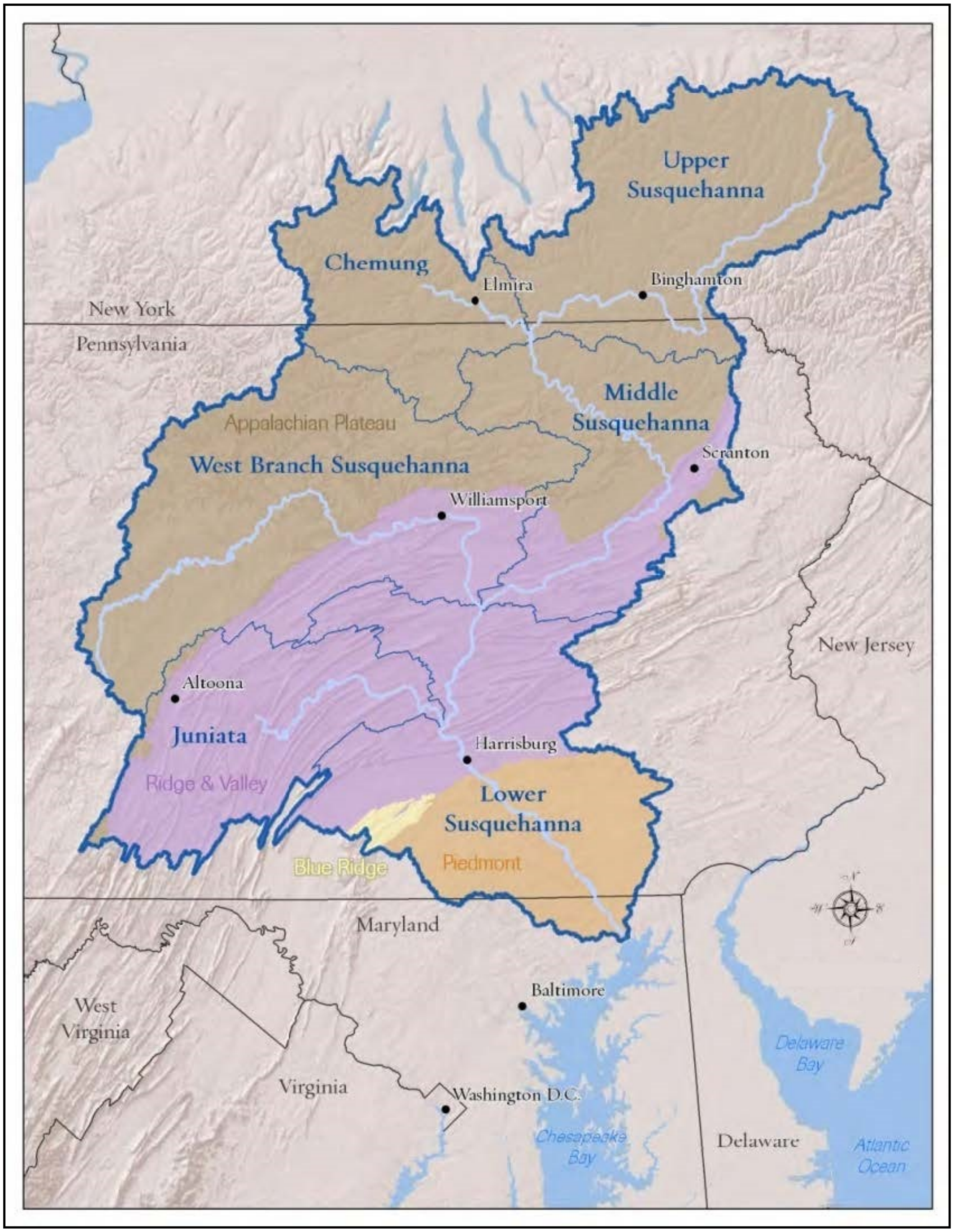
On the Susquehanna River, the nearest upstream U.S. Geological Survey (USGS) gauging station is located approximately 27-mi (43.5-km) upstream from the Peach Bottom site (Exelon 2018a). The nearest USGS downstream gauging station is located immediately downstream of Conowingo Dam (Exelon 2018a, FERC 2015). River flows on the Susquehanna River are generally highest in March and April and lowest from July through September (FERC 2015).

Three hydroelectric projects heavily influence the water flow through Conowingo Pond:

1. the Holtwood Dam, which influences the flow of water into Conowingo Pond
2. the Conowingo Dam, which influences the flow of water out of Conowingo Pond
3. to a lesser extent, the Muddy Run Pumped Storage Facility (Exelon 2018a)

The Muddy Run Pumped Storage Facility is located in the northeast corner of Conowingo Pond. During off-peak electricity demand times, the Muddy Run Facility pumps water from Conowingo Pond into a reservoir that lies at a higher elevation. Then during peak electricity demand times, the Muddy Run Facility allows the water stored at the higher elevation reservoir to flow back into

Conowingo Pond. Before entering Conowingo Pond, the water released from the reservoirs turns turbines that generate electricity (Exelon 2018a).



Source: Modified from The Nature Conservancy 2010

Figure 3-5 Susquehanna River Basin and Sub-Basins

Conowingo Dam controls the water elevations in Conowingo Pond. Operation of Conowingo Dam is subject to the requirements of the Federal Energy Regulatory Commission (FERC). These FERC requirements include minimum flow releases and maintenance of pond levels (SRBC 2006).

The FERC regulations allow Conowingo Pond water levels to fluctuate by 9 ft (2.7 m) between 101.2 and 110.2 ft (30.8 and 33.6 m) ASML. These water elevations minimize the potential for intake difficulties at the Peach Bottom site and problems with cavitation within the turbines of the Muddy Run Pumped Storage Facility. However, while the current Conowingo Pond operating regime allows 9 ft (2.7 m) of water level fluctuation, actual water level fluctuations are usually smaller, fluctuating by 4.5 ft (1.4 m) (between elevation 104.7 to 110.2 ft (32 to 33.6 m) ASML) (FERC 2015).

3.5.1.2 Surface Water Quality

The main stem of the Susquehanna River from York Haven, PA downstream to Conowingo Pond is classified as a warm-water fishery and migratory fishery. It is subject to specific water quality criteria that are applicable Statewide for warm-water fishery and migratory fishery streams. The Pennsylvania–Maryland border bisects Conowingo Pond about 5.7 miles (9.1 km) upstream of Conowingo Dam (see Figure 3-3, "Conowingo Pond and Peach Bottom Site"). As a result, the southern section of Conowingo Pond and the Susquehanna River downstream of Conowingo Dam are within the State of Maryland. Maryland classifies Conowingo Pond water quality as Use I-P (Water Contact Recreation, Protection of Aquatic Life and Public Water Supply). The Susquehanna River from Conowingo Dam downstream to the confluence with the Chesapeake Bay is classified as Use II (Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting). Water quality data collected in Conowingo Pond where near the Muddy Run Pumped Storage Project, usually meets State water quality control criteria (FERC 2015). However, within the Commonwealth of Pennsylvania, the lower Susquehanna River is designated as impaired from polychlorinated biphenyls from unknown sources (PDEP 2016).

Water quality data collected from Conowingo Pond extend back to the 1950s. Primary water quality parameters of interest are water temperature and dissolved oxygen. Conowingo Pond has a seasonal pattern of warm and cool water temperatures. Minimum water temperatures of 32 °F (0 ºC) occur in January and February, while maximum average water temperatures of 81 °F (27.2 ºC) occur in July and August. Thermal stratification with depth does not occur in Conowingo Pond (FERC 2015).

In contrast to water temperatures; average dissolved oxygen levels in Conowingo Pond are highest in January and February (average 14 mg/L) and lowest in July, August, and September, with the lowest average dissolved oxygen levels in August (average 7 mg/L). Dissolved oxygen levels are well mixed with depth through most of the year. However, slower river flows in the warmer months can cause some vertical stratification in the deeper parts of Conowingo Pond (i.e., near Conowingo Dam). Depending on river flows, vertical stratification with lower dissolved oxygen concentrations can persist in these deeper areas for up to 60 days (FERC 2015).

3.5.1.3 Surface Water Discharges to Conowingo Pond

The NRC regulates liquid radioactive releases from the Peach Bottom site to Conowingo Pond. Liquid releases of radionuclides within NRC-allowable limits are a part of normal nuclear power plant operations. To maintain liquid releases as low as reasonably achievable, the site uses various processes such as collection, filtration, holding for decay, dilution, and concentration (Exelon 2018a). The NRC monitors the amount and types of radionuclides released and the calculated dose to the public. The documentation of releases and dose evaluations can be obtained from the NRC web page titled "Radioactive Effluent and Environmental Reports" (see NRC 2017d). This SEIS describes Exelon's radioactive effluent monitoring and radiological environmental monitoring programs in Section 3.11, "Human Health" and 3.13, "Waste Management and Pollution Prevention."

The Commonwealth of Pennsylvania regulates nonradioactive liquid releases from the Peach Bottom site. These releases must comply with NPDES Permit No. PA0009733, which became effective on October 1, 2014 and expires on September 30, 2019 (PDEP 2014a). Under this permit, Exelon must routinely monitor effluents released to confirm that they meet allowable limits.

The National Pollutant Discharge Elimination System permit (Permit No. PA0009733) regulates discharges from various Peach Bottom site plant sources including equipment cooling water, emergency service water, potable water treatment wastewater, settling basin waste water, auxiliary boiler blowdown, dredging/rehandling basin waste water, raw intake screen backwash, and stormwater discharge. It also regulates discharges from use of chemical additives for mollusk control, disinfectants, corrosion inhibitors, and membrane cleaning associated with raw water treatment. Under the National Pollutant Discharge Elimination System permit, Exelon monitors discharges and parameters including aluminum, ammonia-nitrogen, copper, carbonaceous biochemical oxygen demand, discharge rate (flow), dissolved oxygen, fecal coliform, iron, nickel, nitrogen, oil and grease, pH, phosphorus, polychlorinated biphenyls, residual chlorine, suspended solids, temperature, zinc, and Nalco H150M, which is used to control mussels (Exelon 2018a).

With the exception of a few stormwater discharge locations (outfalls) that discharge surface water runoff from precipitation and snow melt directly to Conowingo Pond, all liquid discharges flow into the discharge canal. Prior to discharge into Conowingo Pond, the concentration of any constituents are diluted by the large volume of water in the discharge canal (observations from NRC staff environmental onsite tour that occurred at Peach Bottom on October 2018).

The National Pollutant Discharge Elimination System permit also regulates discharges from the onsite sewage treatment plant. The sewage treatment plant processes a volume of approximately 18,000 to 22,000 gpd (68,137 to 83,279 Lpd) of sewage. The plant is an extended aeration type with sludge settling and chlorination facilities. Liquid effluents from the sewage treatment plant are discharged into the discharge canal (Exelon 2018a).

Exelon's National Pollutant Discharge Elimination System permit also sets temperature limits on Peach Bottom's wastewater discharge into Conowingo Pond. At specified times and conditions, Exelon uses helper cooling towers to reduce the temperature of the water discharged from the primary cooling loop. This is accomplished by diverting portions of the water discharged from the primary cooling through the helper cooling towers. Evaporation in the cooling towers reduces the temperature of the liquid water, which is then released into the discharge canal. This reduces the temperature of the water in the cooling canal prior to discharge into Conowingo Pond (Exelon 2018a).

Peach Bottom must have one helper cooling tower in operation during the summer months (i.e., June 15–August 31). Depending on water intake temperatures from Conowingo Pond, as warranted by operating conditions, and as further specified by the National Pollutant Discharge Elimination System permit, Peach Bottom must use additional cooling towers (Exelon 2018a).

The Peach Bottom National Pollutant Discharge Elimination System permit limits the temperature of the water at the end of the discharge canal to 110 ºF (43.3 ºC). A thermal study conducted during June to September of each year from 2010 through 2013 found that with no cooling towers operating, average surface water temperature 1,600 ft (487.7 m) downstream of the discharge structure was approximately 93.7 ºF (34.3 ºC) and 2,100 ft (640.1 m) downstream, the average surface water temperature was approximately 88.7 ºF (31.5 ºC). With the cooling towers in operation, the area of increased temperatures downstream of the discharge structure is even smaller. Even in summer, the discharge mixing zone in Conowingo Pond where daily water temperature exceeds 95 ºF (35 ºC) is very small compared to the size of Conowingo Pond (Exelon 2018a).

3.5.1.4 Clean Water Act 401 Certification

Section 401 of the Clean Water Act (33 U.S.C. 1251 et seq.) requires an applicant for a Federal license to conduct activities that may cause a discharge of regulated pollutants into navigable waters to provide the licensing agency with a water quality certification from the State. This State water quality certification implies that discharges from the project or facility to be federally licensed will comply with Clean Water Act requirements and will not cause or contribute to a violation of State water quality standards. If the applicant has not received Clean Water Act Section 401 certification, the NRC cannot issue a license unless that State has waived the requirement. The NRC recognizes that some National Pollutant Discharge Elimination System-delegated States explicitly integrate their Clean Water Act Section 401 certification process with the National Pollutant Discharge Elimination System permit issuance.

The U.S. Environmental Protection Agency (EPA) has delegated to the Commonwealth of Pennsylvania its authority to issue National Pollutant Discharge Elimination System permits. Pennsylvania integrates the Section 401 certification process with the issuance of a National Pollutant Discharge Elimination System permit. As previously stated, the Peach Bottom site is regulated by National Pollutant Discharge Elimination System Permit No. PA0009733. In addition, in 2014, the Pennsylvania Department of Environmental Protection issued Exelon a Clean Water Act Section 401 certification associated with an extended power uprate for the Peach Bottom facility.

In a letter to Exelon dated November 20, 2017, the Pennsylvania Department of Environmental Protection stated that the “current National Pollutant Discharge Elimination System permit and 401 certification for the Peach Bottom site remains valid and does not need to be modified for the purposes of another license renewal.” The letter further states that in the future, should Exelon make operational changes “that may change or otherwise affect any discharges from the project, modification of the State water quality certification and/or its companion permits and conditions may be required.” Copies of these authorizations and letters are included in Appendix D of the “Applicant’s Environmental Report –Operating License Renewal Stage – Subsequent License Renewal” (Exelon 2018a). The NRC staff concludes that Exelon has provided the necessary certification to support license renewal.

3.5.1.5 Consumptive Use of Surface Water

Water consumption associated with Peach Bottom operations primarily occurs via evaporation from the discharge canal, from Conowingo Pond downstream from the discharge canal, and from the plant's helper cooling towers, when they are operating. Peach Bottom's consumptive use represents approximately 0.2 percent of the 39,500 cfs (1,119 m^3/s) average annual flow of the Susquehanna River into Conowingo Pond and 2 percent of the lowest 7-day average flow (3,785 cfs) (107 m^3/s) (Exelon 2018a).

The Susquehanna River Basin Commission was created by the Susquehanna River Basin Compact, which is a compact amongst the states of New York, Maryland, and Pennsylvania and the Federal Government. The Commission manages water resources over the entire river basin (SRBC 2018). The Susquehanna River Basin Commission has defined surface water withdrawal and consumptive use rates for the Peach Bottom site. The Federal Energy Regulatory Commission also authorized these consumptive use levels as non-project use of project lands and waters associated with operation of the Conowingo Hydroelectric Project and Conowingo Pond.

The Susquehanna River Basin Commission allows Exelon to withdraw at the Peach Bottom site up to 2,363.62 mgd (8,947 mLd) and to consume up to 49 mgd (185.5 mLd) from Conowingo Pond (Exelon 2018a, SRBC 2004). The NRC staff review of data collected from 2006 through 2017 did not reveal any surface water withdrawals that exceeded the authorized rate (PDEP 2018a).

3.5.1.6 Potential for Flooding

The NRC evaluates the potential effects of floods on a nuclear power plant. This is a separate and distinct process from the license renewal process. The NRC addresses flood hazard issues on an ongoing basis at all licensed nuclear facilities (NRC 2013a). The NRC requires every nuclear power plant to be designed for site-specific flood protection for safety-related equipment and facilities. As new information becomes available, the NRC expects licensees to evaluate the new information to determine if changes are needed to safety systems at a plant. The NRC also evaluates new information important to flood projections and independently confirms that a licensee's actions appropriately consider potential changes in flooding hazards at the site.

The Peach Bottom facility has a certified maximum permissible flood threshold of 26.5 ft (8.1 m) above the Susquehanna River elevation and can safely shut down through normal operational methods if flood waters rise to this level. In addition, Exelon protects underground and ground-level equipment through multiple methods including water-tight doors and specially engineered flood barriers to prevent water intrusion into vital plant equipment (Exelon 2018a).

On March 17, 2017, in response to NRC's direction to re-evaluate flooding hazards in accordance with the recommendations of the NRC's Near-Term Task Force, Exelon submitted a reevaluation study of flood-causing mechanisms for the Peach Bottom site (Exelon 2017c, NRC 2012a). The study concludes that flooding would have no effect on Peach Bottom safety-related systems, structures, and components (Exelon 2018a). The NRC staff completed a review of this study on November 6, 2017. The staff concluded the Exelon had demonstrated that effective flood protection, if appropriately implemented, exists for local intense precipitation and probable maximum storm surge flood mechanisms during a beyond-design-basis external flooding event (NRC 2017c).

3.5.2 Groundwater Resources

Groundwater includes all water below the ground surface, usually within a zone of saturation. Aquifers are zones that are capable of yielding groundwater in sufficient volume to supply wells, springs, and surface water.

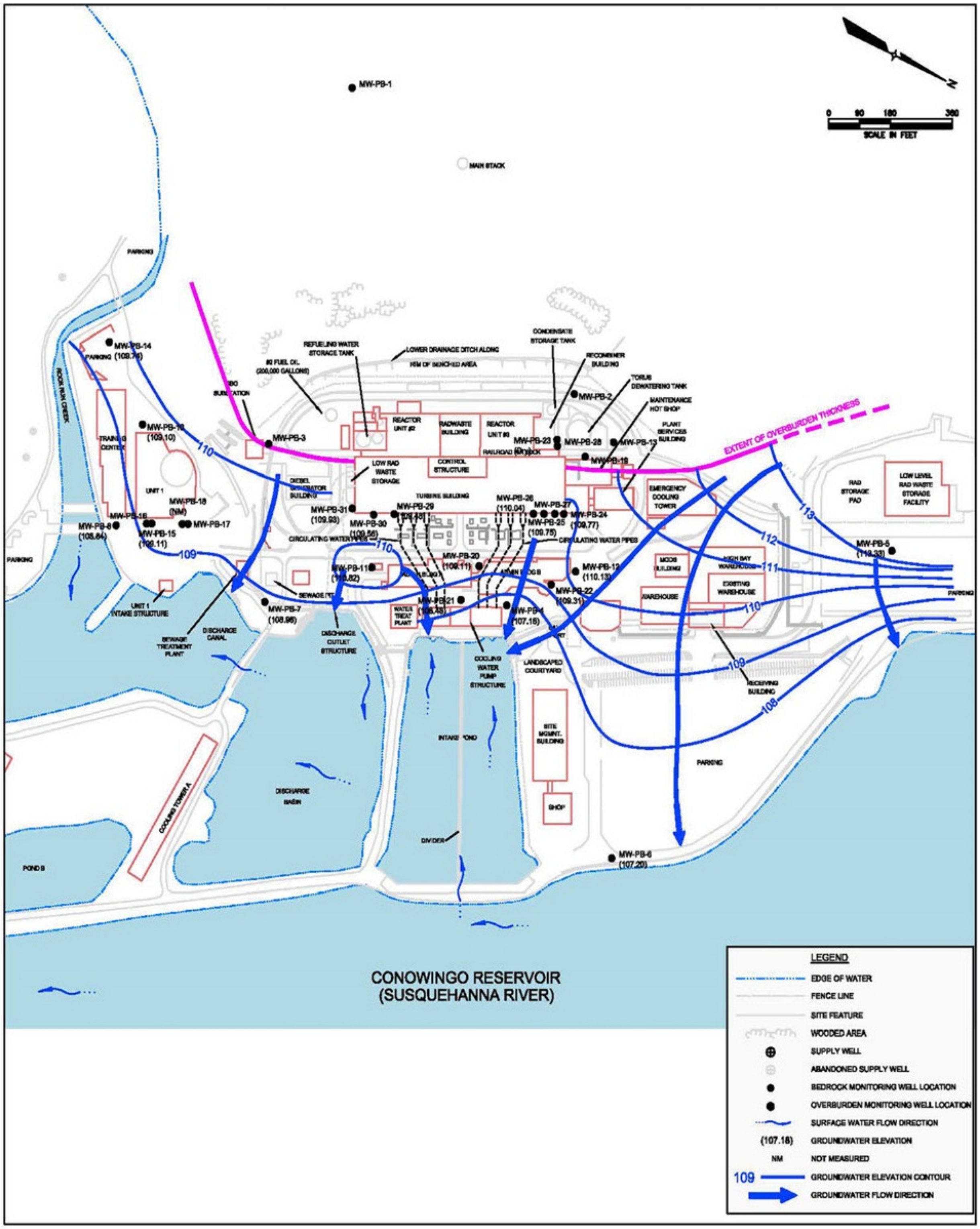
3.5.2.1 Site Description and Hydrogeology

Crystalline rock aquifers, largely composed of metamorphic rocks, are among the most widespread aquifers across the Piedmont region and encompass portions of southeastern Pennsylvania. Major metamorphic rock types that comprise the crystalline rock aquifers include coarse-grained gneisses and schists. However, finer-grained metamorphic rocks such as phyllite and metamorphosed volcanic rocks may also be common locally. The crystalline rock aquifers primarily produce groundwater due to secondary porosity resulting from joints and fractures (Trapp and Horn 1997).

Groundwater flow through crystalline rock aquifers is largely due to interconnected fractures within the rock as the matrix of the rock has a low permeability. The abundance of crystalline rock aquifers decreases with depth as the rock becomes relatively impermeable. This is because fracture density and the degree to which the fractures are interconnected decreases with depth (Exelon 2018a, Trapp and Horn 1997). The well yields of crystalline rock aquifers are generally small, with coarser-grained crystalline rocks such as schist producing higher yields than finer-grained metamorphosed volcanic rocks (Trapp and Horn 1997). The regolith that overlies the region’s bedrock is generally more porous and permeable than the underlying bedrock. As a result, this material is more capable of storing and transmitting water than the underlying bedrock. The regolith is recharged by precipitation and runoff with a portion of the recharge entering the fractures of the underlying bedrock. Thus, where sufficiently deep, the regolith helps to recharge the fracture systems and increase the availability of water to wells withdrawing from the underlying bedrock (Trapp and Horn 1997). As discussed in Section 3.4.1, “Physiography and Geology,” much of the natural regolith within the Peach Bottom main plant complex and along the intake and discharge basins was removed, reworked, or replaced with backfill.

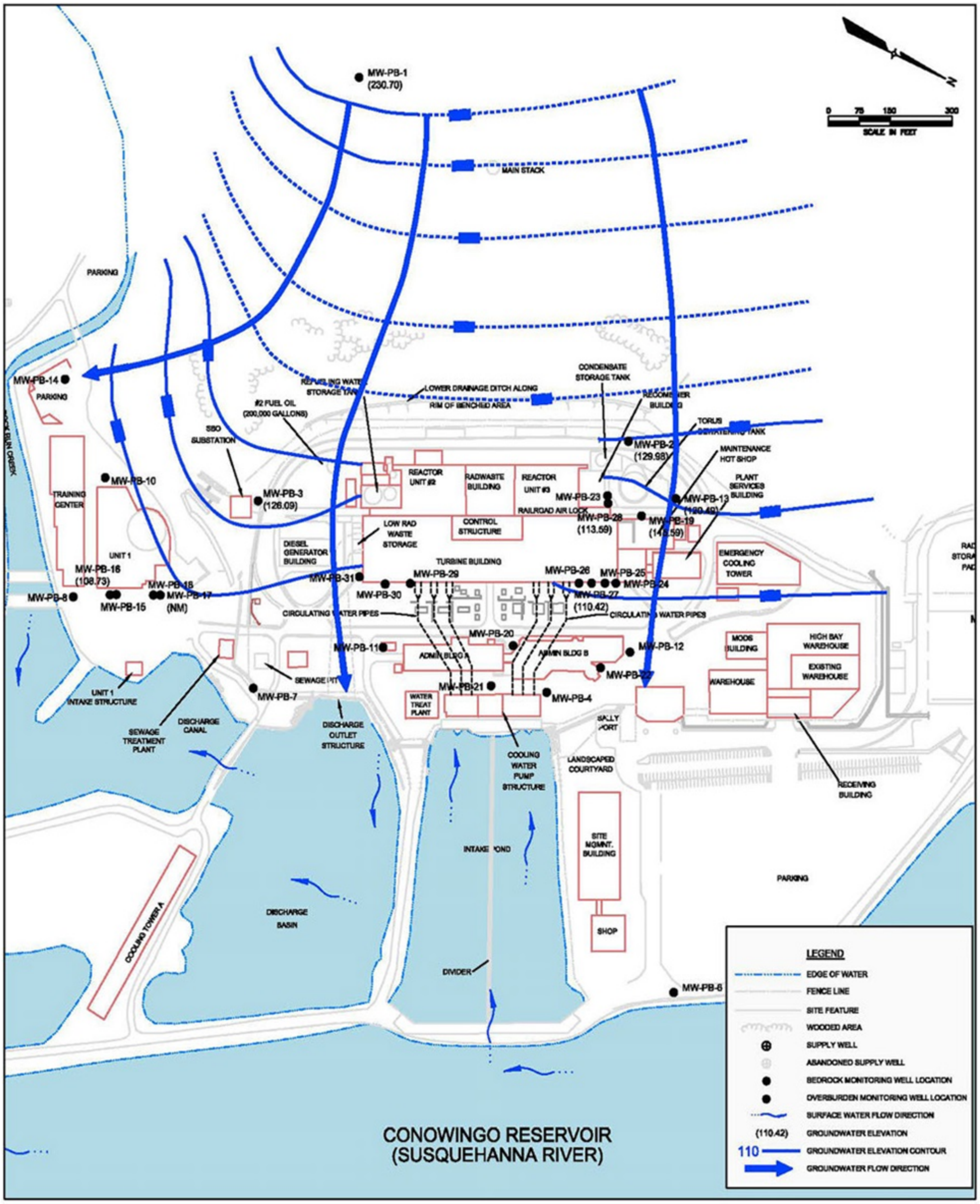
Regionally, the water table generally reflects the overlying topography with groundwater movement occurring over relatively short flow paths, traveling downgradient, and discharging to a nearby stream or other topographic low, with a portion of the recharge entering the fractures of the underlying bedrock (Exelon 2018a; Trapp and Horn 1997). Groundwater discharge provides a substantial portion of the baseflow in streams and rivers across the region (Low et al. 2002). This regional characterization is reasonably consistent with the conceptual model for the Peach Bottom plant site where the direction of groundwater flow in both the regolith and bedrock is roughly west to east toward the Susquehanna River, with groundwater discharging to the intake and discharge basins and to Conowingo Pond. Groundwater movement (flow direction) through the site overburden and the underlying Peters Creek schist at Peach Bottom is illustrated in Figure 3-6 and Figure 3-7, respectively. The water table ranges from over 100 ft (30 m) below the ground surface in the higher, western portion of the plant area to within several feet of the surface at the easterly boundary of the site with Conowingo Pond. Groundwater seeps, and springs intermittently form, in the bedrock cliffs immediately to the west of the plant complex (Exelon 2017e, 2018a).

The results of hydrogeologic investigations of the Peach Bottom plant site show that the groundwater flow rate (horizontal) through the surficial regolith (overburden) is estimated to range from 19 to 38 ft (5.8 to 11.6 m) per year, while the flow rate in the underlying Peters Creek Schist ranges from 91 to 277 ft (28 to 84 m) per year (Exelon 2018a, GHD 2018).



Source: Modified from Exelon 2018a

Figure 3-6 Groundwater Elevations and Movement in Overburden Materials, Peach Bottom Site



Source: Modified from Exelon 2018a

Figure 3-7 Groundwater Elevations and Movement in Bedrock, Peach Bottom Site

3.5.2.2 Groundwater Use

Crystalline rocks encompass the majority of York County, including the southern half of the county where the Peach Bottom site is located. The crystalline rocks such as the Peters Creek schist, as described in Section 3.4.1, "Physiography and Geology," are relatively impermeable and do not support major aquifers, yielding only small volumes of water to wells. The minor aquifers occurring in these rocks are part of the Piedmont and Blue Ridge crystalline rock aquifer as mapped in York County. The associated rocks generally support well yields ranging from 5 to 25 gpm (19 to 95 Lpm) (YCPC 2018). Data compiled by the U.S. Geological Survey for 104 domestic water wells completed in the Peters Creek schist indicate a median well yield of 9 gpm (34 Lpm), with about a third of the wells yielding less than 5 gpm (19 Lpm) (Exelon 2018a; Low et al. 2002). In 2015, total groundwater use for domestic (self-supplied) purposes totaled 9.8 mgd (37 mld) in York County (USGS 2018c).

No groundwater is used to provide water for potable uses (e.g., drinking water) at the Peach Bottom site. Water for potable uses at Peach Bottom is supplied from Conowingo Pond as discussed in Section 3.1.3, "Cooling and Auxiliary Water Systems." As summarized in Table 3-4, Peach Bottom has three active groundwater production wells (well numbers 16, 17, and 20) that are used to supply water for miscellaneous, non-potable uses across the plant site. A fourth well (well number 12) was previously used for rinsing equipment and possibly for personnel hand washing, but Exelon deactivated the well pump several years ago (Exelon 2018c). In addition to the wells listed, there are three former supply wells located on the Peach Bottom site that have been decommissioned and sealed with concrete (Exelon 2018a, GHD 2018).

Table 3-4 Groundwater Supply Wells Peach Bottom Site

Well Number[a]	Depth (feet))[b]	Capacity (gpm)[b]	Location	Use
12	300	6	Former Hazardous Materials Yard; north	Inactive; no plans for future use
16[c]	250	<1-2[d]	North Substation	Non-potable supply for unoccupied control house restroom
17	Unknown	11	Salt Storage Facility (Near North Substation)	Washing vehicles/equipment following winter salting operations
20[c]	300	1-2	South Substation	Non-potable supply for unoccupied control house restroom

(a) Well designations from the site Annual Radiological Environmental Operating Report (Exelon 2018a).

(b) To convert feet to meters, multiply by 0.3048. To convert from gallons per minute (gpm), to liters per minute (Lpm), multiply by 3.7854.

(c) Well owned by Exelon but maintained by Philadelphia Electric Company (PECO) (Exelon 2018c).

(d) Production capacity assumed to be similar to that of well number 20 (Exelon 2018a, 2018c).

Source: Exelon 2018a, 2018c, 2018d, NRC 2003a, PADCNR 2018b

Based on the reported and presumed depths of the wells, the NRC staff concludes that Peach Bottom's active wells are completed in the Peters Creek schist.

Exelon does not compile production volume information for its wells (Exelon 2018c). However, Peach Bottom's maximum groundwater production capacity is about 15 gpm (57 Lpm) for its active wells, which is equivalent to a production volume of approximately 21,600 gpd (81,800 Lpd). As operation of the cited wells is very infrequent (i.e., occasional or seasonal), the NRC staff concludes that actual daily groundwater use at the plant is likely a small fraction of the cited equivalent volume.

Water use for Peach Bottom operation is subject to the rules and regulations of the Susquehanna River Basin Commission (SRBC). Plant water withdrawals, including consumptive use of surface water from Conowingo Pond, are subject to regulation as described in Section 3.5.1, "Surface Water Resources." Additionally, in accordance with the Pennsylvania Water Resources Planning Act as implemented pursuant to Title 25, "Environmental Protection," of the *Pennsylvania Code*, Chapter 110, "Water Resources Planning" (25 Pa. Code Chapter 110), entities whose total withdrawal from a point of withdrawal, or from multiple points of withdrawal operated as a system either concurrently or sequentially, within a watershed, exceeds an average rate of 10,000 gallons per day (38 m^3/day) in any 30-day period are required to register their withdrawals and to periodically report water use to Pennsylvania's Department of Environmental Protection (PDEP). Furthermore, the SRBC-issued Docket (No. 20061209-1) (SRBC 2011) for operation of Peach Bottom requires, in part, that Exelon register all surface water and groundwater sources with the PDEP in accordance with 25 Pa. Code Chapter 110. Based on the NRC staff review of the PDEP's water use reporting database (Exelon 2018c, PDEP 2018a), Exelon has registered its surface water withdrawals as subject to its SRBC docket and submits water withdrawal and use reports to the PDEP. However, Exelon reports that it does not include groundwater usage in its reports to either SRBC or PDEP because the intermittent and seasonal use of onsite groundwater constitutes a de minimis amount of groundwater withdrawal (Exelon 2018c).

Exelon periodically conducts a survey of drinking water wells and has identified a total of 14 privately-owned groundwater supply wells within about a 1-mi (1.6-km) radius of the Peach Bottom site boundary (Exelon 2018d). The most recent survey was performed in 2017 (GHD 2018). These wells are primarily located just beyond the north and northwest boundary of the Peach Bottom property. The NRC staff also conducted a confirmatory review of water well information maintained by the Pennsylvania Department of Conservation and Natural Resources (PADCNR) (PADCNR 2018b). The 14 wells include 11 wells used for domestic water supply, one used for livestock watering, one used for irrigation, and one identified as an unused test well (Exelon 2018a, 2018d, PADCNR 2018b, GHD 2018).

Well records indicate that all the 14 offsite wells are completed in the Peters Creek schist. Well depths range from 30 to 260 ft (9 to 79 m), and yields range from a little as 5 gpm to as much as 60 gpm (19 to 230 Lpm) (GHD 2018, PADCNR 2018b). All the wells are hydrologically upgradient of the Peach Bottom plant site (i.e., located in the opposite direction of groundwater flow).

Other than Exelon's onsite wells and privately-owned supply wells near the Peach Bottom site, the Delta Borough Municipal Authority operates a well field for public water supply that is located approximately 4 mi (6 km) southwest of the Peach Bottom site (SRBC 2018). The Delta Authority's six wells have a combined withdrawal limit of 0.13 mgd (0.49 mld), equivalent to 90 gpm (340 Lpm), and are completed in the Peters Creek schist (SRBC 2007, 2013).

In addition to pumped wells, Peach Bottom has a subsurface drain and sump system that collects infiltrating groundwater. The sumps are located outside and to the west of the two reactor buildings (i.e., the Unit 2 and Unit 3 yard drain sumps) and low-level radioactive waste storage building sump. Water collected by these sumps is discharged to the plant's outfall and storm drainage system in accordance with National Pollutant Discharge Elimination System requirements (see Section 3.5.1.2, "Surface Water Quality," of this SEIS). (Exelon 2018a). The 2 yard drain sumps contribute a combined maximum flow to Outfall 004 of approximately 50 gpm (190 Lpm), or 72,000 gpd (272,500 Lpd). Collected flow from the low-level radioactive waste storage building sump is intermittent with a maximum flow of about 20 gpm (79 Lpm), or 30,000 gpd (114,000 Lpd), to Outfall 901 (Exelon 2018c).

3.5.2.3 Groundwater Quality

<u>Groundwater Quality Standards and Current Designated Uses</u>

Groundwater used for public water supply is regulated by the PDEP in accordance with the Pennsylvania Safe Drinking Water Act as implemented through 25 Pa. Code Chapter 109, "Safe Drinking Water." Watershed-based water quality management and permitting programs, such as the NPDES permit program administered by the PDEP, also serve to enhance the protection of groundwater quality. However, landowners in rural areas of York County use private wells for water supply, and well siting and construction for private use is generally regulated at the municipal level (i.e., by county or township).

Groundwater produced from the crystalline rock aquifers of southeastern Pennsylvania is generally of the calcium plus magnesium-bicarbonate type and suitable for drinking and other uses. The water is characteristically soft and slightly acidic. On a localized basis, the concentration of iron, manganese, sulfur, and other constituents may necessitate treatment for some uses (Low et al. 2002; Trapp and Horn 1997). This is consistent with Peters Creek schist groundwater quality where elevated concentrations of nitrate and radon are common in addition to iron and manganese (Low et al. 2002).

<u>Routine and Potential Inadvertent Releases of Radionuclides and Other Pollutants to Groundwater</u>

Nuclear power plants routinely release dilute concentrations of radionuclides in effluents (liquid and gaseous), including tritium, in accordance with the NRC's regulations in 10 CFR Part 20 and Appendix I to 10 CFR Part 50. These authorized releases are closely monitored by the plant operator and reported to the NRC. Annual radioactive effluent release reports submitted to the NRC are made available to the public on the NRC's Web site. Similarly, potential impacts to the public and to the environment from plant radiological releases are evaluated and reported in radiological environmental operating reports, which are also publicly available on the NRC's Web site. Routine radiological effluents from Peach Bottom and Exelon's associated effluent management and radiological environmental monitoring programs are described in Sections 3.1.4.1, 3.1.4.2, and 3.1.4.5 of this SEIS and not further detailed here.

Since 2006, Exelon has participated in NEI 07-07, "Industry Ground Water Protection Initiative" (NEI 2007) (Exelon 2018a). The initiative identifies actions to improve management and response to instances in which the inadvertent (i.e., unplanned, uncontrolled, and unmonitored) release of radioactive substances may result in low but detectible levels of nuclear power plant-related radioactive materials in subsurface soils and water. NEI 07-07 prescribes actions that are necessary for the implementation of a timely and effective groundwater protection program along with acceptance criteria to demonstrate that program objectives are met. In addition, Exelon follows the principles of NEI 09-14, "Guideline for the Management of Buried Piping

Integrity" (NEI 2010), as part of a program to monitor, inspect and improve buried piping and tank systems to prevent future unintended releases of radiological materials to groundwater (Exelon 2018a).

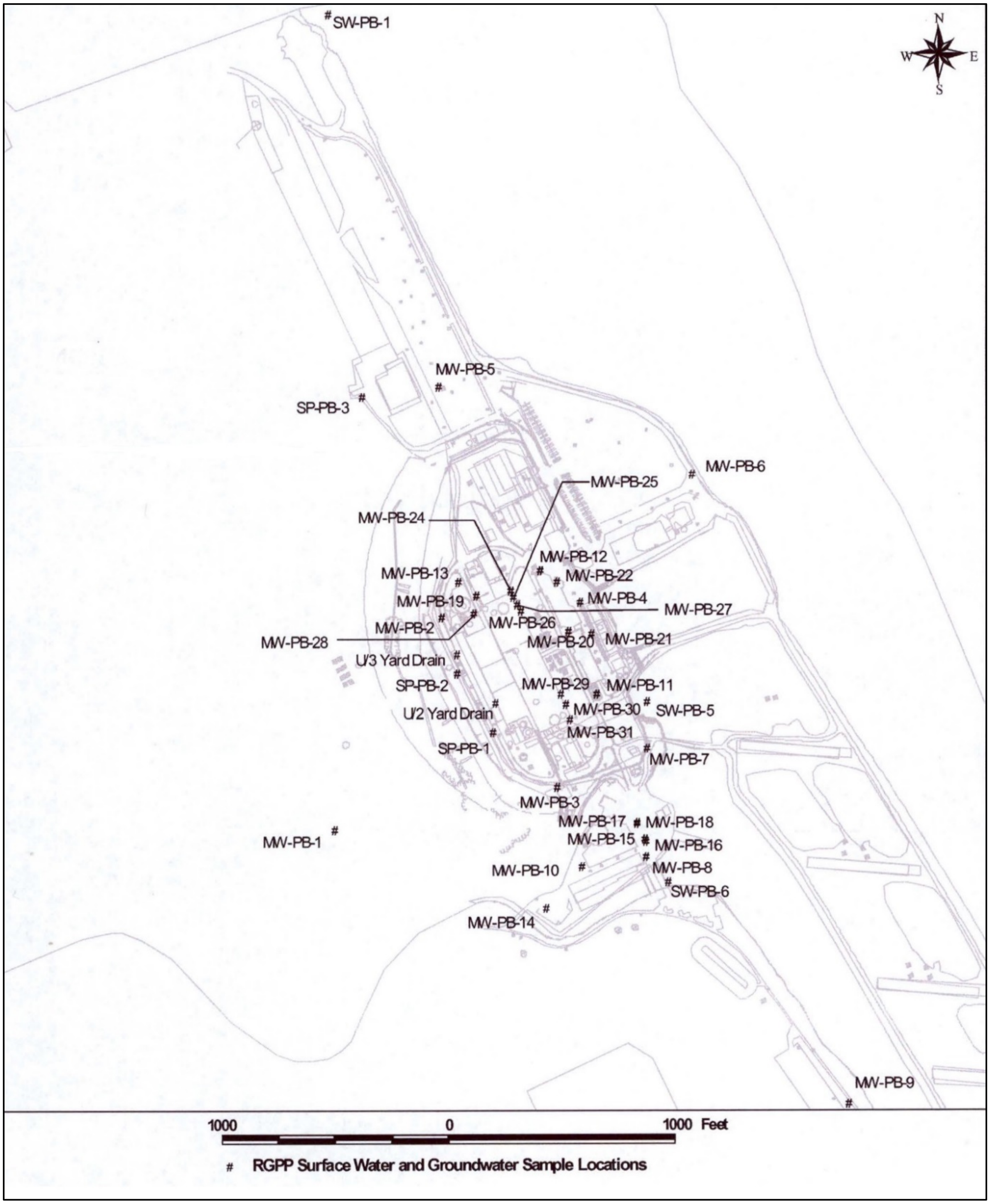
Exelon has integrated the NEI 07-07 industry groundwater protection initiative into the current Peach Bottom radiological groundwater protection program. The program has been implemented at Peach Bottom in accordance with site-specific procedural requirements (Exelon 2018d). Currently, Peach Bottom's groundwater protection monitoring network consists of 31 permanent groundwater monitoring wells, 3 surface water sample locations, 3 groundwater seeps, 2 yard drain sumps, as well as 6 precipitation water sampling locations (Exelon 2018d; Exelon 2018a). Groundwater protection samples are collected at least quarterly and analyzed for gross alpha, gross beta, gamma emitters, strontium, and tritium; samples are periodically analyzed for other hard-to-detect radionuclides (Exelon 2018d). Monitoring locations (monitoring wells, seeps, yard drains, and surface water stations) are depicted in Figure 3-8. The NRC staff visited many of the monitoring locations during the site environmental audit in November 2018.

As required by 10 CFR 50.75(g), Exelon maintains records of spills involving radioactive contamination in and around the Peach Bottom plant, equipment, and site (Exelon 2018a). Exelon transmits reports of unintended releases of radiological materials to groundwater to the NRC, Pennsylvania agencies, and local officials that meet specified reporting criteria in NEI 07-07 (NEI 2007) (Exelon 2018a). Exelon also reports groundwater protection monitoring program results to the NRC as a component of the required annual radiological environmental operating reports (Exelon 2018a).

The NRC staff reviewed the information pertaining to inadvertent releases of radionuclides to groundwater described in Exelon's environmental report and supporting documents as well as in Exelon's annual radiological environmental operating reports submitted to the NRC over the last 5 years (Exelon 2015b, 2016a, 2017a, 2018d). The reports include Peach Bottom's NEI 07-07 industry groundwater protection program monitoring results.

In 2006, Exelon conducted a baseline hydrogeologic investigation at Peach Bottom in accordance with NEI 07-07 and began establishing its groundwater monitoring program as part of characterizing the site's groundwater environment. As part of this investigation, known historical spills or releases of radiological substances were evaluated with respect to potential impacts and three areas of the plant were identified as areas requiring investigation (Exelon 2018a).

Facility-specific investigations and expanded groundwater monitoring in 2008 and 2009 focused on the Unit 2 and 3 reactor and turbine building areas. This work in part was to assess an onsite tritium plume in site overburden materials (i.e., reworked residual soils and backfill) that was identified northeast of the Unit 3 turbine building and extending eastwardly along the prevailing direction of groundwater to the plant's intake basin flow (Exelon 2009a, Exelon 2010a, Exelon 2018a, GHD 2018). In July 2009, tritium concentrations in overburden groundwater were found to exceed the U.S. EPA and PDEP maximum contaminant level for drinking water (20,000 pCi/L) (40 CFR 141.66), with tritium concentrations ranging from 34,100 to 110,000 pCi/L on the northeast side of the Unit 3 turbine building. The tritium levels cited above were observed in temporary geo-probe or vacuum-hole wells installed by Exelon's contractor. In August 2009, permanent monitoring wells (MW-PB-24, MW-PB-25, and MW-PB-26, Figure 3-8) were installed in the overburden materials to replace the temporary wells. Groundwater in the overburden flows preferentially along the routing excavations made for underground circulating water and storm drain pipes toward monitoring well MW-PB-4 (Exelon 2010a, GHD 2018). During this timeframe, in June 2009, Exelon identified and stopped a valve that was leaking tritium-contaminated water into the Unit 3 condensate storage tank moat (Exelon 2010a, Exelon 2018a).



Source: Modified from Exelon 2018d

Figure 3-8 Groundwater Protection Program Monitoring Locations, Peach Bottom Site

In February 2010, installation of two bedrock monitoring wells (MW-PB-27 and MW-PB-28) produced a sharp increase in tritium concentrations in nearby overburden monitoring wells (MW-PB-24, MW-PB-25 and MW-PB-26). The highest tritium concentrations observed were in monitoring wells MW-PB-25 and MW-PB-26 at 161,000 and 196,000 pCi/L, respectively, in March 2010. By December 2010, concentrations had declined to 55,600 and 2,700 pCi/L, respectively (Exelon 2011a).

Subsequently, in 2010 and 2011, Exelon undertook corrective actions to eliminate another tritium leak source to groundwater from leaks within the Unit 3 turbine building moisture separator room. This first involved sealing the floor seams in August 2010 followed by sealing and recoating the entire floor in October 2011. These mitigation activities produced decreased tritium concentrations in the plume in 2011 (Exelon 2011a, Exelon 2012a, Exelon 2013, Exelon 2018a). Thereafter, Exelon had no recorded inadvertent spills or releases of radionuclides in 2011, 2012, 2013, and 2014 (Exelon 2018a).

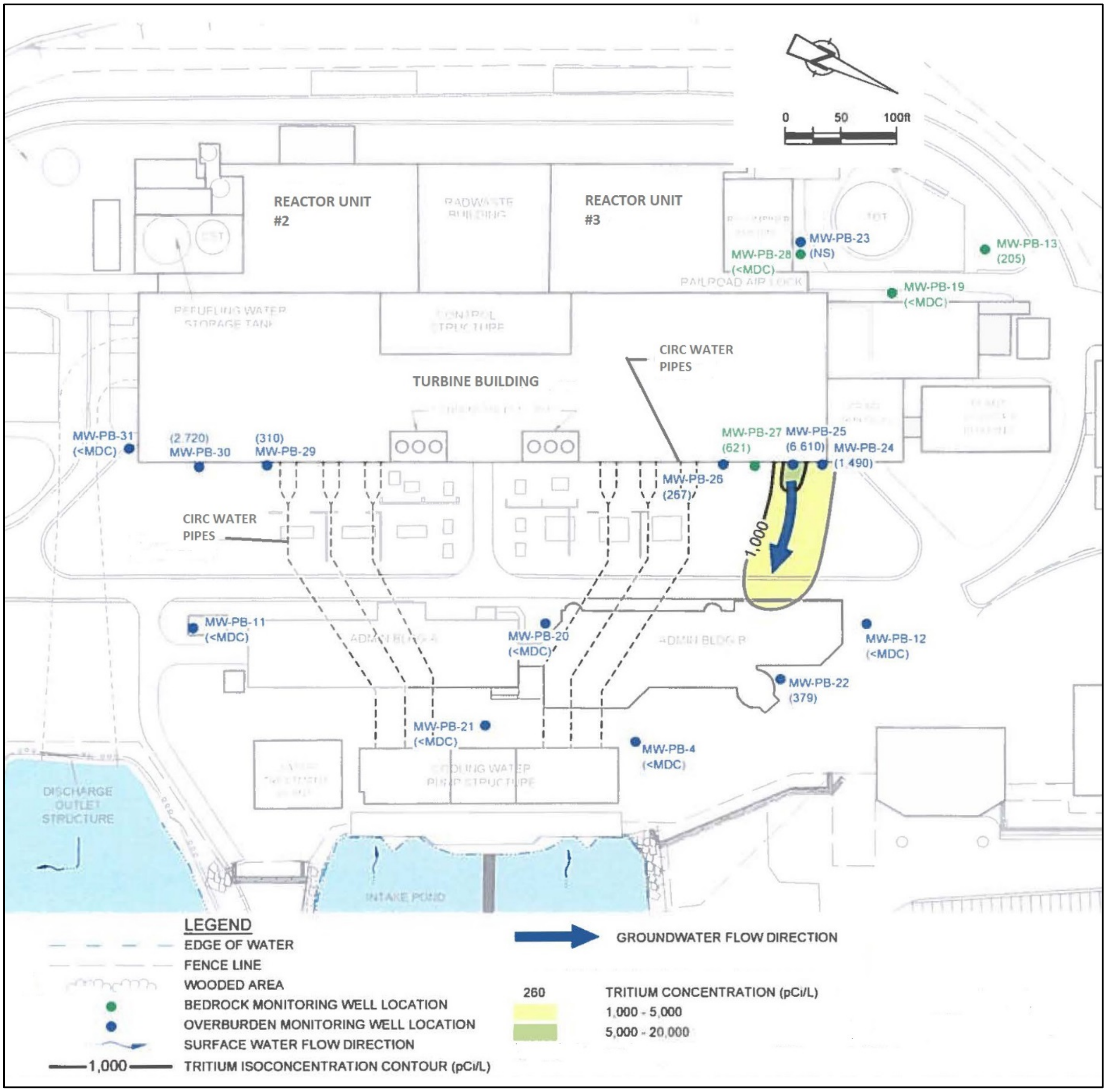
Since 2014, Exelon has recorded only one inadvertent (unplanned) release to groundwater at Peach Bottom (Exelon 2018a). On April 16, 2015, a review of groundwater monitoring results by Peach Bottom personnel revealed an increase in tritium activity in overburden groundwater in monitoring wells located east of the Unit 3 turbine building (i.e., MW-PB-24, MW-PB-25, MW-PB-26, and MW-PB-27). The highest tritium activity (37,700 pCi/L to 38,100 pCi/L) was observed in MW-PB-25 from samples dated April 7, 2015, and additional analysis confirmed the finding. Exelon voluntarily informed the NRC, PDEP Bureau of Radiation Protection, and other entities of the release on April 20, 2015. The source of the release was traced to the Unit 3 turbine building moisture separator area. An investigation determined that condensation had pooled on the floor and leaked through an opening in the floor to the ground below rather than to the floor drains. The floor drains were modified to allow any collected water to flow into the drains and the degraded area around a suspect source drain was repaired. Following the completion of the corrective actions, decreasing tritium activity was observed in monitoring wells (e.g., MW-PN-25) adjacent to the Unit 3 turbine building for the remainder of 2015 (Exelon 2016a, Exelon 2017a, Exelon 2018a).

A tritium plume, primarily confined to the overburden groundwater, continues to exist beneath the Peach Bottom plant complex. The plume is attributable to previous inadvertent spills and leaks from the plant as previously described. This oblong area of elevated concentrations of tritium in groundwater is depicted in Figure 3-9. The plume extends northeast of the Unit 3 turbine building in the direction of monitoring well MW-PB-4. Specifically, it is bounded by wells MW-PB-12 and MW-PB-22 to the north and wells MW-PB-20 and MW-PB-21 to south. The source of the plume is centered near wells MW-PB-24 and MW-PB-25 (Figure 3-8).

Table 3-5 summarizes the latest available radiological groundwater protection monitoring results for tritium reported to the NRC for representative well locations. The table compares the latest results to historical maximum observed concentrations. Monitoring well locations are depicted in Figure 3-8.

The maximum tritium concentrations in onsite wells at Peach Bottom are less than the drinking water standard of 20,000 pCi/L, and tritium is not detectable in the surface waters of Conowingo Pond. A concentration of 20,000 pCi/L of tritium also equates to the reporting action level specified in the Peach Bottom offsite dose calculation manual (Exelon 2010b). Further, tritium is not detectable in wells at or near the site property boundary (Exelon 2018d). The tritium plume does not extend beyond the confines of the plant property boundary and the plume does not threaten any offsite water supply wells given the direction of groundwater flow.

Additionally, Exelon's latest groundwater monitoring results show that gross alpha and gross beta concentrations are consistent with background concentrations. No strontium (i.e., strontium-89 or strontium-90) was detected in any samples, and there were no detections of plant-produced gamma-emitting radionuclides in site groundwater samples (Exelon 2018d).



Source: Modified from GHD 2018

Figure 3-9 Tritium Plume in Overburden Groundwater, Peach Bottom Site, 2017

Table 3-5 Representative Groundwater and Storm Drain Monitoring Results for Tritium, Peach Bottom Groundwater Protection Program, 2017 (in pCi/L)

Well or Site Number[(a)]	First Quarter[(b)]	Second Quarter[(b)]	Third Quarter[(b)]	Fourth Quarter[(b)]	Previous 4-year Maximum Concentration (Calendar Year-Qtr)
MW-PB-3(O)	< MDC	<MDC	<MDC	<MDC	<MDC
MW-PB-4(O)	201	<MDC	138	<MDC	1,090 (2013-Q1)
MW-PB-12(O)	<MDC	<MDC	<MDC	<MDC	323 (2015-Q4)
MW-PB-20(O)	<MDC	<MDC	<MDC	<MDC	<MDC
MW-PB-21(O)	<MDC	<MDC	<MDC	181	227 (2014-Q3)
MW-PB-22(O)	322	220	379	663	1,080 (2013-Q3)
MW-PB-24(O)	815	2,250	1,850	510	3,270 (2016-Q3)
MW-PB-25(O)	17,600	7,760	6,610	13,900	38,100 (2015-Q2)
MW-PB-26 (O)	418	333	267	237	1,740 (2015-Q2)
MW-PB-27(B)	890	942	758	504	7,850 (2013-Q1)
MW-PB-28(B)	<MDC	<MDC	<MDC	190	422 (2015-Q3)
SP-PB-2(S)	<MDC	<MDC	<MDC	<MDC	<MDC
U2 Yard Drain	242	<MDC	<MDC	<MDC	267 (2015-Q3)
U3 Yard Drain	1,150	463	<MDC	195	618 (2016-Q1)
SW-PB-5(SW)	<MDC	<MDC	<MDC	<MDC	<MDC

Notes: < MDC=below minimum detectable concentration for the sample; < less than.

(a) Monitoring wells (MW), groundwater seeps (SP), and surface water (SW) monitoring locations; O=overburden groundwater; B=bedrock groundwater; S=seep; SW=surface water.

(b) All results are reported in pCi/L; if greater than the MDC, reported as the statistical mean with the analytical uncertainty (plus/minus 2 standard deviations) omitted. Values are highest reported for each sampling period. Quarterly samples are generally collected January–February, April–May, July-August, and October–November or more frequently as warranted.

Source: Exelon 2014a, 2015b, 2016a, 2017a, 2018e

With respect to unplanned, nonradiological releases, Exelon reports that there have been no accidental spills or similar releases of nonradioactive substances, including petroleum products, at Peach Bottom over the past 5 years (2014–2018), or any associated notices of violation issued to Exelon for releases from Peach Bottom (Exelon 2018c). The NRC staff's review of available information and regulatory databases found no documented instances of accidental spills of chemical or petroleum products to groundwater that resulted in a regulatory action over the last 5 years (EPA 2018a, PDEP 2018b).

3.6 Terrestrial Resources

This section describes the terrestrial resources of the affected environment, including the surrounding ecoregion, species, and vegetative communities present on the Peach Bottom site, and important species and habitats potentially present on or near the site.

3.6.1 Peach Bottom Ecoregion

The Peach Bottom site lies within the Northern Piedmont ecoregion and the Piedmont physiographic province. This ecoregion covers approximately 11,629 mi^2 (30,120 km^2) in New Jersey, Pennsylvania, Delaware, Maryland, the District of Columbia, and Virginia. It serves as a transitional zone between the Atlantic coast and more mountainous regions to the west and north. The majority of the region was never glaciated, and terrain includes low rounded hills, irregular plains, and open valleys (Auch et al. 2012; Barbour and Anderson 2003). The Northern Piedmont has a humid continental climate with cold winters and hot summers, 40 in. (100 cm) or more of rain per year, and an average of 170 to 210 frost-free days (Woods et al. 1999).

Appalachian oak forest and oak-hickory-pine forest are the predominant native vegetative communities. The former is dominated by red (*Quercus rubra*) and white (*Q. alba*) oaks, and the latter is dominated by hickory (*Carya* species (spp.)), Virginia pine (*Pinus virginiana*), pitch pine (*Pinus rigida*), chestnut oak (*Q. prinus*), white oak, and black oak (*Q. velutina*) (Woods et al. 1999). Wetlands occupy the majority of valleys, and streams are primarily perennial. Many of the ecoregion's wetlands are calcareous, a rare type of wetland that is supported by upland seepage that permeates through limestone or dolostone, resulting in high pH and high concentrations of calcium and magnesium (Barbour and Anderson 2003). Calcareous wetlands are typically saturated to the surface but rarely inundated and support a diverse biotic community. Large portions of the Appalachian Mountains lie within the ecoregion as well. Typical wildlife include white-tailed deer (*Odocoileus virginianus*), gray fox (*Urocyon cinereoargenteus*), red squirrel (*Tamiasciurus hudsonicus*), raccoon (*Procyon lotor*), eastern cottontail (*Sylvilagus floridanus*), mink (*Neovison vison*), muskrat (*Ondatra zibethicus*), ruffed grouse (*Bonasa umbellus*), eastern meadowlark (*Sturnella magna*), field sparrow (*Spizella pusilla*), and great blue heron (*Ardea herodias*) (Wiken et al. 2011).

Upon European settlement, the ecoregion was significantly disturbed for agricultural use. More than 90 percent of original forest cover was removed in the first half of the 1900s leaving only a few patches of old growth forest in remote, inaccessible mountainous areas (Barbour and Anderson 2003). During this time, the chestnut blight also significantly affected the composition of native forests and caused the functional extinction of the American chestnut (*Castanea dentata*), which had previously been the predominant tree in eastern forests. During the second half of the 1900s, agricultural lands were converted to developed uses as major population centers emerged. This ecoregion supports some of the highest levels of land development in the Eastern ecoregions, and urbanization continues to intensify with time. Today, the majority of land is occupied for urban, suburban, and industrial uses. Remaining agricultural lands are typically cultivated for feed, forage crops, and soybeans, as well as used to support nurseries and other horticultural products.

3.6.2 Peach Bottom Site

As described in Section 3.2, "Land Use and Visual Resources," Peach Bottom lies within a 769-ac (311-ha) site in Peach Bottom Township, York County, PA, on the west side of Conowingo Pond, a dammed portion of the Susquehanna River. The site lies 19 mi (31 km) southwest of Lancaster, PA, and 38 mi (61 km) north of Baltimore, MD. Site-specific information in this section is derived from the environmental report that Exelon prepared as part of its subsequent license renewal application (Exelon 2018a) unless otherwise cited.

While the primary function of the Peach Bottom site is for industrial use, much of the site is undeveloped. Roughly half the site is forested (356 ac (144 ha)). Shrub/scrub, woody wetlands, herbaceous cover, and barren land account for an additional 113 ac (46 ha). Approximately 60 ac (24 ha) are cultivated for crops. Open water covers 113 ac (46 ha), and the remainder of the site (127 ac (52 ha)) is occupied by electrical generation and maintenance facilities, laydown areas, parking lots, and roads.

Forested areas occur on the ridges and slopes west of the electrical generating and support facilities, and the primary community types are oak-hickory and oak-tulip tree. Oak-hickory forests occur in slightly drier areas and lack the richer forest species, such as tulip poplar (*Liriodendron tulipifera*), American beech (*Fagus grandifolia*), and sweet birch (*Betual lenta*). Table 3-6 lists the characteristic vegetation of these communities, and Table 3-7 identifies the typical wildlife of both communities.

Table 3-6 Characteristic Vegetation of Oak-Hickory and Oak-Tulip Forests

Oak-Hickory Forests	Species Common in Both Forest Types	Oak-Tulip Forests
HICKORIES (*Carya* spp.)	**OAKS** (*Quercus* spp.)	**TULIPS** (*Liriodendron* spp.)
bitternut (*C. cordiformis*) pignut (*C. glabra*) shagbark (*C. ovata*)	white (*Q. alba*) scarlet (*Q. coccinea*) chestnut (*Q. prinus*) red (*Q. rubra*) black (*Q. velutina*)	Tulip poplar (*L. tulipifera*)
	OTHER TREES	
white ash (*Fraxinus americana*) hophornbeam (*Ostrya virginiana*)	red maple (*Acer rubrum*) sugar maple (*Acer saccararum*) dogwood (*Cornus florida*) white ash (*Fraxinus americana*)	sweet birch (*Betula lenta*) American beech (*Fagus grandifolia*)
	SHRUBS	
beaked hazelnut (*Corylus cornuta*) hawthorn (*Crateagus* spp.) mountain laurel (*Kalmia latifolia*)	blueberry (*Vaccinium* spp.) mapleleaf viburnum (*Viburnum acerifolium*)	witch hazel (*Hamamelis virginiana*) spicebush (*Lindera benzoin*) sassafras (*Sassafras albidum*)

Table 3-6 Characteristic Vegetation of Oak-Hickory and Oak-Tulip Forests (cont.)

Oak-Hickory Forests	Species Common in Both Forest Types	Oak-Tulip Forests
HERBS		**HERBS**
roundleaf liverleaf (*Anemone americana*)		white wood-aster (*Eurybia divaricata*)
wild sarsaparilla (*Aralia nudicaulis*)		large false Solomon's-seal (*Maianthemum racemosum*)
Pennsylvania sedge (*Carex pensylvanica*)		common Solomon's-seal (*Polygonatum biflorum*)
black snakeroot (*Cimicifuga racemosa*)		Christmas fern (*Polystichum acrostichoides*)
Solomon's plume (*Smilacina racemosa*)		New York fern (*Thelypteris novaboracenis*)

Information source: NYNHP 2017, 2018

Table 3-7 Wildlife Typical of Forest and Riparian Communities on the Peach Bottom Site

Species	Common Name
Amphibians	
Desmognathus fuscus	northern dusky salamander
Notophthalmus viridescens	eastern newt
Birds	
Accipiter gentilis	northern goshawk
Antrostomus vociferus	whip-poor-will
Bonasa umbellus	ruffed grouse
Buteo jamaicensis	red-tailed hawk
Cardellina canadensis	Canada warbler
Colaptes auratus	northern flicker
Colinus virginianus	northern bobwhite
Cyanocitta cristata	blue jay
Dryobates pubescens	downy woodpecker
Haliaeetus leucocephalus	bald eagle
Hylocichla mustelina	wood thrush
Megascops asio	eastern screech owl
Meleagris gallopavo	wild turkey
Melospiza melodia	song sparrow
Phasianus colchicus	ring-necked pheasant
Pipilo erythrophthalmus	eastern towhee
Strix varia	barred owl
Thryothorus ludovicianus	Carolina wren

Table 3-7 Wildlife Typical of Forest and Riparian Communities on the Peach Bottom Site (cont.)

Species	Common Name
Mammals	
Castor canadensis	North American beaver
Lasionycteris noctivagans	silver-haired bat
Mephitis mephitis	striped skunk
Neovison vison	American mink
Odocoileus virginianus	white-tailed deer
Ondatra zibethicus	muskrat
Procyon lotor	raccoon
Sciurus carolinensis	gray squirrel
Sylvilagus transitionalis	New England cottontail
Tamias striatus	chipmunk
Urocyon cinereoargenteus	gray fox
Ursus americanus	black bear
Reptiles	
Agkistrodon contortrix	copperhead
Chrysemys picta	painted turtle
Coluber constrictor	black racer
Crotalus horridus	timber rattlesnake
Heterodon platirhinos	eastern hognose snake
Lithobates catesbeianus	American bullfrog
Lithobates pipiens	northern leopard frog
Terrapene carolina carolina	eastern box turtle

Source: AEC 1973, NRC 2003a

3.6.3 Environmental Stewardship Initiatives

Exelon holds Silver Certification from the Wildlife Habitat Council for its management of the Peach Bottom site (Exelon 2018c). The Wildlife Habitat Council is a third-party organization that recognizes and certifies meaningful natural resource conservation programs on corporate lands. Related to this certification, Exelon has undertaken a number of wildlife habitat enhancement and other environmental stewardship projects on the Peach Bottom site, including the following:

- Creation of a pollinator garden containing wildflowers and bushes targeted at attracting native pollinators
- Placement of ten solitary bee hives throughout the site
- Creation of nesting roosts for bald eagles (*Haliaeetus leucocephalus*) and ospreys (*Pandion haliaetus*)
- Placement of nesting boxes for eastern bluebirds (*Sialia sialis*) and wood ducks (*Aix sponsa*)

- Creation of wildlife food plots in outlying meadow areas that contain white (*Trifolium repens*), red (*T. pratense*), crimson clover (*T. incarnatum*), and other herbaceous plants intended to attract pollinators, wild turkey, and other game birds
- Implementation of a white-tailed deer management program to control the local deer population and protect vegetation from over-browsing

3.6.4 Important Species and Habitats

3.6.4.1 State Endangered and Threatened Species

The Commonwealth of Pennsylvania divides authority to designate the status of and to implement programs for the conservation of species to three agencies: Pennsylvania Game Commission for birds and mammals; Pennsylvania Fish and Boat Commission for reptiles, amphibians, and fish; and Pennsylvania Department of Conservation and Natural Resources for plants.

These agencies, in partnership with the Western Pennsylvania Conservancy, form the Pennsylvania Natural Heritage Program, which collects data on the Commonwealth's native biological diversity and guides the conservation work and land-use planning. Additionally, the Pennsylvania Biological Survey, a nonprofit, all-volunteer organization, is responsible for evaluating the population status of species within Pennsylvania and recommending that the responsible State agency designate those species the appropriate regulatory status (i.e., State-endangered or State-threatened).

During preparation of its subsequent license renewal application, Exelon used the Pennsylvania Natural Heritage Program's Pennsylvania Natural Diversity Inventory (PNDI) Environmental Review Tool, an online Web-mapping tool, to determine the species and habitats potentially present on or near the Peach Bottom site. Exelon included the associated report (PNDI 2018) in Appendix C of its environmental report. While the Pennsylvania Natural Heritage Program (PNHP 2018) identifies over 50 animals and plants that occur in York County as endangered, threatened, rare, or candidates (species that could become endangered or threatened in the future), the PNDI tool identified only two State-listed species, both of which are plants, with the potential to occur on the Peach Bottom site or to potentially be affected by the proposed license renewal:

- harbinger-of-spring (*Erigenia bulbosa*)
- American holly (*Ilex opaca*)

A third species, lobed spleenwort (*Asplenium pinnatifidum*), currently has no legal status but is under review for possible future listing. The three species are described below. The PNDI tool also identified the bog turtle (*Glyptemys muhlenbergii*), a federally threatened species, as a species for which the U.S. Fish and Wildlife Service should be consulted. The NRC staff discusses the bog turtle in Section 3.8.1, "Species and Habitats Protected Under the Endangered Species Act."

Harbinger-of-Spring

Harbinger-of-spring is a perennial herb and one of the earliest-blooming wildflowers in Pennsylvania. It grows on wooded slopes, floodplain forests, and in rich woodlands, and its small, white flowers form in small clusters at the end of a long stalk beginning in March and continuing through early April (PNHP 2014b). About 40 populations are currently known from Pennsylvania, most of which occur in the westernmost counties (PNHP 2014b). The Pennsylvania Department of Conservation and Natural Resources lists this species as threatened, the Pennsylvania Biological Survey considers it to be of special concern, and NatureServe ranks it as G5 ("Secure globally") and S4 ("Apparently secure in Pennsylvania") (PNHP 2018).

A population of harbinger-of-spring occurs within the Peach Bottom Woods site—a rich, wooded, east-facing slope in the southern portion of the Peach Bottom site (Exelon 2018a; YCPC 2004). The York County Planning Commission (YCPC 2004) reports that this population was identified beneath a stand of tulip poplar, sweet birch, and ash (*Fraxinus* spp.) during 1993 and 2000 site visits in support of the York County Natural Areas Inventory. Surveyors observed several associated herbs, including Dutchman's-breeches (*Dicentra cucullaria*), Virginia waterleaf (*Hydrophyllum virginianum*), and toothwort (*Dentaria* spp.). The Commission noted that although there were no immediate threats to the Peach Bottom Woods population, several nearby aggressive exotic species, including Japanese honeysuckle (*Lonicera japonica*), could encroach on the populations' habitat in the future. The Commission ranked the Peach Bottom Woods population quality as "good" to "fair," which means that the population is still in recovery from early disturbance or recent light disturbance or is nearly undisturbed but of small to moderate size and number. Protection of such a ranked population could help conserve the diversity of the region's or County's biota or is important to the survival of the species in Pennsylvania.

American Holly

American holly is a small evergreen tree with stiff, leathery foliage and bright red fruit. It is widely distributed in the eastern United States from Massachusetts to Florida, and it also occurs west to Texas and Missouri. In Pennsylvania, the species is near the northern extent of its range and occurs mostly in the southeastern counties (PNHP 2014a). American holly can adapt to a wide range of site conditions. It grows best in full sun on well-drained, sandy soils and wooded slopes but will tolerate shade and somewhat poorly drained soils (USDA 2018l). The Pennsylvania Department of Conservation and Natural Resources lists this species as threatened, the Pennsylvania Biological Survey considers the species to be of special concern, and NatureServe ranks it as G5 ("Secure globally") and S2 ("Imperiled") (PNHP 2018).

A population of American holly occurs within the Atom Road Woods site, a previously logged site on a forested slope along the Susquehanna River that extends into the western portion of the Peach Bottom site (Exelon 2018a; YCPC 2004). The area contains schist/quartzite rock outcrops, and dominant species include tulip poplar, American beech, and sweet birch with an understory consisting of wood fern (*Dryotheris* ssp.), Christmas fern (*Polystichum acrostichoides*), and mountain laurel (*Kalmia latifolia*). The York County Planning Commission (YCPC 2004) reports that a small, scattered population of American holly was present at the Atom Road Woods site during an April 1993 site visit. In 1999, the Commission identified a new population downstream of the original population. The Commission ranked the two populations' quality as "poor," which is the rank assigned to populations in severely disturbed areas with a high likelihood of dying out or being destroyed.

Lobed Spleenwort

Lobed spleenwort is a small fern that grows from a short rhizome on dry shaded cliffs and rock outcrops, particularly on sandstone and schist (PNHP 2014c). The species is designated as a

“Pennsylvania Rare” species by the Pennsylvania Department of Conservation and Natural Resources, a “Species of Special Concern” by the Pennsylvania Biological Survey, and “Vulnerable” by NatureServe (PNHP 2018). Lobed spleenwort is of particular concern due to its specialized habitat, and only about two dozen small populations are currently known to occur in the Commonwealth (PNHP 2014c).

A population of lobed spleenwort occurs within rock outcrops at the Atom Road Woods site (Exelon 2018a; YCPC 2004). The York County Planning Commission (YCPC 2004) reports that this population was present during an April 1999 site visit, at which time the Commission ranked it as being of “poor” quality.

3.6.4.2 Pennsylvania-Responsibility Species

The Pennsylvania Biological Survey designates certain species as Pennsylvania-responsibility species, a term that refers to a species or subspecies for which Pennsylvania plays a key role in sustaining its global security by hosting at least 10 percent of its North American population or encompassing at least 25 percent of its North American range. This designation may be applied in addition to the regulatory status of State-endangered or State-threatened for certain species. Within York County, the Pennsylvania Biological Survey designates the following species as Pennsylvania-responsibility species:

- bog turtle
- glade spurge (*Euphorbia purpurea*)
- Henslow’s sparrow (*Ammodramus henslowii*)
- northern long-eared bat (*Myotis septentrionalis*)
- regal fritillary (*Speyeria idalia*)
- spreading rockcress (*Arabis patens*)
- timber rattlesnake (*Crotalus horridus*)

Although these species occur or may occur within York County, Exelon has no specific records of the above species occurring on or in the vicinity of the Peach Bottom site. The bog turtle and northern long-eared bat are also federally listed as threatened under the Endangered Species Act (16 U.S.C. Section 1801 et seq.) and are discussed in detail in Section 3.8.1.2, “Species and Habitats Under U.S. Fish and Wildlife Jurisdiction,” of this SEIS.

3.6.4.3 Bald Eagles

Bald eagles are federally protected under the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. 668–668c) . This act prohibits anyone from taking, possessing, or transporting an eagle, or the parts, nests, or eggs of eagles, without prior authorization and a U.S. Fish and Wildlife Service-issued permit. This includes nests, whether active or inactive.

Exelon (2018a) reports that three intact bald eagle nests occur along Conowingo Pond near the Peach Bottom site. One nest is within the northern portion of the site on a wooded slope above the river; another is on a transmission line structure in Conowingo Pond; and the third is on a structure in Conowingo Pond north of the site.

During preparation of its license renewal application, Exelon coordinated with the U.S. Fish and Wildlife Service concerning the potential impacts of continued operation of Peach Bottom on bald eagles. Exelon submitted a Bald Eagle Screening Form (Exelon 2017b) to the Service by letter dated September 26, 2017 (Exelon 2017d). In the form, Exelon identified several categories of maintenance and restoration activities that would be associated with the proposed Peach Bottom subsequent license renewal, including:

- Linear utility maintenance (e.g., power lines, pipelines, water and sewer lines)
- Road, bridge, or culvert maintenance
- Dam, levee, berm, canal, and other water-control structure maintenance
- Pond, lake, or reservoir maintenance (e.g., draw downs, dredging)
- Upland habitat maintenance or restoration (e.g., planting or cutting of vegetation, invasive plant control, trash cleanup)

Exelon committed to the U.S. Fish and Wildlife Service to abide by the following measures to avoid disturbing bald eagles and their young.

- From January 1 to July 31 (the breeding season), all activities that may disturb bald eagles will be avoided within 660 ft (200 m) of the nest. This includes, but is not limited to the following: construction, excavation, use of heavy equipment, use of loud equipment or machinery, vegetation clearing, earth disturbance, planting, landscaping, and habitat restoration activities.
- Established landscape buffers that screen the activity from the nest will be maintained.
- If prescribed burning is necessary during the breeding season (January 1 to July 31), burns will only be conducted when adult eagles and young are absent from the nest tree (i.e., at the beginning of, or end of, the breeding season, either before the particular nest is active or after the young have fledged from that nest). Leaves and woody debris will be raked from around the nest tree to prevent crown fire or fire climbing the nest tree.

The U.S. Fish and Wildlife Service (FWS 2017a) confirmed receipt of Exelon's signed Bald Eagle Project Screening Form in a letter dated November 2, 2017.

3.6.4.4 Migratory Birds

The Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703–712}, makes it illegal to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird, except under the terms of a valid Federal permit. The Act currently protects a total of 1,026 migratory species (78 FR 65844), as specified in 50 CFR 10.13, "List of Migratory Birds."

In the vicinity of the Peach Bottom site, the U.S. Fish and Wildlife Service identifies 10 migratory birds as species of particular concern because they either occur on the Service's Birds of Conservation Concern list or otherwise warrant special attention. Table 3-8 identifies these species, their breeding seasons, and probability of their presence in the vicinity of the Peach Bottom site.

Table 3-8 Migratory Birds of Particular Concern Near of the Peach Bottom Site

Species	Common Name	Breeding Season	Probability of Presence[a]
Haliaeetus leucocephalus	bald eagle	Sept 1 to July 31	High year round
Vermivora pinus	blue-winged warbler	May 1 to June 30	Medium in June and September
Dendroica cerulean	cerulean warbler	Apr 28 to July 20	Medium from late April through late July
Antrostomus vociferus	eastern whip-poor-will	May 1 to Aug 20	Medium from mid-May to mid-June
Aquila chrysaetos	golden eagle	Breeds elsewhere	Medium from late Nov through mid-January
Oporornis formosus	Kentucky warbler	Apr 20 to Aug 20	High from mid-April through June
Dendroica discolor	prairie warbler	May 1 to July 31	Medium late May through early September
Protonotaria citrea	prothonotary warbler	Apr 1 to July 31	Medium to high from late April through June and in August
Melanerpes erythrocephalus	red-headed woodpecker	May 10 to Sept 10	Medium from April through November
Hylocichla mustelina	wood thrush	May 10 to Aug 31	High from late April through mid-September

[a] The U.S. Fish and Wildlife Service calculates the relative probability of presence for a species in a given project area based on available survey results and effort within the past 10 years. The Service scores each week of the year with a relative probability of 0 to 10. The NRC staff has simplified these scores into narrative descriptions in this table.

Source: FWS 2018b

In addition to these migratory birds, Exelon personnel report observing black-crowned night herons (*Nycticorax nycticorax*), green night herons (*Nycticorax nycticorax*), great blue herons (*Ardea herodias*), double-crested cormorants (*Phalacrocorax auritus*), mallards (*Anas platyrhynchos*), wood ducks, canvasbacks (*Aythya valisineria*), blue-winged teals (*Anas discors*), Barrow's golden eyes (*Bucephala islandica*), greater scaup (*Aythya marila*), and hooded mergansers (*Lophodytes cucullatus*), among a variety of other shorebirds and waterfowl. All of these species are protected under the Migratory Bird Treaty Act.

The final environmental statement for operation of Peach Bottom (AEC 1973) identifies the following additional migratory birds as having been observed on the Peach Bottom site: green heron (*Butorides virescens*), cattle egret (*Bubulcus ibis*), American bittern (*Botaurus lentiginosus*), snow goose (*Chen caerulescens*), American black duck (*Anas rubripes*), northern pintail (*Anas acuta*), redhead (*Aythya americana*), ring-necked duck (*Aythya collaris*), bufflehead (*Bucephala albeola*), turkey vulture (*Cathartes aura*), sharp-shinned hawk (*Accipiter striatus*), red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), broad-winged hawk (*Buteo platypterus*), American coot (*Fulica americana*), killdeer (*Charadrius vociferus*), spotted sandpiper (*Actitis macularius*), common tern (*Sterna hirundo*), Caspian tern (*Hydroprogne caspia*), and great horned owl (*Bubo virginianus*), among others.

3.6.4.5 Important Bird Areas

The National Audubon Society recognizes two Important Bird Areas in York County: Codorus State Park and Kiwanis Lake Rookery, which lie 30 m (48 km) west and 30 mi (48 km) northwest of the Peach Bottom site, respectively. Codorus State Park consists of a mixture of oak, northern hardwood, and pine and larch plantations surrounding a 1,275-ac (516-ha) lake. Mudflats at low water provide high-quality habitat for migrating birds, and a variety of shorebirds and birds of prey inhabit the area, including the American coot (*Fulica americana*), bald eagle, black tern (*Chlidonias niger*), black-crowned night heron, Eurasian teal (*Anas crecca*), great egret (*Ardea alba*), northern harrier (*Circus hudsonius*), osprey, and pied-billed grebe (*Podilymbus podiceps*) (Audubon 2018a). Kiwanis Lake Rookery provides breeding and nesting habitat for the great egret, black-crowned night heron, and other shorebirds. Golden-crowned kinglets (*Regulus satrapa*), merlins (*Falco columbarius*), Carolina wrens (*Thryothorus ludovicianus*), brown creepers (*Certhia americana*), yellow-bellied sapsuckers (*Sphyrapicus varius*), eastern phoebes (*Sayornis phoebe*), chipping sparrows (*Spizella passerina*), and northern cardinals (*Cardinalis cardinalis*), among other species, have also been observed in the area. (eBird 2018a).

In Maryland, the Susquehanna River Important Bird Area includes two forested blocks on the east and west side of the river that encompass 10,010 ac (4,051 ha) from the Pennsylvania line in Cecil County south to I-95 in Harford County. The area includes the open waters of Susquehanna River from Conowingo Dam south to the southern tip of Spencer Island. Oak-hickory forests account for the majority of the land area and support a variety of woodland songbirds, including rose-breasted grosbeaks (*Pheucticus ludovicianus*), white-eyed vireos (*Vireo griseus*), blue-winged warblers (*Vermivora cyanoptera*), prairie warblers (*Setophaga discolor*), yellow-breasted chats (*Icteria virens*), and eastern bluebirds (*Sialia sialis*) (Audubon 2018b).

3.6.4.6 Pennsylvania Amphibian and Reptile Survey

The Pennsylvania Fish & Boat Commission and the Mid-Atlantic Center for Herpetology and Conservation maintain the Pennsylvania Amphibian and Reptile Survey, whose purpose is to determine the distribution and status of amphibians and reptiles in Pennsylvania and to assist in the study and recovery of those species that are State- and federally listed. The survey has documented 48 amphibian and reptile species in York County (9 salamanders, 10 frogs and toads, 14 turtles, 12 snakes, and 3 lizards). The eastern red-backed salamander (*Plethodon cinereus*), eastern American toad (*Anaxyrus americanus*), green frog (*Lithobates clamitans*), spring peeper (*Pseudacris crucifer*), and northern two-lined salamander (*Eurycea bislineata*) are among the most commonly observed species in the county (PARS 2018a). The bog turtle is the only State- or federally listed species that has been recorded by the survey. The survey's most recent record of this species is from October 2016 when four adults were observed in emergent wetland habitat (PARS 2018b).

3.6.4.7 Important Mammal Areas Project

In 2001, the Pennsylvania Game Commission together with the Pennsylvania Biological Survey, National Wildlife Federation, and several other conservation organizations launched the Important Mammal Areas Project to focus public awareness on important mammals and their habitats and provide landowners and governmental agencies with information to complement land management and land use decisions. Sites are chosen based on the diversity and quality of habitats and uniqueness of the mammal community present. Currently, designation of a site as an Important Mammal Area affords no legal protection. One Important Mammal Area occurs in York County, the East Berlin Shrew site (PGC 2018). This 356-ac (144ha) site lies roughly 35 mi (56 km) northwest of the Peach Bottom site and contains one of only five known populations of least shrews (*Cryptotis parva*) in the State (PGC 2018). The site is privately owned and cultivated for agricultural crops. The prairie deer mouse (*Peromyscus maniculatus bairdii*), another grassland inhabitant, is a co-occurring species.

3.6.4.8 Locally Significant Habitats

The York County Planning Commission (YCPC 2004) identifies the Southside Woods as a locally significant terrestrial habitat within Peach Bottom Township. Southside Woods lies in northwestern Peach Bottom Township roughly 7 mi (11 km) west of the Peach Bottom site. The site encompasses a forested area on both sides of Muddy Creek. Hemlock (*Tsuga canadensis*), tulip poplar, and yellow birch (*Betula alleghaniensis*) dominate the community, and the mixed ages of the trees and good regeneration provide habitat with good potential for rare species.

3.6.5 Non-Native and Invasive Species

Non-native species are those species that are present only as a result of introduction and that would not naturally occur either currently or historically in an ecosystem. Invasive species are those non-native species whose introduction does or is likely to cause economic or environmental harm or harm to human health (64 FR 6183). The Center for Invasive Species and Ecosystem Health (CISEH 2018) identifies 285 invasive species in York County, PA. The Natural Resources Conservation Service (NRCS 2018a) identifies the following invasive plants in Pennsylvania as noxious weeds, which are plants that directly or indirectly cause damage to crops, livestock, irrigation, navigation, the public health, or other natural resources.

- musk thistle (*Carduus nutans*)
- Canadian thistle (*Cirsium arvense*)
- bull thistle (*Cirsium vulgare*)
- jimsonweed (*Datura stramonium*)
- goatsrue (*Galega officinalis*)
- giant hogweed (*Heracleum mantegazzianum*)
- purple loosestrife (*Lythrum salicaria*)
- mile-a-minute (*Polygonum perfoliatum*)
- kudzu-vine (*Pueraria montana*)
- multiflora rose (*Rosa multiflora*)

- shattercane (*Sorghum bicolor*)
- johnsongrass (*Sorghum halepense*)

Exelon (2018c) personnel have observed tree-of-heaven, multiflora rose, and mile-a-minute on the Peach Bottom site. Exelon personnel have undertaken efforts to remove some tree-of-heaven individuals in certain areas of the site as part of ongoing site environmental stewardship initiatives. Additionally, personnel typically mow or remove mile-a-minute and other noxious weeds during regular site vegetative maintenance.

3.7 Aquatic Resources

The aquatic communities of interest for the Peach Bottom site occur in Conowingo Pond, which is a reservoir on the Susquehanna River formed by the Conowingo Dam when it was built in 1928 (NAI and ERM 2014). Peach Bottom is located approximately 8.5-mi (13.7-km) upstream of the Conowingo Dam and approximately 6-mi (9.7-km) downstream of Holtwood Dam. The Conowingo Pond makes up the eastern boundary of the Peach Bottom site, and it supplies makeup water to Peach Bottom's cooling system. The Conowingo Pond also receives the plant's cooling system blowdown. Earlier in this chapter, Section 3.1.3, "Cooling and Auxiliary Water Systems," describes Peach Bottom's cooling system in detail, and Section 3.5.1, "Surface Water Resources," describes the surface water characteristics of the Susquehanna River, Conowingo Pond, and other onsite waterbodies.

The sections below describe the environmental changes within the Susquehanna River, the aquatic habitats and species within the Susquehanna River near Peach Bottom, the aquatic habitats and species of other onsite aquatic resources, State-listed aquatic species near Peach Bottom, and non-native species that occur near Peach Bottom.

3.7.1 Environmental Changes in the Susquehanna River

The Susquehanna River basin includes the largest drainage area on the Atlantic coast of the United States. The river flows 444 mi (715 km) from headwaters at Otsego Lake, NY, through Pennsylvania and Maryland until it empties into the Chesapeake Bay near Havre de Grace, MD (PFBC 2011).

The Susquehanna River historically contained abundant aquatic resources, including large populations of mussels and migratory fish (such as anadromous fish, which migrate from the sea to spawn in freshwater rivers and streams; catadromous fish, which migrate from freshwater to spawn in marine waters; and potamodromous fish, which undertake breeding or dispersal migrations wholly within freshwater). However, the decline in water quality, impoundments that blocked fish passages, and the introduction of non-native species have significantly affected species abundance and composition within the Susquehanna River.

Around the turn of the 18th century, coal mining became a predominant industry within the Susquehanna River Basin. Mining waste effluents degraded downstream water quality and reduced optimal habitat for aquatic life (PFBC 2011). For example, the flow of acidic waters from mines, known as acid mine drainage, lowered pH values and increased dissolution of heavy metals in the river. Aquatic biota often cannot survive in waters with low pH values and increased concentrations of heavy metals (Sadak 2008). The rise of agriculture and the lumber industry further contributed to land use changes that subsequently influenced the decline in water quality due to the increased runoff of nutrients and other contaminants (PFBC 2011). Farming practices currently include the use of fertilizers, pesticides, and herbicides, which wash into the Susquehanna River, especially after large rain events. Plowed fields, as compared to forested areas, also increase the amount of sediments entering the Susquehanna River.

The rise of the lumber, mining, and other industries in the 18th and 19th centuries also influenced the use of the Susquehanna River as a primary transportation route. To facilitate boat navigation, control flooding, and eventually to produce electricity, impoundments were built along the river. Dams have had a significant effect on aquatic habitats by blocking fish migrations, altering the hydrology (e.g., flow speed and current patterns) of the river, and increasing sedimentation in areas of low flow. As a result, many native and migratory fish populations have declined due to limited fish passage to important spawning grounds and poorer water quality. Mussels have also experienced a significant decline. Benthic (bottom-dwelling), sessile invertebrates such as mussels, are particularly susceptible to increases in sedimentation due to the need for clear (non-turbid) water to siphon food and because they are sessile (unable to move) to avoid low-quality habitat. (PFBC 2011)

More recently, the addition of fish lifts on many of the dams, such as the Holtwood Dam and the Conowingo Dam, have helped to increase fish passage and to increase the reach of the river over which fish can migrate upstream. Nonetheless, the populations of anadromous species have not fully recovered to the pre-1900 population size and many species, such as blueback herring (*Alosa aestivalis*) and alewife (*Alosa pseudoharengus*), remain relatively uncommon within the Susquehanna River, especially upstream of Conowingo Dam.

3.7.2 Aquatic Resources in the Susquehanna River

The sections below describe the aquatic habitats and biota near Peach Bottom.

3.7.2.1 Aquatic Habitats near Peach Bottom

The Susquehanna River is a long, meandering river largely influenced by the regional topography and underlying geology (PFBC 2011). A river meanders as it erodes the outer bank and then deposits the sediment on the inner bank, which results in a diverse set of habitats, such as extensive floodplains, vegetative-lined river banks, and other shallow-water habitats. These waterbody features often provide high-quality habitat for aquatic biota due to the structural complexity that supports spawning, feeding, and refuge from predators. In addition, in areas with good water quality, more sunlight can penetrate through the shallow water and help promote the growth of mussel beds and submerged aquatic vegetation.

Impoundments have significantly influenced the hydrology and ecology of the Susquehanna River (PFBC 2011). Dams slow the fast-flowing currents of the river and limit the extent to which the river can meander or bend to create high-quality, shallow habitats for aquatic biota. Within impounded sections of the river, river banks tend to be steeper, contain less in-river features (e.g., varied depths and structure), and provide lower-quality habitat than river banks within free-flowing portions of the river (SRBC 2015). In addition, water quality parameters tend to be more homogenized within impounded sections. The lack of diverse habitats tends to result in lower biological diversity within impounded sections. As a result of the more homogenous water quality parameters and habitat features, the Susquehanna River Basin Commission (SRBC) (2015) determined that habitat complexity, macroinvertebrate diversity, and fish diversity tend to decrease further downstream within the Susquehanna River, especially below River Mile (RM) 44, due to the number of impoundments.

As described in Section 3.5.1, Peach Bottom is located at RM17 in an impounded section of the river referred to as Conowingo Pond. Conowingo Pond is characteristic of the relatively low-quality habitat found within impounded sections of the Susquehanna River (SRBC 2015, Exelon 2018a). Conowingo Pond is a relatively still-water (lentic) system due to the two dams that impound the area. Bottom substrates within lentic systems tend include more fine-grained, silty sediments, whereas bottom substrates within flowing-water (lotic) systems tend to include sand, cobble sediments, or gravel.

The highest-quality habitat within Conowingo Pond is the shallow shoreline. Normandeau Associates, Inc. (NAI) and Environmental Resources Management (ERM) (2014) determined that a limited amount of shallow (under 10 ft (3 m)) shorelines occur near Peach Bottom (less than 10 percent). In addition, the Federal Energy Regulatory Commission (FERC) (2015) determined that the majority of the shoreline in Conowingo Pond consists largely of bedrock, unconsolidated natural materials (e.g., alluvium, colluvium), and disturbed or artificial materials (e.g., walls, fill, rail embankment, and canal tow path berm). Therefore, limited high-quality shoreline habitat with shallow waters and vegetation occurs near Peach Bottom.

3.7.2.2 Aquatic Biota near Peach Bottom

The NRC's 2003 final supplemental environmental impact statement (FSEIS) for the initial Peach Bottom license renewal published as NUREG–1437, Supplement 10 (NRC 2003a), Section 2.2.5 describes aquatic biota near Peach Bottom based on studies from pre- and post-operations (1966–1974) and from studies that assessed the impacts of zero-cooling tower operation (1997–1999). The NRC (2003a) determined that the aquatic biota generally consisted of common warm-water fish species (e.g., gizzard shad (*Dorosoma cepedianum*), spotfin shiner (*Cyprinella spiloptera*), channel catfish (*Ictalurus punctatus*), tessellated darter (*Etheostoma olmstedi*), and bluegill (*Lepomis macrochirus*)), and minimal mollusk taxa (common sphaerid genera, Pisidium and Sphaerium, and a single Unionid (*Utterbackia imbecilis*)). The NRC (2003a) also determined that the fish and invertebrate composition had not changed significantly over time other than the following:

- an increase in migratory fish due to the installation of fish passage facilitates (e.g., fish lifts) at dams along the Susquehanna River
- the appearance and rapid colonization since the mid-1980s of the exotic Asiatic clam, (*Corbicula* spp.)

The NRC staff incorporates the information from NUREG–1437, Supplement 10, Section 2.2.5 into this SEIS by reference (NRC 2003a: 2-22 to 2-23).

The Federal Energy Regulatory Commission's (FERC) "Final Multi-Project Environmental Impact Statement for Hydropower Licenses" (FERC 2015), Section 3.3.2 describes the features of the aquatic community within Conowingo Pond, including submerged aquatic vegetation, common fish species, recreational fish, and freshwater mussels. FERC (FERC 2015) also describes the population trends for migratory fish, including blueback herring, alewife, gizzard shad, hickory shad (*Alosa mediocris*), and striped bass (*Morone saxatilis*), all of which passed the east fish lift on the Conowingo Dam from 1997 through 2014 (see Tables 3-13 and 3-14 in FERC 2015). The NRC staff incorporates the information in Section 3.3.2 of FERC's EIS (FERC 2015) into this SEIS by reference (NRC 2003a: 112-121, 126-129).

Exelon undertook a recent study of aquatic biota near Peach Bottom from 2010 through 2014 as part of Exelon's 316(a) demonstration study for an extended power uprate (EPU) that was proposed at the time of the study and has since been implemented as authorized in license amendments issued by the NRC. In this study, NAI and ERM (2014) reviewed past aquatic surveys and conducted a new survey of the aquatic community near Peach Bottom. In its review of current and past aquatic surveys, NAI and ERM (2014) determined that approximately 60 fish species have been documented within Conowingo Pond and its tributaries since 1996. Common prey species included comely shiner (*Notropis amoenus*), spotfin shiner, bluegill, green sunfish (*Lepomis cyanellus*), bluntnose minnow (*Pimephales notatus*), and spottail shiner (*Notropis hudsonius*) (NAI and ERM 2014). Common recreational fish species included flathead catfish (*Pylodictis olivaris*), which was introduced into Conowingo Pond in 2000, and channel catfish. White crappie (*Pomoxis annularis*) was a common fish in the early 1980s, however, gizzard shad, which was introduced into Conowingo Pond in 1972, has outcompeted and replaced this species more recently (NAI and ERM 2014). Gizzard shad is an important prey species for many fish within Conowingo Pond, although it has replaced many native species due to its ability to outcompete other fish species for food resources when gizzard juveniles consume large amounts of planktonic prey (NAI and ERM 2014). In addition, gizzard shad are tolerant of turbid, low-quality water, and their presence may indicate reduced habitat quality (MDNR undated_a).

During the 2010–2014 study, NAI and ERM (2014) collected a total of 50 species of fish in Conowingo Pond including piscivores (consume fish), filter feeders (filter plankton and other small organisms and debris from the water), omnivores (consume other animals), insectivores (consume insects), generalists (consume a wide variety of prey), and invertivores (consume invertebrates). A list of all fish species captured during the 2010–2013 surveys appears in Tables 5-33 through 5-37 in NAI and ERM (2014). Tables 5-33 through 5-37 in NAI and ERM (2014) are incorporated by reference into this SEIS.

NAI and ERM (2014) concluded that there was large spatial and temporal variability in the community structure and relative abundance of most species. The main factors influencing the biological community structure within Conowingo Pond include the following:

- Spawning success for each species
- Habitat preferences and avoidance
- Seasonal migration of fish into and out of the Conowingo Dam by swimming upstream or downstream via the fish lift on Conowingo Dam and swimming upstream or downstream via the fish lift at the Holtwood Dam
- Biota moving into or out of the Muddy River reservoir, which is located upstream of Peach Bottom and just downstream of the Holtwood Dam

3.7.3 NOAA Trust Resources

The National Oceanographic and Atmospheric Administration (NOAA) trust resources include, but are not limited to, commercial and recreational fishery resources, anadromous species, catadromous species (species that spawn in saltwater and then migrate to freshwater), and threatened and endangered species. NOAA trust resources in the Conowingo Pond include alewife, blueback herring, American shad (*Alosa sapidissima*), striped bass, hickory shad, bluefish, white perch (*Morone americana*), and American eel (*Anguilla rostrata*) as well as their habitats. Alewife, blueback herring, American shad, striped bass, hickory shad, and white perch are anadromous species that spawn in freshwater, and then return to the Atlantic Ocean after spawning. American eel is a catadromous species that spawns in the Atlantic Ocean and returns to freshwater rivers after spawning. Federally listed, proposed, or candidate species are discussed in Section 3.8, "Special Status Species and Habitats," including Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*) and shortnose sturgeon (*Acipenser brevirostrum*).

Since 1997, NAI or other contractors have documented fish passage through the east fish lift on Conowingo Dam. As described above, fish passages from 1997 through 2014 are summarized in FERC (2015) and incorporated by reference into this SEIS (see Tables 3-13 and 3-14 in FERC 2015). Table 3-9 describes the most current fish passage counts from 2015 through

2017 for any species comprising more than one percent of the count and for anadromous fish. Like in previous years, gizzard shad remained the most common species passing through the east fish lift and comprised 96 to 98 percent of the fish passed each year. Anadromous fish, such as American shad, alewife, blueback herring, and hickory shad, use the east fish lift, although river herring (alewife and blueback herring) rarely pass from the lower Susquehanna into Conowingo Pond.

Table 3-9 Fish Passage through the East Fish Lift at Conowingo Dam (2015–2017)

		No. of Individuals		
Species	**Common Name**	**2015**	**2016**	**2017**
Dorosoma cepedianum	gizzard shad	742,661	833,681	813,687
Alosa sapidissima	American shad	8,341	14,276	16,265
Morone americana	white perch	20	6,544	120
Ictalurus punctatus	channel catfish	1,118	3,414	9,972
Morone saxatilis	striped bass	407	236	514
Alosa aestivalis	blueback herring	3	34	59
Alosa pseudoharengus	alewife	10	0	6
Alosa mediocris	hickory shad	8	0	0
TOTAL NUMBER OF SPECIES COLLECTED[a]		30	29	35
TOTAL NUMBER OF FISH COLLECTED		754,057	865,179	844,917

[a] "Species" includes species and hybrids

Sources: NAI 2015b, 2016, 2017

NAI and ERM (2014) surveyed the fish community within Conowingo Pond from 2010 through 2013 via seines, electrofishing, and trawling (see Section 4.7.1.1, "Impingement and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems and Cooling Ponds") for additional information regarding study methods). Like in previous studies in the area, gizzard shad was the most common species (Table 3-10). NAI and ERM (2014) documented other species of NOAA Trust Resources in Conowingo Pond, such as American shad. However, other anadromous fish, such as blueback herring, alewife, and hickory shad, were relatively rare. These results suggest that the relative abundance of migratory fish using the fish ladder at Conowingo Dam is similar to the relative abundance of migratory fish within Conowingo Pond. The one exception is American shad, which was the second most common species in the fish lift but was nevertheless rarely captured within NAI and ERM (2014) surveys within Conowingo Pond.

Table 3-10 Selected NOAA Trust Resources in Conowingo Pond (2010–2013)

Species	Common Name	2010	2011	2012	2013
Dorosoma cepedianum	gizzard shad	5,905 (47%)	10,265 (40%)	8,399 (24%)	3,046(17%)
Alosa sapidissima	American shad	0	1 (<1%)	0	0
Morone americana	white perch	5 (<1%)	35 (<1%)	62 (<1%)	49 (<1%)
Ictalurus punctatus	channel catfish	2,217 (18%)	5,215 (20%)	2,749 (8%)	931 (5%)
Morone saxatilis	striped bass	0	0	30 (<1%)	5 (<1%)
Alosa aestivalis	blueback herring	0	0	0	0
Alosa pseudoharengus	alewife	0	1 (<1%)	0	0
Alosa mediocris	hickory shad	0	0	0	0
TOTAL FISH COLLECTED[a]		12,455	25,690	34,356	18,381

[a] Total number of species collected include species other than the selected NOAA Trust Resources

Sources: NAI and ERM 2014

3.7.4 State-Ranked Species

Five aquatic State-listed species potentially occur near Peach Bottom (Table 3-11). Four of these species (Atlantic sturgeon, shortnose sturgeon, Maryland darter (*Etheostoma sellare*), and Chesapeake logperch) are either federally listed or being considered for Federal listing and, therefore, are discussed in Section 3.8, "Special Status Species and Habitats." The Pennsylvania Fish and Boat Commission listed hickory shad as endangered under the Pennsylvania Code, Title 58, "Recreation," Chapter 75, "Endangered Species."

Table 3-11 State-Ranked Aquatic Species near Peach Bottom

		Designation	
Species	Common Name[a]	State Status	Federal Status
Acipenser brevirostrum	shortnose sturgeon	E	E
Acipenser oxyrhynchus	Atlantic sturgeon	E	E
Alosa mediocris	hickory shad	E	-
Etheostoma sellare	Maryland darter	E	E
Percina bimaculata	Chesapeake logperch	T	C

E= Endangered, T=Threatened, C= Candidate for Federal listing

Source: The Pennsylvania Code 2018; FWS 2018a; Exelon 2018a, NMFS undated_a, undated_b

Hickory shad are diadromous fish that spend their majority of their lives within the ocean and migrate to freshwaters to spawn. Spawning occurs once per season within freshwater rivers, flooded swamps, and channels of tributary creeks with mud, sand, or gravel substrates (ASMFC 2016). Adult shad prefer waters that include vegetative or other physical structures, such as ledges and fallen trees (ASMFC 2016). Peak spawning occurs from mid-April through late May, and most spawning occurs at temperatures of 59–66 °F (15–19 °C). Females release a large number of eggs into the water column that are then fertilized by males, carried by river currents, and then hatch within a few days (MDNR undated_b). Once hatched, larvae continue to drift in the water column until they mature into juveniles and then migrate into the ocean (MDNR undated_b). The NRC staff determined that this species has the potential to occur near

Peach Bottom given that hickory shad occasionally use the east fish lift at the Conowingo Dam (NAI 2015b, 2016, 2017). However, this species is relatively rare within Conowingo Pond and NAI and ERM (2014) did not observe this species during the 2010–2013 fish surveys in Conowingo Pond.

3.7.5 Non-Native and Nuisance Species

Several species of aquatic plants, fish, and invertebrates have been introduced within Conowingo Pond. Many of these species are an ecological concern because they outcompete native species for space, prey, or other limited resources.

The Pennsylvania Fish and Boat Commission (PFBC 2011) estimated that 28 percent of all fish species within the Susquehanna River drainage have been introduced by intentional stocking efforts, as juvenile non-native bait fish, during stream capture events post-flooding, and through unintentional release. The PFBC (2011) identifies six invasive fish species: common carp (*Etheostoma caeruleum)*, mimic shiner (*Notropis volucellus*), flathead catfish, greenside darter (*Etheostoma blennioides*), and banded darter (*Etheostoma zonale*).

Common carp come from coastal areas of the Caspian and Aral Seas and inhabit the Susquehanna River near Peach Bottom (Exelon 2018a; USGS 2017). Common carp tend to grow quickly and outcompete native fish species in consuming prey items, such as aquatic plants, plankton, and benthic invertebrates. Common carp also degrade water-quality conditions by increasing turbidity and uprooting submerged aquatic vegetation during active feeding sessions (USGS 2017).

The flathead catfish is a recent invader of the Susquehanna River (PFBC 2011). Anglers first documented the species upstream of Holtwood Dam in 2002 (PFBC 2011). The FWS considers the control of flathead catfish to be its highest priority among invasive animal species initiatives because flathead catfish prey upon many native fish (FWS 2014a). This predation can initiate trophic-level changes whereby the flathead catfish reduces the abundance of its prey populations, which in turn, allows the prey's food (i.e., aquatic plants, algae, fish, and aquatic invertebrates) to increase in abundance. Additionally, flathead catfish can consume large amounts of anadromous fish, which are relatively rare and an important food source for many native fish.

Non-native invertebrate species have also established substantial populations within the Susquehanna River. The rusty crayfish (*Orconectes rusticus*) was first documented near Conowingo Dam in 2007 (PFBC 2011). This species can cause large ecosystem changes by displacing all native crayfish and then existing at higher densities than the displaced native species. As a result, aquatic plants and other taxa may be less common due to consumption and disturbance by the rusty crayfish.

Zebra mussels (*Dreissena polymorpha*) are native to the Black and Caspian seas and were introduced into the Great Lakes within the ballast water of freighters around 1988. Since that time, zebra mussels have spread throughout the Great Lakes and were first documented in the upper Susquehanna River in 2007 (PFBC 2011). Zebra mussels actively filter feed large amounts of freshwater and remove available plankton food sources making less food available for other aquatic organisms (Sea Grant Pennsylvania 2007). Zebra mussels attach to hard surfaces in order to grow. When attached to underwater piping or other structures related to cooling water intake systems, these organisms can cause biofouling. Exelon (2018a) first detected zebra mussels near Peach Bottom in 1991.

Asian clams (*Corbicula manilensis*) are native to western Asia and parts of Africa. They were first documented in Conowingo Pond in the 1980s (NAI and ERM 2014). This species can be problematic for nuclear facilities because like the zebra mussel, they can also contribute to biofouling (NRC 2013a). Exelon (2018a) maintains a biomonitoring program for the Asian clam.

3.8 Special Status Species and Habitats

This section addresses species and habitats that are federally protected under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), and the Magnuson–Stevens Fishery Conservation and Management Act of 1996, as amended (16 U.S.C. Section 1801 et seq.). The NRC has direct responsibilities under these Acts prior to taking a Federal action, such as the proposed Peach Bottom subsequent license renewal. The terrestrial and aquatic resource sections of this report (Sections 3.6 and 3.7, respectively) address species and habitats protected by other Federal acts and the Commonwealth of Pennsylvania under which the NRC does not have direct responsibilities.

3.8.1 Species and Habitats Protected Under the Endangered Species Act

The U.S. Fish and Wildlife Service and the National Marine Fisheries Service jointly administer the Endangered Species Act. The U.S. Fish and Wildlife Service manages the protection of and recovery effort for listed terrestrial and freshwater species; the National Marine Fisheries Service manages the protection of and recovery effort for listed marine and anadromous species. The following sections describe the Peach Bottom action area and then consider separately those species that could occur in the action area under the jurisdictions of each Service.

3.8.1.1 Peach Bottom Action Area

The implementing regulations for Section 7(a)(2) of the Endangered Species Act define “action area” as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02, “Definitions”). The action area effectively bounds the analysis of federally listed species and critical habitats because only species and habitats that occur within the action area may be affected by the Federal action.

For the purposes of assessing the potential impacts of Peach Bottom subsequent license renewal on federally listed species, the NRC staff considers the action area to consist of the Peach Bottom site and Conowingo Pond. Section 3.2, “Land Use and Visual Resources,” and Section 3.6, “Terrestrial Resources,” of this SEIS describe the 769-ac (311-ha) Peach Bottom site in detail. Section 3.7, “Aquatic Resources,” of this SEIS describes aquatic resources within Conowingo Pond, a 14-mi (22-km) -long, 9,000-ac (3,642-ha) impoundment on the lower Susquehanna River. Although the Peach Bottom cooling system does not influence the entirety of Conowingo Pond, the NRC staff has conservatively chosen to evaluate the entire pond because aquatic organisms within the pond have a somewhat limited ability to move into or out of the area due to damming. While the East Fish Lift Passage Facility at Conowingo Dam facilitates migratory fish passage past the dam, the lift only operates in the spring and targets American shad and gizzard shad. Other species’ ability to successfully use this fish lift for passage depends on their swimming ability and how individuals move up and downstream; therefore, some species can be expected to more effectively navigate the lift than others. Given the more limited movement of aquatic organisms within Conowingo Pond, the NRC staff conservatively assumes that any organism within the pond could occupy the area influenced by Peach Bottom’s cooling water system intake and discharge.

The NRC staff recognizes that while the action area is stationary, federally listed species can move into and out of the action area. For instance, a migratory bird could occur in the action area seasonally as it forages or breeds within the Peach Bottom action area. Similarly, certain fish could swim through the action area seasonally on their way to or from spawning grounds, assuming those species are able to successfully navigate the fish passage at Conowingo Dam. Thus, in its analysis, the NRC staff considers not only those species known to occur directly within the action area, but also those species that may passively or actively move into the action area. The staff then considers whether the life history of each species makes it likely to move into the action area where it could be affected by the proposed subsequent license renewal.

The following sections first discuss species under U.S. Fish and Wildlife Service's jurisdiction followed by those under the National Marine Fisheries Service's jurisdiction.

3.8.1.2 Species and Habitats Under U.S. Fish and Wildlife Jurisdiction

The U.S. Fish and Wildlife Service's Environmental Conservation Online System (ECOS) Information for Planning and Conservation (IPaC) tool identifies four species under the Service's jurisdiction that may be present in the Peach Bottom action area, as follows (FWS 2018a):

- bog turtle
- northern long-eared bat
- Indiana bat (*Myotis sodalis*)
- rufa red knot (*Calidris canutus rufa*)

In addition to these species, the American eel (*Anguilla rostrata*) and Chesapeake logperch (*Percina bimaculata*) occur in Conowingo Pond and have been collected during aquatic monitoring at Peach Bottom.

The U.S. Fish and Wildlife Service considered listing the American eel under the Endangered Species Act but ultimately determined that listing was not warranted in 2015 (80 FR 60834). In its status review, the Service identified a number of stressors on the species that cause individual mortality, including recreational and commercial harvest, predation, and hydroelectric turbines. However, the Service found no stressors of sufficient imminence, intensity, or magnitude to affect the stability of the overall population. The Service concluded that the species is neither in danger of extinction nor likely to become endangered within the foreseeable future. In communications with the NRC staff in connection with the Peach Bottom license renewal environmental review, U.S. Fish and Wildlife Service staff stated that the Service has no plans to reconsider this species (NRC 2018j). Accordingly, the NRC staff does not consider this species in any further detail in this section.

The U.S. Fish and Wildlife Service is currently considering the Chesapeake logperch for listing under the Endangered Species Act. In 2011, the U.S. Fish and Wildlife Service issued a finding that listing may be warranted based on the Service's initial review of scientific and commercial information submitted in a petition from the Center for Biological Diversity and several other organizations (76 FR 59836). The Service currently anticipates completing the status review in 2022 and making a listing decision in 2023 (NRC 2018j). The Service recommends that Federal agencies consider species under listing review as if those species are federally listed when considering the potential impacts of proposed Federal actions (NRC 2018j). Accordingly, the NRC staff addresses the Chesapeake logperch in detail below.

The final species of note are the American peregrine falcon (*Falco peregrinus anatum*), bald eagle, Delmarva Peninsula fox squirrel (*Sciurus niger cinereus*), swamp pink (*Helonias bullata*), and Maryland darter (*Etheostoma sellare*). The final environmental statement related to operation of Peach Bottom (AEC 1973) identifies the first three of these as federally listed species found on the site. The U.S. Fish and Wildlife Service has since delisted all five of these species due to recovery. The bald eagle remains federally protected under the Bald and Golden Eagle Protection Act, which is discussed in Section 3.6.4, "Important Species and Habitats," of this SEIS. The NRC (NRC 2003a) considered the swamp pink during its first license renewal review but determined that the species was not present on the Peach Bottom site, and the FWS (2002) concurred with this determination. Although this species remains federally listed as threatened wherever found, it does not occur in Pennsylvania (FWS 2018g). In its environmental report, Exelon (2018a) describes surveys conducted for the Maryland darter, an endangered species, below Conowingo Dam in 2010–2011 in connection with the Conowingo Hydroelectric Project relicensing. However, the species was not collected during the surveys (NAI et al. 2012), and the U.S. Fish and Wildlife Service (FWS 2018f) identifies Cecil and Harford Counties in Maryland as the only counties in which the species remains.

No proposed or designated critical habitat occurs within the Peach Bottom action area (FWS 2018a).

Bog Turtle (*Clemmys muhlenbergii*)

In 1997, the U.S. Fish and Wildlife Service listed the northern population of bog turtle as threatened wherever found (62 FR 59605). The Service has not designated critical habitat for this species to protect its habitat from intentional destruction. Information in this section is derived from the Service's final recovery plan (Klemens 2001) unless otherwise cited.

Taxonomy and Species Description

The bog turtle is a small, semiaquatic turtle. Individuals grow to only about 4 in. (10 cm) in length, and adults weight 3.9 oz (110 g) on average. The skin and shell are typically dark brown, and the head exhibits bright yellow, orange, or red blotches on each side. The carapace is domed and rectangular and appears oblong when viewed overhead. The bog turtle is distinguished from the spotted turtle (*Clemmys guttata*) by large orange patches on each side of the head rather than many small yellow or orange spots on the head and neck.

Distribution and Relative Abundance

Species Range. The bog turtle is sparsely distributed over a discontinuous geographic range that extends from New England south to Georgia. The two populations of the species (northern and southern) are distinguished geographically by the Maryland–Virginia border, although a 250-mi (400-km) gap separates the two populations' ranges. The northern population inhabits New York, Massachusetts, Connecticut, Pennsylvania, New Jersey, Delaware, and Maryland; and the southern population inhabits Virginia, North Carolina, South Carolina, Tennessee, and Georgia. In the north, populations usually occur below 820 ft (245 m) above mean sea level (ASML) (NatureServe 2018a). Southern populations inhabiting the Appalachians occur from sea level to 4,200 ft (1,280 m) (NatureServe 2018a).

Status within Pennsylvania. In 2010, the Service (FWS 2010a) estimated the northern bog turtle population to consist of 10,000 individuals with the largest number of northern bog turtles occurring in Maryland. Within Pennsylvania, bog turtles inhabit 18 southeastern counties, including York County, although NatureServe (NatureServe 2018a) reports that the species may have been extirpated from 3 of these counties. Multiyear, mark-recapture studies indicate that most known bog turtle sites support only a small number of turtles (10 to 20 individuals) (FWS 2010a). In 2012, the Service reported 193 sites in Pennsylvania (FWS 2012a). Most Pennsylvania bog turtle sites lie within the Delaware and Susquehanna River watersheds, and most bog turtle habitat (85 percent) occurs on privately owned lands (Klemens 2001).

Habitat

Bog turtles inhabit shallow spring-fed fens (frequently flooded low-lying lands), sphagnum bogs, swamps, marshy meadows, and pastures with soft, muddy bottoms. Populations typically occupy wetlands areas that contain a diversity of microhabitats and both dry and saturated areas. Individuals use shallower-water areas in spring and deeper-water areas in winter. As successional changes transform open wetlands into closed-canopy swamplands, bog turtles move into neighboring open-canopy habitats. During hibernation, individuals use more densely vegetated areas. Plant species associated with bog turtle habitats include alders (*Alnus* spp.), willows (*Salix* spp.), sedges (*Carex* spp.), sphagnum moss (*Sphagnum* spp.), jewelweed (*Impatiens capensis*), rice cut-grass (*Leersia oryzoides*), tearthumb (*Polygonum sagittatum*), arrow arum (*Peltandra virginica*), red maple (*Acer rubrum*), skunk cabbage (*Symplocarpus foetidus*), and bulrushes (*Juncus* spp. and *Scirpus* spp.).

Biology

<u>Hibernation</u>. Bog turtles are active spring through early fall and hibernate from October to April. In Pennsylvania, Ernst (1977) reported that bog turtles were active from late March through late September. During the hibernation period, bog turtles typically inhabit more densely vegetated areas and will hibernate just below the upper surface of frozen mud or ice. Individuals may also use muskrat and meadow vole burrows, sedge clumps, and tree stumps. Several reports indicate that populations may hibernate in small, communal groups.

<u>Reproduction</u>. Female bog turtles reach sexual maturity at 5 to 8 years of age. Pairs mate in May and June, and females deposit two to six eggs in slightly elevated areas of sphagnum moss or sedge tussocks in May, June, or July. Eggs hatch after 42 to 56 days, and young emerge in August to early September. Individuals may live 40 or more years.

<u>Diet</u>. Bog turtles eat a varied diet of beetles, lepidopteran larvae, caddisfly larvae, snails, nematodes, millipedes, fleshy pondweed seeds, sedge seeds, and carrion.

Factors Affecting the Species

The continued loss, alteration, and degradation of wetland habitats is the greatest threat to the bog turtle's continued survival. Wetland loss can result in direct mortality or harm to individuals through vehicle collisions and increased exposure to predation and collection. Landscape changes also affect the species indirectly. For instance, alteration of local hydrological regimes can affect inundation frequency and accelerate natural succession to more closed-canopy habitats. Habitat degradation can occur on lands used for livestock grazing through fecal deposition, soil disturbance, and loss of plant diversity through overgrazing. Fragmentation can affect the mosaic of microhabitats that the species requires for various life stages and activities.

Occurrence Within the Action Area

The Peach Bottom action area falls within the range of the northern population of the bog turtle. Although the bog turtle is known to occur in York County, PA, no records exist indicating that the species occurs within the Peach Bottom action area itself. At the U.S. Fish and Wildlife Service's request, Exelon commissioned the engineering firm AECOM to conduct a Phase 1 bog turtle habitat evaluation to support the proposed subsequent license renewal review (AECOM 2017). AECOM biologists conducted the survey in August 2017. AECOM identified five small areas of wetland habitat within the action area, none of which it determined to be suitable bog turtle habitat. Exelon transmitted the habitat evaluation results to the Service by letter dated September 26, 2017 (Exelon 2017d). In a November 2, 2017, letter, the Service (FWS 2017a) confirmed receipt of the evaluation and concurred with AECOM's results. Based on this information, the bog turtle is not likely to occur in the Peach Bottom action area due to lack of suitable habitat. Exelon (Exelon 2018c) has not identified additional wetlands on the Peach Bottom site or any other information that might suggest bog turtle presence in the action area since AECOM completed the habitat evaluation.

<u>Northern Long-Eared Bat (*Myotis septentrionalis*)</u>

The U.S. Fish and Wildlife Service listed the northern long-eared bat as threatened throughout its range in 2015 (80 FR 17974). In 2016, the Service determined that designating critical habitat for the species was not prudent because such designation would increase threats to the species resulting from vandalism and disturbance and could potentially increase the spread of white-nose syndrome (81 FR 24707). Information in this section is organized according to the description of the species in the Service's *Federal Register* notice associated with the final rule to list the species (80 FR 17974) and draws from this source unless otherwise cited.

Taxonomy and Species Description

Although there have been few genetic studies on the northern long-eared bat, the U.S. Fish and Wildlife Service describes it as a monotypic species (i.e., having no subspecies). This species has been recognized by different common names, including Keen's bat, northern Myotis, and the northern bat.

The northern long-eared bat is a medium-sized bat that is distinguished from other *Myotis* species by its long ears, which average 0.7 in. (17 mm) in length. Adults weigh 5 to 8 g (0.2 to 0.3 oz), and females tend to be slightly larger than males. Individuals are medium to dark brown on the back, dark brown on the ears and wing membranes, and tawny to pale brown on the ventral side. Within its range, the northern long eared bat can be confused with the little brown bat (*Myotis lucifugus*) or the western long-eared myotis (*M. evotis*).

Distribution and Relative Abundance

<u>Species Range</u>. The northern long-eared bat is found across much of the eastern and north central United States and all Canadian provinces from the Atlantic coast west to the southern Northwest Territories and eastern British Columbia. Its range includes 37 U.S. States. The species is widely distributed within the eastern portion of its range, which includes Delaware, Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, Pennsylvania, Vermont, Virginia, West Virginia, New York, Rhode Island, and the District of Columbia. Prior to documentation of white-nose syndrome, northern long-eared bats were consistently captured during summer mist-net and acoustic surveys within this region. However, as

white-nose syndrome has spread, growing gaps exist within the eastern region where bats are no longer being captured or detected. In other areas, occurrences are sparse. Frick et al. (2015) documented the local extinction of northern long-eared bats from 69 percent of 468 sites where white nose syndrome has been present for at least 4 years in Vermont, New York, Pennsylvania, Maryland, West Virginia, and Virginia, which was by far the highest extinction rate among six species of North American hibernating bats considered during the study.

Status within Pennsylvania. Within Pennsylvania, the U.S. Fish and Wildlife Service (FWS 2016a) reports 322 known northern long-eared bat hibernacula and 157 known occupied maternity roost trees as of 2016. Historically, the species has been captured in both summer and winter surveys within the State. However, since the appearance of white-nose syndrome in Pennsylvania (2008–2009), winter and summer survey captures have sharply declined. During the U.S. Fish and Wildlife Service's listing review, the Pennsylvania Game Commission reported to the Service a 99 percent decline in bat occurrences at 34 known hibernacula sites across Pennsylvania based on 2013 survey data. The Pennsylvania Game Commission also reported to the Service a 76 percent decline in summer captures as of 2014.

In a 2015 biological assessment associated with the northern long-eared bat final Endangered Species Act Section 4(d) rule, the Service (FWS 2015a) makes the following estimates related to Pennsylvania's northern long-eared bat population:

- 205,200 total adults
- 102,600 total pups
- 5,130 maternity colonies of an average size of 20 individuals
- 33.8 percent occupancy of Pennsylvania's available forested habitat

Habitat

Winter Habitat. Northern long-eared bats predominantly overwinter in hibernacula of various sizes that include underground caves and abandoned mines. Preferred hibernacula have relatively constant, cool temperatures with very high humidity and no air currents. Individuals most often roost in small crevices or cracks in cave or mine walls or ceilings but are also infrequently observed hanging in the open. Less commonly, northern long-eared bats overwinter in abandoned railroad tunnels, storm sewers, aqueducts, attics, and other non-cave or mine hibernacula with temperature, humidity, and air flow conditions resembling suitable caves and mines.

Summer Habitat. In summer, northern long-eared bats typically roost individually or in colonies underneath bark or in cavities or crevices of both live trees and snags. Males and nonreproductive females may also roost in cooler locations, including caves and mines. Individuals have also been observed roosting in colonies in buildings, barns, on utility poles, and in other man-made structures. The species has been documented to roost in many species of trees, including black oak, northern red oak, silver maple (*Acer saccharinum*), black locust (*Robinia pseudoacacia*), American beech (*Fagus grandifolia*), sugar maple (*A. saccharum*), sourwood (*Oxydendrum arboreum*), and shortleaf pine (*Pinus echinata*). Foster and Kurta (1999) found that rather than being dependent on particular tree species, northern long-eared bats are likely to use a variety of trees as long as they form suitable cavities or retain bark. Owen et al. (2002) found that tree-roosting maternal colonies chose roosting sites in larger trees that were taller than the surrounding stand and in areas with abundant snags. Carter and Feldhamer (2005) indicate that resource availability drives roost tree selection more than the actual tree species. However, a number of studies have shown that the species more often roosts in shade-tolerant deciduous trees rather than conifers. Additionally, the U.S. Fish and Wildlife Service concludes in its final listing that the tendency for northern long-eared bats to use healthy live trees for roosting is fairly low.

Northern long-eared bats actively form colonies in the summer, but such colonies are often in flux because members will frequently depart to be solitary or to form smaller groups and later return to the main unit. This behavior is described as "fission-fusion," and it also results in individuals often switching tree roosts (typically every 2 to 3 days). Roost trees are often close to one another within the species' summer range with various studies documenting distances between roost trees ranging from 20 ft (6.1 m) to 2.4 mi (3.9 km).

<u>Spring Staging</u>. Spring staging is the period between winter hibernation and spring migration to summer habitat when bats begin to gradually emerge from hibernation. Individuals will exit the hibernacula to feed but re-enter the same or alternative hibernacula to resume periods of physical inactivity. The spring staging period is believed to be short for the northern long-eared bat and may last from mid-March through early May with variations in timing and duration based on latitude and weather.

<u>Fall Swarming</u>. Fall swarming is the period between the summer and winter seasons and includes behaviors such as copulation, introduction of juveniles to hibernacula, and stopovers at sites between summer and winter regions. Both males and females are present together at swarming sites, and other bat species are often present as well. For northern long-eared bats, the swarming period may occur between July and early October, depending on latitude within the species' range. Northern long-eared bats may use caves and mines during swarming. Little is known about roost tree selection during this period, but some studies suggest that a wider variation in tree selection may occur during swarming than during the summer.

<u>Roost Trees</u>. Northern long-eared bats roost in cavities, crevices, hollows, or under the bark of live and dead trees and snags of greater than 3-in. (8-cm) diameter at breast height. Isolated trees may be considered suitable habitat when they exhibit these characteristics and are less than 1,000 ft (300 m) from the next nearest suitable roost tree within a wooded area. Northern long-eared bats appear to choose roost trees based on structural suitability rather than exhibiting a preference for specific species of trees.

Biology

<u>Hibernation</u>. Northern long-eared bats hibernate during winter months. Individuals arrive at hibernacula in August or September, enter hibernation in October and November, and emerge from hibernacula in March or April. The species has shown a high degree of repeated hibernaculum use, although individuals may not return to the same hibernacula in successive seasons. Northern long-eared bats often inhabit hibernacula in small numbers with other bat species, including little brown bats, big brown bats (*Eptesicus fuscus*), eastern small-footed bats (*Myotis leibii*), tri-colored bats (*Perimyotis subflavus*), and Indiana bats (*M. sodalis*). Northern long-eared bats have been observed moving among hibernacula during the winter hibernation period, but individuals do not feed during this time, and the function of this behavior is not well understood.

Migration and Homing. Northern long-eared bats migrate relatively short distances (between 56 and 89 km (35 and 55 mi)) from summer roosts and winter hibernacula. The spring migration period typically occurs from mid-March to mid-May, and fall migration typically occurs between mid-August and mid-October.

Reproduction. Northern long-eared bats mate from late July in northern regions to early October in southern regions. Hibernating females store sperm until spring, and ovulation takes place when females emerge from hibernacula. Gestation is estimated to be 60 days, after which time females give birth to a single pup in late May or early June. Females raise their young in maternity colonies, which generally consist of 30 to 60 individuals (females and young). Roost tree selection changes depending on reproductive stage with lactating females roosting higher in tall trees with less canopy cover. Young are capable of flight as early as 3 weeks following birth. Maximum lifespan for northern long-eared bats is estimated to be up to 18.5 years, and the highest rate of mortality occurs during the juvenile stage.

Foraging Behavior. Northern long-eared bats are nocturnal foragers that use hawking and gleaning in conjunction with passive acoustic cues to collect prey. The species' diet includes moths, flies, leafhoppers, caddisflies, beetles, and arachnids. Individuals forage 1 to 3 m (3 to 10 ft) above the ground between the understory and canopy of forested hillsides and ridges with peak foraging activity occurring within 5 hours after sunset.

Home Range. Northern long-eared bats exhibit site fidelity to their summer home range, during which time individuals roost and forage in forests. Studies indicate a variety of home range sizes—from as little as 8.6 ha (21.3 ac) to as large as 172 ha (425 ac). Some studies indicate differences in ranges between sexes, while others find no significant differences.

Factors Affecting the Species

The U.S. Fish and Wildlife Service identifies white-nose syndrome, a disease caused by the fungus *Pseudogymnoascus destructans* that affects hibernating bats, to be the predominant threat to this species' continued existence. Other factors include human disturbance of hibernacula and loss of summer habitat due to forest conversion and forest management.

Occurrence Within the Action Area

The Peach Bottom action area falls within the range of the northern long-eared bat. The U.S. Fish and Wildlife Service reports that a documented hibernaculum occurs 12.5 mi (20 km) away from the Peach Bottom site (NRC 2018j). However, no hibernacula occur within the action area itself (FWS 2018c). Because of this, northern long-eared bats would not be present in the action area in winter.

The Service (FWS 2018c) reports that the action area is not within 150 ft (46 m) of a known, occupied maternity roost, and Exelon (Exelon 2018a) reports no known occurrences of the species on the Peach Bottom site. However, no bat surveys have been conducted within the action area nor have any assessments been undertaken to specifically determine habitat suitability or quality for bats. Because of this, the NRC staff conservatively assumes that the oak-hickory and oak-tulip forests in the action area, which total approximately 356 ac (144 ha), could support foraging, mating, roosting, and pup rearing in the spring, summer, and fall. If present during these seasons, individuals would occur in the action area occasionally and in relatively low numbers.

Indiana Bat (*Myotis sodalis*)

The U.S. Fish and Wildlife Service listed the Indiana bat as endangered in 1967 (32 FR 4001). The Service then designated critical habitat for the species in 1976 (41 FR 41914, as corrected by 42 FR 47840) to include 11 caves and 2 mines in six States. No designated critical habitat occurs in the action area.

The following information on the species is organized according to the Service's description of the species in its recovery plan (Pruitt and TeWinkel 2007) and draws from this source unless otherwise cited.

Taxonomy and Species Description

The U.S. Fish and Wildlife Service recognizes the Indiana bat to be a monotypic species. Alternative common names include Indiana myotis, social bat, pink bat, and little sooty bat.

The Indiana bat is a medium-sized bat that closely resembles the northern long-eared bat and little brown bat and is distinguished from the two by its ear size (northern long-eared bat) and distinctly keeled calcar and lighter nose color (little brown bat). Adults are generally 1.6 to 1.9 in. (4.1 to 4.9 cm) in length, grayish brown in color, and have ears and wing membranes that are flat in coloration and do not contrast with the fur.

Distribution and Relative Abundance

Species Range. The Indiana bat is found throughout New England and in the Midwest with highest population concentrations within the central areas of this region from Vermont to southern Wisconsin, eastern Oklahoma, and Alabama. Its current range includes 17 U.S. States. In summer, Indiana bat maternity colonies and individuals may occur throughout this range. In winter, populations are currently distributed among approximately 346 hibernacula in eight states: Missouri, Indiana, Kentucky, Illinois, New York, Ohio, West Virginia, and Tennessee (FWS 2017b). The Indiana bat population has been drastically affected by white-nose syndrome, and the species has practically disappeared from eastern States where the fungus has been present longest, including Vermont, Pennsylvania, New Jersey, and Virginia. Turner et al. (2011) documented a 72 percent mean decline in Indiana bat populations at selected monitoring sites over the period 2006–2011, and Frick et al. (2015) documented local extinction at 17 percent of monitored sites. By State, the largest declines have been observed in Pennsylvania (98 percent), New York (88 percent), West Virginia (87 percent), Vermont (85 percent) and Virginia (69 percent) (Turner et al. 2011). Based on genetic analysis, Vonhof et al. (2016) suggest that Indiana bats may be more vulnerable to white-nose syndrome than other bat species due to their reduced genetic diversity prior to introduction of the fungus. In 2017, the Service (FWS 2017b) estimated the range-wide Indiana bat population in all States to be 530,705 individuals, which represents a 20 percent decline over the last 10 years.

Status within Pennsylvania. The Pennsylvania Game Commission (PGC 2010) has identified nine maternity colonies in seven Pennsylvania counties and has live-captured individuals in the summer in four counties, including York County. The U.S. Fish and Wildlife Service reports that approximately 20 hibernacula are currently known within the State (NRC 2018j). Of these, Indiana bats have been extirpated from many, but the Service has data indicating the species' continued use of at least three hibernacula (NRC 2018j). In 2017, the Service (FWS 2017b) estimated the Pennsylvania population of Indiana bats to be 23 individuals, which represents a

4.2 percent decrease from the previous 2015 estimate and a 98 percent decrease within the State over the past decade.

Habitat

Winter Habitat. Indiana bats prefers hibernacula in areas with karst (limestone, dolomite, and gypsum), although individuals may also use other cave-like locations, such as mines. Suitable hibernacula have low temperatures (below 10 °C (50 °F) with infrequent drops below freezing), high humidity, and little to no air currents.

Spring and Fall Roosts. During fall and spring, Indiana bats use roosting sites similar to those selected in the summer with the exception of pines (*Pinus* spp.), which they more commonly occupy in spring and fall. In spring and fall, Indiana bats tend to roost individually more often than they do in the summer and switch trees every 2 to 3 days, although individuals tend to show fidelity to individual trees and roosting areas within and among years.

Summer Habitat. High-quality summer habitat includes mature forest stands containing open subcanopies, multiple moderate- to high-quality snags, and trees with exfoliating bark (Farmer et al. 2002). At least 33 species of trees have been documented to serve as roosts for reproductive Indiana bat females and their young; these include various ash (*Faxinus* spp.), elm (*Ulmus* spp.), hickory (*Carya* spp.), maple (*Acer* spp.), poplar (*Populus* spp.), and oak (*Quercus* spp.). Most trees occupied by females are dead or dying, and individuals can also be found under the bark of dead sections of living trees. Primary roosts usually receive direct sunlight for more than half the day; are unimpeded by vines or small branches; are typically within canopy gaps in a forest, in a fence line, or along a wooded edge; and are found within 15 m (50 ft) of a forest edge.

Biology

Fall Swarming and Mating. Indiana bats arrive at hibernacula as early as late July, and the number of bats increases throughout August and into September and early October. During this period, Indiana bats fly in and out of cave entrances from dusk to dawn with relatively low numbers of individuals roosting during the day. Mating occurs during the later period of the fall swarming months. Individuals also gain weight during this time to prepare for hibernation. Parsons et al. (2003) found that bats may travel relatively long distances (up to 27 km (17 mi)) from swarming sites to roosting sites during the swarming season.

Hibernation. Hibernation typically lasts from October through April, although it may extend from September through May in northern areas, including New York, Vermont, and Michigan. Indiana bats tend to hibernate in the same hibernaculum at which they swarm, and individuals (especially females) return to the same hibernaculum each year. Indiana bats usually hibernate in large, dense clusters ranging from 300 to 484 bats-per-square-foot, although both smaller clusters and large groups of up to 500 bats-per-square-foot have been observed. Indiana bats often inhabit hibernacula with other species of bats, including gray bats (*Myotis grisescens*), Virginia big-eared bats (*Corynorhinus townsendii virginianus*), little brown bats, and northern long-eared bats.

Spring Emergence and Migration. Indiana bats begin to emerge from hibernacula in April, and emergence continues through May with peak emergence occurring in mid-April. Exact timing varies throughout the species' range depending on latitude and weather, although females tend to emerge in advance of males in most regions. Following emergence, individuals migrate to their summer habitat. Indiana bats may migrate hundreds of kilometers from their hibernacula to their summer habitat. Winhold and Kurta (2006) (*in* Pruitt and TeWinkel 2007) found that 12 female Indiana bats from maternity colonies in Michigan migrated an average of 477 km (296 mi) to their hibernacula in Indiana and Kentucky, with a maximum migration of 575 km (357 mi). By contrast, in 2005, radiotelemetry studies of 70 spring emerging Indiana bats (primarily females) from three New York hibernacula found that most individuals migrated less than 64 km (40 mi) to their summer habitat.

<u>Summer Life History and Behavior</u>. Reproductive Indiana bat females arrive at summer habitats as early as mid-April and continuing through May. Males and nonreproductive females disperse throughout their range and roost individually or in small numbers in the same areas as reproductive females. Because Indiana bats no longer hibernate in Pennsylvania, as described previously in this section, individuals occurring in Pennsylvania in the summer months would have migrated from hibernacula in neighboring States.

<u>Maternity Colony Formation</u>. Maternity colonies typically use 10 to 20 trees each year, although only 1 to 3 of these trees are primary roosts that are used by the majority of females for some or all of the summer (Watrous et al. 2006; Pruitt and TeWinkel 2007). Maternity colonies exhibit fission-fusion characteristics with females switching roosts every 2 to 3 days depending on reproductive condition, roost type, and time of the year. Maternity colonies typically consist of 60 to 80 adult females (Whitaker and Brack 2002). Once established, females usually return to the same colony each year, and fidelity to roost trees and foraging areas has also been observed.

<u>Reproduction</u>. Indiana bats mate during fall swarming, and hibernating females store sperm until spring, at which time ovulation takes place upon emergence from hibernation. Females give birth to a single pup in June or early July. Females raise young in maternity colonies, as described above. Maximum lifespan for Indiana bats is unknown. One study estimated a survival rate of only 4 percent beyond 10 years, while researchers in another study captured a single individual 20 years after initial banding.

<u>Foraging Behavior</u>. Indiana bats are nocturnal foragers that use hawking and gleaning in conjunction with passive acoustic cues to collect prey. The species' diet includes insects of the orders Coleoptera, Diptera, Lepidoptera, and Trichoptera. Indiana bats have been described as selective opportunists because they consistently eat moths, flies, beetles, and caddisflies, but will eat non-preferred prey, such as ants, when available. Individuals forage 2 to 30 m (6 to 100 ft) above ground level near streams, riparian areas, forest edges, and other linear landscape features.

<u>Home Range</u>. Studies on the home ranges of Indiana bats have varied widely in their results, and direct comparisons between studies are difficult due to differences in seasons, sexes, and reproductive status of the females studied, all of which appear to affect home range. In Illinois, mean summer range for 11 male and female Indiana bats was calculated to be 145 ha (357 ac), while in Vermont, mean summer range was calculated to be 83 ha (205 ac) for 14 female Indiana bats.

Factors Affecting the Species

The decline of Indiana bats is attributed to urban expansion, habitat loss and degradation, human-related disturbance of caves or mines, insecticide poisoning, and white-nose syndrome.

Occurrence Within the Action Area

The Peach Bottom action area falls within the range of the Indiana bat. The U.S. Fish and Wildlife Service reports that no hibernacula occur within the action area nor is the action area within the conservation buffer (e.g., fall swarming area) of any known hibernacula (NRC 2018j). Because of this, Indiana bats would not be present in winter.

The Service (FWS 2018c) reports that the nearest documented maternity roost lies 41 mi (66 km) from Peach Bottom and, therefore, the action area is not within any known maternity roost buffers. Exelon (2018a) reports no known occurrences of the species on the Peach Bottom site. However, no bat surveys have been conducted within the action area nor have any assessments been undertaken to specifically determine habitat suitability or quality for bats. Because of this, the NRC staff conservatively assumes that the oak-hickory and oak-tulip forests in the action area could support foraging, mating, roosting, and pup rearing for the Indiana bat in the spring, summer, and fall. If present during these seasons, Indiana bat individuals would occur rarely based on the current Pennsylvania population estimate of 23 individuals and the continuing prevalence of white-nose syndrome within the region.

<u>Rufa Red Knot (*Calidris canutus rufa*)</u>

The U.S. Fish and Wildlife Service's listing of the rufa red knot as threatened became effective in 2015 (79 FR 73706). The Service has not designated critical habitat for this bird species. Information in this section is organized according to the description of the species in the Service's *Federal Register* notice associated with the proposed rule to list the species (78 FR 60024) and draws from this source or the Service's *Federal Register* notice for the final rule (79 FR 73706) unless otherwise cited.

Taxonomy and Species Description

The Service recognizes six subspecies of red knot (*Calidris canatus)*, of which the rufa red knot (*C. canatus rufa*)[1] is one. Each subspecies is believed to occupy a distinct breeding area in various parts of the Arctic. The rufa red knot is a medium-sized (9 to 11 in. (23 to 28 cm) in length) shorebird in the sandpiper family. Adult females on wintering grounds weigh 124.2 g (4.4 oz) on average, while males average 115.7 g (4.1 oz), although individuals can nearly double their weight prior to migration. Plumage on the head, back, and wings are mottled gray, brown, and white, while the face, chest, and belly feathers are red.

Red knots migrate annually between breeding grounds in the Canadian Arctic and several wintering regions, including the Southeastern United States, Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego off the coast of the southern tip of South America. Between both its spring and fall migrations, red knots use key staging and stopover areas to rest and feed.

Breeding

Red knots live up to 7 years (Niles et al. 2008) and likely begin breeding at 2 years (Harrington 2001). The species breeds in June in inland areas near arctic coasts and nests in dry, slightly elevated tundra areas. Breeding success can vary dramatically from year to year based on weather, food availability (insects and other terrestrial invertebrates), and predator

[1] In this SEIS, the term "red knot" refers specifically to the rufa red knot subspecies, *Calidris canatus rufa*, unless otherwise indicated.

abundance (the arctic lemmings *Dicrostonyx torquatus* and *Lemmus sibericus*). Little information is available on mating fidelity, but the species is known to return to the same breeding grounds each year, and pairs seem to form monogamous bonds throughout the breeding season (Niles et al. 2008). Females lay one clutch of 3 to 4 eggs per season. Males and females participate in egg incubation, which lasts for approximately 22 days (Niles et al. 2008). Chicks are born in early July, and the fledgling period lasts 18 days (Niles et al. 2008).

Wintering

Red knots occupy wintering habitat from December to February but may be present in wintering areas as early as September or as late as May. Wintering areas include southeastern United States from Florida to North Carolina, northeastern Gulf of Mexico, northern Brazil, and Tierra del Fuego in southern South America (FWS 2013). Smaller numbers winter in the Caribbean and along the central Gulf coast (Alabama and Mississippi), the mid-Atlantic, and the Northeast United States (FWS 2013). Little information is available on where juveniles spend the winter months, and at least partial segregation between juveniles and adults may occur.

Migration

Red knots migrate up to 19,000 mi (30,000 km) each year—one of the longest migrations known in the animal kingdom—and individuals can undertake flights of several thousand miles without stopping. Northbound migration primarily occurs in February, and stopover areas include the Atlantic coast of Argentina, eastern and northern Brazil, the Virginia barrier islands, and the Delaware Bay. The Delaware Bay is an especially important staging area for the species. Almost the entire population of red knots uses the region during northbound migration over a 2 to 3-week period in late May (Niles et al. 2008). However, red knots may occur in varying numbers all along the Atlantic and Gulf coasts from Argentina to Massachusetts in areas of suitable habitat. Southbound migration occurs from mid-July through August. Important stopover sites include southwest Hudson Bay, James Bay, the St. Lawrence River, the Mingan Archipelago, and the Bay of Fundy in Canada; the coasts of Massachusetts and New Jersey and the mouth of the Altamaha River in Georgia in the United States; the Caribbean; and the northern coast of South America from Brazil to Guyana.

Stopover Habitat

During migration, red knots use coastal marine and estuarine habitats with large areas of exposed intertidal sediments; ocean- or bay-front areas; and tidal flats in more sheltered bays and lagoons (FWS 2014d; Harrington 2001). Along the Atlantic coast, dynamic and ephemeral features are important red knot habitats; these include sand spits, islets, shoals, and sandbars (Harrington 2008). Red knots primarily migrate in close proximity to the coast, although small numbers are reported annually across the interior of the United States. Red knots exhibit some stopover site fidelity in areas where abundant food resources are consistently available from year to year (FWS 2013).

High-quality roosting habitat is a limiting factor during migration and influences selected stopover sites. Red knots require roosts that provide sufficient distance from high tide and are close to feeding areas, protected from predators, and free from excessive human disturbance. Red knots often choose supratidal areas of sandy inlets for roosting.

Diet

The red knot is a specialized molluscivore that primarily eats hard-shelled mollusks, although it may supplement its diet with shrimp, crabs, marine worms, insects, seeds, and vegetable matter. Primary food sources during migration include bivalves, gastropods (a class of mollusks), amphipods (an order of crustaceans), and occasionally polychaetes (a class of marine worms) (Niles et al. 2008). From the east coast specifically, a variety of prey items have been reported, including blue mussel (*Mytilus edulis*), gem clams (*Gemma gemma*), horseshoe crab (*Limulus polyphemus*) eggs, and amphipods (FWS 2013). On breeding grounds, the red knot diet consists primarily of insects and other terrestrial invertebrates (Harrington 2001).

Abundance

The red knot population declined sharply in the late 1800s and early 1900s. Following hunting restrictions, the population recovered to 100,000 to 150,000 individuals by the 1990s, and the population has since declined again (NatureServe 2018b). Survey data from the Tierra del Fuego wintering area and the Delaware Bay spring stopover site suggest a 75 percent decline in the population since surveys began in the 1980s. Survey data from other areas, including the Virginia barrier islands spring stopover site, show no trend since the mid-1990s. NatureServe (NatureServe 2018b) reports that the current red knot population is between 18,000 and 33,000 individuals.

The available literature suggests that migrating red knots are not common in Pennsylvania (FWS 2013, FWS 2014d; Niles et al. 2008, 2010). Some studies have reported that small numbers of red knots wintering in the southeast Caribbean region use an inland route to migrate in the spring; however, most of these individuals travel over the central states and pass over the Great Lakes. One bird with a geolocator was recorded migrating from the southeast over Kentucky and western Pennsylvania to a stopover site at James Bay, Canada (FWS 2014d). The Cornell Lab of Ornithology (eBird 2015) reports that red knots have been observed in two areas of the State: Presque Isle, which lies in northwestern Pennsylvania and juts into Lake Erie; and Conojehola Flats, a group of islands along the southernmost 30 mi (50 km) of the Susquehanna River. Birders have reported infrequent sightings along the Susquehanna River roughly 20 mi (32 km) northwest of Peach Bottom dating back to 1985 (eBird 2018b). Most sightings have been of single individuals, although 31 red knots were observed together in May 2000. Red knots have been reported in 7 years since 1985, and the most recently reported sighting was of two juveniles in 2009. The birds stopped to rest briefly at Gull Island and then continued northwest upriver. South of Peach Bottom, red knots have been reported at the mouth of the Susquehanna River and into the Chesapeake Bay in Havre de Grace, MD (eBird 2018b). Sightings at these locations are from 1999, 2005, and 2011 and ranged from one to six individuals.

Factors Affecting the Species

Many of the factors that the U.S. Fish and Wildlife Service attributes to the red knot's decline are related to climate change. Such factors include habitat loss from sea level rise and shoreline erosion; asynchronies in the timing of the species' annual cycle; and changes in storm frequency, intensity, and timing at key stopover areas. In the Northeast, Cape Cod, Long Island, and most of coastal New Jersey are particularly susceptible to increasing shoreline erosion associated with sea level rise and increased storm frequency and intensity. Overharvesting and related population decline of horseshoe crabs, whose eggs serve as a critical red knot food source during migration, may also be contributing to the red knot's decline (NatureServe 2018a).

Occurrence Within the Action Area

The Peach Bottom action area falls within the known migratory range of the red knot. As described in this section, red knots are not common in Pennsylvania, but infrequent sightings of the species have been reported by birders along the Susquehanna River both north and south of the Peach Bottom action area. Within the action area itself, no surveys have been conducted for red knots, and Exelon (2018a) reports no known occurrences of the species on the Peach Bottom site. Red knots would only be present in the action area during spring and fall migration periods. However, suitable stopover habitat does not occur within the action area, so individuals are more likely to stop north or south of the action area rather than in the action area itself, consistent with reported sightings of the species. These regions of the river north and south of the action area provide exposed flats, islands, inlets, and other shallow riparian habitats that red knots require for resting and foraging. Based on this information, the red knot is not likely to occur in the Peach Bottom action area due to lack of suitable habitat.

<u>Chesapeake Logperch (*Percina bimaculata*)</u>

The Chesapeake logperch is a larger species of darter that the U.S. Fish and Wildlife Service is currently considering for listing under the Endangered Species Act. In 2011, the Service issued a finding that listing may be warranted based on the Service's initial review of scientific and commercial information submitted in a petition from the Center for Biological Diversity and several other organizations (76 FR 59836). This section draws information from the Pennsylvania Fish and Boat Commission's Species Action Plan (PFBC 2015) unless otherwise cited.

Taxonomy and Species Description

The Chesapeake logperch was recognized as a distinct species from the common logperch (*Percina caprodes*) following genetic and morphological analysis in 2008. Like other logperches, the Chesapeake logperch is a larger species of darter characterized by an elongated body, broad interorbital width, and two distinctly separate dorsal fins. Individuals are a pale-yellow color with narrow tiger-like bars on the side and back. Adult Chesapeake logperch reach up to 109 mm (4.3 in.) in standard length, and males exhibit larger snouts and anal fin length. During the breeding season, common logperch males bear a prominent orange band along the first dorsal fin margin, and the body color becomes darker (Spalding 2006). Females may exhibit this change as well.

Distribution and Relative Abundance

The Chesapeake logperch is endemic to the Chesapeake Bay basin. Currently, the species occurs in the lower Susquehanna River above and below Conowingo Dam and in the following creeks in Maryland and Pennsylvania: (1) the Broad, Conowingo, Deer, Northeast, and Octoraro creeks in Maryland and (2) the Michael Run, Fishing, Muddy, and Octoraro creeks in Pennsylvania (FWS 2018e). Historically, the species also occurred in the Potomac River; however, the last reported collection from the Potomac River was in 1938, and the U.S. Fish and Wildlife Service (FWS 2018e) now believes the Chesapeake logperch to be extirpated from this river.

The current population size is unknown. Collections from the mid-1960s through present within Conowingo Pond indicate neither an increase nor a decrease in distribution or abundance.

Habitat

The Chesapeake logperch inhabits larger rivers and lower reaches of tributaries. The species appears to be somewhat of a habitat generalist: it has been collected from areas of fine gravel and sand or silt substrate; in fast currents of riffles with cobble substrates; and in vegetated habitats with slower flows (FWS 2018e). Near (2008) and Ashton and Near (2010) have suggested that the species' preferences are likely similar to the common logperch and other closely related logperches, which prefer warm habitats with unembedded, gravely substrates.

Biology

Life history information on the Chesapeake logperch is limited at this time. Additional research is needed to define basic aspects of the species' ecology; however, Ashton and Near (2010) suggest that reproduction and other life history characteristics are likely similar to the common logperch.

Common logperch reach sexual maturity at 2 years. Females broadcast spawn in the spring in shallow freshwater streams and ponds and often in riffles or other swiftly moving areas (Spalding 2006). Eggs are adhesive and demersal and sink to the sand or gravel below where they are fertilized by males. Eggs hatch in approximately 8 days. At hatching, the appearance of the juvenile common logperch is very similar to adults of the species, and individuals do not exhibit intermediate stages or metamorphosis.

Logperch, like other darters, travel alone or in small groups and do not school. During foraging, logperch use their conical snouts and heads to flip stones and other substrate matter in search of food. Both juveniles and adults exhibit this behavior. Juvenile common logperch eat rotifers (a microscopic phylum of aquatic animals), copepods (a class of small crustaceans), and water fleas. As individuals grow, they incorporate aquatic insects, especially mayfly (Ephemeroptera) and midge larvae (Chironomidae), as well as snails, leeches, and fish eggs into their diet. Common logperch travel significant distances while foraging; marked individuals have been recorded as traveling up to 1 mi (1.6 km) up and downstream from the original point of capture (Spalding 2006).

Common logperch live 3 to 4 years. Predators include pike-perch (*Sander* spp.), bass (*Micropterus* spp.), pike (*Esox* spp.), and piscivorous birds (Spalding 2006).

Factors Affecting the Species

The Pennsylvania Fish and Boat Commission identifies water quality issues, habitat loss, and introduced species to be some of the major threats to the Chesapeake logperch. Notably, the Commission's *Species Action Plan* also notes that direct mortality from impingement of Chesapeake logperch at Peach Bottom is also a contributing factor. Conservation Action (1)(b) of the action plan is, "Continue to work with federal and state government agencies to minimize impingement and entrainment."

Occurrence Within the Action Area

The Peach Bottom action area falls within the range of the Chesapeake logperch. Researchers have confirmed the presence of logperch in Conowingo Pond during various aquatic sampling efforts. However, because the Chesapeake logperch has only recently been distinguished from the common logperch, available surveys and sampling reports do not distinguish between the two species. Logperch (species unspecified) are reported from Conowingo Pond in the following sources.

- In 1999, researchers collected a total of 55 logperch in seine (50 individuals) and electrofisher (5 individuals) samples during Conowingo Pond aquatic community sampling (NAI 2000).
- In 2005 and 2006, researchers collected logperch during Peach Bottom impingement mortality and entrainment studies (URS and NAI 2008).
- In 2010 and 2011, researchers collected 142 logperch in electrofisher, seine, and trawl samples during Conowingo Pond aquatic community sampling (NAI 2013b).
- From 2010 through 2014, researchers collected 559 Chesapeake logperch by boat electrofisher, trawl, and seine in macroinvertebrate samples across 30 Conowingo Pond monitoring stations associated with Peach Bottom thermal studies (NAI and ERM 2014).
- From 2010 through 2015, researchers collected 52 logperch in Peach Bottom intake screen samples associated with Peach Bottom impingement studies. In 2015, researchers specifically reported collecting 11 Chesapeake logperch (NAI 2010a, 2011a, 2012a, 2013a, 2014a, 2015a).
- In 2014, researchers collected two logperch at the East Fish Lift Passage Facility (one on April 21, 2014, and one on May 6, 2014) (NAI 2014b).
- In 2016, researchers collected 74 Chesapeake logperch by boat electrofisher, trawl, and seine in macroinvertebrate samples associated with a followup study to the 2010–2014 thermal study (NAI and ERM 2017).

Based on the above information, the Chesapeake logperch is a consistent resident species of Conowingo Pond, and therefore, the species occurs in the Peach Bottom action area.

Summary of Potential Species Occurrence in the Action Area

Table 3-12 below summarizes the potential for each of the federally listed species to occur in the action area.

Table 3-12 Potential Occurrences of Federally Listed Species in the Action Area

	Type of occurrence in Pennsylvania	Period of occurrence in Pennsylvania (if present)	Likelihood of occurrence in action area
Bog turtle	resident	Year round, although not active during hibernation period of late September through late March	Presence unlikely due to lack of suitable habitat in the action area
Northern long-eared bat	resident	Year round, although not active during hibernation period of November to April	Occasional presence possible in action area forests in spring, summer, and fall
Indiana bat	resident	Year round, although not active during hibernation period of October to April	Rare occurrences possible in action area forests in spring, summer, and fall
Rufa red knot	transient migrant	February and mid-July through August	Presence unlikely due to lack of suitable habitat in the action area
Chesapeake logperch	resident	Year round	Presence confirmed by numerous aquatic studies

3.8.1.3 Species and Habitats Under National Marine Fisheries Service's Jurisdiction

No federally listed endangered or threatened species under the National Marine Fisheries Service's jurisdiction occur within Conowingo Pond (Exelon 2018a, NRC 2019d). Two federally listed species under the National Marine Fisheries Service's jurisdiction may occur below the Conowingo Dam within the lower Susquehanna River (NMFS undated_a, NMFS undated_b):

- shortnose sturgeon
- Atlantic sturgeon

Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

The National Marine Fisheries Service listed five Atlantic sturgeon distinct population segments (DPS) on February 6, 2012 (77 FR 5880; 77 FR 5914). Atlantic sturgeon in the Susquehanna River belong to the Chesapeake Bay DPS, which is listed as endangered. On September 18, 2017, the National Marine Fisheries Service designated critical habitat for the Chesapeake Bay DPS; however, no critical habitat occurs within the action area (82 FR 39160).

Species Description and Life History

The Atlantic sturgeon is an anadromous bony fish that can grow to 16 ft (4.9 m) and weigh up to 800 lbs (370 kg) (NMFS undated_a). Atlantic sturgeon are similar in appearance to shortnose sturgeon—bluish-black to olive brown dorsally with pale sides and underbelly—but are larger in size and have a smaller and differently shaped mouth. Females reach maturity at 7 to 30 years of age, and males reach maturity at 5 to 24 years of age, with fish inhabiting the southern range maturing earlier (75 FR 61872). Females return to natal freshwater rivers to spawn between April and May.

Spawning within the Susquehanna River typically occurs in the lower portion of the Susquehanna River below Deer Creek in areas of flowing fresh water (SRAFRC 2010). This area is downstream of Peach Bottom, below Conowingo Dam. Once females reach spawning grounds, they lay 400,000 to 4 million highly adhesive eggs, which fall to the bottom of the water column and adhere to cobble or other hard bottom substrate. Eggs hatch to yolk-sac larvae in 94 to 140 hours at temperatures of 20 °C (68 °F) and 18 °C (64.4 °F), respectively (ASSRT 2007). The larvae absorb their yolk in 8 to 12 days, during which time the post yolk-sac larvae migrate downstream into brackish water, where they live for a few months (ASSRT 2007). Larvae are demersal and use benthic structures as refugia; thus, they are typically not found in the water column (ASSRT 2007). When juveniles reach a size of 30 to 36 in. (76 to 92 cm), they migrate to nearshore coastal waters (ASSRT 2007). Juveniles and non-spawning adults inhabit estuaries and coastal marine waters dominated by gravel and sand substrates (ASSRT 2007).

Sturgeon consume prey by sucking in organisms off the river bed or sea floor. Juveniles feed on benthic invertebrates, including crustaceans, worms, and mollusks. Adults are opportunistic feeders. Prey include mollusks, snails, worms, shrimp, and benthic fish. (ASMFC 2018)

Range and Abundance

Historically, the Atlantic sturgeon has inhabited riverine, estuarine, and coastal ocean waters from St. Lawrence River, Canada to St. John's River, FL (75 FR 61872). Within the United States, the species was historically present in approximately 38 rivers from St. Croix, ME to St. John's River, FL. Currently, the species resides in 36 U.S. rivers and spawns in at least 20 of these rivers (ASSRT 2007).

Atlantic sturgeon are native to the lower Susquehanna River and historically abundant throughout the Chesapeake Bay (SRAFRC 2010). Overharvesting, poor water quality, and dams that blocked migration routes contributed to the decline of this DPS. By the 1920s, the population within the upper Chesapeake Bay and its tributaries was very small and could no longer support a sturgeon fishery (SRAFRC 2010). The Maryland Department of Natural Resources (2009) considered the population to be biologically extirpated in the Chesapeake Bay due to the extremely low numbers and lack of reproduction. The NRC staff is not aware of any Atlantic sturgeon occurring within Conowingo Pond (NRC 2019d, Exelon 2018a), and no Atlantic sturgeon have been collected or passed through the Conowingo fish lifts since the lifts began operating in 1972 (west lift) and 1991 (east lift) (SRAFRC 2010, FERC 2015). Suitable habitat for the Atlantic sturgeon occurs below the Conowingo Dam; however, the NRC staff identified no documentation of this species in the lower Susquehanna River since 1987 (MDNR 2009, SRAFRC 2010, NAI and GSE 2012a, FERC 2015, Exelon 2018a).

Occurrence Within the Action Area

Although Atlantic sturgeon occur in the lower Susquehanna River, Conowingo Dam physically prevents individuals from entering Conowingo Pond. Thus, the Susquehanna River below Conowingo Dam within the dam's tailwaters is the closest region of the river in which Atlantic sturgeon may occur. This region of the river is outside of the Peach Bottom action area. Accordingly, the NRC staff concludes that Atlantic sturgeon are not present in the Peach Bottom action area.

Shortnose Sturgeon *(Acipenser brevirostrum)*

The U.S. Fish and Wildlife Service listed the shortnose sturgeon as endangered range wide in the first listing (32 FR 4001) under the federal Endangered Species Preservation Act in 1967 (16 USC 668 et seq.). The enactment of the Endangered Species Act (ESA) in 1973 (16 USC 1531 et seq.) deemed this species listed as endangered under the ESA. The National Marine Fisheries Service has not designated critical habitat for this species.

Species Description and Life History

The shortnose sturgeon is an anadromous, primitive bony fish that can be differentiated by other sturgeon species by its smaller size and shorter and blunter nose. Shortnose sturgeons grow to a length of 4.5 ft (1.4 m) and typically weigh up to 50 pounds (23 kg) (NMFS undated_b). Juveniles mature into adults at a fork length of 18 to 22 in. (45 to 55 cm). The shortnose's lifespan varies from 30 years (males) to 67 years (females).

The shortnose sturgeon migrates earlier in the year than other sturgeon species. Adults begin to migrate upstream to freshwater beginning in the winter, spend most of the winter in deep waters of rivers and estuaries, and spawn between January and mid-May (Dadswell et al. 1984). Water temperature is a major determining factor of spawning time, and shortnose begin to spawn when water temperatures reach 46 to 48 °F (8 to 9 °C) (Gilbert 1989). Females produce 40,000 to 200,000 dark brown to black-colored eggs each spring and lay their eggs in faster flowing waters over rock, rubble, or hard clay substrate (Gilbert 1989). Eggs are separate when spawned but become adhesive within 20 minutes of being fertilized and attach to hard substrates on the river bottom (Dadswell et al. 1984). Eggs hatch in 4 to 15 days with incubation time being inversely correlated with water temperature; eggs hatch in 8 days at 63 °F (17°C) and in 13 days at 50 °F (10 °C) (Gilbert 1989). Larvae consume their yolk sac and begin feeding in 8 to 12 days as they migrate downstream and away from the spawning site. Juveniles, which feed on benthic insects and crustaceans, remain in freshwater until the following winter, at which time they migrate to brackish estuaries, where they remain for 3 to 5 years. Shortnose sturgeon are considered adults at a fork length of 18 to 22 in. (45 to 55 cm) and 3 to 10 years of age (Gilbert 1989). As adults, individuals migrate to the nearshore marine environment, where their diet consists of mollusks and large crustaceans.

Range and Abundance

Shortnose sturgeon are native to the lower Susquehanna River and historically abundant throughout the Chesapeake Bay (SRAFRC 2010). Overharvesting, poor water quality, and dams that blocked migration routes contributed to the decline of this species. By the 1920s, the population within the upper Chesapeake Bay and its tributaries was very low and could no longer support a sturgeon fishery (SRAFRC 2010). The Maryland Department of Natural Resources (2009) considered the population biologically extirpated in the Chesapeake Bay due to the extremely low numbers and lack of reproduction. The NRC staff is not aware of any shortnose sturgeon occurring within Conowingo Pond (NRC 2019d, Exelon 2018a), and no shortnose sturgeon have been collected or passed through the Conowingo fish lifts since they began operating in 1972 (FERC 2015). Suitable habitat for the shortnose sturgeon occurs below the Conowingo Dam. NAI and GSE (2012a) conducted a life history review for this species and determined that the Maryland Department of Natural Resources and FWS reported eight shortnose sturgeon within the Susquehanna River based on a sturgeon tagging program initiated in 1992 and a smaller reward program initiated in 1996. In addition, an angler reported two shortnose sturgeon in the Conowingo Dam tailrace in 1986. SRAFRC (2010) determined that reproduction within the Susquehanna River is unlikely based upon the small population and because most of the observed fish were sub-adults, rather than mature adults that could spawn if suitable habitat was present. NAI and GSE (2012a) was not aware of any shortnose sturgeon collections in the Susquehanna River since 2004.

Occurrence Within the Action Area

Although shortnose sturgeon occur in the lower Susquehanna River, Conowingo Dam physically prevents individuals from entering Conowingo Pond. Thus, the Susquehanna River below Conowingo Dam within the dam's tailwaters is the closest region of the river in which shortnose sturgeon may occur. This region of the river is outside of the Peach Bottom action area. Accordingly, the NRC staff concludes that shortnose sturgeon are not present in the Peach Bottom action area.

3.8.2 Species and Habitats Protected Under the Magnuson–Stevens Act

The waters and substrate necessary for spawning, breeding, feeding, or growth to maturity are considered Essential Fish Habitat (EFH) (16 U.S.C. 1802(10)). The National Marine Fisheries Service and Atlantic States Marine Fisheries Commission, which are together responsible for designating EFH, have not designated any portion of the Susquehanna River above Conowingo Dam as EFH (NMFS 2019). However, these agencies have designated EFH near the mouth of the Susquehanna River for six federally managed species (referred to as "EFH species" in this SEIS) whose prey include anadromous fish that inhabit the lower Susquehanna River, including Conowingo Pond (NMFS 2019). The six EFH species and relevant life stages are as follows.

- Atlantic herring (*Clupea harengus*)—juveniles and adults
- clearnose skate (*Raja eglanteria*)—juvenile and adults
- little skate (*Leucoraja erinacea*)—adults
- red hake (*Urophycis chuss*)—all life stages
- windowpane flounder (*Scophthalmus aquosus*)—adults
- winter skate (*Leucoraja ocellata*)—juveniles and adults

These EFH species may consume several species of anadromous fish, including gizzard shad, American shad, alewife, and blueback herring. These anadromous prey fish migrate between freshwater to spawn and marine waters as adults. During migration, individuals may migrate from Conowingo Pond, downstream through EFH-designated areas of the Susquehanna River, and then to estuarine and marine waters. Because of the potential for the proposed Peach Bottom license renewal to affect these anadromous prey fish, which could in turn affect the downstream abundance or availability of prey near the mouth of the Susquehanna River, the NRC staff has conservatively chosen to evaluate the effects of the proposed license renewal on these prey species to determine whether it constitutes a potential adverse effect. In the sections below, the NRC staff briefly describes the designated EFH, habitat use, and typical diet of each of the six EFH species.

<u>Atlantic Herring (*Clupea harengus*)—Juveniles and Adults</u>

Designated Essential Fish Habitat

Designated EFH for Atlantic herring includes the lowest portion of the Susquehanna River near the mouth of the river (NMFS 2019). No designated EFH for this species occurs in Conowingo Pond.

Habitat Use

Adult and juvenile Atlantic herring inhabit pelagic waters of the Atlantic Ocean along the eastern seaboard. Young-of-the-year juveniles can tolerate low salinity waters, including fresher portions of estuaries and river mouths, whereas older juveniles tend to avoid these areas. Adults migrate inland seasonally.

Diet

Juveniles and adults are opportunistic feeders that consume a variety of planktivorous organisms. Juveniles most commonly consume copepods, decapod larvae, barnacle larvae, cladocerans, and molluscan larvae. During this life stage, individuals may consume up to 15 groups of zooplankton (Stevenson and Scott 2005). Adults primarily consume euphausiids, chaetognaths, and copepods.

<u>Clearnose skate (*Raja eglanteria*)—Juveniles and Adults</u>

Designated Essential Fish Habitat

Designated EFH for clearnose skate includes the lowest portion of the Susquehanna River near the mouth of the river (NMFS 2019). No designated EFH for this species occurs in Conowingo Pond.

Habitat Use

Adult and juvenile clearnose skate inhabit pelagic waters of the Atlantic Ocean along the eastern seaboard. Both juveniles and adults occur within the Chesapeake Bay and lower portions of the Susquehanna River.

Diet

This species primarily consumes invertebrates, including polychaetes, amphipods, mysid shrimps (e.g., Neomysisamericana), the shrimp *Crangon septemspinosa*, mantis shrimps, crabs (e.g., *Cancer* spp., mud, hermit, and spider crabs), bivalves (e.g., *Ensis directus*), and squids (Packer et al. 2003a). Piscivorous prey include smaller fishes such as soles (e.g., flatfish), weakfish (*Cynoscion regalis*), American butterfish (*Peprilus triacanthus*), and scup (*Stenotomus chrysops*) (Bigelow and Schroeder 1953; Packer et al. 2003a. In North Carolina, Schwartz (1996) determined that clearnose skate also prey on striped anchovy (*Anchoa hepsetus*), Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), and blackcheek tonguefish (*Symphurus plagiusa*).

<u>Little skate (*Leucoraja erinacea*)—Adults</u>

Designated Essential Fish Habitat

Designated EFH for little skate includes the lowest portion of the Susquehanna River near the mouth of the river (NMFS 2019). No designated EFH for this species occurs in Conowingo Pond.

Habitat Use

Adult little skate inhabit the Atlantic Ocean along the eastern seaboard from Nova Scotia, Canada to Cape Hatteras, NC. This species is demersal (occurs near the bottom of the river bed or ocean floor) and seasonally migrates between onshore (e.g., rivers and estuaries) and offshore regions.

Diet

Adults primarily consume invertebrates, including decapod crustaceans and amphipods (Packer et al. 2003b). Less important prey include isopods, bivalves, and fish (Bigelow and Schroeder 1953; Packer et al. 2003b). Carlson (1991) determined that decapods make up 76 percent of the little skate's diet by weight, whereas fish comprise only 10 percent of the diet by weight. Reported fish prey included sand lance, alewives, herring, cunner (*Tautogolabrus adspersus*), silversides, tomcod (*Microgadus tomcod*), silver hake (*Merluccius bilinearis*), yellowtail flounder (*Limanda ferruginea*), and longhorn sculpin (*Myoxocephalus octodecimspinosus*) (Packer et al. 2003b).

<u>Red hake (*Urophycis chuss*)—All Life Stages</u>

Designated Essential Fish Habitat

EFH for red hake has not been designated in Conowingo Pond. Designated EFH for red hake includes the lowest portion of the Susquehanna River near the mouth of the river (NMFS 2019).

Habitat Use

Red hake inhabit the Atlantic Ocean along the eastern seaboard from Southern Newfoundland, Canada to North Carolina. This species is demersal and seasonally migrates between onshore and offshore regions.

Diet

Red hake larvae primarily consume copepods and other microcrustaceans (Steimle et al. 1999). Juveniles consume small benthic and pelagic crustaceans, such as larval and small decapod shrimp and crabs, mysids, euphausiids, and amphipods (Steimle et al. 1999). Adults also primarily consume crustaceans in addition to a variety of demersal and pelagic fish, such as haddock (*Melanogrammus aeglefinus*), silver hake, sea robins (Triglidae), sand lance, mackerel (*Scomber japonicus*), and small red hake (NOAA Fisheries undated). Northeast Fisheries Science Center's bottom trawl surveys conducted from 1973–1980 determined that fish comprised 2.1 and 20.3 percent of the diet for juveniles and adults, respectively, based on mean percent prey weight (Steimle et al. 1999). Similar surveys conducted from 1981–1990 determined that fish comprised 2.7 and 30.8 percent of the diet for juveniles and adults, respectively, based on mean percent prey volume (Steimle et al. 1999).

<u>Windowpane Flounder (*Scophthalmus aquosus*)—Adults</u>

Designated Essential Fish Habitat

Designated EFH for windowpane flounder includes the lowest portion of the Susquehanna River near the mouth of the river (NMFS 2019). No designated EFH for this species occurs in Conowingo Pond.

Habitat Use

Windowpane flounder inhabit estuaries, coastal waters, and the Atlantic Ocean from the Gulf of Saint Lawrence in Canada and over the continental shelf south to Florida. This species is most abundant from Georges Bank off the Gulf of Maine south to the Chesapeake Bay (Chang et al. 1999). Windowpane flounder spawn in estuaries. Juveniles migrate from estuaries to coastal waters during autumn and overwinter offshore in deeper waters. Adults remain offshore throughout the year but inhabit nearshore waters in spring and autumn (Chang et al. 1999).

Diet

Adults consume mysids, decapod crustaceans, amphipods, copepods, mollusks, and larval or juvenile fish, such as hakes and Atlantic tomcod (Chang et al. 1999, Steimle et al. 2000). Steimle et al. (2000) examined the stomach contents of 570 juvenile and adult windowpane flounder taken from the Hudson-Raritan Estuary of New York and New Jersey and recorded 37 different prey, including juvenile *Alosa* species, such as American shad, blueback herring, and alewife. Dominant prey included the mysid *Neomysis americana* (34 to 93 percent by weight), sand shrimp (24 to 53 percent by weight), and the suprabenthic amphipod (*Gammarus lawrencianus*) (less than 1 to 39 percent by weight). All other prey items, including *Alosa* species, were each less than 5 percent. Steimle et al. (2000) classified *Alosa* species as minor prey for windowpane flounder.

<u>Winter Skate (*Leucoraja ocellata*)—Juveniles and Adults</u>

Designated Essential Fish Habitat

Designated EFH for winter skate includes lowest portion of the Susquehanna River near the mouth of the river (NMFS 2019). No designated EFH for this species occurs in Conowingo Pond.

Habitat Use

Winter skate inhabit sandy- and gravel-bottomed marine waters from Newfoundland, Canada and the southern Gulf of Saint Lawrence in Canada to Cape Hatteras, NC (Bigelow and Schroeder 1953).

Diet

Packer et al. (2003c) determined that the most important prey items for juvenile and adult winter skate include polychaetes and amphipods followed by decapods, isopods, bivalves, and fish. Winter skate consume more fish as they grow larger. American sand lance is the primary fish prey species (Packer et al. 2003c). Other fish prey include smaller skates, eels, Atlantic menhaden (*Brevoortia tyrannus*), rainbow smelt (*Osmerus mordax*), chub mackerel, Atlantic butterfish, cunners (*Tautogolabrus adspersus*), silver hake, Atlantic tomcod, yellowtail flounder, and longhorn sculpin (Packer et al. 2003c). Steimle et al. (2000) examined the stomach contents of 57 adult winter skate within the Hudson-Raritan Estuary and determined that adult winter skate consume a diverse variety of benthic invertebrates and fish. The most common prey included sand shrimp, as well as Atlantic herring, longhorn sculpin, sand lance, and winter flounder (*Pseudopleuronectes americanus*). Bigelow and Schroeder (1953) noted that winter skate may consume *Alosa* species.

3.9 <u>Historic and Cultural Resources</u>

This section describes the cultural background and the historic and cultural resources found at Peach Bottom and in the surrounding area. Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (54 U.S.C. 300101 et seq.), requires Federal agencies to consider the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation an opportunity to review and comment on the undertaking. Undertakings denote a broad range of Federal activities, including the issuance of NRC licenses and permits. Historic properties are defined as resources included on, or eligible for inclusion on, the National Register of Historic Places (National Register). The criteria for eligibility are listed in Title 36, "*Parks, Forest, and Public Propert*y," of the *Code of Federal Regulations* (36 CFR) 60.4, "Criteria for Evaluation," and include (1) association with significant events in history, (2) association with the lives of persons significant in the past, (3) embodiment of distinctive characteristics of type, period, or construction, and (4) sites or places that have yielded, or are likely to yield, important information.

In accordance with 36 CFR 800.8(c), “Use of the NEPA Process for Section 106 Purposes,” the NRC complies with the obligation required under Section 106 of the NHPA through its process under the National Environmental Policy Act of 1969 (NEPA), as amended (42 U.S.C. 4321 et seq). In the context of NHPA, the area of potential effect for a license renewal action is the Peach Bottom site and its immediate environs. Peach Bottom is located within the approximately 770-ac (310-ha) Exelon property site. This property constitutes the area of potential effect and consists primarily of developed land, deciduous forest, and open water. These land areas may be impacted by continued maintenance and operations activities during the subsequent license renewal term. The area of potential effect may extend beyond the immediate Peach Bottom environs if Exelon’s maintenance and operations activities affect offsite historic properties. This is irrespective of land ownership or control.

In accordance with the provisions of the National Historic Preservation Act, the NRC is required to make a reasonable effort to identify historic properties within the area of potential effect. The NRC is required to, in consultation with the State Historic Preservation Office, determine and document the area of potential effect (APE) and identify historic properties within the area of potential effect. If the NRC finds that either there are no historic properties within the area of potential effect or the undertaking (subsequent license renewal) would have no effect on historic properties, the NRC provides documentation of this finding to the appropriate State historic preservation officer. In addition, the NRC notifies all consulting parties, including Indian tribes, and makes this finding public (through the NEPA process) prior to issuing the renewed operating license. Similarly, if historic properties are present and could be affected by the undertaking, the NRC is required to assess and resolve any adverse effects in consultation with the State historic preservation officer and any Indian Tribe that attaches religious and cultural significance to identified historic properties. The Pennsylvania State Historic Preservation Office, a bureau within the Pennsylvania Historical and Museum Commission, administers the State’s historic preservation program.

3.9.1 Cultural Background

Human occupation in the eastern Pennsylvania region extends back to about 10,000 years. Prehistoric occupation of the area is divided into three major periods:

- Paleo-Indian Period (10,000–8,000 BC)
- Archaic Period (8,000–1,000 BC)
- Woodland Period (1,000 BC–European contact)

The Paleo-Indian Period is generally characterized by highly mobile bands of hunters and gatherers that followed available game (mammoth, bison). Vegetation during the earliest known human occupation of eastern Pennsylvania was characterized by a coniferous spruce-pine forest with open grasslands and sedges. River edge settings were favored habitats for Paleo-Indian hunters. Paleo-Indian stone tool technology is well documented (YCPC 2016 and Kinsey 1983). The Archaic Period was characterized by adjustments to warmer and drier trends as a result of the northern retreat of glaciers. Forest types changed from spruce-fir to pine-oak-hemlock and oak-chestnut-hickory. Archaic societies were organized as bands that shared a common heritage, language, and hunting and foraging territory and limited roaming when compared to their predecessors. Subsistence consisted of hunting, fishing, and gathering. During the Archaic Period, ground stone tools, such as the axe, milling stone, and pestle, appeared. Additionally, a large and distinctive group of projectile points with long and narrow blades appeared in eastern Pennsylvania during the Archaic Period (Kinsey 1983).

The Woodland Period experienced a transition from earlier hunting and gathering cultures to one characterized by village settlements, agriculture, and ceramic manufacturing. Additionally, elaborate earthen burial grounds that honored the elite were constructed during this time period. In what is present-day York and Lancaster Counties, PA, the predominant late Woodland culture (1000 AD to European contact) is known as Shenks Ferry. Shenks Ferry sites are represented by two distinct but related settlement types: (1) large, year-round, semi-permanent agricultural villages and sites, and (2) temporary sites (used short term for seasonal food procurement). By the mid-16th century, the Shenks Ferry culture came to an abrupt end, and it is believed that the Shenks Ferry peoples were conquered by and assimilated into the Susquehannocks (Kinsey 1983). The Susquehannocks were an Iroquoian-speaking group that spilt from the Iroquois and settled into present-day Lancaster County, PA. The Susquehannocks followed aboriginal patterns of moving their villages to new and nearby locations; subsistence was a combination of farming, hunting, and fishing. The Susquehannocks built large villages along the Susquehanna River; two sites in York County known as the Byrd and Oscar Leibhart archaeological sites are the last known villages of the Susquehannocks in Pennsylvania (YCPC 2016).

Contact between the Susquehannocks and European explorers may have occurred as early as 1608. By the late 17th century, the Susquehannock culture was disrupted as a result of European trade, disease, and warfare. By 1725, European settlement began in modern-day Lewisberry and Hanover, PA. Early European settlers in York County were trappers and homesteaders, and settlements consisted of widely dispersed log or stone cabin farmsteads (YCPC 2016). Settlements were influenced by the quality of soil, topography, streams, and proximity to transportation routes. By the 1730s, colonial Maryland and Pennsylvania were engulfed in border disputes, and in 1738 a temporary east-west boundary line clarified colonial authority. This temporary boundary remained in place until surveyors Charles Mason and Jeremiah Dixon made the boundary line (Mason–Dixon line) official (YCPC 2016). York County was formed in 1749, the first Pennsylvania county created west of the Susquehanna River. After the French and Indian War ended in 1763, settlement of York County accelerated (YCPC 2016).

3.9.2 Historic and Cultural Resources at Peach Bottom

Historic and cultural resources in the vicinity of Peach Bottom can include prehistoric era and historic era archaeological sites, historic districts, and buildings, as well as any site, structure, or object that may be considered eligible for listing on the National Register of Historic Places (NRHP). Historic and cultural resources also include traditional cultural properties that are important to a living community of people for maintaining their culture. “Historic property” is the legal term for a historic or cultural resource that is included on, or eligible for inclusion on, the NRHP.

Cultural resource surveys were not conducted at the Peach Bottom site prior to construction of the nuclear power plant (NRC 1978). However, in 1972, a field archeologist with the William Penn Museum of the Pennsylvania Historical and Museum Commission visited the Peach Bottom site and concluded that construction of Peach Bottom Units 1, 2, and 3 likely destroyed any historic and archaeological resource that may have been located within the site footprint. The archeologist also concluded that the existence of onsite archeological resources along the flood plain and terraces were unlikely as these areas were flooded by backwaters of the Conowingo Pond (NRC 1978, Exelon 2018a). Approximately 50 percent of the original 620 ac (250 ha) acquired for construction of Peach Bottom has been disturbed (Exelon 2018c). During construction of Peach Bottom, over 1.5 million cubic yards (1.1 cubic meters) of soil and rock were excavated; as discussed in Section 3.4.1, "Physiography and Geology," excavated areas surrounding plant structures were backfilled using compacted residual soil materials taken from the higher elevations of the plant property. Additionally, placement of fill within Conowingo Pond was used to create additional land, intake and discharge canals, and holding ponds, which expanded the 620-ac (250-ha) site boundary (Exelon 2017e; 2018a).

There are no Indian reservations within a 50-mi (80-km) radius of Peach Bottom. Within a 6-mi (10-km) radius of the Peach Bottom site, there are nine historic properties listed on the NRHP and four historic properties that have been determined eligible for listing in the NRHP (Exelon 2018a, Pennsylvania Historical & Museum Commission 2018). These 13 historic properties are not located within the Peach Bottom site.

In 1986, Peach Bottom Unit 1 was awarded the Nuclear Historic Landmark by the American Nuclear Society (ANS 2018). The award memorializes facilities where outstanding physical accomplishments took place that were instrumental in the advancement and implementation of nuclear technology and peaceful uses of nuclear energy. Peach Bottom Unit 1 was an experimental, high-temperature, helium-cooled and graphite-moderated reactor that operated from 1967 through 1978. The development, design, and testing of Peach Bottom Unit 1 was part of a cooperative program that included several industries and utilities whose objective was feasibility demonstration of commercial-scale, high-temperature, helium-cooled and graphite-moderated reactor technology (EISPC 2013). Exelon monitors and maintains Peach Bottom Unit 1 in safe storage (SAFSTOR) mode. Spent fuel and radioactive liquids have been removed and accessible areas have been decontaminated (Exelon 2018c). Exelon performs structural inspections and maintenance activities at Peach Bottom Unit 1 to maintain its integrity (Exelon 2018c). Exelon has installed a video presentation at the entrance lobby of Peach Bottom Unit 1 that chronicles the reactor's life from construction through its entry into SAFSTOR (Exelon 2018c).

3.10 Socioeconomics

This section describes current socioeconomic factors that have the potential to be directly or indirectly affected by changes in operations at Peach Bottom. Peach Bottom and the communities that support it can be described as a dynamic socioeconomic system. The communities supply the people, goods, and services required to operate the nuclear power plant. Power plant operations, in turn, supply wages and benefits for people and dollar expenditures for goods and services. The measure of a community's ability to support Peach Bottom operations depends on its ability to respond to changing environmental, social, economic, and demographic conditions.

3.10.1 Power Plant Employment

The socioeconomic region of influence (ROI) is defined by the area where Peach Bottom workers and their families reside, spend their income, and use their benefits, thus affecting the economic conditions of the region. Currently, Peach Bottom employs a workforce of approximately 830 permanent workers and 89 contract workers (Exelon 2018a). Approximately

70 percent of this workforce resides in Lancaster and York counties in Pennsylvania (see Table 3-13). The remaining workers are spread among 21 counties, with numbers ranging from 1 to 89 workers per county (Exelon 2018a). In 2018, the Pennsylvania Department of Labor & Industry ranked Exelon as number 38 out of the 50 largest employers and industries in York County (PDLI 2018). Since the majority of Peach Bottom workers reside in Lancaster and York counties, the most significant socioeconomic effects of plant operations are likely to occur in these counties. Therefore, the focus of the impact analysis and region of influence is the socioeconomic impacts of continued Peach Bottom operations on Lancaster and York County.

Table 3-13 Residence of Peach Bottom Employees[a] by County

County	Number of Employees	Percentage of Total
Total	**919**	**100**
Pennsylvania		
York	362	39.3
Lancaster	278	30.3
Chester	84	9.1
Other PA counties	17	1.8
Maryland		
Harford	89	9.7
Cecil	41	4.5
Other MD Counties	28	3.0
Other States		
Various	20	2.2

[a] Permanent and contract workers

Source: Exelon 2018a

Refueling outages for Peach Bottom occur on a staggered 24-month schedule per unit and have historically lasted 18 to 20 days per unit. During refueling outages, site employment typically increases by an additional 1,600 contract workers. According to Exelon, refueling outage workers are either permanent residents of the region or stay in temporary housing locations in the region (Exelon 2018a). As there are no license renewal-related refurbishment activities, Exelon has no plans to add additional employees to support plant operations during the extended license renewal period (Exelon 2018a).

3.10.2 Regional Economic Characteristics

This section presents information on employment and income in the Peach Bottom socioeconomic region of influence.

3.10.2.1 Regional Employment and Income

From 2010 to 2016, the labor force in the two-county region of influence increased by 3.3 percent to just over 514,000 persons. In addition, the number of employed persons increased by 7.3 percent, to approximately 492,500 persons. Consequently, from 2010–2016, the number of unemployed people in the region of influence decreased by nearly 43 percent to just over 22,000 persons (BLS 2010, BLS 2016). According to the 2012–2016 American Community Survey 5-year estimates, the combined Lancaster and York County civilian labor force was approximately 510,900 persons (USCB 2018a).

According to the U.S. Census Bureau's (USCB's) 2012–2016 American Community Survey 5-year estimates, educational services and health care and social assistance represents the largest employment sector in the ROI (approximately 22 percent), followed by manufacturing (approximately 17 percent). A list of employment by industry in the ROI is provided in Table 3-14. Estimated income information for the region of influence and Pennsylvania, for comparison, is presented in Table 3-15. According to the USCB's 2012-2016 American Community Survey 5-Year Estimates, people living in the two-county ROI had a median household income greater than the State average. Additionally, the percentage of families and individuals living below the poverty level in Lancaster and York Counties was lower than the percentage of families and individuals in the State of Pennsylvania as a whole.

Table 3-14 Employment by Industry in the Peach Bottom Two-County ROI (2012–2016)

Industry	Lancaster	York	Total	Percent
Agriculture, forestry, fishing and hunting, and mining	6,984	1,951	8,935	1.9
Construction	19,987	14,916	34,903	7.3
Manufacturing	43,234	36,871	80,105	16.6
Wholesale trade	9,420	7,519	16,939	3.5
Retail trade	31,700	25,587	57,287	11.9
Transportation and warehousing and utilities	12,068	12,383	24,451	5.1
Information	3,511	2,967	6,478	1.3
Finance, insurance, real estate, rental, leasing	12,208	11,110	23,318	4.8
Professional, scientific, and administrative and waste management services	21,207	19,170	40,377	8.4
Educational services, and health care and social assistance	59,926	47,964	107,890	22.4
Arts, entertainment, recreation, accommodation and food services	21,184	16,807	37,991	7.9
Other services (except public administration)	14,116	10,938	25,054	5.2
Public administration	6,675	10,768	17,443	3.6

Source: USCB 2018a

Table 3-15 Income Information for the Peach Bottom ROI and Pennsylvania (2012–2016)

	Lancaster	York	Pennsylvania
Median household income (dollars)[a]	70,512	70,732	54,895
Per capita income (dollars)[a]	28,152	28,975	30,137
Families living below the poverty level (percent)	7.2	7.5	9.1
People living below the poverty level (percent)	10.8	10.5	13.3

[a] In 2016 inflation adjusted dollars.

Source: USCB 2018a

3.10.2.2 Unemployment

According to the USCB's 2012–2016 American Community Survey 5-Year Estimates, the unemployment rate in Lancaster and York counties was 5.5 and 6.2 percent, respectively (USCB 2018a). Comparatively, the unemployment rate in the State of Pennsylvania during this same period was 7.2 percent (USCB 2018a).

3.10.3 Demographic Characteristics

An estimated 293,421 people live within 20 mi (32 km) of Peach Bottom, which equates to a population density of 234 persons per square mile (Exelon 2018a). This translates to a

Category 4, "Least sparse" population density using the license renewal GEIS (NRC 1996) measure of sparseness (greater than 120 persons per square mile within 20 miles). An estimated 5,738,258 people live within a 50-mile radius of Peach Bottom, which equates to a population density of 731 persons per square mile. This translates to a Category 4 density, using the license renewal GEIS (NRC 1996) measure of proximity (greater than 190 persons per square mile within 50 miles). Therefore, Peach Bottom is located in a "High" population area based on the license renewal GEIS sparseness and proximity matrix.

Table 3-16 shows population percent growth and projections from 1990 to 2060 in Lancaster and York counties. Over the last several decades, both counties have experienced increasing population. Based on population projections, the population in both counties is expected to continue to increase, but at a lower rate.

Table 3-16 Population and Percent Growth in the Peach Bottom ROI 1990–2060

Year	Lancaster Population	Percent Change	York Population	Percent Change
1990	422,822		339,575	-
2000	470,658	11.3	381,751	12.4
2010	519,445	10.4	434,972	13.9
2016	533,110	2.6	440,604	1.2[(a)]
2020	559,247	7.6	460,514	5.9[(a)]
2030	602,153	7.7	484,497	5.2
2040	641,815	6.5	498,246	2.8
2050	688,733	7.3	546,632	9.7
2060	731,701	6.2	578,856	5.9

(a) From 2010

Source: Decennial population data for 1990–2010 (USCB undated; USCB 2018b; USCB 2018c); Estimated 2016 population (USCB 2018d); 2020–2040 Projected Population (Behney et al., 2014), 2050–2060 Projected Population, NRC calculated.

The 2010 Census demographic profile of the Peach Bottom ROI population is presented in Table 3-17. According to the 2010 Census (USCB 2018c), minorities (race and ethnicity combined) comprised approximately 15 percent of the total population for the Peach Bottom region of influence. The largest minority population in the Peach Bottom region of influence were Hispanic or Latino of any race (7.3 percent of the total population; 64 percent of the total minority population). For comparison, according to the 2010 Census, minorities comprised approximately 21 percent of the total State of Pennsylvania population (USCB 2018e).

Table 3-17 Demographic Profile of the Population in the Peach Bottom Two-County Region of Influence in 2010

	Lancaster	York	ROI
Total Population	519,445	434,972	954,417
Race (Percent of total Population)			
White	88.6	88.5	88.5
Black or African American	3.7	5.6	4.5
American Indian & Alaska Native	0.2	0.2	0.2
Asian	1.9	1.2	1.6
Native Hawaiian & Other Pacific Islander	0.0	0.0	0
Some other race	3.6	2.4	3.1
Two or more races	2.0	2.0	2.0
Ethnicity			
Hispanic or Latino	44,930	24,937	69,327
Percent of total population	8.6	5.6	7.3
Minority Population (including Hispanic or Latino ethnicity)			
Total Minority population	78,476	60,193	108,669
Percent minority	15.1	13.8	14.5

Source: USCB 2018c

According to the USCB's 2012–2016 American Community Survey 5-Year Estimates, since 2010, minority populations in the two-county region of influence were estimated to have increased approximately by 48,500 persons (see Table 3-18).

Table 3-18 Demographic Profile of the Population in Peach Bottom Region of Influence, 2012–2016 Estimates

	Lancaster	York	ROI
Total Population	533,110	440,604	973,714
Race (Percent of Total Population)			
White	88.6	89.0	88.7
Black or African American	4.1	5.8	4.9
American Indian & Alaska Native	0.2	0.1	0.1
Asian	2.1	1.4	1.8
Native Hawaiian & Other Pacific Islander	0.0	0	0
Some other race	3.0	1.4	2.3
Two or more races	2.1	2.3	2.2
Ethnicity			
Hispanic or Latino	52,083	29,299	81,382
Percent of total population	9.8	6.6	8.4
Minority Population (including Hispanic or Latino ethnicity)			
Total Minority population	89,815	67,300	157,115
Percent minority	16.8	15.2	16.1

Source: USCB 2018d

3.10.3.1 Transient Population

York and Lancaster County can experience seasonal transient population growth as a result of local tourism, recreational activities, or colleges and universities. For instance, York County is the Factory Tour Capital of the World. Transient population creates a demand for temporary housing and services in the area.

Based on USCB's 2012–2016 American Community Survey 5-Year Estimates (USCB 2018f), approximately 23,050 seasonal housing units are located in the 25 counties within a 50-mi (80-km) radius of Peach Bottom. Of those, 1,916 housing units are located in the two-county region of influence. Table 3-19 presents information about seasonal housing for the counties within the 50-mi (80-km) radius of Peach Bottom.

Table 3-19 2016 Estimated Seasonal Housing in Counties Located Within 50 mi (80 km) of Peach Bottom

County	Total Housing Units	Total Vacant Units	Vacant Housing Units: for Seasonal, Recreational, or Occasional Use
Delaware			
Kent	67,315	5,966	863
New Caste	220,459	17,935	1,089
Maryland			
Anne Arundel	219,319	14,490	2,977
Baltimore	337,031	24,205	1,355
Baltimore City	296,923	54,507	1,210
Caroline	13,525	1,515	173
Carroll	63,123	2,674	275
Cecil	42,269	5,276	2,138
Frederick	93,645	4,650	409
Harford	98,277	5,780	304
Howard	115,003	5,131	315
Kent	10,667	2,984	1,974
Queen Anne's	20,754	2,969	1,698
New Jersey			
Cumberland	56,299	5,581	529
Gloucester	112,106	7,344	134
Salem	27,630	3,375	270
Pennsylvania			
Adams	41,344	3,075	785
Berks	164,853	12,402	500
Chester	195,720	8,999	655
Cumberland	102,772	6,271	535
Dauphin	121,889	11,678	943
Delaware	221,969	18,359	506
Lancaster	206,308	10,137	977
Lebanon	56,176	3,929	563
Montgomery	327,785	17,901	934
York	180,618	12,610	939

Source: USCB 2018f

3.10.3.2 Migrant Farm Workers

Migrant farm workers are individuals whose employment requires travel to harvest agricultural crops. These workers may or may not have a permanent residence. Some migrant workers follow the harvesting of crops, particularly fruit, throughout rural areas of the United States. Migrant workers may be members of minority or low-income populations. Because they travel and can spend a significant amount of time in an area without being actual residents, migrant workers may be unavailable for counting by census takers. If uncounted, these minority and low-income workers would be underrepresented in the decennial Census population counts.

Since 2002, the Census of Agriculture reports the numbers of farms hiring migrant workers—defined as a farm worker whose employment required travel that prevented the worker from returning to his or her permanent place of residence the same day (USDA 2012). The Census of Agriculture is conducted every 5 years and results in a comprehensive compilation of agricultural production data for every county and parish in the Nation.

Information about both migrant and temporary farm labor (working fewer than 150 days) can be found in the 2012 Census of Agriculture. Table 3-20 presents information on migrant and temporary farm labor in the 25 counties within a 50-mi (80-km) radius of Peach Bottom. According to the 2012 Census, 25,159 farm workers were hired to work for fewer than 150 days and were employed on 6,548 farms in the 25 counties within 50 miles (80 km) of Peach Bottom. The county with the highest number of temporary farm workers (5,855) on 1,841 farms was Lancaster County. Approximately 1,925 farms in the 25 counties within 50 mi of Peach Bottom reported hiring approximately 5,509 migrant workers.

Table 3-20 2012 Migrant Farm Workers and Temporary Farm Labor in Counties Located Within 50 mi (80 km) of Peach Bottom

County	Number of Farms with Hired Farm Labor	Number of Farms Hiring Workers for Less Than 150 Days	Number of Farm Workers Working for Less Than 150 Days	Number of Farms Reporting Migrant Farm Labor	Number of Migrant Farm Worker
Delaware					
Kent	261	148	609	12	7
New Castle	131	71	215	374	68
Maryland					
Anne Arundel	119	89	242		
Baltimore	212	132	475	21	115
Caroline	217	138	486	12	142
Carroll	254	159	569	11	75
Cecil	142	91	468	7	178
Frederick	362	231	779	15	105
Harford	150	103	290	9	70
Howard	111	78	434	3	12
Kent	147	77	345	7	124
Queen Anne’s	172	101	478	11	163
New Jersey					
Cumberland	203	139	1,726	47	1,531
Gloucester	159	115	1,016	46	940
Salem	204	130	829	31	552

Table 3-20 2012 Migrant Farm Workers and Temporary Farm Labor in Counties Located Within 50 mi (80 km) of Peach Bottom (cont.)

County	Number of Farms with Hired Farm Labor	Number of Farms Hiring Workers for Less Than 150 Days	Number of Farm Workers Working for Less Than 150 Days	Number of Farms Reporting Migrant Farm Labor	Number of Migrant Farm Worker
Pennsylvania					
Adams	358	268	2,171	72	8
Berks	590	387	1,886	1,109	51
Chester	788	503	2,819	56	888
Cumberland	301	238	129	13	158
Dauphin	174	696	427	5	19
Delaware	33	20	119	1	
Lancaster	2,385	1,841	5,855	46	162
Lebanon	432	277	881	3	11
Montgomery	178	129	564	1	
York	513	387	1,347	13	130

Source: USDA 2012

3.10.4 Housing and Community Services

This section presents information regarding housing and local public services, including education and water supply.

3.10.4.1 Housing

Table 3-21 lists the total number of occupied and vacant housing units, vacancy rates, and median value in the two-county Peach Bottom region of influence. Based on USCB's 2012–2016 American Community Survey 5-year estimates, there were approximately 386,926 housing units in the region of influence, of which approximately 364,179 were occupied.

Table 3-21 Housing in the Two-County Peach Bottom Region of Influence

	Lancaster County	York County	Region of Influence
Total housing units	206,308	180,618	386,926
Occupied housing units	196,171	168,008	364,179
Total vacant housing units	10,137	12,610	22,747
Percent total vacant	4.9	7.0	5.8
Owner Occupied Units	134,255	125,132	259,387
Median value (dollars)	191,400	168,300	-
Owner vacancy rate (percent)	0.8	1.6	1.2
Renter occupied units	61,916	42,876	104,792
Median rent (dollars/month)	932	871	-
Rental Vacancy rate (percent)	3.9	4.9	4.3

Source: USCB 2018h

3.10.4.2 Education

York County is comprised of 15 public school districts. As discussed below (see Section 3.10.5, "Tax Revenues"), Exelon pays taxes to the South Eastern School District in York County. The South Eastern School district serves the Peach Bottom Township and is comprised of six schools and serves approximately 2,580 students (SESD 2017).

3.10.4.3 Public Water Supply

York County public water supply relies on both surface and groundwater sources. According to EPA's Safe Drinking Water Information System, there are a total of 226 public water supply systems in York County that serve a population of approximately 378,900 (EPA 2018b). In 2011, the York County Planning Commission estimated that 20 percent of York County's population rely on individual onsite wells for water supply (YCPC 2011). Many of the public water systems are small, with 104 of the providers each serving 100 people or less. In Lancaster County, there are a total of 453 public water supply systems that serve a population of approximately 407,523; 246 of the public water providers each serve 100 people or less (EPA 2018b). Table 3-22 presents the top largest public water supplies in Lancaster and York County and provides information regarding the water source and population served.

Table 3-22 Public Water Supply Systems in Lancaster County and York County

Water Supplier	Water Source	Average Daily Water Use (mgd)	Population
Lancaster County			
Elizabethtown Area Water	Surface Water	1.2	18,900
East Hempfield Water Authority	Groundwater	1.4	20,220
Columbia Water Company	Surface Water	2.5	25,200
City of Lancaster	Surface Water	22.1	120,000
York County			
Red Lion Municipal Authority	Surface Water	2	15,882
Dover Township Water System	Surface Water	1	21,097
Hanover Municipal Water Works	Surface Water	4.6	40,900
York Water Company	Surface Water	18	194,000
mgd=millions of gallons			
Source: EPA 2018b, PDEP 2018c			

York County has developed an Integrated Water Resources Plan that serves as the county plan for a reliable supply of water and stormwater management plan (YCPC 2011). According to the York County Planning Commission, the county's water systems are in good condition and there is "ample supply of both surface and groundwater resources to allow the County's water system infrastructure to be expanded to meet future needs." Municipalities within York County use the Integrated Water Resources Plan in planning for the use and protection of water resources by identifying water resources and addressing water use, quality, and quantity issues

(YCPC 2011). Similarly, Lancaster County has an Integrated Water Resources Plan to protect, conserve, and improve surface and groundwater use (Lancaster County 2013).

3.10.5 Tax Revenues

Exelon pays real estate tax to York County, the South Eastern School District, and Peach Bottom Township as a result of operation of Peach Bottom Units 2 and 3. Property taxes in the State of Pennsylvania are not administered at the State level, but rather at the local level to the county, municipality, and school district. A millage rate from each taxing authority is applied to the assessed property value. In York County, the Department of Assessment is responsible for evaluating property value and taxing authorities (county, municipalities, school district) set the millage rates. In 1999, the Pennsylvania General Assembly amended the Tax Reform Act of 1971. Prior to 1999, electric generation facilities were subject to the Public Utility Realty Tax Act; under the Public Utility Tax Act, electric generation facility real estate taxes were paid to the Commonwealth of Pennsylvania and then redistributed to taxing entities (counties, cities, townships, and school districts) within the Commonwealth. Under the 1999 amendments, electric generation facilities are subject to local taxation (county, township, school district, etc.) and the assessment methodology for utilities was revised from depreciated book value to market value of the property (NRC 2009).

In 2000, Exelon challenged real estate taxes assessed for Peach Bottom and was involved in real estate tax appeals regarding the valuation of Peach Bottom by the assessors in York County (Exelon 2008; Exelon 2009b). In 2008, Exelon and taxing authorities entered into an agreement that included settlement of outstanding real estate tax appeals and covered tax years 2008–2012. Under the settlement agreement, Exelon would pay real estate tax based on an agreed assessed value of the plant and also make payments in addition to tax (PATs) to York County, Peach Bottom Township, and the South Eastern School District (Exelon 2018a). The PATs agreed upon were $800,000 to South Eastern School District, $144,000 to York County, and $28,570 to Peach Bottom Township (Exelon 2018a). In 2012, Exelon and the taxing authorities agreed to extend the settlement agreement to cover tax years 2013 to 2017. The agreement between Exelon and taxing jurisdictions expired in 2017, and while the parties have engaged in negotiations, they have not reached a new agreement, and the property tax value for Peach Bottom Units 2 and 3 is being litigated (Exelon 2018c). Exelon anticipates that there will be tax payment adjustments in the future, including during the subsequent license renewal period; however, the magnitude of tax payment adjustments is unknown. Table 3-23 identifies the real estate taxes and payments in addition to tax that Exelon made for years 2013 through 2017 to York County, Peach Bottom Township, and the South Eastern School District. In accordance with the settlement agreement, PATs paid by Exelon were constant as noted in Table 3-23. Changes in property tax payments made by Exelon are as a result of changes in annual millage rate from taxing authorities.

York County funding sources are derived primarily from intergovernmental grants and real estate taxes, and charges for services (York County 2018). In 2017, real estate tax revenues ($159.7 million) comprised approximately 33 percent of total county government and business-type revenues ($482.7 million). York County is permitted by the County Code of the Commonwealth of Pennsylvania to levy taxes up to 25 mills on every dollar of adjusted valuation; the property tax rate for 2017 was 5.8 mills (for every $1,000 of assessed property value, $5.80 is owed in property tax). County revenues cover the expenses of a wide range of services including public safety health, education and welfare, and community development. In 2017, health, education, and welfare had the largest expense of $223.4 million.

The South Eastern School District revenues derive from various sources, primarily from property taxes, other taxes, and grants. In past years property tax has provided the majority of the District's budget revenue. In 2018 property tax revenues ($30.2 million) represented approximately 55 percent of total revenues ($55.0 million) (SESD 2018). Exelon is one of the top ten largest tax payers in South Eastern School District (SESD 2018). South Eastern School District revenue is used for support services, instruction, pupil transportation and extracurricular activities, and operation and maintenance of schools.

Table 3-23 provides the real estate tax revenue for York County, Peach Bottom Township, and the South Eastern School District for years 2013 through 2017. For 2016, the combined Peach Bottom real estate tax and payments in addition to tax to each taxing authority represented approximately 0.17 percent of the York County real estate tax revenue, 3.9 percent of the South Eastern School District Real Estate Tax, and 3.1 percent of the Peach Bottom Township Real Estate Tax (Exelon 2018c). In addition to property tax payments and payments in addition to tax, Exelon and Peach Bottom employees have made monetary donations to local organizations. In 2017, Exelon and Peach Bottom employees donated approximately $460,000 to these various local organizations (Exelon 2018c).

Table 3-23 Local Taxing Jurisdiction Real Estate Tax Revenue and Exelon Tax Payments for Peach Bottom

	Real Estate Revenue (millions)			**Payments by Exelon from Peach Bottom Units 2 and 3**	
	York County[a]	South Eastern School District[a]	Peach Bottom Township[a]	Property Tax	PATs[b]
2013	$ 121.0	$ 28.3	$ 1.0	$ 428,641	$972,570
2014	$ 122.0	$ 28.9	$ 1.1	$ 440,601	$972,570
2015	$ 122.8	$ 29.6	$ 1.1	$ 450,705	$972,570
2016	$ 140.4	$ 30.3	$ 1.2	$ 469,730	$972,570
2017	$ 159.1	$ 30.2	NA	$ 476,607	$972,570

[a] Values rounded up.

[b] Value provided is the combined Payments in Addition to Tax (PATs) that Exelon makes to each taxing entity: $800,000 to South Eastern School District, $144,000 to York County, and $28,570 to Peach Bottom Township.

Source: York County: York County 2018, SESD 2014, SESD 2015, SES 2016, SESD 2018; Peach Bottom Township: Exelon 2018a; Property Tax and PATs: Exelon 2018c and Exelon 2018a.

3.10.6 Local Transportation

The transportation network surrounding the Peach Bottom site is comprised of U.S. and Interstate highways and local highways. Pennsylvania Highway 74, a north-south road, is the largest capacity highway in the immediate vicinity of Peach Bottom (approximately 3 miles (4.8 km) away). Interstate 83 (I-83) runs north-south through York County from Baltimore, MD to Harrisburg, PA. The Norfolk Southern Railway runs parallel and adjacent to the Susquehanna River in Lancaster County (PennDot 2015). York Railway Company operates 42 miles of track through the center of York County; this is the mainline track that links the City of York with the Hanover area (YCPC 2013). Nearby Amtrak stations are located in Lancaster, Harrisburg, Middletown, and Elizabethtown.

Access to Peach Bottom is via Lay Road (State Route 2104); Lay Road is a two-lane paved road and intersects Flintville Road (State Route 2043) approximately 2.0 miles (3.2 km) from the site and Paper Mill Road (State Route 2024) approximately 0.70 miles (1.12 km) from the site.

Employees commuting to and from Peach Bottom use the State roads in the vicinity of the site, including Paper Mill Road (State Route 2024), Flintville Road (State Route 2043), Atom Road (State Route 2026), and Highway 74. Employees commuting from Lancaster County typically use State Route 372, which crosses the Susquehanna River north of Peach Bottom (Exelon 2018a). Employees commuting from the south use U.S. 1, which connects to Maryland State Route 623 and converts into Flintville Road/State Route 2043 in Pennsylvania (Exelon 2018a). Table 3-24 presents annual average daily traffic in the vicinity of Peach Bottom.

Table 3-24 2017 Annual Average Daily Traffic in the Vicinity of Peach Bottom

Location	Annual Average Daily Traffic
Lay Road (State Route 2104)	1,800
Paper Mill Road (State Route 2024)	750
Flintville Road (State Route 2043)	1,200
State Route 372 (at Pennsylvania Route 74)	3,600
Atom Road (State Route 2026)	750
Pennsylvania Highway 74 (at State Route 372)	5,900
Pennsylvania Highway 74 (at State Route 2045)	5,400

Source: PennDot 2017

State roads in the vicinity of the site have been able to support Peach Bottom worker and delivery vehicles, including during refueling outages, without the need for mitigation (e.g., busing workers from offsite parking areas, staggering shifts) (Exelon 2018a). As discussed in Section 3.10, Exelon does not anticipate adding additional employees to support plant operations during the extended license renewal period. In York County, the York Area Metropolitan Planning Organization is responsible for developing a process for transportation planning, programming, and decisionmaking. In 2017, the York Area Metropolitan Planning Organization adopted the 2017–2040 Long Range Transportation Plan, whose purpose is to identify and implement transportation improvements in York County (YCPC 2013). The York Area Metropolitan Planning Organization's congestion management process and Congestion Annual Report identify locations and projects that require congestion mitigation. Similarly, the Lancaster County Transportation Coordinating Committee is responsible for developing a long-range transportation plan; the Lancaster Long Range Transportation Plan was updated in 2016 (Lancaster Transportation Coordinating Committee 2016).

3.11 Human Health

Peach Bottom is both an industrial facility and a nuclear power plant. Similar to any industrial facility or nuclear power plant, the operation of Peach Bottom over the period of extended operation will produce human health risks for both workers and members of the public. This section describes human health risks from the operation of Peach Bottom including from radiological exposure, chemical hazards, microbiological hazards, electromagnetic fields, and other hazards.

3.11.1 Radiological Exposure and Risk

Operation of a nuclear power plant involves the use of nuclear fuel to generate electricity. Through the fission process, the nuclear reactor splits uranium atoms resulting very generally in (1) the production of heat which is then used to produce steam to drive the plant's turbines and generate electricity and (2) the creation of radioactive byproducts. As required by NRC regulations at 10 CFR 20.1101, “Radiation Protection Programs,” Exelon designed a radiation protection program to protect onsite personnel (including employees and contractor employees), visitors, and offsite members of the public from radiation and radioactive material at Peach Bottom.

The Peach Bottom radiation protection program is extensive and includes, but is not limited to, the following:

- Organization and Administration (e.g., a radiation protection manager who is responsible for the program and who ensures trained and qualified workers for the program)
- Implementing Procedures
- ALARA Program to minimize dose to workers and members of the public
- Dosimetry Program (i.e., measure radiation dose of plant workers)
- Radiological Controls (e.g., protective clothing, shielding, filters, respiratory equipment, and individual work permits with specific radiological requirements)
- Radiation Area Entry and Exit Controls (e.g., locked or barricaded doors, interlocks, local and remote alarms, personnel contamination monitoring stations)
- Posting of Radiation Hazards (i.e., signs and notices alerting plant personnel of potential hazards)
- Recordkeeping and Reporting (e.g., documentation of worker dose and radiation survey data)
- Radiation Safety Training (e.g., classroom training and use of mockups to simulate complex work assignments)
- Radioactive Effluent Monitoring Management (i.e., controlling and monitoring radioactive liquid and gaseous effluents released into the environment)
- Radioactive Environmental Monitoring (e.g., sampling and analysis of environmental media, such as direct radiation, air, water, groundwater, broad leaf vegetation, fish, and sediment to measure the levels of radioactive material in the environment that may impact human health)
- Radiological Waste Management (i.e., controlling, monitoring, processing, and disposing of radioactive solid waste)

Regarding radiation exposure to Peach Bottom personnel, the NRC staff reviewed the data contained in NUREG–0713, Volume 38, “Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2016: Forty-Ninth Annual Report” (NRC 2018g). The forty-ninth annual report was the most recent annual report available at the time of this environmental review. It summarizes the NRC’s Radiation Exposure Information and Reporting System database’s occupational exposure data through 2016. Nuclear power plants are required by 10 CFR 20.2206, “Reports of Individual Monitoring,” to report their occupational exposure data to the NRC annually. In this SEIS, Chapter 4, “Environmental Consequences and Mitigating Actions,” includes further discussion of radiological doses associated with Peach Bottom license renewal.

NUREG–0713 calculates a 3-year average collective dose per reactor for workers at all nuclear power reactors licensed by the NRC. The 3-year average collective dose is one of the metrics that the NRC uses in its Reactor Oversight Program to evaluate the applicant's ALARA program. Collective dose is the sum of the individual doses received by workers at a facility licensed to use radioactive material over a 1-year time period. There are no NRC or EPA standards for collective dose. Based on the data for operating boiling water reactors like the ones at Peach Bottom, the average annual collective dose per reactor was 110 person rem (1.10 person Sv). In comparison, Peach Bottom had a reported annual collective dose per reactor of 171 person rem (1.71 person Sv).

In addition, as reported in NUREG–0713, for 2016, no worker at Peach Bottom received an annual dose greater than 2.0 rem (0.02 sievert (Sv)), which is less than half of the NRC occupational dose limit of 5.0 rem (0.05 Sv) as defined in 10 CFR 20.1201, "Occupational Dose Limits for Adults."

Offsite dose to members of the public is discussed in Section 3.1.4, 'Radioactive Waste Management Systems," of this SEIS.

3.11.2 Chemical Hazards

State and Federal environmental agencies regulate the use, storage, and discharge of chemicals, biocides, and sanitary wastes. Such environmental agencies also regulate how facilities like Peach Bottom manage minor chemical spills. Chemical and hazardous wastes can potentially impact workers, members of the public, and the environment.

Exelon currently controls the use, storage, and discharge of chemicals and sanitary wastes at Peach Bottom in accordance with its chemical control procedures, waste-management procedures, and Peach Bottom site-specific chemical spill prevention plans. Exelon monitors and controls discharges of chemical and sanitary wastes through Peach Bottom's National Pollutant Discharge Elimination System permit process. These plant procedures, plans, and processes are designed to prevent and minimize the potential for a chemical or hazardous waste release and, in the event of such a release, minimize impact to workers, members of the public, and the environment (Exelon 2018a).

During the period of extended operation. NRC staff expects that Exelon will minimize chemical hazard impact by implementing good industrial hygiene practices as required by its permits and by Federal and State regulations.

3.11.3 Microbiological Hazards

Thermal effluents associated with nuclear plants that discharge to a river, such as Peach Bottom, have the potential to promote the growth of certain thermophilic microorganisms that are linked to adverse human health effects. Microorganisms of particular concern include several types of bacteria (*Legionella* spp., *Salmonella* spp., *Shigella* spp., and *Pseudomonas aeruginosa*) and the free-living amoeba *Naegleria fowleri*.

The public can be exposed to the thermophilic microorganisms *Salmonella*, *Shigella*, *P. aeruginosa*, and *N. fowleri* during swimming, boating, or other recreational uses of freshwater. If a nuclear plant's thermal effluent enhances the growth of thermophilic microorganisms, recreational users could experience an elevated risk of exposure when using waters near the plant's discharge. Nuclear plant workers can be exposed to *Legionella* spp. when performing maintenance activities on plant cooling systems if workers inhale cooling water vapors because vapors are often within the optimum temperature range for *Legionella* growth.

Thermophilic Microorganisms of Concern

Salmonella typhimurium and *S. enteritidis* are two species of enteric bacteria that cause salmonellosis, a disease more common in summer than winter (CDC 2015a). Salmonellosis is transmitted through contact with contaminated human or animal feces and may be spread through water transmission, contact with food or infected animals, or contamination in laboratory settings (CDC 2015a). These bacteria grow at temperatures ranging from 77 to 113 °F (25 to 45 °C), have an optimal growth temperature around human body temperature (98.6 °F (37 °C)), and can survive extreme temperatures as low as 41 °F (5 °C) and as high as 122 °F (50 °C) (Oscar 2009). Research studies examining the persistence of *Salmonella* spp. outside of a host found that the bacteria can survive for several months in water and in aquatic sediments (Moore et al. 2003). CDC data indicate that no outbreaks or cases of waterborne *Salmonella* infection from recreational waters have occurred in the United States from 2006 through 2017 (CDC 2017a). From 2006 to 2017, all CDC-reported *Salmonella* outbreaks have been caused by consumption of contaminated produce, meats, or prepared foods; contact with contaminated animals; or exposure in laboratories (CDC 2017a). As of January 2019, the Pennsylvania Department of Health is not aware of any *Salmonella* spp. infections associated with exposure to the Susquehanna River or other recreational waters within Pennsylvania (NRC 2019e).

Shigellosis infections are caused by the transmission of *Shigella* spp. from person to person through contaminated feces and unhygienic handling of food. Like salmonellosis, infections are more common in summer than in winter (CDC 2017b). The bacteria grow at temperatures between 77 and 99 °F (25 and 37 °C) and can survive temperatures as low as 41 °F (5 °C) (PHAC 2010). CDC reports (2004, 2006, 2008, 2011, 2014a, 2015b) indicate that less than a dozen shigellosis outbreaks have been attributed to lakes, reservoirs, and other recreational waters from 2001 through 2012. As of January 2019, the Pennsylvania Department of Health is not aware of any *Shigella* spp. infections associated with exposure to the Susquehanna River or other recreational waters within Pennsylvania (NRC 2019e).

Pseudomonas aeruginosa can be found in soil, hospital respirators, water, and sewage and on the skin of healthy individuals. It is most commonly linked to infections transmitted in healthcare settings. Infections from exposure to *P. aeruginosa* in water can lead to development of mild respiratory illnesses in healthy people (CDC 2014b). These bacteria have an optimal growth temperature of 98.6 °F (37 °C) and can survive in temperatures as high as 107.6 °F (42 °C) (Todar 2004). As of January 2019, the Pennsylvania Department of Health is not aware of any *P. aeruginosa* infections associated with exposure to the Susquehanna River or other recreational waters within Pennsylvania (NRC 2019e).

The free-living amoeba *Naegleria fowleri* prefers warm freshwater habitats and is the causative agent of human primary amoebic meningoencephalitis. Infections occur when *N. fowleri* penetrate the nasal tissue through direct contact with water in warm lakes, rivers, or hot springs and migrate to the brain tissues (CDC 2017c). This free-swimming amoeba species is rarely found in water temperatures below 95 °F (35 °C), and infections rarely occur at those temperatures (Tyndall et al. 1989). The *N. fowleri*-caused disease, primary amoebic meningoencephalitis (PAM), is rare in the United States. Between 1962 through 2017, CDC (2018a) reported an average of 2.6 cases of PAM annually. As of January 8, 2019, the Pennsylvania Department of Health (NRC 2019d) is not aware of any *N. fowleri* or PAM infections associated with exposure to the Susquehanna River or other recreational waters within Pennsylvania.

Legionella spp. infections result in legionellosis (e.g., Legionnaires' disease), which manifests as a dangerous form of pneumonia or an influenza-like illness. Legionellosis outbreaks are often associated with complex water system houses inside buildings or structures, such as cooling towers (CDC 2017d). *Legionella* spp. thrive in aquatic environments as intracellular parasites of protozoa and are only infectious in humans through inhalation contact from an environmental source (CDC 2017d). Stagnant water between 95 and 115 °F (35 and 46 °C) tends to promote growth in *Legionella* spp., although the bacteria can grow at temperatures as low as 68 °F (20 °C) and as high as 122 °F (50 °C) (OSHA 1999). Exelon (2018a) tested for *Legionella* within its cooling towers in 2011 and did not detect the bacteria. As of January 2019, the Pennsylvania Department of Health is not aware of any legionellosis infections associated with cooling towers or other structures at nuclear power plants in Pennsylvania (NRC 2019e).

3.11.4 Electromagnetic Fields

Based on its evaluation in the license renewal GEIS (NUREG–1437), the NRC has not found electric shock resulting from direct access to energized conductors or from induced charges in metallic structures to be a problem at most operating plants. Generally, the NRC staff also does not expect electric shock from such sources to be a human health hazard during the subsequent license renewal term. However, a site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of this SEIS. Transmission lines that are within the scope of the NRC's license renewal environmental review are limited to: (1) those transmission lines that connect the nuclear plant to the substation where electricity is fed into the regional distribution system and (2) those transmission lines that supply power to the nuclear plant from the grid (NRC 2013a).

As discussed in Section 3.1.6.5, "Power Transmission Systems," of this SEIS, the only transmission lines that are in scope for Peach Bottom subsequent license renewal are onsite and are not accessible to the general public. Specifically, these onsite, in-scope transmission lines are: (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 Peach Bottom 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 (Exelon 2018a). Therefore, there is no potential shock hazard to offsite members of the public from these onsite transmission lines. As discussed in Section 3.11.5, "Other Hazards," of this SEIS, Peach Bottom maintains an occupational safety program, which includes protection from acute electrical shock, and is in accordance with Occupational Safety and Health Administration regulations.

3.11.5 Other Hazards

This section addresses two additional human health hazards: (1) physical occupational hazards and (2) general electric shock hazards.

Nuclear power plants are industrial facilities that have many of the typical occupational hazards found at any other electric power generation utility. Nuclear power plant workers may perform electrical work, electric power line maintenance, repair work, and maintenance activities and may be exposed to some potentially hazardous physical conditions (e.g., falls, excessive heat, cold, noise, electric shock, and pressure).

The Occupational Safety and Health Administration (OSHA) is responsible for developing and enforcing workplace safety regulations. Congress created OSHA by enacting the Occupational

Safety and Health Act of 1970, as amended (29 U.S.C. 651 et seq.) to safeguard the health of workers. With specific regard to nuclear power plants, plant conditions that result in an occupational risk, but do not affect the safety of licensed radioactive materials, are under the statutory authority of OSHA rather than the NRC as set forth in a memorandum of understanding (53 FR 43950) between the NRC and OSHA. Occupational hazards are reduced when workers adhere to safety standards and use appropriate protective equipment; however, fatalities and injuries from accidents may still occur. As per Exelon corporate procedure, Peach Bottom maintains an occupational safety program for its workers in accordance with OSHA regulations.

3.12 Environmental Justice

Under Executive Order (EO) 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations” (59 FR 7629), Federal agencies are responsible for identifying and addressing, as appropriate, disproportionately high and adverse human health and environmental impacts on minority and low-income populations. Although independent agencies, such as the NRC, are not bound by the terms of EO 12898, they are, as stated in paragraph 6–604 of the executive order, “requested to comply with the provisions of [the] order.” In 2004, the Commission issued the agency’s “Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions” (69 FR 52040), which states, "The Commission is committed to the general goals set forth in EO 12898 and strives to meet those goals as part of its NEPA review process."

The Council on Environmental Quality (CEQ) provides the following information in *Environmental Justice: Guidance Under the National Environmental Policy Act* (CEQ 1997):

> *Disproportionately High and Adverse Human Health Effects.*
>
> Adverse health effects are measured in risks and rates that could result in latent cancer fatalities, as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as employed by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ 1997).
>
> *Disproportionately High and Adverse Environmental Effects.*
>
> A disproportionately high environmental impact that is significant (as employed by NEPA) refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as employed by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian tribes are considered (CEQ 1997).

This environmental justice analysis assesses the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations that could result from the operation of Peach Bottom during the period of extended operation. In assessing the impacts, the NRC staff used the following definitions of minority individuals, minority populations, and low-income population (CEQ 1997):

> *Minority Individuals*
>
> Individuals who identify themselves as members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races, meaning individuals who identified themselves on a Census form as being a member of two or more races, for example, White and Asian. In other words, everyone except persons who identified themselves as White, Not Hispanic or Latino, are considered minority.
>
> *Minority Populations*
>
> Minority populations are identified when (1) the minority population of an affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.
>
> *Low-income Population*
>
> Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series P60, on Income and Poverty.

In determining the location of minority and/or low-income populations, the NRC staff uses a 50-mi (80-km) radius from the facility as the geographic area to perform a comparative analysis. The 50-mi (80-km) radius is consistent with the impact analysis conducted for human health impacts. The NRC staff compares the percentage of minority and/or low-income populations in the 50-mi (80-km) geographic area to the percentage of minority and/or low-income populations in each census block group to determine which block groups exceeds the percentage, thereby identifying the location of these populations (NRC 2013c).

<u>Minority Population</u>

According to the U.S. Census Bureau's 2010 Census data, there are a total of 3,956 block groups within a 50-mi (80-km) radius of Peach Bottom and approximately 30 percent of the population residing within a 50-mi (80-km) radius identified themselves as minority individuals (USCB 2018i). The largest minority populations were Black or African American (approximately 18 percent) followed by Hispanic or Latino of any race (approximately 7 percent).

According to the Council on Environmental Quality's definition, a minority population exists if the percentage of the minority population of an area (e.g., census block group) exceeds 50 percent or is meaningfully greater than the minority population percentage in the general population. This environmental justice analysis applied the meaningfully greater threshold in identifying higher concentrations of minority populations. Meaningfully greater threshold is any percentage greater than the minority population within the 50-mi (80-km) radius. Therefore, census block groups within the 50-mi (80-km) radius of Peach Bottom were identified as minority population block groups if the percentage of the minority population in the block group exceeded 30 percent, which is the percent of the minority population within the 50-mi (80-km) radius of Peach Bottom.

Based on this analysis, there are 1,490 minority population block groups within a 50-mi (80-km) radius of Peach Bottom. As shown in Figure 3-10, minority population block groups are primarily south and southeast of Peach Bottom in Maryland and Delaware. In Maryland, minority population block groups are clustered within Baltimore County and Baltimore City. In Delaware, minority population block groups are clustered within New Castle County. Peach Bottom itself is not located in a minority population block group.

As presented in Section 3.10, "Socioeconomics," and Table 3-17 of this SEIS, in 2010, the minority population in the two-county region of influence was approximately 15 percent, and the minority population in the State of Pennsylvania was approximately 21 percent. Furthermore, as shown in Table 3-18, since 2010, minority populations in the two-county region of influence are estimated to have increased approximately by 48,500 persons.

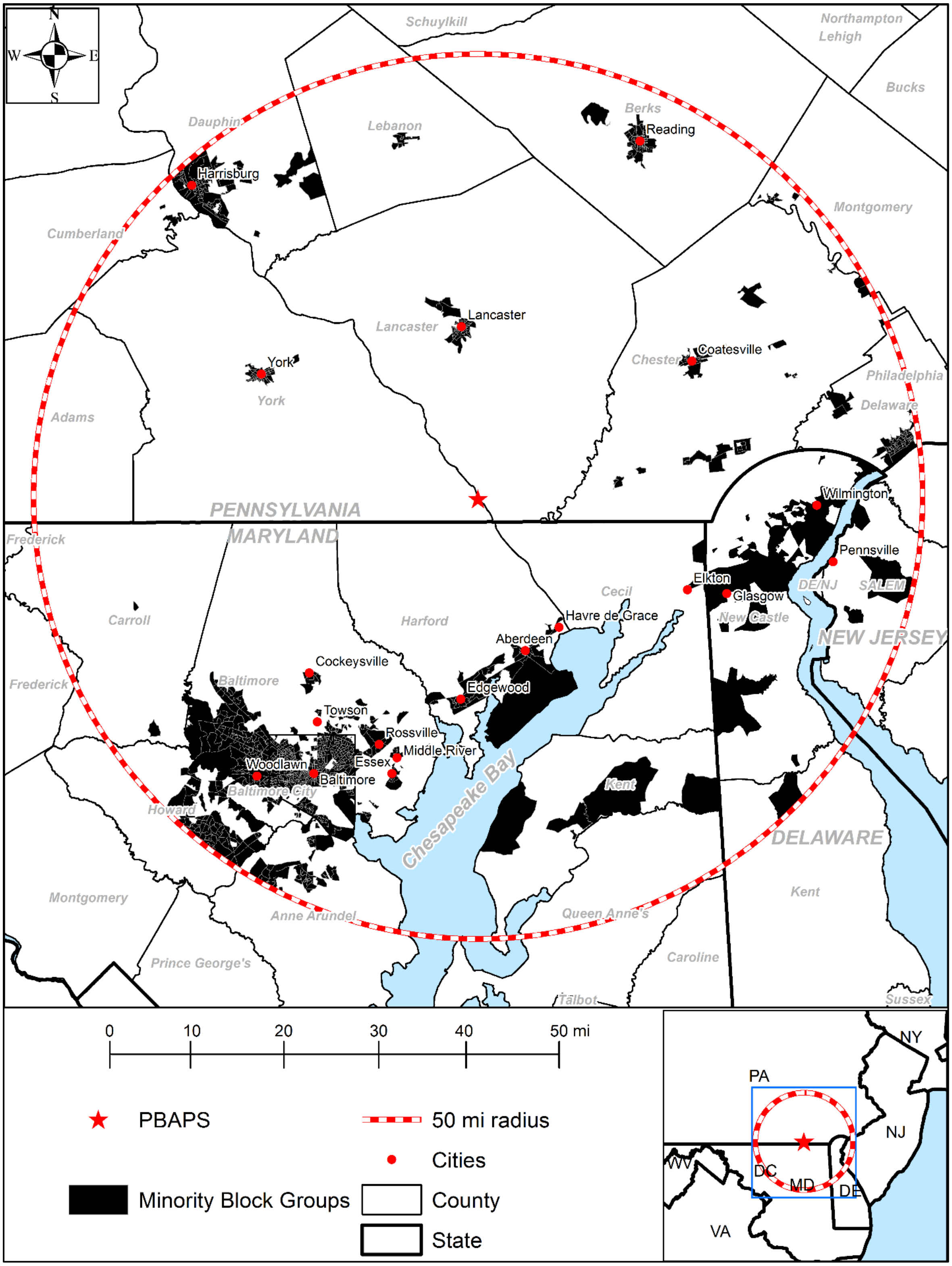
<u>Low-Income Population</u>

The U.S. Census Bureau's 2012–2016 American Community Survey data identifies approximately 11 percent of individuals residing within a 50-mi (80-km) radius of Peach Bottom as living below the Federal poverty threshold (USCB 2018j). The 2016 Federal poverty threshold was $24,563 for a family of four (USCB 2016).

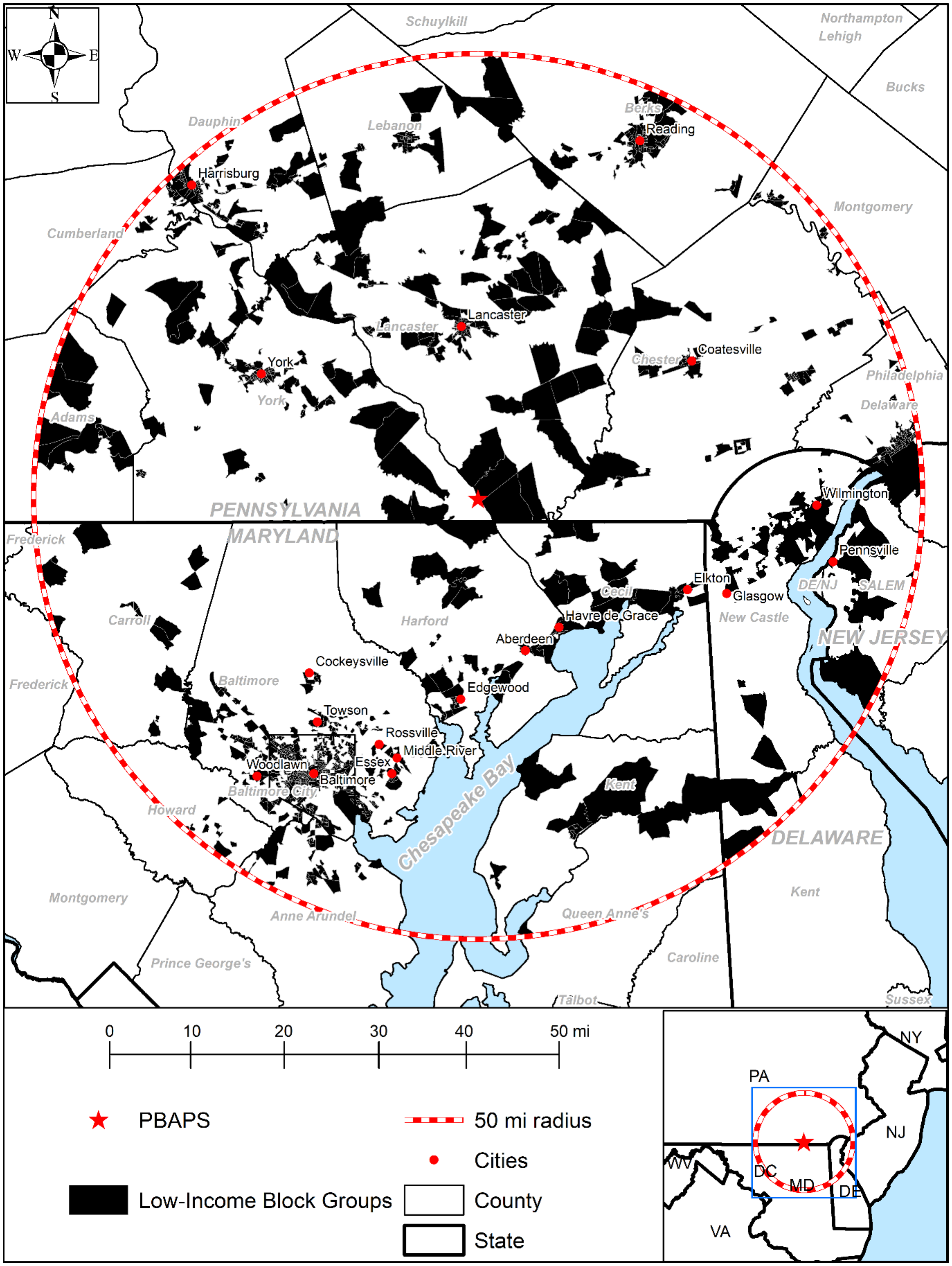
Figure 3-11 shows the location of predominantly low-income population block groups within a 50-mi (80-km) radius of Peach Bottom. In accordance with NRC guidance (NRC 2013c), census block groups were considered low-income population block groups if the percentage of individuals living below the Federal poverty threshold within the block group exceeded 11 percent, which is the percent of the individuals living below the Federal poverty threshold within the 50-mi (80-km) radius of Peach Bottom.

As shown in Figure 3-11, there are low-income population block groups distributed within the 50-mi (80-km) radius of Peach Bottom in Maryland, Delaware, Pennsylvania, and New Jersey. In Maryland, low-income population block groups are clustered within Baltimore City. Based on this analysis, there are 1,496 low-income population block groups (approximately 38 percent of the block groups within a 50-mi radius of Peach Bottom). Peach Bottom itself is not located in a low-income population block group.

As discussed in Section 3.10.2, "Regional Economic Characteristics," of this SEIS, according to the USCB's 2012–2016 American Community Survey 5-Year Estimates, people living in the two-county region of influence had a median household income greater than the State average. Additionally, the percentage of families and individuals living below the poverty level in Lancaster and York counties was lower than the percentage of families and individuals in the State of Pennsylvania as a whole.



1 **Figure 3-10 2010 Census—Minority Block Groups Within a 50-mi (80-km) Radius of**
2 **Peach Bottom (USCB 2018i)**



1 **Figure 3-11 2012–2016: American Community Survey 5-Year Estimates—Low-Income**
2 **Block Groups Within a 50-mi (80-km) Radius of Peach Bottom (USCB 2018j)**

3.13 <u>Waste Management and Pollution Prevention</u>

Like any operating nuclear power plant, Peach Bottom will produce both radioactive and nonradioactive waste during the subsequent licensing period. This section describes waste management and pollution prevention at Peach Bottom.

3.13.1 Radioactive Waste

As discussed in Section 3.1.4, "Radioactive Waste Management Systems," of this SEIS, Peach Bottom uses liquid, gaseous, and solid waste processing systems to collect and treat, as needed, radioactive materials produced as a byproduct of plant operations. Radioactive materials in liquid and gaseous effluents are reduced prior to being released into the environment so that the resultant dose to members of the public from these effluents is well within NRC and EPA dose standards. Radionuclides that can be efficiently removed from the liquid and gaseous effluents prior to release are converted to a solid waste form for disposal in a licensed disposal facility.

3.13.2 Nonradioactive Waste

Waste minimization and pollution prevention are important elements of operations at all nuclear power plants. Licensees are required to consider pollution prevention measures as dictated by the Pollution Prevention Act (Public Law 101-508) and the Resource Conservation and Recovery Act of 1976, as amended (Public Law 94-580) (NRC 2013a).

As described in Section 3.1.5, "Nonradioactive Waste Management System," Peach Bottom has a nonradioactive waste management program to handle nonradioactive waste in accordance with Federal, State, and corporate regulations and procedures. Peach Bottom maintains a waste minimization program that uses material control, process control, waste management, recycling, and feedback to reduce waste.

Peach Bottom has a Stormwater Pollution Prevention Plan that identifies potential sources of pollution that may affect the quality of stormwater discharges from permitted outfalls. The Stormwater Pollution Prevention Plan also describes best management practices for reducing pollutants in stormwater discharges and assuring compliance with the site's NPDES permit.

Peach Bottom also has a Pollution Incident/Hazardous Substance Spill Procedure (Exelon 2018c) to monitor areas within the site that have the potential to discharge oil into or upon navigable waters, in accordance with the regulations in 40 CFR Part 112, "Oil Pollution Prevention." The Pollution Incident/Hazardous Substance Spill Procedure identifies and describes the procedures, materials, equipment, and facilities that Exelon uses to minimize the frequency and severity of oil spills at Peach Bottom.

Peach Bottom is subject to EPA reporting requirements in 40 CFR 110, "Discharge of Oil," pursuant to Section 311(b)(4) of the Federal Water Pollution Control Act. Under these regulations, Peach Bottom must report to the National Response Center any discharges of oil if the quantity may be harmful to the public health or welfare or to the environment. From 2013 through October 2018, Peach Bottom reported no oil discharges that triggered the EPA's reporting requirements in 40 CFR 110 (Exelon 2018a).

Peach Bottom is also subject to the reporting provisions of the Pennsylvania Department of Environmental Protection Regulatory Code, 25 PA Code Chapter 245, "Administration of the

Storage Tank and Spill Prevention Program." This reporting provision requires that all reportable releases of oils and other similar hazardous substances be reported to the Pennsylvania Department of Environmental Protection. From 2013 through October 2018, Exelon reported no releases at Peach Bottom that have triggered this Pennsylvania State notification requirement (Exelon 2018a).

4 ENVIROMENTAL IMPACTS AND MITIGATING ACTIONS

4.1 Introduction

In this chapter, the U.S. Nuclear Regulatory Commission (NRC) staff evaluates the environmental consequences of issuing subsequent renewed licenses authorizing an additional 20 years of operation for Peach Bottom Atomic Power Station Units 2 and 3 (Peach Bottom or Peach Bottom Units 2 and 3). The NRC staff's evaluation of environmental consequences includes the following:

1) impacts associated with continued operations similar to those impacts that have occurred during the current renewed license terms
2) impacts of various alternatives to the proposed action, including a no-action alternative (not issuing the renewed licenses) and replacement power alternatives (new nuclear, supercritical pulverized coal, natural gas combined-cycle, and a combination of natural gas, wind, solar, and purchased power)
3) impacts from the termination of nuclear power plant operations and decommissioning after the subsequent license renewal terms (with emphasis on the incremental effect caused by an additional 20 years of reactor operation)
4) impacts associated with the uranium fuel cycle
5) impacts of postulated accidents (design-basis accidents and severe accidents)
6) cumulative impacts of the proposed action of issuing subsequent renewed licenses for Peach Bottom
7) resource commitments associated with the proposed action, including unavoidable adverse impacts, the relationship between short-term use and long-term productivity, and irreversible and irretrievable commitment of resources
8) new and potentially significant information on environmental issues related to the impacts of operation during the subsequent license renewal terms

In this chapter, the NRC also compares the environmental impacts of subsequent license renewal with the environmental impacts of the no-action alternative and replacement power alternatives to determine whether the adverse environmental impacts of license renewal are so great that it would be unreasonable to preserve the option of subsequent license renewal for energy-planning decisionmakers. Chapter 2, "Alternatives Including the Proposed Action," of this supplemental environmental impact statement (SEIS) describes in detail the attributes of the proposed action (subsequent license renewal of Peach Bottom) and the no-action alternative. Chapter 2, Section 2.2.2, "Replacement Power Alternatives," further describes the NRC staff's process for developing a range of reasonable alternatives to the proposed action and the replacement power alternatives that the staff selected for detailed analysis in this chapter, including supporting assumptions and data. As discussed in Chapter 2, the replacement power alternatives would be located offsite, possibly at existing or retired power plant sites in the PJM Interconnection LLC (PJM) regional transmission States of Pennsylvania, Delaware, Maryland, and New Jersey. Chapter 2, Table 2-2, summarizes the environmental impacts of the proposed action and alternatives to the proposed action.

Chapter 3, "Affected Environment," describes the affected environment (i.e., environmental baseline) for each resource area considered, and against which the potential environmental impacts of the alternatives are measured. As documented in Chapter 3, the effects of ongoing reactor operations at Peach Bottom have become well established as environmental conditions have adjusted to and reflect the presence of the nuclear power plant.

This SEIS documents the NRC staff's environmental review of the Peach Bottom subsequent license renewal application and supplements the information in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (also known as the GEIS) (NRC 2013a). The 2013 GEIS identifies 78 issues (divided into Category 1 and Category 2 issues) to be evaluated for the proposed action in the environmental review process. Section 1.4, "Generic Environmental Impact Statement," of this SEIS provides an explanation of the criteria for Category 1 issues (i.e., those issues generic to all nuclear power plants or a distinct subset of plants) and Category 2 issues (i.e., those issues specific to individual nuclear power plants) as well as the definitions of SMALL, MODERATE, and LARGE impact significance.

For Category 1 issues, the NRC staff can rely on the analysis in the GEIS unless otherwise noted. Table 4-1, below, lists the Category 1 (generic) issues that apply to Peach Bottom during the proposed subsequent license renewal term. For each Category 1 issue, the NRC staff considered whether there is any new and significant information that might alter the conclusions reached in the GEIS for that issue. As discussed in Section 4.14 of this SEIS, Regulatory Guide (RG) 4.2, Supplement 1, "Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications" (NRC 2013e), defines "new and significant information" as (1) information that identifies a significant environmental impact issue that was not considered or addressed in the GEIS and, consequently, not codified in Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants," in Appendix B to Subpart A of Title 10 of the *Code of Federal Regulations* (10 CFR Part 51), or (2) information not considered in the assessment of impacts evaluated in the GEIS leading to a seriously different picture of the environmental consequences of the action than previously considered, such as an environmental impact finding different from that codified in Table B-1.

The NRC staff did not identify any new and significant information during its review of Exelon Generation Company's (Exelon's) environmental report, the site audits, or the scoping period that would change the conclusions in the GEIS. Therefore, there are no impacts related to the Category 1 issues beyond those already discussed in the GEIS. Section 4.14, "Evaluation of New and Significant Information," describes the staff's process for evaluating new and significant information.

Table 4-1 Applicable Category 1 (Generic) Issues for Peach Bottom

Issue	GEIS Section	Impact
Land Use		
Onsite land use	4.2.1.1	SMALL
Offsite land use	4.2.1.1	SMALL
Visual Resources		
Aesthetic impacts	4.2.1.2	SMALL
Air Quality		
Air quality impacts (all plants)	4.3.1.1	SMALL
Air quality effects of transmission lines	4.3.1.1	SMALL

Table 4-1 Applicable Category 1 (Generic) Issues for Peach Bottom (cont.)

Issue	GEIS Section	Impact
Noise		
Noise impacts	4.3.1.2	SMALL
Geologic Environment		
Geology and soils	4.4.1	SMALL
Surface Water Resources		
Surface water use and quality (non-cooling system impacts)	4.5.1.1	SMALL
Altered current patterns at discharge and intake structures	4.5.1.1	SMALL
Scouring caused by discharged cooling water	4.5.1.1	SMALL
Discharge of metals in cooling system effluent	4.5.1.1	SMALL
Discharge of biocides, sanitary wastes, and minor chemical spills	4.5.1.1	SMALL
Effects of dredging on surface water quality	4.5.1.1	SMALL
Temperature effects on sediment transport capacity	4.5.1.1	SMALL
Groundwater Resources		
Groundwater contamination and use (non-cooling system impacts)	4.5.1.2	SMALL
Groundwater use conflicts (plants that withdraw less than 100 gallons per minute)	4.5.1.2	SMALL
Groundwater quality degradation resulting from water withdrawals	4.5.1.2	SMALL
Terrestrial Resources		
Exposure of terrestrial organisms to radionuclides	4.6.1.1	SMALL
Cooling system impacts on terrestrial resources (plants with once-through cooling systems or cooling ponds)	4.6.1.1	SMALL
Bird collisions with plant structures and transmission lines	4.6.1.1	SMALL
Transmission line right of way management impacts on terrestrial resources[a]	4.6.1.1	SMALL
Electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.6.1.1	SMALL
Aquatic Resources		
Entrainment of phytoplankton and zooplankton (all plants)	4.6.1.2	SMALL
Infrequently reported thermal impacts (all plants)	4.6.1.2	SMALL
Effects of cooling water discharge on dissolved oxygen, gas supersaturation, and eutrophication	4.6.1.2	SMALL
Effects of non-radiological contaminants on aquatic organisms	4.6.1.2	SMALL
Exposure of aquatic organisms to radionuclides	4.6.1.2	SMALL
Effects of dredging on aquatic resources	4.6.1.2	SMALL
Effects on aquatic resources (non-cooling system impacts)	4.6.1.2	SMALL
Impacts of transmission line right of way management on aquatic resources[a]	4.6.1.2	SMALL
Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	4.6.1.2	SMALL
Socioeconomics		
Employment and income, recreation and tourism	4.8.1.1	SMALL
Tax revenues	4.8.1.2	SMALL
Community services and education	4.8.1.3	SMALL

Table 4-1 Applicable Category 1 (Generic) Issues for Peach Bottom (cont.)

Issue	GEIS Section	Impact
Socioeconomics (cont.)		
Population and housing	4.8.1.4	SMALL
Transportation	4.8.1.5	SMALL
Human Health		
Radiation exposures to the public	4.9.1.1.1	SMALL
Radiation exposures to plant workers	4.9.1.1.1	SMALL
Human health impact from chemicals	4.9.1.1.2	SMALL
Microbiological hazards to plant workers	4.9.1.1.3	SMALL
Physical occupational hazards	4.9.4.1.5	SMALL
Postulated accidents		
Design-basis accidents	4.9.1.2	SMALL
Waste Management		
Low-level waste storage and disposal	4.11.1.1	SMALL
Onsite storage of spent nuclear fuel	4.11.1.2	SMALL
Offsite radiological impacts of spent nuclear fuel and high-level waste disposal	4.11.1.3	[b]
Mixed waste storage and disposal	4.11.1.4	SMALL
Nonradioactive waste storage and disposal	4.11.1.4	SMALL
Uranium Fuel Cycle		
Offsite radiological impacts—individual impacts from other than the disposal of spent fuel and high-level waste	4.12.1.1	SMALL
Offsite radiological impacts—collective impacts from other than the disposal of spent fuel and high-level waste	4.12.1.1	[c]
Nonradiological impacts of the uranium fuel cycle	4.12.1.1	SMALL
Transportation	4.12.1.1	SMALL
Termination of Nuclear Power Plant Operations and Decommissioning		
Termination of plant operations and decommissioning	4.12.2.1	SMALL

[a] 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.

[b] The environmental impact of this issue for the time frame beyond the licensed life for reactor operations is contained in the NRC's NUREG-2157, "Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel" (NRC 2014b).

[c] 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 Commission concludes that the collective impacts are acceptable. The Commission concludes that the impacts would not be sufficiently large to require the National Environmental Policy Act (NEPA) conclusion, for any plant, that the option of extended operation under 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective impacts of the uranium fuel cycle, this issue is considered Category 1.

Source: Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 and NRC 2013a

The NRC staff analyzed the Category 2 (site-specific) issues applicable to Peach Bottom during the proposed subsequent license renewal period and assigned impacts to these issues as shown below in Table 4-2.

Table 4-2 Applicable Category 2 (Site-Specific) Issues for Peach Bottom

Issue	GEIS Section	Impact[a]
Surface Water Resources		
Surface water use conflicts (plants with cooling ponds or cooling towers using makeup water from a river)[b]	4.5.1.1	SMALL
Groundwater Resources		
Groundwater use conflicts (plants with closed-cycle cooling systems that that withdraw makeup water from a river)[b]	4.5.1.2	SMALL
Radionuclides released to groundwater	4.5.1.2	SMALL
Terrestrial Resources		
Effects on terrestrial resources (non-cooling system impacts)	4.6.1.1	SMALL
Water use conflicts with terrestrial resources (plants with cooling ponds or cooling towers using makeup water from a river)[b]	4.6.1.2	SMALL
Aquatic Resources		
Impingement and entrainment of aquatic organisms (plants with once-through cooling systems or cooling ponds)	4.6.1.2	SMALL
Thermal impacts on aquatic organisms (plants with once-through cooling systems or cooling ponds)	4.6.1.2	SMALL to MODERATE
Water use conflicts with aquatic resources (plants with cooling ponds or cooling towers using makeup water from a river)[b]	4.6.1.2	SMALL
Special Status Species and Habitats		
Threatened, endangered, and protected species and essential fish habitat	4.6.1.3	may affect, but is not likely to adversely affect northern long-eared bat and Indiana bat no adverse effects on essential fish habitat
Historic and Cultural Resources		
Historic and cultural resources	4.7.1	would not adversely affect known historic properties or historic and cultural resources
Human Health		
Chronic effects of electromagnetic fields [c]	4.9.1.1.1	Uncertain Impact
Electric shock hazards	4.9.1.1.1	SMALL
Postulated Accidents		
Severe accidents	4.9.1.2	SMALL

Table 4-2 Applicable Category 2 (Site-Specific) Issues for Peach Bottom

Issue	GEIS Section	Impact[a]
Environmental Justice		
Minority and low-income populations	4.10.1	no disproportionately high and adverse human health and environmental effects
Cumulative Impacts		
Cumulative impacts	4.13	See Section 4.16

(a) Impact determinations for Category 2 issues based on findings described in Section 4.2 through Section 4.13 of this SEIS for the proposed action.

(b) The NRC staff has determined that these issues are applicable because Peach Bottom uses helper cooling towers under certain conditions in combination with its once-through cooling system to cool a portion of the cooling water return flow to the plant's discharge canal, resulting in consumptive water loss.

(c) This issue was not designated as Category 1 or Category 2 and is discussed in Section 4.11.1, "Proposed Action."

Source: Table B-1 in Appendix B, Subpart A, to 10 CFR Part 51 and NRC 2013a

4.2 Land Use and Visual Resources

This section describes the potential land use and visual resources impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.2.1 Proposed Action

According to the GEIS (NRC 2013a), land use and visual resources would not be affected by continued operations and refurbishment associated with license renewal. In addition, nuclear plant operations at Peach Bottom Units 2 and 3 have not changed appreciably with time, and no change in land use and visual impacts are expected during the subsequent license renewal term.

No new and significant information regarding land use and visual resources was identified during the review of the Exelon environmental report, site visit, the scoping process, or the evaluation of other available information. The communities near the plant site have pre-established patterns of development and have adequate public services to support and guide development. Consequently, people living near Peach Bottom Units 2 and 3 would not experience any land use or visual changes during the second renewal term beyond what has already been experienced. In addition, no adverse effects on offsite land use will occur related to other Federal action in the proposed project area. Therefore, the impact of continued reactor operations during the subsequent license renewal term would not exceed the land use and visual impacts predicted in the GEIS. For these issues, the GEIS predicted that the impacts would be SMALL for all nuclear plants.

As identified in Table 4-1, the impacts of all generic land use or visual resource issues would be SMALL. Table 4-2 does not identify any site-specific (Category 2) land use or visual resource issues.

4.2.2 No-Action Alternative

4.2.2.1 Land Use

Under the no-action alternative, the NRC would not renew the operating licenses and Peach Bottom Units 2 and 3 would shut down on or before their license expiration dates (i.e., 2033 and 2034). Plant shutdown under the no-action alternative would not affect onsite land use. Plant structures and other facilities would remain in place until decommissioning. Most transmission lines would remain in service after the plant stops operating. Maintenance of most existing infrastructure would continue as before. Therefore, land use impacts from the termination of Peach Bottom Units 2 and 3 nuclear plant operations at the Peach Bottom site would be SMALL.

4.2.2.2 Visual Resources

Shutdown of Peach Bottom Units 2 and 3 under the no action alternative would not significantly change the visual appearance of the Peach Bottom site. The reactor and turbine buildings, which create the largest visual impact, would remain in place until dismantled. This would reduce the visual impact under the no-action alternative. Therefore, visual impacts from the termination of Peach Bottom Units 2 and 3 nuclear plant operations at the Peach Bottom site would be SMALL.

4.2.3 Replacement Power Alternatives: Common Impacts

4.2.3.1 Land Use

The analysis of land use impacts focuses on the amount of land area that would be affected by the construction and operation of a replacement power plant.

<u>Construction</u>

Construction would require the permanent commitment of land zoned for industrial use for replacement power plants and associated infrastructure. Existing Peach Bottom transmission lines and infrastructure would adequately support each of the replacement power alternatives, thus reducing the need for additional land commitments.

<u>Operations</u>

Operation of new power plants would have no land use impacts beyond land committed for the permanent use of the replacement power generating facilities. Additional land may be required to support power plant operations including land for mining, extraction, and waste disposal activities associated with each alternative.

4.2.3.2 Visual Resources

The visual impact analysis focuses on the degree of contrast between the replacement power plant and the surrounding landscape and the visibility of the new power plant.

Construction

Land for any replacement power plant would require clearing, excavation, and the use of construction equipment. Temporary visual impacts may occur during construction from cranes and other construction equipment.

Operations

Visual impacts during plant operations of any of the replacement power alternatives would be similar in type and magnitude. New cooling towers and their associated plumes would be the most obvious visual impact and would likely be visible farther from the site than other buildings and infrastructure. New plant stacks may require aircraft warning lights that would be visible at night.

4.2.4 New Nuclear Alternative

4.2.4.1 Land Use

Construction

Approximately 220 acres (ac) (90 hectares (ha)) of land would be needed to construct new small modular nuclear power plant units. Land use impacts during construction would be SMALL if located on land already zoned for industrial use.

Operations

Offsite land use impacts associated with uranium mining and fuel fabrication needed to support new nuclear power plant operations generally would be no different from the amount of land needed to support Peach Bottom Units 2 and 3 operations, although more land would be required for mining additional uranium for up to 40 years. Based on this information, onsite and offsite land use impacts from constructing and operating new small modular nuclear power plant units could range from SMALL to MODERATE depending on how much additional land may be needed for uranium mining and fuel fabrication.

4.2.4.2 Visual Resources

Construction and Operations

Visual impacts would be similar to the common impacts described in Section 4.2.3.2. The visual appearance of the three new small modular nuclear power plant facilities would be similar to the appearance of the existing Peach Bottom Units 2 and 3. Mechanical draft cooling towers and associated condensate plumes would add to the visual impact. However, the height of the mechanical draft cooling towers would not likely exceed those of other buildings at the power plant site. Therefore, visual impacts during the construction and operation of the three new small modular nuclear power plant facilities, including steam plumes that could be visible from great distances, could range from MODERATE to LARGE depending on seasonal weather conditions.

4.2.5 Supercritical Pulverized Coal Alternative

4.2.5.1 Land Use

<u>Construction and Operations</u>

The coal-fired power plant would require 4,000 ac (1,600 ha) of land, including coal storage and rail yard, and 480 ac (190 ha) of land for coal ash (Exelon 2018a). Onsite coal storage would make it possible to receive several trains per day at a site with rail access. If the power plant is located on navigable waters, coal and waste material could be delivered and removed by barge. Coal mining impacts would be partially offset because of the elimination of land used for uranium mining to supply fuel for Peach Bottom Units 2 and 3. Although some infrastructure upgrades may be required, it is assumed that the existing transportation and transmission line infrastructure at the selected location would be adequate to support the alternative. Based on this information, onsite and offsite land use impacts from constructing and operating coal-fired power plant units could range from SMALL to MODERATE depending on how much additional land may be needed for coal mining and ash disposal.

4.2.5.2 Visual Resources

<u>Construction and Operations</u>

Visual impacts would be similar to the common impacts described in Section 4.2.3.2. The visual appearance of the coal-fired power plant would be similar to the appearance of the existing Peach Bottom Units 2 and 3. Mechanical draft cooling towers and associated condensate plumes would add to the visual impact. The height of the mechanical draft cooling towers would exceed those of other buildings at the power plant site. Therefore, visual impacts during the construction and operation of the coal-fired power plant, including steam plumes that could be visible from great distances, could range from MODERATE to LARGE depending on seasonal weather conditions.

4.2.6 Natural Gas Combined-Cycle Alternative

4.2.6.1 Land Use

<u>Construction</u>

The natural gas combined-cycle power plant would require 250 ac (100 ha) of land (Exelon 2018a) with additional land needed for right-of-way to connect with existing natural gas supply lines. No new gas wells would be needed to support a natural gas power plant. This land use impact would be partially offset by the elimination of land used for uranium mining to supply fuel to Peach Bottom Units 2 and 3. Land use impacts caused by uranium mining and natural gas extraction and collection are described in Section 4.15.1, “Fuel Cycle.”

Constructing the natural gas power plant at an existing power plant site would make use of available infrastructure. In addition, the land is already zoned for industrial use. However, some natural areas could be converted to industrial use if portions of the new power plant are built outside the existing industrial footprint. Although this use of the land would be noticeable, construction would not likely destabilize adjacent land use, due to the current industrial nature of the site. Accordingly, construction impacts could have SMALL to MODERATE land use impacts. This is primarily due to the amount of non-industrially zoned land that could be affected by this alternative.

Operations

Operation of a natural gas power plant would not cause any additional land use changes; therefore, land use impacts during operations would be SMALL. Overall land use impacts of the natural gas combined-cycle alternative could therefore range from SMALL to MODERATE.

4.2.6.2 Visual Resources

Construction and Operations

Visual impacts from a natural gas power plant would be similar to the description in Section 4.2.3.2, "Visual Resources," for the common impacts from all replacement power alternatives. However, construction and operation of the natural gas power plant would have little to no additional visual impact. The height of the mechanical draft cooling towers would not exceed those of other buildings at the site. Therefore, visual impacts during the construction and operation of a new natural gas power plant at an existing power plant site, including steam plumes that could be visible from great distances, could range from SMALL to MODERATE depending on seasonal weather conditions.

4.2.7 Combination Alternative (Natural Gas Combined Cycle, Wind, Solar, and Purchased Power)

4.2.7.1 Land Use

Construction and Operations

The natural gas power plant component of the combination alternative would require less land than the full-scale natural gas power plant described in Section 4.2.5.1. The natural gas power plant component would require 100 ac (40 ha) of land with additional land that may be needed for gas pipeline right-of-way. Accordingly, land use impacts would be similar to or less than those described for the full-scale natural gas power plant alternative. However, the impacts could still range from SMALL to MODERATE.

Utility-scale wind farms located at multiple sites scattered across the region of influence (ROI) could affect up to an estimated total of 255,000 ac (103,000 ha) of land (NREL 2009, WAPA and FWS 2015). Wind turbines, access roads, and transmission lines, however, would only physically occupy approximately 5 to 10 percent of the land. Because wind farms can be co-located with other land uses, most land uses, such as grazing and crop-producing agriculture, would continue after wind turbines become operational. Land use impacts could therefore range from MODERATE to LARGE, depending on the amount and types of land uses that would be affected by construction and operation of the wind farms.

Utility-scale solar photovoltaic facilities would require approximately 5,000 ac (2,000 ha) of cleared land for solar power installations (Exelon 2018a). Standalone solar photovoltaic facilities cannot be co-located with other land uses (such as grazing and crop-producing agriculture). Land use impacts could range from MODERATE to LARGE, depending on the amount and types of land uses that would be affected by construction of the solar photovoltaic facilities.

Purchased power would not directly require the construction of any new power generating facilities nor the installation of new transmission lines or replacement of existing transmission lines. Power would be purchased from existing power generating facilities. If purchasing power results in the need to indirectly replace or upgrade existing infrastructure, land use impacts from the installation of new or replacement power generating facilities and transmission lines could be minimized by co-locating within existing power plant sites and transmission line corridors. If co-located, power plant and transmission line construction would be unlikely to alter existing land uses. Therefore, any land use impacts would not be noticeable and would be SMALL.

Overall land use impacts of this combination alternative could therefore range from SMALL to LARGE. This is primarily due to the amount and types of land uses that would be affected by the solar photovoltaic facilities.

4.2.7.2 Visual Resources

Construction and Operations

Visual impacts would be similar to the common impacts described in Section 4.2.3.2, "Visual Resources," for all replacement alternatives. However, construction and operation of the natural gas power plant would have little to no additional visual impact. The height of the mechanical draft cooling towers would not likely exceed those of other buildings at the Peach Bottom site. Visual impacts of the natural gas component would be similar to the impacts described in Section 4.2.6.2.

Under this alternative, visual resources could be significantly affected by the installation of wind and solar photovoltaic components. Visual impacts would vary depending on topography and the location of wind turbines, especially along ridgelines. The silhouette of wind turbines against the skyline often creates a significant visual impact, which could range from MODERATE to LARGE. The visual impacts of the solar component of this alternative would also depend on topography. Depending on size and location, standalone solar photovoltaic facilities could have a MODERATE to LARGE visual impact.

Purchased power would not directly require the construction of any new power generating facilities, the installation of new transmission lines, or the replacement of existing transmission lines. Power would be purchased from existing power generating facilities. If purchasing power results in the need to indirectly replace or upgrade existing infrastructure, the visual impact from the installation of new or replacement power generating facilities and transmission lines could be minimized by co-locating within existing power plant sites and transmission line corridors. Therefore, any visual impacts of the purchased power component would not likely be noticeable and would be SMALL.

As a result, the visual impact of the combination alternative could range from SMALL to LARGE. This range is primarily due to the potential visual impacts from the wind and solar components of this alternative.

4.3 Air Quality and Noise

This section describes the potential air quality and noise impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.3.1 Proposed Action

4.3.1.1 Air Quality

According to the GEIS (NRC 1996 and NRC 2013a), the generic issues related to air quality as identified in Table 4-1 above would not be affected by continued operations associated with license renewal. As discussed in Section 4.1, "Introduction," of this SEIS, the NRC staff identified no new and significant information for these issues. Thus, as concluded in the GEIS, the impacts of those generic issues related to air quality would be SMALL. Table 4-2 does not identify any site-specific (Category 2) air quality issues for Peach Bottom Units 2 and 3.

4.3.1.2 Noise

According to the GEIS, noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term. In addition, nuclear plant operations at Peach Bottom Units 2 and 3 have not changed appreciably with time, and no change in noise levels or noise-related impacts are expected during the subsequent license renewal term.

No new and significant information was identified during the review of the Exelon environmental report, site visit, the scoping process, or the evaluation of other available information. Consequently, people living near Peach Bottom Units 2 and 3 would not experience any changes in noise levels during the second renewal term. Therefore, the impact of continued reactor operations during the subsequent license renewal term would not exceed the noise impacts predicted in the GEIS. For these issues, the GEIS predicted that noise impacts would be SMALL for all nuclear plants.

As identified in Table 4-1, the impacts of all generic noise issues would be SMALL. Table 4-2 does not identify any site-specific (Category 2) noise issues.

4.3.2 No-Action Alternative

4.3.2.1 Air Quality

Under the no-action alternative, the cessation of Peach Bottom operations would reduce overall air pollutant emissions (e.g., from diesel generators, engines, and vehicle traffic). Therefore, the NRC staff concludes that if emissions decrease, the impact on air quality from the shutdown of Peach Bottom would be SMALL.

4.3.2.2 Noise

Under the no-action alternative, the termination of reactor operations would result in the reduction in noise sources throughout the nuclear facility, including noise from turbine generators, machinery, pumps, and other noise-generating equipment, and some vehicular traffic. Therefore, noise impacts resulting from the no-action alternative would be SMALL.

4.3.3 Replacement Power Alternatives: Common Impacts

4.3.3.1 Air Quality

<u>Construction</u>

Construction of a replacement power alternative would result in temporary impacts on local air quality. Air emissions would be intermittent and would vary based on the level and duration of specific activities throughout the construction phase. During the construction phase, the primary sources of air emissions would consist of engine exhaust and fugitive dust emissions. Engine exhaust emissions would be from heavy construction equipment and commuter, delivery, and support vehicular traffic traveling to and from the facility as well as within the site. Fugitive dust emissions would be from soil disturbances by heavy construction equipment (e.g., earthmoving, excavating, and bulldozing), vehicle traffic on unpaved surfaces, concrete batch plant operations, and wind erosion, to a lesser extent. Various mitigation techniques and best management practices (e.g., watering disturbed areas, reducing equipment idle times, and using ultra-low-sulfur diesel fuel) could minimize air emissions and reduce fugitive dust. Air emissions would include criteria pollutants (particulate matter, nitrogen oxides, carbon monoxide, and sulfur dioxide), volatile organic compounds, hazardous air pollutants, and greenhouse gases (GHGs). Small quantities of volatile organic compounds and hazardous air pollutants would also be released from equipment refueling, onsite maintenance of the heavy construction equipment, other construction finishing activities, as well as from cleaning products, petroleum-based fuels, and certain paints.

<u>Operations</u>

The impacts on air quality as a result of operation of a power station for a replacement power alternative would depend on the energy technology (e.g., fossil-fuel based, nuclear, or renewable). Fossil fuel-based power plants generally produce more air emissions than nuclear or renewable energy power plants. Worker vehicles, auxiliary power equipment, and mechanical draft cooling tower operation will also result in additional air emissions.

4.3.3.2 Noise

<u>Construction</u>

Construction of a replacement power facility would be similar to the construction of any industrial facility in that all involve many noise-generating activities. In general, noise emissions would vary during each phase of construction, depending on the level of human activity, types of equipment and machinery used, and site-specific conditions. Typical construction equipment, such as dump trucks, loaders, bulldozers, graders, scrapers, air compressors, generators, and mobile cranes, would be used, and pile-driving and blasting activities could take place. Other noise sources include construction worker vehicle and truck delivery traffic. However, noise from vehicular traffic would be intermittent and would generate noise levels similar to those from Peach Bottom Units 2 and 3 during reactor operations.

<u>Operations</u>

Noise generated during operations could include noise from mechanical draft cooling towers, transformers, turbines, machinery, equipment, communication announcements, sirens, and offsite sources such as employee and delivery vehicular traffic. Noise from vehicles would be intermittent and similar to current vehicle noise levels at Peach Bottom. Similarly, apart from noise from mechanical draft cooling towers, operational noise levels at a replacement power plant would likely be similar to existing noise levels at Peach Bottom Units 2 and 3.

4.3.4 New Nuclear Alternative

4.3.4.1 Air Quality

Construction

Air emissions and sources associated with construction of the new nuclear alternative (six or more co-located small modular reactors) would include those identified as common to all replacement power alternatives in Section 4.3.3.1, "Air Quality." Because air emissions from construction activities would be limited, local, and temporary, the NRC staff concludes that the associated air quality impacts from construction of a new nuclear alternative would be SMALL.

Operations

Operation of the new nuclear alternative would result in air emissions similar in magnitude to air emissions from the operation of Peach Bottom. Sources of air emissions would include stationary combustion sources (e.g., diesel generators, auxiliary boilers, and fire pumps) and mobile sources (e.g., worker vehicles, delivery vehicles, and support vehicles). Additional air emissions would result from the new nuclear plant's use of mechanical draft cooling towers (rather than the once-through cooling system with helper towers currently used by Peach Bottom) and could contribute to impacts associated with the formation of visible plumes, fogging, and subsequent icing downwind of the towers. In general, most stationary combustion sources at a nuclear power plant would operate only for limited periods, often during periodic maintenance testing. A new nuclear power plant would need to secure a permit from the Pennsylvania Department of Environmental Protection for air pollutants associated with its operations (e.g., criteria pollutants, volatile organic compounds, hazardous air pollutants, and greenhouse gases). The NRC staff expects the air emissions for combustion sources from a new nuclear plant to be similar to those currently being emitted from Peach Bottom (see Section 3.3.2, "Air Quality"). Emissions from the mechanical draft cooling towers would be approximately 10 tons/year (9 MT/year) for particulate matter less than 10 microns (NRC 2018b). Therefore, NRC staff expects the combined air quality impact of emissions from onsite sources would be minor. Additional air emissions would result from the approximately 1,500 employees commuting to and from the new nuclear facility. The NRC staff does not expect air emissions from operation of a new nuclear alternative to contribute to National Ambient Air Quality Standard violations. The NRC staff concludes that the impacts of operation of a new nuclear alternative on air quality would be SMALL.

4.3.4.2 Noise

Construction

Noise generated during the construction of a new nuclear power plant would be similar to noise for all replacement power alternatives as discussed earlier in Section 4.3.3.2, "Noise." Noise impacts during construction would be limited to the immediate vicinity of the construction site. Because of the distance, noise impacts during the construction of a new nuclear power facility could range from SMALL to MODERATE depending on the noise-sensitive receptor.

Operations

Mechanical draft cooling towers generate noise during operations. Other sources of noise during nuclear power plant operations would include industrial equipment, machinery, vehicles, and communications. In general, noise would be limited to the immediate vicinity of the nuclear facility and noise levels would be similar to noise levels generated during the operation of Peach Bottom Units 2 and 3. Therefore, noise impacts during power plant operations would be SMALL.

4.3.5 Supercritical Pulverized Coal Alternative

4.3.5.1 Air Quality

Construction

Air emissions and sources associated with construction of the coal alternative would include those identified as common to all replacement power alternatives in Section 4.3.3.1, "Air Quality." Air emissions would be localized, intermittent, and short lived, and adherence to well-developed and well-understood construction best management practices would mitigate air quality impacts. Therefore, the NRC staff concludes that construction-related impacts on air quality from a coal alternative would be of relatively short duration and would be SMALL.

Operations

Operation of a coal plant would result in emissions of criteria pollutants and greenhouse gases. The staff estimated air emissions for operating the coal alternative using air emission factors developed by the U.S. Department of Energy's National Energy Technology Laboratory (NETL 2012) for a supercritical pulverized coal power plant equipped with low nitrogen oxide burners and over-fire air to control nitrogen oxides, wet limestone forced-oxidation scrubbers to control sulfur dioxide, and a mono-ethanolamine (MEA)-based solvent process to remove carbon dioxide from the flue gas. Assuming a total gross capacity of 2,940 MW and capacity factor of 0.85 (EIA 2015b), the NRC staff estimates the following air emissions would result from operation of the coal alternative:

- sulfur oxides 337 tons (306 metric tons (MT)) per year
- nitrogen oxides 9,880 tons (8,960 MT) per year
- PM_{10} 1,880 tons (1,700 MT) per year
- carbon monoxide 224 tons (203 MT) per year
- mercury 0.17 tons (0.16 MT) per year
- carbon dioxide equivalents 3.2 million tons (2.9 million MT) per year

Operation of the mechanical draft cooling towers would also result in additional criteria emissions above those presented in the list. Indirect criteria emission sources would include up to 440 worker vehicles commuting to and from the coal facility and particulate matter as a result of coal mining. A new coal plant would qualify as a major emitting industrial facility and would be subject to a New Source Review (NSR) and Title Vpermitting requirements under the Clean Air Act of 1970, as amended (CAA) (42 U.S.C. 7651 et seq.). These permitting requirements ensure that the plant operator minimizes air emissions and does not substantially degrade the local air quality. Additionally, various Federal and State regulations aimed at controlling air pollution would affect a coal plant.

Based on the NRC staff's air emission estimates listed above, criteria pollutant emissions and greenhouse gas emissions from a coal alternative would be noticeable and significant. Carbon dioxide emissions would be much larger than the threshold in the EPA's Greenhouse Gas Tailoring Rule, and criteria pollutant emissions would exceed the threshold for major sources. As a result of the significant criteria air emissions (particularly nitrogen oxides and particulate matter) and greenhouse gas emissions, the NRC staff concludes that the air quality impacts associated with operation of a coal alternative would be MODERATE.

4.3.5.2 Noise

<u>Construction</u>

Noise generated during the construction and operation of a new coal-fired power plant would be similar to those discussed above in Sections 4.3.3.2. and 4.3.4.2., both titled, "Noise." Noise impacts during construction would be limited to the immediate vicinity of the construction site. Because of the distance, noise impacts during the construction of a new coal-fired power facility could range from SMALL to MODERATE depending on the noise-sensitive receptor.

<u>Operations</u>

Noise generated during power plant operations would include noise from mechanical draft cooling towers, industrial equipment, machinery, vehicles, communications, and coal fuel delivery. In general, noise would be limited to the immediate vicinity of the construction site and noise levels would be similar to noise levels generated during the operation of Peach Bottom Units 2 and 3. Therefore, noise impacts during coal-fired power plant operations would be SMALL.

4.3.6 Natural Gas Combined-Cycle Alternative

4.3.6.1 Air Quality

<u>Construction</u>

Air emissions and sources associated with construction of the natural gas alternative would include those identified as common to all replacement power alternatives in Section 4.3.3.1, "Air Quality." Depending on the plant site location and the availability of existing infrastructure, there could also be additional air emissions resulting from construction of pipelines needed to connect the plant to existing natural gas supply lines. Air emissions would be localized, intermittent, and short lived, and adherence to well developed and well understood construction best management practices would mitigate air quality impacts. Therefore, the NRC staff concludes that construction-related impacts on air quality from a natural gas alternative would be of relatively short duration and would be SMALL.

<u>Operations</u>

Operation of a natural gas plant would result in emissions of criteria pollutants and greenhouse gases. The sources of air emissions during operation include gas turbines through heat recovery steam generator stacks. The staff estimated air emissions for the natural gas alternative using emission factors developed by the U.S. Department of Energy's National Energy Technology Laboratory (NETL 2012). Assuming a total gross capacity of 2,875 MW and capacity factor of 0.87 (EIA 2015a), the NRC staff estimates the following air emissions for the natural gas alternative:

• sulfur oxides	34 tons (31 metric tons (MT)) per year
• nitrogen oxides	736 tons (667 MT) per year
• PM_{10}	54 tons (49 MT) per year
• carbon monoxide	76 tons (69 MT) per year
• carbon dioxide equivalents	9.5 million tons (8.6 million MT) per year

Operation of the mechanical draft cooling towers and up to 100 worker vehicles would also result in additional criteria emissions above those presented in the list. A new natural gas plant would qualify as a major emitting industrial facility. As such, the new natural gas plant would be subject to Prevention of Significant Deterioration (PSD) and Title V air permitting requirements under the Clean Air Act of 1970, as amended (42 U.S.C. 7651 et seq.), to ensure that air emissions are minimized and that the local air quality is not substantially degraded. Additionally, various Federal and State regulations aimed at controlling air pollution would affect a natural gas alternative.

Based on the NRC staff's air emission estimates, nitrogen oxide and greenhouse gas emissions from a natural gas plant would be noticeable and significant. Carbon dioxide emissions would be much larger than the threshold in the EPA's Greenhouse Gas Tailoring Rule, and nitrogen oxide emissions would exceed the threshold for major sources. The NRC staff concludes that the overall air quality impacts associated with operation of a natural gas alternative would be SMALL to MODERATE.

4.3.6.2 Noise

Construction

In addition to the common impacts discussed above under Section 4.3.3.2, "Noise," for all replacement power alternatives, additional noise would be generated during the construction of pipelines to support a natural gas power plant. Because of the distance, noise impacts during the construction of a natural gas power plant and gas pipeline could range from SMALL to MODERATE depending on noise-sensitive receptors along the gas pipeline.

Operations

Noise generated during natural gas power plant operations would include noise from mechanical draft cooling towers, compressor stations, and pipeline blowdowns. However, the majority of noise-producing equipment (e.g., mechanical draft cooling towers, turbines, pumps) would be located inside the power block. Therefore, noise impacts during natural gas-fired power plant operations would be SMALL.

4.3.7 Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)

4.3.7.1 Air Quality

Construction

Air emissions and sources associated with construction of the combination alternative would include those identified as common to all replacement power alternatives in Section 4.3.3.1, "Air Quality.. Air emissions from construction would be localized and intermittent, and well understood construction best management practices would mitigate air quality impacts. Therefore, the NRC staff concludes that construction-related impacts on air quality from the combination alternative would be SMALL

Operations

Air emissions associated with the operation of the natural gas portion of the combination alternative would be similar to those associated with the natural gas-only alternative. However, emissions associated with the natural gas portion of the combination alternative would be substantially reduced because the electricity output of the natural gas unit under the combination alternative would be approximately 40 percent of electricity output of the natural gas-only alternative.

The NRC staff estimates the following air emissions for the natural gas portion of the combination alternative based on emission factors developed by the U.S. Department of Energy's National Energy Technology Laboratory and the National Renewal Energy Laboratory (NETL 2012):

- sulfur oxides 14 tons (12 metric tons (MT)) per year
- nitrogen oxides 294 tons (267 MT) per year
- PM_{10} 21 tons (19 MT) per year
- carbon monoxide 30 tons (28 MT) per year
- carbon dioxide equivalents 3.8 million tons (3.4 million MT) per year

Operation of the mechanical draft cooling towers and up to 100 worker vehicles would also result in additional criteria emissions above those presented in the list. The new natural gas units would qualify as major emitting industrial facilities and would be subject to Clean Air Act Prevention of Significant Deterioration and Title V air permitting programs aimed at controlling air pollution. Carbon dioxide emissions would be greater than the threshold in EPA's Greenhouse Gas Tailoring Rule, and nitrogen oxide and carbon monoxide emissions would exceed the threshold for major sources.

Air emissions associated with the operation of wind and solar energy facilities are negligible because no fossil fuels are burned to generate electricity. Emissions from wind turbine arrays and solar fields would include fugitive dust and engine exhaust emissions from worker vehicles and heavy equipment associated with site inspections, maintenance activities (panel washing or replacement), and wind erosion from cleared lands and access roads. Emissions would be localized and intermittent. These emissions should not cause exceedances of air quality standards or have any impacts on climate change.

Air quality impacts associated with power purchased from existing plants are also expected to be negligible as there would be minimal change in existing plant operations and emissions. If a third-party supplier constructed a new power plant to provide purchased power, the impact on the air quality would depend on the type of plant (e.g., nuclear, natural gas), as well the air quality status (attainment, nonattainment, or maintenance status) where the plant is located. Air emissions and air quality impacts therefore would be similar to those discussed under the new nuclear alternative, coal alternative, or natural gas alternative discussed above.

The NRC staff concludes that the overall air quality impacts associated with operation of the combination alternative would be SMALL to MODERATE.

4.3.7.2 Noise

Construction

Construction-related noise sources for the natural gas power plant portion of the combination alternative would be similar to the impacts discussed earlier for the natural gas-only power plant alternative under Section 4.3.5.2, "Noise," and the common impacts in Section 4.3.3.2, "Noise," for all replacement power alternatives. Noise impacts during the construction of wind and solar power generating units could range from SMALL to MODERATE depending on their location in proximity to noise-sensitive receptors. Purchased power generally would not require any new construction and thus would result in no construction-related noise impacts. Therefore, construction impacts from the combination alternative could range from SMALL to MODERATE depending on noise-sensitive receptors.

Operations

Noise generated during natural gas power plant operations would include noise from mechanical draft cooling towers, compressor stations, and pipeline blowdowns. Noise impacts during operation of the natural gas-fired power plant component of the combination alternative would be similar to those described in Section 4.3.5.2. Noise generated by wind turbines would include aerodynamic noise from the turbine rotor and mechanical noise from turbine drivetrain components and could range from SMALL to MODERATE depending on its location in proximity to noise-sensitive receptors. Except for maintenance activities, very little noise would be generated by the solar power generating units. Purchased power from existing power plants would generate no additional noise. Therefore, noise impacts during facility operations could range from SMALL to MODERATE.

4.4 Geologic Environment

This section describes the potential geology and soils impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.4.1 Proposed Action

The NRC staff identified no new and significant information during the review of the Exelon environmental report, site visit, the scoping process, or the evaluation of other available information. As identified in Table 4-1, the impacts of the single geologic environment issue (geology and soils) would be SMALL. Table 4-2 does not identify any site-specific (Category 2) geologic environment issues under the proposed action.

4.4.2 No-Action Alternative

Under the no-action alternative, there would be little or no incremental impacts on site geology and soils associated with the shutdown of Peach Bottom. This is because prior to the commencement of decommissioning activities, little or no new ground disturbance would occur at the plant site as operational activities are reduced and eventually cease. As a result, the NRC staff concludes that the impact of the no-action alternative on geology and soils would be SMALL.

4.4.3 Replacement Power Alternatives: Common Impacts

Construction

During facility construction for all the replacement power alternatives, sources of aggregate material (such as crushed stone, sand, and gravel) would be required to construct buildings, foundations, roads, parking lots, pad sites, transmission lines, and other supporting infrastructure, as applicable to each replacement power component. The NRC staff presumes that these resources would likely be obtained from commercial suppliers using local or regional sources. Land clearing, grading, and excavation work expose soils to erosion and alter surface drainage, although most impacts would be localized. The NRC staff also presumes that best management practices would be implemented in accordance with applicable permitting requirements to reduce soil erosion and offsite impacts. These practices would include the use of sediment fencing, staked hay bales, check dams, sediment ponds, riprap aprons at construction and laydown yard entrances, mulching and geotextile matting of disturbed areas, and rapid reseeding of temporarily disturbed areas. Removed soils and any excavated materials would be stored on-site for redistribution such as for backfill at the end of construction.

Operation

During operations of replacement power facilities, previously disturbed areas would not be subject to long-term soil erosion and any consumption of aggregate materials for maintenance purposes would be negligible. Areas disturbed during construction would be within the footprint of the completed facilities, overlain by other impervious surfaces (such as roadways and parking lots), or revegetated, so there would be no additional direct operations impacts on geology and soils.

4.4.4 New Nuclear Alternative

The impacts on geologic and soil resources from construction and operations associated with the new nuclear alternative (six or more co-located small modular reactors) would likely be similar to but of lesser intensity than those described and assumed as common to all alternatives in Section 4.4.3. This assessment is based on the smaller land area that would be disturbed from construction and the reduced potential for soil erosion and reduced loss of natural soils from conversion to industrial use as compared to the other replacement power alternatives. Therefore, NRC staff concludes that the impacts to geology and soil resources from the new nuclear alternative would be SMALL.

4.4.5 Supercritical Pulverized Coal Alternative

The impacts on geologic and soil resources from construction and operations associated with the supercritical pulverized coal alternative would likely be similar to but of greater intensity than those described and assumed as common to all alternatives in Section 4.4.3. This is primarily attributable to the additional construction impacts including the potential for soil erosion and the direct soil loss associated with coal storage and coal-combustion waste management facilities under this alternative. In addition, the operation of waste management facilities poses a risk of soil contamination. The operation, maintenance, and closure of coal-combustion waste management facilities also requires the consumption of soil and aggregate materials. As a result, the NRC staff concludes that the impacts to geology and soil resources from the supercritical pulverized coal alternative could range from SMALL to MODERATE.

4.4.6 Natural Gas Combined-Cycle Alternative

The impacts on geologic and soil resources from construction and operations associated with the natural gas combined-cycle alternative would likely be similar to but of lesser intensity than those described and assumed as common to all alternatives in Section 4.4.3. This assessment is based on the smaller land area that would be disturbed from construction and the reduced potential for soil erosion and reduced loss of natural soils from conversion to industrial use as overall compared to the other replacement power alternatives. Therefore, NRC staff concludes that the impacts to geology and soil resources from this alternative would be SMALL.

4.4.7 Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)

The overall impacts on geologic and soil resources from construction and operations associated with the combination alternative would generally be similar to but of substantially wider scale and greater intensity than those described and assumed as common to all alternatives in Section 4.4.3. This assessment is primarily based on the substantial land area that would be impacted from construction of the onshore wind and solar photovoltaic components of this alternative. The aggregate potential for soil erosion and loss during construction is the largest of any alternative, as is the total acreage of natural soils that could be converted to industrial use. Based on these factors, the NRC staff concludes that the impacts to geology and soil resources from the supercritical pulverized coal alternative could range from SMALL to MODERATE.

4.5 <u>Water Resources</u>

This section describes the potential surface water and groundwater resources impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.5.1 Proposed Action

4.5.1.1 Surface Water Resources

The NRC staff identified no new and significant information during the review of the Exelon environmental report, site visit, the scoping process, or the evaluation of other available information. As identified in Table 4-1," the impacts of all generic surface water resources issues of the proposed action of subsequent license renewal would be SMALL. Table 4-2 identifies one site-specific (Category 2) issue related to surface water resources applicable to Peach Bottom during the subsequent license renewal term. This Category 2 issue is analyzed below.

Category 2 Issue Related to Surface Water Resources: Surface Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River)

Potential surface water use conflicts from nuclear power plants using cooling towers or cooling ponds supplied with makeup water from a river must be evaluated as a Category 2 issue. Category 2 issues require a plant-specific assessment of the impacts.

Exelon states that Peach Bottom utilizes a once-through cooling system and does not utilize either a cooling pond or closed-cycle cooling towers that require makeup water. Therefore, Exelon concluded that this Category 2 issue does not apply to Peach Bottom (Exelon 2018a). The NRC staff recognizes that in the GEIS (NRC 2013a), the NRC staff determined that surface water use conflicts from plants with once-through cooling systems are a Category 1 issue. However, Peach Bottom uses helper cooling towers. The NRC staff performs a site-specific review under this Category 2 issue for sites that use once-through cooling systems and also have helper cooling towers (NRC 2013a, NRC 2015d).

In previous license renewal environmental reviews, the NRC staff has found that surface water use conflicts are SMALL for plants with once-through cooling systems, because they return most of their withdrawn water to the same surface water body. Regarding the relatively low consumption rate of surface water associated with closed-cycle cooling systems, the GEIS cites the Peach Bottom plant as an example. Section 4.6.1.1 of the GEIS states that Peach Bottom's consumptive water use, even with its helper cooling towers, represents less than 2 percent of the minimum monthly average flow of the Susquehanna River (NRC 2013a).

Peach Bottom's current surface water consumptive use rate represents approximately 0.2 percent of the 39,500 cubic feet per second (cfs) (1,118,500 liters per second (Lps)) average annual flow of the Susquehanna River into Conowingo Pond. This is a very low percentage of the available flow volume in Conowingo Pond water. Therefore, the NRC staff concludes that surface water use impacts over the subsequent license renewal term would be SMALL.

4.5.1.2 Groundwater Resources

According to the GEIS (NRC 1996 and NRC 2013a), groundwater resources would not be significantly affected by continued operations associated with license renewal in most circumstances. As discussed in Section 3.5.2, "Groundwater Resources," of this SEIS, the NRC staff identified no new and significant information relating to groundwater use and quality. The NRC staff identified no new and significant information regarding groundwater resources during the review of the Exelon environmental report, site visit, the scoping process, or the evaluation of other available information. As identified in Table 4-1, the impacts of all generic groundwater resources issues would be SMALL.

Category 2 Issues

Table 4-2 identifies two Peach Bottom site-specific (Category 2) issues related to groundwater resources during the subsequent license renewal term. These issues are analyzed below.

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

For nuclear power plants with cooling towers or cooling ponds that rely on a river for makeup of consumed (evaporated) cooling water, it is possible that water withdrawals from the river could lead to groundwater use conflicts with other users. This situation could occur because of the interaction between groundwater and surface water, especially in the setting of an alluvial aquifer in a river valley (NRC 2013a). Consumptive use of river water, if significant enough to lower the river's water level, would also influence water levels in an alluvial aquifer. Shallow wells of nearby groundwater users could therefore be adversely affected. This is a Category 2 issue and requires a plant-specific assessment that includes the consideration of new and significant information.

The NRC staff has determined that this issue is applicable to the proposed action. The issue is applicable because Peach Bottom uses helper cooling towers under certain conditions in combination with its once-through cooling system to cool a portion of the cooling water return flow to the plant's discharge canal, resulting in consumptive water loss before the water is discharged to Conowingo Pond.

In evaluating the potential impacts resulting from groundwater use conflicts associated with subsequent license renewal, the NRC staff uses as its baseline the existing groundwater resource conditions described in Sections 3.5.2.1 through 3.5.2.3 of this SEIS (as applicable). These baseline conditions encompass the existing hydrogeologic framework and conditions (including aquifers) potentially affected by continued operations, as well as the nature and magnitude of groundwater withdrawals for cooling and other purposes (as compared to relevant appropriation and permitting standards). The baseline also considers other downgradient or in-aquifer uses and users of groundwater.

The nature of Peach Bottom's withdrawals from Conowingo Pond combined with the hydrogeologic environment of the Peach Bottom site and vicinity largely precludes any impact on or conflict with groundwater availability.

The Susquehanna River Basin Commission (SRBC) regulates Peach Bottom's consumptive use of surface water from Conowingo Pond. SRBC issues dockets to water users as part of the comprehensive planning process for managing the region's water resources. The SRBC docket issued to Exelon authorizes Peach Bottom to withdraw up to 2,363.62 million gallons per day (mgd) (8,947 millions of liters per day (mld)) of water, which is equivalent to approximately 3,657 cfs (103 cubic meters per second (m^3/s)). The SRBC docket limits the plant's peak (daily) consumptive water use to 49 mgd (185 mld); 75.8 cfs (2.1 m^3/s)). The annual mean discharge of the river measured at Marietta, PA, 27 mi (43 km) upstream of Peach Bottom, is 40,800 cfs (1,155 m^3/s) (USGS 2018b).

Peach Bottom largely limits its consumptive water use to the warmer months when it operates one or more helper cooling towers in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements. Over the last 5 years, Peach Bottom's highest peak daily consumptive water use was 38.3 mgd (145 mld), or 59.3 cfs (1.7 m^3/s) (Exelon 2018a). This consumption rate is approximately 0.14 percent of the mean flow of the river. Consumptive water use at this level in support of continued operations of Peach Bottom is unlikely to have any effect on the water levels in Conowingo Pond and, thus, would have no effect on water levels in any aquifers intersecting Conowingo Pond.

Additionally, geologic mapping of the Peach Bottom site and vicinity shows that alluvial deposits that could support local aquifers along the Conowingo Pond portion of the Susquehanna River are extremely limited. Rather, the predominant surficial deposits consist of schist bedrock and colluvial regolith along and immediately adjacent to the river (Sevon 1996b, 1996c). The local groundwater flow system is one where the river valley acts as a drain for groundwater rather than a source of recharge to groundwater. As a result, groundwater flow in both the regolith and bedrock is roughly toward the Susquehanna River as described and illustrated in Section 3.5.2.1, "Site Description and Hydrogeology." As discussed in Section 3.5.2.2, "Groundwater Use," the supply wells serving the Peach Bottom site and the wells used by other private entities in the local groundwater basin are generally completed in the Peters Creek schist. The bedrock fracture systems that yield water to wells are recharged by the infiltration of precipitation and runoff and offer no hydrologic connection with water levels in Conowingo Pond. As a result, the NRC staff does not expect any groundwater use conflicts to arise due to Peach Bottom's continued surface water withdrawals and consumptive use from Conowingo Pond.

In summary, the NRC staff's review indicates that Peach Bottom's continued surface water withdrawals and relatively low rate of consumptive use of river flow from the Conowingo Pond portion of the Susquehanna River would not measurably affect local groundwater resources. As Exelon stated in the environmental report submitted as part of its subsequent license renewal application, Exelon does not anticipate the need to withdraw or consume surface water at a rate exceeding its current SRBC docket. Therefore, the NRC staff concludes that the potential for groundwater use conflicts associated with Peach Bottom's operations during the subsequent license renewal term would continue to be SMALL.

<u>Radionuclides Released to Groundwater</u>

All commercial nuclear power plants plan to routinely release radioactive gaseous and liquid materials into the environment. These radioactive releases are designed to be planned, monitored, documented, and released into the environment at designated discharge points. In contrast, this section considers the potential impact to groundwater quality from the unplanned, inadvertent discharge of liquids containing radionuclides into groundwater. Such unknown, uncontrolled, and unmonitored releases of radioactive liquids have occurred at nuclear power plant sites from power plant systems, piping, spent fuel pools, valves, and tanks. The majority of the inadvertent liquid release events involve tritium, which is a radioactive isotope of hydrogen. However, other radioactive isotopes, such as cesium and strontium, have also been inadvertently released into the groundwater at some sites. The inadvertent release of radionuclides to groundwater is a Category 2 issue and therefore requires a plant-specific assessment that includes the consideration of new and significant information.

In evaluating the potential impacts on groundwater quality associated with subsequent license renewal, the NRC staff uses as its baseline the existing groundwater conditions described in Sections 3.5.2.1 through 3.5.2.3 of this SEIS. These baseline conditions encompass the existing quality of groundwater potentially affected by continued operations (as compared to relevant State or the U.S. Environmental Protection Agency (EPA) primary drinking water standards), as well as the current and potential onsite and offsite uses and users of groundwater for drinking and other purposes. The baseline also considers other downgradient or in-aquifer uses and users of groundwater.

Section 3.5.2.3, "Groundwater Quality," of this SEIS describes existing groundwater quality at the Peach Bottom site, including instances where radionuclides have been inadvertently released at the site and the results of site groundwater monitoring conducted by Exelon. In summary, since 2006, Exelon has participated in the Industry Ground Water Protection Initiative, NEI 07-07 (NEI 2007), which is focused on actions to improve management and response to the inadvertent release of radioactive substances to subsurface soils and water. Exelon has integrated the NEI 07-07 program into the current Peach Bottom radiological groundwater protection program. The groundwater protection monitoring network at Peach Bottom consists of 31 permanent groundwater monitoring wells, 3 surface water sample locations, 3 groundwater seeps, 2 yard drain sumps, as well as 6 precipitation water sampling locations.

Exelon initiated hydrogeologic investigations at the Peach Bottom site in 2006 that resulted in the discovery of a tritium plume resulting from inadvertent releases of radionuclides to groundwater from plant equipment. The plume was delineated as extending northeast of the Unit 3 turbine building along the prevailing direction of groundwater flow. As discussed in Section 3.5.2.3, subsequent investigations were performed to assess the plume and characterize site groundwater quality. In June 2009, Exelon identified and stopped a tritium-contaminated water leak source at the Unit 3 condensate storage tank. In 2010 and 2011, Exelon undertook additional corrective actions to eliminate a tritium leak to groundwater from the Unit 3 turbine building moisture separator room.

Exelon documents any inadvertent leaks, spills, and releases to the environment from Peach Bottom operations in its annual radiological groundwater protection program reports. These reports are included in Exelon's annual radiological environmental operating reports submitted to the NRC. The NRC staff reviewed these reports as part of this environmental review. Over the last 5 years (2014–2018), Exelon has had only one inadvertent release of radionuclides to groundwater at Peach Bottom. As summarized in Section 3.5.2.3, this inadvertent release was discovered in April 2015 and was traced to the Unit 3 turbine building separator area. The highest tritium activity (37,700 picocuries per liter (pCi/L) to 38,100 pCi/L) was observed in monitoring well MW-PB-25 based on sampling performed April 7, 2015, with the result confirmed by additional analysis. Exelon undertook immediate corrective actions to modify and repair the floor drains in the moisture separator area that were the source of the release. Following the completion of the corrective actions, monitoring showed decreasing tritium activity in monitoring wells (e.g., MW-PN-25) adjacent to the Unit 3 turbine building for the remainder of 2015.

A plume of tritium-contaminated groundwater exists in the overburden material beneath the Peach Bottom plant site. The plume is the result of previous inadvertent spills and leaks of radionuclide-containing liquids from the plant. The plume extends northeast of the Unit 3 turbine building toward the Peach Bottom intake basins in the direction of monitoring well MW-PB-4 (Figure 3-9).

Table 3-5, "Representative Groundwater and Storm Drain Monitoring Results for Tritium, Peach Bottom Groundwater Protection Program, 2017 (in PicoCuries per Liter)," in Section 3.5.2.3 summarizes the latest available radiological groundwater protection monitoring results for Peach Bottom and compares the results to historical maximum observed concentrations at each location. The 2017 groundwater monitoring results show that tritium concentrations range from less than the minimum detectable concentration in most wells to a maximum observed concentration of 17,600 pCi/L in one overburden groundwater monitoring well (MW-PB-25). Monitoring well MW-PB-25 is located in the source area of the onsite tritium plume adjacent to the Unit 3 turbine building. Adjoining monitoring wells in the area of the plume (e.g., monitoring wells MW-PB-22 and MW-PB-24) also show elevated tritium levels, with tritium concentrations ranging from 220 to 2,250 pCi/L in 2017. The Unit 3 yard drain also exhibited elevated tritium levels throughout 2017, with a maximum observed concentration of 1,150 pCi/L. The 2017 monitoring results also show no tritium in excess of the minimum detectable concentration in surface waters (e.g., site SW-PB-5) adjacent to the Peach Bottom site. Groundwater flows generally from west to east across the Peach Bottom site and discharges to the plant intake and discharge basins and to Conowingo Pond, where any tritium-containing groundwater is quickly diluted. Thus, there is no drinking water pathway for tritium to reach other groundwater users.

The NRC staff observes that there are currently no discernible trends in radiological groundwater protection monitoring data that would indicate either a new inadvertent release or an ongoing, uncontrolled inadvertent release of radionuclides to groundwater at Peach Bottom. The monitoring data also show that there is no occurrence or migration of tritium in groundwater from the Peach Bottom site at concentrations exceeding the EPA and Commonwealth of Pennsylvania primary maximum contaminant level (drinking water standard) of 20,000 pCi/L (40 CFR 141.16, 25 Pa. Code 109.202). Additionally, the overburden material beneath the Peach Bottom plant site primarily consists of reworked, residual soils, crushed rock, and engineered backfill. The groundwater in this material and in the underlying bedrock is not a current source of drinking water and is not proposed for drinking water use during the subsequent license renewal term.

In summary, based on the information presented, the NRC staff finds that inadvertent releases of radionuclides (primarily tritium) have not substantially impaired or noticeably altered groundwater quality with respect to drinking water standards within the overburden and bedrock groundwater beneath the Peach Bottom site. Onsite inadvertent releases of radionuclides have had no measurable effect on surface waters adjoining the Peach Bottom site and do not currently affect or threaten offsite groundwater. Thus, the NRC staff concludes that impacts on groundwater quality and use from inadvertent releases of radionuclides from Peach Bottom are SMALL and are projected to remain SMALL during the subsequent license renewal term.

4.5.2 No-Action Alternative

4.5.2.1 Surface Water Resources

Under the no-action alternative, surface water withdrawals and the rate of consumptive water use would greatly decrease. Heated water from the condenser cooling water circuit would cease to be discharged to Conowingo Pond. Wastewater discharges would be reduced considerably. Stormwater runoff would continue to be discharged from the plant site to Conowingo Pond. Shutdown would reduce the overall impacts on surface water use and quality. Overall, the impact of the no-action alternative on surface water resources would be SMALL.

4.5.2.2 Groundwater Resources

Site groundwater is withdrawn to supply water for miscellaneous, non-potable uses across the plant site (see Section 3.5.2.2, "Groundwater Use"). Under the no-action alternative, it is likely that Exelon's use of groundwater at Peach Bottom would be greatly reduced because of plant shutdown but would not likely cease until sometime during decommissioning. Additionally, with the cessation of power plant operations, the potential for inadvertent releases of radionuclides would be greatly reduced with little or no additional impacts on groundwater quality.

Therefore, the NRC staff concludes that the impact of the no-action alternative on groundwater resources would be SMALL.

4.5.3 Replacement Power Alternatives: Common Impacts

4.5.3.1 Surface Water Resources

The NRC assumes that replacement power alternatives would be located somewhere within a region that comprises Pennsylvania, Delaware, Maryland, and New Jersey (see Section 2.2.2, "Replacement Power Alternatives," of this SEIS). This area includes freshwater rivers, brackish estuaries, brackish and saltwater bays, and the Atlantic Ocean. In addition, the replacement power alternatives could be located next to existing reservoirs or in some cases require the construction of a new reservoir. The diversity of potential sites with very different surface water conditions injects a significant amount of uncertainty into the projection and ranking of replacement power alternative impacts on surface water bodies. This geographic uncertainty influences the range of possible impact rankings more than the type of technology chosen.

The NRC staff assumes that replacement power facilities would be located at existing power plant sites and would use existing available site infrastructure, such as cooling water intake systems, to the extent practicable. Construction activities associated with replacement power alternatives may cause temporary impacts to surface water quality by increasing sediment loading to surface water bodies from disturbed areas and excavations. Construction activities may also impact surface water quality from spills and leaks from construction equipment and any dredge and fill activities. Potential impacts would vary depending on the nature and acreage of land area disturbed and the intensity of excavation work.

Nevertheless, all site construction activities would have to be conducted under a NPDES permit. To prevent or minimize any surface water quality impacts during construction, best management practices would be used for waste management, water discharge, stormwater pollution prevention, soil erosion control, site stabilization techniques, and spill prevention practices.

Water would be required for potable and sanitary use by the construction workforce and for concrete production, equipment cleaning, dust suppression, soil compaction, and other miscellaneous uses. This water could be obtained either from groundwater, surface water, or some combination of the two. Any impacts on surface water quality and from surface water consumption would be short lived.

During operations and depending on the replacement power alternative in question, most of the water consumed would be used to cool the thermoelectric portions of the power plant. Thermoelectric power plant cooling would use a closed-cycle cooling circuit with mechanical-draft cooling towers. Water consumed would be lost to the atmosphere via evaporation. In general, while closed-cycle cooling circuits consume more water than once-through cooling water circuits, they discharge most of the heat generated to the atmosphere and not to surface water bodies. The new nuclear and supercritical pulverized coal alternatives would consume more water than the proposed action, while the natural gas combined-cycle alternative would consume considerably less water than the proposed action.

Saltwater mechanical draft cooling towers would be needed at sites that use saltwater bodies as a source of cooling water. The blowdown from these towers would likely produce a concentrated brine that would require disposal. Possible options are deep well injection or discharge back into the saltwater body. Best management practices would continue to be practiced during operation of this alternative. The use of these best management practices plus the implementation of NPDES requirements would help to reduce surface water quality impacts during operation of a replacement power alternative using a saltwater body for cooling water.

4.5.3.2 Groundwater Resources

Construction

Construction activities associated with replacement power facilities at some sites could require groundwater dewatering (removal of subsurface water), especially of deep excavations associated with emplacement of thermoelectric power facility foundations and substructures (i.e., new nuclear, coal, and natural gas facilities). This could require the use of cofferdams, sheet piling, sumps, wells, or other methods to address high water table conditions. However, the NRC staff expects that any impacts on groundwater flow and quality within the aquifers affected by dewatering would be highly localized and of short duration, with minor effects on other aquifer users. Pumped groundwater removed from excavations would be discharged in accordance with applicable State and local permits.

Construction of replacement power generating facilities would increase the amount of impervious surfaces and could alter subsurface conditions because of excavation work and the placement of any backfill following facility completion. Below-grade portions of new power generating facilities at some site locations could also alter the direction of groundwater flow. Such effects would likely be localized.

Application of best management practices, as referenced in Section 4.5.3.1, would prevent or minimize any areawide groundwater quality impacts during construction.

In addition to construction dewatering of groundwater, onsite groundwater could be used to support construction activities. Groundwater withdrawals could have a temporary impact on local water tables or groundwater flow, but such withdrawals would be subject to applicable water use permitting requirements. The use of portable sanitary facilities, serviced by a commercial vendor, would serve to reduce overall water use and sanitary wastewater generation by the construction workforce.

Operation

Post-construction groundwater dewatering could be required during the operational period of some replacement power facilities at some sites. Dewatering rates would likely be much lower than during construction. Once extracted, collected groundwater would be properly managed in accordance with applicable NPDES permitting requirements.

The thermoelectric components of replacement power facilities would require freshwater for various uses including general service water, fire protection, demineralized water makeup, and potable and sanitary needs. Some water would also be required for maintenance of onshore wind and solar photovoltaic facilities. Water for these uses could be obtained from onsite groundwater or from a local water supply utility. Any onsite groundwater withdrawals would be subject to applicable State water appropriation and registration requirements.

Facility effluent discharges—including cooling water, sanitary wastewater, and stormwater—to surface water and groundwater would be subject to applicable Federal, State, and other permit requirements. Adherence by facility operators to proper procedures during all material, chemical, and waste handling and conveyance activities would reduce the potential for any releases to the environment, including to soils and groundwater.

4.5.4 New Nuclear Alternative

4.5.4.1 Surface Water Resources

The NRC staff did not identify any impacts on surface water resources for the new nuclear alternative (six or more co-located small modular reactors) beyond those discussed above as impacts common to all replacement power alternatives. Therefore, the NRC staff concludes the impacts on surface water resources from a new nuclear alternative would be SMALL to MODERATE.

4.5.4.2 Groundwater Resources

Groundwater use and quality impacts from construction and operations associated with the new nuclear alternative would likely be similar to but of somewhat lesser intensity than those described and assumed as impacts common to all replacement power alternatives in Section 4.5.3.2. Deep excavation work and dewatering would be required for construction, but impacts would be localized and temporary. Potential groundwater quality impacts during operations of a new nuclear facility would generally be similar to those of the other replacement power facilities, as well as to continued operations of Peach Bottom. Therefore, the NRC staff concludes that the impacts on groundwater resources from construction and operations associated with the new nuclear alternative would be SMALL.

4.5.5 Supercritical Pulverized Coal Alternative

4.5.5.1 Surface Water Resources

The supercritical pulverized coal alternative has the additional potential to degrade surface water quality from spills of coal deliveries and from the discharge of leachate from onsite coal and ash piles. However, as coal spills, runoff, and the discharge of leachate from onsite coal and ash piles, would be subject to applicable environmental permitting and monitoring, the NRC staff concludes the impacts on surface water resources from a coal alternative would be SMALL to MODERATE.

4.5.5.2 Groundwater Resources

Potential impacts on groundwater resources from a coal alternative would be similar to but likely of greater intensity than those described and assumed as impacts common to all replacement power alternatives in Section 4.5.3.2. This assessment is based on the larger construction and operational footprint of a supercritical pulverized coal facility, which would include associated coal handling and waste (e.g., ash and sludge) management facilities, as compared to other standalone replacement power facilities and to the continued operations of Peach Bottom.

Management of runoff and leachate from coal and ash storage facilities would require additional regulatory oversight and would present an additional risk to groundwater resources during operations due to the potential for leachate from coal storage and coal-combustion residuals (e.g., ash and scrubber wastes) to reach groundwater during operations or due to facility failure. However, contaminants from coal storage and waste material management facilities (i.e., landfills or impoundments) can be minimized in modern facilities with protective barriers, disposal cell liners, and leachate collection and treatment systems, along with groundwater monitoring systems. Based on these considerations, the NRC staff concludes that the overall impacts on groundwater resources from construction and operations associated with the supercritical pulverized coal alternative would be SMALL to MODERATE.

4.5.6 Natural Gas Combined-Cycle Alternative

4.5.6.1 Surface Water Resources

The NRC staff did not identify any impacts on surface water resources for the natural gas combined-cycle alternative beyond those discussed above in Section 4.5.3.2as impacts common to all replacement power alternatives. Therefore, the NRC staff concludes the impacts on surface water resources from a natural gas alternative would be SMALL to MODERATE.

4.5.6.2 Groundwater Resources

Groundwater use and quality impacts from construction activities and operations associated with the natural gas combined-cycle alternative would be similar to but likely of lesser intensity than those described and assumed as impacts common to all replacement power alternatives in Section 4.5.3.2. This is because less extensive excavation work and associated dewatering would be required for construction of the natural gas facility. Potential groundwater quality impacts during operations would be similar to or less than those from the other replacement power facilities and from continued Peach Bottom operations.

Construction of a new natural gas pipeline would result in additional ground-disturbing impacts and the need for dewatering areas around pipeline pad and pier supports. However, any groundwater impacts would likely be localized and temporary.

For the natural gas combined-cycle alternative, the NRC staff concludes that impacts on groundwater resources from construction and operations would be SMALL.

4.5.7 Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)

4.5.7.1 Surface Water Resources

The wind and solar parts of this combination alternative should impact surface water resources much less than any of the previously discussed replacement power alternatives (i.e., new nuclear, coal, and natural gas only). Because the natural gas combined-cycle portion of this alternative would be smaller and produce less power, it would consume less surface water than the natural gas combined-cycle only alternative. However, the purchased power aspect of the combination alternative may rely on the construction of new facilities or require older and less-power-efficient plants to operate for longer periods of time or at higher capacities. Therefore, the NRC staff concludes that the impacts on surface water resources from the combination alternative would be SMALL to MODERATE.

4.5.7.2 Groundwater Resources

Groundwater use and quality impacts from construction activities and operations associated with the natural gas combined-cycle portion of the combination alternative would be similar to but of substantially lesser intensity than those described and assumed as impacts common to all replacement power alternatives in Section 4.5.3.2, “Groundwater Resources.” The impacts of this portion would also be substantially less than those of the natural gas combined-cycle-only alternative evaluated in Section 4.5.6.2, “Groundwater Resources.” This is because the construction and operational aspects of the gas-fired power plant under this combination alternative would be scaled down by approximately 60 percent.

The NRC staff expects that there would be little or no groundwater use or groundwater quality impacts from construction and operations of the offsite wind and solar photovoltaic facilities, despite the considerable land area that would be affected. This is because groundwater dewatering would likely be minimal due to the relatively small footprint of individual pad sites, access roads, and utility corridors where excavation, grading, and trenching might be required. The NRC staff also expects that water use for wind and solar photovoltaic facilities would be modest as compared to other replacement power facilities, and no onsite groundwater would be required for construction and operations.

The impacts on groundwater resources from operating other power generating facilities associated with the purchased power component of this alternative would likely not be substantially different from those described in Section 4.5.3.2 as impacts common to all replacement power alternatives.

Based on the above, the NRC staff concludes that the overall impacts on groundwater resources from construction and operations associated with the combination alternative would be SMALL.

4.6 Terrestrial Resources

This section describes the potential terrestrial resources impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.6.1 Proposed Action

As identified in Table 4-1, “Applicable Category 1 (Generic) Issues for Peach Bottom,” the impacts of all generic terrestrial resource issues would be SMALL. The NRC staff analyzed Category 1 issues in the GEIS (NRC 2013a) and determined that the impacts of continued nuclear power plant operation during a license renewal term would have SMALL effects for these issues. The NRC staff has identified no new and significant information for terrestrial resource Category 1 issues that would call into question the GEIS’s conclusions for subsequent license renewal of Peach Bottom. Accordingly, as concluded in the GEIS, the impacts of the Category 1 terrestrial resource issues identified in Table 4-1 would be SMALL for Peach Bottom subsequent license renewal. Table 4-2, “Applicable Category 2 (Site-Specific) Issues for Peach Bottom,” identifies two site-specific (Category 2) issues related to terrestrial resources during the Peach Bottom subsequent license renewal term. These issues are analyzed below.

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

According to the GEIS, non-cooling system impacts on terrestrial resources can include those impacts that result from site and landscape maintenance activities, stormwater management, elevated noise levels, and other ongoing operations and maintenance activities that would occur during the license renewal term on and near a plant site. The NRC staff based its analysis in this section on information in Exelon’s (Exelon 2018a) environmental report unless otherwise cited.

Site and Landscape Maintenance Activities

Exelon's landscape maintenance practices primarily consist of grass cutting and weed control within developed or previously disturbed areas of the site. PECO, the transmission owner, manages onsite transmission line rights-of-way except for one 500-kV tie line. Rights-of-way are managed through periodic herbicide application, mechanical clearing, hand clearing, pruning, or tree removal in accordance with procedures designed to comply with the North American Electric Reliability Corporation standards for minimum vegetation clearance. Shrubs and shorter trees are maintained in the rights-of-way to promote lower-growing vegetative community.

Approximately 60 percent (469 ac (190 ha)) of the Peach Bottom site remains as undeveloped, uncultivated natural areas. Exelon has no plans to disturb these areas during the subsequent license renewal term. Exelon holds Silver Certification from the Wildlife Habitat Council for its management of the Peach Bottom site, and the company has undertaken a number of environmental stewardship initiatives to enhance existing wildlife habitat (described in Section 3.6.3, "Environmental Stewardship Initiatives").

Continued site and landscape maintenance during the subsequent license renewal term is unlikely to result in noticeable effects on the terrestrial environment.

Stormwater Management

Stormwater runoff from impervious surfaces can change the frequency or duration of inundation and soil infiltration within neighboring terrestrial habitats. Effects can include erosion, altered hydrology, sedimentation, and other changes to plant community characteristics. Runoff may contain sediments, contaminants from road or parking surfaces, or herbicides. The Pennsylvania Department of Environmental Protection authorizes Exelon to discharge stormwater from a number of its outfalls (Outfall Nos. 004, 008 through 010, 012 through 022, and 025 through 033) as specified in the site's NPDES permit. Collection of stormwater and discharge to the Susquehanna River through these outfalls minimizes the amount of runoff that terrestrial habitats experience and associated effects. The NPDES permit also requires Exelon to maintain a Stormwater Pollution Prevention Plan. This plan identifies potential sources of pollutants that could be present in stormwater and identifies best management practices that Exelon uses to reduce those pollutants in its discharges to the river. The best management practices include measures to minimize spills and leaks, procedures for handling industrial materials and wastes that can be readily mobilized by contact with stormwater, and practices to minimize erosion and sedimentation. Exelon further monitors areas with higher potential for spills of oil or other regulated substances under its Spill Prevention Control and Countermeasures Plan. Collectively, the measures described in this section ensure that Exelon would continue to minimize the effects of stormwater pollutants on terrestrial resources during the subsequent license renewal term.

Noise

The GEIS (NRC 2013a) indicates that elevated noise levels from transformers and cooling towers could disrupt wildlife behavioral patterns or cause animals to avoid such areas. However, limited wildlife inhabit site areas that experience elevated noise levels due to the developed, industrial nature of the site, regular presence of human activity, and associated lack of high-quality habitat. Wildlife that does occur in developed areas has already adapted to the conditions of the site and is tolerant of disturbance. Therefore, continued noise associated with the operation of transformers and cooling towers during the subsequent license renewal term is unlikely to create noticeable impacts on terrestrial resources.

General Operations and Maintenance Activities

During the subsequent license renewal term, Exelon may undertake a variety of general maintenance activities or repairs of existing buildings, roadways, parking lots, piping, fencing, and security-related structures. Such activities would likely be confined to previously disturbed areas of the site, and Exelon maintains various procedures to ensure that its personnel appropriately consider environmentally sensitive areas during the project planning phase and protect those areas, if present, when activities are carried out. Exelon's procedures direct personnel to obtain appropriate local, State, or Federal permits prior to beginning work; to implement best management practices to protect natural areas; and to consult with the appropriate agencies wherever federally or State-listed species or environmentally sensitive habitats may be affected. For instance, because of the number of active raptor and waterfowl nests on the Peach Bottom site, Exelon's avian and wildlife management procedures describe how personnel should respond when a nest is encountered and what steps to take if personnel need to disturb or remove a nest during site activities. In most situations involving wildlife or birds, Exelon's procedures require its personnel to notify the station environmental manager prior to proceeding with an activity. This ensures that a designated, knowledgeable person is involved in projects that could affect the site's terrestrial resources and that the appropriate measures are taken to protect terrestrial habitats and biota.

In addition to applicant-maintained procedures, Appendix B of Peach Bottom's renewed facility operating licenses includes an Environmental Protection Plan that requires Exelon to prepare an environmental evaluation for any activities that would involve previously unreviewed harmful effects on the environment (NRC 2003b, NRC 2003c). Exelon must submit such evaluations to the NRC along with a plan of action to eliminate or significantly reduce any detrimental effects (NRC 2003b, NRC 2003c). The renewed licenses, if issued, would include an Environmental Protection Plan with identical or substantially similar requirements.

Conclusion

Based on the NRC staff's independent review, the staff concludes that site and landscape maintenance activities, stormwater management, elevated noise levels, and other general operations and maintenance activities that Exelon may undertake during the subsequent license renewal term would primarily be confined to already disturbed areas of the Peach Bottom site. If any such activities have the potential to affect terrestrial resources, Exelon maintains procedures to ensure that personnel consider how to minimize such impacts prior to performing work. The NRC staff did not identify any activities that would have noticeable effects on terrestrial resources or that would destabilize any important attributes of the terrestrial environment. Accordingly, the NRC staff concludes that non-cooling system impacts on terrestrial resources during the subsequent license renewal term would be SMALL.

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

Water use conflicts occur when the amount of water needed to support terrestrial resources is diminished as a result of agricultural, municipal, or industrial uses; droughts; or a combination of these factors.

Section 4.5.1.1, “Surface Water Resources,” addresses surface water use conflicts and concludes that the potential impacts on surface water resources and downriver water availability from Peach Bottom’s consumptive water use during the subsequent license renewal term would be SMALL because of Peach Bottom’s very low consumptive use relative to river flow. The SRBC also imposes water withdrawal restrictions through a consumptive water use permit to further ensure adequate instream and downstream flows. Section 4.7.1.1, “Water Use Conflicts with Aquatic Resources (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a River),” addresses water use conflicts with aquatic resources and determines that Peach Bottom consumes a very small amount of the Susquehanna River’s flow each year and that the impacts of water use conflicts would be SMALL for aquatic resources. The NRC staff finds no other impacts that terrestrial or riparian habitats or species would uniquely experience beyond those already discussed in these sections. Accordingly, the NRC staff concludes that the impacts of water use conflicts on terrestrial resources from the subsequent license renewal would be SMALL.

4.6.2 No-Action Alternative

Under the no-action alternative, some impacts on terrestrial resources, such as cooling tower drift, would cease following reactor shutdown. Other impacts would continue at a reduced level. For example, impacts on noise and impacts associated with herbicide application and landscape maintenance would likely continue during the shutdown period. Other impacts on terrestrial resources would be the same as if the plant were operating, such as the potential for bird collisions with plant structures and transmission lines. Thus, shutdown itself is unlikely to noticeably alter or have more than minor effects on terrestrial resources. The NRC staff concludes that the impacts of the no-action alternative on terrestrial resources during the subsequent license renewal term would be SMALL.

4.6.3 Replacement Power Alternatives: Common Impacts

The replacement power alternatives would each entail construction and operation of a new energy generating facility at an existing nuclear power plant site or retired coal plant site in either Pennsylvania, Delaware, Maryland, or New Jersey. This section addresses the qualitatively similar impacts to terrestrial resources that would result from implementation of any of the replacement power alternatives.

During construction, the use of an existing or retired power facility site would allow Exelon to locate buildings and facilities on previously disturbed land. The new facility could incorporate some existing buildings and infrastructure depending on the condition of such structures and the specific needs of the replacement power alternative. Existing transmission lines and structures would likely be adequate to support each alternative, and existing intake and discharge structures could also possibly be used with some modifications. For these reasons, disturbance to or loss of existing terrestrial habitats during construction would be less than if the replacement power alternatives were built on a green field site. However, the exact level of disturbance to terrestrial habitats and biota would depend on the site selected, the terrestrial habitats present, the amount of land required for each alternative, and the specific locations of buildings and infrastructure within the site footprint. Clearing of some plant communities within the construction footprint could occur. Wildlife in these areas would be displaced but could relocate to neighboring natural areas. Some habitat loss or fragmentation, loss of food resources, and altered behavior due to noise and other construction-related disturbances would be possible. Erosion and sedimentation from clearing, leveling, and excavating land could affect adjacent riparian and wetland habitats, but implementation of appropriate best management practices and revegetation following construction would minimize such impacts.

In the GEIS (NRC 2013a), the NRC staff concludes that impacts to terrestrial resources from operation of nuclear and fossil-fueled plants would be similar and would include cooling tower salt drift, noise, bird collisions with plant structures and transmission lines, impacts connected with herbicide application and landscape management, and potential water use conflicts connected with cooling water withdrawals. The fossil-fueled alternatives would generate air emissions of greenhouse gases. Additional impacts to terrestrial resources during the operational period could occur as a result of offsite mining, extraction, or waste disposal activities associated with each plant's particular type of fuel.

4.6.4 New Nuclear Alternative

The impacts of the new nuclear alternative (six or more co-located small modular reactors) are largely addressed in the impacts common to all replacement power alternatives described in the Section 4.6.3. The direct impacts to terrestrial resources resulting from this alternative would be minimal for the following reasons: the use of an existing or retired power facility site, the relatively small land requirements, the short-term nature of the construction activities, and the assumption that Exelon would implement best management practices to minimize impacts to sensitive terrestrial habitats. For these reasons, impacts during operation would be qualitatively similar to, but quantitatively less than, those that would result from continued operation of Peach Bottom during the subsequent license renewal term.

The NRC staff concludes that construction and operation of a new nuclear alternative would result in SMALL impacts to terrestrial resources.

4.6.5 Supercritical Pulverized Coal Alternative

The supercritical pulverized coal alternative would likely result in the highest level of impact to the terrestrial environment because a new coal plant would require a large area of land and coal mining would result in various offsite impacts. Depending on the site selected, that site's current land uses, and the terrestrial habitats present, construction of a new coal plant could necessitate temporary disturbance or permanent loss of undisturbed or sensitive terrestrial habitats. In addition to the common impacts described in Section 4.6.3, this alternative would require coal deliveries, cleaning, and storage during the operational period, which would create noise, dust, and loss of terrestrial habitats. Limestone preparation and storage would create dust and runoff that could affect soil and vegetation. Air emissions from the coal plant could create acid precipitation, which can injure foliage, leach nutrients from the soil, and contribute to decreased biodiversity over time. Disposal of combustion wastes could result in habitat loss and potential seepage of trace minerals and other elements into soils.

The NRC staff concludes that implementation of a coal alternative would result in MODERATE impacts on terrestrial resources during construction and SMALL to MODERATE impacts during operation. The predicted range during the operational period is due to the variable impacts that terrestrial resources could experience from air emissions and coal mining.

4.6.6 Natural Gas Combined-Cycle Alternative

Construction of a natural gas combined-cycle alternative would likely result in minimal direct impacts to terrestrial resources for the following reasons: the use of an existing or retired power facility site, the relatively small land requirements, the short-term nature of the construction activities, and the assumption that Exelon would implement best management practices to minimize impacts to sensitive terrestrial habitats. However, this alternative would require construction of a gas pipeline, which could result in loss, modification, or fragmentation of terrestrial habitat. Exact impacts would vary depending on the site selected, the ability for Exelon to use existing pipeline infrastructure or co-locate the pipeline along an existing right-of-way, and the quality and sensitivity of terrestrial habitats that would be impacted by pipeline construction activities. Impacts during operation would be similar to the common impacts described in Section 4.6.3although this alternative would require additional gas extraction to supply fuel for operations. Much of the fuel would be sourced from lands already in use for extraction, which would minimize additional impacts on the terrestrial environment. The degree to which the terrestrial environment would be affected by air emissions during operations would depend on the baseline air quality, the plant's use of technologies that minimize or mitigate emissions, and the sensitivity of the biota and habitats present in the surrounding region.

The NRC staff concludes that implementation of a natural gas alternative would result in SMALL to MODERATE impacts on terrestrial resources during both construction and operation. The predicted range in impacts is due to the variable impacts that gas pipeline construction could have on the terrestrial environment as well as the variable impacts of air emissions during the operational period.

4.6.7 Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)

Many of the impacts that terrestrial resources would experience from implementation of the combination alternative are described in the common impacts in Section 4.6.3. This section describes unique impacts that the terrestrial environment could experience from each component of the alternative.

Impacts from the natural gas combined-cycle component of this alternative would be similar to those described for the natural gas-only alternative described in Section 4.6.6. Impacts of construction and operation of this component would likely be SMALL due to the smaller scale of the natural gas facility within the combination alternative as compared to the natural gas-only alternative.

The wind component would require a substantial amount of land: an estimated 5,100 ac (2,060 ha) of temporary disturbance and 2,100 ac (850 ha) of permanent disturbance. Land used for equipment laydown and turbine component assembly and erection could be returned to its original state following construction, while permanently disturbed land would hold the wind turbines, access roads, and transmission lines. Temporarily disturbed lands would be restored to reduce long-term impacts to the terrestrial environment through Exelon's implementation of best management practices. Wind turbine operation could uniquely affect terrestrial species through mechanical noise, collision with turbines and meteorological towers, and interference with migratory behavior. Bird and bat collision mortality is an ongoing concern at operating wind farms; however, recent developments in turbine design have reduced strike risk. Nevertheless, the wind component could noticeably alter terrestrial resources through the disturbance, loss, or fragmentation of terrestrial habitats during construction and would increase the risk of bird and bat injury or mortality during wind turbine operation. Accordingly, construction and operation of the wind component would result in MODERATE impacts on terrestrial resources.

The solar component would require an estimated 5,000 ac (2,020 ha) of land across the region of influence. Impacts to terrestrial habitats could be largely avoided if solar installations were to be installed on the roofs of existing residential, commercial, or industrial buildings or at existing standalone solar facilities. However, the resulting magnitude of impacts would depend on the exact siting of installations and the amount of terrestrial habitat that would be disturbed, lost, or fragmented as a result of construction. Operation would have no measurable effects on the terrestrial environment. This component of the alternative would have SMALL to MODERATE construction impacts on terrestrial resources depending on the locations of solar installations and the amount and quality of terrestrial habitats affected. Operational impacts on terrestrial resources would be SMALL.

Impacts from the purchased power portion of this alternative would depend substantially on the generation technologies used to supply the purchased power. Exelon would likely purchase power from existing facilities in Pennsylvania or neighboring States, which would likely intensify existing impacts to the terrestrial environment rather than create wholly new impacts. This component of the alternative would have no construction effects and SMALL operational effects on terrestrial resources.

The NRC staff concludes that implementation of a combination alternative would result in MODERATE impacts on terrestrial resources during both construction and operation. Although many of this alternative's components would result in SMALL impacts, the wind component would create MODERATE impacts during construction and operation. As a result, the staff's overall conclusion for the combination alternative is MODERATE.

4.7 Aquatic Resources

This section describes the potential aquatic resources impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.7.1 Proposed Action

As identified in Table 4-1, "Applicable Category 1 (Generic) Issues for Peach Bottom," the impacts of all generic aquatic resource issues would be SMALL. The NRC staff analyzed Category 1 issues in the GEIS (NRC 2013a) and determined that the impacts of continued nuclear power plant operation during a license renewal term would have SMALL effects for these issues. The NRC staff has identified no new and significant information for aquatic resource Category 1 issues that would call into question the GEIS's conclusions for subsequent license renewal of Peach Bottom. Accordingly, and as concluded in the GEIS, the impacts of the Category 1 aquatic resource issues identified in Table 4-1 would be SMALL for Peach Bottom subsequent license renewal. Table 4-2, "Applicable Category 2 (Site-Specific) Issues for Peach Bottom," identifies three site-specific (Category 2) issues related to aquatic resources during the Peach Bottom subsequent license renewal term. These issues are analyzed below.

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

In the GEIS (NRC 2013a), the NRC determined that impingement and entrainment of aquatic organisms is a Category 2 issue that requires a site-specific evaluation during each license renewal review for plants with once-through cooling systems, such as Peach Bottom.

Impingement is the entrapment of all life stages of fish and shellfish on the outer part of an intake structure or against a screening device during periods of water withdrawal

(40 CFR 125.83, "What Special Definitions Apply to This Subpart"). Impingement can kill organisms immediately or contribute to a slower death from exhaustion, suffocation, injury, and other physical stresses. The potential for injury or death is generally related to the amount of time an organism is impinged, its susceptibility to injury, and the physical characteristics of the screen washing and fish return system (if present).

Entrainment is the incorporation of all life stages of fish and shellfish with intake water flow entering and passing through a cooling water intake structure and into a circulating water system (40 CFR 125.83). Organisms susceptible to entrainment are generally of a smaller size than those susceptible to impingement and include ichthyoplankton (fish eggs and larvae), larval stages of shellfish and other macroinvertebrates, zooplankton, and phytoplankton. Entrained organisms may experience physical trauma and stress, pressure changes, excess heat, and exposure to chemicals, all of which may result in injury or death (Mayhew et al. 2000).

A particular species can be subject to both impingement and entrainment if some individual fish are impinged on screens while others pass through the screens and are entrained. For instance, adults could be impinged while larvae could be entrained, if they are small enough to pass through the intake screen openings.

At Peach Bottom, aquatic organisms that inhabit the Susquehanna River may be impinged when cooling water is drawn from the river through an intake structure. Organisms entrained by passing through the intake structure and into the Peach Bottom cooling water system are subject to mechanical, thermal, and toxic stresses that make survival unlikely.

This section's analysis uses a retrospective assessment of the present and past impacts to the aquatic ecosystem resulting from Peach Bottom operation to provide a prospective assessment for future impacts over the subsequent license renewal term. In addition, the NRC staff used a modified weight-of-evidence (WOE) approach to evaluate the effects of impingement and entrainment on the aquatic resources in the Susquehanna River. The NRC staff chose this approach because EPA recommends a WOE approach for ecological risk assessment (EPA 1998). The WOE approach is a useful tool because of the complex nature of assessing risk (or impact). The NRC has used this approach in other evaluations of the effects of nuclear power plant cooling systems on aquatic communities (e.g., NRC 2010, 2013f, 2015b, 2015c, 2016a, 2018c). Menzie et al. (1996) defines WOE as "…the process by which multiple measurement endpoints are related to an assessment endpoint to evaluate whether significant risk of harm is posed to the environment." In the present WOE approach, the NRC staff examined three lines of evidence (LOE) to determine if operation of Peach Bottom is contributing to adverse impacts on aquatic resources in the Susquehanna River. From these lines of evidence, the staff then predicts whether and to what extent future impacts are likely under the proposed action. The lines of evidence are (1) impingement studies, (2) entrainment studies, and (3) engineered designs and operational controls that minimize impingement and entrainment rates.

<u>LOE 1: Impingement Studies</u>

Exelon has undertaken several impingement studies in connection with the Clean Water Act Section (CWA) 316(b) requirements, NPDES permit requirements, and in agreements with the Susquehanna River American shad restoration program and the Pennsylvania Fish and Boat Commission, including the following:

- CWA Section 316(b) Impingement and Entrainment Demonstration Study from 1973 to 1976
- American Shad and Migratory Fish Impingement Studies from 1985 through 1999

- CWA Section 316(b) Impingement Demonstration Study from 2005 to 2006
- Migratory Fish Impingement Studies from 2010 through 2015

A summary and the findings of each of these studies is provided below.

CWA Section 316(b) Impingement and Entrainment Demonstration Study, 1973–1976

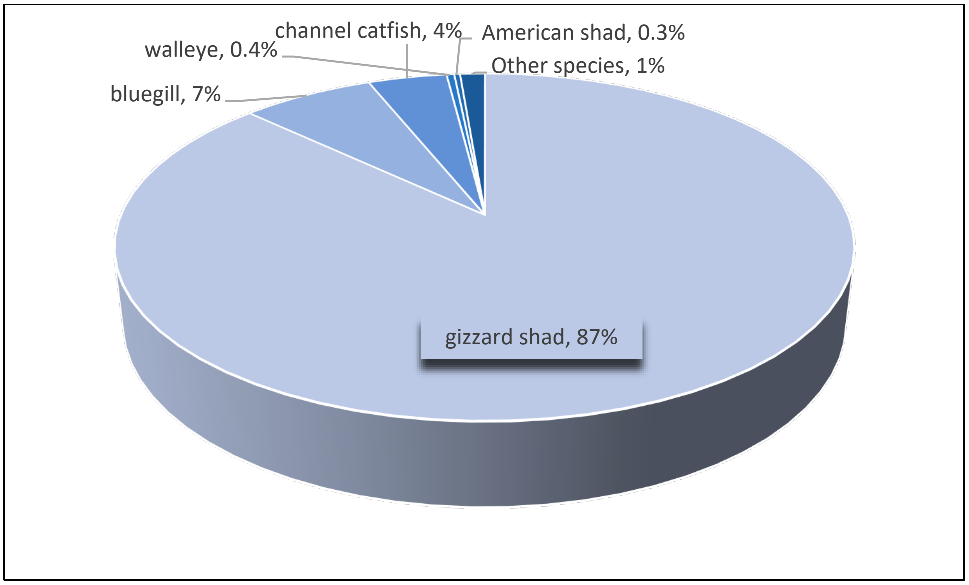
Philadelphia Electric Company (PECO), the owner of Peach Bottom prior to Exelon, submitted a CWA Section 316(b) Demonstration study to the State in accordance with its NPDES permit that was initially issued in 1976. PECO (1975) compared the biological community prior to and after operations commenced and determined that no significant detrimental effects had occurred as a result of Peach Bottom operation. In addition, PECO (1975) concluded that: "the intake structure at Peach Bottom reflects the best technology available for minimizing adverse environmental effects." PECO and subsequent owners of Peach Bottom continued to apply for renewed NPDES permits every 5 years. During such renewals, no additional impingement studies were required until after the EPA published its 2004 CWA Section 316(b) Phase II rule (69 FR 41576), which has since been rescinded and replaced by the 2014 rule described in LOE 3. The post-2004 studies are described below.

American Shad and Migratory Fish Impingement Studies, 1985–1999

Exelon monitored intake screens at Peach Bottom from 1985 through 1999 at various intervals (NRC 2003a; Exelon 2018a). In Section 4.1.3 of the NRC's SEIS for the initial license renewal of Peach Bottom (2003a), the NRC staff reviewed the results of these studies through 1999 and determined that the impacts of continued operation would be SMALL because the number of impinged migratory fish was a small fraction of the migratory fish population within Conowingo Pond. The NRC staff incorporates this analysis by reference into this SEIS (see Section 4.1.3, pages 4-15 through 4-17 in NRC 2003a).

CWA Section 316(b) Impingement and Entrainment Demonstration Study, 2005–2006

Exelon contracted the URS Corporation (URS and NAI 2008) to conduct an impingement and entrainment study in response to an EPA data request related to the EPA's 2004 CWA Section 316(b) Phase II rule (69 FR 41576), which has since been rescinded and replaced by the 2014 rule. In the study, URS (URS and NAI 2008) determined that the outer intake structure provides the best available technology because it minimizes adverse environmental impacts from the operation of Peach Bottom. The most commonly impinged species included gizzard shad (*Dorosoma cepedianum*; 87 percent of impinged fish), bluegill (*Lepomis macrochirus*; 6.9 percent), and channel catfish (*Ictalurus punctatus*; 4.1 percent) (Figure 4-1; URS and NAI 2008). Other notable species impinged included walleye (*Stizostedion vitreum*) and American shad (*Alosa sapidissima*), which comprised approximately 0.4 percent and 0.3 percent of impinged fish, respectively (URS and NAI 2008). These data indicate that for most species, relatively few fish are impinged at Peach Bottom (see Figure 4-1). Therefore, impingement is not likely to noticeably alter the population for these species. The majority (87 percent) of the impinged fish at Peach Bottom were gizzard shad. Gizzard shad is an introduced species to Conowingo Pond and its population has been increasing since the 1970s, in part, due to this species' ability to outcompete native fish for zooplankton prey (NAI and ERM 2014). This upward population trend suggests that impingement does not noticeably alter the gizzard shad population within Conowingo Pond.



Source: Created with data from URS and NAI 2008

Figure 4-1 Relative Percentage of Impinged Fish by Species

URS (URS and NAI 2008) estimated Peach Bottom's actual annual impingement rate to be 221,421 fish per year by multiplying the impingement rates determined during the sampling period by the annual water withdrawal amount from August 30, 2005 through August 29, 2006. The study also determined a baseline impingement rate of 1,470,000 fish per year. This baseline calculation estimated the impingement rate assuming Peach Bottom did not incorporate any mitigation to reduce impingement, such as the use of traveling screens or locating the intake in a location with lower biological productivity. Based on the baseline and actual impingement rates, URS (URS and NAI 2008) determined that the design (e.g., traveling screens), location (e.g., impounded section of the Susquehanna River), and operation of Peach Bottom's intake structure reduces impingement by 85 percent. In addition, URS (URS and NAI 2008) concluded that the diversity and relative abundance of the aquatic population remained unchanged since before operation at Peach Bottom began.

The NRC staff notes that in the SEIS for Peach Bottom's initial license renewal (2003a), the NRC staff described the major changes in the aquatic community since Peach Bottom operation began. The major changes include an increase in the gizzard shad and anadromous fish populations. The NRC staff attributed this change to the introduction of gizzard shad into Conowingo Pond in 1972 and the operation of the Conowingo Dam east fish lift, which lifts fish from the lower Susquehanna River into Conowingo Pond. The NRC staff did not identify any noticeable changes to the aquatic community as a result of the operation of the Peach Bottom cooling system.

Annual Impingement Studies, 2010–2015

As part of a collaborative effort with the Susquehanna River American shad restoration program and the Pennsylvania Fish and Boat Commission, researchers have collected impingement samples each year during the annual American shad outmigration period (October–November). From 2010 through 2015, the most commonly impinged species included gizzard shad (75 percent) and bluegill (27 percent) (see Table 4-3) (NAI 2010a, 2011a, 2012a, 2013a, 2014a; 2015a). Migratory species such as American shad and alewife (*Alosa pseudoharengus*) comprised 1 percent or less of the total fish impinged from 2010 through 2015. NAI 2010a, NAI 2014a, and NAI 2015a noted that the impinged alewife were likely a population present in Conowingo Pond (rather than alewife migrating from the Chesapeake Bay) because no or very few alewife were observed passing through the Conowingo east fish lift in those years. The impingement studies did not capture any blueback herring (*Alosa aestivalis*).

Table 4-3 Number of Fish Impinged During 2010-2015 Collections at Peach Bottom

Species	2010	2011	2012	2013	2014	2015	Overall Percent
gizzard shad	7791	3,111	78528	13989	7634	25585	72%
bluegill	5533	2411	28147	5693	371	5986	25%
channel catfish	602	69	129	154	395	290	1%
alewife	510	25	683	0	7	5	1%
green sunfish	70	3	101	21	0	112	<1%
American shad	11	0	29	49	0	62	<1%
white perch	1	0	7	1	16	1014	1%
blueback herring	0	0	0	0	0	0	0%
Total	**14692**	**5738**	**108004**	**20062**	**8496**	**33410**	**100%**

Source: NAI 2010a, 2011a, 2012a, 2013a, 2014a, 2015a

Similar to the results reported in past impingement studies, the impingement studies from 2010 through 2015 indicate that for most species, relatively few fish are impinged at Peach Bottom, and therefore, impingement is not likely to noticeably alter the population for these species. The majority (72 percent) of the impinged fish at Peach Bottom were gizzard shad, which is an introduced species that has been increasing in population within Conowingo Pond since 1972. This upward population trend suggests that impingement is not noticeably altering the gizzard shad population within Conowingo Pond.

Future Studies

NAI is currently analyzing impingement sampling data, among other biological data, that its personnel have collected over several years pursuant to Exelon's compliance with CWA Section 316(b) Best Technology Available requirements. As part of this effort, NAI will prepare impingement and entrainment characterization reports for Exelon. Exelon will submit these studies and other required information with its NPDES renewal application to the PDEP in 2019. Exelon's NPDES permit renewal application was not available for NRC staff review during preparation of this draft SEIS. However, the NRC staff will update this SEIS with relevant information from Exelon's application, which will be available for staff review during its preparation of the final SEIS

LOE 1 Conclusion

Exelon (and previous owners) have conducted several impingement studies at Peach Bottom. Since 2000, gizzard shad has consistently comprised the majority of the impinged fish, ranging from 53 to 99 percent of the fish impinged during a single year. Gizzard shad is an introduced species to Conowingo Pond, and its population has been increasing since 1972 (NAI and ERM 2014). This upward population trend suggests that impingement does not noticeably alter the gizzard shad population within Conowingo Pond.

In Exelon's most recent CWA Section 316(b) demonstration study, URS (URS and NAI 2008) determined that the design (e.g., traveling screens), location (e.g., impounded section of the Susquehanna River), and operation of Peach Bottom's intake structure reduces impingement by

85 percent compared to the estimated baseline. In addition, URS (URS and NAI 2008) and the NRC staff (2003a) concluded that the operation of Peach Bottom has not resulted in changes to the aquatic community within Conowingo Pond. Based on the available information, previous impingement studies suggest that operation of the Peach Bottom cooling system has not had a noticeable impact on aquatic biota within Conowingo Pond. Exelon (2018c) will submit its NPDES renewal permit application, which will include new impingement and entrainment characterization reports, in 2019. Exelon's NPDES permit renewal application was not available for NRC staff review during preparation of this draft SEIS. However, the NRC staff will update this SEIS with relevant information from Exelon's application, which will be available for staff review during its preparation of the final SEIS

<u>LOE 2: Entrainment Study</u>

Exelon has completed two entrainment studies in connection with CWA Section 316(b) and NPDES permit requirements, including the following:

- CWA Section 316(b) Impingement and Entrainment Demonstration Study from 1973 to 1976
- CWA Section 316(b) Entrainment Demonstration Study from 2005 to 2006

A summary and the findings within each of these studies is provided below.

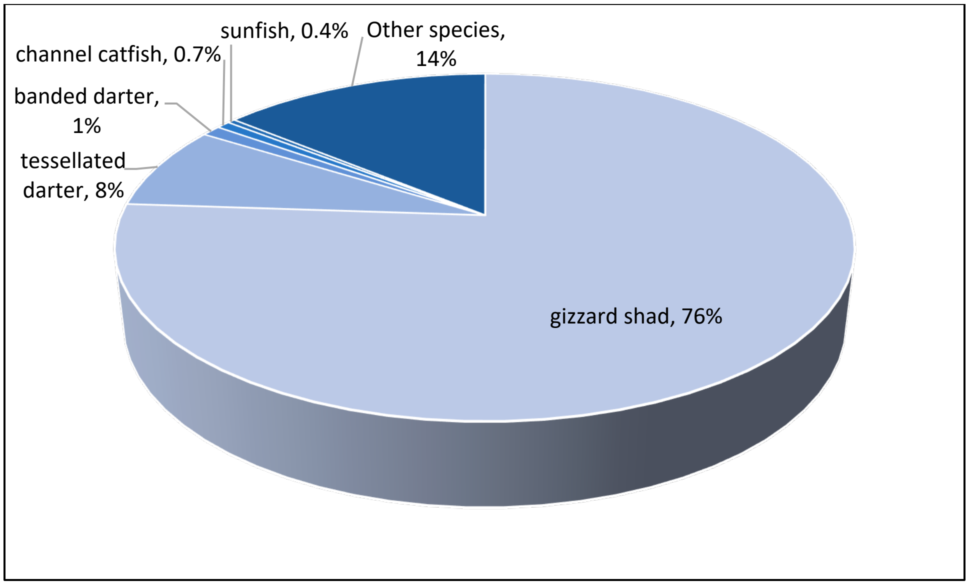
CWA Section 316(b) Impingement and Entrainment Demonstration Study, 1973–1976

As described in LOE 1 above, PECO (1975) submitted a CWA Section 316(b) demonstration study in accordance with its NPDES permit that was initially issued in 1976. PECO (1975) compared the biological community prior to and after operations commenced and determined that no significant detrimental effects had occurred to the aquatic community as a result of Peach Bottom operation. In addition, PECO (1975) concluded that: "the intake structure at Peach Bottom reflects the best technology available for minimizing adverse environmental effects."

CWA Section 316(b) Entrainment Demonstration Study, 2012

In 2010 and as a condition of Peach Bottom's 2011 renewed NPDES permit, the Pennsylvania Department of Environmental Protection required Exelon to conduct an entrainment characterization study over at least one fish spawning season. To characterize the species and life stages most likely to be entrained within the Peach Bottom cooling water intake system, NAI (2013b) collected water samples over one 24-hour sampling period each week from March through September 2012. During each collection period, NAI used a 3-inch (8-cm) electric pump to obtain a water sample through a 3-inch (8-cm) diameter pipe positioned vertically in the discharge basin as close as possible to the discharge structure outfall for approximately 3 hours. The sample was then filtered through a 500-micron mesh net.

NAI (2013b) collected a total of 1,529 fish eggs and larvae. The most commonly collected species included gizzard shad (1,162 fish; 76 percent), tessellated darter *(Etheostoma olmstedi*; 119 fish; 7.8 percent), banded darter (*E. zonale*; 19 fish; 1.2 percent) and channel catfish (11 fish; 0.7 percent) (Figure 4-2). NAI also collected 6 sunfish (less than 1 percent), which may have been either green sunfish (*Lepomis cyanellus*), bluegill, or pumpkinseed (*Lepomis gibbosus*).



Source: Created with data from URS and NAI 2008

Figure 4-2 Relative Percentage of Entrained Fish by Species

The most commonly entrained species was gizzard shad, which comprised 76 percent of all entrained fish. Gizzard shad is a common species within Conowingo Pond and a generalist broadcast spawner. Eggs and sperm are released near the surface of the water (MDNR undated_a), where they would be more susceptible to entrainment as compared to fish that build nests and lay eggs closer to the river bed. As noted above, gizzard shad was introduced into Conowingo Pond in 1972 and its population has been increasing since the 1970s, in part, due to this species' ability to outcompete native fish for zooplankton prey (NAI and ERM 2014). This upward population trend suggests that entrainment does not noticeably alter the gizzard shad population within Conowingo Pond.

NAI (2013b) noted that spawning habitat for many species does not occur near the Peach Bottom intake, which reduces the likelihood of entrainment for many species. In addition, NAI also noted that many of the fish species within Conowingo Pond are not as likely to be susceptible to entrainment because many of these fish build nests and then lay adhesive and demersal eggs that sink to the river bed and stick to hard surfaces. For example, fish within the family Centrarchidae (e.g., bluegill, largemouth and smallmouth bass, and green sunfish), Ictaluridae (catfishes), and several darter species (*Etheostoma* spp.) lay adhesive and demersal eggs. Likewise, entrainment rates are generally low for these species (1 percent or less) even though these species may be relatively common within Conowingo Pond.

The study did not collect any species that were State or federally listed at the time of the study. NAI (2013b) collected one Chesapeake logperch (*Percina bimaculata)*, which is currently being considered as a candidate for Federal listing as described in Section 4.8.1.1, "Species and Habitats Protected Under the Endangered Species Act Under U.S. Fish and Wildlife Service Jurisdiction," and one juvenile American eel (*Anguilla rostrata*). Entrainment of anadromous *Alosa* spp. (alewife, blueback herring, hickory shad, American shad) are not expected because suitable spawning habitat generally occurs upstream of Peach Bottom. Therefore, eggs and larvae would not occur within Conowingo Pond (NRC 2003a). Once juveniles migrate downstream, juvenile American shad, blueback herring, and alewife would be too large to fit through the traveling screens and become entrained within the cooling water intake system (SRAFRC 2012). As noted above, juveniles could become impinged.

Future Studies

NAI is currently analyzing entrainment sampling data, among other biological data, that its personnel have collected over several years pursuant to Exelon's compliance with CWA Section 316(b) Best Technology Available requirements. As part of this effort, NAI will prepare impingement and entrainment characterization reports for Exelon. Exelon will submit these studies and other required information with its NPDES renewal application to the PDEP in 2019. Exelon's NPDES permit renewal application was not available for NRC staff review during preparation of this draft SEIS. However, the NRC staff will update this SEIS with relevant information from Exelon's application, which will be available for staff review during its preparation of the final SEIS

LOE 2 Conclusion

Exelon (and previous owners) have conducted two entrainment studies at Peach Bottom. In the most recent study from 2012, gizzard shad comprised 76 percent of the entrained fish. This species has been increasing in population since its introduction to Conowingo Pond in 1972, suggesting that entrainment does not noticeably alter the gizzard shad population within Conowingo Pond. The study did not collect any species listed as State or federally endangered or threatened in 2012, or any anadromous *Alosa* spp. Exelon (2018c) will submit its NPDES renewal permit application, which will include new impingement and entrainment characterization reports, in 2019. Exelon's NPDES permit renewal application was not available for NRC staff review during preparation of this draft SEIS. However, the NRC staff will update this SEIS with relevant information from Exelon's application, which will be available for staff review during its preparation of the final SEIS

Based on the information available during the development of this SEIS, the two previous entrainment studies suggest that operation of the Peach Bottom cooling system has not had a noticeable impact on aquatic biota within Conowingo Pond.

<u>LOE 3: Engineered Designs and Operational Controls</u>

In August 2014, the EPA published a final rule establishing requirements under Section 316(b) of the CWA for cooling water intake structures at existing facilities (Phase II Rule; 79 FR 48300). The final Phase II Rule indicates that two basic approaches can reduce impingement and entrainment mortality: (1) flow reduction and (2) including technologies into the cooling water intake design that either gently exclude organisms or collect and return organisms without harm to the water body. The EPA also notes that two additional approaches can reduce impingement and entrainment; however, these technologies may not be available to all facilities. The two additional approaches are: (3) relocating the facility's intake to a less biologically rich area in a water body and (4) reducing the intake velocity. Below, the NRC staff discusses whether the Peach Bottom intake structure on Conowingo Pond incorporates these four approaches.

Flow Reduction

Reducing the amount of water withdrawn for cooling purposes from a water body reduces the number of aquatic organisms that are drawn through the intake structure and subject to impingement or entrainment. Peach Bottom uses a once-through system, which generally withdraws and discharges more cooling water than closed-cycle systems that recirculate water before discharging thermal effluent into the source waterbody (NRC 2013a). The SRBC approved Exelon's withdraw of up to 2,363.62 mgd (3,657.06 cfs or 103.6 m^3/s). This volume represents 9.25 percent of the average annual flow of the Susquehanna River into Conowingo

Pond (39,500 cfs (1,119 m^3/s)) (Exelon 2018a). The percent of withdrawn water relative to the flow past the plant is relatively high compared to other once-through nuclear plants on rivers. For instance, LaSalle County Station, Units 1 and 2, in Illinois withdraws approximately 1 percent of the Illinois River's flow past the plant (NRC 2016a), and Waterford Steam Electric Station, Unit 3, in Louisiana withdraws approximately 0.3 percent of the Mississippi River's flow past the plant (NRC 2018c). Therefore, flow reduction is not an approach that Peach Bottom uses to reduce impingement and entrainment, and the withdrawal of a relatively large percentage of Conowingo Pond's flow past the plant may contribute to adverse impingement and entrainment effects at Peach Bottom.

Technologies That Exclude or Collect and Return Organisms

The Peach Bottom cooling system contains technologies that help exclude organisms from becoming impinged or entrained. Water enters the intake structure through an outer intake structure on the west bank of Conowingo Pond. Trash racks line the outer intake structure, which may prevent some of the larger fish from entering the intake. Twenty-four traveling screens (12 per unit) with 0.375-inch (0.952-cm) square mesh are located about 12 m (40 ft) behind the trash racks. The traveling screens on the outer intake prevent debris and some aquatic biota from entering the system. In addition, Exelon regularly rotates the screen panels to remove debris, including fish, by using a high-pressure spray back-wash system. The wash water that is sprayed on the traveling screens at the outer intake is returned to Conowingo Pond (Exelon 2018c).

The EPA indicates that, ideally, traveling screens would be used with a fish handling and return system (79 FR 48300). Peach Bottom's intake does not contain a fish handling and return system (Exelon 2018c). Although some engineered controls currently in place may reduce impingement (e.g., trash racks) or entrainment (e.g., traveling screens), the lack of a fish return system may contribute to adverse impingement and entrainment effects at Peach Bottom.

Location of Intake in a Less Biologically Rich Area

Location of the intake system is a design factor that can affect impingement and entrainment because locating intake systems in areas with high biological productivity or sensitive biota can negatively affect aquatic life (EPA 2004). As discussed in Section 3.7.2, "Aquatic Resources in the Susquehanna River," the SRBC (SRBC 2015) determined that the biological, water quality, and habitat conditions tend to degrade closer to the mouth of the Susquehanna River (near Peach Bottom) and within impounded portions of the river (such as Conowingo Dam) because dams have influenced the homogenization of habitats and water quality parameters. As a result, biological diversity tends to be lower in impounded reaches of the river, such as Conowingo Pond. Within Conowingo Pond, the highest-quality habitat is along the shallow shorelines. These habitats are more common on the west side of the pond and upstream of Peach Bottom (NAI and ERM 2014). Thus, the location of Peach Bottom's intake structure avoids some of the higher-quality upstream habitat. NAI (2013b) noted that entrainment rates were generally low within Conowingo Pond because the intake is not located near suitable spawning habitat for many species, including anadromous species. Because Peach Bottom withdraws cooling water from an area of lower biological diversity and importance along the Susquehanna River, its location likely reduces impingement and entrainment compared to other locations along the river.

Reduced Intake Velocity

Water velocity associated with the intake structure greatly influences the rate of impingement and entrainment. The higher the approach velocity, through-screen velocity, or both, the greater the number of organisms that will be impinged or entrained. At an approach velocity of 0.5 foot per second (fps) (0.15 meters per second (m/s)) or less, most fish can swim away and escape from the intake current (79 FR 48300). The approach velocity at Peach Bottom is 0.75 fps (0.23 m/s) (Exelon 2015d). At the intake screens, velocity increases to 1.21 fps (0.37 m/s) (Exelon 2015d). Because this rate is greater than that recommended by the EPA for protection of aquatic organisms, this flow rate could contribute to impingement and entrainment effects at Peach Bottom.

Best Technology Available

In August 2014, the EPA published the final Phase II Rule that includes applicable regulations for cooling water intake systems at existing power plants and an associated schedule for implementation (79 FR 48300). In September 2014, the Pennsylvania Department of Environmental Protection (PDEP 2014a) issued Peach Bottom's current NPDES permit, which lists conditions to which Exelon must abide during the permit's term to meet best technology available (BTA) standards for Peach Bottom's cooling water intake structure. The specific conditions of the NPDES permit include the following:

Condition II.A. The [Peach Bottom] cooling water intake structures must meet [best technology available] 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.

Condition II.B. The [Peach Bottom] cooling water intake structures must meet [best technology available] standards for entrainment which will be established by [P]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 40 CFR122.21(r)(9)(10)(11) (12) and (13).

Regarding the first condition listed above, the PDEP (2014b) further clarified that Exelon must consider the seven methods for compliance with the best technology available standards for impingement mortality. The PDEP (2014b) also explained that Exelon must provide information to develop site-specific entrainment best technology available requirements (see NPDES Permit No. PA0009733, Parts C.11.B and D), and that the PDEP would evaluate such information using best professional judgment to determine appropriate technologies, management practices, and operating measures that are considered the best technology available for impingement and entrainment reductions at Peach Bottom. In Exelon's final September 2014 NPDES Permit No. PA0009733 (see Parts C.11.B and E), the PDEP stated that Exelon must submit the necessary information" with the subsequent permit application."

Pursuant to 40 CFR 122.21 (r)(6) and (9) within the Phase II Rule and specified within its 2014 NPDES Permit, Exelon (2018c) stated that it completed the biological data collections in October 2018 and is currently analyzing the data as of December 2018. Exelon (2018c) further stated that once it has finished analyzing all the data, it will prepare the necessary reports, as required by the Phase II Rule and its NPDES Permit, including an impingement characterization and mortality study and an entrainment characterization report. These studies will be the basis for a compliance technology selection in Exelon's next NPDES permit application in 2019 (Exelon 2018c).

Therefore, the NRC staff assumes that if the PDEP renews Exelon's NPDES permit based upon its next NPDES permit renewal application in 2019, the renewed NPDES permit would specify the necessary conditions to comply with the final 2014 Phase II Rule to achieve the best technology available to minimize impingement and entrainment impacts. The NRC staff assumes that such requirements would be in place before the subsequent license renewal term would begin.

Conclusion

For LOE 3, the NRC staff examined engineering and operation controls currently in place, as well as engineering and operational controls that the PDEP has evaluated as part of its review of Exelon's NPDES permit. Although some engineered and operational controls currently in place may reduce impingement (e.g., placement of the intake system within an impounded section of the river with relatively lower biological productivity) or entrainment (e.g., traveling screens), the withdrawal rates associated with a once-through cooling system, the lack of a fish return system, and the approach velocity may contribute to adverse impingement and entrainment effects. However, the NRC staff assumes that if the PDEP renews the current NPDES permit, the renewed permit would specify the necessary conditions to comply with the final 2014 Phase II Rule to achieve best technology available and minimize impingement and entrainment impacts.

<u>Overall Impingement and Entrainment Conclusion</u>

In the preceding analysis, the NRC staff's LOE analysis yielded no evidence of noticeable or detectable ecological impairment resulting from impingement or entrainment of aquatic organisms at Peach Bottom. During the subsequent license renewal term, the NRC staff expects that impacts would be similar (i.e., not noticeable or detectable) because continued operation would neither intensify existing effects nor introduce any new effects. As explained previously in this section, in 2019, Exelon will apply to the PDEP for a renewed NPDES permit. Exelon will include with its application new impingement and entrainment characterization reports. Based on the results of its review, the PDEP could impose additional requirements to reduce impingement or entrainment at the facility. The NRC staff assumes that the PDEP would impose any requirements that it deems appropriate as conditions in a future renewed NPDES permit that would take effect prior to the proposed license renewal term. The NRC staff also assumes that any additional requirements that the PDEP imposes would further reduce the impacts of impingement and entrainment over the course license renewal term. For these reasons, the NRC staff concludes that the impacts of impingement and entrainment of aquatic organisms resulting from the subsequent license renewal of Peach Bottom would be SMALL.

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

In the GEIS (NRC 2013a), the NRC determined that thermal impacts on aquatic organisms is a Category 2 issue (see Table 4-2, above) for plants with once-through cooling systems, such as Peach Bottom, which requires a site-specific evaluation during each license renewal review.

The discharge of heated effluent (i.e., water) can create lethal and sublethal effects on fish, shellfish, and other aquatic organisms inhabiting the receiving water; influence food web characteristics and structure of the local aquatic community; and increase susceptibility of organisms to diseases and parasites. In 1965, the EPA defined waste heat as a pollutant under the Federal Water Pollution Control Act of 1965 (subsequently amended and commonly known as the CWA). Waste heat can directly kill sensitive aquatic organisms if the duration and extent of the organism's exposure exceeds its upper thermal tolerance limit. Waste heat can also result in indirect effects on the aquatic environment, such as disruptions or changes to spawning behavior, accelerated or diminished growth rates of early life stages, or diminished growth or survival due to effects on the food web. Waste heat can also create a thermal plume in the receiving water that can restrict or block fish migration or cause avoidance behaviors that affect the viability of, or the susceptibility to predation of, the avoiding individuals. Waste heat discharges can also increase the incidence of disease or parasitism of the local aquatic community and change the concentration of dissolved gas in the receiving water (NRC 2013a).

Consistent with the analyses in Section 4.7.1.1, this section's analysis uses a retrospective assessment of the present and past impacts to the aquatic ecosystem resulting from Peach Bottom's operation in order to provide a prospective assessment for the future impacts over the subsequent license renewal term (i.e., through 2054). The NRC staff used a modified WOE approach to evaluate thermal impacts on the aquatic resources in Conowingo Pond near Peach Bottom. The NRC staff examined three lines of evidence as follows: (1) thermal effluent studies, (2) biological sampling, and (3) State-imposed thermal effluent limitations.

<u>LOE 1: Thermal Effluent Studies</u>

From 2010 through 2013, NAI and ERM (2014) conducted a thermal effluent study to support Exelon's request for a Section 316(a) variance under the CWA for the Peach Bottom extended power uprate (EPU), which was proposed at the time of the study and subsequently implemented in 2014. Several of the study's objectives and findings relate to the staff's analysis of thermal impacts. These objectives are:

1. Determine the extent and characterization of the thermal plume
2. Determine the effectiveness of the helper cooling towers (referred to as cooling towers)
3. Determine whether the thermal plume resulted in changes to the biological community in Conowingo Pond

During the study period, NAI and ERM (2014) collected water temperature measurements at the intake structure and at each end of the discharge canal throughout the spring, summer, and fall of each year. These three measurement points represented ambient river conditions, the temperature of the thermal effluent leaving the plant, and the temperature of the thermal effluent upon mixing with the river, respectively. NAI and ERM also monitored temperatures at stations upriver and downriver of the discharge canal and at all biological collection sites (discussed in LOE 2 below) to determine the geographical extent of the thermal plume within Conowingo Pond (see Figures 3-1 and 5-25 in NAI and ERM 2014). To evaluate the effectiveness of the cooling towers for mitigating the thermal plume, Exelon varied the number of cooling towers in operation during each year of the study. In 2011, 2012, and 2013, Exelon operated one, two, and three cooling towers, respectively.

NAI and ERM (2014) determined that the main factors influencing the intensity and extent of the thermal plume include the discharge rate, the discharge temperature, and the flow of Susquehanna River water into Conowingo Pond. NAI and ERM also determined that operation of the cooling towers lowered thermal effluent temperatures within the discharge canal and at the closest monitoring stations within Conowingo Pond. For example, cooling tower operation lowered thermal effluent temperatures in the discharge canal by an average of 1.6 °F (0.9 °C) per cooling tower. The cooling towers also consistently lowered thermal plume temperatures in Conowingo Pond at monitoring stations within 1.2 mi (1.9 km) of the discharge canal. Deeper nearshore monitoring stations and monitoring stations closest to the western shoreline also exhibited lower water temperatures during cooling tower operation. The degree to which the cooling towers lowered thermal plume temperatures was measurably influenced by river flow conditions. For example, in measurements taken during operation of one cooling tower, Station 215 (0.65 mi (1.0 km) from the discharge) experienced a 1.3 °F (0.7 °C), 0.3 °F (0.2 °C), or 0.9 °F (0.5 °C) decrease, depending on the volume of Susquehanna River flow into Conowingo Pond during sampling. NAI and ERM observed more varied water temperatures at stations further than 1.2 mi (1.9 km) from the discharge canal. At these further stations, the river's flow affected water temperatures to a greater degree than the number of cooling towers in operation.

Stations 214 and 215, which lie closest to the discharge and along the western shore, exhibited highest water temperatures during July and August of each year (see Figures 3-1 and 5-25 in NAI and ERM 2014). During the study period, these stations exhibited 66 days (Station 214) and 59 days (Station 215) on average each year of instantaneous maximum temperatures of 90 °F (32 °C) or greater. In contrast, the instantaneous maximum temperature at the intake monitoring station, which represents ambient water conditions, only exceeded 90 °F (32 °C) one day over the 4-year study period (see Table 4-4). NAI and ERM (2014) determined that river temperatures of 90 °F (32 °C) or greater do not typically occur under natural conditions within Conowingo Pond. Thus, stations exposed to such temperatures were influenced by the thermal plume.

Table 4-4 Number of Days with Instantaneous Maximum Temperature Greater Than or Equal to 90 °F (32 °C)

		No. Days with Instantaneous Maximum Temperature ≥90 °F (≥32 °C)				
Station	**Distance from end of discharge canal (in miles)**	**2010**	**2011**	**2012**	**2013**	**Average**
Intake	N/A	0	1	0	0	0.25
214	0.37	46	74	84	40	66
215	0.65	43	70	78	28	59
189	1.32	18	32	43	8	25
190	2.05	10	22	30	5	17
217	4.02	*	16	14	3	11

*Station not monitored in 2010. Source: NAI and ERM 2014

NAI and ERM (2014) found that the thermal plume is warmest at the surface of the water column and near the western shoreline. Therefore, shallow shoreline habitat near the discharge would be the most likely to experience increased water temperatures resulting from Peach Bottom's thermal effluent. NAI and ERM (2014) determined the amount of shoreline habitat that could be thermally affected by calculating the area within Conowingo Pond that contains 10 ft (3 m) or less of water. Researchers found that a total of 488.2 ac (197.6 ha) of shallow shoreline habitat occurs within Conowingo Pond, of which 306.8 ac (102.4 ha) are upstream of Peach Bottom and 181.1 ac (73.3 ha) are downstream of Peach Bottom (see Figure 5-20 in NAI and ERM 2014). Within the downstream area, NAI and ERM (2014) determined that 19 ac (7.7 ha) of shallow shoreline habitat (from the discharge through Station 189) could be affected by Peach Bottom's thermal effluent based on the temperatures recorded during the study. This 19-ac (7.7-ha) area includes 12 ac (4.9 ha) from the end of the discharge canal to Station 215, which experienced the greatest increases in temperature due to the thermal plume, and an additional 7.3 ac (3.0 ha) from Station 215 to Station 189, which also experienced heightened temperatures (see Table 4-4). The thermally influenced area comprises 4 percent of the calculated total shoreline habitat within Conowingo Pond (NAI and ERM 2014). This area is a relatively narrow band of habitat that would not block fish passage (NAI and GSE 2012b, NAI and ERM 2014).

In 2016, NAI and ERM (2017) conducted a follow-up study using the same methods described above to collect temperature data. During the follow-up study, Exelon operated the cooling towers in accordance with the conditions set forth in Part C of its NPDES Permit (as described below in LOE 3). Researchers identified similar patterns with respect to the intensity and extent of the thermal plume but found that cooling tower operation had more of an effect on water temperature than in the previous study. While in the 2010-2013 study, NAI and ERM (2014) found that operation of each cooling tower lowered water temperatures at Station 215 (0.65 mi (1.0 km) from the discharge) by 1.6 °F (0.9 °C), in the follow-up study, NAI and ERM (2017) found that operation of each cooling tower lowered the water temperature at the end of the discharge canal by 2.2 °F (1.2 °C) (NAI and ERM 2017).

LOE 1 Conclusion

For LOE 1, the NRC staff examined studies that characterized the thermal plume created in Conowingo Pond by Peach Bottom's discharge of waste heat (NAI and ERM 2014, 2017). The studies indicated that operation of each cooling tower at Peach Bottom lowers water temperatures at the discharge and at several downstream stations. The number of cooling towers in operation directly influences the amount that water temperatures are lowered. The thermal plume is warmest closest to the discharge canal and along the western shoreline within shallow water habitat. Monitoring stations within 1.3 mi (2.1 km) experienced heighted temperatures (beyond that which would occur naturally within Conowingo Pond) resulting from the thermal effluent. The area of heightened temperatures includes 19 ac (7.7 ha) of shallow shoreline habitat, which comprises approximately 4 percent of the shallow shoreline habitat within Conowingo Pond. Given the narrow dimensions of the thermal plume, the thermal effluent would not block fish passage or migration through Conowingo Pond, nor would it appreciably reduce habitat availability for species that rely on shallow shoreline habitat.

<u>LOE 2: Biological Sampling</u>

To determine the potential thermal effects on aquatic biota and the effectiveness of using cooling towers to mitigate such impacts, NAI and ERM (2014) sampled the benthic (e.g., bottom dwelling) macroinvertebrate and fish community in Conowingo Pond during the study described in LOE 1. NAI and ERM (2014) sampled biotic communities and ambient water temperature from July through October (in 2010) and from April through October (from 2011 through 2013). As explained above, Exelon varied cooling tower operation during each of the study years.

Macroinvertebrate Sampling

NAI and ERM (2014) sampled macroinvertebrate communities at four stations exposed to the thermal plume and at five stations outside the thermal plume to determine whether the thermal plume affected the biological community (see Figure 5-25 in NAI and ERM 2014). In this component of the study, NAI and ERM used macroinvertebrate community measurements as an indicator of water quality (in this case, temperature). Researchers used PDEP-approved methodology to sample the community and to quantify habitat. NAI and ERM (2014) collected macroinvertebrates with a D-frame kick net within five habitats: cobble/gravel, snag, coarse particulate organic matter, submerged aquatic vegetation, and sand/fine sediment. Researchers then calculated the index of biological integrity (IBI) at each site. This index incorporates several types of biological information—such as number and abundance of taxa, pollution tolerance/intolerance of taxa, and other population attributions like number of predators—into a numerical score. The IBI index score represents the associations between human influence and biological attributes, and the individual metrics of the IBI reflect the condition of important biological components in the aquatic community. A lower IBI index score indicates a more degraded system.

The two stations closest to the discharge (Stations 214 and 215; see Figure 5-25 in NAI and ERM 2014) exhibited the lowest IBI scores during July and August (NAI and ERM 2014). The IBI scores at Station 214, which is 0.35 mi (0.56 km) below the discharge canal, were lower than all other stations, and the difference was statistically significant. The IBI scores at Station 215, which is 0.65 mi (1.0 km) below the discharge canal, were lower than all other stations, but the difference was not statistically significant. Seasonally, IBI scores and species richness (total number of species) tended to increase from April through October at all sites, except at Station 214. At Station 214, which is the closest monitoring station to the discharge canal at approximately 0.35 mi (0.56 km) away, the IBI score and species richness was highest in April and lowest in August. Based on this data, NAI and ERM (2014) determined that Peach Bottom's thermal plume results in an "observable effect on the benthic community" within approximately 12 ac (4.9 ha) of the discharge, or the area from Station 215 to the discharge canal. Although stations further downstream experienced heightened temperatures, as indicated in Table 4-4, the biological monitoring results suggest that the increase in temperature was not sufficient to result in observable changes to the biological community. For example, at Station 139—which is located 1.3 mi (2.1 km) downstream of the discharge canal and which experienced an average of 25 days per year where the instantaneous maximum temperature exceeded 90°F (32°C)—the IBI scores were similar to non-thermally influenced stations.

The lower IBI scores at Stations 214 and 215 suggest that exposure of these regions to Peach Bottom's thermal plume caused observable habitat degradation during the summer. NAI and ERM (2014) determined that lower IBI scores generally occurred when daily mean water temperatures exceeded 93°F (34°C). While NAI and ERM (2014) did not have sufficient data to conclusively determine the exact temperature threshold at which a drop in the IBI score would occur, researchers estimated that an observable change in the benthic community would occur if the daily mean temperature exceeds 93°F (34°C) for at least 7 to 21 days. Table 4-5 shows the number of days each year at each station where the daily mean water temperature exceeded 93°F (34 °C).

Table 4-5 Number of Days with Daily Mean Temperature Greater than 93 °F (34 °C)

		No. of Days with Daily Mean Temperature >93°F (>34 °C)				
Station	Distance from end of discharge canal (in miles)	2010*	2011	2012	2013	Average
Intake	N/A	0	0	0	0	0
214	0.37	28	36	39	7	28
215	0.65	25	25	21	5	19
189	1.32	4	11	0	0	4
190	2.05	0	0	0	0	0
217	4.02	0	0	0	0	0

*Monitoring began July 28

Source: NAI and ERM 2014

The results of NAI and ERM (2014)'s IBI index calculations suggest that the thermal plume degrades water quality to an extent that observable, short-term impacts on the aquatic community occur when daily mean water temperatures increase above 93 °F for at least 7 to 21 days. NAI and ERM (2014) found that IBI scores at Stations 214 and 215 increased once the water temperature decreased in fall and early winter, which indicates that effects are short-term and seasonal. Nonetheless, non-thermally influenced stations exhibited higher IBI scores during the fall compared to spring whereas Stations 214 and 215 had similar scores in both seasons. These patterns suggest that in the summer, the thermal plume adversely affects the macroinvertebrate community near Stations 214 and 215. In the fall, the community recovers but not to the same extent as if the community was not exposed to the thermal plume. This component of NAI and ERM (2014)'s study suggests that the area where the macroinvertebrate community exhibits noticeable changes is limited to a narrow band of 12 ac (4.9 ha) that extends from the end of the discharge canal to Station 215, which primarily consists of shallow-water habitat along the western shoreline of Conowingo Pond.

Fish Sampling

NAI and ERM (2014) also sampled the fish community within areas affected by the thermal plume (Stations 214 and 215) and within areas upstream of the thermal plume (see Figure 5-25 in NAI and ERM 2014). Researchers collected fish by seine, which targets small fish in shallow shoreline habitat, and by electrofishing, which targets small and large fish using shallow shoreline habitats. Seine collections were taken by sweeping a 10 x 4 ft (3 x 1.2 m) seine with a 0.25-inch (0.64-cm) mesh at seven shoreline locations. Seines were limited to five hauls (or pulling the seine in a forward direction along the shoreline). Electrofishing collections were taken at night at seven stations along the shore. Sampling consisted of a 30-minute run that was typically completed in one pass through the sampling location.

Like previous aquatic surveys in Conowingo Pond, the most commonly collected species included gizzard shad, comely shiner, bluegill, spotfin shiner, channel catfish, bluntnose minnow, and smallmouth bass. In all years (2010-2013), seine collections yielded fewer species at the thermally influenced stations (Stations 214 and 215) than at non-thermally influenced stations (NAI and ERM 2014). Species richness did not exhibit a seasonal pattern at most stations, but it declined in July and August at Stations 214 and 215. The lower number of species collected via seining suggests that some fish that inhabit shallow shoreline habitat avoid the thermal plume during the warmest months of the year.

The electrofishing sampling results also indicated that some fish may avoid the thermal plume. For example, Station 161 is the closest electrofishing station to the discharge and experienced the highest water temperatures among all the electrofishing stations. Species richness at Station 161 was lower than all other stations during July in all years and in August in some years. At all other stations, species richness tended to increase throughout the season, such that the highest species richness occurred in September and October. Species richness at Station 161 did not follow this general pattern and instead was lower in August than in April. Species richness increased during the fall, suggesting that fish avoidance of this region is temporary and limited to July and August. The density of gizzard shad, a species that is tolerant of poor water quality (MDNR undated_a) and that competes with many native fish for zooplankton prey, was higher at thermally influenced stations (e.g., Station 161) than non-thermally influenced stations (e.g., Station 165).

NAI and ERM (2014) also collected fish in areas with the warmest water to determine the thermal tolerance for resident fish and the temperature threshold at which point fish avoid the thermal plume. The study collected few fish when the water temperature exceeded 96.8 °F (36 °C). The only stations that experienced temperatures greater than 96.8 °F (36 °C) included the closest thermally influenced stations (Station 214, 215, and 161). At Station 161, electrofishing data indicated that some fish avoided the area when the water temperature exceeded 91 °F (33 °C). At Stations 214 and 215, seining data suggested that some fish avoided the thermal plume when the water temperature exceeded 93 ° F (34 °C). NAI and ERM (2014) noted that fish collected within water greater than 89.6 °F (32 °C) exhibited thermal stress. Nonetheless, Exelon (2018c) is not aware of thermal stress in connection with Peach Bottom's thermal effluent resulting in any observable fish kills or other unusual event since Peach Bottom began operating.

Follow-up Biological Sampling

In 2016, NAI and ERM (2017) conducted a follow-up study using the same methods described above. The follow-up study found similar patterns of thermal influence and observable changes in the aquatic community in the area of Conowingo Pond near Peach Bottom's discharge canal. NAI and ERM (2017) found decreased IBI scores at Stations 214 and 215 during September 2016, which NAI and ERM attributed to lowered flow of the Susquehanna River into Conowingo Pond and high ambient water temperatures. In its review of the study, the PDEP (2017) noted that Peach Bottom's thermal effluent may have contributed to the unusually high temperatures at these two downstream stations. The PDEP's review of this study is described in additional detail below in LOE 3.

LOE 2 Conclusion

For LOE 2, the NRC staff reviewed the biological monitoring results from Exelon's thermal impacts studies (NAI and ERM 2014, 2017). The studies' biological monitoring data and IBI scores indicate that during the summer, the thermal plume results in observable changes to the benthic macroinvertebrate community. Fish diversity is also lowest at the three monitoring stations closest to the discharge canal. These results suggest that the thermal plume creates short-term noticeable impact on the aquatic community. NAI and ERM (2014) estimated that observable impacts occur when the daily mean water temperature increases above 93 °F (32 °C) for at least 7 to 21 days. The area where the aquatic community noticeably changes is limited to a narrow band of 12 ac (4.9 ha) that extends from the end of the discharge canal along the western shoreline. This area is approximately 2.5 percent of the shallow shoreline habitat within Conowingo Pond and only comprises a very small fraction of the width of Conowingo Pond. Therefore, this narrow band should not block fish passage through Conowingo Pond because migrating fish can avoid the thermal plume to move up or downstream.

<u>LOE 3: State-Imposed Thermal Effluent Limitations</u>

Exelon's NPDES Permit No. PA0009733 (PDEP 2014a) imposes regulatory controls on Peach Bottom's thermal effluent to mitigate or reduce impacts on the aquatic environment. For example, the NPDES permit limits the temperature of water at the end of the discharge canal to 110 °F (43.3 °C), even in late summer. The NPDES permit also requires Exelon to operate its helper cooling towers at specified times and conditions to reduce the temperature of the water in thermal effluent discharged to Conowingo Pond.

The PDEP determined that cooling tower operation was necessary based on the results of Exelon's CWA Section 316(a) thermal demonstration study (NAI and ERM 2014, 2017), which is discussed above in LOE 2 and LOE 3. NAI and ERM (2014, 2017) determined that operation of each cooling tower can lower the temperature of the thermal effluent at the end of the discharge canal by approximately 1.6 °F (0.9 °C) to 2.2 °F (1.2 °C). NAI and ERM (2014, 2017) also documented that operation of the helper cooling towers lowered temperatures in Conowingo Pond within 1.2 mi (1.9 km) downstream of the discharge structure.

Under the NPDES permit, the PDEP requires Exelon to operate its helper cooling towers from June 15 through August 31 each year if temperature-critical levels are exceeded or if drought or hot weather begins to impact the temperature within Conowingo Pond. Depending on conditions, up to 60 percent of the cooling water flow can be diverted through the helper cooling towers (Exelon 2018a). The specific conditions in the NPDES permit include the following:

1) Exelon must continuously operate one cooling tower from June 15 through August 31 unless a delay in commencement is requested and approved by PDEP.

2) If the average intake temperature is equal to or greater than 83 °F (28 °C), Exelon must operate a second cooling tower. Once operation of the second tower commences, Exelon must continue to operate it through August 31, unless permission to terminate the second tower operation is requested and approved by PDEP.

3) If the average intake temperature is equal to or greater than 86 °F (30 °C), Exelon must operate a third cooling tower. Exelon must operate this third tower for a minimum of 7 days.

By letter dated May 3, 2017, the PDEP (2017) documented its review of the 2016 follow-up study described in the previous LOEs (i.e., NAI and ERM 2017). The PDEP (2017) concluded that Exelon had achieved compliance with the existing 2014 NPDES permit requirements and that the continuation of the CWA Section 316(a) thermal variance is warranted for the current NPDES permit term (September 2014 through September 2019). The PDEP strongly recommended that Exelon consider operating the cooling tower(s) until the end of September each year because many downstream measurements indicated higher temperatures in September 2016 than prior to the EPU. The PDEP (2017) suggested that the higher temperatures observed at the downstream (thermally influenced) stations were the result of Peach Bottom's thermal effluent in combination with higher river temperatures and that the use of the helper cooling tower(s) in September would further mitigate the potential impacts of the thermal effluent on fish and macroinvertebrate populations in Conowingo Pond. In response to the PDEP's request, by letter dated August 18, 2017, Exelon stated that it would operate its helper cooling towers if the following conditions occur from August 31 through September 30:

- If the intake temperature is equal to or greater than 81 °F (27 °C), Exelon will operate one cooling tower continuously through September 30. If the intake temperature is below 81 °F, Exelon may operate the cooling tower.
- If the intake temperature is equal to or greater than 83 °F (28 °C), Exelon will operate a second tower. When the intake temperature is less than 83 °F (28.3 °C), Exelon will stop operating the second cooling tower.
- Exelon will operate the third cooling tower in accordance with the conditions described in the current 2014 NPDES Permit.

The PDEP (2017) also stated in its May 3, 2017, letter that it would consider the results of Exelon's final thermal report (NAI and ERM 2017) and any additional relevant information when it develops permit requirements for the next NPDES permit renewal. Exelon (2018c) will submit its NPDES renewal permit application, including any updated biological studies, in 2019. Exelon's NPDES permit renewal application was not available for NRC staff review during preparation of this draft SEIS. However, the NRC staff will update this SEIS with relevant information from Exelon's application, which will be available for staff review during its preparation of the final SEIS. Based on the results of its NPDES permit renewal application review, the PDEP could impose additional requirements related to Peach Bottom's thermal effluent to assure the protection of a balanced, indigenous aquatic community. The NRC staff assumes that PDEP would impose any additional requirements that it deems appropriate as conditions in a future renewed NPDES permit that would take effect prior to the subsequent license renewal term. The NRC staff also assumes that any additional requirements would further reduce thermal impacts on aquatic organisms over the course subsequent license renewal term.

LOE 3 Conclusion

For LOE 3, the NRC staff examined State-imposed conditions and limitations imposed by the PDEP under Peach Bottom's NPDES permit. The NPDES permit currently limits thermal effluent to a maximum water temperature of 110 °F (43.3 °C)) at the end of the discharge canal. The NPDES permit also requires Exelon to operate its cooling towers to lower thermal effluent temperatures from June through August when warm or drought conditions occur in Conowingo Pond. Exelon has also voluntarily agreed to operate its cooling towers during certain conditions in September. Cooling tower operation reduces the exposure of aquatic organisms inhabiting Conowingo Pond to stressful or lethal conditions and also reduces the spatial and temporal extent of the thermal plume over which aquatic organisms would experience these conditions.

Thermal Impacts Conclusion

Based on the preceding analysis, the NRC staff finds that during most of the year and in most areas of Conowingo Pond, the thermal effluent would not noticeably affect the aquatic community and would be SMALL. However, during summer months, a narrow 12-ac (4.9-ha) band of shallow water habitat downstream of the discharge canal would exhibit short-term, observable changes, including reduced macroinvertebrate community health (i.e., lower IBI scores) and lower fish diversity. Seasonal impacts in this region would be MODERATE because water temperatures would result in thermal stress and avoidance behaviors. Exelon's operation of its cooling towers in accordance with NPDES permit conditions and voluntary agreements with the PDEP would help minimize the duration and frequency of these seasonal impacts. Additionally, the PDEP could impose additional requirements related to Peach Bottom's thermal effluent to assure the protection of a balanced, indigenous aquatic community. The NRC staff assumes that the PDEP would impose any additional requirements that it deems appropriate as conditions in a future renewed NPDES permit that would take effect prior to the subsequent license renewal term. The NRC staff also assumes that any such requirements would further reduce thermal impacts on aquatic organisms over the course of the subsequent license renewal term. However, absent information indicating that Peach Bottom's operation could be effectively conditioned to reduce or mitigate existing impacts, the NRC staff conservatively concludes that the thermal impacts to aquatic resources in Conowingo Pond during the Peach Bottom subsequent license renewal term would be SMALL to MODERATE.

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

Water use conflicts occur when the amount of water needed to support aquatic resources is diminished as a result of demand for agricultural, municipal, or industrial use or decreased water availability due to droughts, or a combination of these factors.

The average annual flow from the Susquehanna River into Conowingo Pond is 39.500 cfs, as described in Section 4.5.1.1, "Surface Water Resources." Peach Bottom is authorized to withdraw 3,657 cfs of water from the Conowingo Pond. Consumptive use is 75.8 cfs, which is equivalent to about 0.02 percent of the flow within Conowingo Pond.

The amount of water Peach Bottom consumes is minor in comparison to the flow of water past the plant (0.02 percent). In addition, the withdrawal of water by Peach Bottom and other water users is regulated by the SRBC. In setting consumptive use limits, the SRBC considers the cumulative amount of water from all water users in Conowingo Pond. Therefore, Peach Bottom does not consume an amount that would be harmful to aquatic biota during low flow conditions. The NRC staff did not identify any information that indicates that the Susquehanna River biota are affected by the loss of river water consumed by Peach Bottom's makeup water withdrawals.

The NRC staff concludes that water use conflicts would not occur from the subsequent license renewal or would be so minor that the effects on aquatic resources would be undetectable. Thus, the NRC staff concludes that the impacts of water use conflicts on aquatic resources during the subsequent license renewal term would be SMALL.

4.7.2 No-Action Alternative

Under the no-action alternative, impacts to aquatic ecology would decrease or stop following reactor shutdown. Some withdrawal of water from the Susquehanna River would continue during the shutdown period as the fuel is cooled, although the amount of water withdrawn would decrease over time. The reduced demand for cooling water would substantially decrease the effects of impingement, entrainment, and thermal effluent. These effects likely would stop following the removal of fuel from the reactor core and shutdown of the spent fuel pool. Given the small area of the thermal plume in the Susquehanna River under normal operating conditions (12 ac (4.9 ha) to 19 ac (7.7 ha)), noticeable effects from cold shock are unlikely.

Thus, the NRC staff concludes that the impacts of the no-action alternative on aquatic resources during the subsequent license renewal term would be SMALL.

4.7.3 Replacement Power Alternatives: Common Impacts

Construction activities for a new replacement power plant and mechanical draft cooling towers could degrade the water quality of nearby waterbodies, such as creeks, streams, or the Susquehanna River, through erosion and sedimentation; result in loss of habitat through wetland filling; or result in direct mortality of aquatic organisms from dredging or other in-water work. Because of the short-term nature of construction activities, degradation of habitat quality would be relatively localized and temporary. Loss of habitat could be minimized by siting a plant far from the river, streams, and other onsite aquatic resources, as well as using the existing intake and discharge structures, transmission lines, roads, parking areas, and other infrastructure. Appropriate permits would ensure that water quality impacts would be addressed through mitigation or best management practices, as stipulated in the permits. The U.S. Army Corps of Engineers and/or the Pennsylvania Department of Environmental Protection would oversee applicable permitting, including the CWA Section 404 permit, CWA Section 401 certification, and CWA Section 402(p) NPDES general stormwater permit. Because of the short-term nature of the construction activities, use of existing infrastructure, and use of required best management practices, the NRC staff concludes that hydrological alterations to aquatic habitats and impacts to aquatic resources from construction of replacement power alternatives would be minimal.

The NRC staff analyzed the operational impacts to aquatic biota in the GEIS (NRC 2013a) for a power plant using cooling towers. Based on the relatively slow withdrawal and discharge rates, the NRC staff determined that impacts to aquatic biota from replacement power alternatives at the Peach Bottom site, such as impingement, entrainment, and thermal effects, would be minimal. In addition, water use conflicts with aquatic resources would depend upon the final location. However, given that all the replacement power alternatives would use cooling towers, the new units would likely withdraw a smaller percentage of the flow from selected water body used for cooling purposes.

4.7.4 New Nuclear Alternative

The NRC staff did not identify any impacts on aquatic resources for the new nuclear alternative (six or more co-located small modular reactors) beyond those discussed in the impacts common to all replacement power alternatives. However, the common impact could be slightly less intense for the new nuclear alternative as compared to coal or gas alternatives, due to the smaller land area requirements. As described above, hydrological alterations to aquatic habitats and direct impacts to aquatic resources would be minimal because construction activities at the plant site would be short term and impacts would be minimized by using existing infrastructure and implementing best management practices. Therefore, the NRC staff concludes that the impacts to aquatic resources from construction and operation of a new nuclear alternative would be SMALL.

4.7.5 Supercritical Pulverized Coal Alternative

In addition to the impacts to aquatic resources common to all alternatives, operation of the coal alternative could impact aquatic resources because of the greater land use. For example, a coal plant would require coal deliveries, cleaning, and storage, which would require periodic dredging (if coal is delivered by barge). These activities would create dust, sedimentation, and turbidity and introduce trace elements and minerals into the water. Air emissions from the coal units would include sulfur dioxide, particulates, and mercury that would settle on water bodies or be introduced into the water from soil erosion. Impacts from erosion and sedimentation, fugitive dust, construction debris, and air particulates would likely be minor with the implementation of appropriate best management practices. Therefore, the NRC staff concludes that the impacts to aquatic resources from construction and operation of the coal alternative would be SMALL.

4.7.6 Natural Gas Combined-Cycle Alternative

The impacts on aquatic resources common to all alternatives would be less intense for the natural gas alternative as compared to the new nuclear, coal, and combination alternatives because the natural gas alternative would withdraw and discharge the least amount of water, which would reduce the level of impingement and entrainment of aquatic biota as well as reduce the size and intensity of the thermal plume.

In addition to the impacts on aquatic resources common to all replacement power alternatives, the natural gas alternative may create additional impacts because the natural gas plant would require construction of new pipelines, which could impact previously undisturbed habitats. This impact would vary depending on the route of the pipeline and would be more likely to impact terrestrial resources than aquatic resources. Because the natural gas alternative would be built at an existing or retired power plant site, new pipelines could be co-located in existing corridors and existing infrastructure could be used to reduce impacts. During operations, air emissions from the natural gas units would include nitrogen oxide, carbon dioxide, and particulates that would settle on water bodies or be introduced into the water from soil erosion. Impacts from erosion and sedimentation, fugitive dust, construction debris, and air particulate would likely be minor with the implementation of appropriate best management practices. The NRC staff concludes that the impacts to aquatic resources from construction and operation of a natural gas plant would be SMALL.

4.7.7 Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)

The NRC staff did not identify any impacts for the natural gas, wind, and solar portions of the combination alternative beyond those discussed in the impacts common to all replacement power alternatives and those described for the natural gas alternative. The purchased power portion of the combination alternative would depend substantially on the generation technologies used to supply the purchased power. The most likely replacement power technologies would be those discussed above. However, if power is purchased from a power plant that uses once-through cooling, the impacts from impingement, entrainment, and the thermal plume could noticeably alter important attributes of the aquatic community and habitat.

Based on the minimal impacts to aquatic resources, the NRC staff concludes that the impacts on aquatic resources from the combination alternative would be SMALL to MODERATE, depending on whether the purchased power is from a power plant that uses once-through cooling and whether operation of that cooling system noticeably alters important attributes of the aquatic community and habitat. If operation does not noticeably alter aquatic resources, the impact would be SMALL.

4.8 Special Status Species and Habitats

This section describes the potential special status species impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.8.1 Proposed Action

Table 4-2 identifies the one site-specific (Category 2) issue related to special status species and habitats applicable to Peach Bottom during the subsequent license renewal term. This issue is analyzed in the below sections:

- Species and habitats protected under the Endangered Species Act under U.S. Fish and Wildlife jurisdiction
- Species and habitats protected under the Endangered Species Act under National Marine Fisheries Service jurisdiction
- Cumulative effect considerations for these species and habitats
- Species and habitats protected under the Magnuson–Stevens Act

4.8.1.1 Species and Habitats Protected Under the Endangered Species Act Under U.S. Fish and Wildlife Service Jurisdiction

Section 3.8.1.2, "Species and Habitats Under U.S. Fish and Wildlife Service Jurisdiction," considers whether several federally listed species under the Service's jurisdiction occur in the Peach Bottom action area (as defined and described in Section 3.8.1.1, "Peach Bottom Action Area") based on each species' habitat requirements, life history, occurrence records, and other available information. In these sections, the NRC staff concludes that two listed species may occur in the action area: (1) the northern long-eared bat (*Myotis septentrionalis*) and (2) the Indiana bat (*M. sodalis*). An additional species that is currently under the Service's review for listing, the Chesapeake logperch (*Percina bimaculata*), also occurs in the action area. The NRC staff also determines in Section 3.8.1.2 that the bog turtle (*Clemmys muhlenbergii*) and rufa red knot (*Calidris canutus rufa*) do not occur in the action area. No proposed or designated critical habitat occurs within the Peach Bottom action area. The NRC staff analyzes the potential impacts of the Peach Bottom subsequent license renewal on these federally listed and under-review species below. Table 4-6 identifies the NRC staff's Endangered Species Act effect determination for each species.

Table 4-6 Effect Determinations for Federally Listed Species Under U.S. Fish and Wildlife Service Jurisdiction

Species	Federal Status[a]	Potentially Present in the Action Area?	Effect Determination[b]
Bog turtle	FT	No	No effect
Northern long-eared bat	FT	Yes	May affect, but is not likely to adversely affect
Indiana bat	FE	Yes	May affect, but is not likely to adversely affect
Rufa red knot	FT	No	No effect
Chesapeake logperch	CL	Yes	May affect[c]

[a] Under the Endangered Species Act, species may be designated as federally endangered (FE) or federally threatened (FT). Species under consideration for Federal status may be either formally proposed for listing (PL) as endangered or threatened through a draft rule issued in the *Federal Register* or may otherwise be under Service review as a candidate for listing (CL).

[b] The NRC staff makes its effect determinations for federally listed species in accordance with the language and definitions specified in the U.S. Fish and Wildlife Service and National Marine Fisheries Service's *Endangered Species Consultation Handbook* (FWS and NMFS 1998).

[c] Because the Chesapeake logperch remains under the Service's review for listing, Section 7 of the Endangered Species Act does not require the NRC to consult with the Service on this species at this time.

Bog Turtle (*Clemmys muhlenbergii*)

In Section 3.8.1.2 in the subsection titled, "Bog Turtle (*Clemmys muhlenbergii*)," the NRC staff concludes that the bog turtle does not occur in the action area due to lack of suitable habitat. That section describes the 2017 Phase I bog turtle habitat survey that the Exelon-contracted engineering firm AECOM conducted on the Peach Bottom site as well as Exelon's communications with the U.S. Fish and Wildlife Service concerning the survey results. In a November 2, 2017, letter, the FWS (2017a) stated that the proposed action would not affect the bog turtle. The NRC staff has identified no additional information during its environmental review that would suggest either the presence of suitable bog turtle habitat or the presence of bog turtles in the Peach Bottom action area. Accordingly, the NRC staff concludes that the Peach Bottom subsequent license renewal would have *no effect* on the bog turtle.

Northern Long-Eared Bat (*Myotis septentrionalis*) and Indiana Bat (*Myotis sodalis*)

In Section 3.8.1.2 in the subsections titled, "Northern Long-Eared Bat (*Myotis septentrionalis*)" and Indiana Bat (*Myotis sodalis*)," the NRC staff concludes that northern long-eared bats and Indiana bats may occur in the action area's oak-hickory and oak-tulip forests in spring, summer, and fall. If present, Indiana bats would occur more rarely than northern long-eared bats.

The potential stressors that bats could experience from operation of a nuclear plant (generically) are as follows:

- Mortality or injury from collisions with plant structures and vehicles
- Habitat loss, degradation, disturbance, or fragmentation, and associated effects
- Behavioral changes resulting from refurbishment or other site activities

This section addresses each of these stressors below.

Mortality or Injury from Collisions with Plant Structures and Vehicles

Several studies have documented bat mortality or injury resulting from collisions with man-made structures. Saunders (1930) reported that five bats of three species—eastern red bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), and silver-haired bat (*Lasionycteris noctivagans*)—were killed when they collided with a lighthouse in Ontario, Canada. In Kansas, Van Gelder (1956) documented five eastern red bats that collided with a television tower. In Florida, Crawford and Baker (1981) collected 54 bats of seven species that collided with a television tower over a 25-year period, Zinn and Baker (1979) reported 12 dead hoary bats at another television tower in the state over an 18-year period, and Taylor and Anderson (1973) reported 1 dead yellow bat (*Lasiurus intermedius*) at a third Florida television tower. Bat collisions with communications towers have been reported in North Dakota, Tennessee, and Saskatchewan, Canada; with convention center windows in Chicago, IL; and with power lines, barbed wire fences, and vehicles in numerous locations (Johnson and Strickland 2003).

More recently, bat collisions with wind turbines have been of concern in North America. Bat fatalities have been documented at most wind facilities throughout the United States and Canada (USGS 2015a). For instance, during a 1996–1999 study at the Buffalo Ridge wind power development project in Minnesota, Johnson et al. (2003) reported 183 bat fatalities, most of which were hoary bats and eastern red bats. The U.S. Geological Survey's Fort Collins Science Center estimates that tens to hundreds of thousands of bats die at wind turbines in North America each year (USGS 2015a).

Bat collisions with man-made structures at nuclear power plants are not well documented but are likely rare based on the available information. In an assessment of the potential effects of operation of Davis-Besse Nuclear Power Station in Ohio, the NRC staff (NRC 2014a) noted that four dead bats were collected at the plant during bird mortality studies conducted from 1972 through 1979. Two red bats (*Lasiurus borealis*) were collected at the cooling tower, and one big brown bat and one tri-colored bat were collected near other plant structures. The NRC staff (NRC 2014a) found that future collisions of bats would be extremely unlikely and, therefore, discountable given the small number of bats collected during the study and the marginal suitable habitat that the plant site provides. The U.S. Fish and Wildlife Service (FWS 2014c) concurred with this determination. In a 2015 assessment associated with Indian Point Nuclear Generating Units 2 and 3, in New York, the NRC staff (NRC 2015a) determined that bat collisions were less likely to occur at Indian Point than at Davis-Besse because Indian Point does not have cooling towers or similarly large obstructions. The tallest structures on the Indian Point site are 134-ft (40.8-m) tall turbine buildings and 250-ft (76.2-m) tall reactor containment structures. The NRC staff (NRC 2015a) concluded that the likelihood of bats colliding with these and other plant structures on the Indian Point site during the license renewal term was extremely unlikely to occur and, therefore, discountable. The Service (FWS 2015b) concurred with this determination. Most recently, the NRC staff (2018a) determined that the likelihood of bats colliding with site buildings or structures on the Seabrook Station, Unit 1 site in New Hampshire would be extremely unlikely. The tallest structures on that site are a 199-ft (61-m) tall containment structure and 103-ft (31-m) tall turbine and heater bay building. The Service (FWS 2018d) again concurred with the NRC staff's determination.

On the Peach Bottom site, the tallest structures on the site are the Unit 2 and 3 reactor buildings, each of which are 300-ft (91-m) high (Exelon 2018a). A number of other buildings and structures exist on the site that are relatively low in height. For instance, the three mechanical draft cooling towers are each 53-ft (16-m) tall. In-flight bats are unlikely to collide with site structures because of the unique topography of the Peach Bottom site. The industrial area of the site is set into a hillside that was created by cutting away a rock cliff along the Susquehanna River to create space to construct the plant. The remaining hillside is taller than the reactor buildings such that the reactor buildings and other site structures do not create the same level of collision hazard as they would if they were sited on a flat, open landscape. To date, Exelon has reported no incidents of injury or mortality of any species of bat on the Peach Bottom site associated with site buildings or structures. Accordingly, the NRC staff finds the likelihood of future northern long-eared bat or Indiana bat collisions with site buildings or structures to be extremely unlikely and, therefore, discountable.

Vehicle collision risk for bats varies depending on factors including time of year, location of roads and travel pathways in relation to roosting and foraging areas, the characteristics of individuals' flight, traffic volume, and whether young bats are dispersing. Although collision has been documented for several species of bats, the Indiana Bat Draft Recovery Plan (FWS 2007) indicates that bat species do not seem to be particularly susceptible to vehicle collisions. However, the Service (FWS 2016b) also finds it difficult to determine whether roads increase or decrease the risk of bats colliding with vehicles by deterring bat activity. In most cases, the Service (FWS 2016b) expects that roads of increasing size decrease the likelihood of bats crossing the roads and, therefore, reduce collision risk. At Peach Bottom, vehicle traffic from truck deliveries, site maintenance activities, and personnel commuting to and from the site would continue throughout the subsequent license renewal term as they have during the current licensing term. Vehicle use would occur primarily in areas that bats would be less likely to frequent, such as along established county and State roads or within industrial-use areas of the Peach Bottom site. Additionally, most vehicle activity would occur during daylight hours when bats are less active. To date, Exelon has reported no incidents of injury or mortality of any species of bat on the Peach Bottom site associated with vehicle collisions. Accordingly, the NRC staff finds the likelihood of future northern long-eared bat or Indiana bat collisions with vehicles to be extremely unlikely and, therefore, discountable.

Habitat Loss, Degradation, Disturbance, or Fragmentation, and Associated Effects

As previously established in this SEIS, the Peach Bottom action area includes 356 ac (144 ha) of forested habitat, and northern long-eared bats and Indiana bats may occur in these areas in spring, summer, and fall. In its final rule listing the northern long-eared bat (80 FR 17974), the U.S. Fish and Wildlife Service states that forest conversion and forest modification from management are two of the most common causes of habitat loss, degradation, disturbance, or fragmentation affecting the species. Forest conversion is the loss of forest to another land use type, such as cropland, residential, or industrial. Forest conversion can affect bats in the following ways (80 FR 17974):

- Loss of suitable roosting or foraging habitat
- Fragmentation of remaining forest patches, leading to longer flights between suitable roosting and foraging habitat
- Removal of travel corridors, which can fragment bat colonies and networks
- Direct injury or mortality during active forest clearing and construction

Forest management practices maintain forest habitat at the landscape level but involve practices that can have direct and indirect effects on bats. Impacts from forest management are typically temporary in nature and can include positive, neutral, and negative impacts, such as (80 FR 17974):

- Maintaining or increasing suitable roosting and foraging habitat within the species' home range (positive)
- Removing trees or small areas of forest outside of the species' summer home range or away from hibernacula (neutral)
- Removing potential roost trees within the species' summer home range (negative)
- Performing management activities near hibernacula that could disturb hibernating bats (negative)
- Direct injury or mortality during forest clearing (negative)

Concerning forest conversion and its effects, the proposed action would not involve forest conversion or other activities that could result in similar impacts. Accordingly, bats would not experience the effects identified above and associated with forest conversion as a result of the proposed action.

Concerning forest management, the proposed action would not involve forest management specifically, but Exelon (Exelon 2018c) would continue to implement its Vegetation Management Program on the Peach Bottom site. Most maintenance would be of grassy, mowed areas between buildings and along walkways within the industrial portion of the site or on adjacent hillsides. PECO and Asplundh Tree Expert, LLC would continue to maintain onsite transmission line rights-of-way in accordance with North American Electric Reliability Corporation standards. Less-developed areas and forested areas would be largely unaffected during the subsequent license renewal term. Exelon (Exelon 2018a) does not intend to expand the existing facilities or otherwise perform construction or maintenance activities within these areas. However, site personnel may remove select trees around the margins of existing forested areas if those trees are deemed hazardous to buildings, infrastructure, or other site facilities or to existing overhead clearances (Exelon 2018a). Negative impacts to bats could result if such trees are potential roost trees. Bats could also be directly injured during tree clearing. However, hazardous tree removal would be infrequent, and Exelon (Exelon 2018c) site procedures require its personnel to complete an environmental screening checklist prior to acting in order to determine the need for further environmental evaluation. Site procedures also require personnel to notify the station environmental manager prior to proceeding with an activity that could affect wildlife. The station environmental manager would ensure that Exelon takes the appropriate measures to minimize or eliminate any impacts, that Exelon contacts the appropriate State or Federal agencies (as appropriate), and that Exelon obtains the appropriate permits (if applicable). The NRC staff finds that these measures, in addition to the infrequency with which hazardous trees would likely be removed in forested areas, would not affect to a measurable degree any potential spring staging, summer roosting, or fall swarming habitat in the action area. Direct injury or mortality to bats during tree removal is also unlikely because Exelon site procedures would ensure that personnel take the appropriate measures to avoid this potential impact. For instance, Exelon could avoid this impact by removing hazardous trees in the winter when bats are unlikely to be present on the site. Additionally, the continued preservation of the existing forested areas on the site during the subsequent license renewal term would result in positive impacts to both species of bats, if present within or near the action area.

Behavioral Changes Resulting from Refurbishment or Other Site Activities

Construction or refurbishment and other site activities, such as site maintenance and infrastructure repairs, could prompt behavioral changes in bats. Noise and vibration and general human disturbance are stressors that may disrupt normal feeding, sheltering, and breeding activities (FWS 2016a). At low noise levels or farther distances, bats initially may be startled but would likely habituate to the low background noise levels. At closer range and louder noise levels, particularly if accompanied by physical vibrations from heavy machinery, many bats would probably be startled to the point of fleeing from their daytime roosts. Fleeing individuals could experience increased susceptibility to predation and would expend increased levels of energy, which could result in decreased reproductive fitness (FWS 2016a, Table 4-1). Increased noise may also affect foraging success. Schaub et al. (2003) found that foraging success of the greater mouse-eared bat (*Myotis myotis*) diminished in areas with noise mimicking the traffic sounds that would be experienced within 15 m (49 ft) of a highway.

Within the Peach Bottom action area, noise, vibration, and other human disturbances could dissuade bats from using the existing upland forest habitat during migration, which could also reduce fitness of migrating bats. However, bats that use the action area have likely become habituated to such disturbance because Peach Bottom has been consistently operating for several decades. According to the Service (FWS 2010b), bats that are repeatedly exposed to predictable, loud noises may habituate to such stimuli over time. For instance, Indiana bats have been documented as roosting within approximately 300 m (1000 ft) of a busy state route adjacent to Fort Drum Military Installation and immediately adjacent to housing areas and construction activities on the installation (U.S. Army 2014). Northern long-eared bats would likely respond similarly.

Continued operation of Peach Bottom during the subsequent license renewal term would not include major construction or refurbishment and would involve no other maintenance or infrastructure repair activities other than those routine activities already performed on the site. Levels and intensity of noise, lighting, and human activity associated with continued day-to-day activities and site maintenance during the subsequent license renewal term would be similar to ongoing conditions since Peach Bottom began operating, and such activity would only occur on the developed, industrial-use portions of the site. While these disturbances could cause behavioral changes in migrating or summer roosting bats, such as the expenditure of additional energy to find alternative suitable roosts, the NRC staff assumes that northern long-eared bats and Indiana bats, if present in the action area, have already acclimated to regular site disturbances. Thus, continued disturbances during the subsequent license renewal term would not cause behavioral changes in bats to a degree that would be able to be meaningfully measured, detected, or evaluated or that would reach the scale where a take might occur.

Summary of Effects

The potential stressors evaluated in this section are unlikely to result in effects on the northern long-eared bat or Indiana bat that could be meaningfully measured, detected, or evaluated, or such stressors are otherwise unlikely to occur for the following reasons:

- Bat collisions with nuclear power plant structures in the United States are rare, and none have been reported at Peach Bottom. Vehicle collisions attributable to the proposed action are also unlikely, and none have been reported at Peach Bottom.
- The proposed action would not involve any construction, land clearing, or other ground-disturbing activities.
- Bats, if present in the action area, have likely already acclimated to the noise, vibration, and general human disturbances associated with site maintenance, infrastructure repairs, and other site activities. During the subsequent license renewal term, such disturbances and activities would continue at current rates and would be limited to the industrial-use portions of the site.

Conclusion for Northern Long-Eared Bat

All potential effects on the northern long-eared bat resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect, but is not likely to adversely affect* the northern long-eared bat.

Conclusion for Indiana Bat

All potential effects on the Indiana bat resulting from the proposed action would be insignificant or discountable. Therefore, the NRC staff concludes that the proposed action *may affect, but is not likely to adversely affect* the Indiana bat.

<u>Rufa Red Knot (*Calidris canutus rufa*)</u>

In Section 3.8.1.2, in the subsection titled, "Rufa Red Knot (*Calidris canutus rufa*)," the NRC staff concludes that the rufa red knot does not occur in the Peach Bottom action area due to lack of suitable habitat. In communications with the U.S. Fish and Wildlife Service in connection with this review, Service staff agreed with this determination (NRC 2018j). Because the species is not present in the action area, the NRC staff concludes that the Peach Bottom subsequent license renewal would have no effect on the rufa red knot.

<u>Chesapeake Logperch (*Percina bimaculata*)</u>

In Section 3.8.1.2, in the subsection titled, "Chesapeake Logperch (*Percina bimaculata*)," the NRC staff concludes that Chesapeake logperch reside year-round in Conowingo Pond. The potential stressors that this species could experience from operation of a nuclear plant (generically) are as follows:

- Impingement and entrainment
- Thermal effects

- Exposure to radionuclides and other contaminants
- Reduction in available food resources due to impingement and entrainment or thermal impacts to prey species

Impingement and Entrainment

Impingement is the entrapment of all life stages of fish and shellfish on the outer part of a water intake structure or against a screening device during periods of water withdrawal (40 CFR 125.83). Entrainment is the incorporation of all life stages of fish and shellfish with intake water flow entering and passing through a cooling water intake structure and into a circulating-water intake structure (40 CFR 125.83). In Section 4.7.1.1, “Impingement and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems and Cooling Ponds),” of this SEIS, the NRC staff evaluates the collective effects of impingement and entrainment for all Conowingo Pond aquatic organisms and concludes that impacts would be SMALL over the course of the subsequent license renewal term. This section evaluates the species-specific impacts of impingement and entrainment on the Chesapeake logperch using a line-of-evidence approach.

For impingement, the NRC staff considered as its first line of evidence the Peach Bottom cooling water intake structure intake velocity in relation to Chesapeake logperch swimming ability. Swimming speed is an important factor that influences a species’ ability to avoid impingement. Fish are likely to become impinged in situations where a facility’s intake velocity is greater than a species’ burst swimming speeds. Fish naturally exhibit burst swimming behavior when navigating short-term fast currents, capturing prey, and avoiding predators. Burst swimming behavior also helps individuals avoid the draw of water into a cooling water intake system.

Section 3.1.3, “Cooling and Auxiliary Water Systems,” of this SEIS describes how Peach Bottom withdraws cooling water from Conowingo Pond through a series of intake structures. Water approaches the outer intake structure at a velocity of 0.75 fps (23 cm/s), and water travels through the intake structures screens at a velocity of 1.21 fps (37 cm/s). Based on these velocity parameters, fish capable of burst swimming speeds of 0.75 fps (23 cm/s) or greater are likely capable of avoiding the draw of water into the intake structure and would not be impinged.

Data on swimming speeds of Chesapeake logperch are unavailable. However, researchers have investigated swimming speeds of various darters (family Percidae) as summarized in Table 4-7. Swimming speed data on darters, taken together as a group, can serve as a reasonable surrogate for the Chesapeake logperch because this family of fish all exhibit a common body structure and are of similar size at maturity. Based on the NRC staff’s review of these research findings, the staff expects that most healthy adult Chesapeake logperch have sufficient swimming ability to avoid impingement. However, if individuals do not exhibit burst behavior upon initially sensing the change in current caused by the outer intake structure’s draw of cooling water, these individuals may have difficulty escaping impingement. Water velocity would increase and make escape increasingly difficult as those individuals approach the intake screens such that even healthy adults could occasionally become impinged.

Smaller or weakened adults and juveniles may not be capable of exhibiting the burst swimming behavior necessary to escape the draw of intake water. The NRC staff did not identify any data on the swimming speeds of smaller or weakened darters. Therefore, the NRC staff conservatively assumes that such individuals’ swimming capabilities would be sufficiently reduced to a point where impingement of these individuals is possible when present near Peach Bottom's outer intake structure.

Table 4-7 Summary of Research Findings on Swimming Speeds of Darters

Species	Test	Findings	Reference
Roanoke darter (*Percina roanoka*) fantail darter (*Etheostoma flabellare*)	Critical current speeds (maximum current speed at which benthic stream fishes are able to hold station without active swimming) measured in laboratory flow chamber.	Critical current speeds determined to be 30.2 cm/s (adult *P. roanoka*), 24.0 cm/s (adult *E. flabellare*), and 16.2 cm/s (juvenile *E. flabellare*)	Matthews 1985
paleback darter (*Etheostoma pallidorsum*) greenside darter (*Etheostoma blennoides*) orangebelly darter (*Etheostoma radiosum*)	Swimming speeds tested in laboratory with submersible pump at varying velocities in a pipe intended to represent a stream culvert.	Individuals of the three species exhibited difficulty holding position at an average of 31.16, 28.02, and 29.6 cm/s, respectively	Layher 1993
leopard darter (*Percina pantherina*)	Burst frequency and total distance covered evaluated in laboratory setting using corrugated-pipe and open box culverts over 10-minute periods.	Swimming activity highest in 25 cm/s current velocity; burst speed at this velocity was 14.23 cm/s (± 20.01 cm)	Toepfer et al. 1999
Rio Grande darter (*Etheostoma grahami*)	Swimming speeds tested in laboratory swim tunnel with initial current velocity of 0 cm/s with increase of 3 to 5 cm/s every 10 seconds until fish stopped swimming due to fatigue.	40.0 cm/s (± 3.92 cm) mean absolute speed	Leavy and Bonner 2009

The second line of evidence is data from impingement studies. Exelon has undertaken several impingement studies in connection with CWA Section 316(b) and NPDES permit requirements. No logperch were collected in the first Peach Bottom impingement study (1973 to 1976) (URS and NAI 2008). Logperch, reported as common logperch (*Percina caprodes*), were collected in a 2005–2006 impingement study (URS and NAI 2008). However, the study does not report specific impingement numbers for logperch because it was not selected as a representative important species. Since 2010, as part of a collaborative effort with the Susquehanna River American shad restoration program and the Pennsylvania Fish and Boat Commission, researchers have collected impingement samples annually during the annual American shad outmigration period (October–November). From 2010 through 2015, researchers collected 52 logperch in these samples (NAI 2010a, 2011a, 2012a, 2013a, 2014a). Table 4-8 presents this data by year. Section 4.7.1.1, "Impingement and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems and Cooling Ponds)," describes the study's methods and materials in detail.

In addition to these past studies, the environmental consulting company Normandeau Associates, Inc. is currently analyzing impingement sampling data, among other biological data, that its personnel have collected over several years pursuant to Exelon's compliance with CWA Section 316(b) best technology available requirements. As part of this effort, Normandeau will prepare an impingement characterization/mortality study and entrainment characterization report for Exelon. Exelon (2018c) will submit its NPDES renewal permit application, which will include the new impingement and entrainment characterization reports, in 2019. Exelon's NPDES permit renewal application was not available for NRC staff review during preparation of this draft SEIS. However, Exelon (Exelon 2018a, 2018c) reports that Normandeau has collected five Chesapeake logperch in impingement samples associated with this effort (four individuals in 2016 and one individual in 2017).

Table 4-8 Logperch Collected in Peach Bottom Impingement Samples Associated with the Susquehanna River American Shad Restoration Program, 2010–2015

	Number of Fish Collected		
Sampling Dates	**Unit 2**	**Unit 3**	**TOTAL**
Chesapeake Logperch and Common Logperch[a]			
2010 (Oct 25–Dec 10)	2	5	7
2011 (Nov 2–Dec 2)	0	1	1
2012 (Nov 2–Dec 7)	6	23	29
2013 (Nov 4–Dec 6)	1	0	1
2014 (Oct 1–Oct 17)	1	2	3
Chesapeake Logperch[b] 2015 (Nov 2–Nov 25)	5	6	11
TOTAL (2010–2015)	**15**	**37**	**52**

[a] For 2010–2014, values in this table are the combined number of Chesapeake logperch and common logperch collected because the referenced studies do not distinguish between the two species.

[b] In 2015, researchers distinguished between common logperch and Chesapeake logperch in collections, and the value in this table represents only the number of Chesapeake logperch collected.

Sources: NAI 2010a, 2011a, 2012a, 2013a, 2014a

Based on the above lines of evidence, which review the Peach Bottom cooling water intake velocity, Chesapeake logperch swimming speeds, and available impingement data, the NRC staff finds that impingement of Chesapeake logperch occurs at Peach Bottom, and this impingement is likely to continue during the subsequent license renewal term. Due to the limited available data, the NRC staff is unable to estimate the annual number of individuals that are likely to be impinged during the subsequent license renewal term. The final SEIS will include additional information, as appropriate, from Exelon's submission of its renewed NPDES permit application to the Pennsylvania Department of Environmental Protection.

Concerning entrainment, the NRC staff considered as its first line of evidence the life history characteristics of Chesapeake logperch eggs and larvae. Eggs are adhesive and demersal in that they quickly sink into sand or gravel substrate upon release from the female. Therefore, Chesapeake logperch eggs would not be present in the water column where they could be entrained into Peach Bottom's cooling water intake structure. The larval stage of the logperch is atypical—at hatching, logperch appear very similar to adults, and individuals do not exhibit intermediate stages. Because Chesapeake logperch larvae are more immediately mobile than the larvae of many other fish, individuals are less likely to be entrained. For these reasons, the

NRC staff does not expect Chesapeake logperch eggs or larvae to be entrained into the Peach Bottom cooling water intake system.

The second line of evidence is the Peach Bottom entrainment studies. In 2010 (as a condition of Peach Bottom's 2011 renewed NPDES permit), the Pennsylvania Department of Environmental Protection required Exelon to conduct an entrainment characterization study over at least one fish spawning season. In the NPDES permit, the PDEP highlighted the Chesapeake logperch as one species, among others, that was of particular concern due to its State-threatened status in both Pennsylvania and Maryland. In 2012, NAI (NAI 2013b) collected ichthyoplankton samples over 24-hour periods each week from March through September at the Peach Bottom circulating-water discharge outfall. Section 4.7.1.1, "Thermal Impacts on Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds," of this SEIS describes the methods and materials of this study in detail. Researchers collected neither the Chesapeake logperch nor the common logperch during the study. Based on a review of this and other studies, NAI and ERM (2014) postulated that Chesapeake logperch likely spawn in lower tributary regions and tributary mouths of Conowingo Pond but not spawn in the pond itself. Individuals move into the pond in the summer and fall to feed and use various preferred habitats once they have gained size. Thus, Chesapeake logperch eggs and larvae are unlikely to be present in areas influenced by the Peach Bottom cooling water intake structure and would, therefore, not be susceptible to entrainment.

Based on the above review of Chesapeake logperch life history characteristics and available entrainment data, the NRC staff does not expect entrainment of Chesapeake logperch during the subsequent license renewal term. Because entrainment is extremely unlikely to occur, the potential for entrainment is a discountable impact.

With respect to impingement and entrainment collectively, the NRC concludes that the subsequent license renewal of Peach Bottom would result in impingement, but not entrainment, of Chesapeake logperch. As described in Section 4.7.1.1 of this SEIS, during its NPDES permit renewal review, the Pennsylvania Department of Environmental Protection will evaluate impingement and entrainment study results and use best professional judgment to determine the appropriate technologies, management practices, and operating measures that are considered best technology available to meet CWA Section 316(b) impingement and entrainment standards. As part of this process, the Commonwealth of Pennsylvania may require Exelon to implement additional measures for protection of State-threatened and endangered or otherwise fragile species, including the Chesapeake logperch. If the U.S. Fish and Wildlife Service lists the Chesapeake logperch under the Endangered Species Act during the subsequent license renewal term, the Service could impose additional requirements to minimize or avoid impingement of the species.

Thermal Effects

The primary thermal effect that would be of concern at Peach Bottom is heat shock, which the NRC (NRC 2013a) defines as occurring when the water temperature meets or exceeds the thermal tolerance of a species for some duration of exposure. In most situations, fish are capable of moving out of or avoiding areas that exceed their thermal tolerance limits. In Section 4.7.1.2 of this SEIS, the NRC staff evaluates thermal impacts for all Conowingo Pond aquatic organisms. This section evaluates the species-specific thermal effects on the Chesapeake logperch.

The NRC staff considered whether Chesapeake logperch may be sensitive to elevated water temperatures. Although no avoidance temperature data is available for the species, Yoder (2012) calculated the upper avoidance temperature for the common logperch to be 23 °C (73.4 °F). However, Yoder's calculated temperature threshold likely does not apply to the population of Chesapeake logperch inhabiting Conowingo Pond because researchers have collected live individuals at temperatures exceeding this threshold. For instance, during a 2010–2014 thermal study of Conowingo Pond, researchers collected four live Chesapeake logperch at temperatures of 33.9 °C (93 °F). In addition, ambient water temperatures in Conowingo Pond can reach or exceed 30 °C (86 °F) during the summer months (NAI and ERM 2017). Because the Chesapeake logperch's upper thermal tolerance is unclear, the NRC staff considered the results of recent thermal studies that Exelon has undertaken to determine the effects of Peach Bottom's thermal effluent.

From 2010 through 2013, NAI and ERM (2014) researchers conducted temperature monitoring and boat electrofisher, seine, and otter trawl fish sampling at monitoring stations throughout Conowingo Pond under various cooling tower scenarios (i.e., with zero to three cooling towers in operation). Researchers designated monitoring stations as either thermally influenced (Stations 161, 189, 190, and 214–217) or non-thermally influenced (all other stations). Researchers selected Chesapeake logperch as one of 11 representative important species for the study. In 2016, NAI and ERM (2017) conducted a second thermal study following Exelon's implementation of the Peach Bottom extended power uprate, which raised the thermal effluent discharge temperature by approximately 3 °F (1.7 °C). The follow-up study evaluated the composition and relative abundance of the 11 representative important species, including the Chesapeake logperch, at each of the monitoring stations established during the previous study.

Section 4.7.1.2 of this SEIS describes methods, materials, and communitywide results of these studies in detail. The NRC staff's conclusions in that section are relevant to this analysis because they establish a baseline for potential impacts on the Chesapeake logperch. The NRC staff's conclusions for all aquatic organisms is summarized in the paragraph below.

In its analysis of thermal effects on aquatic organisms, the NRC staff determines that, for the majority of the year, the overall Conowingo Pond aquatic community would not be noticeably altered or experience detectable effects through exposure to Peach Bottom's thermal effluent over the course of the subsequent license renewal term. During the summer months, a 12- to 19-ac (4.9- to 7.7-ha) area of shallow shoreline habitat downstream of the Peach Bottom discharge would experience heightened temperatures. Within this area, lowered fish diversity and observable changes in the macroinvertebrate community would result under scenarios where the daily mean water temperature increases above 93 °F (36 °C) for at least 7 to 21 days. This narrow band of heightened temperatures, which comprises only 2.5 percent of Conowingo Pond's shallow shoreline habitat, would not block fish passage. Migrating fish could avoid the thermal plume in order to move up or downstream. These effects would be seasonal, localized, and temporary.

While NAI and ERM researchers established monitoring stations based on thermal or non-thermal influence, the NRC staff determined that detectable effects would only occur seasonally at a subset of stations (Stations 189, 214, and 215) that lie 0.37, 0.65, and 1.32 mi (0.60, 1.05, 2.12 km), respectively, from the end of the Peach Bottom discharge canal.

As a baseline for the current analysis, the NRC staff assumes that Chesapeake logperch inhabiting Conowingo Pond would experience the same effects as the overall aquatic community, as evaluated in Section 4.7.1.2 and summarized above. However, the Chesapeake logperch may be uniquely sensitive to thermal effects because the species is already experiencing a variety of other stressors that could warrant the U.S. Fish and Wildlife Service's future listing of the species under the Endangered Species Act. In particular, the Pennsylvania Fish and Boat Commission (PFBC 2015) identifies water quality as one of the major threats to Chesapeake logperch in its 2015 Species Action Plan. Below, the NRC staff examines whether the Chesapeake logperch would experience measurable or more intense thermal effects beyond the established baseline.

During the 2010–2013 study, NAI and ERM (2014) researchers collected a total of 559 Chesapeake logperch across all gear types. Collections represented 0.6 percent composition of all species collected across all years. Chesapeake logperch appeared in electrofishing samples (87.8 percent of logperch collections) significantly more often than in seine (11.6 percent) or trawl (0.5 percent) samples. In all years, the species was present in Conowingo Pond in greatest numbers from mid-summer to early fall (July through October) and was most prevalent in late summer (August and September). Table 4-9 and Table 4-10 below show Chesapeake logperch collections by gear type and month, respectively.

Table 4-9 Total Chesapeake Logperch Collections in Peach Bottom Thermal Studies by Gear Type, 2010–2013

Gear Type	2010	2011	2012	2013	TOTAL	Percent
Electrofisher	58	56	70	307	**491**	**87.8%**
Seine	19	7	9	30	**65**	**11.6%**
Otter Trawl	0	2	1	n/a	**3**	**0.5%**
TOTAL	**77**	**65**	**80**	**337**	**559**	**100.0%**

n/a = no collections made with gear type in given year. Source: NAI and ERM 2014

Table 4-10 Total Chesapeake Logperch Collections in Peach Bottom Thermal Studies by Month and Year for All Gear Types, 2010–2013

	2010	2011	2012	2013	TOTAL
January	n/a	n/a	0	2	**2**
February	n/a	0	0	n/a	**0**
March	n/a	n/a	n/a	0	**0**
April	n/a	0	6	2	**8**
May	n/a	2	9	3	**14**
June	n/a	7	6	9	**22**
July	21	6	15	37	**79**
August	20	39	19	78	**156**
September	11	6	13	153	**183**
October	25	5	12	53	**95**
TOTAL	**77**	**65**	**80**	**337**	**559**
Percent of all collected fishes	**0.6%**	**0.3%**	**0.2%**	**1.8%**	**0.6%**

n/a=no collections made in given month and year. Source: NAI and ERM 2014

As previously established, NAI and ERM (2014) detected lower fish diversity at Stations 189, 214, and 215, a subset of the thermally affected stations, under certain temperature conditions in the summer months. The baseline of this analysis assumes that Chesapeake logperch would also exhibit avoidance behavior at these stations. To determine whether Chesapeake logperch would be more sensitive to thermal conditions and possibly display avoidance behavior over a larger range of monitoring stations, the NRC staff examined the catch-per-unit effort (CPUE; the number of fish collected per unit of collection effort) for the species across all monitoring stations (see Table 4-11). While CPUE was low at Stations 214, 215, and 189, no clear distribution pattern emerged from the data. CPUE was also low at Station 161 and several of the upstream stations. CPUE was highest at Station 217 (the most downstream location) and at Stations 187 and 165 (two upstream locations). In its study report, NAI and ERM (2014) postulate that Chesapeake logperch distribution may be more influenced by proximity to tributary streams, shallow shoreline habitat, and substrate type than water temperature. Station 217 is just upstream of Muddy Creek, Station 187 is downstream of Muddy Creek, and Station 165 is above Peters Creek. Within these areas, individuals may be selecting for habitat that includes a unique combination of factors not present at other stations (e.g., shallow water, sand, clean gravel, submerged aquatic vegetation, complex structure, and woody debris for protective cover and feeding opportunity) (NAI and ERM 2014). For instance, in 2010, URS (2012) conducted a habitat mapping study related to water level fluctuations. The study evaluated shoreline sediment class and location of submerged aquatic vegetation in Conowingo Pond. During the study, researchers collected the highest numbers of Chesapeake logperch in locations with fairly large areas of shallow shoreline habitat containing sand or gravel substrate.

Table 4-11 Chesapeake Logperch Collections by Station in Peach Bottom Thermal Studies, July and August 2010–2013, Expressed as Catch Per Unit Effort (CPUE)

Station[(a)]	Collection Type[(b)]	Distance from Discharge Canal (mi) [(c)]	CPUE[(d)]
203	S	-4.15	0
202	S	-3.93	1
221	S	-2.96	3
220	S	-2.74	35
187	E	-2.07	60
164	E	-1.7	1
208	S	-1.52	8
165	E	-1.34	60
161	E	0.34	1
214	S	0.37	1
215	S	0.65	0
189	E	1.32	7
190	E	2.04	26
217	E	4.02	90

(a) Highlighted stations (161, 214, 215, 189, 190, 217) are those that NAI and ERM researchers determined to be thermally influenced by the Peach Bottom thermal discharge. Those stations highlighted in red (214, 215, 189) are the subset of stations over which researchers detected observable changes in the aquatic community.

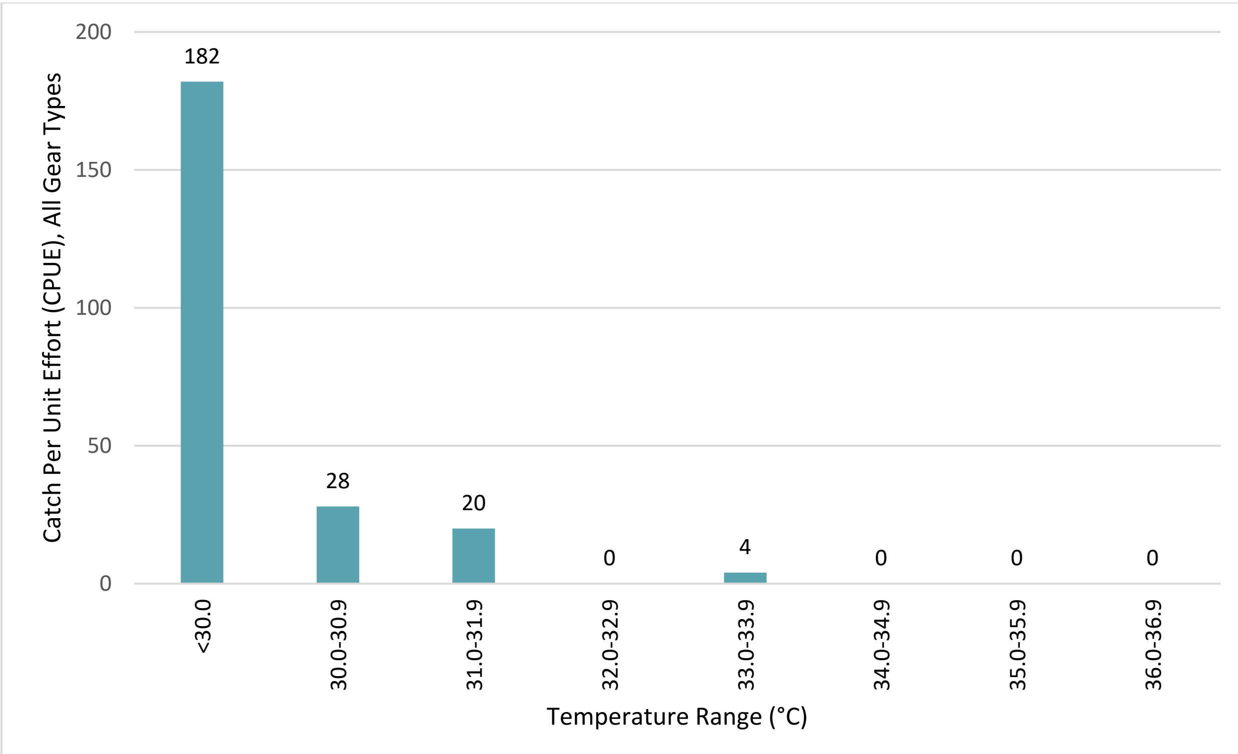
(b) E=boat electrofisher; S=seine

(c) The discharge canal location is set as zero (0) such that negative numbers indicate an upstream location and positive numbers indicate a downstream location.

(d) CPUE=catch (number of individuals) per unit effort. Electrofisher CPUE is expressed as number of individuals per 0.5 hours. Seine CPUE is expressed as number of individuals per collection event (seine haul).

Source: NAI and ERM 2014

To further investigate the role of temperature in the distribution of Chesapeake logperch, the NRC staff considered whether Chesapeake logperch appeared more often at certain temperatures in July and August, the months when Conowingo Pond temperatures are highest, across all monitoring stations. Combining temperature data across all stations should remove habitat selection as a factor, which may have played a significant role in the species' presence at the various sampling stations during the study. Figure 4-3 illustrates CPUE across all stations and gear types for temperatures ranging from 30 °C (86 °F) to 36.9 °C (98.4 °F). CPUE was significantly higher at water temperatures of 30 °C (86 °F) or less. To a lesser degree, Chesapeake logperch were collected at temperatures of up to 32 °C (89.6 °F). The highest temperature at which researchers collected Chesapeake logperch was 33.9 °C (93.0 °F) at Station 217 in 2011. Station 217 is the most downstream location and exhibited the highest CPUE of all stations. Individuals collected at this station may have been preferentially selecting other habitat factors over temperature. With the exception of this collection, Chesapeake logperch appear to preferentially select areas of Conowingo Pond of temperatures less than 30 °C (86 °F), and the species can tolerate temperatures up to 32 °C (89.6 °F). Chesapeake logperch would generally not occur in water where the temperature is higher than 32 °C (89.6 °F).



Source: Created with data from NAI and ERM 2014

Figure 4-3 Chesapeake Logperch Collections by Temperature in Peach Bottom Thermal Studies, July and August 2010–2013, Expressed as Catch Per Unit Effort (CPUE)

NAI and ERM (2014) modeled avoidance scenarios for representative important species under typical summer conditions: 26.7 °C (80 °F) ambient water temperature, Peach Bottom discharge of 13,000 cfs (4,000 m^3/s), and assuming extended power uprate power levels. While researchers did not model avoidance scenarios for the Chesapeake logperch specifically due to the lack of thermal tolerance data on the species, researchers modeled scenarios for walleye and white crappie (see Table 4-12). Both of these species inhabit shallow shoreline areas and avoid temperatures of greater than 32 °C (89.6 °F) at an acclimation of 26.7 °C (80 °F). Like Chesapeake logperch, neither species typically occurs at the surface, although walleye use deep water habitat and white crappie inhabit mid-depth areas in addition to shallower habitats. Therefore, the modeled avoidance areas at 10-ft (3-m) depths and the bottom of the water column are the most relevant to the Chesapeake logperch.

Table 4-12 Modeled Avoidance Areas for a Typical Conowingo Pond Summer Scenario for Fish with an Avoidance Temperature of Greater Than or Equal to 32 °C

	Total Avoidance Area (acres)			
Cooling Towers in Operation	**None**	**One**	**Two**	**Three**
Surface area	661	517	371	240
Area at 10-ft depth	4	3	3	3
Bottom area	14	14	14	14

Source: NAI and ERM 2014

Under all cooling tower scenarios, the area of avoidance would constitute a maximum of 14 ac (0.2 ha) along the western shoreline directly downstream of the Peach Bottom discharge (see Table 4-12). This area coincides with the baseline area of 12 to 19 ac (4.9 to 7.7 ha) over which the NRC staff identified measurable effects in the aquatic community in Section 4.7.1.2 of this SEIS. Accordingly, the Chesapeake logperch do not appear to be more sensitive to thermal conditions than the aquatic community as a whole, and the baseline assumptions regarding thermal effects established above in this analysis appear to hold true for this species.

In 2016, NAI and ERM (2017) conducted a follow-up study. Researchers collected 74 Chesapeake logperch during the study period (May–September). Overall trends mirrored the 2010–2014 study, and collected individuals exhibited a similar size structure between the two study periods. NAI and ERM (2017) found no observable changes in the Chesapeake logperch population between the pre- and post-uprate study periods, and the NRC staff did not identify any information in the study that would further inform this analysis.

Based on the above review of recent Conowingo Pond thermal studies, the NRC staff concludes that Chesapeake logperch are unlikely to be affected by Peach Bottom's thermal plume beyond the baseline for all aquatic organisms established in Section 4.7.1.2 of this SEIS and summarized at the beginning of this analysis. Accordingly, the NRC staff expect Chesapeake logperch to exhibit avoidance behavior over a 12- to 19-ac (4.9- to 7.7-ha) area of shallow shoreline habitat downstream of the Peach Bottom discharge during summer months when the daily mean water temperature increases above 93 °F (36 °C) for at least 7 to 21 days. This effect would be seasonal, temporary, and localized; would not affect the species' ability to move up or downstream of the plant; and would not reach the scale of a take. As established in the impingement and entrainment discussion, Chesapeake logperch eggs and larvae are unlikely to be present in the pond and would, therefore, not be thermally influenced. The NRC staff concludes that the potential thermal effect on Chesapeake logperch during the subsequent license renewal is an insignificant impact.

Exposure to Radionuclides and Other Contaminants

The NRC(2013a) determined in the GEIS that exposure to radionuclides would be of SMALL significance for aquatic resources because exposure would be well below U.S. Environmental Protection Agency guidelines developed to protect aquatic biota. The GEIS also concludes that effects of nonradiological contaminants on aquatic organisms would be SMALL because best management practices and discharge limitations required by applicable State-issued NPDES permits would minimize the potential for impacts to aquatic resources. In Section 4.7, "Aquatic Resources," of this SEIS, the NRC staff did not identify any new and significant information that would call into question the applicability of these conclusions to the Peach Bottom subsequent license renewal. Therefore, exposure of aquatic organisms to radionuclides and nonradiological contaminants during the subsequent license renewal term would not be detectable or would be so minor as to neither destabilize nor noticeably alter any important attribute of the aquatic environment.

The NRC staff did not identify any scientific studies or other information during its review indicating that Chesapeake logperch could experience measurable adverse effects from the minimal discharges of radionuclides and other contaminants that would occur during the Peach Bottom subsequent license renewal term. Based on the above information, the NRC staff finds that exposure to radionuclides and other contaminants during the subsequent license renewal term represents a discountable impact because it would not be able to be meaningfully detected, measured, or evaluated and insignificant because exposure would never reach the scale where a take would occur.

Reduction in Available Food Resources Due to Impingement and Entrainment or Thermal Impacts to Prey Species

The diet of Chesapeake logperch changes with age and is described in Section 3.8.1.2 in the subsection titled, "Chesapeake Logperch (*Percina bimaculata*)." As identified in Table 4-2 and analyzed in Section 4.7, "Aquatic Resources," impingement and entrainment of aquatic resources would be SMALL during the subsequent license renewal term, and thus, would not be detectable or would be so minor as to neither destabilize nor noticeably alter the aquatic community during the subsequent license renewal term. Thermal impacts would be SMALL during most of the year and SMALL to MODERATE during summer months. During these months, lower IBI scores and fish diversity are likely over a 12- to 19-ac (4.9- to 7.7-ha) area of shallow water habitat downstream of the Peach Bottom discharge. These impacts would be limited in both time (i.e., seasonal and short term) and scope (i.e., would only affect a small area of Conowingo Pond's shallow water habitat). Any small reduction in available prey that could result from Peach Bottom operations is unlikely to affect Chesapeake logperch through the food web to an extent that could be meaningfully measured, detected, or evaluated. Therefore, impacts to prey species would be a discountable impact.

Summary of Effects

The majority of potential stressors evaluated in this section are unlikely to result in effects on the Chesapeake logperch that could be meaningfully measured, detected, or evaluated or such stressors are otherwise unlikely to occur for the following reasons.

- Entrainment of Chesapeake logperch is unlikely due to the species' life history characteristics. In addition, the Chesapeake logperch has not been collected in entrainment studies associated with Peach Bottom.
- Thermal effects would be insignificant. While certain summer conditions would likely result in the Chesapeake logperch's avoidance of a small area of shallow shoreline habitat downstream of the Peach Bottom discharge, such avoidance would be seasonal, temporary, and localized; would not affect the species' ability to move up or downstream of the plant; and would not reach the scale of a take.

- Exposure to radionuclides and other contaminants related to Peach Bottom operations would be minimal and discountable.
- Any small reductions in available prey resulting from Peach Bottom operations would not affect Chesapeake logperch to an extent that would be able to be meaningfully measured, detected, or evaluated.

Impingement, however, would result in adverse effects on the species. Although continued impingement of individuals into Peach Bottom's cooling water intake system would occur, data is unavailable at this time to estimate the annual number of individuals likely to be impinged or the effect such impingement would have on the overall sustainability of the Chesapeake logperch population.

Conclusion for Chesapeake Logperch

The potential impacts of entrainment, thermal effects, exposure to radionuclides and other contaminants, and reduction in food resources on the Chesapeake logperch resulting from the proposed action would be insignificant or discountable. However, impingement of individuals into Peach Bottom's cooling water intake system would result in take of the species. The NRC staff concludes that the proposed action *may affect* the Chesapeake logperch.[1]

4.8.1.2 Species and Habitats Protected Under the Endangered Species Act Under National Marine Fisheries Service Jurisdiction

Section 3.8.1.3, "Species and Habitats Under National Marine Fisheries Service's Jurisdiction," considers whether two federally listed species under the National Marine Fisheries Service's jurisdiction—Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus)* and shortnose sturgeon (*Acipenser brevirostrum)*—occur in the action area (as defined and described in Section 3.8.1.1, "Peach Bottom Action Area") based on each species' habitat requirements, life history, occurrence records, and other available information. In that section, the NRC staff concludes that neither species occurs in the action area. Because these species are not present in the action area, the subsequent license renewal would have no effect on these species. In Table 4-13 below, NMFS identifies the NRC staff's Endangered Species Act effect determination for the two sturgeon species. No candidate species, proposed species, or proposed or designated critical habitats under the National Marine Fisheries Service's jurisdiction occur within the action area.

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[1] The Endangered Species Act does not necessitate Section 7 consultation for the Chesapeake logperch at the time of issuance of this SEIS because the U.S. Fish and Wildlife Service continues to evaluate this species for listing under the Endangered Species Act. The NRC staff makes its "may affect" conclusion for this species to inform future evaluations of the species, if listed; future Section 7 consultation with the U.S. Fish and Wildlife Service, if required; and for the purposes of informing the staff's National Environmental Policy Act review of the proposed action.

Table 4-13 Effect Determinations for Federally Listed Species Under National Marine Fisheries Service Jurisdiction

Species	Federal Status[(a)]	Potentially Present in the Action Area?	Effect Determination[(b)]
Atlantic sturgeon	FE	No	No effect
shortnose sturgeon	FE	No	No effect

[(a)] Under the Endangered Species Act, species may be designated as federally endangered (FE) or federally threatened (FT). Species under consideration for Federal status may be either formally proposed for listing (PL) as endangered or threatened through a draft rule issued in the *Federal Register* or may otherwise be under Service review as a candidate for listing (CL).

[(b)] The NRC staff makes its effect determinations for federally listed species in accordance with the language and definitions specified in the U.S. Fish and Wildlife Service and National Marine Fisheries Service's *Endangered Species Consultation Handbook* (FWS and NMFS 1998).

4.8.1.3 Cumulative Effects for Species and Habitats Protected Under the Endangered Species Act

The Endangered Species Act regulations at 50 CFR 402.12(f)(4) direct Federal agencies to consider cumulative effects as part of the proposed action effects analysis. Under the Endangered Species Act, cumulative effects are defined as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR 402.02). Unlike the National Environmental Policy Act definition of cumulative impacts (see Section 4.16, "Cumulative Impacts"), cumulative effects under the Endangered Species Act do not include past actions or other Federal actions requiring separate Endangered Species Act Section 7 consultation. When formulating biological opinions under formal Endangered Species Act Section 7 consultation, the U.S. Fish and Wildlife Service and National Marine Fisheries Service consider cumulative effects when determining the likelihood of jeopardy or adverse modification (FWS and NMFS 1998). Therefore, cumulative effects need only be considered under the Endangered Species Act if the listed species will be adversely affected by the proposed action and formal Section 7 consultation is necessary (FWS 2014b). Because the NRC staff concluded earlier in this section that the subsequent license renewal is not likely to adversely affect any federally listed species, the NRC staff did not consider cumulative effects. Further, the NRC staff did not identify any actions within the action area that meet the definition of cumulative effects under the regulations implementing the Endangered Species Act (50 CFR 402.02).

4.8.1.4 Species and Habitats Protected Under the Magnuson–Stevens Act

In Section 3.8.2, "Species and Habitats Protected Under the Magnuson–Stevens Act," the NRC staff establishes that Essential Fish Habitat (EFH) is not designated within Conowingo Pond. However, the National Marine Fisheries Service and Atlantic States Marine Fisheries

Commission have designated EFH near the mouth of the Susquehanna River for the following six federally managed species (referred to as “EFH species” in this SEIS) and life stages.

- Atlantic herring (*Clupea harengus*)—juveniles and adults
- clearnose skate (*Raja eglanteria*)—juvenile and adults
- little skate (*Leucoraja erinacea*)—adults
- red hake (*Urophycis chuss*)—all life stages
- windowpane flounder (*Scophthalmus aquosus*)—adults
- winter skate (*Leucoraja ocellata*)—juveniles and adults

As described in Section 3.8.2, these EFH species may consume anadromous prey fish that migrate from Conowingo Pond, downstream through EFH-designated areas of the Susquehanna River, and to estuarine and marine waters. Because of this, the effects of the Peach Bottom subsequent license renewal on these EFH species’ prey is a potential adverse effect according to the National Marine Fisheries Service’s regulatory definition of this term (50 CFR 600.810, “Definitions and Word Usage”):

> *Adverse effect* means any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

Further, in 50 CFR 600.815(a)(7), adverse effects to EFH resulting from prey loss are described as follows:

> Loss of prey may be an adverse effect on EFH and managed species because the presence of prey makes waters and substrate function as feeding habitat, and the definition of EFH includes waters and substrate necessary to fish for feeding. Therefore, actions that reduce the availability of a major prey species, either through direct harm or capture, or through adverse impacts to the prey species' habitat that are known to cause a reduction in the population of the prey species, may be considered adverse effects on EFH if such actions reduce the quality of EFH.

In order to assess whether the continued operation of Peach Bottom during the subsequent license renewal term has the potential to cause adverse effects on EFH, the NRC staff considered the following questions in a step-wise approach:

- Do anadromous fish constitute a major portion of the prey base of the identified EFH species?
- Are anadromous prey fish present in Conowingo Pond?
- Would continued operation of Peach Bottom during the subsequent license renewal term reduce the availability of anadromous prey fish?
- Would continued operation of Peach Bottom during the subsequent license renewal term result in adverse impacts to the habitat of anadromous prey fish that could reduce the abundance of these populations?

Do Anadromous Fish Constitute a Major Portion of the Prey Base of the Identified EFH Species?

Section 3.8.2, "Species and Habitats Protected Under the Magnuson–Stevens Act," of this SEIS describes the diet and foraging habitats of each of the six EFH species. In that section, the NRC staff determines that Atlantic herring, clearnose skate, and red hake do not consume gizzard shad, American shad, hickory shad, alewife, blueback herring, or other anadromous fish that may migrate between Conowingo Pond and EFH-designated regions of the Susquehanna River. The NRC staff also determines in that section that although little skate, windowpane flounder, and winter skate consume anadromous fish, these fish constitute only a minor portion of the three EFH species' total food consumption (or less than 10 percent of the diet by weight). Accordingly, the NRC staff finds that anadromous fish do not constitute a major portion of the prey base of any of the six EFH species.

Are Anadromous Prey Fish Present in Conowingo Pond?

The anadromous prey fish present in and near Conowingo Pond include gizzard shad, American shad, hickory shad, alewife, and blueback herring. As described in Section 3.7.3, "NOAA Trust Resources," anadromous fish use Conowingo Pond's east fish lift to access the pond. Within Conowingo Pond, gizzard shad is the most common anadromous species. In 2010–2013 surveys, gizzard shad comprised 17 to 47 percent of the fish within Conowingo Pond (see Table 3-10). During the same time period, alewife and blueback herring rarely passed from the lower Susquehanna into Conowingo Pond, and all *Alosa* species (e.g., American shad, hickory shad, alewife, and blueback herring) were relatively rare in Conowingo Pond collections. Over the study period, NAI and ERM captured only one American shad, one alewife, and no blueback herring, alewife, or hickory shad (NAI 2014b, 2015b, 2016, 2017). Based on the above information, the NRC staff finds that anadromous prey fish are present in Conowingo Pond.

Would Continued Operation of Peach Bottom During the Subsequent License Renewal Term Reduce the Availability of Anadromous Prey Fish?

Peach Bottom's continued operation during the subsequent license renewal term has the potential to reduce the availability of anadromous prey fish through impingement, entrainment, and thermal effects. If these effects individually or cumulatively were to result in a reduction in the abundance of these prey species, an adverse impact on EFH could result.

<u>Impingement and Entrainment</u>. In Section 4.7.1.1, "Impingement and Entrainment of Aquatic Organisms (Plants with Once-Through Cooling Systems and Cooling Ponds)," of this SEIS, the NRC staff determines that the majority of individuals impinged or entrained into the Peach Bottom cooling water intake system are gizzard shad. Since 2000, gizzard shad have consistently comprised the majority (53 to 99 percent) of impinged or entrained fish each year. Gizzard shad is an introduced, non-native species in Conowingo Pond, and its population has been increasing since the 1970s in part due to this species' ability to outcompete native fish for zooplankton prey (NAI and ERM 2014). The gizzard shad's upward population trend suggests that impingement and entrainment do not noticeably alter the gizzard shad population within Conowingo Pond.

In Section 4.7.1.1, the NRC staff finds that impingement and entrainment of *Alosa* species is rare or does not occur. In 2010–2015 impingement studies, researchers did not collect any blueback herring in impingement samples. In the same study, researchers collected between 0 and 683 alewife and between 0 and 49 American shad each year (see Table 4-3). In its study report, NAI (2010a, 2014a, 2015a) noted that alewife collected during the study were likely part of a resident population of the species present in Conowingo Pond rather than individuals that had migrated from the Chesapeake Bay because no or very few alewife passed the Conowingo east fish lift in those years. As described in Section 4.7.1.1, *Alosa* species are unlikely to experience entrainment into the Peach Bottom cooling water intake system because suitable spawning habitat does not occur in the area.

Based on the above information, the NRC staff finds that impingement and entrainment over the course of the Peach Bottom subsequent license renewal term would not appreciably or noticeably reduce the abundance of any anadromous prey species' populations. Therefore, the NRC staff anticipates no adverse impacts to EFH.

<u>Thermal Impacts</u>. In Section 4.7.1.2, "Thermal Impacts on Aquatic Organisms (Plants with Once-Through Cooling Systems or Cooling Ponds)," of this SEIS, the NRC staff determines that, for the majority of the year, the overall Conowingo Pond aquatic community would not be noticeably altered or experience detectable effects through exposure to Peach Bottom's thermal effluent over the course of the subsequent license renewal term. During the summer months, a 12- to 19-ac (4.9- to 7.7-ha) area of shallow shoreline habitat downstream of the Peach Bottom discharge would experience heightened temperatures. However, this narrow band of heightened temperatures, which comprises only 2.5 percent of Conowingo Pond's shallow shoreline habitat, would not block fish passage. Migrating fish could avoid the thermal plume in order to move up or downstream, and these effects would be seasonal, localized, and temporary.

Prior to the 2014 power uprate at Peach Bottom, Exelon contracted two thermal studies to, in part, evaluate the potential impacts of Peach Bottom operation at the increased power level on migratory fish, such as hickory shad and American eel (NAI and GSE 2012b) and to, in part, prepare for Exelon's application to relicense the Muddy Run Reservoir project (NAI and GSE 2012b). As a result of radio-tagging performed during the studies, NAI (NAI and GSE 2012b) concluded that Peach Bottom's thermal plume does not block the migration of anadromous fish traveling through Conowingo Pond. NAI found that the greatest impediment to fish migration was the inefficient use of fish lifts at Conowingo Dam and spikes in natural river flows at Holtwood Dam in combination with high water turbulence and velocity.

Based on the above information, the NRC staff finds that thermal impacts that anadromous prey fish may experience over the course of the Peach Bottom subsequent license renewal term would not appreciably or measurably reduce the abundance of these species' populations. Therefore, the NRC staff anticipates no adverse impacts to EFH.

Would Continued Operation of Peach Bottom During the Subsequent License Renewal Term Result in Adverse Impacts to the Habitat of Anadromous Prey Fish That Could Reduce the Abundance of These Populations?

Beyond the direct effects evaluated above (i.e., impingement, entrainment, and thermal effects), the Peach Bottom subsequent license renewal could indirectly affect anadromous prey fish through adverse impacts to those species' habitats. If such habitat effects were to result in reductions in the abundance of anadromous prey fish, an adverse impact on EFH could result. The potential adverse impacts to habitat include the following, all of which the NRC (2013a) determined generically in the GEIS would have SMALL impacts on the aquatic environment as a whole (see Table 4-1).

- entrainment of phytoplankton and zooplankton
- effects of dissolved oxygen content, gas supersaturation, or eutrophication associated with cooling water discharge
- effects related to nonradiological contaminants

- exposure to radionuclides
- effects related to dredging
- predation, parasitism, and disease from exposure to sublethal stresses

In Section 4.7, “Aquatic Resources,” of this SEIS, the NRC staff concludes that the GEIS’s generic conclusions of “SMALL” apply to the subsequent license renewal. This determination means that the above-listed impacts would either not be detectable or would be so minor that they would not destabilize or noticeably alter any important attribute of the aquatic environment. The NRC staff did not identify any information indicating that these effects could more intensely or uniquely affect anadromous prey fish populations. Accordingly, the NRC staff finds that these effects would not appreciably or measurably reduce the abundance of these species’ populations. Therefore, the NRC staff anticipates no adverse impacts to EFH.

Summary of Effects and Conclusions for Designated EFH

The Peach Bottom subsequent license renewal would have no direct effects on the EFH of any species because no designated EFH is present in Conowingo Pond. All potential adverse impacts on EFH would be limited to loss of prey for those EFH species that consume anadromous prey species that migrate through Conowingo Pond. Atlantic herring, clearnose skate, and red hake do not consume anadromous prey fish. Therefore, subsequent license renewal would result in *no effects* on the designated EFH of these species.

Although the remaining EFH species—little skate, windowpane flounder, and winter skate—consume anadromous prey fish, these fish constitute a minor portion of the three EFH species’ diet. Some anadromous prey fish are present in Conowingo Pond. The gizzard shad is common in the pond, while all *Alosa* species have been rare in collections associated with Conowingo Pond aquatic studies. None of the available studies or other information indicates that impingement, entrainment, thermal effects, or indirect impacts to the habitat of these anadromous species would be noticeably affected as a result of Peach Bottom operations during the subsequent license renewal term. Accordingly, no adverse effects to EFH would result from loss of prey, and the NRC staff concludes that the proposed action would have *no adverse effects* on the designated EFH for little skate, windowpane flounder, or winter skate.

4.8.2 No-Action Alternative

Under the no-action alternative, the Endangered Species Act action area and the EFH area of potential effect under the no-action alternative would most likely be the same or similar to those areas described in Section 3.8.1.1, “Peach Bottom Action Area,” and 3.8.2, “Species and Habitats Protected Under the Magnuson–Stevens Act.” Upon shutdown, the plant would require substantially less cooling water and would produce less thermal effluent. Thus, the potential for impacts to all aquatic species related to cooling system operation would be significantly reduced. Overall, the effects on federally listed species and critical habitats and EFH would likely be smaller than the effects under continued operation but would depend on the specific shutdown activities as well as the listed species, critical habitats, and designated EFH present when the no-action alternative is implemented.

4.8.3 Replacement Power Alternatives: Common Impacts

The replacement power alternatives would each entail construction and operation of a new energy-generating facility at an existing nuclear power plant site or retired coal plant site in either Pennsylvania, Delaware, Maryland, or New Jersey. Certain alternatives would also entail offsite construction, which is addressed for each of those alternatives below. This section addresses the qualitatively similar impacts to special status species and habitats that would result from implementation of any of the replacement power alternatives (e.g., new nuclear, coal, natural gas, or the combination alternative).

The Endangered Species Act action area and marine waters potentially containing designated EFH for any of the replacement alternatives would depend on factors including: site selection, current land uses, planned construction activities, temporary and permanent structure locations and parameters, and timeline of the alternative. The listed species, critical habitats, and EFH potentially affected by a particular alternative would depend on the boundaries of that alternative's effects and the species and habitats federally protected at the time the alternative is implemented. For instance, if Peach Bottom continues to operate until the end of the current license terms (2033 for Unit 2 and 2034 for Unit 3) and a replacement power alternative is implemented at that time, the U.S. Fish and Wildlife Service or the National Marine Fisheries Service may have listed new species, delisted currently listed species whose populations have recovered, or revised EFH designations. These listing and designation activities would change the potential for the various alternatives to impact special status species and habitats. Additionally, requirements for Endangered Species Act, Section 7 consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service as well as EFH consultation with the National Marine Fisheries Service would depend on whether Federal permits or authorizations are required to implement each particular alternative.

Sections 4.6.3 and 4.7.3, both titled "Replacement Power Alternatives: Common Impacts," describe the types of impacts that terrestrial and aquatic resources would experience under each alternative. Impacts on special status species and habitats would likely be similar in type. However, the magnitude and significance of such impacts could be larger because special status species and habitats are rare and more sensitive to environmental stressors.

4.8.4 New Nuclear Alternative

The impacts of the new nuclear alternative (six or more co-located small modular reactors) are largely addressed in the impacts common to all replacement power alternatives described in the previous section. Because the NRC would remain the licensing agency under this alternative, the Endangered Species Act and Magnuson–Stevens Act would require the NRC to consult with the U.S. Fish and Wildlife Service and National Marine Fisheries Service, as applicable, prior to issuing a license for construction and operation of new small modular reactors. During these consultations, the agencies would determine whether the new reactors would affect any federally listed species, adversely modify or destroy designated critical habitat, or result in adverse effects on EFH, if present. If the new reactors required a CWA Section 404 permit, the U.S. Army Corps of Engineers may be a cooperating agency for the ESA consultation or the U.S. Army Corps may be required to consult separately. Ultimately, the magnitude and significance of adverse impacts on special status species and habitats would depend on the site location and layout, plant design, plant operations, and the special status species and habitats present in the area when the alternative is implemented.

4.8.5 Supercritical Pulverized Coal Alternative

The NRC staff did not identify any impacts to special status species and habitats for the supercritical pulverized coal alternative beyond those discussed in the impacts common to all replacement power alternatives. Unlike Peach Bottom subsequent license renewal or the licensing of a new nuclear alternative, the NRC does not license coal facilities; therefore, the

NRC would not be responsible for initiating Endangered Species Act Section 7 consultation or EFH consultation if special status species or habitats might be adversely affected under this alternative. Other Federal agencies could be responsible for addressing impacts on special status species and habitats depending on the specific permits or licenses that the new plant would require. For instance, if the new reactors required a CWA Section 404 permit, the Endangered Species Act would require the U.S. Army Corps of Engineers to consider impacts on federally listed species and EFH. If no Federal permits were required, the companies or entities implementing this alternative would be responsible for ensuring that their actions do not jeopardize the continued existence of listed species because the Endangered Species Act, Section 9 take prohibitions apply to both Federal and non-Federal entities. The Magnuson–Stevens Act only requires EFH consultation for Federal actions. Therefore, EFH consultation would be required if a Federal agency, such as the U.S. Army Corps of Engineers, is involved in the permitting or authorization of this alternative and adverse effects are possible. Ultimately, the magnitude and significance of adverse impacts on special status species and habitats would depend on the site location and layout, plant design, plant operations, and the special status species and habitats present in the area when the alternative is implemented.

4.8.6 Natural Gas Combined-Cycle Alternative

The NRC staff did not identify any impacts to special status species and habitats for the natural gas combined-cycle alternative beyond those discussed in the impacts common to all alternatives. The NRC does not license natural gas facilities; therefore, the NRC would not be responsible for Endangered Species Act Section 7 or EFH consultation. The Federal and private responsibilities for addressing impacts on special status species and habitats under this alternative would be similar to those described for the coal alternative in Section 4.8.3.2. Ultimately, the magnitude and significance of adverse impacts on special status species and habitats resulting from the natural gas alternative would depend on the site location and layout, plant design, plant operations, and the special status species and habitats present in the area when the alternative is implemented.

4.8.7 Combination Alternative (Natural Gas Combined-Cycle Alternative, Wind, Solar, and Purchased Power)

The NRC staff did not identify any impacts to special status species and habitats for the combination alternative beyond the common impacts for all replacement power alternatives as described in Section 4.8.3. The NRC does not license natural gas, wind, or solar facilities or play a role in energy-planning decisions; therefore, the NRC would not be responsible for Endangered Species Act Section 7 or EFH consultation. The Federal and private responsibilities for addressing impacts on special status species and habitats under this alternative would be similar to those described for the coal alternative in Section 4.8.3.2. Ultimately, the magnitude and significance of adverse impacts on special status species and habitats resulting from the combination alternative would depend on the site location and layout, plant design, plant operations, and the special status species and habitats present in the area when the alternative is implemented.

4.9 Historic and Cultural Resources

This section describes the potential historic and cultural resources impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.9.1 Proposed Action

Table 4-2 identifies one site-specific (Category 2) issue related to historic and cultural resources applicable to Peach Bottom during the subsequent license renewal term. This issue is analyzed below.

4.9.1.1 Category 2 Issue Related to Historic and Cultural Resources

The National Historic Preservation Act of 1966, as amended (54 U.S.C. 300101 et seq.) (NHPA), requires Federal agencies to consider the effects of their undertakings on historic properties. Issuing a subsequent renewed operating license to a nuclear power plant is an undertaking that could potentially affect historic properties. Historic properties are defined as resources included on, or eligible for inclusion on, the National Register of Historic Places (NRHP). The criteria for eligibility are listed in Title 36, "Parks, Forests, and Public Property," of the *Code of Federal Regulations* (36 CFR) 60.4 "Criteria for evaluation," and include, in part, (a) association with significant events in history, (b) association with the lives of persons significant in the past, (c) embodiment of distinctive characteristics of type, period, or construction, and (d) sites or places that have yielded, or may be likely to yield, important information.

The historic preservation review process (NHPA Section 106) is outlined in regulations issued by the Advisory Council on Historic Preservation (ACHP) in 36 CFR Part 800, "Protection of Historic Properties." In accordance with NHPA provisions, the NRC establishes the undertaking (subsequent license renewal), identifies the appropriate State or Tribal historic preservation officer, and initiates consultation with the appropriate officer. The NRC is required to make a reasonable effort to identify historic properties in the area of potential effect that are included in, or eligible for inclusion in, the NRHP. The area of potential effect for a subsequent license renewal action includes the power plant site, the transmission lines up to the first substation, and immediate environs that may be affected by the subsequent license renewal decision and land-disturbing activities associated with continued reactor operations during the subsequent license renewal term. In addition, the NRC is required to notify the State historic preservation officer if historic properties would not be affected by license renewal or if no historic properties are present. In Pennsylvania, the Pennsylvania State Historic Preservation Office, a bureau within the Pennsylvania Historical and Museum Commission, administers the State's historic preservation program.

4.9.1.2 Consultation

In accordance with 36 CFR 800.8, "Coordination with the National Environmental Policy Act," on September 10, 2018, the NRC initiated consultations by sending letters to the ACHP and the Pennsylvania State historic preservation officer (NRC 2018d). Also, on September 10, 2018, the NRC initiated consultation by sending letters to the following Federally recognized Tribes (NRC 2018d, see Appendix C):

- Absentee-Shawnee Tribe of Oklahoma
- Cayuga Nation
- Delaware Nation
- Delaware Tribe of Indians
- Oneida Indian Nation
- Oneida Nation
- Onondaga Nation

- Seneca Nation of Indians
- Seneca-Cayuga Nation
- St. Regis Mohawk Tribe
- Shawnee Tribe
- Stockbridge-Munsee Community
- Tonawanda Band of Seneca
- Tuscarora Nation

In these letters, the NRC provided information about the proposed action, defined the area of potential effect, and indicated that the NRC would integrate its NHPA review with its National Environmental Policy Act process, in accordance with 36 CFR 800.8(c). The NRC invited participation in the identification of, and possible decisions concerning, historic properties and also invited participation in the scoping process. On October 3, 2018, the NRC and staff from the Pennsylvania State Historic Preservation Office participated in a historic and cultural resource tour of Peach Bottom with Exelon staff (NRC 2018i). The tour included the Peach Bottom Atomic Power Station Unit 1, the site training center, and the onsite boat ramp and picnic area. Additionally, NRC and Pennsylvania State Historic Preservation Office staff viewed a video documenting construction and operation of Peach Bottom Atomic Power Station Unit 1 and historical site construction photographs. The Pennsylvania State Historic Preservation Office subsequently stated in correspondence to the NRC that "[t]here may be historic buildings, structures, and/or archaeological resources located in or near the project. In our opinion, the activities described in your proposal should have no effects on these resources." (Pennsylvania State Historic Preservation Office 2018).

4.9.1.3 Findings

As discussed in Section 3.9, "Historic and Cultural Resources," cultural resource surveys have not been conducted within the Peach Bottom site. However, in 1972, a field archeologist noted that archeological resources that may have been present along the flood plain and terraces were flooded by backwaters of the Conowingo Pond, and construction of Peach Bottom Units 1, 2 and 3 likely disturbed any historic and archaeological resources that may have been located within the site footprint. Exelon states in its environmental report (submitted as part of its subsequent license renewal application) that no known archaeological resources were disturbed during construction of Peach Bottom (Exelon 2018a). Peach Bottom Unit 1 has not been evaluated for eligibility for listing in the National Register of Historic Places. Given Peach Bottom Unit 1's age (older than 50 years), design, development, and operation, as well as the consortium of utilities involved, it is potentially eligible for listing in the National Register of Historic Places under Criterion a (association with significant events in history) or Criterion c (embodiment of distinctive characteristics of type, period, or construction). Exelon intends to manage the status of Peach Bottom Unit 1 (in SAFSTOR) and coincide final decommissioning of Unit 1 with the decommissioning of Peach Bottom Units 2 and 3 (Exelon 2018a, Exelon 2018c). After permanent shutdown of Peach Bottom Units 2 and 3, Exelon will review potential impacts of decommissioning resources as part of the post-shutdown activities report preparation and submission to the NRC. Before commencing decommissioning activities that would dismantle potentially significant historic resources at the site, such as Peach Bottom Unit 1, Exelon will take steps in accordance with company procedures and applicable laws to ensure that it conducts consultations with the Pennsylvania State Historic Preservation Office, that it considers historic significance, and that it addresses decommissioning effects (Exelon 2018c, Exelon 2018a).

Exelon did not identify ground-disturbing activities, new construction, or facility modifications necessary for the subsequent license renewal term (Exelon 2018a). Plant operations and maintenance activities during the subsequent license renewal term are expected to be similar to current operations (Exelon 2018a). In the event that ground-disturbing activities are required as a result of plant operations and maintenance activities, Exelon has procedures in place regarding the actions to take if cultural resources are discovered inadvertently. These procedures state that if a cultural or historic resource is encountered inadvertently, work should be stopped, appropriate personnel will be notified, a cover would be placed to protect the exposed resource, and access to the area would be controlled (Exelon 2018a; Exelon 2018c). Furthermore, Exelon has procedures that provide a process for screening proposed activities, such as land disturbance, that assist in determining if there is a need to further evaluate environmental impacts and risks prior to commencing the activity (Exelon 2018c). If impacts or risks are identified as part of the evaluation, Exelon would contact the Pennsylvania State Historic Preservation Office to determine what measures should be taken to minimize and mitigate the impacts. Exelon ensures that employees are aware of procedures and actions to take through job training, pre-job briefs, procedural compliance, and supervisory oversight (Exelon 2018a; Exelon 2018c).

During the subsequent license renewal term, Exelon does not anticipate ground-disturbing or construction activities. Exelon has procedures in place that describe measures taken if cultural or historic resources are encountered inadvertently. Based on this information and input provided to the NRC staff by the Pennsylvania State Historic Preservation Office, the NRC staff concludes that subsequent license renewal for Peach Bottom Units 2 and 3 would not adversely affect any known historic properties or historic and cultural resources.

4.9.2 No-Action Alternative

Under the no-action alternative, land-disturbance activities or dismantlement are not anticipated, as these would be conducted during decommissioning. Therefore, facility shutdown would have no immediate effect on historic properties.

4.9.3 Replacement Power Alternatives: Common Impacts

The potential for impacts to historic and cultural resources from construction and operation of a replacement power alternative would vary greatly depending on the location of the site. If construction and operation of replacement power alternatives require a Federal undertaking (e.g., license, permit), the Federal agency would need to make a reasonable effort to identify historic properties within the area of potential effects and consider the effects of their undertakings on historic properties, in accordance with Section 106 of the NHPA. Historic and cultural resources identified would need to be recorded and evaluated for eligibility for listing on the NRHP. If historic properties are present and could be affected by the undertaking, adverse effects would be assessed, determined, and resolved in consultation with the State historic preservation officer and any Indian Tribe that attaches religious and cultural significance to identified historic properties through the Section 106 process.

<u>Construction</u>

Impacts to historic and cultural resources from the construction of replacement power alternatives are primarily related to ground disturbance (land clearing, excavations, etc.). As discussed above, in accordance with 36 CFR 800, potentially affected land areas would need to be surveyed, including land required for new roads, transmission corridors, and other rights-of-way (ROWs) if construction of the replacement alternative requires a Federal undertaking. Any historic and cultural resources found during these surveys would need to be recorded and evaluated for eligibility for listing on the NRHP. Mitigation of adverse effects would need to be considered if eligible resources are encountered. Areas with the greatest sensitivity and most cultural resources could be avoided. Construction at a previously disturbed site and avoidance of undisturbed land could reduce potential impacts to historic and cultural resources.

Operation

The potential for impacts on historic and cultural resources from the operation of replacement power alternatives would be related to maintenance activities at the site as well as visual impacts that would vary with plant heights and associated exhaust stack or cooling towers.

4.9.4 New Nuclear Alternative

Impacts on historic and cultural resources from the construction and operation of a new nuclear alternative (six or more co-located small modular reactors) would include those discussed above as impacts common to all replacement power alternatives. The new nuclear alternative would require an estimated 220 ac (89 ha) and would be located at an existing or retired plant site. Some infrastructure upgrades may be required, but existing transportation and transmission line infrastructure would be adequate to support the alternative. The tallest buildings/structures would be in the power block reaching approximately 160 ft (50 m) in height. Since the alternative would be located at an existing power plant or retired plant site, tall structures or plumes are likely to already exist at the site. Therefore, the NRC staff does not anticipate viewshed (area visible from a given location) impacts to historic or cultural resources from the introduction of additional structures that are compatible with an industrial site and not out of character with the current setting.

Given the preference to use a previously disturbed existing or former power plant site, that no major infrastructure upgrades would be necessary, and that avoidance of significant historic and cultural resources should be possible and effectively managed under current laws and regulations, the NRC staff concludes that construction of a new nuclear alternative would not adversely affect known historic and cultural resources.

4.9.5 Supercritical Pulverized Coal Alternative

Impacts on historic and cultural resources from the construction and operation of a coal alternative would include those discussed above as impacts common to all replacement power alternatives. The coal alternative would require an estimated 4,000 ac (1,600 ha) for the facility and coal storage and would be located at an existing or retired plant site. Some infrastructure upgrades may be required, but existing transportation and transmission line infrastructure would be adequate to support the alternative. The tallest structures would be the cooling towers and exhaust stack. Since the alternative would be located at an existing power plant or retired plant site, tall structures or plumes are likely to already exist at the site. Therefore, the NRC staff does not anticipate viewshed impacts to historic or cultural resources from the introduction of additional cooling towers or exhaust stacks that are compatible with an industrial site and not out of character with the current setting.

Given the preference to use a previously disturbed existing or former power plant site, that no major infrastructure upgrades are necessary, and that avoidance of significant historic and cultural resources should be possible and effectively managed under current laws and regulations, the NRC staff concludes that construction of a coal alternative would not adversely affect known historic and cultural resources.

4.9.6 Natural Gas Combined-Cycle Alternative

Impacts on historic and cultural resources from the construction and operation of a natural gas alternative would include those discussed above as impacts common to all replacement power alternatives. The natural gas alternative would require up to an estimated 10,400 ac (4,200 ha) and would be located at an existing or retired plant site. Land requirements for this alternative would be primarily for gas extraction; approximately 250 ac (100 ha) would be required for the plant itself. Existing transportation and transmission line infrastructure would be adequate to support the alternative. Depending on the site location and availability of existing natural gas pipelines, additional rights-of-way may be needed and some infrastructure upgrades may be required. Therefore, historic and archaeological resources could potentially be affected, depending on the resource richness of the land required for a new gas pipeline. The tallest structures would be the plant stack and cooling towers. Since the alternative would be located at an existing or retired plant site, tall structures or plumes are likely to already exist at the site. Therefore, the NRC staff does not anticipate viewshed impacts to historic or cultural resources from the introduction of additional cooling towers or exhaust stacks that are compatible with an industrial site. The potential for impacts on historic and cultural resources from the construction and operation of a gas alternative would vary depending on the site location and infrastructure upgrades.

For the plant site itself, given that the preference is to use a previously disturbed existing or retired power plant site and that avoidance of significant historic and cultural resources should be possible and effectively managed under current laws and regulations, the NRC staff concludes that construction and operation of the natural gas alternative would not adversely affect known historic and cultural resources at the plant site. However, historic and archaeological resources could potentially be adversely affected, depending on the resource richness of the land required if construction of a new pipeline is needed.

4.9.7 Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)

Historic and cultural resource impacts from the natural gas portion of the combination alternative would be similar to the natural gas-only alternative as described in Section 4.9.6. Therefore, construction and operation of the natural gas alternative would not adversely affect known historic and cultural resources at the plant site itself. However, historic and archaeological resources could potentially be adversely affected, depending on the resource richness of the land required, if construction of a new pipeline is needed.

The potential for impacts on historic and cultural resources from the wind and solar portion of the combination alternative would vary greatly, depending on the location of the proposed sites. Utility-scale wind farms would require relatively large areas. Areas with the greatest cultural sensitivity could be avoided or effectively managed under current laws and regulations. Construction of wind farms and their support infrastructure could impact historic and cultural resources because of earth-moving activities (e.g., grading and digging) and the aesthetic changes to the viewshed of historic properties located nearby as a result of the wind turbines. The potential for impacts on historic and cultural resources from the solar component would result from land disturbances and aesthetic changes that could have a noticeable effect on the viewshed of nearby historic properties. Using previously disturbed sites and co-locating any new transmission lines with existing rights-of-way could minimize impacts to historic and cultural resources. Depending on the resource richness of the sites chosen for the wind and solar portions of the combination alternative, the impacts on historic and cultural resources could range from "will not adversely affect known historic and cultural resources" to "may adversely affect known historic and cultural resources."

The potential for impacts on historic and cultural resources from purchased power would vary greatly and would depend on plant modifications or the need to construct new electrical power generating facilities. For instance, if purchased power would require plant modifications at existing facilities or construction of transmission lines requiring land disturbance, there is a potential for impacts on historic and cultural resources. However, if there are no changes to the facility or no need for additional transmission lines, impacts on historic and cultural resources would not be anticipated. If new electrical power generating facilities need to be constructed and operated, the potential for impacts on historic and cultural resources would vary and would depend on site location, land disturbance, plant or facility technology, and aesthetic changes. Therefore, the impacts on historic and cultural resources from purchased power could range from "will not adversely affect known historic and cultural resources" to "may adversely affect known historic and cultural resources."

4.10 Socioeconomics

This section describes the potential socioeconomic impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.10.1 Proposed Action

Socioeconomic effects of ongoing reactor operations at Peach Bottom have become well established as regional socioeconomic conditions have adjusted to the presence of the nuclear power plant. Any changes in employment and tax revenue caused by license renewal and any associated refurbishment activities could have a direct and indirect impact on community services and housing demand, as well as traffic volumes in the communities around the nuclear power plant.

As discussed in Section 3.10, "Socioeconomics," Exelon has no plans to add additional employees to support plant operations during the subsequent license renewal term and will not conduct refurbishment activities. Therefore, the NRC does not anticipate changes in housing demand or traffic volumes as a result of subsequent license renewal. However, there may be changes in tax revenue as a result of future property tax settlements between Exelon and taxing jurisdictions (York County, Peach Bottom Township, and South Eastern School District). While the magnitude of future tax payment adjustments is unknown, the combined Peach Bottom real estate tax and payments in addition to tax have represented less than 4 percent of each taxing jurisdiction's real estate tax revenue. Given the total amount of revenue received by the taxing jurisdictions, future incremental adjustments to Exelon's tax payments likely would not be noticeable. Consequently, the impact of continued reactor operations during the subsequent license renewal term would not exceed the socioeconomic impacts predicted in the GEIS (NRC 2013a). As identified in Table 4-1, the socioeconomic impacts of continued reactor operations during the subsequent license renewal term would be SMALL. Table 4-2 in Section 4.1 of this SEIS does not identify any site-specific (Category 2) socioeconomic issues for Peach Bottom.

4.10.2 No-Action Alternative

4.10.2.1 Socioeconomics

Under the no-action alternative, termination of nuclear power plant operations would result in cessation of electrical power production and a loss of jobs, income, and tax revenues. Socioeconomic impacts from the termination of reactor operations would be concentrated in Lancaster and York counties since the majority of Exelon workers reside in these counties. Employment and income from the buying and selling of goods and services needed to operate and maintain the nuclear power plant would also be reduced. Indirect employment and income generated by power plant operations would also be reduced.

As jobs are eliminated, some, but not all, of the approximately 920 Exelon workers (permanent and contractor) could begin to leave the region. If Exelon workers and their families move out of the region, increased housing vacancies and decreased demand could cause housing prices to fall. However, the Exelon workforce represents approximately 0.18 percent of the civilian labor force of the two-county socioeconomic region of influence (i.e., Lancaster and York counties) (see Section 3.10.2.1, "Regional Employment and Income"). The loss of tax revenue could result in the reduction or elimination of some public and educational services. As noted in Section 3.10.5, "Tax Revenues," real estate tax revenues constitute a significant amount of total local jurisdiction revenues. The combined Peach Bottom real estate tax and payments in addition to tax represented approximately 0.17 percent of the total York County real estate tax revenue, 3.9 percent of the total South Eastern School District real estate tax revenue, and 3.1 percent of the total Peach Bottom Township real estate tax revenue (Exelon 2018c). Therefore, the socioeconomic impacts from not renewing the operating license and terminating reactor operations at Peach Bottom would range from SMALL to MODERATE, depending on the jurisdiction.

4.10.2.2 Transportation

Traffic volume as a result of commuting workers on roads in the vicinity of Peach Bottom would be reduced after plant shutdown. The reduction in traffic would be associated with the loss of jobs. Similarly, truck deliveries to Peach Bottom would be reduced. A reduction in worker vehicles and truck deliveries could be noticeable on roads in the immediate vicinity of Peach Bottom. However, the reduction of vehicles would not destabilize traffic flow. Therefore, traffic-related transportation impacts would be SMALL as a result of the shutdown of Peach Bottom Units 2 and 3.

4.10.3 Replacement Power Alternatives: Common Impacts

The NRC staff evaluated the workforce requirements for replacement power alternatives to measure their possible effects on current socioeconomic and transportation conditions. The following provides a discussion of the common socioeconomic and transportation impacts during construction and operations of replacement power generating facilities.

4.10.3.1 Socioeconomics

Socioeconomic impacts are defined in terms of changes in the social and economic conditions of a region. For example, the creation of jobs and the purchase of goods and services during construction and operation of a replacement power facility could affect regional employment, income, and tax revenue. The NRC staff assumes that the replacement power alternative facilities could be located anywhere in Pennsylvania or the adjoining PJM regional transmission organization States of Delaware, Maryland, and New Jersey. The socioeconomic region of influence would depend on where workers and their families reside, spend their income, and use their benefits, thus affecting the economic conditions of the region. For each replacement power alternative, two types of jobs would be created:

(1) construction jobs—transient, short in duration, and less likely to have a long-term socioeconomic impact
(2) operations jobs—have the greater potential for permanent, long-term socioeconomic impacts

Construction

The relative economic effect of an influx of workers on the local economy and tax revenue would vary and depend on the size of the workforce and construction completion time. The greatest impact would occur in the communities where the majority of construction workers would reside and spend their incomes. While some construction workers would be local, additional workers may be required from outside the immediate area depending on the local availability of appropriate trades and occupational groups. For instance, at plants in rural locations, a larger number of construction workers would come from outside the local area, while most of the workforce in semi-urban locations would likely commute to the job site rather than relocate (NRC 2013a). The construction workforce would stimulate spending on goods and services resulting in the creation of indirect jobs. The socioeconomic region of influence could experience a short-term economic boom during construction from increased tax revenue (e.g., sales tax, income tax, property tax), expenditures for goods and services, and the increased demand for temporary (rental) housing. After construction, the socioeconomic region of influence would likely experience a return to preconstruction economic conditions. The economic effect from construction would include increased tax revenue, additional wages and benefits, and increased income generated by operational expenditures. Overall, the relative socioeconomic impact from job creation, labor wages and salaries, and additional tax revenue as a result of construction, while beneficial, would depend on the tax structure of the local economy, availability of local workforce and worker migration, and location of major equipment suppliers.

Operation

Prior to the commencement of startup and operations of a replacement power alternative facility, local communities could see an influx of operations workers and their families resulting in an increased demand for permanent housing and public services. These communities would also experience the economic benefits from increased income and tax revenue generated by the purchase of goods and services needed to operate a new power plant, local taxes on worker incomes, sales tax from worker expenditures, and property tax of the facilities. Consequently, power plant operations would have a greater potential for affecting permanent, long-term socioeconomic impacts on the region. As would be the case for construction, the impacts of the operation of power plants on employment and income in the local area and region around a new plant would vary depending on the location of major equipment suppliers and the availability of local labor. The economic effect from operating a new facility could include increased tax revenue from property and sales tax, additional wages, increased income generated by operational expenditures, and increased demand for housing. The relative socioeconomic impact would depend on the tax structure of the local economy, availability of local workforce and worker migration, and available housing.

4.10.3.2 Transportation

Transportation impacts are defined in terms of changes in level of service conditions on local roads in the region. Additional vehicles on local roadways during construction and operations could lead to traffic congestion, level-of-service impacts, and delays at intersections. Transportation impacts depend on the size of the workforce and additional vehicles, the capacity of the local road network and infrastructure, and baseline traffic conditions and patterns.

Construction

Transportation impacts during the construction of a replacement power plant would consist of commuting workers and truck deliveries of equipment and material to the construction site. Workers would arrive via site access roads and the volume of traffic would increase during shift changes. In addition, trucks would transport equipment and material to the construction site, thus increasing the amount of traffic on local roads. The increase in traffic volumes could result in levels of service impacts and delays at intersections during certain hours of the day. In some instances, construction material could also be delivered by rail or barge.

Operation

Traffic-related transportation impacts would be greatly reduced after construction of the replacement power alternative facility has been completed. Transportation impacts would include daily commuting by the operations workforce and deliveries of material, and the removal of commercial waste material by truck. Increased commuter traffic would occur during shift changes and deliveries of materials and equipment to the power plant.

4.10.4 New Nuclear Alternative

4.10.4.1 Socioeconomics

The socioeconomic impacts from construction and operation of a new nuclear alternative (six or more co-located small modular reactors) would include those discussed above in Section 4.10.3 as impacts common to all replacement power alternatives. Construction of a new nuclear alternative would require a large workforce, with a peak at approximately 3,330 workers. The construction of a new nuclear power plant would create a relatively large number of jobs (directly and indirectly) and wages. Given the large construction workforce, the socioeconomic impacts would be noticeable. Therefore, depending on the site location and local economy, the socioeconomic impacts from construction of a new nuclear alternative would range from MODERATE to LARGE.

Approximately 1,500 workers would be required during operations (approximately half the construction workforce). Additional property tax revenues would result from the land requirements and operation of the facility. However, a new nuclear alternative would require a relative small amount of land (approximately 200 ac (81 ha)). Therefore, the socioeconomic impacts from operating a new nuclear power plant would be SMALL to MODERATE and would depend on the location of the new nuclear power plant and the local economy in that area.

4.10.4.2 Transportation

The transportation impacts from construction and operation of a new nuclear alternative would include those discussed above in Section 4.10.3 as impacts common to all replacement power alternatives.

An additional peak 3,330 workers and truck deliveries during construction would increase traffic on roads in the vicinity of the site and could result in a loss of service for nearby roads. Given the relatively large number of peak workers during construction, traffic-related transportation impacts would be noticeable, particularly during shift changes during peak construction. Depending on the site location and therefore the nearby site road system and traffic levels, traffic-related transportation impacts as a result of construction could range from MODERATE to LARGE.

Approximately 1,300 workers would be commuting daily to the site during operations. While worker and delivery vehicle traffic would be reduced after construction of the small modular facility, level-of-service impacts could still be experienced on nearby site access roads, particularly during shift changes, as a result of worker and delivery vehicles. Therefore, traffic-related transportation impacts during operation of a new nuclear power plant would range from SMALL to MODERATE.

4.10.5 Supercritical Pulverized Coal Alternative

4.10.5.1 Socioeconomics

The socioeconomic impacts from construction and operation of a coal alternative would include those discussed above in Section 4.10.3 as impacts common to all replacement power alternatives.

Construction of a supercritical pulverized coal plant would require a large workforce, with a peak at approximately 2,500 workers. Given the relative large construction workforce, the socioeconomic impacts from construction of a supercritical pulverized coal plant would range from MODERATE to LARGE, and would depend on the local economy.

Approximately 440 workers would be required during operations, a substantially lower number of workers than needed during construction. Additional property tax revenues would result from the land requirement and operation of the facility. The coal alternative would require approximately 4,800 ac (1,600 ha) for the facility itself and coal storage. The socioeconomic impacts from operating a supercritical pulverized coal facility would range from SMALL to MODERATE and would depend on site location and local economy.

4.10.5.2 Transportation

Transportation impacts from the construction and operation of a new supercritical pulverized coal facility would include those discussed above in Section 4.10.3 as impacts common to all replacement power alternatives.

Given the large construction workforce of a new supercritical pulverized coal facility (2,500 peak construction workers), traffic-related transportation impacts during construction would be similar to the transportation impacts described for the construction of the new nuclear alternative above. Therefore, traffic-related transportation impacts during construction of a new supercritical pulverized coal facility would range from MODERATE TO LARGE and would depend on the site location, nearby site road system and existing traffic levels.

Worker vehicles during operation (440 workers) of a supercritical pulverized coal facility would not be as large as the additional vehicles during construction. However, in addition to worker vehicles, coal and limestone deliveries would add to the overall transportation impact during power plant operations. If the facility is located near navigable waters, coal fuel and other materials could be delivered by barge. If the site has rail access, coal and materials could be delivered via railroads. Rail deliveries, if frequent, could result in level-of-service impacts due to delays at railroad crossings. Therefore, traffic-related transportation impacts during operation of a new supercritical pulverized coal facility could range from SMALL to MODERATE.

4.10.6 Natural Gas Combined-Cycle Alternative

4.10.6.1 Socioeconomics

The socioeconomic impacts from construction and operation of a natural gas alternative would include those discussed above in Section 4.10.3 as impacts common to all replacement power alternatives.

At about 800 workers, the construction workforce for a natural gas alternative would not be as large as the construction workforce for the new nuclear alternative or supercritical pulverized coal alternative. Therefore, the socioeconomic impacts during construction and operation of a natural gas facility would be SMALL to MODERATE and would depend on the local economy.

The estimated workforce that would be required during operations of the natural gas alternative (100 workers) is substantially lower than the operations workforce required for the new nuclear alternative or supercritical pulverized coal alternative. An additional 100 workers would not be noticeable on the local community. However, given the relatively large land requirement for a natural gas facility (up to 10,400 ac (4,209 ha), with approximately 250 ac (101 ha) needed for the plant), this would result in additional property tax revenue. Depending on the local community tax base, the increased tax revenue may be noticeable. Therefore, the socioeconomic impacts during construction and operation of a natural gas facility would be SMALL to MODERATE.

4.10.6.2 Transportation

Transportation impacts from the construction and operation of a new natural gas facility would include those discussed above in Section 4.10.3 as impacts common to all replacement power alternatives.

An additional peak 800 workers and delivery vehicles during construction would increase traffic on roads in the vicinity of the site. Depending on site location, need for additional rights-of-way, and the availability of existing natural gas pipeline, gas pipeline construction or modifications of an existing pipeline to support operations of a natural gas facility may occur. Gas pipeline construction or modification could require road and street disturbances and therefore temporary traffic disruptions. Therefore, traffic-related transportation impacts during construction of a natural gas facility would range from SMALL to MODERATE and would depend on the site location, nearby site road system, existing traffic level, and extent of road construction or modifications.

Given the relatively small number of operations workers, transportation impacts from the operation of a new natural gas facility would be minor. Additionally, because natural gas fuel will be transported via a pipeline, the transportation infrastructure would experience little to no increased traffic during power plant operations as a result of fuel delivery. Therefore, the traffic-related transportation impacts during construction of a natural gas facility would be SMALL.

4.10.7 Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)

4.10.7.1 Socioeconomics

The socioeconomic impacts from construction and operation of the natural gas facility component of the combination alternative would be similar to the impacts discussed above in Section 4.10.6 for the natural gas-only alternative. The construction and operations workforce would be the same as for the natural gas-only alterative. Therefore, the socioeconomic impacts during construction and operation of the natural gas facility component of the combination alternative would be SMALL to MODERATE.

Utility-scale wind farms would be located across multiple sites in the PJM region of influence. An estimated total workforce of 460 workers during peak construction and 280 workers during operation would be required and distributed across the multiple sites, a relatively small workforce. The visual impact of wind turbines may have adverse impacts on recreation in the local area and on property values and quality of life (NRC 2013a). However, utility-scale wind farms require relatively large amount of land and therefore property tax revenues could increase as a result of the land requirement of the facilities. Therefore, the socioeconomic impacts from construction and operation of the wind component would range from SMALL to MODERATE.

The solar component of the combination alternative would consist of two utility-scale facilities across the PJM region of influence. The construction and operations workforce likely would not be large; an estimated construction workforce of 500 peak workers and 25 workers during operation would be required. Given the large land requirement for solar photovoltaic facilities, the property tax revenues generated, could be noticeable, depending on the local economic tax base. Therefore, the socioeconomic impacts from construction and operation of the solar component would range from SMALL to MODERATE.

Purchased power from existing power generating facilities could have socioeconomic impacts if there are changes in power plant operations, workforce, or new transmission line construction. If the amount of purchased power exceeds the available supply, new electrical power generating facilities may be needed. Construction and operation of new electrical power generating facilities could cause noticeable socioeconomic impacts in the communities located near the new facility. Therefore, socioeconomic impacts would range anywhere from SMALL to LARGE.

4.10.7.2 Transportation

Transportation impacts from the construction and operation of the combination alternative would include those discussed above in Section 4.10.3 as impacts common to all replacement power alternatives.

Traffic-related transportation impacts during construction and operation of the natural gas facility portion of the combination alternative would be similar to the natural gas-only alternative since the worker and delivery vehicles would be similar. Therefore, traffic-related transportation impacts during construction of a natural gas facility would range from SMALL to MODERATE. During operations, traffic-related transportation impacts would be SMALL.

Given the number of workers during construction and operations of the wind portion of the combination alternative and that the workforce would be distributed across various sites, the traffic-related transportation impacts during construction and operations would be SMALL. Given the relatively small number of workers during construction and operations of the solar component of the combination alternative and that the workforce would be distributed across two locations, the traffic-related transportation impacts during construction and operations would be SMALL.

Traffic-related transportation impacts from purchased power from existing power facilities would depend on the extent of changes in power plant operations. For instance, if there are no changes in workforce or power plant operations, transportation impacts would be SMALL. However, if transmission lines need to be constructed or new electrical power generating facilities need to be constructed, noticeable transportation impacts may occur depending on the number of workers and truck deliveries required to build and operate the new electrical power generating facility. Therefore, traffic-related transportation impacts from purchased power could range from SMALL to LARGE

4.11 Human Health

This section describes the potential human health impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.11.1 Proposed Action

According to the GEIS (NRC 1996 and NRC 2013a), the generic issues related to human health as identified in Table 4-1, "Applicable Category 1 (Generic) Issues for Peach Bottom," would not be affected by continued operations associated with license renewal. As discussed in Section 4.1, "Introduction," of this SEIS, the NRC staff identified no new and significant information for these issues. Thus, as concluded in the GEIS, the impacts of those generic issues related to human health would be SMALL.

Table 4-2, "Applicable Category 2 (Site-Specific) Issues for Peach Bottom," identifies one uncategorized issue (chronic exposure to electromagnetic fields) and one site-specific (Category 2) issue (electric shock hazards) related to human health applicable to Peach Bottom during the subsequent license renewal term. These issues are analyzed below.

4.11.1.1 Uncategorized Issue Relating to Human Health: Chronic Effects of Electromagnetic Fields

The GEIS (NRC 2013a) does not designate the chronic effects of 60-Hz electromagnetic fields (EMFs) from power lines as either a Category 1 or Category 2 issue. Until a scientific consensus is reached on the health implications of electromagnetic fields, the NRC will not include them as Category 1 or 2 issues.

The potential for chronic effects from these fields continues to be studied and is not known at this time. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy (DOE).

The report by the NIEHS, “NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields” (NIEHS 1999), states:

> The NIEHS concludes that ELF-EMF [extremely low frequency-electromagnetic field] exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement was not sufficient to cause the NRC to change its position with respect to the chronic effects of electromagnetic fields. The NRC staff considers the GEIS finding of “UNCERTAIN” still appropriate and will continue to follow developments on this issue.

4.11.1.2 Category 2 Issue Related to Human Health: Electric Shock Hazards

Based on the GEIS (NRC 2013a), the Commission found that electric shock resulting from direct access to energized conductors or from induced charges in metallic structures has not been identified to be a problem at most operating plants and generally is not expected to be a problem during the subsequent license renewal term. However, a site-specific review is required to determine the significance of the electric shock potential along the portions of the transmission lines that are within the scope of Peach Bottom subsequent license renewal review.

As discussed in Section 3.11.4, “Electromagnetic Fields,” there are no offsite transmission lines that are in scope for this SEIS. Therefore, there are no potential impacts to members of the public.

As discussed in Section 3.11.5, “Other Hazards,” Peach Bottom maintains an occupational safety program for its workers in accordance with Occupational Safety and Health Administration regulations, which includes protection from acute electric shock. Therefore, the NRC staff concludes that the potential impacts from acute electric shock during the subsequent license renewal term would be SMALL.

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

In the GEIS (NRC 2013a), the NRC determined that the effects of thermophilic microorganisms on the public for plants using cooling ponds, lakes, or canals or cooling towers or that discharge to a river is a Category 2 issue (see Table 4-2) that requires site-specific evaluation during each license renewal review.

To determine whether the continued operations of Peach Bottom could promote increased growth of thermophilic microorganisms and thus have an adverse effect on the public, the NRC staff considered several factors: the thermophilic microorganisms of concern, Peach Bottom’s thermal effluent characteristics, the recreational use of the Susquehanna River near the discharge structure, and the Pennsylvania Department of Health’s (PADH) input.

Section 3.11.3, "Microbiological Hazards," describes the thermophilic microorganisms that the GEIS identified to be of potential concern at nuclear power plants and summarizes data from the Centers for Disease Control and Prevention (CDC) on the prevalence of waterborne diseases associated with these microorganisms. CDC data and PADH input indicate that no outbreaks or cases of waterborne *Salmonella*, *Pseudomonas aeruginosa*, or *Naegleria fowleri* infection from the Susquehanna River or recreational waters have occurred in Pennsylvania in the past 10 years (CDC 2017a, 2018a, NRC 2019a). Based on the information presented in Section 3.11.3, the thermophilic organisms most likely to be of potential concern at or near Peach Bottom are *Shigella* and *Legionella*.

Shigellosis infections have been reported in the United States due to exposure within lakes, reservoirs, and other recreational waters (CDC 2004, 2006, 2008, 2011, 2014a, 2015b). Peach Bottom continuously discharges thermal effluent to the Susquehanna River, creating a thermal plume with temperatures elevated above 90 °F (32.2 °C) that is generally limited to a small swath of shoreline that extends approximately 2,100 ft (640 m) or less from the discharge structure during summer months (NAI and ERM 2014, 2017; Exelon 2018a). While thermal discharge during the summer could be within the range of optimal growth temperature for *Shigella* (95 °F (35 °C)), the thermal discharge is not likely to increase the rate of Shigellosis infections because the size of the thermal plume is relatively small compared to the width and depth of the Susquehanna River (Exelon 2018a). In addition, the thermal effluent quickly dissipates given the operational design of the discharge diffuser (Exelon 2018a). Further, human contact with the thermal discharge is unlikely because Exelon restricts public access to the discharge canal. Therefore, recreational activities, such as boating, swimming, or fishing, do not occur near the Peach Bottom discharge structure (Exelon 2018a). As of January 2019, PADH is not aware of any *Shigella* spp. infections associated with exposure to the Susquehanna River or other recreational waters within Pennsylvania (NRC 2019e). Given the small area of thermally heated waters, the unlikelihood of conditions favorable to thermophilic microorganisms, the lack of recreational activities that occur near the Peach Bottom thermal plume, and the fact that PADH is not aware of any infections associated with the Susquehanna River or other recreational waters in Pennsylvania, Shigellosis infections in connection with Peach Bottom's thermal effluent are highly unlikely.

Legionellosis outbreaks are often associated with complex water system housing inside buildings or structures, such as cooling towers (CDC 2017d). Peach Bottom uses cooling towers as part of its cooling water system, although the cooling towers are only used during warm periods when Exelon is required to lower the discharge temperature of the thermal effluent. Public exposure to aerosolized *Legionella* would not be likely because such exposure would be confined to a small area of the site where public access is restricted.

<u>Conclusion</u>

CDC data and PADH records indicate that there are no known *Salmonella*, *Pseudomonas aeruginosa*, or *Naegleria fowleri* infections associated with the Susquehanna River or other recreational waters in Pennsylvania (CDC 2017am; Exelon 2018a; NRC 2019e). *Shigella* infections are unlikely given the small area of thermally heated waters, the unlikelihood of conditions favorable to thermophilic microorganisms, and the lack of recreational water use near the Peach Bottom thermal plume. In addition, PADH did not identify any concerns regarding thermophilic organisms as a result of Peach Bottom's thermal effluent (Exelon 2018a; NRC 2019d). Although *Legionella* has the potential to occur within cooling towers at Peach Bottom, infection is not likely given that these areas are restricted to the public, cooling water is withdrawn from the Susquehanna River (which is not stagnant), and PADH is not aware of any legionellosis infections associated with cooling towers or other structures at nuclear power plants in Pennsylvania. Based on the above information, the NRC staff concludes that the impacts of thermophilic microorganisms to the public are SMALL for the Peach Bottom subsequent license renewal.

4.11.1.4 Environmental Consequences of Postulated Accidents

The GEIS (NRC 2013a) evaluates the following two classes of postulated accidents as they relate to license renewal:

- Design-Basis Accidents: Postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety.
- Severe Accidents: Postulated accidents that are more severe than design-basis accidents because they could result in substantial damage to the reactor core.

As shown in Table 4-1, the GEIS (NRC 2013a) addresses design-basis accidents as a Category 1 issue and concludes that the environmental impacts of design-basis accidents are of SMALL significance for all nuclear power plants.

As shown in Table 4-2, the GEIS (NRC 2013a) designates severe accidents as a Category 2 issue requiring site-specific analysis. Based on information in the 2013 GEIS, the NRC determined in 10 CFR Part 51 that for all nuclear power plants, the environmental impacts of severe accidents associated with license renewal is SMALL, with a caveat:

> 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 (NRC 2013a).

Exelon's 2001 environmental report submitted as part of its initial license renewal application included an analysis of severe accident mitigation alternatives (SAMAs) for Peach Bottom Units 2 and 3 (Exelon 2001). During its review of Exelon's 2001 initial license renewal, the NRC staff performed a site-specific analysis of SAMAs for Peach Bottom and documented its review in a supplement to the GEIS (Supplement 10, "Regarding Peach Bottom Power Station, Units 2 and 3," to NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants") (NRC 2003a). Because the NRC staff has previously considered SAMAs for Peach Bottom Units 2 and 3, Exelon is not required to perform another SAMA analysis for its subsequent license renewal application (10 CFR 51.53(c)(3)(ii)(L)).

However, the NRC's regulations in 10 CFR Part 51, which implement Section 102(2) of the National Environmental Policy Act of 1969, as amended (NEPA), require that all applicants for license renewal submit an environmental report to the NRC and in that report identify 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)). This includes new and significant information that could affect the environmental impacts related to postulated severe accidents or that could affect the results of a previous SAMA assessment. Accordingly, in its subsequent license renewal application environmental report, Exelon evaluated areas of new and potentially significant information that could affect the environmental impact of postulated severe accidents during the subsequent license renewal term. The NRC staff provides a discussion of new information pertaining to SAMAs in Appendix E, “Environmental Impacts of Postulated Accidents,” in this SEIS.

Based on the NRC staff’s review and evaluation of Exelon’s analysis of new and potentially significant information regarding SAMAs and the staff’s independent analyses as documented in Appendix E, “Environmental Impacts of Postulated Accidents,” to this SEIS, the staff finds that there is no new and significant information for Peach Bottom related to SAMAs.

4.11.2 No-Action Alternative

Under the no-action alternative, the NRC would not issue a renewed license, and Peach Bottom would shut down on or before the expiration of the current facility operating license. Human health risks would be smaller following plant shutdown. The reactor units, which currently operate within regulatory limits, would emit less radioactive gaseous, liquid, and solid material to the environment. In addition, following shutdown, the variety of potential accidents at the plant (radiological or industrial) would be reduced to a limited set associated with shutdown events and fuel handling and storage. In Section 4.11.1, “Proposed Action,” the NRC staff concluded that the impacts of continued plant operation on human health would be SMALL, except for “Chronic effects of electromagnetic fields (EMFs),” for which the impacts are UNCERTAIN. In Section 4.12, “Environmental Justice,” the NRC staff concludes that the impacts of accidents during operation are SMALL. Therefore, as radioactive emissions to the environment decrease, and as the likelihood and types of accidents decrease following shutdown, the NRC staff concludes that the risk to human health following plant shutdown would be SMALL.

4.11.3 Replacement Power Alternatives: Common Impacts

Impacts on human health from construction of a replacement power station would be similar to impacts associated with the construction of any major industrial facility. Compliance with worker protection rules, the use of personal protective equipment, the use of training, and placement of engineered barriers would control those impacts on workers at acceptable levels.

The human health impacts from the operation of a power station include public risk from inhalation of gaseous emissions. Regulatory agencies, including the U.S. Environmental Protection Agency and Pennsylvania agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits to protect human health.

4.11.4 New Nuclear Alternative

The construction impacts of the new nuclear alternative (six or more co-located small modular reactors) would include those identified in Section 4.11.3 above. Since the NRC staff expects the licensee would limit access to active construction areas to only authorized individuals, the impacts on human health from the construction of new small modular nuclear units would be SMALL.

The human health effects from the operation of the new nuclear alternative would be similar to those of operating the existing Peach Bottom Units 2 and 3. Small modular reactor designs would use the same type of fuel (i.e., form of the fuel, enrichment, burnup, and fuel cladding) as those plants considered in the NRC staff’s evaluation in the GEIS (NRC 2013a).As such their impacts would be similar to Peach Bottom Units 2 and 3. As presented in Section 4.11.1, impacts on human health from the operation of Peach Bottom would be SMALL, except for "chronic effects of electromagnetic fields (EMFs)," for which the impacts are UNCERTAIN. Therefore, the NRC staff concludes that the impacts on human health from the operation of the new nuclear alternative would be SMALL.

4.11.5 Supercritical Pulverized Coal Alternative

The construction impacts of a supercritical pulverized coal alternative would include those identified in Section 4.11.3, "Replacement Power Alternatives: Common Impacts," as common to the construction of all replacement power alternatives. Since the NRC staff expects the builder will limit access to the active construction area to only authorized individuals, the impacts on human health from the construction of supercritical pulverized coal alternative would be SMALL.

Coal-fired power generation introduces worker risks from coal and limestone mining; worker and public risk from coal, lime, and limestone transportation; worker and public risk from disposal of coal-combustion waste; and public risk from inhalation of stack emissions. In addition, human health risks are associated with the management and disposal of coal combustion waste. Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash and scrubber sludge. Human health risks may extend beyond the facility workforce to the public depending on their proximity to the coal combustion waste disposal facility. The character and the constituents of coal combustion waste depend on both the chemical composition of the source coal and the technology used to combust it. Generally, the primary sources of adverse consequences from coal combustion waste are from exposure to sulfur oxide and nitrogen oxide in air emissions and radioactive elements such as uranium and thorium, as well as the heavy metals and hydrocarbon compounds contained in fly ash, bottom ash, and scrubber sludge (NRC 2013a).

Regulatory agencies, including the U.S. Environmental Protection Agency and State agencies, base air emission standards and requirements on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. Given the regulatory oversight exercised by the EPA and State agencies, the NRC staff concludes that the human health impacts from radiological doses, inhaled toxins, and particulates generated from coal-fired generation would be SMALL (NRC 2013a).

4.11.6 Natural Gas Combined-Cycle Alternative

The construction impacts of a natural gas alternative would include those identified in Section 4.11.3, "Replacement Power Alternatives: Common Impacts," as common to the construction of all replacement power alternatives. Since the NRC staff expects the builder will limit access to the active construction area to only authorized individuals, the impacts on human health from the construction of a natural gas alternative would be SMALL.

The human health effects from the operation of a natural gas alternative would include those identified in Section 4.11.3 as common to the operation of all replacement power alternatives. The risk may be attributable to nitrogen oxide emissions that contribute to ozone formation, which in turn contribute to health risk (NRC 2013a). Given the regulatory oversight exercised by EPA and State agencies, the NRC staff concludes that the human health impacts from the natural gas alternative would be SMALL.

4.11.7 Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)

Impacts on human health from construction of a combination of natural gas, wind, solar, and purchased power alternative would include those identified in Section 4.11.3 as common to the construction of all replacement power alternatives. Since the NRC staff expects the builder will limit access to the active construction area to only authorized individuals, the impacts on human health from the construction of a natural gas, wind, solar, and purchased power combination alternative would be SMALL.

Operational hazards at a natural gas facility are discussed in Section 4.11.6, "Natural Gas Combined-Cycle Alternative."

Operational hazards at a wind facility for the workforce include working at heights, working near rotating mechanical or electrically energized equipment, and working in extreme weather. Potential impacts to workers and the public include ice thrown from rotor blades and broken blades thrown as a result of mechanical failure. Potential impacts also include EMF exposure, aviation safety hazards, and exposure to noise and vibration from the rotating blades (MDPH 2012). Based on this information, the human health impacts from the operation of the wind component for the combination alternative would be SMALL.

Solar photovoltaic panels are encased in heavy-duty glass or plastic. Because of this encasement, there is little risk that the small amounts of hazardous semiconductor material they contain will be released into the environment. In the event of a fire, hazardous particulate matter could be released to the atmosphere. Given the short duration of fires and the high melting points of the materials found in the solar photovoltaic panels, the impacts from inhalation are minimal. Also, the risk of fire at ground-mounted solar installations is minimal due to precautions taken during site preparation, such as the removal of fuels and the lack of burnable materials contained in the solar photovoltaic panels. Another potential risk associated with photovoltaic systems and fire is the potential for shock or electrocution from contact with a high-voltage conductor. Proper procedures and clear marking of system components should be used to provide emergency responders with appropriate warnings to diminish risk of shock or electrocution (OIPP 2010).

Photovoltaic solar panels do not produce electromagnetic fields at levels considered harmful to human health as established by the International Commission on Non-Ionizing Radiation Protection. These small electromagnetic fields diminish significantly with distance and are indistinguishable from normal background levels within several yards (OIPP 2010). Based on this information, the human health impacts from the operation of the solar component for the combination alternative would be SMALL.

Purchased power is expected to come from the types of electricity generation available within the region of influence: coal, natural gas, nuclear, and wind. The human health impacts from the operation of these types of power plants are discussed above and in Sections 4.11.4-6. Based on the information in those sections, the NRC staff concludes that the human health impacts of the purchased power component of the combination alternative using nuclear, coal, natural gas, wind, and solar would be SMALL.

Therefore, given the expected compliance with worker and environmental protection rules and the use of personal protective equipment, training, and engineered barriers, the NRC staff concludes that the potential human health impacts for the natural gas, wind, solar, and purchased power combination alternative would be SMALL.

4.12 Environmental Justice

In Section 3.12, "Environmental Justice," of this SEIS, the NRC staff explains the basis for its consideration of environmental justice impacts in an EIS and identifies environmental justice populations (i.e., minority and low-income populations) within a 50-mi (80-km) radius of Peach Bottom. In this section, the staff describes the potential human health and environmental effects of the proposed action (subsequent license renewal) and alternatives to the proposed action on minority and low-income populations.

4.12.1 Proposed Action

The NRC addresses environmental justice matters for license renewal (including subsequent license renewal) by (1) identifying the location of minority and low-income populations that may be affected by the continued operation of the nuclear power plant during the subsequent license renewal term, (2) determining whether there would be any potential human health or environmental effects to these populations and special pathway receptors (groups or individuals with unique consumption practices and interactions with the environment), and (3) determining whether any of the effects may be disproportionately high and adverse. Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionately high environmental effects refer to impacts or risks of impacts on the natural or physical environment in a minority or low-income community that are significant and appreciably exceed the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts.

Figure 3-10 and Figure 3-11 show the location of predominantly minority and low-income population block groups residing within a 50-mi (80-km) radius of Peach Bottom. This area of impact is consistent with the 50-mi (80-km) impact analysis for public and occupational health and safety. This chapter (Chapter 4) of the SEIS presents the assessment of environmental and human health impacts for each resource area. With the exception of aquatic resources, for which the impacts would be SMALL to MODERATE, the NRC staff's analyses of impacts to all other resource areas indicated that the impact from subsequent license renewal would be SMALL. As discussed in Section 4.7.1.2, during the majority of the year and in most areas in Conowingo Pond the aquatic resources impacts would be SMALL because the thermal effluent would not be warm enough to cause any observable changes within the biological community. MODERATE impacts to aquatic resources would be short-term, localized, and limited to 12 ac (4.9 ha) of shallow shoreline habitat, which is equal to 2.5 percent of the shoreline habitat within Conowingo Pond. Therefore, the impacts on aquatic resources would not be disproportionately high and adverse.

Based on this information and the analysis of human health and environmental impacts presented in Chapter 4 of this SEIS, there would be no disproportionately high and adverse human health and environmental effects on minority and low-income populations from the continued operation of Peach Bottom during the subsequent license renewal term.

4.12.1.1 Subsistence Consumption of Fish and Wildlife

As part of addressing environmental justice concerns associated with subsequent license renewal, the NRC also assessed the potential radiological risk to special population groups (such as migrant workers or Native Americans) from exposure to radioactive material received through their unique consumption practices and interactions with the environment. Such exposure could occur through subsistence consumption of fish, wildlife, and native vegetation; contact with surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of airborne radioactive material released from the plant during routine operation. The special pathway receptors analysis is an important part of the environmental justice analysis because consumption patterns may reflect the traditional or cultural practices of minority and low-income populations in the area.

Section 4-4 of Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," (59 FR 7629) directs Federal agencies, whenever practical and appropriate, to collect and analyze information about the consumption patterns of populations that rely principally on fish and wildlife for subsistence and to communicate the risks of these consumption patterns to the public. In this SEIS, the NRC considered whether there were any means for minority or low-income populations to be disproportionately affected by examining impacts on American Indians, Hispanics, migrant workers, and other traditional lifestyle special pathway receptors. Pennsylvania has the second largest population of Amish in the United States, and in 2010 Lancaster County had the second largest Amish settlement (Donnermeyer et al. 2013). While Amish communities do not meet the definition of a minority population as defined in Section 3.12 of this SEIS, they are known to maintain large gardens to supplement their food sources (Exelon 2018a). The analysis below considers if human health impacts would be expected in special pathway receptor populations in the region as a result of subsistence consumption of water, local food, fish, and wildlife.

The assessment of special pathways considered the levels of radiological contaminants in fish, sediments, water, milk, and food products on or near Peach Bottom. Radionuclides released to the atmosphere may deposit on soil and vegetation and may therefore eventually be incorporated into the human food chain. To assess the impact of Peach Bottom operations to humans from the ingestion pathway, Exelon collects and analyzes samples of air, water, sediment, fish, vegetation, and milk, if available, for radioactivity as part of its ongoing, comprehensive Radiological Environmental Monitoring Program.

To assess the impact of nuclear power plant operations on the environment, Exelon collects samples annually from the environment and analyzes them for radioactivity. A plant effect would be indicated if the radioactive material detected in a sample was larger or higher than background levels. Two types of samples are collected. The first type, a control sample, is collected from areas that are beyond the influence of the nuclear power plant or any other nuclear facility. These control samples are used as reference data to determine normal background levels of radiation in the environment. The second type of samples, indicator samples, are collected near the nuclear power plant from areas where any radioactivity contribution from the nuclear power plant will be at its highest concentration. These indicator samples are then compared to the control samples, to evaluate the contribution of nuclear power plant operations to radiation or radioactivity levels in the environment. An effect would be indicated if the radioactivity levels detected in an indicator sample were larger or higher than the control sample or background.

Exelon collected samples from the aquatic and terrestrial environment in the vicinity of Peach Bottom in 2017 (Exelon 2018d). The aquatic pathways include surface water samples, drinking water samples, and fish and sediment samples. The terrestrial environment was evaluated by performing radiological analyses on milk and green leaf vegetation samples. As discussed in Section 3.1.4.5, "Radiological Environmental Monitoring Program," NRC staff reviewed 5 years of annual radiological environmental monitoring data from 2013 through 2017 (Exelon 2014a, 2015b, 2016a, 2017a, 2018e). A 5-year period provides a dataset that covers a broad range of activities that occur at a nuclear power plant, such as refueling outages, routine operation, and maintenance that can affect the generation and release of radioactive effluents into the environment. The NRC staff looked for indications of adverse trends (i.e., increasing radioactivity levels) over that period. The data show that there were no significant radiological impacts to the environment from operations at Peach Bottom. Additionally, as discussed in Section 4.5.1.2, since 2006, Exelon has participated in NEI 07-07, "Industry Ground Water Protection Initiative" (NEI 2007) and has integrated the NEI 07-07 program into the current Peach Bottom radiological groundwater protection program. While inadvertent releases of radionuclides have occurred, the NRC staff finds that inadvertent releases of radionuclides (primarily tritium) have not substantially impaired or noticeably altered groundwater quality relative to drinking water standards within the overburden and bedrock groundwater beneath the Peach Bottom site (see Section 4.5.1.2).

Based on the radiological environmental data from Peach Bottom, the NRC staff finds that no disproportionately high and adverse human health impacts would be expected in special pathway receptor populations in the region as a result of subsistence consumption of water, local food, fish, and wildlife.

4.12.2 No-Action Alternative

Under the no-action alternative, impacts on minority and low-income populations would depend on the number of jobs and the amount of tax revenues lost by communities in the immediate vicinity of the nuclear power plant after it ceases operations. Not renewing the operating licenses and terminating reactor operations could have a noticeable impact on socioeconomic conditions in the communities located near Peach Bottom. The loss of jobs and income could have an immediate socioeconomic impact. In addition, the plant would generate less tax revenue, which could reduce the availability of public services. This could disproportionately affect minority and low-income populations that may have become dependent on these services.

4.12.3 Replacement Power Alternatives: Common Impacts

The following discussions identify common impacts from the construction and operation of replacement power facilities that could disproportionately affect minority and low-income populations. The NRC staff cannot determine whether any of the replacement power alternatives would result in disproportionately high and adverse human health and environmental effects on minority and low-income populations. This determination would depend on site location, plant design, operational characteristics of the new power plant, unique consumption practices and interactions with the environment of nearby populations, and the location of predominantly minority and low-income populations.

Construction

Potential impacts to minority and low-income populations from the construction of a new replacement power plant would mostly consist of environmental (e.g., noise, dust, traffic) and socioeconomic effects (employment and housing impacts). Minority and low-income migrant agricultural workers could be particularly vulnerable to noise impacts if working near the construction site. However, noise impacts from construction would be short term and primarily limited to onsite activities. Air emissions would result from increased vehicle traffic, construction equipment, and fugitive dust from construction activities. These emissions would be temporary and minor. Minority and low-income populations residing along site access roads could be affected by increased truck traffic and increased commuter vehicle traffic, especially during shift changes. Increased demand for rental housing during construction could affect low-income populations and this would depend on the housing stock available.

Operation

Minority and low-income populations living near the replacement power site that rely on subsistence consumption of fish and wildlife could be disproportionately affected by replacement power alternatives. Emissions during power plant operations could disproportionately affect nearby minority and low-income populations, depending on the fuel-type used to generate replacement power.

4.12.4 New Nuclear Alternative

Potential impacts to minority and low-income populations from the construction and operation of the new nuclear alternative (six or more co-located small modular reactors) would include the impacts discussed above in Section 4.12.3. Potential impacts to minority and low-income populations from operations would mostly consist of radiological effects; however, radiation doses are expected to be well below regulatory limits and the plant operator would maintain a radiological environmental monitoring program (REMP) (NRC 2018b).

4.12.5 Supercritical Pulverized Coal Alternative

Potential impacts to minority and low-income populations from the construction and operation of a coal alternative would include those discussed above in Section 4.12.3. As discussed in Section 4.3.5, “Supercritical Pulverized Coal Alternative,” operation of a coal alternative can emit substantial amounts of air emissions. Depending on the location of the coal alternative and concentration of minorities and low-income populations in the vicinity of the power plant, operation of a coal alternative could create disproportionately high and adverse human health effects on minority and low-income populations.

4.12.6 Natural Gas Combined-Cycle Alternative

Potential impacts to minority and low-income populations from the construction and operation of the natural gas alternative would include those discussed above in Section 4.12.3. As discussed in Section 4.3.6, “Natural Gas Combined-Cycle Alternative,” operation of a natural gas alternative can emit substantial amounts of air emissions. Depending on the location of the natural gas alternative and concentration of minorities and low-income populations in the vicinity of the power plant, operation of a natural gas alternative could create disproportionately high and adverse human health effects on minority and low-income populations.

4.12.7 Combination Alternative

Potential impacts to minority and low-income populations from the construction and operation of the combination alternative would include those discussed above in Section 4.12.3. Additionally, purchased power from existing power generating facilities would not likely have disproportionately high and adverse effects on minority populations, because there would be no change in power plant operations or workforce. However, if there are increases in utility bills because of the cost of purchased power, low-income populations could be disproportionately affected. Additionally, if new electric power generating facilities are needed and result in construction and operation of a new power generating facility to supply purchased power, this could result in new human health and environmental effects in communities located near the new facility. Potential human health and environmental effects have been described for other replacement power alternatives in this SEIS. Therefore, depending on the need for construction and operation of a new electric power generating facility, there could be disproportionately high and adverse human health effects on minority and low-income populations as a result of purchased power.

4.13 Waste Management

This section describes the potential waste management impacts of the proposed action (subsequent license renewal) and alternatives to the proposed action.

4.13.1 Proposed Action

According to the GEIS (NRC 1996 and NRC 2013a), the generic issues related to waste management as identified in Table 4-1 would not be affected by continued operations associated with license renewal. As discussed in Section 4.1, "Introduction," of this SEIS, the NRC staff identified no new and significant information for these issues. Thus, as concluded in the GEIS, the impacts of those generic issues related to human health would be SMALL. Table 4-2 does not identify any Peach Bottom site-specific (Category 2) waste management issues resulting from issuing a renewed license for an additional 20 years of operations.

4.13.2 No-Action Alternative

Under the no-action alternative, If the NRC chooses the no-action alternative, it would not issue renewed licenses, and Peach Bottom would cease operation at the end of the term of the current operating licenses or sooner and enter decommissioning. After entering decommissioning, the plant would generate less spent nuclear fuel, emit less gaseous and liquid radioactive effluents into the environment, and generate less low-level radioactive and nonradioactive wastes. In addition, following shutdown, the variety of potential accidents at the plant (radiological and industrial) would be reduced to a limited set associated with shutdown events and fuel handling and storage. Therefore, as radioactive emissions to the environment decrease, and the likelihood and variety of accidents decrease following shutdown and decommissioning, the NRC staff concludes that impacts resulting from waste management from implementation of the no-action alternative would be SMALL.

4.13.3 Replacement Power Alternatives: Common Impacts

Impacts from waste management common to all analyzed replacement power alternatives would be from construction-related debris generated during construction activities. This waste would be recycled or disposed of in approved landfills.

4.13.4 New Nuclear Alternative

Impacts from the waste generated during the construction of the new nuclear alternative (six or more co-located small modular reactors) would include those identified in Section 4.13.3, as common to all replacement power alternatives.

During normal plant operations, routine plant maintenance and cleaning activities would generate radioactive low-level waste, spent nuclear fuel, high-level waste, and nonradioactive waste. Sections 3.1.4 and 3.1.5 of this SEIS discuss radioactive and nonradioactive waste management at Peach Bottom. Small modular reactor designs would use the same type of fuel (i.e., form of the fuel, enrichment, burnup, and fuel cladding) as those plants considered in the NRC staff's evaluation in the GEIS (NRC 2013a). As such all wastes generated would be similar to Peach Bottom Units 2 and 3. According to the GEIS, the NRC does not expect the generation and management of solid radioactive and nonradioactive waste during the subsequent license renewal term to result in significant environmental impacts. Based on this information, the waste impacts would be SMALL for the new nuclear alternative.

4.13.5 Supercritical Pulverized Coal Alternative

Impacts from the waste generated during the construction of a supercritical pulverized coal plant would include those identified in Section 4.13.3 of this SEIS as common to all replacement power alternatives.

During normal plant operations, coal combustion generates waste in the form of fly ash and bottom ash. In addition, equipment for controlling air pollution generates additional ash, spent selective catalytic reduction (SCR) catalyst, and scrubber sludge. The management and disposal of the large amounts of coal combustion waste is a significant part of the operation of a coal-fired power generating facility.

Although a coal-fired power generating facility is likely to use offsite disposal of coal combustion waste, some short-term storage of coal combustion waste (either in open piles or in surface impoundments) is likely to take place onsite, thus establishing the potential for leaching of toxic chemicals into the local environment (NRC 2013a).

Based on the large volume, as well as the toxicity of waste generated by coal combustion, the NRC staff concludes that the impacts from waste generated at a coal-fired plant would be MODERATE.

4.13.6 Natural Gas Combined-Cycle Alternative

Impacts from the waste generated during the construction of a natural gas power plant would include those identified in Section 4.13.3 of this SEIS as common to all replacement power alternatives.

Waste generation from natural gas technology would be minimal. The only significant waste generated at a natural gas combined-cycle power plant would be spent selective catalytic reduction catalyst (plants use selective catalytic reduction catalyst to control nitrogen oxide emissions).

The spent catalyst would be regenerated or disposed of offsite. Other than the spent selective catalytic reduction catalyst, waste generation at an operating natural gas fired plant would be limited largely to typical operations and maintenance of nonhazardous waste (NRC 2013a). Overall, the NRC staff concludes that waste impacts from the natural gas alternative would be SMALL.

4.13.7 Combination Alternative (Natural Gas Combined-Cycle, Wind, Solar, and Purchased Power)

Impacts on waste management from construction of a combination of natural gas, wind, solar, and purchased power alternative would include those identified in Section 4.11.3 as common to the construction of all replacement power alternatives. Since the NRC staff expects the builder will limit access to the active construction area to only authorized individuals, the impacts on human health from the construction of a natural gas, wind, solar, and purchased power combination alternative would be SMALL.

Waste management at a natural gas facility is discussed in Section 4.13.6, "Natural Gas Combined-Cycle Alternative."

Waste generation from wind and solar alternatives would be minimal, consisting of debris from routine maintenance and the disposal of worn or broken parts. Based on this information, the NRC staff concludes that waste impacts from the construction and operation of the wind and solar components of the combination alternative would be SMALL.

The types of waste generated by the alternative electricity generation sources (i.e., coal, natural gas, nuclear, and wind) used in the purchased power component of the combination alternative are discussed above and in Sections 4.13.4-6. Depending on the type of power generation plants used to provide the electricity for the purchased power component, the NRC staff concludes that the waste management impacts would range from SMALL to MODERATE.

Overall, the NRC staff concludes that the potential waste management impacts for the natural gas, wind, solar, and purchased power combination alternative would be SMALL to MODERATE.

4.14 Evaluation of New and Significant Information

As stated in Section 4.1, "Introduction," of this SEIS, for Category 1 (generic) issues, the NRC staff can rely on the analysis in the GEIS (NRC 2013a) unless otherwise noted. Table 4-1 lists the Category 1 issues that apply to Peach Bottom during the subsequent license renewal term. For these issues, the NRC staff did not identify any new and significant information during its review of Exelon's environmental report, the site audits, or the scoping period that would change the conclusions presented in the GEIS.

The NRC defines new and significant information in Regulatory Guide (RG) 4.2, Supplement 1, "Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications," (NRC 2013b), as (1) information that identifies a significant environmental impact issue that was not considered or addressed in the GEIS and, consequently, not codified in Table B-1, in Appendix B to Subpart A of 10 CFR Part 51, or (2) information not considered in the assessment of impacts evaluated in the GEIS leading to a seriously different picture of the environmental consequences of the action than previously considered, such as an environmental impact finding different from that codified in Table B-1. Further, a significant environmental issue includes, but is not limited to, any new activity or aspect associated with the nuclear power plant that can act upon the environment in a manner or with an intensity and/or scope (context) not previously recognized.

In accordance with 10 CFR 51.53(c), “Operating License Renewal Stage,” the applicant’s environmental report must analyze the Category 2 (site-specific) issues in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51. Additionally, the applicant’s environmental report must discuss actions to mitigate any adverse impacts associated with the proposed action and environmental impacts of alternatives to the proposed action. In accordance with 10 CFR 51.53(c), the applicant’s environmental report does not need to analyze any Category 1 issue unless there is new and significant information on a specific issue.

NUREG-1555, Supplement 1, Revision 1, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants for Operating License Renewal” describes the NRC process for identifying new and significant information (NRC 2013c). The search for new information includes:

- review of the applicant’s environmental report (Exelon 2018a) and the process for discovering and evaluating the significance of new information
- review of public comments
- review of environmental quality standards and regulations
- coordination with Federal, State, and local environmental protection and resource agencies
- review of technical literature as documented through this SEIS

New information is evaluated for significance using the criteria set forth in the GEIS. For Category 1 issues for which new and significant information is identified, reconsideration of the conclusions for those issues is limited in scope to an assessment of the relevant new and significant information; the scope of the assessment does not include other facets of an issue that the new information does not affect.

The NRC staff reviewed the discussion of environmental impacts associated with operation during the subsequent license renewal term in the GEIS and conducted its own independent review, including a public involvement process (e.g., a public meeting and comments) to identify new and significant issues for the Peach Bottom subsequent license renewal application environmental review. The NRC staff did not identify any new and significant information during its review of Exelon’s environmental report, the site audits, or the scoping period that would change the conclusions presented in the GEIS.

4.15 Impacts Common to All Alternatives

This section describes the impacts that the NRC staff considers common to all alternatives discussed in this SEIS, including the proposed action and replacement power alternatives. The continued operation of a nuclear power plant and replacement fossil fuel power plants both involve mining, processing, and the consumption of fuel that result in comparable impacts (NRC 2013a). In addition, the following sections discuss termination of operations and the decommissioning of both a nuclear power plant and replacement fossil fuel power plants and greenhouse gas emissions.

4.15.1 Fuel Cycle

This section describes the environmental impacts associated with the fuel cycles of both the proposed action and all replacement power alternatives. Most replacement power alternatives employ a set of steps in the use of their fuel sources, which can include extraction, transformation, transportation, and combustion. Emissions generally occur at each stage of the fuel cycle (NRC 2013a).

4.15.1.1 Uranium Fuel Cycle

The uranium fuel cycle includes uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials, and management of low-level wastes and high-level wastes related to uranium fuel cycle activities. The GEIS describes in detail the generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes (NRC 1996, NRC 1999, NRC 2013a). The GEIS does not identify any site-specific (Category 2) uranium fuel cycle issues. Table 4-1 lists applicable generic (Category 1) issues.

4.15.1.2 Replacement Power Plant Fuel Cycles

<u>Fossil Fuel Energy Alternatives</u>

Fuel cycle impacts for a fossil fuel-fired plant result from the initial extraction of fuel, cleaning and processing of fuel, transport of fuel to the facility, and management and ultimate disposal of solid wastes from fuel combustion. These impacts are discussed in more detail in Section 4.12.1.2 of the GEIS (NRC 2013a) and can generally include the following:

- significant changes to land use and visual resources
- impacts to air quality, including release of criteria pollutants, fugitive dust, volatile organic compounds, and coalbed methane into the atmosphere
- noise impacts from vehicles, equipment and possible us of explosives
- geology and soil impacts due to land disturbances and mining
- water resource impacts, including degradation of surface water and groundwater quality due to runoff, consumptive use, potential contamination, and wastewater
- ecological impacts, including loss of habitat and wildlife disturbances
- historic and cultural resources impacts within the mine or auxiliary facilities
- socioeconomic impacts from employment of both the mining workforce and service and support industries
- environmental justice impacts
- health impacts to workers from exposure to airborne dust and methane gases
- generation of coal and industrial wastes associated with vehicle and equipment maintenance and spills of fuel dispensed and stored onsite

New Nuclear Energy Alternatives

Uranium fuel cycle impacts for a nuclear plant result from the initial extraction of fuel, transport of fuel to the facility, and management and ultimate disposal of spent fuel. The environmental impacts of the uranium fuel cycle are discussed above in Section 4.15.1.1 of this SEIS.

Renewable Energy Alternatives

The fuel cycle for renewable energy facilities is difficult to define for different technologies because the affected natural resources (e.g., wind, solar, geothermal, ocean wave) exist regardless of any effort to harvest them for electricity production. Impacts from the presence or absence of these renewable energy technologies are often difficult to determine (NRC 2013a).

4.15.2 Terminating Power Plant Operations and Decommissioning

This section describes the environmental impacts associated with the termination of operations and the decommissioning of a nuclear power plant and replacement power alternatives. All operating power plants will terminate operations and be decommissioned at some point after the end of their operating life or after a decision is made to cease operations. For the proposed action at Peach Bottom, subsequent license renewal would delay this eventuality for an additional 20 years beyond the current license terms, which end in 2033 (Unit 2) and 2034 (Unit 3).

4.15.2.1 Existing Nuclear Power Plant

Decommissioning would occur whether Peach Bottom is shut down at the end of its current renewed license terms or at the end of the subsequent license renewal term. NUREG-0586, Supplement 1, "Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Regarding the Decommissioning of Nuclear Power Reactors" (Decommissioning GEIS), evaluates the environmental impacts from the activities associated with the decommissioning of any power reactor before or at the end of an initial or renewed license (NRC 2002). Additionally, the GEIS (NRC 2013a) discusses the incremental environmental impacts associated with decommissioning activities resulting from continued plant operation during the renewal term. As noted in Table 4-1 on page 4-2, there is one Category 1 issue applicable to Peach Bottom decommissioning following the subsequent license renewal term. The GEIS did not identify any site-specific (Category 2) decommissioning issues.

4.15.2.2 Replacement Power Plants

Fossil Fuel Energy Alternatives

The environmental impacts from the termination of power plant operations and decommissioning of a fossil fuel-fired plant are dependent on the facility's decommissioning plan. General elements and requirements for a fossil fuel plant decommissioning plan are discussed in Section 4.12.2.2 of the GEIS and can include the removal of structures to at least 3 feet (1 m) below grade; removal of all coal, combustion waste, and accumulated sludge; removal of intake and discharge structures; and the cleanup and remediation of incidental spills and leaks at the facility. The decommissioning plan outlines the actions necessary to restore the site to a condition equivalent in character and value to the site on which the facility was first constructed (NRC 2013a).

The environmental consequences of decommissioning are discussed in Section 4.12.2.2 of the GEIS and can generally include the following:

- short-term impacts on air quality and noise from the deconstruction of facility structures
- short-term impacts on land use and visual resources
- long-term reestablishment of vegetation and wildlife communities
- socioeconomic impacts due to decommissioning the workforce and the long-term loss of jobs
- elimination of health and safety impacts on operating personnel and the general public

New Nuclear Alternatives

Termination of operations and decommissioning impacts for a nuclear power plant (six or more co-located small modular reactors) include all activities related to the safe removal of the facility from service and the reduction of residual radioactivity to a level that permits release of the property under restricted conditions or unrestricted use and termination of a license (NRC 2013a). The environmental impacts of the uranium fuel cycle are discussed in Section 4.15.1.1, "Uranium Fuel Cycle."

Renewable Alternatives

Termination of power plant operation and decommissioning for renewable energy facilities would be similar to the impacts discussed for fossil fuel-fired plants above. Decommissioning would involve the removal of facility components and operational wastes and residues to restore the site to a condition equivalent in character and value to the site on which the facility was first constructed (NRC 2013a).

4.15.3 Greenhouse Gas Emissions and Climate Change

The following sections discuss greenhouse gas (GHG) emissions and climate change impacts. Section 4.15.3.1 evaluates GHG emissions associated with operation of Peach Bottom Units 2 and 3 and replacement power alternatives. Section 4.15.3.2 discusses the observed changes in climate and the potential future climate change during the subsequent license renewal term based on climate model simulations under future global GHG emission scenarios. In Section 4.16, "Cumulative Impacts," of this SEIS, the NRC staff considers the potential cumulative, or overlapping, impacts from climate change on environmental resources where there are incremental impacts of the proposed action (subsequent license renewal).

4.15.3.1 Greenhouse Gas Emissions from the Proposed Action and Alternatives

Gases found in the Earth's atmosphere that trap heat and play a role in the Earth's climate are collectively termed greenhouse gases (GHGs). Greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), water vapor (H_2O), and fluorinated gases, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). The Earth's climate responds to changes in concentrations of GHGs in the atmosphere because these gases affect the amount of energy absorbed and heat trapped by the atmosphere. Increasing GHG concentrations in the atmosphere generally increase the Earth's surface temperature. Atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have significantly increased since 1750 (IPCC 2007, IPCC 2013). Carbon dioxide, methane, nitrous oxide, and fluorinated gases (termed long-lived greenhouse gases) are well mixed throughout the Earth's atmosphere, and their impact on climate is long lasting and cumulative in nature as a result of their long atmospheric lifetime (EPA 2016a). Therefore, the extent and nature of climate change is not specific to the specific location where GHGs are emitted. Carbon dioxide is of primary concern for global climate change because of its long atmospheric lifetime; it is the primary GHG emitted as a result of human activities. Climate change research indicates that the cause of the Earth's warming over the last 50 to 100 years is due to the buildup of GHGs in the atmosphere resulting from human activities (IPCC 2013, USGCRP 2014, USGCRP 2017, USGCRP 2018). The EPA has determined that GHGs "may reasonably be anticipated both to endanger public health and to endanger public welfare" (74 FR 66496).

Proposed Action

The operation of Peach Bottom results in both direct and indirect GHG emissions. The Peach Bottom site's direct GHG emissions primarily result from stationary and portable combustion sources (see Section 3.3.2, Table 3-2, "Permitted Air Emission Sources at Peach Bottom Units 2 and 3"). Indirect GHG emissions originate from mobile combustion sources (e.g., employee vehicles, visitor vehicles, and delivery vehicles). Table 4-14 below presents quantified GHG emissions from sources at Peach Bottom. Specifically, the Peach Bottom site's estimated GHG emissions are based on all site combustion sources operating at their maximum allowable fuel usage and hours, as prescribed by Exelon's air emission permit (Exelon 2018a). Therefore, Peach Bottom's estimates of GHG emissions are overestimates of actual emissions. Exelon does not compile or report GHG data for mobile combustion sources. However, the NRC staff estimated potential GHG emissions from employee vehicles based on emission factors and assumptions regarding site employee commuting (see Table 4-14 below).

Fluorinated gas emissions from refrigerant sources and from electrical transmission and distribution systems can result from leakage, servicing, repair, or disposal of sources. In addition to being GHGs, chlorofluorocarbons and hydrochlorofluorocarbons are ozone-depleting substances that are regulated by the Clean Air Act under Title VI, "Stratospheric Ozone Protection." Fluorinated gases are typically emitted in small quantities from facilities such as Peach Bottom, but their impacts could be appreciable because of their high global warming potential. Estimating GHG emissions from refrigerant sources is complicated due to their ability to deplete stratospheric ozone, which itself is a greenhouse gas, making the global warming potentials of refrigerant sources difficult to quantify. As a result, GHG emissions from refrigerant sources are commonly excluded from greenhouse gas inventories (EPA 2014).

Table 4-14 Estimated Greenhouse Gas Emissions from Operation at Peach Bottom

Peach Bottom Combustion Sources[(a)] (tons/year)	Workforce Commuting[(b)] (tons/year)	Total[(b)] (tons/year)
29,705	10,090	39,795

Note: All values are rounded. To convert tons/year to metric tons per year, multiply by 0.90718.

(a) Includes stationary and portable diesel and gasoline engines described in Table 3-2.

(b) Emissions estimated by the NRC staff consider Peach Bottom full-time employees do not include ~1,600 additional contractor workers during refueling outages. Refueling outages occur on a staggered, 24-month schedule and last approximately 18-20 days per unit.

Sources: Exelon 2018a, NRC staff

No-Action Alternative

At some point, all nuclear plants will terminate operations and undergo decommissioning. The Decommissioning GEIS (NRC 2002) considers the impacts from decommissioning. Therefore, the scope of impacts considered under the no-action alternative includes the immediate impacts resulting from activities at Peach Bottom that would occur between plant shutdown and the beginning of decommissioning (i.e., activities and actions necessary to cease operation of Peach Bottom Units 2 and 3). Peach Bottom operations would terminate at or before the expiration of the current renewed licenses. When the facility stops operating, a reduction in GHG emissions from activities related to plant operation, such as use of diesel generators and employee vehicles, would occur. The NRC staff anticipates that GHG emissions for the no-action alternative would be less or equal to than those presented in Table 4-14, which shows the estimated GHG emissions from operation of Peach Bottom Units 2 and 3.

Since the no-action alternative would result in a loss of power generating capacity due to shutdown, the sections below discuss GHG emissions associated with replacement baseload power generation for each replacement power alternative analyzed.

New Nuclear Alternative

The GEIS presents life-cycle greenhouse gas emissions associated with nuclear power generation. As presented in Tables 4.12-4 through 4.12-6 of the GEIS (NRC 2013a), life-cycle GHG emissions from nuclear power generation can range from 1 to 288 grams carbon equivalent per kilowatt-hour (g C_{eq}/kWh). Nuclear power plants do not burn fossil fuels to generate electricity. Sources of GHG emissions from the new nuclear alternative would include stationary combustion sources such as emergency diesel generators, boilers, and pumps similar to existing sources at Peach Bottom (see Section 3.3.2, "Air Quality," of this SEIS). The NRC staff estimates that GHG emissions from a new nuclear alternative would be similar to GHG emissions from current operation of Peach Bottom (see Table 4-14).

Supercritical Pulverized Coal Alternative

The GEIS (NRC 2013a) presents life-cycle GHG emissions associated with coal-fired generation. As presented in Table 4.12-4 of the GEIS, life-cycle GHG emissions from coal can range from 264 to 1,689 g Ceq/kWh. The NRC staff estimates that direct emissions from operation of four, 625-MWe supercritical pulverized coal units would total 19.4 million tons (17.6 million metric tons) of carbon dioxide equivalents ($CO2_{eq}$) per year.

Natural Gas Combined-Cycle Alternative

The GEIS (NRC 2013a) presents life-cycle GHG gas emissions associated with natural gas power generation. As presented in Table 4.12-5 of the GEIS, life-cycle GHG emissions from natural gas can range from 120 to 930 g C_{eq}/kWh. The NRC staff estimates that direct emissions from operation of five, 500-MWe natural gas combined-cycle units would total 9.5 million tons (8.6 million metric tons) of carbon dioxide equivalents (CO_{2eq}) per year.

Combination Alternative

For the combination alternative, greenhouse gases would primarily be emitted from the natural gas and the purchased power components of this alternative, which the NRC staff presumes would predominantly consist of natural gas generation. The NRC staff conservatively estimates that operation of the natural gas-fired unit and operation of generating facilities that would provide purchased power would emit a total of 4.5 million tons (4.1 million metric tons) of CO_{2eq} per year.

Summary of Greenhouse Gas Emissions from the Proposed Action and Alternatives

Table 4-15 below presents the direct GHG emissions from facility operations under the proposed action of subsequent license renewal as well as under alternatives to the proposed action. Greenhouse gas emissions from the proposed action (subsequent license renewal), no-action alternative, and new nuclear alternative would be the lowest. Greenhouse gas emissions from the supercritical pulverized coal, natural gas combined-cycle, and combination alternatives are several orders of magnitude greater than those from the continued operation of Peach Bottom. If Peach Bottom's generating capacity were to be replaced by any of these three alternatives, there would be an increase in GHG emissions. Therefore, the NRC staff concludes that continued operation of Peach Bottom (the proposed action) results in GHG emissions avoidance as compared to the supercritical pulverized coal, natural gas, and combination alternatives.

Table 4-15 Direct Greenhouse Gas Emissions from Facility Operations Under the Proposed Action and Alternatives

Technology/Alternative	CO_{2eq}[(a)] (tons/year)
Proposed Action (Peach Bottom subsequent license renewal)[(b)]	29,705
No-Action Alternative[(c)]	< 29,705
New Nuclear[(d)]	29,705
Supercritical Pulverized Coal[(e)]	19,400,000
Natural Gas Combined-Cycle[(f)]	9,500,000
Combination Alternative[(g)]	4,500,000

(a) Carbon dioxide equivalent (CO_{2eq}) is a metric used to compare the emissions of GHG based on their global warming potential (GWP). The GWP is a measure used to compare how much heat a GHG traps in the atmosphere. The GWP is the total energy that a gas absorbs over a period of time compared to carbon dioxide. CO_{2eq} is obtained by multiplying the amount of the GHG by the associated GWP. For example, the GWP of methane is 21; therefore, 1 ton of methane emission is equivalent to 21 tons of carbon dioxide emissions.

(b) Greenhouse gas emissions include only direct annualized emissions from combustion sources as presented in Table 4-14 (Source: Exelon 2018a).

(c) Emissions resulting from activities at Peach Bottom that would occur between plant shutdown and the beginning of decommissioning and assumed not to be greater than greenhouse gas emissions from operation of Peach Bottom.

(d) Emissions assumed to be similar to Peach Bottom operation.

(e) Emissions from direct combustion of bituminous coal. GHG emissions estimated using emission factors developed by the U.S. Environmental Protection Agency (EPA 2010).

(f) Emissions from direct combustion of natural gas. GHG emissions estimated using emission factors developed by the U.S. Department of Energy's (DOE's) National Energy Technology Laboratory (NETL 2012).

(g) Emissions from the natural gas combined-cycle component of the combination alternative. GHG emissions estimated using emission factors developed by DOE's National Renewable Energy Laboratory (NETL 2012).

4.15.3.2 Climate Change

Observed Trends in Climate Change Indicators

Climate change is the decades or longer change in climate measurements (e.g., temperature and precipitation) that has been observed on a global, national, and regional level (IPCC 2007, EPA 2016a, USGCRP 2014). Climate change can vary regionally, spatially, and seasonally, depending on local, regional, and global factors. Just as regional climate differs throughout the world, the impacts of climate change can vary among locations.

On a global level, from 1901 to 2015, average surface temperatures rose at a rate of 0.15 ˚F (0.08 ˚C) per decade, and total annual precipitation increased at an average rate of 0.08 in. (0.2 cm) per decade (EPA 2016a). The years 2016, 2017, and 2018 were the first, second, and fourth warmest years, respectively, on record globally. This finding is based on average global temperature data dating back to 1880. Analyses performed by both National Aeronautics and Space Administration (NASA) and National Oceanic and Atmospheric Administration's (NOAA) show that globally, the last 5 years have been the warmest in the modern record (NASA 2018, NASA 2019).

The observed global change in average surface temperature and precipitation has been accompanied by an increase in sea surface temperatures, a decrease in global glacier ice, an increase in sea level, and changes in extreme weather events. Changes in extreme events include increases in the frequency of heat waves, of very heavy precipitation (defined as the heaviest 1 percent of all daily events), and of recorded maximum daily high temperatures (IPCC 2007, EPA 2016a, USGCRP 2009, USGCRP 2014).

The U.S. Global Change Research Program (USGCRP) compiles the best available information and maintains the current state of knowledge regarding climate change trends and effects at the regional and national level. The USGCRP reports that, from 1901 to 2016, average surface temperature increased by 1.8 °F (1.0 °C) across the contiguous United States (USGCRP 2017, 2018). Since 1901, average annual precipitation has increased by 4 percent across the United States, including increases in the Northeast, Midwest, and Great Plains and decreases across parts of the Southwest and Southeast (USGCRP 2017, 2018: Fig 2.5). On a seasonal basis, warming has been the greatest in winter. Since the 1980s, NOAA data show an increase in the length of the frost-free season—the period between the last occurrence of 32 ˚F (0 °C) in the spring and first occurrence of 32 ˚F (0 °C) in the fall—across the contiguous United States. Over just the past two decades, the number of high temperature records observed in the United States far exceeds the number of low temperature records (USGCRP 2018).

Observed climate change indicators across the United States include increases in the frequency and intensity of heavy precipitation, earlier onset of spring snowmelt and runoff, rise of sea level and increased tidal flooding in coastal areas, increase in occurrence of heat waves, and a decrease in occurrence of cold waves. Since the 1980s, the intensity, frequency, and duration of North Atlantic hurricanes has increased; however, there is no trend in landfall frequency along the U.S. eastern and Gulf coasts (USGCRP 2014).

In the Northeast region of the United States, where Peach Bottom is located, average annual air temperatures have increased by 2 °F (1.1 °C) between 1895 and 2011 (USGCRP 2014). This observed warming has not been uniform, with average temperatures increasing less than 1 °F (0.6 °C) in West Virginia to 3 °F (1.7 °C) or more across New England (USGCRP 2018). All regions of Pennsylvania have warmed over the last century (using 1901 as a benchmark), with increases averaging more than 0.5 °F (0.3 °C). The easternmost counties of Pennsylvania have experienced the greatest warming, where annual average temperatures have been higher by more than 2 °F (1.1 °C) (EPA 2016a, 2016b, USGCRP 2018: Fig 2.4). Along with the observed increase in annual temperatures, the average length of the frost-free season has increased by 10 to 14 days across the Northeast during the 1991 to 2012 timeframe relative to 1901 to 1960 timeframe (USGCRP 2014, USGCRP 2017).

The effects of climate change are also reflected in precipitation across the Northeast region. Between 1958 and 2016, the Northeast experienced a 55-percent increase in heavy precipitation events (i.e., the amount of annual precipitation falling in the heaviest 1 percent of events). This is the largest increase of any region in the United States (USGCRP 2018: Fig 2.6). Changes in annual average precipitation have been more modest. Across most of southeastern Pennsylvania, average annual precipitation increased by 5 to 10 percent from 1986–2015 as compared to the 1901–1960 average (USGCRP 2018: Fig 2.5).

Heavy precipitation events can lead to an increase in flooding because of greater runoff (USGCRP 2014, USGCRP 2018). Since the 1920s, the magnitude of river flooding has been increasing across the Northeast region by up to 12 percent per decade (USGCRP 2014). Other climate-related changes in the Northeast include a sea level rise by 1 ft (0.3 m) since 1900, a rate that exceeds the global average of 8 in. (20 cm) (USGCRP 2014).

The NRC staff used the NOAA Climate at a Glance tool to analyze temperature and precipitation trends for the period of 1865 to 2018 in the southeastern Piedmont region of Pennsylvania, where Peach Bottom is located (NOAA 2018). Since 1895, the average annual temperature of the region has increased at a rate of 0.2 °F (0.11 °C) per decade (as compared to the annual mean temperature for the period 1901–2000). Positive deviations from the mean have been most prevalent since 1998 with annual temperature deviations of up to 4.0 °F (2.2 °C). Meanwhile, average annual precipitation for the region shows substantial year-to-year variations over the period. However, the overall trend shows that annual precipitation has increased at a rate of 0.27 in. (0.69 cm) per decade (NOAA 2018).

<u>Climate Change Projections</u>

Future global GHG emission concentrations (emission scenarios) and climate models are commonly used to project possible climate change. Climate models indicate that over the next few decades, temperature increases will continue due to current GHG concentrations in the atmosphere (USGCRP 2014). Over the longer term, the magnitude of temperature increases and climate change effects will depend on both past and future global emissions (IPCC 2007, 2013, USGCRP 2009, 2014, 2018). Climate model simulations often use GHG emission scenarios to represent possible future social, economic, technological, and demographic developments that, in turn, drive future emissions. Consequently, the GHG emission scenarios, their supporting assumptions, and the projections of possible climate change effects entail substantial uncertainty.

The Intergovernmental Panel on Climate Change (IPCC) has generated various emission-based climate scenarios and representative concentration pathway (RCP) scenarios that are used by climate-modeling groups to project future climate conditions (IPCC 2000, IPCC 2013, USGCRP 2017, 2018). For instance, the A2 scenario is representative of a high-emission scenario in which GHG emissions continue to rise during the 21st century from 40 gigatons (GT) of CO_{2eq} per year in 2000 to 140 GT of CO_{2eq} per year by 2100. The B1 scenario, on the other hand, is representative of a low-emission scenario in which emissions rise from 40 GT of CO_{2eq}

per year in 2000 to 50 GT of CO_{2eq} per year by midcentury before falling to 30 GT of CO_{2eq} per year by 2100 (IPCC 2000, USGCRP 2014).

The RCP scenarios are based on predicted changes in radiative forcing (a measure of the influence that a factor, such as GHG emissions, has in changing the global balance of incoming and outgoing energy) in the year 2100 relative to preindustrial conditions. The RCPs are numbered in accordance with the change in radiative forcing measured in watts per square meter (i.e., +2.6 (very low), +4.5 (lower), +6.0 (mid-high) and +8.5 (higher)) (USGCRP 2014, 2017, 2018). For example, RCP 8.5 reflects a continued increase in global emissions resulting in increased warming by 2100, while RCP 2.6 assumes immediate and rapid reductions in emissions resulting in less warming by 2100 (USGCRP 2014). Most recently, the USGCRP and IPCC have used the RCPs and associated modelling results as the basis of their climate change assessments (IPCC 2013, USGCRP 2017, 2018).

The NRC staff considered the best available climate change studies performed by the USGCRP and partner agencies as part of the staff's assessment of potential changes in climate indicators during the Peach Bottom subsequent license renewal terms (2033–2053 for Unit 2 and 2034–2054 for Unit 3). The results of these studies are summarized as follows.

As input to the Third National Climate Assessment Report (USGCRP 2014), NOAA analyzed future regional climate change scenarios based on climate model simulations using the high (A2) and low (B1) emission scenarios (NOAA 2013a). For the Northeast region, the climate model simulations project increases in both annual mean temperature and precipitation (NOAA 2013a, NOAA 2013b). More specifically, NOAA's climate model simulations for the period between 2041 and 2070 (with 2055 as a midpoint) relative to the reference period,(1971–1999) indicate that annual mean temperature will increase by 3.5 to 4.5 °F (1.9 to 2.5 °C) across southeastern Pennsylvania under a low-emission modeled scenario and 4.5 to 5.5 °F (2.5 to 3.1 °C) under a high-emission modeled scenario. Increases in temperature during this timeframe are projected to occur for all seasons across the region, with the largest increases occurring in the summer followed by the winter (NOAA 2013a).

Newer USGCRP regional projections for annual mean temperature are available from the Fourth National Climate Assessment (USGCRP 2017). The projections are based on the RCP 4.5 and RCP 8.5 scenarios for midcentury (2036–2065) as compared to the average temperature for 1976–2005. The USGCRP projections indicate annual mean temperature increases of 3.98 and 5.09 °F (2.2 to 2.8 °C) under the RCP 4.5 and RCP 8.5 scenarios, respectively, by midcentury across the Northeast region overall (USGCRP 2017: Tab 6.4). Specific to the southern portion of the Northeast region and encompassing southeastern Pennsylvania, predicted annual temperature increases range from 2–4 °F (1.1–2.2 °C) under the RCP 4.5 scenario and 4–6 °F (2.2–3.3 °C) under the RCP 8.5 scenario (USGCRP 2017: Figure 6.7).

Climate models projecting changes in precipitation across the Northeast through the end of the century are less certain than models projecting temperature increases (NOAA 2013a, USGCRP 2014). Nevertheless, precipitation models predict continued increases in precipitation during winter and spring, particularly in the northern part of the Northeast region. Projected changes during the summer and fall and on an annual basis are generally small as compared to natural variations (USGCRP 2014). For the period 2041–2070 (2055 midpoint), a 0- to 6-percent increase in annual mean precipitation is projected for both a low- and high-emission modeled scenario across the Northeast region, with the northern areas of the region experiencing the larger increases. The model results indicate a 0- to 3-percent increase across southeastern Pennsylvania (NOAA 2013a).

The USGCRP predicts continued increases in the frequency and intensity of heavy or extreme precipitation events across the United States (USGCRP 2014, USGCRP 2017, USGCRP 2018). For the Northeast region, models project a 10-percent increase in extreme precipitation (representing change in the 20-year return period amount for daily precipitation) under the lower RCP 4.5 scenario and up to 13 percent under the higher RCP 8.5 scenario by midcentury (USGCRP 2017: Fig 7.7).

With a warming climate, model simulations indicate that the total number of tropical storms will either remain steady or decrease worldwide. However, projections show that the frequency of the most intense storms will increase and rainfall will be more intense with a given storm (USGCRP 2018). Relative to the Northeast region of the United States, the USGCRP reports that there is medium confidence that the intensity of North Atlantic hurricanes will increase and high confidence that hurricane rainfall will increase. However, there is a low level of confidence in the projected increase in frequency of Atlantic hurricanes (USGCR 2017, USGCRP 2018).

Changes in climate have broader implications for public health, water resources, land use and development, and ecosystems. For instance, changes in precipitation patterns and increases in air temperature can affect water availability and quality, distribution of plant and animal species, land use patterns, and land cover, which can in turn affect terrestrial and aquatic habitats. In Section 4.16 of this SEIS, the NRC staff considers the potential cumulative, or overlapping, impacts from climate change on environmental resources that could also be impacted by the proposed action (subsequent license renewal).

The effects of climate change on Peach Bottom structures, systems, and components are outside the scope of NRC's license renewal environmental review. The environmental review documents the potential effects from continued nuclear power plant operation on the environment. Site-specific environmental conditions are considered when siting nuclear power plants. This includes the consideration of meteorological and hydrologic siting criteria as set forth in 10 CFR Part 100, "Reactor Site Criteria." Peach Bottom was designed and constructed in accordance with 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants." However, NRC regulations require that plant structures, systems, and components important to safety be designed to withstand the effects of natural phenomena, such as flooding, without loss of capability to perform safety functions. Furthermore, nuclear power plants are required to operate within technical safety specifications in accordance with the NRC operating license, including coping with natural phenomena hazards. The NRC conducts safety reviews prior to allowing licensees to make operational changes due to changing environmental conditions. In addition, through the NRC's Reactor Oversight Program, the NRC staff evaluates nuclear power plant operating conditions and physical infrastructure to ensure ongoing safe operations under the plant's initial and renewed operating licenses. If new information about changing environmental conditions becomes available, the NRC staff will evaluate the new information to determine if any safety-related changes are needed at licensed nuclear power plants. This is a separate and distinct process from the NRC staff's subsequent license renewal environmental review that it conducts in accordance with the National Environmental Policy Act (NEPA). Nonetheless, as discussed below in Section 4.16, the NRC staff considers the impacts of climate change in combination with the effects of subsequent license renewal in assessing cumulative impacts.

4.16 Cumulative Impacts

Cumulative impacts may result when the environmental effects associated with the proposed action (subsequent license renewal) add to the effects from other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over time. An effect that may be inconsequential by itself could result in a greater environmental impact when combined with the effects of other actions. The effects of the subsequent license renewal action combined with the effects of other actions could generate cumulative impacts on a given resource.

For the purposes of analysis, past actions are those that occurred since the commencement of reactor operations and prior to the submittal of the subsequent license renewal application, present actions are those that are occurring during current power plant operations, and reasonably foreseeable future actions are those that would occur through the end of power plant operation, including the period of extended operation. Therefore, the cumulative impacts analysis considers potential effects through the end of the current license term, as well as through the 20-year renewal license term.

The cumulative impacts analysis accounts for both geographic (spatial) and time (temporal) considerations of past, present, and reasonably foreseeable future actions to determine whether other potential actions are likely to contribute to the total environmental impact. In addition, because cumulative impacts accrue to resources and focus on overlapping impacts with the proposed action, no cumulative impacts analysis was performed for resource areas where the proposed action is unlikely to have any incremental impacts on that resource. Consequently, no cumulative impacts analyses were performed for the following resource areas: land use and visual resources, noise, the geologic environment, terrestrial resources, historic and cultural resources, and environmental justice.

As noted in Section 4.15.3.2, “Climate Change,” of this SEIS, changes in climate could have broad implications for certain resource areas. Accordingly, a climate change impact discussion is provided for those resource areas that could be incrementally impacted by the proposed action (subsequent license renewal). It is also important to note that the potential effects of climate change would occur irrespective of the proposed action.

Information provided by Exelon in its environmental report; responses to requests for additional information; information from other Federal, State, and local agencies; scoping comments; and information gathered during the visit to Peach Bottom Units 2 and 3 were used to identify past, present, and reasonably foreseeable future actions in the cumulative impacts analysis. To evaluate cumulative impacts resulting from the continued operation of Peach Bottom Units 2 and 3, the incremental impacts of the proposed action, as described in Sections 4.2 to 4.13, are combined with the impacts of other past, present, and reasonably foreseeable future actions regardless of which agency (Federal or non-Federal) or person undertakes such actions. In general, the effects of past actions have already been described in Chapter 3, “Affected Environment,” which serves as the environmental baseline for the cumulative impacts analysis.

Three nuclear power plants are located within the 50-mi (80-km) radius of Peach Bottom Units 2 and 3: Salem/Hope Creek (approximately 43 mi (70 km) southeast), Three Mile Island (approximately 33 mi (53 km) northwest), and Limerick (approximately 47 mi (76 km) northeast) (Exelon 2018a). In addition, there are three hydroelectric facilities within 8 mi (13 km) of the Peach Bottom site. The Muddy Run Pumped Storage Facility is approximately

5 mi (8 km) upstream on the east side of the Susquehanna River; the Holtwood Dam and Hydroelectric Facility is approximately 6 miles (10 km) upstream; and the Conowingo Dam and Hydroelectric Facility is approximately 8 miles (13 km) downstream in Maryland (NRC 2003a, p. 2-38).

The Lower Susquehanna River Watershed has 85 NPDES-permitted facilities, including Peach Bottom Units 2 and 3, the Conowingo hydroelectric power plant, and the Muddy Run Pumped Storage Facility. These three facilities all withdraw water from Conowingo Pond. Table 4-16 presents a list of existing electricity generating plants and their capacities in York and Lancaster counties.

Table 4-16 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: Exelon 2018a

As previously discussed in this SEIS, the SRBC, a Federal-interstate commission created by the Susquehanna River Basin Compact between the Federal Government and the Commonwealth of Pennsylvania and the States of New York and Maryland, manages water resources over the entire river basin. The Commission works to: reduce damages caused by floods; provide for the reasonable and sustained development and use of surface and groundwater for municipal, agricultural, recreational, commercial and industrial purposes; protect and restore fisheries, wetlands and aquatic habitat; protect water quality and instream uses; and ensure future availability of flows to the Chesapeake Bay.

There are no anticipated transportation projects near the Peach Bottom site. Recent construction includes the rapid Fishing River Bridge replacement project located across

Conowingo Pond from Peach Bottom Units 2 and 3 and the Norman Wood Bridge construction project, located 5 mi (8 km) north–northeast of Peach Bottom. None of these transportation projects are likely to contribute to cumulative impacts due to short construction schedules, distance from the Peach Bottom site, and relative size (Exelon 2018a).

The Old Dominion Electric Cooperative (ODEC) is constructing a natural gas-fired power plant in Cecil County, MD, approximately 6.5 mi (10.5 km) southeast of Peach Bottom Units 2 and 3. The facility will generate approximately 1,000 MW of electricity. In addition, Calpine Mid-Merit, LLC is constructing Block 2 at the York Energy Center power plant. Block 2 is expected to increase the Center's generation of baseload electricity by 830 MW. The plant will employ dual-fueled, combined-cycle technology using natural gas and diesel (Exelon 2018a).

Sonoco is in the process of constructing a new pipeline—80 percent of which will follow an existing line—from Ohio to Delaware County, PA. The proposed Atlantic Sunrise Pipeline will bring natural gas from Ohio and Pittsburgh to Delaware County, PA, and will cross both York and Lancaster counties. The proposed pipeline would also traverse York and Lancaster counties near the Peach Bottom site. 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 (Exelon 2018a).

Eurofins Lancaster Laboratory is expanding its Lancaster County facility, adding 350 jobs. Construction of the expansion would also add temporary employment to the area (Exelon 2018a).

Additional independent spent fuel storage installation (ISFSI) storage capacity will be needed to accommodate spent nuclear fuel generated during the second renewal term. This could require the expansion of the existing ISFSI or the construction of a new ISFSI at Peach Bottom adjacent to the existing pad in accordance with the requirements of 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste." (Exelon 2018c, Response to RAI-WM-3)

Regardless, if implemented, each of these actions would be completed prior to the commencement of the second renewal term. No other new and significant information was identified during the review of Exelon's environmental report for Peach Bottom Units 2 and 3, the site audit, the scoping process, or evaluation of other available information.

4.16.1 Air Quality

The region of influence the NRC staff considered in the cumulative air quality analysis consists of Lancaster and York counties because air quality designations in Pennsylvania are made at the county level. Exelon has not proposed any refurbishment-related activities during the subsequent license renewal term. As a result, NRC staff expects that air emissions at Peach Bottom during the subsequent license renewal term would be similar to those presented in Section 3.3.2, "Air Quality." Section 4.16 discusses present and reasonably foreseeable projects that could contribute to the cumulative impacts to air quality in Lancaster and York counties. Current air emission sources operating in Lancaster and York counties have not resulted in long-term National Ambient Air Quality Standards (NAAQS) violations given the designated unclassifiable/attainment status for all National Ambient Air Quality Standards in those two counties. Consequently, cumulative changes to air quality in Lancaster and York counties would be the result of future projects and actions that change present-day emissions within the counties.

Development and construction activities identified above in Section 4.16 can increase air emissions during their respective construction periods, but those air emissions would be temporary and localized. However, future operation of new commercial and industrial facilities and increases in vehicular traffic can result in overall long-term air emissions that contribute to cumulative air quality impacts. Any entity establishing new stationary sources of emissions in the region of influence would be required to apply for an air permit from the Pennsylvania Department of Environmental Protection and would also be required to operate in accordance with applicable Federal, State, and local regulatory requirements.

Climate Change

Climate change can impact air quality as a result of changes in meteorological conditions. The formation, transport, dispersion, and deposition of air pollutants depend, in part, on weather conditions (IPCC 2007). Ozone is particularly sensitive to climate change (IPCC 2007; EPA 2009a). Ozone is formed by the chemical reaction of nitrogen oxides and volatile organic compounds in the presence of heat and sunlight. Sunshine, high temperatures, and air stagnation are favorable meteorological conditions for higher levels of ozone (IPCC 2007, EPA 2009b). The emission of ozone precursors also depends on temperature, wind, and solar radiation (IPCC 2007). According to the EPA, both nitrogen oxide and biogenic volatile organic compound emissions are expected to be higher in a warmer climate (EPA 2009a). Although surface temperatures are expected to increase in the Northeast region of the United States (where Peach Bottom is located), this may not necessarily result in an increase in ozone. While some climate models project seasonal, short-term increases of ozone concentrations during summer months in the Northeast United States (e.g., Wu et al. 2008), others project decreases in the annual average ozone concentrations for this same region (e.g., Tagaris et al. 2009).

4.16.2 Water Resources

4.16.2.1 Surface Water Resources

Surface water impacts from Peach Bottom activities are restricted to Conowingo Pond and areas downstream from the plant site along the Susquehanna River. Therefore, the area of impact evaluation includes Conowingo Pond and the Susquehanna River below Conowingo Dam.

The SRBC manages water withdrawals from Conowingo Pond. In addition to the Peach Bottom site, water from Conowingo Pond is used by the Muddy Run Pumped Storage Facility, the York Energy Center, Holtwood Dam, and Conowingo Dam to produce electricity. The waters of Conowingo Pond serve as a public water supply source for the Chester Water Authority (Pennsylvania), the city of Baltimore, and Harford County (Maryland). Conowingo Pond is also used as a recreational resource, and as an ecologic resource. To satisfy these resource needs, Federal Energy Regulatory Commission requirements include provisions related to minimum flow releases and maintenance of pond levels (FERC 2015, SRBC 2006).

The Conowingo Dam provides the minimum flow releases required under its current license to users downstream of the Conowingo Dam. Required minimum releases to downstream users are as follows (FERC 2015):

- March 1–31: 3,500 cfs (99 m^3/s) or natural river flow, whichever is less
- April 1–30: 10,000 cfs (283 m^3/s) or natural river flow, whichever is less
- May 1–31: 7,500 cfs (212 m^3/s) or natural river flow, whichever is less
- June 1–Sep 14: 5,000 cfs (142 m^3/s) or natural river flow, whichever is less
- Sep 15–Nov 30: 3,500 cfs (99 m^3/s) or natural river flow, whichever is less
- Dec 1–Feb 28: 3,500 cfs (99 m^3/s) intermittent release

As assessed in Section 4.5.1.1, “Surface Water Resources,” of this SEIS, Peach Bottom consumes only a very small amount of the water available in Conowingo Pond. Continued operation of the Peach Bottom site under the proposed action should not have any significant impact on the amount of water available to be released to downstream users from Conowingo Pond with minimal contributions to cumulative impacts on surface water availability.

In Conowingo Pond and downstream from Conowingo Pond to the Chesapeake Bay, relevant water-quality parameters include (1) sediment transport, (2) dissolved oxygen and (3) water temperature (FERC 2015). The following paragraphs discuss each of these three water-quality parameters; however, of these three parameters, only water temperature is influenced by the Peach Bottom site.

The Pennsylvania–Maryland border bisects Conowingo Pond about 5.7-mi (9.2-km) upstream of Conowingo Dam (see Figure 3-3, “Conowingo Pond and Peach Bottom Site” on page 3-5). The Commonwealth of Pennsylvania is upstream of the border and the State of Maryland is downstream. The water quality in Conowingo Pond influences the water quality of the Susquehanna River downstream of the Conowingo Dam. The State of Maryland has designated Exelon’s Station 643, which is located 0.6-mi (1-km) downstream of the dam, as the primary Maryland State standard compliance monitoring location.

While discharges by Peach Bottom do not change the dissolved oxygen levels in Conowingo Pond (Exelon 2018a), the pond can exhibit dissolved oxygen stratification with higher dissolved oxygen levels near the surface and lower dissolved oxygen levels at depth. This creates the potential for water containing less dissolved oxygen to flow through the deep-water intakes of Conowingo Dam. However, with the installation of aerating turbine runners in Conowingo Dam, downstream river water quality meets Maryland State dissolved oxygen standards nearly 100 percent of the time (FERC 2015).

The lower Susquehanna River and the Chesapeake Bay are affected by sediment transported past Conowingo Dam. Once the river enters the Chesapeake Bay, coarser-grained sediments settle out of the water into the northern part of the bay, while finer-grained particles are transported further south. Within Chesapeake Bay, nutrients contained in the sediments are more harmful to the bay’s aquatic life than the sediments themselves. Under certain conditions, the nutrients can move from the sediments into the water of the bay where they contribute to algae growth. The algae growth may then result in dissolved oxygen depletion (FERC 2015).

Nearly all sediment and associated nutrients that enter Conowingo Pond originate upstream of Conowingo Pond. Since its construction, Conowingo Pond has been trapping some of the sediments and nutrients that would otherwise travel downstream to the Chesapeake Bay. However, it is presently estimated that the sediment trapping capacity of Conowingo Pond is currently minimal as the pond is in a state of dynamic equilibrium. A state of dynamic equilibrium implies that sediment under average river flows will continue to accumulate in Conowingo Pond until a large high-flow event occurs. The high-flow event will scour sediment already deposited on the bottom of Conowingo Pond. The scoured sediments are then transported past the dam. The electrical generating industry and State and Federal agencies are currently focused on ways to reduce the sediment and nutrient load delivered to the Chesapeake Bay. (FERC 2015, USGS 2015b). Operations at the Peach Bottom site do not contribute to or effect the transport of sediment within, into, or out of Conowingo Pond (Exelon 2018a).

Thermal discharges from the Peach Bottom site affect a very small area of Conowingo Pond. Exelon's National Pollutant Discharge Elimination System permit for the Peach Bottom site contains mitigation measures Exelon will use if specified temperature levels are exceeded, or if drought or hot weather begins to impact pond temperatures (Exelon 2018a). Water temperatures downstream of Conowingo Dam (Exelon's Station 643) closely reflect the water temperatures in Conowingo Pond. At Station 643, Susquehanna River water temperatures exhibit similar seasonal trends and minimum and maximum levels to those observed in Conowingo Pond. River water temperatures downstream of Conowingo Dam normally meet Maryland State standards, even with the presence of the heated discharge from the Peach Bottom site into Conowingo Pond (FERC 2015).

As described in Section 4.15.3.2, "Climate Change," over the Peach Bottom subsequent license renewal term, climate models project increases in annual mean temperature as GHG emissions continue to rise in the atmosphere. Annual mean temperatures might increase by 3.5 to 4.5 °F (1.9 to 2.5 °C) across southeastern Pennsylvania under a low-emission-modeled scenario and 4.5 to 5.5 °F (2.5 to 3.1 °C) under a high-emission-modeled scenario. The largest temperature increases are projected to occur in the summer.

An increase in air temperatures should also result in an increase in surface water temperatures. During the summer and early fall months, this increase in surface water temperatures may require Peach Bottom to make greater use of its helper cooling towers to meet its National Pollutant Discharge Elimination System permit requirements. A greater use of helper cooling towers would result in an increase in consumption of water during the summer and early fall.

4.16.2.2 Groundwater Resources

The description of the affected environment in Section 3.5.2, "Groundwater Resources," of this SEIS serves as the baseline for the NRC staff's cumulative impacts assessment for groundwater water resources. For groundwater, the geographic area of interest encompasses the local groundwater basin relative to the Peach Bottom plant site in which groundwater is recharged and flows to discharge points or is withdrawn through wells. As such, this review focuses on those projects and activities that would withdraw water from, or discharge effluents to, the local surficial (regolith) and bedrock aquifers at the Peach Bottom site.

Water Use Considerations

Relatively small volumes of groundwater occur in the crystalline rocks that underlie the southern half of York County where the Peach Bottom site is located, as described in Section 3.5.2.2 of this SEIS. These rocks, such as the Peters Creek schist that underlies the Peach Bottom site and site vicinity, support minor aquifers in the fractured bedrock. Most, if not all, of the 14 privately-owned groundwater supply wells within a 1-mi (1.6-km) radius of the Peach Bottom site, as well as Exelon's three on-site wells, are completed in the Peters Creek schist.

Exelon withdraws groundwater from its three active on-site wells at Peach Bottom to support various non-potable uses at the site. The water is not used for drinking water purposes. The NRC staff estimates that Peach Bottom's maximum groundwater production capacity is about 15 gpm (57 Lpm), which is equivalent to a daily production volume of approximately 0.022 mgd (0.076 mld) (Section 3.5.2.2). Exelon's usage is very small as compared to groundwater usage in York County (2015 data) for domestic purposes, which totaled 9.8 mgd (37 mld) (USGS 2018c). Exelon has no plans to increase groundwater consumption during the subsequent license renewal term (Exelon 2018a).

The NRC staff has identified one other groundwater user in the local groundwater basin, as discussed in Section 3.5.2.2. The Delta Borough Municipal Authority operates a well field for public water supply that is located approximately 4 mi (6 km) southwest of the Peach Bottom site. The authority's six wells, completed in the Peters Creek schist, have a combined withdrawal limit of 0.13 mgd (0.49 mld). Otherwise, the NRC staff has not identified any proposed projects that would use groundwater within the local groundwater basin or in areas adjoining Conowingo Pond.

The local groundwater basin within which the Peach Bottom site is located is recharged by local precipitation and runoff. Joints and fracture systems in the uppermost portion of the schist bedrock that yield water to wells are not connected over long distances. Groundwater in southeastern York County generally flows from west to east along relatively short flow paths and discharges to the Susquehanna River, local streams, and other topographically low areas. Relative to the Peach Bottom site, the Susquehanna River serves as a hydrologic barrier to groundwater flow from one side of the river to the other, and the effects of groundwater withdrawals would not extend from one side of Conowingo Pond to the other. For these reasons, the NRC staff finds that groundwater use associated with continued operations at the Peach Bottom site would neither be likely to affect offsite domestic and public water supplies nor substantially contribute to cumulative impacts on groundwater availability in the local groundwater basin.

Water Quality Considerations

Peach Bottom operations have resulted in inadvertent release of radionuclides (principally tritium) to groundwater beneath the Peach Bottom plant site. These releases have produced a tritium plume, as detailed in Section 3.5.2.3 of this SEIS. However, as evaluated in detail in Section 4.5.1.2 of this SEIS, there is no migration of tritium in groundwater from the Peach Bottom site at concentrations exceeding the U.S. EPA primary maximum contaminant level (drinking water standard) (20,000 pCi/L) (40 CFR 141.66). Site groundwater locally discharges to the plant intake and discharge basins and to Conowingo Pond where rapid mixing and dilution occurs. Furthermore, as discussed above, the Susquehanna River serves as a hydrologic barrier to groundwater flow from one side of the river to the other. The results of surface water monitoring conducted in accordance with the Peach Bottom groundwater protection program show that tritium is not detectable in the surface waters of Conowingo Pond adjacent to Peach Bottom. Meanwhile, Exelon maintains an ongoing radiological groundwater protection program and associated surveillance and corrective action programs at Peach Bottom to prevent, detect and respond to inadvertent releases of radionuclides. As a result, the NRC finds that continued operations at Peach Bottom would be unlikely to contribute to cumulative impacts on groundwater quality in the local groundwater basin.

Climate Change and Related Considerations

As described in Section 4.15.3.2 of this SEIS, the latest climate models predict continuation of the strong trend of increasing temperatures across the Northeast region of the United States. The USGCRP forecasts temperatures to rise by an additional 2–4°F (1.1–2.2 °C) by mid-century (2036–2065), and perhaps by as much as 4–6 °F (2.2–3.3 °C), depending on the rise in global emissions of GHGs. Climate models project continued but modest increases of up to 3 percent in annual mean precipitation by mid-century across the portion of the Northeast region comprising southeastern Pennsylvania. The precipitation increases are projected to occur mainly during winter and spring. Additionally, models predict continued increases in the frequency and intensity of heavy or extreme precipitation events, with increases in extreme precipitation events of between 10 and 13 percent across the Northeast region by mid-century (USGCRP 2017).

Climate change can impact groundwater availability and quality as a result of changes in temperature and precipitation. Climate change impacts on groundwater depend on basin geology, frequency and intensity of high rainfall periods, recharge, soil moisture, and interaction between groundwater and surface water (USGCRP 2014). Precipitation and evapotranspiration are key drivers in groundwater recharge. A reduction in groundwater recharge reduces groundwater availability to wells, baseflow to streams, and can negatively affect groundwater quality.

Projected temperature increases along with increased evapotranspiration from vegetation could reduce the amount of water available for surface runoff, streamflow, and groundwater recharge during the subsequent license renewal term for Peach Bottom. However, climate models forecast a modest increase in annual mean precipitation across the region. This annual increase combined with projected increases in heavy precipitation events could at least partially offset reductions in groundwater recharge due to temperature increases alone.

Nevertheless, the effects of climate change are projected to significantly increase water demand across most of the United States. When accounting for regional changes in population, coupled with predicted climate change impacts, current projections indicate that southeastern Pennsylvania could experience climate-change induced increases in water demand of between 0 and 10 percent by 2060 (USGCRP 2014: Figure 3.11). Assuming the upper bounds of this forecast, the NRC staff does not expect that such an increase would substantially impact groundwater availability from the Peach Bottom region's crystalline bedrock aquifers. This is because the crystalline rock aquifers of the region are locally recharged, poorly or not interconnected over long distances, and primarily used to supply groundwater to support domestic needs.

High-volume water needs in the surrounding region are primarily supplied by surface water from the Susquehanna River, rather than groundwater. Should regional groundwater deficits arise during the subsequent license renewal term, municipalities could take action to increase the efficiency and extent of their production and water distribution infrastructure to serve domestic and other groundwater users now dependent on individual wells. This could include redeveloping existing production wells or drilling new ones and extending service areas to manage water supply conflicts. Alternatively, public water suppliers and individual users could also seek out new water supply sources such as the abundant resources of the Susquehanna River, although this approach would entail investments in new infrastructure and increased operating costs. Suppliers could also pursue a combination of approaches such as conservation measures and new water sources.

4.16.3 Aquatic Resources

Section 4.7, "Aquatic Resources," finds that the direct and indirect impacts on aquatic resources from the subsequent license renewal would be SMALL to MODERATE for thermal impacts and SMALL for all other aquatic resource issues. The geographic area considered in the cumulative aquatic resources analysis includes Conowingo Pond. The baseline, or benchmark, for assessing cumulative impacts on aquatic resources takes into account the preoperational environment as recommended by EPA (1998) for its review of NEPA documents.

Section 3.7, "Aquatic Resources," presents an overview of the current condition of the Susquehanna River and the history and factors that led to the current conditions, such as land use changes and the addition of dams or other structures that blocked fish passage and changed water flow dynamics. Many natural and human activities can influence the current and future aquatic life in the area surrounding Peach Bottom. Potential biological stressors include operational impacts from Peach Bottom (as described in Section 4.7); runoff from industrial, agricultural, and urban areas; other water users and dischargers; and climate change.

4.16.3.1 Runoff from Industrial, Agricultural, and Urban Areas

The Susquehanna River basin includes portions of New York, Pennsylvania, and Maryland. Land use changes and industrial activities within this area have had a substantial impact on aquatic habitat and water quality within the Susquehanna River. For example, the Susquehanna River historically experienced decreased water quality as a result of industrial discharges, agricultural runoff, municipal sewage discharges, surface runoff from mining activity, and surface runoff from municipalities (PFBC 2011). However, over the past few decades, water quality within the Susquehanna River has improved because of the implementation of the CWA and other environmental regulations (PFBC 2011). For example, most of the older, first-generation chlorinated insecticides have been banned since the late 1970s. Similarly, the addition and upgrading of numerous municipal sewage treatment facilities, rural septic systems, and animal waste management systems have helped to significantly decrease the concentration of median fecal coliform bacteria in many rivers within the United States. Despite the trend of improving water quality within the Susquehanna River, trace levels of some contaminants and increased nutrients from agricultural lands, past and present mining activities, and runoff from urbanized areas remain a source of concern for aquatic life (PFBC 2011).

4.16.3.2 Water Users and Discharges

Several other facilities withdraw and discharge water from and to Conowingo Pond to produce electricity, including the Muddy Run Pumped Storage Facility, the York Energy Center, Holtwood Dam, and the Conowingo Dam. These facilities also may entrain and impinge aquatic organisms and add to the cumulative thermal stress to aquatic populations that inhabit waters near Peach Bottom.

Several engineered design factors and operational controls suggest that the cumulative impacts from other water users and discharges would be minimal. For example, the location of the intake system and discharge structure is a design factor that can affect impingement and entrainment because locating such structures in areas with high biological productivity or sensitive biota can negatively affect aquatic life (EPA 2004). The location of the intake and discharge structures within Conowingo Pond, which is impounded and does not provide as high-quality habitat as free-flowing portions of the Susquehanna River, suggests that the areas immediately surrounding the intakes do not provide high-quality habitat (SRBC 2015).

In addition, several other regulatory reviews help to minimize the cumulative impacts from the multiple water users that could impinge and entrain aquatic biota and add to the thermal effects within Conowingo Pond. For example, water withdrawals on the Susquehanna River are managed by the SRBC. SRBC considers the consumptive water use of all water users in Conowingo Pond when granting specified allowable withdrawal and consumptive use rates. In addition, Exelon and other water dischargers are required to comply with NPDES permits that must be renewed every 5 years, allowing PDEP to ensure that the permit limits provide the appropriate level of environmental protection. FERC regulates the Muddy Run Pumped Storage Facility, Holtwood Dam, and Conowingo Dam. During its licensing and relicensing reviews of these facilities, FERC examined the individual and cumulative impacts to aquatic biota in Conowingo Pond and the lower Susquehanna River. Within its analysis, FERC (2015) characterized the potential cumulative impacts from entrainment, blockage of fish passage, and changes to water quality and flow. The NRC incorporates FERC's cumulative analysis into this SEIS (FERC 2015; Section 3.3.2.3 pages 94-96).

4.16.3.3 Climate Change

The potential effects of climate change, including increased temperatures and heavy downpours, could result in degradation to aquatic resources in the Conowingo Pond. Increased temperature and thermal stress to aquatic biota could increase the frequency of shellfish-borne illness, alter the distribution of native fish, increase the local loss of rare species, and increase the displacement of native species by non-native species (USGCRP 2014, 2017, 2018).

More rainfall and heavy downpours can increase the rate of runoff and pollutants reaching the Susquehanna River because pollutants washed away in the high volume of runoff have less time to absorb into the soil before reaching the river. Over the past 50 years, as a result of climate change and land use changes that have increased non-permeable surfaces, the Susquehanna River Basin is yielding more nitrogen loading. Future increases in runoff would further increase the sediment load within the Susquehanna River and concurrently limit photosynthesis and growth of primary producers that provide an important food source for fish and other aquatic organisms.

The cumulative effects of increased temperatures, altered river flows, and increased sediment loading could exacerbate existing environmental stressors, such as high nutrient levels and low dissolved oxygen, both of which are associated with eutrophication. A decline in oxygen is especially likely within shallow aquatic habitats that provide high-quality habitat for spawning, foraging, and resting. Low oxygen also may lead to fish, shellfish, eggs, and larvae mortality.

4.16.3.4 Protected Habitats

Several wildlife management areas, parks, and recreation sites lie within the vicinity of Peach Bottom. The continued preservation of these areas will protect aquatic habitats, and these areas will become ecologically more important in the future because they will provide large areas of protected aquatic habitats as other stressors increase in magnitude and intensity.

4.16.4 Socioeconomics

This section addresses socioeconomic factors that have the potential to be directly or indirectly affected by changes in operations at Peach Bottom in addition to the aggregate effects of other past, present, and reasonably foreseeable future actions. As discussed in Section 4.10, "Socioeconomics," continued operation of Peach Bottom during the subsequent license renewal term would have SMALL socioeconomic impacts. The region of influence (ROI) is Lancaster and York counties. This is where the economy, tax base, and infrastructure would most likely be affected because the majority of Peach Bottom workers and their families reside, spend their incomes, and use their benefits within these two counties.

Past, present, and reasonably foreseeable future actions within the socioeconomic region of influence could contribute to cumulative socioeconomic impacts. Relevant actions in this cumulative impact analysis include future planned activities at the Peach Bottom site that are unrelated to the proposed action of subsequent license renewal, population increases, transportation infrastructure projects, and other reasonably foreseeable planned offsite activities. Future activities and planned projects (e.g., operation of Calpine's York 2 Energy Center Combined-Cycle Power Station, gas pipeline construction, Eurofins Lancaster Laboratory expansion) in the socioeconomic region of influence could bring additional workers and traffic. Construction of facilities would add temporary employment to the area and long-term employment would occur as a result of operation and maintenance of the project facilities. For instance, expansion of Eurofins Lancaster Laboratory would add 350 jobs, which in turn would result in beneficial socioeconomic impacts including additional wages, tax revenue, and indirect jobs. Additional workers would increase the local population and cause increased traffic on local roads and increased demand for public services and housing.

Changes in climate conditions could impact certain industries such as tourism and recreation, which create jobs and bring significant revenue to regional economies. The U.S. Global Change Research Program reports that climate changes (changes in the length and timing of seasons, increases in ambient temperatures and humidity, and increases in severe weather events) can have a direct impact on tourism and recreational activities. Extreme weather events can also damage roads and transportation infrastructure or exacerbate existing issues with aging infrastructure. For instance, in Pennsylvania, bridges are expected to be more prone to damage during extreme weather events because the State leads in the highest percentage of structurally deficient bridges (USGCRP 2018).

4.16.5 Human Health

The NRC and EPA have established radiological dose limits to protect the public and workers from both acute and long-term exposure to radiation and radioactive materials. These dose limits are in 10 CFR Part 20, "Standards for Protection Against Radiation," and 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations." As discussed in Section 4.11, "Human Health," of this SEIS, the impacts to human health from continued plant operations during the subsequent license renewal term are SMALL. For the purposes of this cumulative impacts analysis, the geographical area considered is the area within a 50-mi (80-km) radius of Peach Bottom Units 2 and 3. There are three other nuclear power facilities located within the 50-mi (80-km) radius: Salem/Hope Creek (43 miles southeast), Three Mile Island (33 miles northwest), and Limerick (47 miles northeast).

As discussed in Section 3.1.4.4, "Radioactive Waste Storage," of this SEIS, Exelon stores spent nuclear fuel from Units 2 and 3 in a storage pool and in an onsite ISFSI. As a reasonably foreseeable project, Exelon has stated that the current ISFSI will be full on or before the year 2020 (Exelon 2018a). To accommodate storage of spent fuel through the current license terms for both Units 2 and 3 (2033 and 2034, respectively), Exelon is expanding the current ISFSI storage pad and expects construction to be completed in 2019. Exelon also stated that spent fuel management beyond 2034 may be at a second onsite ISFSI pad or at an offsite facility if one becomes available. Exelon states that it has adequate space onsite to accommodate the construction of a new ISFSI pad if necessary (Exelon 2018c).

EPA regulations in 40 CFR Part 190 limit the dose to members of the public from all sources in the nuclear fuel cycle, including nuclear power plants, fuel fabrication facilities, waste disposal facilities, and transportation of fuel and waste. As discussed in Section 3.1.4.5, "Radiological Environmental Monitoring Program," in this SEIS, Exelon has a radiological environmental monitoring program (REMP) that measures radiation and radioactive materials in the environment from Peach Bottom Units 2 and 3, its ISFSI, and all other sources. The NRC staff reviewed the radiological environmental monitoring results for the 5-year period from 2013 to 2017 as part of this cumulative impacts assessment. The review of Exelon's data showed no indication of an adverse trend in radioactivity levels in the environment from either Peach Bottom Units 2 and 3 or the ISFSI. The data showed that there was no measurable significant impact to the environment from operations at Peach Bottom.

In summary, the NRC staff concludes that there is no significant cumulative effect from the proposed action of subsequent license renewal on human health. This staff bases this conclusion on its review of radiological environmental monitoring program data, radioactive effluent release data, and worker dose data; the expectation that Peach Bottom would continue to comply with Federal radiation protection standards during the period of extended operation; and the continued regulation of any future development or actions in the vicinity of Peach Bottom by the NRC and the Commonwealth of Pennsylvania.

4.16.6 Waste Management and Pollution Prevention

This section describes waste management impacts during the subsequent license renewal term when combined with the aggregate effects of other past, present, and reasonably foreseeable future actions. For the purpose of this cumulative impacts analysis, the NRC staff considered the area within a 50-mi (80-km) radius of Peach Bottom. In Section 4.11, "Human Health," the NRC staff concluded that the potential human health impacts from Peach Bottom's waste during the subsequent license renewal term would be SMALL.

As discussed in Sections 3.1.4 and 3.1.5 of this SEIS, Exelon maintains waste management programs for radioactive and nonradioactive waste generated at Peach Bottom and is required to comply with Federal and State permits and other regulatory waste management requirements. The nuclear power plants and other facilities within a 50-mile (80-km) radius of Peach Bottom are also required to comply with appropriate NRC, EPA, and State requirements for the management of radioactive and nonradioactive waste. Current waste management activities at Peach Bottom would likely remain unchanged during the subsequent license renewal term, and the NRC staff expects that Exelon will continue to comply with Federal and State requirements for radioactive and nonradioactive waste.

In summary, the NRC staff concludes that there would be no significant cumulative effect from the generation of radioactive and nonradioactive waste during the period of extended operation authorized by the proposed action of subsequent license renewal. The NRC staff bases its conclusion on the continued compliance of Exelon with Federal and Commonwealth of Pennsylvania requirements for radioactive and nonradioactive waste management and on the expected regulatory compliance of other waste producers in the area.

4.17 Resource Commitments Associated with the Proposed Action

This section describes the NRC's consideration of potentially unavoidable adverse environmental impacts that could result from implementation of the proposed action (subsequent license renewal) and alternatives to the proposed action, the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity, and the irreversible and irretrievable commitments of resources.

4.17.1 Unavoidable Adverse Environmental Impacts

Unavoidable adverse environmental impacts are impacts that would occur after implementation of all workable mitigation measures. Carrying out either the proposed action of Peach Bottom subsequent license renewal or any of the reasonable replacement energy alternatives considered in this SEIS would result in some unavoidable adverse environmental impacts.

Minor unavoidable adverse impacts on air quality would occur due to emission and release of various chemical and radiological constituents from power plant operations. Nonradiological emissions resulting from power plant operations are expected to comply with EPA emissions standards, although the alternative of operating a fossil-fueled power plant in some areas may worsen existing attainment issues. Chemical and radiological emissions would not exceed the national emission standards for hazardous air pollutants.

During nuclear power plant operations, workers and members of the public would face unavoidable exposure to minor levels of radiation as well as to hazardous and toxic chemicals. Workers would be exposed to radiation and chemicals associated with routine plant operations and the handling of nuclear fuel and waste material. Workers would have higher levels of exposure than members of the public, but doses would be administratively controlled and would not exceed regulatory standards or administrative control limits. In comparison, the alternatives involving the construction and operation of a non-nuclear power generating facility would also result in unavoidable exposure to hazardous and toxic chemicals to workers and the public.

The generation of spent nuclear fuel and waste material—including low-level radioactive waste, hazardous waste, and nonhazardous waste—would be unavoidable. Non-nuclear power generating facilities would generate both hazardous and nonhazardous waste. For wastes generated during operations, power plant operators would collect, store, and ship these for suitable treatment, recycling, or disposal in accordance with applicable Federal and State regulations. Due to the costs of handling these materials, NRC staff expects that power plant operators would optimize all waste management activities and operations in a way that generates the smallest possible amount of waste.

4.17.2 Relationship between Short-Term Use of the Environment and Long-Term Productivity

The operation of power generating facilities would result in short-term uses of the environment, as described in Chapter 4, "Environmental Consequences and Mitigating Actions," of this SEIS. Short term is the period in which continued power generating activities take place.

Power plant operations require short-term use of the environment and commitment of resources (e.g., land and energy), indefinitely or permanently. Certain short-term resource commitments are substantially greater under most energy alternatives, including license renewal, than under the no-action alternative because of the continued generation of electrical power and the continued use of generating sites and associated infrastructure. During operations, all energy alternatives entail similar relationships between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

Air emissions from nuclear power plant operations introduce small amounts of radiological and nonradiological emissions to the region around the plant site. Over time, these emissions would result in increased concentrations and exposure, but the NRC staff does not expect that these emissions would impact air quality or radiation exposure to the extent that they would impair public health or long-term productivity of the environment.

Continued employment, expenditures, and tax revenues generated during power plant operations directly benefit local, regional, and State economies over the short term. Local governments investing project-generated tax revenues into infrastructure and other required services could enhance economic productivity over the long term.

The management and disposal of spent nuclear fuel, low-level radioactive waste, hazardous waste, and nonhazardous waste requires an increase in energy and consumes space at treatment, storage, or disposal facilities. Regardless of the location, the use of land to meet waste disposal needs would reduce the long-term productivity of the land.

Power plant facilities are committed to electricity production over the short term. After decommissioning of these facilities and restoration of the area, the land could be available for other future productive uses.

4.17.3 Irreversible and Irretrievable Commitment of Resources

Resource commitments are irreversible when primary or secondary impacts limit the future options for a resource. For example, the consumption or loss of nonrenewable resources is irreversible. An irretrievable commitment refers to the use or consumption of resources for a period of time (e.g., for the duration of the action under consideration) so that the resources are neither renewable nor recoverable for future use. Irreversible and irretrievable commitments of resources for electrical power generation include the commitment of land, water, energy, raw materials, and other natural and man-made resources required for power plant operations. In general, the commitments of capital, energy, labor, and material resources are also irreversible.

The implementation of any of the replacement energy alternatives considered in this SEIS would entail the irreversible and irretrievable commitments of energy, water, chemicals, and—in some cases—fossil fuels. These resources would be committed during the subsequent license renewal term and over the entire life cycle of the power plant, and they would be unrecoverable.

Energy expended would be in the form of fuel for equipment, vehicles, and power plant operations and electricity for equipment and facility operations. Electricity and fuel would be purchased from offsite commercial sources. Water would be obtained from existing water supply systems. These resources are readily available, and the NRC staff does not expect that the required amounts would deplete available supplies or exceed available system capacities.

5 CONCLUSION

This draft supplemental environmental impact statement (SEIS) contains the NRC staff's environmental review of the Exelon Generation Company, LLC (Exelon) application for renewed operating licenses for Peach Bottom Atomic Power Station Units 2 and 3 (Peach Bottom or Peach Bottom Units 2 and 3), as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." The regulations at 10 CFR Part 51 implement the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.). This chapter briefly summarizes the environmental impacts of subsequent license renewal, lists and compares the environmental impacts of alternatives to subsequent license renewal, and presents the NRC staff's conclusions and recommendation.

5.1 Environmental Impacts of Subsequent License Renewal

After reviewing new and potentially significant information with respect to generic (Category 1) environmental issues in this SEIS, the NRC staff concluded that issuing subsequent renewed licenses for Peach Bottom would not have impacts beyond those discussed in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (NRC 2013a).

After reviewing the site-specific (Category 2) environmental issues in this SEIS, the NRC staff concluded that issuing renewed licenses for Peach Bottom would have SMALL impacts for the Category 2 issues applicable to subsequent license renewal at Peach Bottom with one exception: for aquatic resources, the impact would be SMALL to MODERATE. The NRC staff considered mitigation measures for each Category 2 issue, as applicable. The NRC staff concluded that no additional mitigation measures are warranted.

5.2 Comparison of Alternatives

In Chapter 4, "Environmental Consequences and Mitigating Actions," of this SEIS, the staff considered the following alternatives to issuing renewed operating licenses to Peach Bottom:

- no-action alternative
- new nuclear alternative
- supercritical pulverized coal alternative
- natural gas combined-cycle alternative
- combination alternative (natural gas, wind, solar, and purchased power)

Based on the evaluation presented in this draft SEIS, the NRC staff concludes that the environmentally preferred alternative is the proposed action of subsequent license renewal. As shown in Table 2-2, "Summary of Environmental Impacts of the Proposed Action and Alternatives," all other reasonable power-generation alternatives have impacts in at least six resource areas that are greater than the impacts of subsequent license renewal and only one resource area has lesser impacts. The no action alternative does not expressly meet the purpose and need of the proposed action because the no action alternative does not provide a means of delivering baseload power to meet future electric system needs. Assuming that a need currently exists for the power generated by Peach Bottom Units 2 and 3, the no action alternative would likely create a need for a replacement power alternative.

5.3 Preliminary Recommendation

The NRC staff's preliminary recommendation is that the adverse environmental impacts of subsequent license renewal for Peach Bottom are not so great that preserving the option of license renewal for energy-planning decisionmakers would be unreasonable. The NRC staff bases its recommendation on the following:

- the analysis and findings in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants"
- the environmental report submitted by Exelon
- the NRC staff's consultation with Federal, State, Tribal, and local agencies
- the NRC staff's independent environmental review
- the NRC staff's consideration of public comments

6 REFERENCES

10 CFR Part 2. *Code of Federal Regulations*. Title 10, *Energy*, Part 2, "Agency Rules of Practice and Procedure."

10 CFR Part 20. *Code of Federal Regulations*. Title 10, *Energy*, Part 20, "Standards for Protection against Radiation."

10 CFR Part 50. *Code of Federal Regulations*. Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. *Code of Federal Regulations*. Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. *Code of Federal Regulations*. Title 10, *Energy*, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 61. *Code of Federal Regulations*. Title 10, *Energy*, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste."

10 CFR Part 71. *Code of Federal Regulations*. Title 10, *Energy*, Part 71, "Packaging and Transportation of Radioactive Material."

10 CFR Part 72. *Code of Federal Regulations*. Title 10, *Energy*, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste."

10 CFR Part 100. *Code of Federal Regulations*. Title 10, *Energy*, Part 100, "Reactor Site Criteria."

15 CFR Part 930. *Code of Federal Regulations*. Title 15, *Commerce and Foreign Trade*, Part 930, "Federal Consistency with Approved Coastal Management Programs."

36 CFR Part 60. *Code of Federal Regulations*. Title 36, *Parks, Forests, and Public Property*, Part 60, "National Register of Historic Places."

36 CFR Part 800. *Code of Federal Regulations*. Title 36, *Parks, Forests, and Public Property*, Part 800, "Protection of Historic Properties."

40 CFR Part 50. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 50, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR Part 51. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 60. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

40 CFR Part 63. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 63, "National Emission Standards for Hazardous Air Pollutants for Source Categories."

40 CFR Part 81. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 81, "Designation of Areas for Air Quality Planning Purposes."

40 CFR Part 110. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 110, "Discharge of Oil."

40 CFR Part 112. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 112. "Oil Pollution Prevention."

40 CFR Part 125. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 125, “Criteria and Standards for the National Pollutant Discharge Elimination System.”

40 CFR Part 131. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 131, “Water Quality Standards.”

40 CFR Part 141. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 141, “National Primary Drinking Water Regulations.”

40 CFR Part 143. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 143, “National Secondary Drinking Water Regulations.”

40 CFR Part 190. *Code of Federal Regulations*. Title 40, *Protection of Environment*, Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations.”

50 CFR Part 10. *Code of Federal Regulations*. Title 50, *Wildlife and Fisheries*, Part 10, “General Provisions.”

50 CFR Part 17. *Code of Federal Regulations*. Title 50, *Wildlife and Fisheries*, Part 17, “Endangered and Threatened Wildlife and Plants.”

50 CFR Part 402. *Code of Federal Regulations*. Title 50, *Wildlife and Fisheries*, Part 402, “Interagency Cooperation – Endangered Species Act of 1973, as Amended.”

50 CFR Part 600. *Code of Federal Regulations*. Title 50, *Wildlife and Fisheries*, Part 600, “Magnuson-Stevens Act Provisions.”

32 FR 4001. U.S. Fish and Wildlife Service. “Endangered Species.” *Federal Register* 32(48):4001. March 11, 1967.

41 FR 41914. U.S. Fish and Wildlife Service. “Part 17 -- Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for American Crocodile, California Condor, Indiana Bat, and Florida Manatee.” *Federal Register* 41(187):41914–41916. September 24, 1976.

42 FR 47840. U.S. Fish and Wildlife Service. “Part 17 -- Endangered and Threatened Wildlife and Plants; Final rule; Correction and Augmentation of Published Rulemaking.” *Federal Register* 42(184):47840–47845. September 22, 1977.

51 FR 19926. U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration. “Interagency Cooperation—Endangered Species Act of 1973, as Amended; Final Rule.” *Federal Register* 51(106):19926–19963. June 3, 1986.

53 FR 43950. U.S. Nuclear Regulatory Commission. “Memorandum of Understanding Between The Nuclear Regulatory Commission and the Occupational Safety and Health Administration; Worker Protection at NRC-licensed Facilities.” *Federal Register* 53(210):43950–43952. October 31, 1988.

55 FR 36641. U.S. Fish and Wildlife Service. “Endangered and Threatened Wwildlife and Plants; Determination of Endangered Status for the Pallid Sturgeon. *Federal Register* 55(173):36641–36647. September 6, 1990.

59 FR 7629. Executive Order No. 12898. “Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations.” *Federal Register* 59(32):7629–7634. February 16, 1994.

61 FR 28467. U.S. Nuclear Regulatory Commission. “Environmental Review for Renewal of Nuclear Power Plant Operating Licenses.” *Federal Register* 61(109):28467–28481. June 5, 1996.

61 FR 66537. U.S. Nuclear Regulatory Commission. "Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register* 61 (244):66537–66544. December 18, 1996.

64 FR 6183. Executive Order 13112. "Invasive Species." *Federal Register* 64(25):6183–6186. February 8, 1999.

65 FR 79825. U.S. Environmental Protection Agency. "Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units." *Federal Register* 65(245):79825–79831. December 20, 2000

69 FR 41576. Environmental Protection Agency. "National Pollutant Discharge Elimination System—Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities." *Federal Register* 69 (131):41576 – 41693. July 9, 2007.

69 FR 52040. U.S. Nuclear Regulatory Commission. "Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions." *Federal Register* 69(163):52040–52048. August 24, 2004.

70 FR 39104. U.S. Environmental Protection Agency. "Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations." *Federal Register* 70(128):39104–39172. July 6, 2005.

74 FR 13926. U.S. Nuclear Regulatory Commission. "Power Reactor Security Requirements." *Federal Register* 74(58):13926–13993. March 27, 2009S

74 FR 56260. U.S. Environmental Protection Agency. "Mandatory Reporting of Greenhouse Gases." *Federal Register* 74(209):56260–56519. October 30, 2009.

74 FR 66496. U.S. Environmental Protection Agency. "Endangerment and Cause or Contribute Findings for gGreenhouse Gases Under Section 202(a) of the Clean Air Act." *Federal Register* 74(239):66496–66546. December 15, 2009.

75 FR 31514. U.S. Environmental Protection Agency. "Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule." *Federal Register* 75(106):31514–31608. June 3, 2010.

75 FR 61872. National Oceanic and Atmospheric Administration. "Endangered and Threatened Wildlife and Plants; Proposed Listing Determinations for Three Distinct Population Segments of Atlantic Sturgeon in the Northeast Region." *Federal Register* 75(193):61872-61904. October 6, 2010.

76 FR 59836. U.S. Fish and Wildlife Service. "Endangered and Threatened Wildlife and Plants; Partial 90-Day Finding on a Petition To List 404 Species in the Southeastern United States as Endangered or Threatened With Critical Habitat." *Federal Register* 76(187):59836–59862. September 27, 2011.

77 FR 5880. National Oceanic and Atmospheric Administration. "Endangered and Threatened Wildlife and Plants; Final Listing Determinations for Two Distinct Population Segments of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) in the Northeast Region." *Federal Register* 77(24):5880–5912. February 6, 2012.

77 FR 5914. National Oceanic and Atmospheric Administration. "Endangered and Threatened Wildlife and Plants; Final Listing Determinations for Two Distinct Population Segments of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) in the Southeast." *Federal Register* 77(24):5914–5982. February 6, 2012.

77 FR 41051. U.S. Environmental Protection Agency. "Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule Step 3 and GHG Plantwide Applicability Limits." *Federal Register* 77(134):41051–41075. July 12, 2012.

78 FR 37282. U.S. Nuclear Regulatory Commission. "Revisions to Environmental Review for Renewal of Nuclear Power Plant Operating Licenses." *Federal Register* 78(119):37282–37324. June 20, 2013.

78 FR 60024. U.S. Fish and Wildlife Service. "Endangered and Threatened Wildlife and Plants; Proposed Threatened Species Status for the Rufa Red Knot." *Federal Register* 78(189):60024–60098. September 30, 2013.

78 FR 65844. U.S. Fish and Wildlife Service. "General Provisions; Revised List of Migratory Birds." *Federal Register* 78(212):65844–65864. November 1, 2013.

79 FR 48300. U.S. Environmental Protection Agency. "National Pollutant Discharge Elimination System—Final Regulations To Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities." *Federal Register* 79(158):48300–48439. August 15, 2014.

79 FR 73706. U.S. Fish and Wildlife. "Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Rufa Red Knot." *Federal Register* 79(238):73706–73748. December 11, 2014.

80 FR 17974. U.S. Fish and Wildlife Service. "Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule." *Federal Register* 80(63):17974–18033. April 2, 2015.

80 FR 60834. U.S. Fish and Wildlife Service. Endangered and Threatened Wildlife and Plants; 12-Month Findings on Petitions To List 19 Species as Endangered or Threatened species. *Federal Register* 80(195):60834–60850. October 8, 2015.

81 FR 24707. U.S. Fish and Wildlife Service. "Endangered and Threatened Wildlife and Plants; Determination That Designation of Critical Habitat Is Not Prudent for the Northern Long-Eared Bat." *Federal Register* 81(81):24707–24714. April 27, 2016.

82 FR 39160. National Oceanic and Atmospheric Administration. "Endangered and Threatened Species; Designation of Critical Habitat for the Endangered New York Bight, Chesapeake Bay, Carolina and South Atlantic Distinct Population Segments of Atlantic Sturgeon and the Threatened Gulf of Maine Distinct Population Segment of Atlantic Sturgeon." *Federal Register* 82(158):39160-39274. August 17, 2017.

25 Pa. Code 109. *Pennsylvania Administrative Code*. Part 1, *Department of Environmental Protection,* Title 25, *Environmental Protection*, Chapter 109, "Safe Drinking Water." Available at <http://www.pacode.com/secure/data/025/025toc.html> (accessed September 28, 2018).

25 Pa. Code 110. *Pennsylvania Administrative Code*. Part 1, *Department of Environmental Protection*, Title 25, *Environmental Protection*, Chapter 110, "Water Resources Planning." Available at< http://www.pacode.com/secure/data/025/025toc.html> (accessed September 28, 2018). [AEC] U.S. Atomic Energy Commission. 1973*. Final Environmental Statement Related to Operation of Peach Bottom Atomic Power Station Units 2 and 3*. Washington, DC: AEC. April 1973. 519 p. ADAMS Accession No. ML18291A605.

[AECOM] AECOM. 2017. *Peach Bottom Atomic Power Station Phase I Bog Turtle Habitat Evaluation*. AECOM Project No. 60509072. September 20, 2017. 19 p. In Appendix C of Exelon 2018a.

[ANS] American Nuclear Society. 2018. Nuclear Historic Landmark Award. Available at <http://www.ans.org/honors/recipients/va-nuclandmark> (accessed January 3, 2019).

Archer C.L., Jacobson M.Z. 2007. Supplying baseload power and reducing transmission requirements by interconnecting wind farms. *Journal of Applied Meteorology and Climatology* 46(11):1701–1717. Available at <https://web.stanford.edu/group/efmh/winds/aj07_jamc.pdf> (accessed March 7, 2019).

Ashton M.J., Near T.J. 2010. Threatened fishes of the world: *Percina bimaculata* (Haldeman, 1844) (Percidae: Etheostomatinae). *Environmental Biology of Fishes* 88(2010):37–38.

[ASME/ANS] American Society of Mechanical Engineers/ American Nuclear Society. 2009. *Addenda to ASME/ANS RA-S–2008 Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications*. New York, NY: American Society of Mechanical Engineers/American Nuclear Society. ASME/ANS RA-SA–2009. February 2009. 1 p. ADAMS Accession No. ML092870592.

[ASMFC] Atlantic States Marine Fisheries Commission. 2016. "Hickory shad (*Alosa mediocris*)." June 2016. Available at <https://www.asmfc.org/files/Habitat/Species%20factsheets/HickoryShad.pdf> (accessed on January 3, 2019).

[ASMFC] Atlantic States Marine Fisheries Commission. 2018. "Species Profile: Atlantic Sturgeon." Excerpt from *ASMFC Fisheries Focus* 27(2): 3 p. Available at <http://www.asmfc.org/uploads/file/5b90016eAtlSturgeonAprilMay2018.pdf> (accessed February 8, 2019).

[ASSRT] Atlantic Sturgeon Status Review Team. 2007. *Status Review of Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus).* Gloucester, MA*:* Report to National Marine Fisheries Service, Northeast Regional Office. February 23, 2007. 188 p. Available at <https://repository.library.noaa.gov/view/noaa/16197> (accessed December 28, 2018).

Auch R.F., Napton D.E., Kambly S., Moreland Jr. T.R., Sayler K.L. 2012. The driving forces of land change in the Northern Piedmont of the United States. *Geographical Review* 102(1):53–75. Prepared for U.S. Geological Survey. Available at <https://pubs.er.usgs.gov/publication/70040397> (accessed May 13, 2019).

[Audubon] National Audubon Society. 2018a. "Important Bird Areas: Codorus State Park." Available at <https://www.audubon.org/important-bird-areas/codorus-state-park> (accessed August 23, 2018).

[Audubon] National Audubon Society. 2018b. "Important Bird Areas: Susquehanna River." Available at <https://www.audubon.org/important-bird-areas/susquehanna-river> (accessed August 23, 2018).

Baker A., Gonzalez P., Morrison R.I.G., Harrington B. A. 2013. Red Knot (*Calidris canutus*), version 2.0. In: The Birds of North America (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA.

Bald and Golden Eagle Protection Act of 1940, as amended. 16 U.S.C. 668–668c.

Barbour H, Anderson M.G, et al. 2003. *Lower New England – Northern Piedmont Ecoregional Conservation Plan. First Iteration, Edited*. Boston, MA: The Nature Conservancy, Northeast & Caribbean Division. February 2003. 212 p. Available at <https://www.conservationgateway.org/ConservationBy

Geography/NorthAmerica/UnitedStates/edc/Documents/ED_terrestrial_ERAs_LNE_fullreport.pdf> (accessed August 16, 2018).

Behney M., Copella S., Shultz J., Bowalick D., Koontz A., Meyers L., Kotovsky M. (The Institute of State and Regional Affairs, Penn State Harrisburg). 2014. *Pennsylvania Population Projections 2010-2040*. Harrisburg, PA: The Center for Rural Pennsylvania. March 2014. 46 p. Available at <https://www.rural.palegislature.us/documents/reports/Population_Projections_Report.pdf> (accessed October 22, 2018).

[BEIR] National Research Council. 2006. *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2*. Washington, DC: The National Academies Press. 422 p. DOI: 10.17226/11340.

Bigelow H.B., Schroeder W.C.. 1953. *Fishes of the Gulf of Maine*. Washington, DC: U.S. Fish and Wildlife Service. Fishery Bulletin 74, Fishery Bulletin of the Fish and Wildlife Service Vol. 53. 577 p.

[BLS] U.S. Bureau of Labor Statistics. 2010. Labor Force Data by County, 2010 Annual Averages. Available at <https://www.bls.gov/lau/> (accessed November 19, 2018).

[BLS] U.S. Bureau of Labor Statistics. 2016. Labor Force Data by County, 2016 Annual Averages. Available at <https://www.bls.gov/lau/> (accessed November 19, 2018).

[BOEM] Bureau of Ocean Energy Management. undated. "Ocean Wave Energy." Available at <https://www.boem.gov/Renewable-Energy-Program/Renewable-Energy-Guide/Ocean-Wave-Energy.aspx> (accessed September 12, 2018).

Carlson J.K. 1991. Trophic relationships among demersal fishes off New Haven Harbor (New Haven, CT) with special emphasis on the winter flounder (*Pseudopleuronectes americanus*). M.S. thesis, as cited in Packer et al.

Carter T.C., Feldhamer G. 2005. Roost tree use by maternity colonies of Indiana bats and northern long-eared bats in southern Illinois. *Forest Ecology and Management* 219(2–3):259–268.

[CDC] Centers for Disease Control and Prevention. 2004. *Surveillance for Waterborne-Disease Outbreaks and Other Health Events Associated with Recreational Water—United States, 2001–2002*. Atlanta, GA: CDC. Morbidity and Mortality Weekly Report 53(8):1–22. October 22, 2004. Available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5308a1.htm> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2006. *Surveillance for Waterborne Disease and Outbreaks and Other Health Events Associated with Recreational Water—United States, 2003–2004*. Atlanta, GA: CDC. Morbidity and Mortality Weekly Report 55(12):1–24. December 22, 2006. Available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5512a1.htm> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2008. *Surveillance for Waterborne Disease and Outbreaks Associated with Recreational Water Use and Other Aquatic Facility-Associated—United States, 2005-2006*. Atlanta, GA: CDC. Morbidity and Mortality Weekly Report 57(9):1–29. September 9, 2008. Available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5709a1.htm> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2011. *Surveillance for Waterborne Disease Outbreaks and Other Health Events Associated with Recreational Water—United States, 2007–2008*. Atlanta, GA: CDC. Morbidity and Mortality Weekly Report 60(12):1–32.

September 23, 2011. Available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/ss6012a1.htm?s_cid=ss6012a1_w> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2014a. *Recreational Water–Associated Disease Outbreaks — United States, 2009–2010*. Atlanta, GA: CDC. Morbidity and Mortality Weekly Report 60(01):6-10. January 10, 2014. Available at <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6301a2.htm?s_cid=mm6301a2_w> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2014b. "Healthcare-Associated infections: *Pseudomonas aeruginosa* in Healthcare Settings." May 7, 2014. Available at <http://www.cdc.gov/hai/organisms/pseudomonas.html> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2015a. "*Salmonella*: Information for Healthcare Professionals and Laboratories." Updated March 9, 2015. Available at <http://www.cdc.gov/salmonella/general/technical.html> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2015b. *Outbreaks of Illness Associated with Recreational Water — United States, 2011–2012*. Atlanta, GA: CDC. Morbidity and Mortality Weekly Report 64(24):668-672. June 26, 2015. Available at <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6424a4.htm?s_cid=mm6424a4_w> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2017a. "*Salmonella*: Reports of *Salmonella* Outbreak Investigations from 2017." Updated September 15, 2017. Available at <https://www.cdc.gov/salmonella/outbreaks-2017.html> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2017b. "*Shigella*—Shigellosis." July 25, 2017. Available at <http://www.cdc.gov/shigella/index.html> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2017c. "*Naeglaria fowleri*: Pathogen & Environment." February 28, 2017. Available at <http://www.cdc.gov/parasites/naegleria/pathogen.html> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2017d. "*Legionella*: Legionnaires' Disease and Pontiac Fever." November 8, 2017. Available at <http://www.cdc.gov/legionella/index.html> (accessed December 18, 2018).

[CDC] Centers for Disease Control and Prevention. 2018. "*Naegleria fowleri*: Number of Case-reports of Primary Amebic Meningoencephalitis by State of Exposure." July 19, 2018. Available at <http://www.cdc.gov/parasites/naegleria/state-map.html> (accessed January 8, 2019).

[CEQ] Council on Environmental Quality. 1997. *Environmental Justice: Guidance under the National Environmental Policy Act*. Washington, DC: CEQ. December 10, 1997. Available at <https://www.epa.gov/environmentaljustice/ceq-environmental-justice-guidance-under-national-environmental-policy-act> (accessed January 8, 2019).

Chang S., Berrien P.L., Johnson D.L., Morse W.W. 1999. *Essential Fish Habitat Source Document: Windowpane, Scophthalmus aquosus, Life History and Habitat Characteristics*. Washington, DC: National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS-NE-137. September 1999. 32 p.

[CISEH] Center for Invasive Species and Ecosystem Health at the University of Georgia. 2018. "Early Detection and Distribution Mapping System: Invasives by County Search." May 8, 2018.

Available at <https://www.eddmaps.org/tools/statereport.cfm?id=us_pa> (accessed September 19, 2018).

Clean Air Act of 1970. 42 U.S.C. Section 7401 et seq.

Conner A.M., Francfort J.E., Rinehart B.N. 1998. U.*S. Hydropower Resource Assessment, Final Report*. Idaho Falls, ID: Idaho National Engineering and Environmental Laboratory. DOE/ID 10430.2. December 1998. Available at <https://www.osti.gov/servlets/purl/771504> (accessed May 4, 2019).

Crawford R.L., Baker W.W. 1981. Bats killed at a north Florida television tower: a 25-year record. *Journal of Mammalogy* 62:651–652.

Dadswell M.J., Taubert B.D, Squiers T.S., Marchette D., and Buckley J. 1984. *Synopsis of Biological Data on Shortnose Sturgeon,* Acipenser brevirostrum*, LeSeuer 1818.* Washington, DC: National Oceanic and Atmospheric Administration. NOAA Technical Report NMFS 14, FOA Fisheries Synopsis No. 140. October 1984. Available at <http://www.fao.org/docrep/017/ap943e/ap943e.pdf> (accessed December 28, 2018).

[DOE] U.S. Department of Energy. 2008. *20% Wind Energy by 2030—Increasing Wind Energy's Contribution to U.S. Electricity Supply*. Washington DC: DOE. DOE/GO-102008-2567. July 2008. 228 p. Available at <http://www.nrel.gov/docs/fy08osti/41869.pdf> (accessed September 10, 2018).

[DOE] U.S. Department of Energy. 2010. *Kemper County Integrated Gasification Combined Cycle (IGCC) Project, Final Environmental Impact Statement*. Washington, DC. DOE. DOE/EIS-0409, Volume 1. May 2010. Available at <https://www.energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/EIS-0409-FEIS-01-2010.pdf> (accessed September 13, 2018).

[DOE] U.S. Department of Energy. 2011a. *2010 Solar Technologies Market Report*. Washington, DC: DOE. November 2011. Available at <https://www.nrel.gov/docs/fy12osti/51847.pdf> (accessed December 2, 2018).

[DOE] U.S. Department of Energy. 2011b. *Final Environmental Impact Statement for the US Department of Energy Loan Guarantee to Royal Bank of Scotland for Construction and Startup of the Topaz Solar Farm, San Luis Obispo County, California*. Washington DC: DOE. DOE/EIS-0458, Volume 1. August 2011. Available at <http://energy.gov/sites/prod/files/Topaz-FEIS-Volume-I-PDF-Version.pdf> (accessed December 2, 2018).

[DOE] U.S. Department of Energy. 2013a. "Geothermal Basics." August 14, 2013. Available at <https://www.energy.gov/eere/geothermal/geothermal-basics> (accessed September 6, 2018).

[DOE] U.S. Department of Energy. 2013b. "Fuel Cell Basics." August 14, 2013. Available at <https://www.energy.gov/eere/fuelcells/fuel-cell-basics> (accessed September 6, 2018).

[DOE] U.S. Department of Energy. 2015. *2014 Wind Technologies Market Report*. Washington DC: DOE. August 2015. Available at <http://www.energy.gov/sites/prod/files/2015/08/f25/2014-Wind-Technologies-Market-Report-8.7.pdf> (accessed March 7, 2019).

[DOE] U.S. Department of Energy. 2018. "Advanced Small Modular Reactors (SMRs)." Available at <http://energy.gov/ne/nuclear-reactor-technologies/small-modular-nuclear-reactors> (accessed September 13, 2018).

[DOE] U.S. Department of Energy. 2019. "Wind Energy State Information." Available at <https://windexchange.energy.gov/states> (accessed April 29, 2019).

Donnermeyer J.F., Ander C., and Cooksey C.C. 2013. The Amish population: county estimates and settlement patterns. *Journal of Amish and Plain Anabaptist Studies* 1(1)72–109.

[eBird] eBird. 2015. "Birders Can Help the Threatened Red Knot and Other Shorebirds." eBird.com. September 7, 2015. Available at <https://ebird.org/pa/news/birders-can-help-the-threatened-red-knot-and-other-shorebirds/> (accessed October 18, 2018).

[eBird] eBird. 2018a. "Kiwanis Lake Rookery (IBA)." Ithaca, NY: Cornell Lab of Ornithology Updated August 23, 2018. Available at <https://ebird.org/hotspot/L692812?yr=cur&m=&rank=hc> (accessed August 23, 2018).

[eBird] eBird. 2018b. "Range Map for Red Knot." Ithaca, NY: Cornell Lab of Ornithology. Available at <http://www.ebird.org/map> (accessed October 18, 2018).

[EIA] U.S. Energy Information Administration. 2013a. *Annual Energy Outlook 2013 with Projections to 2040*. Washington, DC: EIA. DOE/EIA-0383 (2013). April 2013. 244 p. Available at <http://www.eia.gov/forecasts/aeo/pdf/0383(2013).pdf> (accessed January 29, 2019).

[EIA] U.S. Energy Information Administration. 2013b. *Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants*. Washington, DC: EIA. April 2013. 201 p. Available at <http://www.eia.gov/forecasts/capitalcost/pdf/updated_capcost.pdf> (accessed August 28, 2018).

[EIA] U.S. Energy Information Administration. 2015a. *Annual Energy Outlook 2015 with Projections to 2040.* Washington, DC: EIA. DOE/EIA–0383 (2015). April 2015. 154 p. Available at <http://www.eia.gov/forecasts/aeo/pdf/0383(2015).pdf> (accessed August 31, 2018).

[EIA] U.S. Energy Information Administration. 2015b. *Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2015*. Washington, DC: EIA. June 2015. 12 p. Available at <https://www.eia.gov/outlooks/archive/aeo15/pdf/electricity_generation_2015.pdf> (accessed August 31, 2018).

[EIA] U.S. Energy Information Administration. 2016. *Annual Energy Outlook 2016 with Projections to 2040*. Washington, DC: EIA. DOE/EIA–0383 (2016). August 2016. 256 p. Available at <http://www.eia.gov/outlooks/aeo/pdf/0383(2016).pdf> (accessed October 30, 2018).

[EIA] U.S. Energy Information Administration. 2017. "Electric Power Annual 2016, Table 1.2. Summary Statistics for the United States, 2006–2016. Utility Scale Capacity: Solar Photovoltaic." March 2018. 231 p. Available at <https://www.eia.gov/electricity/annual/> (accessed September 20, 2018).

[EIA] U.S. Energy Information Administration. 2018a. "Electric Power Monthly, Table 6.7.B—Capacity Factors for Utility Scale Generators Not Primarily Using Fossil Fuels." Available at <https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_b> (accessed November 28, 2018).

[EIA] U.S. Energy Information Administration. 2018b. "State Profile and Energy Estimates—Analysis." July 19, 2018. Available at <https://www.eia.gov/state/analysis.php?sid=PA> (accessed November 4, 2018).

[EIA] U.S. Energy Information Administration. 2018c. "Today in Energy—Future U.S. electricity generation mix will depend largely on natural gas prices." February 7, 2018. Available at <https://www.eia.gov/todayinenergy/detail.php?id=34852> (accessed August 30, 2018).

[EIA] U.S. Energy Information Administration. 2018d. "Annual Energy Outlook 2018—Table: Electricity Supply, Disposition, Prices, and Emissions—Electricity Reference Case." Available at <https://www.eia.gov/outlooks/aeo/data/browser/#/?id=8-AEO2018&region=0-0&cases=ref2018&start=2016&end=2050&f=A&linechart=~~ref2018-d121317a.44-8-AEO2018~ref2018-d121317a.42-8-AEO2018&ctype=linechart&sourcekey=0> (accessed August 30, 2018).

[EIA] U.S. Energy Information Administration. 2019a. State Electricity Profiles. Table 4. Electric Power Industry Capability by Primary Energy Source, 1990 through 2017. Available at <https://www.eia.gov/electricity/state> (accessed April 29, 2019).

[EIA] U.S. Energy Information Administration. 2019b. State Electricity Profiles. Table 5. Electric Power Industry Generation by Primary Energy Source, 1990 through 2017. Available at <https://www.eia.gov/electricity/state> (accessed April 29, 2019).

[EISPC] Eastern Interconnection States' Planning Council. 2013. *Assessment of the Nuclear Power Industry—Final Report.* June 2013. Available at: <http://large.stanford.edu/courses/2018/ph241/toner1/docs/eispc-jun13.pdf> (accessed November 6, 2018)

Endangered Species Act of 1973. 16 U.S.C. 1531, *et seq*.

Endangered Species Preservation Act in 1967. 16 U.S.C. 668 *et seq*.

[Energy Daily] The Energy Daily. 2016. "First U.S. Offshore Wind Farm Delivers Power to Grid." *The Energy Daily* 44(238). December 13, 2016. Available at <http://www.theenergydaily.com> (accessed September 13, 2018).

[Energy Daily] The Energy Daily. 2017. "Southern Stops Work on Kemper's Lignite Gasification Technology." *The Energy Daily* 45(124). June 29, 2017. Available at <http://www.theenergydaily.com> (accessed September 13, 2018).

[EPA] U.S. Environmental Protection Agency. 1998. *Guidelines for Ecological Risk Assessment*. Washington, DC: EPA Risk Assessment Forum. EPA/630/R–95/002F. April 1998. 188 p. Available at <https://www.epa.gov/risk/guidelines-ecological-risk-assessment> (accessed December 8, 2018).

[EPA] U.S. Environmental Protection Agency. 2004. *Technical Development Document for the Final Section 316(b) Phase II Existing Facilities Rule*. Washington, DC: EPA Office of Water. EPA 821-R-04-007. February 12, 2004. 228 p. Available at <https://www.epa.gov/cooling-water-intakes/support-documents-phase-ii-cooling-water-intake-rule-2004-withdrawn> (accessed December 8, 2017).

[EPA] U.S. Environmental Protection Agency. 2009a. *Assessment of the Impacts of Global Change on Regional U.S. Air Quality: A Synthesis of Climate Change Impacts on Ground-Level Ozone*. Washington, DC: EPA. EPA/600/R-07/094F. April 2009. 131 p. Available at <https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=203459> (accessed March 18, 2019).

[EPA] U.S. Environmental Protection Agency. 2009b. "Endangerment and Cause or Contribute Findings for Greenhouse Gases under the Section 202(a) of the Clean Air Act." July 11, 2017. Available at <https://www.epa.gov/ghgemissions/endangerment-and-cause-or-contribute-findings-greenhouse-gases-under-section-202a-clean> (accessed March 18, 2019).

[EPA] U.S. Environmental Protection Agency. 2010. *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from Coal-Fired Electric Generating Units*. Washington, DC: EPA Office of Air and Radiation. October 2010. 48 p. Available at

<https://www.epa.gov/sites/production/files/2015-12/documents/electricgeneration.pdf> (accessed December 7, 2018).

[EPA] U.S. Environmental Protection Agency. 2014. *Greenhouse Gas Inventory Guidance: Direct Fugitive Emissions from Refrigeration, Air Conditioning, Fire Suppression, and Industrial Gases*. Washington, DC: EPA. November 2014. 20 p. Available at <https://www.epa.gov/sites/production/files/2015-07/documents/fugitiveemissions.pdf> (accessed December 7, 2018).

[EPA] U.S. Environmental Protection Agency. 2015. "Mercury and Air Toxics Standards (MATS)." February 13, 2018. Available at <https://www.epa.gov/mats> (accessed August 28, 2018).

[EPA] U.S. Environmental Protection Agency. 2016a. *Climate Change Indicators in the United States, 2016. Fourth Edition*. Washington, DC: EPA. EPA-430-R-16-004. 96 p. Available at <https://www.epa.gov/climate-indicators> (accessed December 7, 2018).

[EPA] U.S. Environmental Protection Agency. 2016b. *What Climate Change Means for Pennsylvania*. Washington, DC: EPA. EPA 430-F-16-040. August 2016. 2 p. Available at <https://www.epa.gov/sites/production/files/2016-08/documents/climate-change-pa.pdf> (accessed December 7, 2018).

[EPA] U.S. Environmental Protection Agency. 2018a. "Cleanups in My Community." Map updated November 21, 2018. Available at <https://www.epa.gov/cleanups/cleanups-my-community#map> (accessed December 7, 2018).

[EPA] U.S. Environmental Protection Agency. 2018b. "Envirofacts: Safe Drinking Water Search for the State of Pennsylvania." Available at <https://iaspub.epa.gov/enviro/sdw_form_v3.create_page?state_abbr=PA> (accessed November 28, 2018).

[EPA] U.S. Environmental Protection Agency. 2018c. "NAAQS [National Ambient Air Quality Standards] Table." December 20, 2016. Available at <https://www.epa.gov/criteria-air-pollutants/naaqs-table> (accessed September 14, 2018).

[EPA] U.S. Environmental Protection Agency. 2019a. "Energy Recovery from the Combustion of Municipal Solid Waste (MSW)." February 13, 2018. Available at <https://www.epa.gov/smm/energy-recovery-combustion-municipal-solid-waste-msw#EnergyRecovery> (accessed May 3, 2019).

[EPA] U.S. Environmental Protection Agency. 2019b. "2014 National Emissions Inventory Report." February 2018. Available at <https://gispub.epa.gov/neireport/2014/> (accessed February 15, 2019).

[EPA] U.S. Environmental Protection Agency. 2019c. "Nonattainment Areas for Criteria Pollutants (Green Book)". January 31, 2019. Available at <https://www.epa.gov/green-book> (accessed January 31, 2019).

[EPRI] Electric Power Research Institute. 2011. *Mapping and Assessment of the United States Ocean Wave Energy Resource*. Palo Alto, CA: EPRI. 1024637. December 2011. 176 p. Available at <http://www1.eere.energy.gov/water//pdfs/mappingandassessment.pdf> (accessed May 3, 2019).

Ernst C.H. 1977. Biological notes on the bog turtle, *Clemmys muhlenbergii*. *Herpetologica* 33(2):241–246.

[Exelon] Exelon Generation Company, LLC. 2001. "Applicant's Environmental Report - Operating License Renewal Stage, Peach Bottom Units 2 and 3." Pennsylvania. July 02, 2001. ADAMS Accession No. ML011840375.

[Exelon] Exelon Corporation. 2008. United States Securities and Exchange Commission, Form 10K, For Fiscal Year Ending December 31, 2007. Available at <http://www.exeloncorp.com/investor-relations/reports-and-sec-filings> (accessed December 7, 2018).

[Exelon] Exelon Corporation. 2009a. *Peach Bottom Atomic Power Units 2 and 3, Annual Radiological Environmental Operating Report, Report No. 66, January 1 through December 31, 2008.* April 2009. ADAMS Accession No. ML091270075.

[Exelon] Exelon Corporation. 2009b. United States Securities and Exchange Commission, Form 10K, For Fiscal Year Ending December 31, 2008. Available at <http://www.exeloncorp.com/investor-relations/reports-and-sec-filings> (accessed December 7, 2018).

[Exelon] Exelon Generation Company, LLC. 2010a. *Peach Bottom Atomic Power Station Units 2 and 3, Annual Radiological Environmental Operating Report, Report No. 67, January 1 through December 31, 2009.* April 2010. ADAMS Accession No. ML101520342.

[Exelon] Exelon Generation Company, LLC. 2010b. *Peach Bottom Atomic Power Station Units 2 and 3*, *Offsite Dose Calculation Manual, Revision 13.* 2010. ADAMS Accession No. ML101250144.

[Exelon] Exelon Generation Company, LLC. 2011. *Peach Bottom Atomic Power Units 2 and 3, Annual Radiological Environmental Operating Report, Report No. 68, January 1 through December 31, 2010.* Delta, PA: Prepared by Exelon Nuclear. May. ADAMS Accession No. ML11152A159.

[Exelon] Exelon Generation Company, LLC. 2012a. *Peach Bottom Atomic Power Units 2 and 3, Annual Radiological Environmental Operating Report, Report No. 69, January 1 through December 31, 2011.* Delta, PA: Prepared by Exelon Nuclear. May. ADAMS Accession No. ML12153A208.

[Exelon] Exelon Generation Company, LLC. 2012b. Letter from K. Borton, Exelon, to U.S. Nuclear Regulatory Commission. Subject: License Amendment Request - Extended Power Uprate. September 28, 2012. ADAMS Accession No. ML122860201.

[Exelon] Exelon Generation Company, LLC. 2013. *Peach Bottom Atomic Power Units 2 and 3, Annual Radiological Environmental Operating Report, Report No. 70, January 1 through December 31, 2012.* Delta, PA: Prepared by Exelon Generation. May. ADAMS Accession No. ML13155A003.

[Exelon] Exelon Generation Company, LLC. 2014a. *Peach Bottom Atomic Power Units 2 and 3, Annual Radiological Environmental Operating Report, Report No. 71, January 1 through December 31, 2013.* May 2014. ADAMS Accession No. ML14154A008.

[Exelon] Exelon Generation Company, LLC. 2014b. *Peach Bottom Atomic Power Units 2 and 3, Radioactive Effluent Release Report No. 56. – January 1, 2013 through December 31, 2013.* April 2014. ADAMS Accession No. ML14120A213.

[Exelon] Exelon Generation Company, LLC. 2014c. *Seismic Hazard and Screening Report in Response to the 50.54(f) Information Request Regarding Fukushima Near-Term Task Force Recommendation 2.1: Seismic, for the Peach Bottom Atomic Power Stations Units 2 & 3.* Chicago, Illinois: Exelon. Submitted March 31, 2014. ADAMS Accession No. ML14090A247.

[Exelon] Exelon Generation Company, LLC. 2015a. *Expedited Seismic Evaluation Process (ESEP) Report in Response to the 50.54(f) Information Request Regarding Fukushima Near-Term Task Force Recommendation 2.1: Seismic, for the Peach Bottom Atomic Power Station Units 2 & 3*. Chicago, Illinois: Exelon. Submitted December 19, 2014. ADAMS Accession No. ML14353A333.

[Exelon] Exelon Generation Company, LLC. 2015b. Peach Bottom Atomic Power Units 2 and 3, Annual Radiological Environmental Operating Report, Report No. 72, January 1 through December 31, 2014. May 29, 2015. 136 p. ADAMS Accession No. ML15154A513.

[Exelon] Exelon Generation Company, LLC. 2015c. Peach Bottom Atomic Power Units 2 and 3, Radioactive Effluent Release Report No. 57. – January 1, 2014 through December 31, 2014. April 29, 2015. 90 p. ADAMS Accession No. ML15121A720.

[Exelon] Exelon Generation Company, LLC. 2015d. "Application for Approval of Agreement for Increase in Consumptive Use at Peach Bottom Atomic Power Station of Water Withdrawn from Project Reservoir." FERC Project No. 405 Conowingo. May 1, 2015.

[Exelon] Exelon Generation Company, LLC. 2016a. Peach Bottom Atomic Power Units 2 and 3, Annual Radiological Environmental Operating Report No. 73. – January 1, 2015 through December 31, 2015." May 27, 2016. 101 p. ADAMS Accession No. ML16153A189.

[Exelon] Exelon Generation Company, LLC. 2016b. Peach Bottom Atomic Power Units 2 and 3, Radioactive Effluent Release Report No. 58. – January 1, 2015 through December 31, 2015. April 29, 2016. 223 p. ADAMS Accession No. ML16126A371.

[Exelon] Exelon Generation Company, LLC. 2017a. "Annual Radiological Environmental Operating Report No. 74. – January 1, 2016 through December 31, 2016." Peach Bottom Atomic Power Units 2 and 3. May 31, 2017. 138 p. ADAMS Accession No. ML17151A398.

[Exelon] Exelon Generation Company, LLC. 2017b. Bald Eagle Project Screening Form for Peach Bottom Environmental Review in Support of Operating License Renewal. September 11, 2017. In Appendix C of Exelon 2018a.

[Exelon] Exelon Generation Company, LLC. 2017c. Exelon Generation Company, LLC Response to March 12, 2012, Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 3, Flooding Focused Evaluation Summary Submittal. March 17, 2017. ADAMS Accession No. ML17079A052.

[Exelon] Exelon Generation Company, LLC. 2017d. Letter from M. Gallagher, Exelon, to Pennsylvania Field Office, U.S. Fish and Wildlife Service. Subject: Peach Bottom Atomic Power Station, Units 2 and 3; Second Renewal of NRC Operating Licenses; Request for Information on Federally Protected Species. September 26, 2017. In Appendix C of Exelon 2018a.

[Exelon] Exelon Generation Company, LLC. 2017e. Peach Bottom Atomic Power Station Units 2 and 3, Updated Final Safety Analysis Report (UFSAR). Revision 26. April 2017. ADAMS Accession No. ML17130A259.

[Exelon] Exelon Generation Company, LLC. 2017f. "Radioactive Effluent Release Report No. 59 – January 1, 2016 through December 31, 2016." Peach Bottom Atomic Power Units 2 and 3. April 28, 2017. 93 p. ADAMS Accession No. ML17125A196.

[Exelon] Exelon Generation Company, LLC. 2017g. "Request for License Amendment Regarding Measurement Uncertainty Recapture Power Uprate." Peach Bottom Atomic Power Units 2 and 3. February 17, 2017. ADAMS Accession No. ML17048A444.

[Exelon] Exelon Generation Company, LLC. 2018a. 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. July 2018. ADAMS Accession No. ML18271A185.

[Exelon] Exelon Generation Company, LLC. 2018b. Subsequent License Renewal Application, Peach Bottom Atomic Power Station Units 2 and 3, Facility Operating License Nos. DPR-44 and DPR-56, The Second License Renewal Application. July 2018. ADAMS Accession No. ML18193A773.

[Exelon] Exelon Generation Company, LLC. 2018c. Letter from M. Gallagher, Vice President License Renewal and Decommissioning, Exelon Generation, to NRC Document Control Desk. Subject: Response to NRC Request for Additional Information, dated November 23, 2018, Regarding the Peach Bottom Atomic Power Station, Units 2 and 3, Subsequent License Renewal Application, Environmental Requests for Additional Information. December 20, 2018. ADAMS Accession No. ML18354B113.

[Exelon] Exelon Generation Company, LLC. 2018d. Annual Radiological Environmental Operating Report, Report No. 75, January 1 through December 31, 2017. Peach Bottom Atomic Power Units 2 and 3. May 2018. ADAMS Accession No. ML18152A869.

[Exelon] Exelon Generation Company, LLC. 2018e. Exelon Corporation 2017 Annual Report. Available at <https://www.exeloncorp.com/company/Documents/Exelon%202017%20Annual%20Report.pdf> (accessed April 8, 2019).

[Exelon] Exelon Generation Company, LLC. 2018f. "Radioactive Effluent Release Report No. 60 – January 1, 2017 through December 31, 2017." Peach Bottom Atomic Power Units 2 and 3. April 2018. 157 p. ADAMS Accession No. ML18116A324.

[Exelon] Exelon Generation Company, LLC. 2019. Response to NRC Request for Additional Information, dated December 13, 2018, Regarding Peach Bottom Atomic Power Station, Units 2 and 3, Subsequent License Renewal Severe Accident Mitigation Alternatives Requests for Additional Information (EPID L-2018-RNW-0013). January 28, 2019. ADAMS Accession No. ML19028A280.

[FERC] Federal Energy Regulatory Commission. 2015. Final Multi-Project Environmental Impact Statement for Hydropower Licenses, Susquehanna River Hydroelectric Projects, York Haven Project—FERC Project No. 1888-030–Pennsylvania, Muddy Run Project—FERC Project No. 2355-018–Pennsylvania, Conowingo Project—FERC Project No. 405-106–Maryland/Pennsylvania, FERC/FEIS-0255F. March 2015. Available at https://www.ferc.gov/industries/hydropower/enviro/eis/2015/03-11-15.asp> (accessed on October 15, 2018).

Faill, R.T., compiler. 2004. *Earthquake Epicenters In and Near Pennsylvania*. Harrisburg, PA: Commonwealth of Pennsylvania, Department of Conservation and Natural Resources, Bureau of Topographic and Geological Survey. Map 69. Available at <http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_016095.zip> (accessed September 28, 2018).

Farmer, A., Cade, S., Staufer, D.F. 2002. *Evaluation of Habitat Suitability Index Model*. p. 172–181. In: Kurta A., Kennedy J., eds. *The Indiana Bat: Biology and Management of an Endangered Species.* Austin, TX: Bat Conservation International. 253 p.

Foster, R.W., Kurta, A. 1999. Roosting ecology of the Northern bat (Myotis septentrionalis) and comparisons with the endangered Indiana bat (Myotis sodalis). *Journal of Mammalogy* 80(2):659–672.

Frankson, R., K. Kunkel, S. Champion, A. Degaetano, B. Stewart, W. Sweet. 2017. Pennsylvania State Climate Summary. NOAA Technical Report NESDIS 149-PA. 4 p. Available at <https://statesummaries.ncics.org/sites/default/files/downloads/PA-screen-hi.pdf> (accessed January 7, 2019).

Frick, W.F. et al. 2015. Disease alters macroecological patterns of North American bats. *Global Ecology and Biogeography* 24(7):741-749.

[FWS] U.S. Fish and Wildlife Service. 2002. Letter from D. Densmore, Supervisor, to D. Wheeler, NRC. Subject: Concurrence with the NRC's determinations that Peach Bottom license renewal is not likely to affect the bald eagle and would have no effect on the bog turtle. April 17, 2002. ADAMS Accession No. ML021510200.

[FWS] U.S. Fish and Wildlife Service. 2007. *Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision*. Fort Snelling, MN: FWS Region 3. April 2007. 258 p. Available at <https://www.fws.gov/Midwest/Endangered/mammals/inba/pdf/inba_fnldrftrecpln_apr07.pdf> (accessed December 6, 2018).

[FWS] U.S. Fish and Wildlife Service. 2010a. *Biological Opinion: Effects of the Implementation of Habitat Restoration Practices by the Natural Resources Conservation Service on the Northern Population of the Bog Turtle*. Hadley, MA: FWS Region 5. September 10, 2010. 61 p. Available at <https://www.fws.gov/northeast/pafo/pdf/bt_habitat_management%20bo_nrcs_091010.pdf> (accessed October 17, 2018).

[FWS] U.S. Fish and Wildlife Service. 2010b. *Programmatic Biological Opinion on the Effects of Ongoing and Future Military and Land Management Activities at the Camp Atterbury Joint Maneuver Training Center in Bartholomew, Brown, and Johnson Counties in Indiana on the Federally Endangered Indiana Bat (*Myotis sodalis*)*. October 21, 2010. Available at <http://www.fws.gov/midwest/endangered/mammals/inba/bos/10_IN_FinalAtterburyBO.pdf> (accessed December 6, 2018).

[FWS] U.S. Fish and Wildlife Service. 2012. Biological Opinion on the Effects of Habitat Restoration Practices by the U.S. Fish and Wildlife Service on the Northern Population of the Bog Turtle. Hadley, MA: FWS Region 5. June 11, 2012. 84 p. Available at <https://www.fws.gov/northeast/endangered/TEBO/PDFs/USFWS_BTHabitatRestorationBO20120723.pdf> (accessed October 17, 2018).

[FWS] U.S. Fish and Wildlife Service. 2013*. Rufa Red Knot Ecology and Abundance: Supplement to Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Rufa Red Knot (*Calidris canutus rufa*)*. 54 p. Available at <https://www.fws.gov/northeast/redknot/pdf/20130923_REKN_PL_Supplement02_Ecology%20Abundance_Final.pdf> (accessed October 18, 2018).

[FWS] U.S. Fish and Wildlife Service. 2014a. *Flathead Catfish (*Pylodictis olivaris*) Ecological Risk Screening Summary*. September 3, 2014. Available at <https://www.fws.gov/fisheries/ans/erss/highrisk/Pylodictis-olivaris-WEB-9-3-2014.pdf> (accessed on January 3, 2019).

[FWS] U.S. Fish and Wildlife Service. 2014b. "Guidance for Preparing a Biological Assessment." 6 p. Available at

<http://www.fws.gov/midwest/endangered/section7/pdf/BAGuidance.pdf> (accessed October 31, 2018).

[FWS] U.S. Fish and Wildlife Service. 2014c. Letter from F. Clark, Action Field Supervisor, to D. Wrona, NRC. Subject: Concurrence with effect determinations for Davis-Besse license renewal. September 30, 2014. ADAMS Accession No. ML14296A559.

[FWS] U.S. Fish and Wildlife Service. 2014d. *Rufa Red Knot Background Information and Threats Assessment. Supplement to Endangered and Threatened Wildlife and Plants; Final Threatened Status for the Rufa Red Knot (*Calidris canutus rufa*)*. Plesantville, NJ: FWS Northeast Region. November 2014. 383 p. Available at <https://www.regulations.gov/document?D=FWS-R5-ES-2013-0097-0703>(accessed October 18, 2018).

[FWS] U.S. Fish and Wildlife Service. 2015a. Final Environmental Assessment for Final 4(d) Rule for the Northern Long-Eared Bat. December 2015. 85 p. Available at <https://www.fws.gov/midwest/endangered/mammals/nleb/pdf/NLEB4dRuleEAFINALDec2015.pdf> (accessed October 15, 2018).

[FWS] U.S. Fish and Wildlife Service. 2015b. Letter from D. Stilwell, Field Supervisor, to D.J Wrona, Chief, NRC. Subject: Concurrence with determination that Indian Point license renewal is not likely to adversely affect the Indiana bat or northern long-eared bat. July 14, 2015. ADAMS Accession No. ML15196A013.

[FWS] U.S. Fish and Wildlife Service. 2016. *Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and Activities Excerpted from Take Prohibitions*. Bloomington, MN: FWS Midwest Regional Office. January 5, 2016. 109 p. Available at <https://www.fws.gov/midwest/endangered/mammals/nleb/pdf/BOnlebFinal4d.pdf> (accessed October 23, 2018).

[FWS] U.S. Fish and Wildlife Service. 2017a. Letter from L. Lattanzi to M. Gallagher, Exelon Generation. Subject: Reply to request for information on federally protected species. November 2, 2017. In Appendix C of Exelon 2018a.

[FWS] U.S. Fish and Wildlife Service. 2017b. *2017 Indiana Bat* (Myotis sodalis*) Population Status Update*. July 5, 2017. Available at <https://www.fws.gov/midwest/Endangered/mammals/inba/pdf/2017IBatPopEstimate5July2017.pdf> (accessed October 22, 2018).

[FWS] U.S. Fish and Wildlife Service. 2018a. Letter from Pennsylvania Ecological Services Field Office to Whom It May Concern, NRC. Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project [Peach Bottom subsequent license renewal]. September 10, 2018. ADAMS Accession No. ML18253A272.

[FWS] U.S. Fish and Wildlife Service. 2018b. Letter from Pennsylvania Ecological Services Field Office, to B. Grange, NRC. Subject: Peach Bottom subsequent license renewal list of IPaC trust resources. December 4, 2018. ADAMS Accession No. ML19007A282.

[FWS] U.S. Fish and Wildlife Service. 2018c. Letter from Sonja Jahrsdoerfer, Project Leader, Pennsylvania Ecological Services Field Office, to M. Ma, NRC. Subject: Notice of intent to prepare an environmental impact statement and conduct scoping process for Peach Bottom Atomic Power Station, Units 2 and 3 (EPID NO. L-2018-RNW-0013). October 9, 2018. ADAMS Accession No. ML18282A169.

[FWS] U.S. Fish and Wildlife Service. 2018d. Letter from T.R. Chapman, Supervisor, New England Field Office, to B. Beasley, NRC. Subject: Concurrence with the NRC's determination that license renewal of Seabrook Station, Unit 1, is not likely to adversely affect the northern long-eared bat, Indiana bat, piping plover, or roseate tern. September 20, 2018. ADAMS Accession No. ML18263A200.

[FWS] U.S. Fish and Wildlife Service. 2018e. Species Assessment and Listing Priority Assignment Form for *Percina bimaculuata*. January 15, 2018. 31 p. Available at <https://rcngrants.org/sites/default/files/final_reports/RCN%202016-2%20Percina_bimaculata_5FactorAnalysis.pdf> (accessed October 24, 2018).

[FWS] U.S. Fish and Wildlife Service. 2018f. "Species Profile for Maryland Darter (*Etheostoma sellare*)." Available at <https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=E003> (accessed October 29, 2018).

[FWS] U.S. Fish and Wildlife Service. 2018g. "Species Profile for Swamp Pink (*Helonias bullata*)." Available at <https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=4333> (accessed October 24, 2018).

[FWS and NMFS] U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1998. *Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act*. March 1998. 315 p. Available at <http://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf> (accessed October 31, 2018).

Geyer, A.R., Wilshusen, J. P. 1982. *Engineering Characteristics of the Rocks of Pennsylvania*. Harrisburg, PA: Bureau of Topographic and Geological Survey. Environmental Geology Report 1. 300 p. Available at <http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_016799.zip> (accessed September 28, 2018).

[GHD] GHD. 2018. *Hydrogeologic Investigation Report, Peach Bottom Atomic Power Station, Delta, Pennsylvania*. Redacted version. Exton, PA: Prepared for Exelon Generation, LLC. May 2018. In: Exelon 2018c, GW-7, Response a. ADAMS Accession Nos. ML18354B061 and ML18354B066.

Gilbert, C.R. 1989. *Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Mid-Atlantic)-Atlantic and Shortnose Sturgeons.* U.S. Fish and Wildlife Service Biological Report 82(11.122). U.S. Army Corps of Engineers TR EL-82-4. December 1989. 28 p. Available at <https://www.nwrc.usgs.gov/wdb/pub/species_profiles/82_11-122.pdf> (accessed December 28, 2018).

Harrington B.R. 2008. *Coastal Inlets as Strategic Habitat for Shorebirds in the Southeastern United States*. Vicksburg, MS: U.S. Army Engineering Research and Development Center. Technical Note ERDC TN-DOER-E25. October 2008. 9 p. Available at <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwiGosKw49rZAhXyhOAKHdxnAzIQFggqMAA&url=http%3A%2F%2Fwww.dtic.mil%2Fget-tr-doc%2Fpdf%3FAD%3DADA491729&usg=AOvVaw0EgyZ5qr4ChzVQJPytDl4G> (accessed October 18, 2018).

[IEA] International Energy Agency. 2007. *Biomass for Power Generation and C*HP. IEA Energy Technology Essentials ETE03. January 2007. 4 p. Available at <https://www.iea.org/publications/freepublications/publication/essentials3.pdf> (accessed April 18, 2019).

[IPCC] Intergovernmental Panel on Climate Change. 2000. *Special Report on Emissions Scenarios*. Geneva, Switzerland: IPCC. 570 p. Available at <https://www.ipcc.ch/report/emissions-scenarios/> (accessed December 7, 2018).

[IPCC] Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: The Physical Science Basis*. *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY. 996 p. Available at <https://www.ipcc.ch/report/ar4/wg1/> (accessed December 7, 2018).

[IPCC] Intergovernmental Panel on Climate Change. 2013. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY. 1535 p. Available at <https://www.ipcc.ch/report/ar5/wg1/> (accessed December 7, 2018).

Johnson G.D., Strickland M.D. (Western Ecosystems Technology, Inc.). 2003. *Biological Assessment for the Federally Endangered Indiana Bat* (Myotis sodalis) *and Virginia Big-eared Bat* (Corynorhinus townsendii virginianus): *NedPower Mount Storm Wind Project, Grant County, West Virginia*. Chantilly, VA: Prepared for NedPower Mount Storm LLC. October 8, 2003. 47 p. Available at <https://tethys.pnnl.gov/sites/default/files/publications/JohnsonNedPower-2003.pdf> (accessed December 6, 2018).

Johnson G.D. et al. 2003. Mortality of bats at a large-scale wind power development at Buffalo Ridge, Minnesota. *The American Midland Naturalist* 150(2):332–342.

Kinsey W.F. 1983. Eastern Pennsylvania Prehistory: A Review. *Pennsylvania History* 50(2): 69–108.

Klemens M. (Wildlife Conservation Society in cooperation with Pennsylvania Field Office, U.S. Fish and Wildlife Service). 2001. *Bog Turtle* (Clemmys muhlenbergii) *Northern Population Recovery Plan*. Hadley, MA: Region 5, U.S. Fish and Wildlife Service. May 15, 2001. 103 p. Available at <https://ecos.fws.gov/docs/recovery_plan/010515.pdf> (accessed October 16, 2018).

[Lancaster County] Lancaster County Planning Commission. 2013. *Blueprints: An Integrated Water Resources Plan for Lancaster County*. Available at <https://lancastercountyplanning.org/131/Blueprints> (accessed November 20, 2018)

[Lancaster Transportation Coordinating Committee] Lancaster County Transportation Coordinating Committee. 2016. *Connections 2040, 2016 Update*. Available at <https://lancastercountyplanning.org/DocumentCenter/View/822/Connections2040-2016-Update?bidId> (accessed November 28, 2018).

Layher, W. 1993. *Determining Swimming Speeds for Darters of the Genera Etheostoma and Two Cyprinid Fishes, Final Report*. Pine Bluff, AR: University of Arkansas at Pine Bluff. 22 p. Available at <https://www.fs.fed.us/biology/nsaec/fishxing/fplibrary/Layher-1993.pdf> (accessed December 14, 2018).

[LBNL] Lawrence Berkeley National Laboratory. 2017. "U.S. Renewables Portfolio Standards 2017 Annual Status Report." July 2017. Available at <http://eta-publications.lbl.gov/sites/default/files/2017-annual-rps-summary-report.pdf> (accessed August 30, 2018).

Leavy T.R., Bonner T.H. 2009. Relationships among swimming ability, current velocity association, and morphology for freshwater lotic fishes. *North American Journal of Fisheries Management* 29:72–83.

Low D.J., Hippe D.J., Yannacci D. 2002. *Geohydrology of Southeastern Pennsylvania*. New Cumberland, PA: U.S. Geological Survey. Water-Resources Investigations Report 00-4166. 347 p. Available at <https://pubs.er.usgs.gov/publication/wri004166> (accessed September 28, 2018).

Lux F.E., Nichy F.E. 1981. *Movements of Tagged Summer Flounder,* Paralichthys dentatus*, off Southern New England*. Seattle, WA: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Report NMFS-SSRF-752*,* p. 16, in Packer et al., 1999.

Matthews W.J. 1985. Current critical speeds and microhabitats of the benthic fishes *Percina roanoka* and *Etheostoma flabellare*. *Environmental Biology of Fishes* 12(4):303–308.

Mayhew D.A., Jensen L.D., Hanson D.F., Muessig P.H. 2000. A comparative review of entrainment survival studies at power plants in estuarine environments. *Environmental Science and Policy* 3:295–301.

[MDNR] Maryland Department of Natural Resources Fisheries Service. 2009. *Sturgeon Restoration*. As cited in SRAFRC 2010.

[MDNR] Maryland Department of Natural Resources. Undated_a. "Maryland Fish Facts: American Gizzard Shad." Available at <https://dnr.maryland.gov/fisheries/Pages/Fish-Facts.aspx?fishname=American%20Gizzard%20Shad> (accessed January 3, 2019).

[MDNR] Maryland Department of Natural Resources. Undated_b. "Maryland Fish Facts: Hickory Shad." Available at <https://dnr.maryland.gov/fisheries/Pages/Fish-Facts.aspx?fishname=Hickory%20Shad> (accessed on January 3, 2019).

[MDPH] Massachusetts Department of Public Health. 2012. *Wind Turbine Health Study: Report of Independent Expert Panel*. Springfield, MA: Massachusetts Department of Environmental Protection and Massachusetts Department of Public Health. January 2012. 164 p. Available at <https://puc.sd.gov/commission/dockets/electric/2018/EL18-003/testimony/dakotarange/rExhibit7.pdf> (accessed February 28, 2019).

[MGS] Maryland Geological Survey. 2019. "Earthquakes in Maryland." Available at <http://www.mgs.md.gov/geology/geohazards/earthquakes_and_maryland.html#notes> (accessed July 7, 2019).

Menzie C., Henning M.H., Cura J., Finkelstein K., Gentile J., Maughan J., Mitchell D., Petron S., Potocki B., Svirsky S., Tyler P. 1996. Special report of the Massachusetts weight-of-evidence workgroup: A weight-of-evidence approach for evaluating ecological risks. *Human and Ecological Risk Assessment* 2(2):227–304.

Michaels T. 2010. *The 2010 ERC Directory of Waste-to-Energy Plants*. Washington, DC: Energy Recovery Council. November 2010. 32 p. Available at <http://www.seas.columbia.edu/earth/wtert/sofos/ERC_2010_Directory.pdf> (accessed May 3, 2019).

[Monitoring Analytics] Monitoring Analytics, LLC. 2016. *State of the Market Report for PJM, Q2 2016, January through June*. August 11, 2016. Available at <http://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2016/2016q2-som-pjm.pdf> (accessed March 7, 2019).

Moore B.C., Martinez E., Gay J.M., Rice D.H. 2003. Survival of *Salmonella enterica* in freshwater and sediments and transmission by the aquatic midge *Chironomus tentans* (Chironomidae: Diptera). *Applied and Environmental Microbiology* 69(8):4556–4560.

[NAI] Normandeau Associates, Inc. 2000. *A Report on the Thermal Conditions and Fish Populations in Conowingo Pond Relative to Zero Cooling Tower Operation at the Peach Bottom Atomic Power Station (June–October 1999)*. Philadelphia, PA: Prepared for PECO Energy Company. February 2000. 113 p. ADAMS Accession No. ML19007A327.

[NAI] Normandeau Associates, Inc. 2010a. Data Report on Intake Screen Sampling at Peach Bottom Atomic Power Station in 2010. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 20316.003. December 2010. 5 p. ADAMS Accession No. ML19007A327.

[NAI] Normandeau Associates, Inc. 2010b. *Summary of Operations at the Conowingo Dam East Fish Passage Facility Spring 2010*. Darlington, MD: Prepared for Exelon Generation Company, LLC. August 2010. 24 p. Available at <https://www.srbc.net/srafrc/docs/2010/Conowingo%20East%20Fish%20Lift%20Passage%202010.pdf> (accessed October 30, 2018).

[NAI] Normandeau Associates, Inc. 2011a. *Data Report on Intake Screen Sampling at Peach Bottom Atomic Power Station in 2011*. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 20316.003. December 2011. 5 p. ADAMS Accession No. ML19007A327.

[NAI] Normandeau Associates, Inc. 2011b. Summary of Operations at the Conowingo Dam East Fish Passage Facility Spring 2011. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 22192. October 2011. 23 p. Available at <https://www.srbc.net/srafrc/docs/2011/Conowingo%20East%20Fish%20Lift%20Passage%202011.pdf> (accessed October 30, 2018).

[NAI] Normandeau Associates, Inc. 2012a. *Data Report on Intake Screen Sampling at Peach Bottom Atomic Power Station in 2012*. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 20316.003. December 2012. 5 p. ADAMS Accession No. ML19007A327.

[NAI] Normandeau Associates, Inc. 2012b. Summary of Operations at the Conowingo Dam East Fish Passage Facility Spring 2012. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 22755. November 2012. 31 p. Available at <https://www.srbc.net/srafrc/docs/2012/Conowingo%20East%20Fish%20Lift%20Passage%202012.pdf> (accessed October 30, 2018).

[NAI] Normandeau Associates, Inc. 2013a. *Data Report on Intake Screen Sampling at Peach Bottom Atomic Power Station in 2013*. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 20316.003. December 2013. ADAMS Accession No. ML19007A327.

[NAI] Normandeau Associates, Inc. 2013b. Peach Bottom Atomic Power Station Entrainment Characterization Study 2012. Darlington, MD: Prepared for Exelon Generation Company, LLC. February 2013. 50 p. ADAMS Accession No. ML19007A327.

[NAI] Normandeau Associates, Inc. 2013c. *Summary of Operations at the Conowingo Dam East Fish Passage Facility Spring 2013*. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 22755.001. August 2013. 27 p. Available at <https://www.srbc.net/srafrc/docs/2013/Conowingo%20East%20Fish%20Lift%20Passage%202013.pdf> (accessed October 30, 2018).

[NAI] Normandeau Associates, Inc. 2014a. *Data Report on Intake Screen Sampling at Peach Bottom Atomic Power Station in 2014*. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 20316.003. December 2014. 5 p. Available at ADAMS Accession No. ML19007A327.

[NAI] Normandeau Associates, Inc. 2014b*. Summary of Operations at the Conowingo Dam East Fish Passage Facility Spring 2014*. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 23249.000. December 2014. 25 p. Available at <https://www.srbc.net/srafrc/docs/2014/Conowingo%20East%20Fish%20Lift%20Passage%202014.pdf> (accessed October 30, 2018).

[NAI] Normandeau Associates, Inc. 2015a. *Data Report on American Shad Sampling at Peach Bottom Atomic Power Station in 2015*. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 203444.002. December 2015. 5 p. ADAMS Accession No. ML19007A327.

[NAI] Normandeau Associates, Inc. 2015b. *Summary of Operations at the Conowingo Dam East Fish Passage Facility Spring 2015*. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 23249.001. December 2015. 24 p. Available at <https://www.srbc.net/srafrc/docs/2015/Conowingo%20East%20Lift%20Fish%20Passage%202015.pdf> (accessed October 30, 2018).

[NAI] Normandeau Associates, Inc. 2016. *Summary of Operations at the Conowingo Dam East Fish Passage Facility Spring 2016*. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 23249.003. November 2016. 25 p. Available at <https://www.srbc.net/srafrc/docs/2016/Conowingo%20East%20Lift%20Fish%20Passage%202016.pdf> (accessed October 30, 2018).

[NAI] Normandeau Associates, Inc. 2017. *Summary of Operations at the Conowingo Dam East Fish Passage Facility Spring 2017*. Darlington, MD: Prepared for Exelon Generation Company, LLC. Normandeau Associates Project No. 23983.000. December 2017. 24 p. Available at <https://www.srbc.net/srafrc/docs/2017/Conowingo%20East%20Lift%20Fish%20Passage%202017.pdf> (accessed October 30, 2018).

[NAI and ERM] Normandeau Associates, Inc. and Environmental Resource Management. 2013. *Analysis for the Maryland Department of Natural Resources' Question of the Effect of Peach Bottom Power Station Uprate on Migratory Fishes*. Darlington, MD: Prepared for Exelon Generation Company, LLC. July 2013. ADAMS Accession No. ML19186A383.

[NAI and ERM] Normandeau Associates, Inc. and Environmental Resource Management. 2014. *Final Report for the Thermal Study to Support a 316(a) Demonstration: Peach Bottom Atomic Power Station*. Darlington, MD: Prepared for Exelon Generation Company, LLC. February 2014. ADAMS Accession Nos. ML19007A328 and ML19007A330.

[NAI and ERM] Normandeau Associates, Inc. and Environmental Resource Management. 2017. *Final Report for Post-EPU Thermal and Biological Monitoring Peach Bottom Atomic Power Station*. Darlington, MD: Prepared for Exelon Generation Company, LLC. February 2017. ADAMS Accession No. ML19007A331.

[NAI and GSE] Normandeau Associates, Inc. and Gomez and Sullivan Engineers, P.C. 2012a. *Final Study Report: Shortnose and Atlantic Sturgeon Life History Studies. RSP 3.22. Conowingo Hydroelectric Project FERC, Project Number 405.* Darlington, MD: Prepared for Exelon Generation Company, LLC. August 2012. Available at <https://mde.maryland.gov/programs/water/WetlandsandWaterways/Documents/ExelonMD/FERC/Conowingo-FRSP-3.22.pdf> (accessed on December 28, 2018).

[NAI and GSE] Normandeau Associates, Inc. and Gomez and Sullivan Engineers, P.C. 2012b. *Final Study Report Muddy Run Project Effects on Migratory Fishes: Interactions with the PBAPS Thermal Plume, RSP 3.6 Muddy Run Pumped Storage Project, FERC Project Number 2355.* Darlington, MD: Prepared for Exelon Generation Company, LLC. August 2012.

[NAI and GSE] Normandeau Associates, Inc. and Gomez and Sullivan Engineers, P.C. 2012c. *Final Study Report, Maryland Darter Survey RSP 3.10, Conowingo Hydroelectric Project, FERC Project Number 405*. Prepared for Exelon Generation Company, LLC. August 2012. 70 p. Available at <https://mde.maryland.gov/programs/water/WetlandsandWaterways/Documents/ExelonMD/FERC/Conowingo-FRSP-3.10.pdf> (accessed October 30, 2018).

[NASA] National Aeronautics and Space Administration. 2018. "2017 Was the Second Hottest Year Since 1880, When Global Measurements First Became Possible." Release 18-003. January 18, 2018. Available at <https://www.nasa.gov/press-release/long-term-warming-trend-continued-in-2017-nasa-noaa> (accessed August 10, 2018).

[NASA] National Aeronautics and Space Administration. 2019. "2018 Fourth Warmest Year in Continued Warming Trend, According to NASA, NOAA." Release 19-002. February 6, 2019. Available at <https://climate.nasa.gov/news/2841/2018-fourth-warmest-year-in-continued-warming-trend-according-to-nasa-noaa/> (accessed April 29, 2019).

National Historic Preservation Act, as amended. 54 U.S.C. 300101 et seq.

[NatureServe] NatureServe. 2018a. *Calidris canutus rufa* Species Report. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, VA. Available at <http://explorer.natureserve.org> (accessed October 17, 2018).

[NatureServe] NatureServe. 2018b. *Glyptemys muhlenbergii* Species Report. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, VA. Available at <http://explorer.natureserve.org> (accessed October 17, 2018).

[NCEI] National Climatic Data Center. 2018. "Local Climatological Data Annual Summary With Comparative Data, Harrisburg, Pennsylvania (KMDT)." Available at <https://www1.ncdc.noaa.gov/pub/orders/IPS/IPS-B18A0C9A-2077-4089-A09E-45B09AF0F600.pdf> (accessed February 19, 2019).

[NCEI] National Climatic Data Center. 2019. "Storms Events Database" Database search: Pennsylvania, Lancaster and York Counties, 01/1950–12/2018. Available at <https://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=42%2CPENNSYLVANIA> (accessed January 28, 2019).

Near, T.J. 2008. Rescued from synonymy: a redescription of *Percina bimaculata* and a molecular phylogenetic analysis of logperch darters. *Bulletin of the Peabody Museum of Natural History* 49(1):3–18.

[NEI] Nuclear Energy Institute. 2005a. *10 CFR 50.69 SSC Categorization Guideline*. Washington, DC: NEI. NEI 00-04, Revision 0. July 2005. ADAMS Accession No. ML052910035.

[NEI] Nuclear Energy Institute. 2005b. *Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document.* NEI 05-01, Revision A. Washington, DC: NEI. November 2005. 79 p. ADAMS Accession No. ML060530203.

[NEI] Nuclear Energy Institute. 2007. *Industry Ground Water Protection Initiative—Final Guidance Document.* NEI 07-07, Final. Washington, DC: NEI. August 2007. 27 p. ADAMS Accession No. ML072610036.

[NEI] Nuclear Energy Institute. 2010. *Guideline for the Management of Underground Piping and Tank Integrity*. NEI 09-14, Revision 1. Washington, DC: NEI. December 2010. ADAMS Accession No. ML110700122.

[NEI] Nuclear Energy Institute. 2017. *Model SLR New and Significant Assessment Approach for SAMA*. NEI 17-04, Revision 0. Washington, DC: NEI. June 2017. 24 p. ADAMS Accession No. ML17181A470.

[NETL] National Energy Technology Laboratory. 2007. "Natural Gas Combined-Cycle Plant." 4 p. Available at <https://wecanfigurethisout.org/ENERGY/Web_notes/Bigger%20Picture/Where%20do%20we%20go%20-%20Supporting%20-%20Files/Natural%-0Gass%20Combined%20Cycle%20Plant%20-%20DOE.pdf> (accessed March 1, 2019).

[NETL] National Energy Technology Laboratory. 2012. *Life Cycle Analysis: Natural Gas Combined Cycle (NGCC) Power Plant.* DOE/NETL-403-110509. September 10, 2012. 148 pp. Available at <https://www.netl.doe.gov/energy-analysis/search> (accessed April 29, 2019).

[NETL] National Energy Technology Laboratory. 2013. *Cost and Performance Baseline for Fossil Energy Plants, Volume 1: Bituminous Coal and Natural Gas to Electricity*. DOE/NETL-2010/1397, Revision 2a. September 2013. 626 p. Available at <http://folk.ntnu.no/andersty/4.%20Klasse/TKP4170%20-%20Prosjektering%20Prosessanlegg/Report/Sources/Sigurd600pages.pdf> (accessed March 1, 2019).

[NIEHS] National Institute of Environmental Health Sciences. 1999. *NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields*. Research Triangle Park, NC: NIEHS. Publication No. 99-4493. May 4, 1999. 80 p. Available at <https://www.niehs.nih.gov/health/assets/docs_p_z/report_powerline_electric_mg_predates_58.pdf> (accessed February 28, 2019).

Niles L.J. et al. 2008. *Studies in Avian Biology.* No. 36. Status of the Red Knot (*Calidris Canatus Rufa*) in the Western Hemisphere. Ephrata, PA: Cooper Ornithological Society. 204 p. Available at <https://sora.unm.edu/sites/default/files/journals/sab/sab_036.pdf> (accessed October 18, 2018).

[NMFS] National Marine Fisheries Service. 2019. EFH Mapper. NOAA, National Marine Fisheries Service, Habitat Protection. Available at <https://www.habitat.noaa.gov/protection/efh/efhmapper/> (accessed on February 6, 2019).

[NMFS] National Marine Fisheries Service. Undated_a. "Species Directory: Atlantic Sturgeon." Available at <https://www.fisheries.noaa.gov/species/atlantic-sturgeon> (accessed on December 28, 2018).

[NMFS] National Marine Fisheries Service. Undated_b. "Species Directory: Shortnose Sturgeon." Available at <https://www.fisheries.noaa.gov/species/shortnose-sturgeon> (accessed on December 28, 2018).

[NMFS] National Marine Fisheries Service. Undated_c. "Summary of Essential Fish Habitat (EFH) and General Habitat Parameters for Federally Managed Species." Available at <https://www.greateratlantic.fisheries.noaa.gov/hcd/efhtables.pdf> (accessed on December 28, 2018).

[NOAA] National Oceanic and Atmospheric Administration. 2013a. *Regional Climate Trends and Scenarios for the U.S. National Climate Assessment, Part 1. Climate of the Northeast U.S.* Washington, DC: NOAA. NOAA Technical Report NESDIS 142-1. January 2013. 87 p. Available at <https://www.nesdis.noaa.gov/content/technical-reports> (accessed December 7, 2018).

[NOAA] National Oceanic and Atmospheric Administration. 2013b. *Regional Climate Trends and Scenarios for the U.S. National Climate Assessment, Part 9. Climate of the Contiguous United States.* Washington, DC: NOAA. NOAA Technical Report NESDIS 142-9. January 2013. 85 p. Available at <https://www.nesdis.noaa.gov/content/technical-reports> (accessed December 7, 2018).

[NOAA] National Oceanic and Atmospheric Administration. 2018. "National Climactic Data Center, Climate at a Glance: Divisional Time Series." [Parameters: average annual temperature and precipitation.] Available at <https://www.ncdc.noaa.gov/cag/divisional/time-series> (accessed December 14, 2018).

NOAA Fisheries. Undated. "Species Directory: Red Hake." Available at <https://www.fisheries.no aa.gov/species/red-hake> (accessed on February 6, 2019).

[NRC] U.S. Nuclear Regulatory Commission. 1978. *Final Environmental Statement Related to Operation of Peach Bottom Atomic Power Station Units 2 and 3*. Washington, DC: April 1973. ADAMS Accession No. ML18291A605.

[NRC] U.S. Nuclear Regulatory Commission. 1990a. *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*. Washington, DC: NRC. NUREG-1150, Vol. 1. December 1990. ADAMS Accession No. ML040140729.

[NRC] U.S. Nuclear Regulatory Commission. 1990b. *Evaluation of Severe Accident Risks: Peach Bottom, Unit 2.* Washington, DC: NRC. NUREG/CR-4551, Volume 4, Parts 1 and 2. December 1990. ADAMS Accession No. ML063490176 and ML063540020.

[NRC] U.S. Nuclear Regulatory Commission. 1993. *Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States, Final Report.* Washington, DC: NRC. NUREG-1449. September 1993. ADAMS Accession No. ML063470582.

[NRC] U.S. Nuclear Regulatory Commission. 1995. *Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Surry, Unit 1*. Washington, DC: NRC. NUREG/CR-6144. October 1995. ADAMS Accession No. ML18151A386.

[NRC] U.S. Nuclear Regulatory Commission. 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Final Report.* Washington, DC: NRC. NUREG-1437, Volumes 1 and 2. May 31, 1996. 1,204 p. ADAMS Accession Nos. ML040690705 and ML040690738.

[NRC] U.S. Nuclear Regulatory Commission. 1997. *Issuance for Public Comment of Proposed Rulemaking Package for Shutdown and Fuel Storage Pool Operation*. Commission Paper SECY-97-168. July 30, 1997. Available at <https://www.nrc.gov/reading-rm/doc-collections/commission/secys/1997/> (accessed on February 6, 2019).

[NRC] U.S. Nuclear Regulatory Commission. 1999. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal.*

Washington, DC: NRC. NUREG-1555, Supplement 1. March 2000. ADAMS Accession No. ML003702019.

[NRC] U.S. Nuclear Regulatory Commission. 2001. *Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants*. Washington, DC: NRC. NUREG-1738. February 2001. ADAMS Accession No. ML010430066.

[NRC] U.S. Nuclear Regulatory Commission. 2002. *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*. Washington, DC: NRC. NUREG-0586, Volumes 1 and 2. November 30, 2002. 516 p. ADAMS Accession Nos. ML023470327, ML023500228, and ML023500295.

[NRC] U.S. Nuclear Regulatory Commission. 2003a. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Peach Bottom Atomic Power Station, Units 2 and 3, Final Report*. Washington, DC: NRC. NUREG-1437, Supplement 10. January 2003. 496 p. ADAMS Accession No. ML030270059.

[NRC] U.S. Nuclear Regulatory Commission. 2003b. *Exelon Generation Company, LLC, and PSEG Nuclear, LLC, Docket No. 50-277, Peach Bottom Atomic Power Station, Unit 2, Renewed Facility Operating License*. May 7, 2003. ADAMS Accession No. ML052720266.

[NRC] U.S. Nuclear Regulatory Commission. 2003c. *Exelon Generation Company, LLC, and PSEG Nuclear, LLC, Docket No. 50-278, Peach Bottom Atomic Power Station, Unit 3, Renewed Facility Operating License.* May 7, 2003. ADAMS Accession No. ML052720269.

[NRC] U.S. Nuclear Regulatory Commission. 2004. *Protecting Our Nation–Since 9-11-01*. Washington, DC: NRC. NUREG/BR-0314. September 2004. ADAMS Accession No. ML15232A263.

[NRC] U.S. Nuclear Regulatory Commission. 2005a. *Frequently Asked Questions on License Renewal of Nuclear Power Reactors*. Washington, DC: NRC. NUREG-1850. Mar 31, 2005. ADAMS Accession No. ML061110022.

[NRC] U.S. Nuclear Regulatory Commission. 2005b. *Staff Review of the National Academies Study of the Health Risks from Exposure to Low Levels of Ionizing Radiation (BEIR VII)*. Commission Paper SECY-05-0202. October 29, 2005.

[NRC] U.S. Nuclear Regulatory Commission. 2006. *Guidelines for Categorizing Structures, Systems, and Components in Nuclear Power Plants according to their Safety Significance*. Regulatory Guide 1.201, Revision 1. May 2006. ADAMS Accession No. ML061090627.

[NRC] U.S. Nuclear Regulatory Commission. 2008. State-of-the-Art Reactor Consequence Analyses (SOARCA) Project Accident Analysis, Randall Gauntt and Charles Tinkler, presented at the 2007 Regulatory Information Conference (RIC), Rockville, MD. March 11, 2008. Available at <https://www.nrc.gov/public-involve/conference-symposia/ric/slides/gauntt-soarca.pdf> or <https://www.nrc.gov/about-nrc/regulatory/research/soar.html> (accessed May 2, 2019).

[NRC] U.S. Nuclear Regulatory Commission. 2009a. *Generic Environmental Impacts Statement for License Renewal of Nuclear Plants, Regarding Three Mile Island Nuclear Station, Unit 1*. Washington, DC: NRC. NUREG-1437, Supplement 37. May 31, 1996. ADAMS Accession No. ML091751063.

[NRC] U.S. Nuclear Regulatory Commission. 2009b. *An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities*. Regulatory Guide 1.200, Revision 2. March 2009. ADAMS Accession No. ML090410014.

[NRC] U.S. Nuclear Regulatory Commission. 2010. *Supplemental Environmental Impact Statement Regarding Indian Point Generating, Units 2 and 3*. Washington, DC: NRC. NUREG-1437, Supplement 38. December 2010. ADAMS Accession No. ML103270072.

[NRC] U.S. Nuclear Regulatory Commission. 2011. Memorandum and Order in the Matter of *Union Electric Co. d/b/a Ameren Missouri* (Callaway Plant, Unit 2). CLI-11-05, 74 NRC 167-68. ADAMS Accession No. ML11252A795.

[NRC] U.S. Nuclear Regulatory Commission. 2012. Letter from E.J. Leeds, Director, Office Nuclear Reactor Regulation, and M.J. Johnson, Director, Office of New Reactors, to all power reactor licensees and holders of construction permits in active or deferred status. Subject: Request for information pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force review of insights from the Fukushima Dai-ichi accident. March 12, 2012. ADAMS Accession No. ML12053A340.

[NRC] U.S. Nuclear Regulatory Commission. 2013a. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. Washington, DC: NRC. NUREG-1437, Volumes 1, 2, and 3, Revision 1. June 30, 2013. 1,535 p. ADAMS Accession Nos. ML13106A241, ML13106A242, and ML13106A244

[NRC] U.S. Nuclear Regulatory Commission. 2013b. Issuance of Order to Modify Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions. NRC Order No. EA-13-109. June 6, 2013. ADAMS Accession No. ML13130A067.

[NRC] U.S. Nuclear Regulatory Commission. 2013c. *Procedural Guidance for Preparing Categorical Exclusions, Environmental Assessments, and Considering Environmental Issues*. LIC-203, Revision 3. June 24, 2013. 72 p. ADAMS Accession No. ML12234A708.

[NRC] U.S. Nuclear Regulatory Commission. 2013d. *Exelon Generation Co., LLC* (Limerick Generating Station, Units 1 and 2), CLI-13-07, (Oct. 31, 2013). ADAMS Accession No. ML13304B417.

[NRC] U.S. Nuclear Regulatory Commission. 2013e. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal*. Washington, DC: NRC. NUREG-1555, Supplement 1, Revision 1. June 30, 2013. 325 p. ADAMS Accession No. ML13106A246.

[NRC] U.S. Nuclear Regulatory Commission. 2013f. *Final Supplemental Environmental Impact Statement Regarding South Texas Project*. Washington, DC: NRC. NUREG-1437, Supplement 48. November 2013. ADAMS Accession No. ML13322A890.

[NRC] U.S. Nuclear Regulatory Commission. 2013g. *State-of-the-Art Reactor Consequence Analyses Project, Volume 1: Peach Bottom Integrated Analysis*. Washington, DC: NRC. NUREG/CR-7110, Volume 1, Revision 1. May 2013. ADAMS Accession No. ML1350A053.

[NRC] U.S. Nuclear Regulatory Commission. 2014a. *Assessment of Impacts to Kirtland's Warbler (*Setophaga kirtlandii*), Northern Long-Eared Bat (*Myotis septentrionalis*) and Red Knot (*Calidris canutus rufa*), Davis-Besse Nuclear Power Station Proposed License Renewal*. May 2014. ADAMS Accession No. ML14168A616.

[NRC] U.S. Nuclear Regulatory Commission. 2014b. *Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel*. Washington, DC: NRC. NUREG-2157, Volumes 1 and 2. September 2014. ADAMS Accession Nos. ML14196A105 and ML14196A107.

[NRC] U.S. Nuclear Regulatory Commission. 2014c. Letter from R.B. Ennis, Senior Project Manager, to M. Pacillo, President and Chief Nuclear Officer, Exelon Nuclear. Subject: Peach Bottom Atomic Power Station, Units 2 and 3 - issuance of amendments re: extended power uprate (TAC Nos. ME9631 and ME9632). August 25, 2014. ADAMS Accession No. ML14133A046.

[NRC] U.S. Nuclear Regulatory Commission. 2014d. *Environmental Assessment and Finding of No Significant Impact for Peach Bottom Atomic Power Station, Units 2 and 3*. March 24, 2014. ADAMS Accession No. ML14042A387.

[NRC] U.S. Nuclear Regulatory Commission. 2014e. *Probabilistic Seismic Hazard Analysis: Background Information*. May 20, 2014. 6 p. ADAMS Accession No. ML14140A648.

[NRC] U.S. Nuclear Regulatory Commission. 2014f. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants Regarding Limerick Generating Station Units 1 and 2, Final Report.* Washington, DC: NRC. NUREG-1437, Supplement 49. August 2014. ADAMS Accession Nos. ML14238A284 and ML14238A559.

[NRC] U.S. Nuclear Regulatory Commission. 2015a. *Biological Assessment on the Northern Long-Eared Bat (*Myotis septentrionalis*) and Indiana Bat (*Myotis sodalis*) for the Indian Point Nuclear Generating Units 2 and 3 Proposed License Renewal*. July 2015. ADAMS Accession No. ML15161A086.

[NRC] U.S. Nuclear Regulatory Commission. 2015b. *Final Supplemental Environmental Impact Statement Regarding Braidwood Station*. Washington, DC: NRC. NUREG-1437, Supplement 55. November 2015. ADAMS Accession No. ML15062A428.

[NRC] U.S. Nuclear Regulatory Commission. 2015c. *Final Supplemental Environmental Impact Statement Regarding Seabrook Station*. Washington, DC: NRC. NUREG-1437, Supplement 46. July 2015. ADAMS Accession Nos. ML15209A575 and ML15209A870.

[NRC] U.S. Nuclear Regulatory Commission. 2015d. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 53, Regarding Sequoyah Nuclear Plant, Units 1 and 2, Final Report*. Washington, DC: NRC. NUREG-1437, Supplement 53. March 2015. ADAMS Accession No. ML15075A438.

[NRC] U.S. Nuclear Regulatory Commission. 2015e. Letter from F. Vega, Project Manager, Hazards Management Branch, Japan Lessons-Learned Division, Office of Nuclear Reactor Regulation, to B.C. Hanson, President and Chief Nuclear Officer, Exelon Nuclear. Subject: Peach Bottom Atomic Power Station, Units 2 and 3 – staff review of interim evaluation associated with reevaluated seismic hazard implementing Near-Term Task Force Recommendation 2.1 (TAC Nos. MF5259 and MF5260). June 30, 2015. ADAMS Accession No. ML15173A385.

[NRC] U.S. Nuclear Regulatory Commission. 2015f. Letter from T. Govan, Project Manager, Hazards Management Branch, Japan Lessons-Learned Division, Office of Nuclear Reactor Regulation, to B.C. Hanson, President and Chief Nuclear Officer, Exelon Nuclear. Subject: Peach Bottom Atomic Power Station, Units 2 and 3 – staff assessment of information provided pursuant to Title 10 of the *Code of Federal Regulations* Part 50, Section 50.54(f), seismic hazard reevaluations relating to Recommendation 2.1 of the Near-Term Task Force review of insights from the Fukushima Dai-Ichi accident (TAC Nos. MF3866 and MF3867). April 20, 2015. ADAMS Accession No. ML15051A262.

[NRC] U.S. Nuclear Regulatory Commission. 2016a. *Final Supplemental Environmental Impact Statement Regarding LaSalle County Station*. Washington, DC: NRC. NUREG-1437, Supplement 57. August 2016. ADAMS Accession No. ML16238A029.

[NRC] U.S. Nuclear Regulatory Commission. 2016b. Letter from R.B. Ennis, Senior Project Manager, to B.C. Hanson, President and Chief Nuclear Officer, Exelon Nuclear. Subject: Peach Bottom Atomic Power Station, Units 2 and 3 - issuance of amendments re: Maximum Extended Load Line Limit Analysis Plus (CAC Nos. MF4760 and MF4761). March 21, 2016. ADAMS Accession No. ML16034A372.

[NRC] U.S. Nuclear Regulatory Commission. 2017a. "Design Certification Application–NuScale." October 24, 2017. Available at <https://www.nrc.gov/reactors/new-reactors/design-cert/nuscale.html> (accessed November 9, 2018).

[NRC] U.S. Nuclear Regulatory Commission. 2017b. Letter from R.B. Ennis, Senior Project Manager, to B.C. Hanson, President and Chief Nuclear Officer, Exelon Nuclear. Subject: Peach Bottom Atomic Power Station, Units 2 and 3 - issuance of amendments re: measurement uncertainty recapture power uprate (CAC Nos. MF9289 and MF9290; EPID L-2017-LLS-0001). November 15, 2017. ADAMS Accession No. ML17286A013.

[NRC] U.S. Nuclear Regulatory Commission. 2017c. *Staff Assessment by the Office of Nuclear Reactor Regulation Related to the Focused Evaluation for Peach Bottom Atomic Power Station, Units 2 and 3 as a Result of the Reevaluated Flooding Hazard Near-Term Task Force Recommendation 2.1 - Flooding (CAC Nos. MG0092 and MG0093)*. November 6, 2017. ADAMS Accession No. ML17292B763.

[NRC] U.S. Nuclear Regulatory Commission. 2017d. "Radioactive Effluent and Environmental Reports." June 3, 2019. Available at <http://www.nrc.gov/reactors/operating/ops-experience/tritium/plant-info.html> (accessed October 23, 2018).

[NRC] U.S. Nuclear Regulatory Commission. 2018a. *Biological Evaluation of Impacts to Northern Long-Eared Bat, Rufa Red Knot, Piping Plover, and Roseate Tern for the Seabrook Station, Unit 1, Proposed License Renewal*. July 2018. ADAMS Accession No. ML18186A692.

[NRC] U.S. Nuclear Regulatory Commission. 2018b. *Environmental Impact Statement for an Early Site Permit (ESP) at the Clinch River Nuclear Site. Draft Report for Comment*. Washington, DC: NRC. NUREG-2226, Volumes 1 and 2. April 2018. ADAMS Accession Nos. ML18100A220 and ML18100A223.

[NRC] U.S. Nuclear Regulatory Commission. 2018c. *Final Supplemental Environmental Impact Statement Regarding Waterford Steam Electric Station*. Washington, DC: NRC. NUREG-1437, Supplement 59. November 2018. ADAMS Accession No. ML18323A103.

[NRC] U.S. Nuclear Regulatory Commission. 2018d. Letter from B. Beasley, Chief, to R. Nelson, Director, Office of Federal Agency Programs, Advisory Council on Historic Preservation. Subject: Request for scoping comments concerning the environmental review of Peach Bottom Atomic Power Station, Units 2 and 3 subsequent renewal application. September 10, 2018. ADAMS Accession Nos. ML18243A453, ML18243A454, ML18243A456.

[NRC] U.S. Nuclear Regulatory Commission. 2018e. Letter from G. Wilson, NRC, to J.E. Hanson and N. Ranek, Senior Project Managers, Nuclear Energy Institute. Subject: Interim endorsement of NEI 17-01, Industry Guideline for Implementing the Requirements Of 10 CFR Part 54 for Subsequent License Renewal and NEI 17-04, Model SLR New and Significant Assessment Approach for SAMA." January 31, 2018. ADAMS Accession No. ML18029A368.

[NRC] U.S. Nuclear Regulatory Commission. 2018f. Letter from G.A. Wilson, Director, to M. Gallagher, Vice President License Renewal, Exelon Nuclear. Subject: Peach Bottom Atomic Power Station, Units 2 and 3 - determination of acceptability and sufficiency for docketing, proposed review schedule, and opportunity for a hearing regarding the Exelon Generation Company, LLC, application for subsequent renewal. August 27, 2018. ADAMS Accession No. ML18191B085.

[NRC] U.S. Nuclear Regulatory Commission. 2018g. *Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2016: Forty-Ninth Annual Report*. Washington, DC: NRC. NUREG-0713, Volume 38. May 2018. 237 p. ADAMS Accession No. ML18151A364.

[NRC] U.S. Nuclear Regulatory Commission. 2018h. *Seismic Reviews at U.S. Nuclear Power Plants*. Washington, DC: NRC. June 2018. 4 p. ADAMS Accession No. ML081620327.

[NRC] U.S. Nuclear Regulatory Commission. 2018i. Summary of the site orientation visit related to the review of the subsequent license renewal application for the Peach Bottom Atomic Power Stations, Units 2 and 3. October 25, 2018. ADAMS Accession No. ML18288A194.

[NRC] U.S. Nuclear Regulatory Commission. 2018j. Teleconference with the U.S. Fish and Wildlife Service regarding Endangered Species Act Section 7 consultation for Peach Bottom Atomic Power Station, Units 2 and 3, subsequent license renewal. October 24, 2018. ADAMS Accession No. ML18299A029.

[NRC] U.S. Nuclear Regulatory Commission. 2018k. U.S. Nuclear Regulatory Commission public meeting summary: public scoping meeting for environmental review of Peach Bottom Atomic Power Station, Units 2 and 3 subsequent license renewal application. October 18, 2018. ADAMS Accession No. ML18289A509.

[NRC] U.S. Nuclear Regulatory Commission. 2018l. *2018–2019 Information Digest*. Washington, DC: NRC. NUREG-1350, Volume 30. August 2018. ADAMS Accession No. ML18226A114.

[NRC] U.S. Nuclear Regulatory Commission. 2018m. *Monitoring the Effectiveness of Maintenance at Nuclear Power Plants*. Regulatory Guide 1.160, Revision 4. August 2018. ADAMS Accession No. ML18220B281.

[NRC] U.S. Nuclear Regulatory Commission. 2018n. E-mail from B. Hayes, Project Manager, to M. Gallagher, Exelon. Subject: Peach Bottom Atomic Power Station, Units 2 and 3, subsequent license renewal severe accident mitigation alternatives requests for additional information. December 18, 2018. ADAMS Accession No. ML18348B029.

[NRC] U.S. Nuclear Regulatory Commission. 2019a. *Supplemental Environmental Impact Statement Scoping Process, Summary Report, Peach Bottom Atomic Power Station, Delta, Pennsylvania*. July 2019. ADAMS Accession No. ML19037A348.

[NRC] U.S. Nuclear Regulatory Commission. 2019b. Letter from E.R. Oesterle, Chief, to M. Gallagher, Vice President, License Renewal, Exelon Nuclear. Subject: Peach Bottom Atomic Power Station Units 2 and 3 - summary of the subsequent license renewal environmental audit. January 31, 2019. ADAMS Accession No. ML18346A675.

[NRC] U.S. Nuclear Regulatory Commission. 2019c. Letter from E.R. Oesterle, Chief, to M. Gallagher, Vice President, License Renewal, Exelon Nuclear. Subject: Peach Bottom Atomic Power Station Units 2 and 3 – summary of the subsequent license renewal severe accident mitigation alternatives audit. February 5, 2019. ADAMS Accession No. ML19023A227.

[NRC] U.S. Nuclear Regulatory Commission. 2019d. Teleconference summary between Michelle Rome Moser, Biologist, and Julie Crocker, Endangered Fish Branch Chief, National Marine Fisheries Service. Subject: ESA Listed Species with the Potential to Occur near Peach Bottom Atomic Station. February 15, 2019. ADAMS Accession No. ML19046A035.

[NRC] U.S. Nuclear Regulatory Commission. 2019e. Teleconference summary between Michelle Moser, NRC, and Kirsten Waller, Pennsylvania Department of Health. Subject: Thermophilic organisms related to the operation of Peach Bottom for the environmental review of the Peach Bottom license renewal application. January 8, 2019. ADAMS Accession No. ML19046A040.

[NRCS] Natural Resources Conservation Service. 2018a. Introduced, Invasive, and Noxious Plants: Pennsylvania State-listed Noxious Weeds. Available at <https://plants.usda.gov/java/noxious?rptType=State&statefips=42> (accessed September 24, 2018).

[NRCS] Natural Resources Conservation Service. 2018b. *Web Soil Survey, Soil Map—Lancaster County, Pennsylvania, and York County, Pennsylvania*. [search parameters: soil map; soil data explorer: soil reports; map unit description.] Last Modified: 08/21/2017. U.S. Department of Agriculture, National Resources Conservation Service. Available at <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm> (accessed September 28, 2018).

[NREL] National Renewable Energy Laboratory. 2009. *Land-Use Requirements of Modern Wind Power Plants in the United States*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A2-45834. August 2009. 39 p. Available at <http://www.nrel.gov/docs/fy13osti/56290.pdf> (accessed January 24, 2019).

[NREL] National Renewable Energy Laboratory. 2013. Land-Use Requirements for Solar Power Plants in the United States. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-56290. June 2013. 47 p. Available at <http://www.nrel.gov/docs/fy13osti/56290.pdf> (accessed August 30, 2018).

[NREL] National Renewable Energy Laboratory. 2014. Concentrating Solar Power Projects in the United States. Available at <https://solarpaces.nrel.gov/by-country/US> (accessed August 30, 2018).

[NREL] National Renewable Energy Laboratory. 2017. Global Horizontal Solar Resource. April 4, 2017. Available at <http://www.nrel.gov/gis/solar.html> (accessed September 12, 2018).

[NREL] National Renewable Energy Laboratory. 2019. NREL Wind Resource Assessment , Dynamic Maps, GIS Data, and Analysis Tools, Wind Energy Resource Atlas Available at <https://www.nrel.gov/wind/resource-assessment.html> (accessed April 28, 2019).

[NRR] Natural Resource Report. 2010. Federal Land Managers' Air Quality Related Values Work Group (FLAG). NPS/NRPC/NRR-2010/232. October 2010. Available at <https://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf> (accessed January 18, 2019).

[NuScale] NuScale Power, LLC. 2018. NuScale FAQs. Available at <http://www.nuscalepower.com/about-us/faqs#p1a5> (accessed September 13, 2018).

[NYNHP] New York Natural Heritage Program. 2017. Oak-Tulip Tree Forest. Available at <http://www.acris.nynhp.org/report.php?id=9985> (accessed August 20, 2018).

[NYNHP] New York Natural Heritage Program. 2018. Appalachian Oak-Hickory Forest. Available at <http://www.acris.nynhp.org/report.php?id=9980> (accessed August 20, 2018).

[OIPP] Office of Innovative Partnerships and Alternate Funding, Highway Division, Oregon Department of Transportation, State of Oregon. 2010. "Health and Safety Concerns of Photovoltaic Solar Panels." Salem, Oregon. Available at <https://www.ssti.us/wp/wp-content/uploads/2016/09/Health_and_Safety_Concerns_of_Photovoltaic_Solar_Panels_2010_OR.pdf> (accessed February 28, 2019).

[ORNL] Oak Ridge National Laboratory. 2012. "An Assessment of Energy Potential at Non-Powered Dams in the United States." Oak Ridge, TN: ORNL. April 2012. 44 p. Available at <https://www.energy.gov/sites/prod/files/2013/12/f5/npd_report_0.pdf> (accessed April 28, 2019).

Oscar T. P. 2009. Predictive model for survival and growth of Salmonella typhimurium DT104 on chicken skin during temperature abuse. *Journal of Food Protection* 72(2):304–314.

[OSHA] Occupational Safety and Health Administration. 1999. *OSHA Technical Manual (OTM). Section* III: Chapter 7, "Legionnaires' Disease." Available at <https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_7.html> (accessed December 18, 2018).

Owen S.F. et al. 2002. *Roost Tree Selection by Maternal Colonies of Northern Long-Eared Myotis in an Intensely Managed Forest*. Newtown Square, PA: Northeastern Research Station, Forest Service, U.S. Department of Agriculture. General Technical Report NE-292. March 2002. 6 p. Available at <http://www.fs.fed.us/ne/newtown_square/publications/technical_reports/pdfs/2002/gtrne292.pdf> (accessed October 15, 2018).

Packer D.B. et al. 1999. "Essential Fish Habitat Source Document: Summer Flounder, *Paralichthys dentatus*, Life History and Habitat Characteristics," *NOAA Technical Memorandum NMFS-NE*-151, p. 88.

Packer D.B., Zetlin C.A, Vitaliano J.J. 2003a. Essential Fish Habitat Source Document: Clearnose Skate, *Raja eglanteria*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-174. March 2003.

Packer D.B., Zetlin C.A., Vitaliano J.J. 2003b. Essential Fish Habitat Source Document:

Little skate**,** *Leucoraja erinacea***,** life history and habitat characteristics. NOAA Tech Memo NMFS NE 175. April 2003.

Packer D.B., Zetlin C.A., and Vitaliano J.J. 2003c. "Essential Fish Habitat Source Document: Winter Skate, *Leucoraja ocellata*, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-179, p. 57.

[PADCNR] Pennsylvania Department of Conservation and Natural Resources. 1998. Pennsylvania Geology. Preliminary Results from the Investigation of the Pymatuning Earthquake of September 25, 1998, 29 (4): 2-14. Available at <http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_006823.pdf> (accessed September 28, 2018).

[PADCNR] Pennsylvania Department of Conservation and Natural Resources. 2018a. "PA DCNR Interactive Map." Available at <http://www.gis.dcnr.state.pa.us/maps/index.html?geology=true> [geology layer.] (accessed September 28, 2018).

[PADCNR] Pennsylvania Department of Conservation and Natural Resources. 2018b. "Pennsylvania Groundwater Information System." [PaGWIS Multiple Criteria Search map, circular search.] Available at<https://www.dcnr.pa.gov/Conservation/Water/Groundwater/PAGroundwaterInformationSystem/Pages/default.aspx> (accessed October 26, 2018).

[PDEP] Pennsylvania Department of Environmental Protection. 2014a. Authorization to Discharge Under the National Pollutant Discharge Elimination System Discharge Requirements for Industrial Wastewater Facilities, 3800-PM-WSFR0011 Rev. 8/2009 NPDES PERMIT NO: PA0009733. May 2014. Available at <https://www.ahs.dep.pa.gov/eFACTSWeb/default.aspx> (accessed January 17, 2019).

[PDEP] Pennsylvania Department of Environmental Protection. 2014b. Enclosure "Comment/Response Document" to Letter to Exelon Generation (F. Leone) Re: Final NPDES Permit - Industrial Waste, Peach Bottom Atomic Power Station NPDES Permit No. PA0009733. September 22, 2014. As cited in Exelon 2018c.

[PDEP] Pennsylvania Department of Environmental Protection. 2014c. State Only Operating Permit No. 67-05020. Available at <http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Permits/PermitDocuments/1000506[67-05020]_Issued_v1.pdf> (accessed January 16, 2019).

[PDEP] Pennsylvania Department of Environmental Protection. 2016. Pennsylvania's Integrated Water Quality Monitoring and Assessment Report for 2016. 2016. Available at <http://www.depgis.state.pa.us/integratedreport/index.html> and <http://www.dep.pa.gov/Business/Water/CleanWater/WaterQuality/Integrated%20Water%20Quality%20Report-2016/Pages/default.aspx> (accessed January 17, 2019).

[PDEP] Pennsylvania Department of Environmental Protection. 2017. Letter to P. Navin, Plant Manager, Exelon Generation Company LLC. Subject "Re: Response to Final Report for Post-EPU Thermal and Biological Monitoring and Notice of Planned Measurement Uncertainty Recapture Uprate Peach Bottom Atomic Power Station (PBAPS) NPDES Permit No. PA0009733 Peach Bottom Township, York County. May 3, 2017. ADAMS Accession No. ML18354B061.

[PDEP] Pennsylvania Department of Environmental Protection. 2018a. "Water Use Reports, Water Quantity Report by Source." [search parameters: water use type, county, primary facility name, Peach Bottom Atomic Power Station.] Available at <https://www.dep.pa.gov/DataandTools/Reports/Pages/Water.aspx> (accessed October 26, 2018).

[PDEP] Pennsylvania Department of Environmental Protection. 2018b. "Welcome to eFACTS." Pennsylvania's Environment Facility Application Compliance Tracking System (eFACTS). [search Sites By County/Municipality, Peach Bottom, Exelon.] Available at <https://www.ahs.dep.pa.gov/eFACTSWeb/default.aspx/default.aspx> (accessed November 2, 2018).

[PDEP] Pennsylvania Department of Environmental Protection. 2018c. Water Use Report by Water Supplier-PWS Primary Facility Report. Available at: <https://www.dep.pa.gov/DataandTools/Reports/Pages/Water.aspx> (accessed November 28, 2018).

[PARS] Pennsylvania Amphibian and Reptile Survey. 2018a. "York County." Available at <https://paherpsurvey.org/county.php?r_county=1178> (accessed August 23, 2018).

[PARS] Pennsylvania Amphibian and Reptile Survey. 2018b. "Bog Turtle (*Glyptemys muhlenbergii*)." October 31, 2016. Available at <https://paherpsurvey.org/viewrecord.php?r_id=110804> (accessed August 23, 2018).

Parsons K.N., Jones G., Greenaway F. 2003. Swarming activity of temperate zone microchiropteran bats: effects of season, time of night and weather conditions. *Journal of Zoology (London)* 261:257–264.

[PDLI] Pennsylvania Department of Labor & Industry. 2018. York County, 1st Quarter, 2018, Combined Government Ownerships. Available at: <https://www.workstats.dli.pa.gov/Documents/Top%2050/York_County_Top_50.pdf> (accessed December 6, 2018).

[PennDot] Pennsylvania Department of Transportation. 2015. Pennsylvania Railroad Map. Available at <https://www.penndot.gov/ProjectAndPrograms/Planning/Maps/Documents/Pennsylvania%20Railroad%20Map.pdf> (accessed November 5, 2018).

[PennDot] Pennsylvania Department of Transportation. 2017. Traffic Volume Map, York County. Available at <https://www.penndot.gov/ProjectAndPrograms/Planning/Maps/Pages/Traffic-Volume.aspx> (accessed November 5, 2018).

[PECO] Philadelphia Electric Company. 1975. "Materials prepared for the Environmental Protection Agency, Section 316(a) Demonstration for PBAPS Units No. 2 & 3 on Conowingo Pond." July 1975. ADAMS Accession Nos. ML19007A334 and ML19007A335.

[PEI] Power Engineering International. 2017. "South Korea fuel cell CHP plant comes online." March 21, 2017. Available at <http://www.powerengineeringint.com/articles/2017/03/south-korea-fuel-cell-chp-plant-comes-online.html> (accessed August 28, 2018).

The Pennsylvania Code. 2018. Title 58. Recreation. Chapter 75. Endangered species. Available at https://www.pacode.com/secure/data/058/chapter75/chap75toc.html (accessed December 27, 2018).

[Pennsylvania Historical & Museum Commission] Pennsylvania Historical & Museum Commission. 2018. Pennsylvania Cultural Resources Geographic Information System. Available at <https://www.dot7.state.pa.us/CRGIS> (accessed January 3, 2019).

[Pennsylvania State Historic Preservation Office] Pennsylvania State Historic Preservation Office. 2018. Letter from Douglas C. McLearen to Benjamin Beasley, NRC. Subject: "Request for Scoping Comments Concerning the Environmental Review of Peach Bottom Atomic Power Station, Units 2 and 3 Subsequent License Renewal Application Peach Bottom Twp., York Co. ADAMS No. ML18299A124.

[PFBC] Pennsylvania Fish and Boat Commission. 2011. Susquehanna River Management Plan. May 26, 2011. Available at <https://www.fishandboat.com/Fish/Fisheries/SusquehannaRiverManagement/Documents/SusquehannaRiverMgmtPlan.pdf> (accessed on December 28, 2018).

[PFBC] Pennsylvania Fish and Boat Commission. 2015. *Species Action Plan: Chesapeake Logperch* (*Percina bimaculata*). Bellefonte, PA: PFBC. April 3, 2015. 9 p. Available at <https://www.fishandboat.com/Resource/Documents/species-plan-chesapeake-logperch.pdf> (accessed October 29, 2018).

[PGC] Pennsylvania Game Commission. 2010. "Indiana Bat, *Myotis sodalis*." February 10, 2010. Available at <https://www.pgc.pa.gov/Wildlife/EndangeredandThreatened/Pages/IndianaBat.aspx> accessed October 22, 2018).

[PGC] Pennsylvania Game Commission. 2018. “Pennsylvania Important Mammal Area #23: East Berlin Shrew Site.” Available at <https://www.pgc.pa.gov/Wildlife/HabitatManagement/Documents/IMA%2023%20East%20Berlin%20Shrew%20Site.pdf> (accessed September 19, 2018).

[PHAC] Public Health Agency of Canada. 2010. *Shigella* spp.—Pathogen Safety Data Sheets. September 2010. Available at <http://www.phac-aspc.gc.ca/lab-bio/res/psds-ftss/shigella-eng.php> (accessed December 18, 2018).

[PNDI] Pennsylvania Natural Diversity Inventory. 2018. Receipt for Pennsylvania Natural Diversity Inventory Search ID PNDI-617811. In Exelon 2018a.

[PNHP] Pennsylvania Natural Heritage Program. 2014a. “American Holly, *Ilex opaca*.” Available at <http://www.naturalheritage.state.pa.us/factsheets/12926.pdf> (accessed September 10, 2018).

[PNHP] Pennsylvania Natural Heritage Program. 2014b. “Harbinger-of-spring, *Erigenia bulbosa*.” Available at <http://www.naturalheritage.state.pa.us/factsheets/12883.pdf> (accessed August 24, 2018).

[PNHP] Pennsylvania Natural Heritage Program. 2014c. “Lobed Spleenwort, *Asplenium pinnatifidum*.” Available at <http://www.naturalheritage.state.pa.us/factsheets/15825.pdf> (accessed August 24, 2018).

[PNHP] Pennsylvania Natural Heritage Program. 2018. PNHP Species Lists. Search: All Species by County, York County. Available at <http://www.naturalheritage.state.pa.us/Species.aspx> (accessed August 24, 2018).

[Power] POWER Magazine. 2018. “The Big Picture: Storage Mandates.” Volume 162, Number 3. March.

Pruitt L., TeWinkel L., eds. 2007. *Indiana Bat (*Myotis sodalis*) Draft Recovery Plan*: *First Revision*. Fort Snelling, MN: U.S. Fish and Wildlife Service. April 2007. 258 p. Available at <http://ecos.fws.gov/docs/recovery_plan/070416.pdf> (accessed October 22, 2018).

Sadak T. 2008. Acid mine drainage pollution in the West Branch Schuylkill and Upper Schuylkill River, Schuylkill County, Pennsylvania: A case study and recommendations for the future. Presented to the Faculties of the University of Pennsylvania in Partial Fulfillment of the Requirements for the Degree of Master of Environmental Studies. April 2008. 62 p. Available at <http://repository.upenn.edu/mes_capstones/34> (accessed December 28, 2018).

Safe Drinking Water Act of 1974, as amended. 42 U.S.C 300f et seq.

Saunders W.E. 1930. Bats in migration. *Journal of Mammalogy* 11(2):225.

Scharnberger C.K. 2007. *Earthquake Hazard in Pennsylvania*. Fourth Printing. Harrisburg, PA: Commonwealth of Pennsylvania, Bureau of Topographic and Geological Survey. Educational Series 10. June 2007. Available at <https://www.dcnr.pa.gov/Geology/GeologicHazards/Earthquakes/Pages/default.aspx> (accessed September 28, 2018).

Schaub A., Ostwald J., Siemers B.M. 2008. Foraging bats avoid noise. *Journal of Experimental Biology* 211:3174–3180.

Schwartz F.J. 1996. Biology of the clearnose skate, *Raja eglanteria*, from North Carolina. Fla. Sci. 59: 82-95. In Packer et al. 2003.

Sea Grant Pennsylvania. 2007. Zebra Mussel and Quagga Mussel, *Dreissena polymorpha* and *Dreissena rostriformis bugensis*. ADAMS Accession No. ML081000190.

Sevon W.D. 1996a. *Surficial Geology of the Airville, Conestoga, Gap, Glen Rock, Holtwood, Kirkwood, Quarryville, Red Lion, Safe Harbor, Stewartstown, Wakefield, and York Quadrangles and the Pennsylvania Part of the Conowingo Dam, Delta, Fawn Grove, New Freedom, Norrisville, and Rising Sun Quadrangles in York, Lancaster, and Chester Counties, Pennsylvania*. Harrisburg, PA: Pennsylvania Geological Survey. Open-File Reports 96–01 to 96–18. 24 p. Available at <http://www.docs.dcnr.pa.gov/topogeo/publications/pgspub/openfile/index.htm> (accessed September 28, 2018).

Sevon W.D. 1996b. *Surficial Geology of the Holtwood 7.5' Quadrangle, PA*. Harrisburg, PA: Pennsylvania Geological Survey. Open-File Report 96–10. 1 plate. Available at <http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_017290.zip> (accessed September 28, 2018).

Sevon W.D. 1996c. *Surficial Geology of the Pennsylvania Part of the Conowingo Dam 7.5' Quadrangle, MD–PA*. Harrisburg, PA: Pennsylvania Geological Survey. Open-File Report 96–17. 1 plate. Available at <http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_017290.zip (accessed September 28, 2018).

Sevon W.D., compiler. 2008. *Physiographic Provinces of Pennsylvania*. Second printing. Harrisburg, PA: Commonwealth of Pennsylvania, Department of Conservation and Natural Resources, Bureau of Topographic and Geological Survey. Map 13. Available at <http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_016202.pdf> (accessed September 28, 2018).

Sevon W.D., compiler. 2018. Physiographic Provinces of Pennsylvania. Second printing. Harrisburg, PA: Commonwealth of Pennsylvania, Department of Conservation and Natural Resources, Bureau of Topographic and Geological Survey. Map 13. Available at <http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_016202.pdf> (accessed September 28, 2018).

Smith R.W., Daiber F.C. 1977. Biology of the summer flounder *Paralichthys dentatus*, in Delaware Bay. *Fishery Bulletin* 75(4): 823-830.

[SESD] South Eastern School District. 2014. South Eastern School District Financial Report. June 30, 2014. Available at <http://www.sesdweb.net/school_board/financial_statements> (accessed December 26, 2018).

[SESD] South Eastern School District. 2015. South Eastern School District Financial Report. June 30, 2015. Available at <http://www.sesdweb.net/school_board/financial_statements> (accessed December 26, 2018).

[SESD] South Eastern School District. 2016. South Eastern School District Financial Report June 30, 2016. Available at <http://www.sesdweb.net/school_board/financial_statements> (accessed December 26, 2018).

[SESD] South Eastern School District. 2017. South Eastern School District. October 1st Enrollment 1975 to present. Available at <http://www.sesdweb.net/cms/One.aspx?portalId=142370&pageId=864743> (accessed October 24, 2018).

[SESD] South Eastern School District. 2018. South Eastern School District Financial Report June 30, 2018. Available at <http://www.sesdweb.net/school_board/financial_statements> (accessed December 26, 2018).

Spalding W. 2006. "*Percina caprodes*, Log perch." University of Michigan Museum of Zoology Animal Diversity Web. Available at https://animaldiversity.org/accounts/Percina_caprodes/ (accessed October 30, 2018).

[SRAFRC] Susquehanna River Anadromous Fish Restoration Cooperative. 2010. Migratory Fish Management and Restoration Plan for the Susquehanna River Basin. Draft for Policy Committee and public review. March 11, 2010. Available at: <https://www.fws.gov/northeast/susquehannariver/pdf/FinalSRAFRCRestorationPlanforpubliccomment3-11-10.pdf> (accessed on December 28, 2018).

[SRAFRC] Susquehanna River Anadromous Fish Restoration Cooperative. 2012. Restoration of American Shad to the Susquehanna River, Annual Progress Report 2011. March 2012. Available at <https://www.fws.gov/northeast/susquehannariver/pdf/2011.pdf> (accessed on January 25, 2019).

[SRBC] Susquehanna River Basin Commission. 2004. Docket No. 20061209-1, Exelon Generation Company, LLC, Peach Bottom Atomic Power Station. Approval date December 5, 2006. Modification date June 24, 2011. Available at <https://mdw.srbc.net/WAAV/Search> (accessed October 26, 2018).

[SRBC] Susquehanna River Basin Commission. 2006. Conowingo Pond Management Plan, Publication No. 242. June 2006. Available at <https://www.srbc.net/our-work/reports-library/technical-reports/242-conowingo-pond-management-plan/docs/conowingo-pond-management-plan.pdf> (accessed January 17, 2019).

[SRBC] Susquehanna River Basin Commission. 2007. Docket No. 20070306, Delta Borough. Harrisburg, PA: SRBC. Approval Date: March 14, 2007. Available at <https://mdw.srbc.net/WAAV/Search> (accessed December 7, 2018).

[SRBC] Susquehanna River Basin Commission. 2011. *Docket No. 20061209-1, Exelon Generation Company, LLC, Peach Bottom Atomic Power Station*. Harrisburg, PA: SRBC. Approval date December 5, 2006. Modification date June 24, 2011. Available at <https://mdw.srbc.net/WAAV/Search> (accessed October 26, 2018).

[SRBC] Susquehanna River Basin Commission. 2013. Docket No. 20130605, Delta Borough Municipal Authority. Harrisburg, PA: SRBC. Approval Date: June 20, 2013. Available at <https://mdw.srbc.net/WAAV/Search> (accessed December 7, 2018).

[SRBC] Susquehanna River Basin Commission. 2015. *Biological and Water Quality Assessment of the Lower Susquehanna River: New Cumberland, PA (RM 69) to Conowingo, MD (RM 10), June to August 2014*. Harrisburg, PA: SRBC. Publication No. 301. September 30, 2015. 33 p. Available at <https://www.srbc.net/our-work/reports-library/technical-reports/301-biological-water-quality-lower-susquehanna/docs/biological-water-quality-lower-susquehanna.pdf> (accessed on December 28, 2018).

[SRBC] Susquehanna River Basin Commission. 2018a. "About Us." 2018. Available at <https://www.srbc.net/about/about-us/> (accessed on October 29, 2018).

[SRBC] Susquehanna River Basin Commission. 2018b. "Water Application and Approval Viewer – WAAV, Map of Projects." Available at <http://mdw.srbc.net/WAAV/Map> (accessed December 7, 2018).

Steimle F.W., Morse W.W., Berrien P.L., Johnson D.L. 1999. *Essential Fish Habitat Source Document: Red Hake,* Urophycis chuss*, Life History and Habitat Characteristics*. Woods Hole, MA. NOAA Tech Memo NMFS-NE-133. September 1999. 34 p. Available at <https://www.nefsc.noaa.gov/publications/tm/tm133/> (accessed July 20, 2019).

Steimle F.W., Pikanowski R.A., McMillan D.G., Zetlin C.A., and Wilko S.J. 2000. *Demersal Fish and American Lobster Diets in the Lower Hudson-Raritan Estuary.* Woods Hole, MA. NOAA Technical Memorandum NMFS-NE-161. November 2000. p. 106. Available at <https://www.nefsc.noaa.gov/publications/tm/tm161/> (accessed July 20, 2019).

Stevenson D.K., Scott M.L. 2005. *Essential Fish Habitat Source Document: Atlantic Herring,* Clupea harengus*, Life History and Habitat Characteristics. Second Edition*. Gloucester, MA: National Marie Fisheries Service, Northeast Regional Office. NOAA Technical Memorandum NMFS-NE-192. July 2005. 84 p. Available at <https://www.nefsc.noaa.gov/publications/tm/tm192/> (accessed July 20, 2019).

Tagaris E., Liao K.J., Delucia A.J., Deck L., Amar P., Russell A.G. 2009. Potential impact of climate change on air pollution-related human health effects. *Environmental Science and Technology* 43:4979–4988. Available at <https://pubs.acs.org/doi/pdf/10.1021/es803650w> (accessed March 18, 2019).

Taylor W.K., Anderson B.H. 1973. Nocturnal migrants killed at a central Florida TV tower: autumns 1969–1971. *Wilson Bulletin* 85(1):42–51.

[The Nature Conservancy] The Nature Conservancy. 2010. *Ecosystem Flow Recommendations for the Susquehanna River Basin, Report to the Susquehanna River Basin Commission and U.S. Army Corps of Engineers*. Harrisburg, PA: The Nature Conservancy. November 2010. Available at <https://www.nature.org/media/pa/tnc-final-susquehanna-river-ecosystem-flows-study-report.pdf> (accessed on December 7, 2018).

Todar K. 2004. *Pseudomonas aeruginosa*. Available at <http://textbookofbacteriology.net/pseudomonas.html> (accessed December 18, 2018).

Toepfer C.S., Fisher W.L., Haubelt J.A. 1999. Swimming performance of the threatened leopard darter in relation to road culverts. *Transactions of the American Fisheries Society* 128:155–161.

Trapp H., Horn M.A. 1997. *Ground Water Atlas of the United States, Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, West Virginia*. Washington, DC: U.S. Geological Survey. HA-730-L. Available at <https://pubs.usgs.gov/ha/ha730/ch_l/> (accessed September 28, 2018).

Turner G.G., Reeder D.M., Coleman J.T.H. 2011. A five-year assessment of mortality and geographic spread of white-nose syndrome in North American bats and a look to the future. *Bat Research News* 52:13–27.

Tyndall R.L., Ironside K.S., Metler P.L., Tan E.L., Hazen T.C., Fliermans C.B. 1989. Effect of thermal additions on the density and distribution of thermophilic amoebae and pathogenic *Naegleria fowleri* in a newly created cooling lake. *Applied and Environmental Microbiology* 55(3):722–732.

[URS] URS Corporation. 2012. *Final Study Report: Water Level Management Study RSP 3.12, Conowingo Hydroelectric Project, FERC Project Number 405*. Prepared for Exelon Generation. August 2012. 141 p. Available at <https://mde.maryland.gov/programs/water/WetlandsandWaterways/Documents/ExelonMD/FERC/Conowingo-FRSP-3.12.pdf> (accessed January 25, 2019).

[URS and NAI] URS Corporation and Normandeau Associates, Inc. 2008. *316(b) Compliance Report with Source Waterbody Information, Impingement Mortality Characterization Study, and Design and Construction Technology Plan.* Prepared for Exelon Generation. June 2008. 34 p. ADAMS Accession No. ML19007A326.

[U.S. Army] U.S. Army Garrison Fort Drum, Fish and Wildlife Management Program. 2014. *Biological Assessment on the Proposed Activities on Fort Drum Military Installation, Fort Drum, New York (2015–2017) for the Indiana Bat (*Myotis sodalis*) and Northern Long-Eared Bat (*Myotis septentrionalis*)*. September 2014. 176 p. Available at <https://fortdrum.isportsman.net/docs/default-source/publications1/fort-drum-2014-ba-2015-2017.pdf?sfvrsn=2> (accessed December 6, 2018).

[USCB] U.S. Census Bureau. 2016. Poverty Thresholds by Size of Family and Number of Related Children Under 18 Years. Available at <https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html> (accessed January 4, 2019).

[USCB] U.S. Census Bureau. 2018a. American Fact Finder, "2012-2016 American Community Survey 5-Year Estimates, Table DP03 Selected Economic Characteristics." Available at <https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t> (accessed November 30, 2018).

[USCB] U.S. Census Bureau. 2018b. Pennsylvania, Census 2000 Summary File 1. Available at <https://www.census.gov/census2000/sumfile1.html> (accessed January 2, 2019).

[USCB] U.S. Census Bureau. 2018c. Profile of General Population and Housing Characteristics: 2010, DP-1, Lancaster and York County. Available at <https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t> (accessed January 2, 2019).

[USCB] U.S. Census Bureau. 2018d. American Fact Finder: 2012-2016 American Community Survey 5-Year Estimates, Table DP-5: ACS Demographic and Housing Estimates. Available at: <https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t> (accessed November 30, 2018).

[USCB] U.S. Census Bureau. 2018e. Profile of General Population and Housing Characteristics: 2010, DP-1, DP-1, Pennsylvania. Available at <https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t> (accessed January 2, 2019).

[USCB] U.S. Census Bureau. 2018f. American Fact Finder 2012-2016 American Community Survey 5-Year Estimates, Table B25004, Vacancy Status, Lancaster and York County. Available at <https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t> (accessed November 30, 2018).

[USCB] U.S. Census Bureau. 2018g. American Fact Finder: 2012-2016 American Community Survey 5-Year Estimates, Table DP-5, Demographic and Housing Estimates. Available at <https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t> (accessed November 30, 2018).

[USCB] U.S. Census Bureau. 2018h. American Fact Finder, 2012-2016 American Community Survey, Table DP-4, Selected Housing Characteristics. Available at: <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk> (accessed November 19, 2018).

[USCB] U.S. Census Bureau. 2018i. American Fact Finder: 2010 Census Summary File 1, P9 Hispanic or Latino and not Hispanic or Latino by Race. Available at <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk> (accessed January 8, 2019).

[USCB] U.S. Census Bureau. 2018j. American Fact Finder: 2012-2016 American Community Survey 5-Year Estimates. Selected Economic Characteristics. Available at

<https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk> (accessed January 8, 2019).

[USCB] U.S. Census Bureau. Undated. Population of States and Counties of the United States: 1790 to 1990. Available at: <https://www.census.gov/population/www/censusdata/pop1790-1990.html> (accessed January 2, 2019).

[USDA] U.S. Department of Agriculture. 2012. "Table 7. Hired Farm Labor—Workers and Payroll: 2012." 2012 Census, Volume 1, Chapter 2, County Level Data. Available at <https://www.nass.usda.gov/Publications/AgCensus/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Pennsylvania/> (accessed October 23, 2018).

[USDA] U.S. Department of Agriculture. 2018. "Plant Fact Sheet: American Holly." February 5, 2002. Available at <https://plants.usda.gov/factsheet/pdf/fs_ilop.pdf> (accessed September 10, 2018).

[USGCRP] U.S. Global Change Research Program. 2009. *Global Climate Change Impacts in the United States*. New York, NY: Cambridge University Press. June 2009. 196 p. Available at <https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf> (accessed December 7, 2018).

[USGCRP] U.S. Global Change Research Program. 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. Washington, DC: USGCRP. doi:10.7930/J0Z31WJ2. May 2014. Revised October 2014. 841 p. Available at <https://www.globalchange.gov/nca3-downloads-materials> (accessed December 7, 2018).

[USGCRP] U.S. Global Change Research Program. 2017. *Climate Science Special Report: Fourth National Climate Assessment, Volume 1*. Washington, DC: USGCRP. doi:10.7930/J0J964J6. 2017. 470 p. Available at <https://science2017.globalchange.gov/downloads/CSSR2017_FullReport.pdf> (accessed December 7, 2018).

[USGCRP] U.S. Global Change Research Program. 2018. *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II.* Washington, DC: USGCRP. doi: 10.7930/NCA4.2018. 2018. 1,515 p. Available at <https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf> (accessed December 7, 2018).

[USGS] U.S. Geological Survey. 2008. *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States.* Menlo Park, CA: USGS. Fact Sheet 2008–3082. 2008. 4 p. Available at <http://pubs.usgs.gov/fs/2008/3082/pdf/fs2008-3082.pdf> (accessed September 6, 2018).

[USGS] U.S. Geological Survey. 2015a. "Bat Fatalities at Wind Turbines—Investigating the Causes and Consequences." March 18, 2015. Available at <https://www.usgs.gov/centers/fort/science/bat-fatalities-wind-turbines-investigating-causes-and-consequences?qt-science_center_objects=0#qt-science_center_objects> (accessed November 8, 2018).

[USGS] U.S. Geological Survey. 2015b. *Sediment Transport and Capacity Change in Three Reservoirs, Lower Susquehanna River Basin, Pennsylvania and Maryland 1900–2012*. Reston, VA: USGS. Open-File Report 2014–1235. 2015. Available at <https://pubs.usgs.gov/of/2014/1235/pdf/ofr2014-1235.pdf> (accessed November 7, 2018).

[USGS] U.S. Geological Survey. 2016. *Holtwood Quadrangle, Pennsylvania, 7.5 Minute Series*. U.S. Department of the Interior, U.S. Geological Survey. Available at <https://store.usgs.gov/map-locator> (accessed September 24, 2018).

[USGS] U.S. Geological Survey. 2018a. "Search Earthquake Catalog." [search parameters: center latitude 39.7597 N, center longitude -76.72681 W, and outside radius 100 km; all catalogs]. U.S. Geological Survey, Earthquake Hazards Program. Available at <https://earthquake.usgs.gov/earthquakes/search/> (accessed October 12, 2018).

[USGS] U.S. Geological Survey. 2018b. "Water-Year 2017 Summary for Site 01576000 Susquehanna River at Marietta, PA." Available at <https://waterdata.usgs.gov/nwis/wys_rpt/?site_no=01576000&agency_cd=USGS> (accessed November 23, 2018).

[USGS] U.S. Geological Survey. 2018c. "Water Use Data for Pennsylvania." October 25, 2018. Available at <https://waterdata.usgs.gov/pa/nwis/water_use/> (accessed October 26, 2018).

[USGS] U.S. Geological Survey. 2018d. "*Cyprinus carpio*, 1758: USGS Nonindigenous Aquatic Species Database." Gainesville, FL: USGS. February 16, 2018. Available at <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=4> (accessed June 5, 2019).

Van Gelder R.G. 1956. Echo-location failure in migratory bats. *Transactions of the Kansas Academy of Science* 59:220–222.

Vonhof M.J., Amelon S.K., Currie R.R., McCracken G.F. 2016. Genetic structure of winter populations of the endangered Indiana bat (*Myotis sodalis*) prior to the white nose syndrome epidemic: implications for the risk of disease spread. *Conservation Genetics* 17(5):1025–1040. Available at <https://www.fs.fed.us/nrs/pubs/jrnl/2016/nrs_2016_vonhof_001.pdf> (accessed October 23, 2018).

Wagner K., Gauntt R. 2006. *Mitigation of Spent Fuel Pool Loss-of-Coolant Inventory Accidents and Extension of Reference Plant*. Albuquerque, NM: Sandia National Laboratories. Sandia Letter Report, Revision 2. November 2006. 120 p. ADAMS No. ML120970086.

[WAPA and FWS] Western Area Power Administration and U.S. Fish and Wildlife Service. 2015. *Upper Great Plains Wind Energy Programmatic Environmental Impact Statement, Final*. DOE/EIS 0408. April 2015. 938 p. Available at <https://www.energy.gov/nepa/downloads/eis-0408-final-programmatic-environmental-impact-statement> (accessed December 19, 2018).

Watrous K.S. et al. 2006. Predicting minimum habitat characteristics for the Indiana bat in the Champlain Valley. *The Journal of Wildlife Management* 70(5):1228–1237.

Whitaker J.O., Jr., Brack V., Jr. *Distribution and Summer Ecology in Indiana*. p 48–54. In: Kurta, A., Kennedy, J., eds. 2002. *The Indiana Bat: Biology and Management of an Endangered Species.* Austin, TX: Bat Conservation International. 253 p.

Wiken E., Nava F.J., Griffith G. 2011. *North American Terrestrial Ecoregions—Level III*. Montreal, Canada: Commission for Environmental Cooperation. April 2011. 149 p. Available at <http://www3.cec.org/islandora/en/item/10415-north-american-terrestrial-ecoregionslevel-iii> (accessed August 16, 2018).

Winhold L., Kurta A. 2006. Aspects of migration by the endangered Indiana bat, *Myotis sodalis*. *Bat Research News* 47:1–11.

Woods A.J., Omernik J.M., Brown D.D. 1999. *Level III and IV Ecoregions of Delaware, Maryland, Pennsylvania, Virginia, and West Virginia*. Corvallis, OR: U.S. Environmental Protection Agency National Health and Environmental Effects Research Laboratory. July 1999.

61 p. Available at <https://extension.umd.edu/sites/extension.umd.edu/files/_docs/programs/master-gardeners/Natives/1999_Woods_Omernik_reg3_ecoregion_descriptions.pdf> (accessed August 16, 2018).

Wu S., Mickley L.J., Leibensperger E.M., Jacob D.J., Rind D., and Streets D.G. 2008. Effects of 2000–2050 global change on ozone air quality in the United States. *Journal of Geophysical Research* 113:D06302. DOI: 10.1029/2007JD008917.

[YCPC] York County Planning Commission. 2004. *York County Natural Areas Inventory*. York, PA: YCPC. October 27, 2004. 204 p. Available at <http://www.naturalheritage.state.pa.us/CNAI_PDFs/York%20County%20NAI%202004_web.pdf> (accessed August 22, 2018).

[YCPC] York County Planning Commission. 2011. *Integrated Water Resources Plan*. York, PA: YCPC. March 2011. Available at <http://www.ycpc.org/Search?searchPhrase=Integrated%20Water%20Resources%20Plan%20(PDF)> (accessed November 19, 2018).

[YCPC] York County Planning Commission. 2013. *2017–2040 York Area Metropolitan Planning Organization Long Range Transportation Plan*. York, PA: YCPC. April 25, 2013. Available at <http://www.ycpc.org/DocumentCenter/View/341/2017-to-2040-Long-Range-Transportation-Plan-Draft-PDF> (accessed November 16, 2018).

[YCPC] York County Planning Commission. 2016. *York County Heritage Preservation Plan*. York, PA: YCPC. August 17, 2016. Available at <http://www.ycpc.org/DocumentCenter/View/329/York-County-Heritage-Preservation-Plan-PDF> (accessed October 30, 2018).

[YCPC] York County Planning Commission. 2018. *York County Environmental Resources Inventory*. York, PA: YCPC. February 2018. Available at <https://www.ycpc.org/DocumentCenter/View/285/Environmental-Resources-Inventory-PDF> (accessed October 26, 2018).

Yoder C.O. 2012. *Development of a Database for Upper Thermal Tolerances for New England Freshwater Fish Species*. Columbus, OH: Midwest Biodiversity Institute, Center for Applied Bioassessment & Biocriteria. Technical Report MBI/2012-4-6. May 25, 2012. 69 p. Available at <https://www.ctriver.org/documents/VY/MBI%20Report%20Appendix%202012-05-25.pdf> (accessed January 8, 2019).

[York County] York County. 2018. *County of York, Pennsylvania Comprehensive Annual Financial Report for the Year Ended December 31, 2017*. York, PA: County of York. July 22, 2018. Available at <https://yorkcountypa.gov/county-administration/budget-and-finance/comprehensive-annual-financial-reports.html> (accessed October 25, 2018).

Zinn T.L., Baker W.W. 1979. Seasonal migration of the hoary bat, *Lasiurus cinereus*, through Florida. *Journal of Mammalogy* 60:634–635.

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APPENDIX A
COMMENTS RECEIVED ON ENVIRONMENTAL REVIEW

A.1 Comments Received During the Scoping Period

The scoping process for the environmental review of the Peach Bottom Atomic Power Station Units 2 and 3 (Peach Bottom or Peach Bottom Units 2 and 3) subsequent license renewal application began in July 2018, in accordance with the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq). On September 4, 2018, the U.S. Nuclear Regulatory Commission (NRC) issued a notice of intent to conduct an environmental scoping process for subsequent license renewal of Peach Bottom that was published in the *Federal Register* on September 10, 2018 (83 FR 45692)). The scoping process included a public meeting held in Delta, PA, on September 25, 2018. The NRC issued a press release and purchased newspaper advertisements to advertise the public meeting. In addition to participation from Exelon Generation Company, LLC and state government representatives, several members of the public attended the meeting. After the NRC staff presented prepared statements on the subsequent license renewal process, the staff opened the meeting for public comments. Attendees were provided the opportunity to make oral statements that were recorded and transcribed by a certified court reporter. A summary and transcript of the scoping meeting is available in NRC's Agencywide Documents Access and Management System (ADAMS). The ADAMS Public Electronic Reading Room is accessible at http://www.nrc.gov/reading-rm/adams.html. The scoping meeting summary is available at ADAMS Accession No. ML18289A509. The transcript of the meeting is available at ADAMS Accession No. ML18288A438.

In addition to comments received during the public meeting, comments were also received electronically and by letter. The NRC staff developed and issued a scoping summary report that provides information on how to access the comments received and the staff's responses to comments received as part of the Peach Bottom environmental scoping process. The scoping summary report is available at ADAMS Accession No. ML19037A348.

APPENDIX B
APPLICABLE LAWS, REGULATIONS, AND REQUIREMENTS

There are a number of Federal laws and regulations that affect environmental protection, health, safety, compliance, and consultation at every NRC-licensed nuclear power plant. Some of these laws and regulations require permits by or consultation with other Federal agencies or State, Tribal, or local governments. Certain Federal environmental requirements have been delegated to State authorities for enforcement and implementation. Furthermore, States have also enacted their own laws to protect public health and safety and the environment. It is the NRC's policy to make sure nuclear power plants are operated in a manner that provides adequate protection of public health and safety and protection of the environment through compliance with applicable Federal and State laws, regulations, and other requirements.

The Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.) (AEA), authorizes the NRC to enter into an agreement with any State that allows the State to assume regulatory authority for certain activities (see 42 U.S.C. 2021). Pennsylvania is an NRC Agreement State The Bureau of Radiation Protection within the Pennsylvania Department of Environmental Protection (PDEP) has regulatory responsibility over the radioactive materials program under the AEA Section 274b Agreement between the NRC and the Commonwealth of Pennsylvania.

In addition to carrying out certain Federal programs, State legislatures develop their own laws. State statutes can supplement, as well as implement, Federal laws for protection of air, surface water, and groundwater. State legislation may address solid waste management programs, locally rare or endangered species, and historic and cultural resources.

The U.S. Environmental Protection Agency (EPA) has the primary responsibility to administer the Clean Water Act (33 U.S.C. 1251 et seq.) (CWA). The National Pollutant Discharge Elimination System (NPDES) program addresses water pollution by regulating the discharge of potential pollutants to waters of the United States. EPA allows for primary enforcement and administration of the NPDES program through State agencies, as long as the State program is at least as stringent as the Federal program.

The EPA has delegated the authority to issue NPDES permits to Pennsylvania. Among other things, the PDEP provides oversight for public water supplies, issues permits to regulate the discharge of industrial and municipal wastewaters—including discharges to groundwater—and monitors State water resources for water quality. The PDEP issues NPDES permits to regulate and control water pollutants.

B.1 <u>Federal and State Requirements</u>

Peach Bottom Atomic Power Station Units 2 and 3 (Peach Bottom, or Peach Bottom Units 2 and 3) are subject to various Federal and State requirements. Table B-1 lists the principal Federal and State regulations and laws that are used or mentioned in this supplemental environmental impact statement for Peach Bottom.

Table B-1 Federal and State Requirements

Law/regulation	Requirements
Current operating license and license renewal	
Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 et seq.	The Atomic Energy Act (AEA)and the Energy Reorganization Act of 1974, as amended (42 U.S.C. 5801 et seq.) (ERA) give the NRC the licensing and regulatory authority for commercial nuclear energy use. They allow the NRC to establish dose and concentration limits for protection of workers and the public for activities under NRC jurisdiction. The NRC implements its responsibilities under the AEA through regulations set forth in Title 10, "Energy," of the *Code of Federal Regulations* (CFR).
10 CFR Part 2	Regulations in 10 CFR Part 2, "Agency Rules of Practice and Procedure," govern the conduct of all proceedings (other than export and import licensing proceedings) for: (a) granting, suspending, revoking, amending, or taking other action with respect to any license, construction permit, or application to transfer a license, (b) issuing orders and demands for information to persons subject to the Commission's jurisdiction, including licensees and persons not licensed by the Commission, (c) imposing civil penalties under AEA Section 234 AEA, (d) rulemaking under the AEA and the Administrative Procedure Act, and (e) standard design approvals under 10 CFR Part 52.
10 CFR Part 20	Regulations in 10 CFR Part 20, "Standards for Protection Against Radiation," establish standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the NRC. These regulations are issued under the AEA, and the ERA. The purpose of these regulations is to control the receipt, possession, use, transfer, and disposal of licensed material by any licensee in such a manner that the total dose to an individual (including doses resulting from licensed and unlicensed radioactive material and from radiation sources other than background radiation) does not exceed the standards for protection against radiation prescribed in the regulations in 10 CFR Part 20.
10 CFR Part 50	Regulations in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," are NRC regulations issued under the AEA and Title II of the ERA, to provide for the licensing of production and utilization facilities, including power reactors.
10 CFR Part 51	Regulations in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," contain the NRC's regulations that implement Section 102(2) of the National Environmental Policy Act (NEPA).
10 CFR Part 54	Regulations in 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," govern the issuance of renewed operating licenses and renewed combined licenses for nuclear power plants licensed under Sections 103 or 104b of the AEA and Title II of the ERA. The regulations focus on managing adverse effects of aging and are intended to ensure that important systems, structures, and components will continue to perform their intended functions during the period of extended operation.
10 CFR Part 100	Regulations in 10 CFR Part 100, "Reactor Site Criteria," establish approval requirements for proposed sites for stationary power and testing reactors.

Table B-1 Federal and State Requirements (cont.)

Law/regulation	Requirements
Current operating license and license renewal (cont.)	
National Environmental Policy Act of 1969, as amended, 42 U.S.C. 4321 et seq.	The National Environmental Policy Act (NEPA)requires Federal agencies to integrate environmental values into their decisionmaking process by considering the environmental impacts of proposed Federal actions and reasonable alternatives to those actions. NEPA establishes policy, sets goals (in Section 101), and provides means (in Section 102) for carrying out the policy. NEPA Section 102(2) contains action-forcing provisions to ensure that Federal agencies follow the letter and spirit of the act. For major Federal actions significantly affecting the quality of the human environment, Section 102(2)(C) of the act requires Federal agencies to prepare a detailed statement that includes the environmental impacts of the proposed action and other specified information.
40 CFR Part 50	Regulations in 40 CFR Part 50, "National Primary and Secondary Ambient Air Quality Standards," establish the following: (1) national primary ambient air quality standards that define levels of air quality which the EPA judges are necessary to protect the public health and (2) national secondary ambient air quality standards that define levels of air quality which the EPA judges necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
40 CFR Part 51	Regulations in 40 CFR Part 51, "Requirements for Preparation, Adoption and Submittal of Implementing Plans," include Section 51.308, "Regional haze program requirements," (referred to as the Regional Haze Rule), which establishes requirements for implementation plans, plan revisions, and periodic progress reviews to address regional haze.
40 CFR Part 60	Regulations in 40 CFR Part 60, "Standards of Performance for New Stationary Sources," contain emissions guidelines and standards of performance for new stationary sources.
40 CFR Part 63	Regulations in 40 CFR Part 63, "National Emission Standards for Hazardous Air Pollutants [NESHAP] for Source Categories," contain national emission standards for hazardous air pollutants, established pursuant to Section 112 of the Clean Air Act, that regulate specific categories of stationary sources that emit (or have the potential to emit) one or more hazardous air pollutants listed in this part.
40 CFR Part 81	Regulations in 40 CFR Part 81, "Designation of Areas for Air Quality Planning Purposes," designate Air Quality Control Regions (Subpart B), list the attainment status designations by state(Subpart C), and identify Mandatory Class I Federal Areas Where Visibility Is an Important Value (Subpart D).
40 CFR Part 110	Regulations in 40 CFR Part 110, "Discharge of Oil," establish regulations applicable to the discharge of oil prohibited by Section 311(b)(3) of the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq., also known as the Clean Water Act (CWA).
40 CFR Part 112	Regulations in 40 CFR Part 112, "Oil Pollution Prevention" establish procedures, methods, equipment, and other requirements to prevent the discharge of oil from non-transportation-related onshore and offshore facilities into or upon the navigable waters of the United States or adjoining shorelines.
40 CFR Part 125	Regulations in 40 CFR Part 125, "Criteria and Standards for the National Pollutant Discharge Elimination System," establish criteria and standards for the imposition of technology-based treatment requirements in permits under Section 301(b) of the CWA , including the application of EPA promulgated effluent limitations and case-by-case determinations of effluent limitations under section 402(a)(1) of the CWA.

Table B-1 Federal and State Requirements (cont.)

Law/regulation	Requirements
Current operating license and license renewal (cont.)	
40 CFR Part 131	Regulations in 40 CFR Part 131, “Water Quality Standards,” contain requirements and procedures for developing, reviewing, revising, and approving water quality standards by the States as authorized by Section 303(c) of the CWA.
40 CFR Part 141	Regulations in 40 CFR Part 141, “National Primary Drinking Water Regulations,” establish primary drinking water regulations pursuant to Section 1412 of the Public Health Service Act, as amended by the Safe Drinking Water Act.
40 CFR Part 143	Regulations in 40 CFR Part 143, “National Secondary Drinking Water Regulations,” establish National Secondary Drinking Water Regulations pursuant to Section 1412 of the Safe Drinking Water Act, as amended.
40 CFR Part 190	Regulations in 40 CFR Part 190, “Environmental Radiation Protection Standards for Nuclear Power Operations,” establish limits for radiation dose equivalent to the public and the total quantity of radioactive materials entering the environment from the entire uranium fuel cycle.
Air quality protection	
Clean Air Act of 1970, as amended, 42 U.S.C. 7401 et seq.	The Clean Air Act (CAA) is intended to “protect and enhance the quality of the nation’s air resources so as to promote the public health and welfare and the productive capacity of its population.” The CAA establishes regulations to ensure maintenance of air quality standards and authorizes individual States to manage permits. Section 109 of the CAA directs the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for criteria pollutants. The EPA has identified and set NAAQS for the following criteria pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. Section 111 of the CAA requires the establishment of national performance standards for new or modified stationary sources of atmospheric pollutants. Section 160 of the CAA requires that specific emission increases must be evaluated before permit approval to prevent significant deterioration of air quality. Section 112 establishes specific standards for release of hazardous air pollutants (including radionuclides). These standards are implemented through plans developed by each State and approved by the EPA. The CAA requires sources to meet standards and obtain permits to satisfy those standards. Nuclear power plants may be required to comply with the CAA Title V, Sections 501–507, for sources subject to new source performance standards or sources subject to National Emission Standards for Hazardous Air Pollutants. EPA regulates the emissions of air pollutants using 40 CFR Parts 50 to 99.

Table B-1 Federal and State Requirements (cont.)

Law/regulation	Requirements
Water resources protection	
Clean Water Act, of 1972, as amended, 33 U.S.C. 1251 et seq., and the National Pollutant Discharge Elimination System (NPDES) (40 CFR 122)	The Clean Water Act (CWA) was enacted to "restore and maintain the chemical, physical, and biological integrity of the Nation's water." As authorized by the CWA, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. The NPDES program requires all facilities that discharge pollutants from any point source into waters of the United States to obtain an NPDES permit. A nuclear power plant may also participate in the NPDES General Permit for Industrial Stormwater due to stormwater runoff from industrial or commercial facilities to waters of the United States. EPA is authorized under the CWA to directly implement the NPDES program; however, EPA has authorized many States to implement all or parts of the national program. Section 401 of the CWA requires applicants for federal licenses or permits for activities that may result in discharge into navigable waters to provide a certification from the State that the permitted discharge would comply with all limitations necessary to meet established State water quality standards, treatment standards, or schedule of compliance. The U.S. Army Corps of Engineers (USACE) is the lead agency for enforcement of CWA wetland requirements (33 CFR Part 320, "General Regulatory Policies"). Under Section 401 of the CWA, the EPA or a delegated State agency has the authority to review and approve, condition, or deny all permits or licenses that might result in a discharge to waters of the State, including wetlands.
Coastal Zone Management Act of 1972, as amended 16 U.S.C. 1451 et seq.	Congress enacted the Coastal Zone Management Act (CZMA) in 1972 to address the increasing pressures of over-development upon the Nation's coastal resources. The National Oceanic and Atmospheric Administration administers the CZMA. The CZMA encourages States to preserve, protect, develop, and, where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. Participation by States is voluntary. To encourage States to participate, the CZMA makes Federal financial assistance available to any coastal State or territory, including those on the Great Lakes, as long as the State or territory is willing to develop and implement a comprehensive coastal management program.
25 Pa. Code Ch. 109. Pennsylvania Administrative Code	Title 25, Environmental Protection, Chapter 109, "Safe Drinking Water," establishes drinking water quality standards, permit requirements, design and construction standards, system management responsibilities and requirements for public notification.
25 Pa. Code Ch. 110. Pennsylvania Administrative Code	Title 25, Environmental Protection, Chapter 110, "Water Resources Planning," establishes the registration, monitoring, recordkeeping and reporting requirements for purposes of obtaining accurate information for water resources planning.
Wild and Scenic Rivers Act of 1968, as amended, 16 U.S.C. 1271 et seq.	The Wild and Scenic River Act created the National Wild and Scenic Rivers System, which was established to protect the environmental values of free flowing streams from degradation by impacting activities, including water resources projects.

Table B-1 Federal and State Requirements (cont.)

Law/regulation	Requirements
Waste management and pollution prevention	
Resource Conservation and Recovery Act of 1976, as amended, 42 U.S.C. 6901 et seq.	The Resource Conservation and Recovery Act (RCRA) requires the EPA to define and identify hazardous waste; establish standards for its transportation, treatment, storage, and disposal; and require permits for persons engaged in hazardous waste activities. Section 3006, "Authorized State Hazardous Waste Programs" (42 U.S.C. 6926), allows States to establish and administer these permit programs with EPA approval. EPA regulations implementing the RCRA are found in 40 CFR Parts 260 through 282. Regulations imposed on a generator or on a treatment, storage, and/or disposal facility vary according to the type and quantity of material or waste generated, treated, stored, or disposed. The method of treatment, storage, or disposal also impacts the extent and complexity of the requirements.
Pollution Prevention Act of 1990, 42 U.S.C. 13101 et seq.	The Pollution Prevention Act establishes a national policy for waste management and pollution control that focuses first on source reduction, then on environmental issues, safe recycling, treatment, and disposal.
Protected species	
Endangered Species Act of 1973, as amended, 16 U.S.C. 1531 et seq.	The Endangered Species Act (ESA) was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. Section 7, "Interagency Cooperation," of the ESA requires Federal agencies to consult with the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS) on Federal actions that may affect listed species or designated critical habitats.
50 CFR Part 17	Regulations in 50 CFR Part 17, "Endangered and Threatened Wildlife and Plants," implement the ESA.
50 CFR Part 402	Regulations in 50 CFR Part 402, "Interagency Cooperation - Endangered Species Act of 1973, as Amended," interprets and implements sections 7(a)-(d) of theESA regarding endangered or threatened species of fish, wildlife, or plants ("listed species") and habitats of such species that have been designated as critical ("critical habitat").
Magnuson–Stevens Fishery Conservation and Management Act of 1996, as amended 16 U.S.C. 1801–1884	The Magnuson–Stevens Fishery Conservation and Management Act (Magnuson–Stevens Act), governs marine fisheries management in U.S. Federal waters. The Magnuson–Stevens Act created eight regional fishery management councils and includes measures to rebuild overfished fisheries, protect Essential Fish Habitat, and reduce bycatch. Under Section 305 of the Magnuson–Stevens Act, Federal agencies are required to consult with the National Marine Fisheries Service for any Federal actions that may adversely affect Essential Fish Habitat.
58 Pa. Code Ch. 75. Pennsylvania Administrative Code	Title 58, Recreation, Chapter 75, "Endangered species," lists the species of fish, amphibians and reptiles and invertebrates that are classified as endangered or threatened. The catching, taking, killing, possessing, importing, exporting, or selling of any individual of these species, alive or dead, is prohibited without a special permit.

Table B-1 Federal and State Requirements (cont.)

Law/regulation	Requirements
Historic preservation and cultural resources	
National Historic Preservation Act of 1966, as amended 16 U.S.C. 470 et seq.	The National Historic Preservation Act (NHPA) was enacted to create a national historic preservation program, including the National Register of Historic Places and the Advisory Council on Historic Preservation (ACHP). Section 106 of the NHPA requires Federal agencies to take into account the effects of their undertakings on historic properties.
36 CFR Part 60	Regulations in 36 CFR Part 60, "National Register of Historic Places," establishes procedural requirements for listing properties on the National Register.
36 CFR Part 800	Regulations in 36 CFR Part 800, "Protection of Historic Properties," establish provisions for public involvement in the National Historic Preservation Act Section 106 consultation process, including involvement from Indian Tribes and other interested members of the public, as applicable.

B.2 Operating Permits and Other Requirements

Table B-2 lists the permits and licenses issued by Federal, State, and local authorities for activities at Peach Bottom, as identified in Chapter 9 of Exelon's environmental report submitted as part of its subsequent license renewal application and on the NRC public website.

Table B-2 Federal, State, and Local Permits and Other Requirements

Permit	Responsible Agency	Number	Expiration Date	Authorized Activity
		Federal Authorizations		
Licensing of nuclear power plant	NRC	DPR-44	Issue date: 05/07/2003 Expiration date: 08/08/2033	Operation of Unit 2
Licensing of nuclear power plant	NRC	DPR-56	Issue date: 05/07/2003 Expiration date: 07/02/2034	Operation of Unit 3
General license for storage of spent fuel at power reactor sites	NRC	General license	N/A	Storage of power reactor spent fuel and other associated radioactive materials in an ISFSI
Non-Project consumptive use of Conowingo Reservoir water	FERC	152 FERC ¶ 62,142	Issued on 9/2/2015 Indefinite until system is modified	Non-Project consumptive use of Conowingo Reservoir water

Table B-2 Federal, State, and Local Permits and Other Requirements (cont.)

Permit	Responsible Agency	Number	Expiration Date	Authorized Activity
		Federal Authorizations (cont.)		
Compliance with state water quality standards	EPA PDEP	PDEP 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)	Certification of compliance with state water quality standards
Operation of air emission sources	EPA PDEP	67-05020	Issued on 10/28/14; Expires on 10/31/19	Operation of air emission sources
		Commonwealth of Pennsylvania Authorizations		
Individual Discharge Permit	PDEP	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
Storage Tanks	PDEP	67-60412	Issued annually	Gasoline, used oil, hazardous substances, unlisted materials
Public Water Supply	PDEP	6709503	Issued: 9/22/2011 Indefinite (valid until system is modified)	Public Water Supply
Occupation of Submerged Lands of the Commonwealth	PDEP	E67-503	Indefinite (valid until system is modified)	Occupation of Submerged Lands of the Commonwealth
Hazardous waste generation	PDEP	PAD000798132	Not applicable	Hazardous waste generation
		Other States' Authorizations		
Radioactive waste shipments	Utah Department of Environmental Quality	0112001213	Renewed annually	Radioactive waste shipments to land disposal facility in Utah
		Local Authorizations		
Consumptive use of Conowingo Pond water	SRBC	Docket 20061209-1	Approved 6/23/2011; Expires on 7/3/2034	Consumptive use of Conowingo Pond water

Source: Exelon 2018a and https://www.nrc.gov/waste/spent-fuel-storage/licensing.html

APPENDIX C
CONSULTATION CORRESPONDENCE

C.1 Endangered Species Act Section 7 Consultation

As a Federal agency, the U.S. Nuclear Regulatory Commission (NRC) must comply with the Endangered Species Act of 1973, as amended (16 United States Code (U.S.C.) Section 1531 et seq.) (ESA), as part of any action authorized, funded, or carried out by the agency. In this case, the proposed agency action is whether to issue a renewed license for the continued operation of Peach Bottom Atomic Power Station, Units 2 and 3 (Peach Bottom), which would authorize operation for an additional 20 years beyond the current renewed license term. Under Section 7 of the ESA, the NRC must consult with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) (referred to jointly as "the Services" and individually as "Service"), as appropriate, to ensure that the proposed agency action is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat.

C.1.1 Federal Agency Obligations under Section 7 of the Endangered Species Act

The Endangered Species Act and the regulations that implement Section 7 of the ESA (Title 50 of the *Code of Federal Regulations* (50 CFR) Part 402, "Interagency Cooperation—Endangered Species Act of 1973, as Amended") describe the consultation process that Federal agencies must follow in support of agency actions. As part of this process, the Federal agency shall either request that the Services (1) provide a list of any listed or proposed species or designated or proposed critical habitats that may be present in the action area or (2) request that the Services concur with a list of species and critical habitats that the Federal agency has created (50 CFR 402.12(c)). If any such species or critical habitats may be present, the Federal agency prepares a biological assessment to evaluate the potential effects of the action and determine whether the species or critical habitat are likely to be adversely affected by the action (50 CFR 402.12(a); 16 U.S.C. 1536(c)). Biological assessments are required for any agency action that is a "major construction activity" (50 CFR 402.12(b)), which is defined as a construction project or other undertaking having construction-type impacts that is a major Federal action significantly affecting the quality of the human environment under the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321 et seq.)(NEPA) (51 FR 19926). Federal agencies may fulfill their obligations to consult with the Services under ESA Section 7 and to prepare a biological assessment, if required, in conjunction with the interagency cooperation procedures required by other statutes, including NEPA (50 CFR 402.06(a)). In such cases, the Federal agency should include the results of the ESA Section 7 consultation in the NEPA document (50 CFR 402.06(b)).

C.1.2 Biological Evaluation

License renewal does not require the preparation of a biological assessment because it is not a major construction activity. However, this supplemental environmental impact statement (SEIS) evaluates the potential impacts to federally listed species and critical habitats to support the NRC staff's Endangered Species Act Section 7 consultations with the Services. The NRC staff refers to these evaluations as biological evaluations.

The NRC staff structured its evaluations in accordance with the Services' suggested biological assessment contents described at 50 CFR 402.12(f). Section 3.8 of this SEIS describes the action area as well as the federally listed and proposed species and designated and proposed critical habitats potentially present in the action area. This section includes information pursuant to 50 CFR 402.12(f)(1), (2), and (3). Section 4.8 of this SEIS provides an assessment of the potential effects of the proposed Peach Bottom subsequent license renewal on the species and critical habitats present. Section 4.8 also contains the NRC's effect determinations, which are consistent with the Endangered Species Act conclusions described in Section 3.5 of the Endangered Species Consultation Handbook (FWS and NMFS 1998). Finally, Section 4.8 of this SEIS addresses cumulative effects and alternatives to the proposed action pursuant to 50 CFR 402.12(f)(4) and (5).

C.1.3 Chronology of Endangered Species Act Section 7 Consultation

<u>Endangered Species Act Section 7 Consultation with the U.S. Fish and Wildlife Service</u>

During its review of Exelon Generation, LLC's license renewal application, the NRC staff considered whether any federally listed, proposed, or candidate species or proposed or designated critical habitats may be present in the action area (as defined at 50 CFR 402.02, "Definitions," and described in Section 3.8.1.1, "Peach Bottom Action Area") for the proposed Peach Bottom subsequent license renewal. With respect to species under the U.S. Fish and Wildlife Service's jurisdiction, the NRC staff submitted project information to the Service's Environmental Conservation Online System (ECOS) Information for Planning and Conservation (IPaC) system to obtain a list of species in accordance with 50 CFR 402.12(c), "Request for Information." On September 10, 2018, the Service provided the NRC with a list of threatened and endangered species that may occur in the proposed action area. The list identified four species—bog turtle (*Clemmys muhlenbergii*), northern long-eared bat (*Myotis septentrionalis*), Indiana bat (*M. sodalis*), and rufa red knot (*Calidris canutus rufa*)—and stated that no critical habitats are within the project area under review. During communications with the Service, the NRC staff also determined that the Chesapeake logperch (*Percina bimaculata*), a species under review for listing, occurs in Conowingo Pond.

The NRC staff evaluated the potential impacts to the identified species in Section 3.8, "Special Status Species and Habitats," and Section 4.8, "Special Status Species and Habitats," of this SEIS. The NRC staff concludes that the proposed subsequent license renewal may affect, but is not likely to adversely affect, the northern long eared bat and the Indiana bat. The NRC staff concludes that the proposed subsequent license renewal would have no effect on the bog turtle and the rufa red knot. The NRC staff concludes that the proposed subsequent license renewal may affect the Chesapeake logperch. However, because the Chesapeake logperch is currently a candidate under U.S. Fish and Wildlife Service review for listing, Section 7 of the Endangered Species Act does not require the NRC to consult with the Service on this species for the proposed subsequent license renewal. No other listed species, proposed or candidate species, or proposed or designated critical habitats occur in the action area. The NRC staff will submit a copy of this draft SEIS, upon its issuance, to the Service for review accompanied by a request for the Service to concur with the NRC staff's "not likely to adversely affect" determinations for the northern long-eared bat and the Indiana bat in accordance with 50 CFR 402.12(j), "Submission of Biological Assessment."

Table C-1 lists the communications and correspondence between the NRC staff and U.S. Fish and Wildlife Service concerning the proposed Peach Bottom subsequent license renewal and compliance with Endangered Species Act Section 7. The NRC staff will update this table in the final SEIS to include any correspondence transpiring between the issuance of this draft SEIS and the final SEIS.

Table C-1 Endangered Species Act Section 7 Consultation Correspondence with the U.S. Fish and Wildlife Service

Date	Sender and Recipient	Description	ADAMS Accession No.[a]
September 10, 2018	Pennsylvania Ecological Services Field Office (FWS) to B. Grange (NRC)	List of threatened and endangered species for the Peach Bottom subsequent license renewal	ML18253A272
October 9, 2018	S. Jahrsdoerfer (FWS) to M. Ma (NRC)	Comments on NRC's notice of intent to prepare an environmental impact statement and conduct scoping process for Peach Bottom subsequent license renewal	ML18282A169
October 24, 2018	B. Grange (NRC)	Summary of October 24, 2018, teleconference between the NRC and FWS regarding Peach Bottom subsequent license renewal	ML18299A029

[a] Access these documents through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://adams.nrc.gov/wba/.

Endangered Species Act Section 7 Consultation with the National Marine Fisheries Service

With respect to species under the National Marine Fisheries Service's jurisdiction, the NRC staff requested information on listed species and critical habitats during a teleconference with Service staff in June 2018. The National Marine Fisheries Service stated that no listed species, proposed species, candidate species, or proposed or designated critical habitats under its jurisdiction occur within Conowingo Pond. However, Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*) and shortnose sturgeon (*Acipenser brevirostrum)*, both Federally listed as endangered, may occur downstream of Peach Bottom and below Conowingo Dam in lower portions of the Susquehanna River.

The NRC staff evaluated the potential impacts to these two species in Section 3.8, "Special Status Species and Habitats," and Section 4.8, "Special Status Species and Habitats," of this SEIS. In these sections, the NRC staff concludes that neither species occurs in the Peach Bottom action area and that the proposed subsequent license renewal would have no effect on either species. Federal agencies are not required to consult under Section 7 of the Endangered Species Act if they determine that an action will not affect listed species or critical habitats. Thus, the Endangered Species Act does not require the NRC to consult with the National Marine Fisheries Service for the proposed Peach Bottom subsequent license renewal. Accordingly, the NRC staff considers its obligations under Endangered Species Act Section 7 to be fulfilled with respect to species and habitats under this agency's jurisdiction.

Table C-2 lists the communications and correspondence between the NRC staff and National Marine Fisheries Service concerning the proposed Peach Bottom subsequent license renewal and compliance with Endangered Species Act Section 7. The NRC staff will update this table in the final SEIS to include any correspondence transpiring between the issuance of this draft SEIS and the final SEIS.

Table C-2 Endangered Species Act Section 7 Consultation Correspondence with the National Marine Fisheries Service

Date	Sender and Recipient	Description	ADAMS Accession No.[a]
February 15, 2019	M. Moser (NRC)	Summary of June 5, 2018, teleconference regarding federally listed species with the potential to occur near Peach Bottom	ML19046A035

[a] Access these documents through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://adams.nrc.gov/wba/.

C.2 Essential Fish Habitat Consultation

The NRC must comply with the Magnuson–Stevens Fishery Conservation and Management Act of 1996, as amended (16 U.S.C. Section 1801 et seq.), for any actions authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken that may adversely affect any Essential Fish Habitat (EFH) identified under the Magnuson–Stevens Act. In Section 3.8.2, "Species and Habitats Protected Under the Magnuson–Stevens Act," of this SEIS, the NRC staff considers whether any designated EFH occurs in or above Conowingo Pond. The NRC staff finds that although no designated EFH occurs in this area, the National Marine Fisheries Service and Atlantic States Marine Fisheries Commission have designated EFH near the mouth of the Susquehanna River for six federally managed species whose prey include anadromous fish that inhabit the lower Susquehanna River, including Conowingo Pond. These six species and relevant life stages are as follows:`

- Atlantic herring (*Clupea harengus*)—juveniles and adults
- clearnose skate (*Raja eglanteria*) —juveniles and adults
- little skate (*Leucoraja erinacea*) —adults
- red hake (*Urophycis chuss*) —all life stages
- windowpane flounder (*Scophthalmus aquosus*) —adults
- winter skate (*Leucoraja ocellata*) —juveniles and adults

In Section 4.8.1.4, "Species and Habitats Protected Under the Magnuson–Stevens Act," of this SEIS, the NRC staff evaluates whether effects on the anadromous prey fish of these six federally managed species could result in downstream effects within EFH-designated portions of the Susquehanna River. The NRC staff concludes that the proposed subsequent license renewal would have no effect on the designated EFH of Atlantic herring, clearnose skate, and red hake and no adverse effects on the designated EFH of little skate, windowpane flounder, and winter skate. The Magnuson–Stevens Act does not require Federal agencies to consult with the National Marine Fisheries Service for "no effect" and "no adverse effect" findings. Accordingly, the NRC staff considers its obligations under the Magnuson–Stevens Act to be fulfilled with respect to designated EFH for the proposed action.

C.3 National Historic Preservation Act Section 106 Consultation

The National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et seq.) (NHPA), requires Federal agencies to consider the effects of their undertakings on historic properties and consult with applicable State and Federal agencies, Tribal groups, individuals, and organizations with a demonstrated interest in the undertaking before taking action. Historic properties are defined as resources that are eligible for listing on the National Register of Historic Places. The historic preservation review process (Section 106 of the NHPA) is outlined in regulations issued by the Advisory Council on Historic Preservation (ACHP) in 36 CFR Part 800, “Protection of Historic Properties.” In accordance with 36 CFR 800.8(c), “Use of the NEPA Process for Section 106 Purposes,” the NRC has elected to use the NEPA process to comply with its obligations under NHPA Section 106. .

Table C-3 lists the chronology of consultation and consultation documents related to the NRC staff’s NHPA Section 106 review of the Peach Bottom subsequent license renewal. The NRC staff is required to consult with the State and Federal agencies and Tribal governments as identified in Section 1.8 of this SEIS in accordance with the statutes listed above.

Table C-3 National Historic Preservation Act Correspondence

Date	Sender and Recipient	Description	ADAMS Accession No. [(a)]
September 10, 2018	B. Beasley (NRC) to E. Butler-Wolfe, Absentee-Shawnee Tribe of Oklahoma	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to C. Halftown, Cayuga Nation	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to D. Dotson, Delaware Nation	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to C.L. Brooks, Delaware Tribe of Indians	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to G.J. Walla, Eastern Shawnee Tribe of Oklahoma	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to R. Halbritter, Oneida Indian Nation	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to T. Hill, Oneida Nation	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to Council of Chiefs, Onondaga Nation	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B Beasley (NRC) to T. Gates, Seneca Nation of Indians	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to W.L. Fisher, Seneca-Cayuga Nation	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to Tribal Chiefs, St. Regis Mohawk Tribe	Request for scoping comments/notification of Section 106 review	ML18243A456

Table C-3 National Historic Preservation Act Correspondence (cont.)

Date	Sender and Recipient	Description	ADAMS Accession No. [(a)]
September 10, 2018	B. Beasley (NRC) to R. Sparkman, Shawnee Tribe	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to S. Holsey, Stockbridge-Munsee Community	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to R. Hill, Tonawanda Band of Seneca	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to L. Henry, Tuscarora Nation	Request for scoping comments/notification of Section 106 review	ML18243A456
September 10, 2018	B. Beasley (NRC) to A. MacDonald, Pennsylvania State Historic Preservation Office	Request for scoping comments/notification of Section 106 review	ML18243A454
September 10, 2018	B. Beasley (NRC) to R. Nelson, Advisory Council on Historic Preservation	Request for scoping comments/notification of Section 106 review	ML18243A453
October 1, 2018	D. McLearen, Pennsylvania State Historic Preservation Office to B. Beasley (NRC)	Re: Request for scoping comments/notification of Section 106 review	ML18299A124

[(a)] Access these documents through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://adams.nrc.gov/wba/.

APPENDIX D
CHRONOLOGY OF CORRESPONDENCE

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) and external parties as part of the agency's environmental review of the Peach Bottom Atomic Power Station Units 2 and 3 (Peach Bottom or Peach Bottom Units 2 and 3) subsequent license renewal application. This appendix does not include consultation correspondence or comments received during the scoping process. For a list and discussion of consultation correspondence, see Appendix C, "Consultation Correspondence," of this supplemental environmental impact statement (SEIS). For scoping comments, see Appendix A, "Comments Received on the Peach Bottom Atomic Power Station Units 2 and 3 Environmental Review," of this SEIS and the NRC's scoping summary report (NRC 2019a). All documents are available electronically from the NRC's Public Electronic Reading Room at http://www.nrc.gov/reading-rm.html. From this site, the public can access the Agencywide Documents Access and Management System (ADAMS), which provides text and image files of the NRC's public documents. The ADAMS accession number for each document is included in the following table.

D.1 Environmental Review Correspondence

Table D-1 lists the environmental review correspondence, by date, beginning with the request by Exelon Generation Company, LLC (Exelon) for subsequent license renewal of the operating licenses for Peach Bottom Units 2 and 3.

Table D-1 Environmental Review Correspondence

Date	Correspondence Description	ADAMS Accession No.
July 10, 2018	Peach Bottom Units 2 and 3—Submittal of Subsequent License Renewal Application	ML18193A689
July 10, 2018	Peach Bottom Units 2 and 3—Submittal of CDs and Paper Copies of Subsequent License Renewal Application	ML18193A699
July 24, 2018	Peach Bottom Units 2 and 3, Subsequent License Renewal Application—Letter from Exelon redacting one figure	ML18205A311
August 1, 2018	Receipt and Availability of the Subsequent License Renewal Application for the Peach Bottom Units 2 and 3	ML18191B175
August 27, 2018	Determination of Acceptability and Sufficiency for Docketing, Proposed Review Schedule, and Opportunity for a Hearing Regarding the Application from Exelon for Subsequent Renewal of the Peach Bottom Units 2 and 3	ML18191B085
September 5, 2018	Peach Bottom Units 2 and 3, Subsequent License Renewal Application Online Reference Portal	ML18214A383
September 10, 2018	Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process for Peach Bottom Subsequent License Renewal Application	ML18232A438
September 14, 2018	Peach Bottom Units 2 and 3, Subsequent License Renewal Application—Supplement 1	ML18257A143
October 25, 2018	Site Environmental Audit Plan for the Peach Bottom Subsequent License Renewal Application Review	ML18289A379

Table D-1 Environmental Review Correspondence (cont.)

Date	Correspondence Description	ADAMS Accession No.
November 6, 2018	In-Office Severe Accident Mitigation Alternatives Audit Plan for the Peach Bottom Subsequent License Renewal Application Review	ML18304A200
November 23, 2018	Requests for Additional Information for the Environmental Review of the Peach Bottom Subsequent License Renewal Application	ML18330A157
December 13, 2018	Requests for Additional Information for the Severe Accident Mitigation Alternatives Assessment of the Peach Bottom Subsequent License Renewal Application	ML18348B029
December 20, 2018	Responses to Requests for Additional Information for the Environmental Review	ML18354B061 ML18354B066
January 28, 2019	Responses to Requests for Additional Information for the Severe Accident Mitigation Alternatives Assessment	ML19028A280
January 31, 2019	Peach Bottom Units 2 and 3—Summary of the Site Environmental Audit	ML18346A675
February 5, 2019	Peach Bottom Units 2 and 3—Summary of the In-Office Severe Accident Mitigation Alternatives Audit	ML19023A227
July 2019	Environmental Scoping Summary Report Associated with the Staff's Review of the Peach Bottom Units 2 and 3 Subsequent License Renewal Application	ML19037A348

APPENDIX E
ENVIRONMENTAL IMPACTS OF POSTULATED ACCIDENTS

This appendix describes the environmental impacts from postulated accidents that may occur at Peach Bottom Atomic Power Stations Units 2 and 3 (Peach Bottom or Peach Bottom Units 2 and 3) during the subsequent renewal license period. The term “accident” refers to any unintentional event outside normal plant operations that could result in either (a) an unplanned release of radioactive materials into the environment or (b) the potential for an unplanned release of radioactive materials into the environment. NUREG-1437, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants” (GEIS) (NRC 1996, 2013a), evaluates in detail the following two classes of postulated accidents as they relate to license renewal:

- Design-Basis Accidents: Postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety.
- Severe Accidents: Postulated accidents that are more severe than design-basis accidents because they could result in substantial damage to the reactor core, whether or not there are serious offsite consequences.

This appendix first describes the evaluation of new and significant information related to design-basis accidents. This is followed by an evaluation of new and significant information for severe accidents at Peach Bottom Units 2 and 3.

E.1 Background

Although this supplemental environmental impact statement documents the NRC staff’s review of a subsequent license renewal application, it is helpful to keep in mind that long before any license renewal actions, an operating reactor has already completed the NRC licensing process for the original 40-year operating license. To receive a license to operate a new nuclear power reactor, an applicant must submit to the NRC an operating license application that includes, among many other requirements, a safety analysis report. The applicant’s safety analysis report presents the design criteria and design information for the proposed reactor and includes comprehensive data on the proposed site. The applicant’s safety analysis report also describes various design-basis accidents and the safety features designed to prevent or mitigate their impacts. The NRC staff reviews the operating license application to determine if the plant’s design—including designs for preventing or mitigating accidents—meet the NRC’s regulations and requirements.

E.1.1 Design-Basis Accidents

Design-basis accidents are postulated accidents that a nuclear facility must be designed and built to withstand without loss to the systems, structures, and components necessary to ensure public health and safety. Planning for design-basis accidents ensures that the proposed plant can withstand normal transients (rapid changes in the reactor coolant system temperature or pressure, or rapid changes in reactor power), as well as a broad spectrum of postulated accidents without undue hazard to the health and safety of the public. Many of these design-basis accidents may occur but are unlikely to occur even once during the life of the plant; nevertheless, carefully evaluating each design-basis accident is crucial to establishing the design basis for the preventive and mitigative safety systems of the proposed nuclear power plant. Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 100, "Reactor Site Criteria," describe the NRC's acceptance criteria for design-basis accidents.

Before the NRC will issue an operating license for a new nuclear power plant, the applicant must demonstrate the ability of its proposed reactor to withstand all design-basis accidents. The applicant and the NRC staff evaluate the environmental impacts of design-basis accidents for the hypothetical maximum-exposed individual. The results of these evaluations of design-basis accidents are found in the reactor's original licensing documents such as the applicant's final safety analysis report, the NRC staff's safety evaluation report, and the final environmental statement. Once the NRC issues the operating license for the new reactor, the licensee is required to maintain the acceptable design and performance criteria (which includes withstanding design-basis accidents) throughout the operating life of the nuclear power plant, including any license renewal periods of extended operation. The consequences for design-basis accidents are evaluated for the hypothetical maximum-exposed individual; as such, changes in the plant environment will not affect these evaluations.

The NRC regulation, 10 CFR 54.29(a), requires license renewal applicants to demonstrate that identified actions have been or will be taken to manage the effects of aging and perform any required time -limited aging analyses (as further described in the regulation), such that there is reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the plant's current licensing basis (CLB). Furthermore, the applicant must show that any changes made to the plant's CLB in order to comply with paragraph (a) of 10 CFR 54.29, "Standards for Issuance of a Renewed License," are in accordance with the Atomic Energy Act and the NRC's regulations. In other words, because of the requirements that the existing design basis and aging management programs be in effect for license renewal, the environmental impacts of design-basis accidents as calculated for the original operating license application should not differ significantly from the environmental impacts of design-basis accidents at any other time during plant operations, including during the initial license renewal and subsequent renewal periods. Accordingly, the design of the nuclear power plant, relative to design-basis accidents during the period of extended operation, is considered to remain acceptable.

E.1.2 Design-Basis Accidents and License Renewal

The early identification and resolution of the design-basis accidents (prior to subsequent license renewal) makes them a part of the CLB of the plant. The NRC requires licensees to maintain the CLB of the plant under the current operating license, as well as during any license renewal period. Therefore, under the provisions of 10 CFR 54.30, "Matters not Subject to a Renewal Review," design-basis accidents are not subject to review under license renewal.

As stated in Section 5.3.2 of the 1996 GEIS, the NRC staff assessed the environmental impact from design-basis accidents in the individual plant-specific EISs at the time of the initial license application review. Since the licensee is required to maintain the plant within acceptable design and performance criteria, including during any license renewal term, the NRC staff would not expect environmental impacts to change significantly. Therefore, additional assessment of the environmental impacts from design-basis accidents is not necessary (NRC 2013a).

The GEIS concludes that the environmental impacts of design-basis accidents are of SMALL significance for all nuclear power plants because the plants were designed to withstand these accidents. For the purposes of initial or subsequent license renewal, the NRC designates design-basis accidents as a Category 1 generic issue—applicable to all nuclear power plants (see 10 CFR Part 51, Subpart A, Appendix B, Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants"). During the license renewal review process, the NRC staff adopts the applicable Category 1 issue conclusions from the GEIS (unless there exists new and significant information about the issue). Hence, the NRC staff need not address most Category 1 issues (like design-basis accidents) in the site-specific supplemental environmental impact statement for license renewal, unless new and significant information exists for those issues.

In its environmental report for the Peach Bottom subsequent license renewal application, Exelon Generation Company, LLC (Exelon) did not identify any new and significant information related to design-basis accidents at Peach Bottom (Exelon 2018a). The NRC staff also did not identify any new and significant information related to design-basis accidents during its independent review of Exelon's environmental report, through the scoping process, or in its evaluation of other available information. Therefore, the NRC staff concludes that there are no environmental impacts related to design-basis accidents at Peach Bottom during the subsequent license renewal period beyond those already discussed generically for all nuclear power plants in the GEIS.

E.1.3 Severe Accidents

Severe accidents are postulated accidents that are more severe than design-basis accidents because severe accidents can result in substantial damage to the reactor core, whether or not there are serious offsite consequences. Severe accidents can entail multiple failures of equipment or function. The likelihood of a severe accident occurring is generally even lower than the likelihood of a design-basis accident occurring.

E.1.4 Severe Accidents and License Renewal

Chapter 5 of the 1996 GEIS (NUREG-1437) conservatively predicts the environmental impacts of postulated severe accidents that may occur during the period of extended operations at nuclear power plants. In the 2013 GEIS, the staff updated the NRC's 1996 plant-by-plant severe accident environmental impact assessments (NRC 2013a, Appendix E). In the GEIS, the NRC considered impacts of severe accidents including:

- dose and health effects of accidents
- economic impacts of accidents
- effect of uncertainties on the results

The NRC staff calculated these estimated impacts by studying the risk analysis of severe accidents as reported in the environmental impact statements (EISs) and/or final environmental statements that the NRC staff had prepared for each of the plants in support of their original reactor operating licenses. When the NRC staff prepared the 1996 GEIS, 28 nuclear power plant sites (44 units) had EISs or final environmental statements that contained a severe accident analysis. Not all original operating reactor licenses contain a severe accident analysis because the NRC has not always required such analyses. The 1996 GEIS assessed the environmental impacts of severe accidents during the license renewal period for all plants by using the results of existing analyses and site-specific information to make conservative predictions. With few exceptions, the severe accident analyses evaluated in the 1996 GEIS were limited to consideration of reactor accidents caused by internal events. The 1996 GEIS addressed the impacts from external events qualitatively.

For its severe accident environmental impact analysis for each plant, the 1996 GEIS used very conservative 95th percentile upper confidence bound estimates for environmental impact whenever available. This approach provides conservatism to cover uncertainties, as described in Section 5.3.3.2.2 of the 1996 GEIS. The 1996 GEIS concluded that the probability-weighted impacts of severe accidents as related to license renewal are SMALL compared to other risks to which the populations surrounding nuclear power plants are routinely exposed. Since issuing the 1996 GEIS, the NRC's understanding of severe accident risk has continued to evolve. The updated 2013 GEIS assesses more recent information and developments in severe accident analyses and how they might affect the conclusions in Chapter 5 of the 1996 GEIS. The 2013 GEIS also provides comparative data where appropriate. Based on information in the 2013 GEIS, the NRC staff determined that for all nuclear power plants, the probability-weighted consequences of severe accidents are SMALL. However, the GEIS determined that alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives as a Category 2 issue. See Table B-1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants," of Appendix B to Subpart A of 10 CFR Part 51, which states:

> 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.

An analysis of severe accident mitigation alternatives was performed for Peach Bottom at the time of initial license renewal. The staff documented its review in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 10, Regarding Peach Bottom Units 2 and 3," issued January 2003. For the Peach Bottom subsequent license renewal severe accident mitigation alternatives analysis, the NRC staff considered any new and significant information that might alter the conclusions of that analysis, as discussed below.

E.2 Severe Accident Mitigation Alternatives

In a severe accident mitigation alternatives (SAMA) analysis, the NRC requires license renewal applicants to consider the environmental impacts of severe accidents, their probability of occurrence, and potential means to mitigate those accidents. As quoted above, 10 CFR Part 51, Table B-1 states, "alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives." This NRC requirement to consider alternatives to mitigate severe accidents can be fulfilled by a SAMA analysis. The purpose of the SAMA analysis is to identify design alternatives, procedural modifications, or training activities that may further reduce the risks of severe accidents at nuclear power plants and that are also potentially cost beneficial to implement. The SAMA analysis includes the identification and evaluation of SAMAs that may reduce the radiological risk from a severe accident by preventing substantial core damage (i.e., preventing a severe accident) or by limiting releases from containment if substantial core damage occurs (i.e., mitigating the impacts of a severe accident) (NRC 2013a). The regulation, 10 CFR 51.53(c)(3)(ii)(L), states that each license renewal applicant must submit an environmental report that considers alternatives to mitigate severe accidents, "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."

E.2.1 Peach Bottom Initial License Renewal Application and SAMA Analysis in 2001

As part of its initial license renewal application submitted in 2001, Exelon's environmental report included an analysis of SAMAs for Peach Bottom Units 2 and 3 (Exelon 2001). Exelon based this SAMA analysis on (1) the Peach Bottom probabilistic risk assessment (PRA) for total accident frequency, core damage frequency (CDF), and containment large early release frequency (LERF), and (2) a supplemental analysis of offsite consequences and economic impacts for risk determination provided in NUREG/CR-4551, Volume 4, Rev 0. The Peach Bottom PRA included a Level 1 analysis to determine the CDF from internally initiated events and a Level 2 analysis to determine containment performance during severe accidents. The Level 3 PRA determined the offsite risk impacts on the surrounding environment and the public. Inputs for the latter analysis included plant- or site-specific values for core radionuclide inventory, source term and release fractions, meteorological data, projected population distribution (based on 1990 census data, projected out to 2034), emergency response evacuation modeling, and economic data. To help identify and evaluate potential SAMAs, Exelon considered insights and recommendations from SAMA analyses for other plants, potential plant improvements discussed in NRC and industry documents, and documented insights provided by Peach Bottom staff.

In its 2001 environmental report for initial Peach Bottom license renewal, Exelon considered 204 potential SAMA candidates. Exelon then performed a qualitative screening of those SAMAs, eliminating SAMAs that were not applicable to Peach Bottom, had already been implemented at Peach Bottom, were related to phenomena that are not risk significant in boiling-water reactors (BWRs), or were similar to other SAMAs being considered. This screening left 30 unique SAMA candidates (Table G.4-2 of Exelon's 2001 environmental report) that were potentially applicable to Peach Bottom and were of potential value in averting the risk of severe accidents (Exelon 2001). Section G.5 of Exelon's 2001 environmental report describes the process it used to disposition the remaining SAMAs and the results. Table G.6-1 of Exelon's 2001 environmental report summarizes the results of the detailed analyses that Exelon performed for the SAMA candidates. Ultimately, Exelon concluded that none of the SAMA candidates would yield a significant reduction in public risk relative to the cost required to implement the SAMA. Exelon identified no plant changes or modifications for implementation or further review at Peach Bottom.

As part of the NRC staff's review of the initial Peach Bottom license renewal application, the NRC staff reviewed Exelon's 2001 analysis of SAMAs for Peach Bottom and documented this review in its SEIS, which the NRC published in 2003- (NRC 2003a). Chapter 5 of Supplement 10 to NUREG-1437 contains the NRC staff's evaluation of the potential environmental impacts of plant accidents and examines each SAMA (individually and, in some cases, in combination) to determine the SAMA's individual risk reduction potential. The NRC staff then compared this potential risk reduction against the cost of implementing the SAMA to quantify the SAMA's cost-benefit value.

In Section 5.2 of the NRC's 2003 SEIS for the initial Peach Bottom license renewal (NUREG-1437, Supplement 10), the NRC staff found that Exelon used a systematic and comprehensive process for identifying potential plant improvements for Peach Bottom, and that its bases for calculating the risk reductions afforded by these plant improvements were reasonable. In the NRC's 2003 SEIS, the NRC staff concluded that Exelon's SAMA methods and implementation of those methods were sound and concluded that none of the SAMA candidates would be cost beneficial. The staff found its conclusion consistent with the low residual level of risk indicated in the Peach Bottom probabilistic safety assessment. The staff also found Exelon's conclusion reasonable since Peach Bottom had already implemented many plant improvements identified during two risk analysis processes: (1) the individual plant examination (IPE), a risk analysis that considers the unique aspects of a particular nuclear power plant, identifying the specific vulnerabilities to severe accident of that plant, and (2) the individual plant examination for external events (IPEEE), a risk analysis that considers external events such as earthquakes, internal fires, and high winds (NRC 2003a).

E.2.2 Peach Bottom 2018 Subsequent License Renewal Application and New and Significant Information as It Relates to the Probability-Weighted Consequences of Severe Accidents

As mentioned above, a license renewal application must include an environmental report that describes SAMAs if the NRC staff has not previously evaluated SAMAs for that plant in an environmental impact statement (EIS), in a related supplement to an EIS, or in an environmental assessment. Also discussed above, the NRC staff performed a site-specific analysis of Peach Bottom SAMAs in NUREG-1437, Supplement 10 (NRC 2003a). Therefore, in accordance with 10 CFR 51.53(c)(3)(ii)(L) and Table B-1 of Appendix B to Subpart A of 10 CFR Part 51, Exelon was not required to provide another SAMA analysis in its environmental report for the Peach Bottom subsequent license renewal application.

The NRC's regulations in 10 CFR Part 51, which implement Section 102(2) of the National Environmental Policy Act (NEPA), require that all applicants for license renewal submit an environmental report to the NRC in which they identify 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)). This includes new and significant information that could affect the environmental impacts related to postulated severe accidents or that could affect the results of a previous SAMA analysis. Accordingly, in its subsequent license renewal application environmental report, Exelon evaluates areas of new and significant information that could affect the environmental impact of postulated severe accidents during the subsequent license renewal period of extended operation, and possible new and significant information as it relates to SAMAs.

In Exelon's assessment of new and significant information related to SAMAs in its subsequent license renewal application, Exelon used recently issued Nuclear Energy Institute (NEI) guidance, which the NRC staff has endorsed (NRC 2018e). As discussed in Section E-5 below, NEI developed a model approach for license renewal applicants to use in assessing the significance of new information, of which the applicant is aware, that relates to a prior SAMA analysis that was performed in support of the issuance of an initial license, renewed license, or combined license. This effort led to the publication of NEI 17-04, Revision 0, "Model SLR New and Significant Assessment Approach for SAMA," on June 29, 2017 (NEI 2017). NEI 17-04 provides a tiered approach that entails a three-stage screening process for the evaluation of new information. Details regarding this screening process is provided in Section E.5. The NRC staff endorsed NEI 17-04 for use by license renewal applicants on January 31, 2018 (NRC 2018e). Exelon's assessment of new and significant information related to its SAMA cost-benefit analysis is discussed in Section E.5 of this appendix.

Below, the NRC staff summarizes possible areas of new and significant information and assesses Exelon's conclusions.

E.3 Evaluation of New Information Concerning Severe Accident Consequences for Peach Bottom as It Relates to the GEIS

The 2013 GEIS considers developments in plant operation and accident analysis that could have changed the assumptions made in the 1996 GEIS concerning severe accident consequences. The 2013 GEIS confirmed the determination in the 1996 GEIS that the probability-weighted consequences of severe accidents are SMALL for all plants. In the 2013 GEIS, Appendix E provides the NRC staff's evaluation of the environmental impacts of postulated accidents. Table E-19, "Summary of Conclusions," of the 2013 GEIS shows the developments that the NRC staff considered as well as the staff's conclusions. Consideration of the listed items was the basis for the NRC staff's overall determination in the 2013 GEIS that the probability-weighted consequences of severe accidents remain SMALL for all plants.

For subsequent license renewal for Peach Bottom, the staff confirmed that there is no new and significant information that would change the 2013 GEIS or the 2003 Peach Bottom SEIS conclusions on the consequences of severe accidents. The NRC staff evaluated Exelon's information related to the 2013 GEIS, Table E-19, "Summary of Conclusions," during the Peach Bottom audit and by reviewing docketed information (NRC 2019c). The results of that review follow.

E.3.1 New Internal Events Information (Section E.3.1 of the 2013 GEIS)

After Exelon submitted the Peach Bottom initial license renewal application environmental report in 2001 and the NRC staff issued its corresponding SAMA review in its 2003 SEIS, there have been many improvements to Peach Bottom's risk profile. The core damage frequency (CDF) is an expression of the likelihood that, given the way a reactor is designed and operated, an accident could cause the fuel in the reactor to be damaged. The Peach Bottom internal events CDF in the initial license renewal SAMA was approximately $4.5x10^{-6}$/year. Notably, the Peach Bottom initial license renewal SAMA CDF is more than an order of magnitude less than the mean boiling-water reactor (BWR) internal event (full power) CDF of $5.4x10^{-5}$/year provided in Table E-2 of the 2013 GEIS. The current Peach Bottom internal events PRA model of record has a CDF of approximately $3.12x10^{-6}$/year. This change represents a factor-of-17 reduction in CDF for each Peach Bottom unit since the previous license renewal application.

In the 2013 GEIS, the NRC staff reviewed the updated BWR and pressurized-water reactor (PWR) internal event CDFs. The 2013 GEIS addresses new information on the risk and environmental impacts of severe accidents caused by internal events that had emerged following issuance of the 1996 GEIS and included consideration of Peach Bottom's plant-specific PRA analysis. The new information addressed in the 2013 GEIS indicates that PWR and BWR CDFs evaluated for the 2013 GEIS are generally comparable to or less than the CDFs that formed the basis of the 1996 GEIS (NRC 2013a).

Therefore, the NRC staff concludes that the offsite consequences of severe accidents initiated by internal events during the subsequent license renewal term at Peach Bottom would not exceed the impacts predicted in the 2013 GEIS. For these issues, the GEIS predicted that the impacts would be small for all nuclear plants. The NRC staff identified no new and significant information regarding internal events during its review of Exelon's environmental report, during the SAMA audit, through the scoping process, or through the evaluation of other available information. Thus, the NRC staff finds acceptable Exelon's conclusion that no new and significant information exists for Peach Bottom concerning offsite consequences of severe accidents initiated by internal events that would alter the conclusions reached in the 2013 GEIS.

E.3.2 External Events (Section E.3.2 of the 2013 GEIS)

Section E.3.2.3 of the 2013 GEIS concludes that the CDFs from severe accidents initiated by external events, as quantified in NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants" (NRC 1990), and other sources, are comparable to CDFs from accidents initiated by internal events but lower than the CDFs that formed the basis for the 1996 GEIS. In the 2013 GEIS, the environmental impacts from externally initiated events are generally significantly lower—one or more orders of magnitude lower—than the environmental impacts from external events determined in the 1996 GEIS.

The 1996 GEIS concluded that severe accidents initiated by external events (such as earthquakes or fires) could have potentially high consequences but also found that the risks from these external events are adequately addressed through a consideration of severe accidents initiated by internal events (such as a loss of cooling water). Therefore, the 1996 GEIS concluded that an applicant for license renewal need only analyze the environmental impacts from an internal event to characterize the environmental impacts from either internal or external events.

The fire and seismic CDFs ($4.1x10^{-5}$ per reactor-year and $8.3x10^{-6}$ per reactor-year, respectively) for Peach Bottom as well as the sum of the two, were less than $5.4x10^{-5}$ per reactor-year. This value ($5.4x10^{-5}$) was the internal events mean value CDF for BWRs that the 2013 GEIS used to estimate probability-weighted, offsite consequences from airborne, surface water, and groundwater pathways, as well as the resulting economic impacts from such pathways. Exelon also evaluated the effect of implementing FLEX strategies at Peach Bottom to address safety issues brought to light by the 2011 Fukushima incident in Japan, which have not been incorporated into current CDF values. From this evaluation, Exelon concluded that, if Peach Bottom FLEX strategies were credited in PRA models, the credit would reduce the overall risk calculated in the fire and seismic PRA models.

In conclusion, there was a greater-than-a-factor-of-17 decrease in the Peach Bottom internal events CDF from those calculated in the previous license renewal application, and seismic and fire risk for Peach Bottom was determined to be within the values calculated in the GEIS. Therefore, the offsite consequences of severe accidents initiated by external events during the subsequent license renewal term would not exceed the impacts predicted in the GEIS. For these issues, the GEIS predicts that the impacts would be small for all nuclear plants. The NRC staff identified no new and significant information regarding external events during its review of Exelon's environmental report, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff concludes that no new and significant information exists for Peach Bottom concerning offsite consequences of severe accidents initiated by external events that would alter the conclusions reached in the 2013 GEIS.

E.3.3 New Source Term Information (Section E.3.3 of the 2013 GEIS)

The source term refers to the magnitude and mix of the radionuclides released from the fuel (expressed as fractions of the fission product inventory in the fuel), as well as their physical and chemical form, and the timing of their release following an accident. The 2013 GEIS concludes that, in most cases, more recent estimates give significantly lower release frequencies and release fractions than was assumed in the 1996 GEIS. Specifically, the 2013 GEIS states that "a comparison of population dose from newer assessments illustrates a reduction in impact by a factor of 5 to 100 when compared to older assessments, and an additional factor of 2 to 4 due to the conservatism built into the 1996 GEIS values." Thus, the environmental impacts of radioactive materials released during severe accidents, used as the basis for the 1996 GEIS (i.e., the frequency-weighted release consequences), are higher than the environmental impacts that would be estimated today using more recent source term information. The NRC staff also notes that results from the NRC's State-of-the-Art Reactor Consequence Analysis (SOARCA) project (which represents a significant ongoing effort to quantify realistic severe accident source terms) confirm that source term timing and magnitude values estimated in the SOARCA studies are significantly lower than those quantified in previous studies. The NRC staff expects to incorporate the information gleaned from the SOARCA project in future revisions of the GEIS (NRC 2013a). For this assessment, the NRC staff conservatively estimates the reduction in impact by a factor of 5 when compared to older assessments and an additional factor of 2 due to the conservatism built into the 1996 GEIS.

For the reasons described above, current source term timing and magnitude at Peach Bottom is likely to be significantly lower than had been quantified in previous studies and the initial license renewal Peach Bottom SAMA analysis in 2001. Therefore, the offsite consequences of severe accidents initiated by the new source term during the subsequent license renewal term would not exceed the impacts predicted in the GEIS. For these issues, the GEIS predicts that the impacts would be small for all nuclear plants. The NRC staff identified no new and significant information regarding internal events during its review of Exelon's environmental report, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff concludes that no new and significant information exists for Peach Bottom concerning offsite consequences of severe accidents initiated by internal events that would alter the conclusions reached in the 2013 GEIS.

E.3.4 Power Uprate Information (Section E.3.4 of the 2013 GEIS)

Operating at a higher reactor power level results in a larger fission product radionuclide inventory in the core than if the reactor were operating at a lower power level. In the event of an accident, the larger radionuclide inventory in the core would result in a larger source term. If the accident is severe, this larger source term could result in higher doses to offsite populations.

Large early release frequency (LERF) represents the frequency of event sequences that could result in early fatalities. The impact of a power uprate on early fatalities can be measured by considering the impact of the uprate on the LERF calculated value. To this end, Table E-14 of the 2013 GEIS presents the change in LERF calculated by each licensee that has been granted a power uprate of greater than 10 percent. Table E-14 shows that the increase in LERF ranges from a minimal impact to an increase of about 30 percent (with a mean of 10.5 percent). The 2013 GEIS, Section E.3.4.3, "Conclusion," determines that power uprates will result in a small to (in some cases) moderate increase in the environmental impacts from a postulated accident. However, taken in combination with the other information presented in the GEIS, the increases would be bounded by the 95 percent upper confidence bound values in Table 5.10 and Table 5.11 of the 1996 GEIS. The NRC staff requested additional information from Exelon regarding power uprates and LERF (NRC 2018n).

The NRC approved a 12.4 percent extended power uprate (EPU) for Peach Bottom Units 2 and 3 on August 25, 2014 (NRC 2014c). Before the EPU, Exelon calculated the Peach Bottom Unit 2 internal events LERF to be 4.6×10^{-7} /year. After the EPU, Exelon conservatively projected the Unit 2 LERF to be 4.7×10^{-7} /year. This is a change of approximately 1.0×10^{-8}/year, or an increase in LERF of about 2 percent. Exelon and the NRC evaluated the effects of the uprates in the EPU license amendment request (Exelon 2012b) and the EPU safety evaluation

(NRC 2014c), respectively. The NRC staff's safety evaluation on this EPU at Peach Bottom states that this increase in LERF falls within the acceptance guidelines for being "very small" (i.e., less than $1x10^{-7}$ per reactor year) as defined in Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment In Risk Informed Decisions on Plant Specific Changes to the Licensing Basis," and therefore does not raise any concerns of adequate protection (NRC 2014c).

In March 2016, the NRC approved another license amendment request in which Exelon reported increases in CDF and LERF due to the transition of plant operation from the Maximum Extended Load Line Limit Analysis (MELLLA) domain to the expanded MELLLA Plus (MELLLA+) domain. The reported increases were determined using a plant-specific PRA in which the generic risk discussion was augmented with plant-specific information on initiating event frequencies, component reliability, operator response, success criteria, external events, shutdown risk, and PRA quality. The increases were $3.6x10^{-8}$ per year, or 7 percent for LERF, primarily due to slight changes to human error probabilities associated with anticipated transients without scram sequences. The NRC staff concluded that these expected increases in risk at Peach Bottom would be well within the risk acceptance guidelines defined by Regulatory Guide 1.174 (NRC 2016b).

In the safety evaluation for a license amendment request regarding a 1.62 percent measurement uncertainty recapture (MUR) power uprate for Peach Bottom (Exelon 2017g), Exelon reviewed and determined that the Peach Bottom probabilistic risk assessment would not need to be updated because the change in plant risk due to the MUR power uprate would be insignificant. This conclusion is supported by NRC Regulatory Issue Summary (RIS) 2002-03, "Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications" (NRC 2002). The NRC staff's safety evaluation on the MUR power uprate concluded that the CLB dose consequence analyses for design-basis accidents will remain bounding at the proposed MUR uprated power level with a margin that is within the assumed uncertainty associated with the leading-edge flow meter system (NRC 2017b).

In sum, the NRC staff finds that the conclusions of the 2013 GEIS regarding power uprates are appropriate for the Peach Bottom subsequent license renewal application. As noted above, LERF increased by 3.5 percent due to the EPU. The reported increase in LERF due to the transition to a MELLLA+ domain was 7.7 percent. MUR increases in LERF were not quantified but are characterized as "insignificant." Accordingly, the change to LERF is bounded by the 30 percent increase specified in Table E-14 of the 2013 GEIS. The NRC staff has identified no new and significant information regarding power uprates during its review of Exelon's environmental report, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff concludes that no new and significant information exists for Peach Bottom concerning offsite consequences due to power uprates that would alter the conclusions reached in the 2013 GEIS.

E.3.5 Higher Fuel Burnup Information (Section E.3.5 of the 2013 GEIS)

According to the 2013 GEIS, increased peak fuel burnup from 42 to 75 gigawatt days per metric ton uranium (GWd/MTU) for PWRs, and 60 to 75 GWd/MTU for BWRs, results in small to moderate increases (up to 38 percent) in environmental impacts in the event of a severe accident. However, taken in combination with the other information presented in the 2013 GEIS, the increases would be bounded by the 95 percent upper confidence bound values in Table 5.10 and Table 5.11 of the 1996 GEIS.

In response to a staff RAI (NRC 2018n), Exelon indicated that it has no plan to increase average peak rod fuel burnup beyond 62 GWd/MTU for either Peach Bottom unit during the subsequent period of extended operation (Exelon 2019). Therefore, the offsite consequences from higher fuel burnup would not exceed the impacts predicted in the 2013 GEIS. For these issues, the GEIS predicted that the impacts would be small for all nuclear plants. The NRC staff identified no new and significant information regarding higher fuel burnup during its review of Exelon's environmental report, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the staff concludes that no new and significant information exists for Peach Bottom concerning offsite consequences due to higher fuel burnup that would alter the conclusions reached in the 2013 GEIS.

E.3.6 Low Power and Reactor Shutdown Event Information (Section E.3.6 of the 2013 GEIS)

The 2013 GEIS concludes that the environmental impacts from accidents at low-power and shutdown conditions are generally comparable to those from accidents at full power, based on a comparison of the values in NUREG/CR-6143, "Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Grand Gulf, Unit 1" (NRC 1995a), and NUREG/CR-6144, "Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Surry, Unit 1" (NRC 1995b), with the values in NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants" (NRC 1990). The 1996 GEIS estimates of the environmental impact of severe accidents bound the potential impacts from accidents at low power and shutdown, with margin. Peach Bottom was one of the five power plants evaluated in NUREG-1150, thus the plant configurations in low-power and shutdown conditions evaluated in the GEIS apply to Peach Bottom.

Finally, as discussed in SECY-97-168, "Issuance for Public Comment of Proposed Rulemaking Package for Shutdown and Fuel Storage Pool Operation" (NRC 1997), industry initiatives taken during the early 1990s have also contributed to the improved safety of low-power and shutdown operations for all plants. Therefore, the offsite consequences of severe accidents, considering low-power and reactor shutdown events, would not exceed the impacts predicted in either the 1996 or 2013 GEIS. For these issues, the GEIS predicts that the impacts would be small for all nuclear plants. The NRC staff identified no new and significant information regarding low-power and reactor shutdown events during its review of Exelon's environmental report, through the NRC staff's SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the staff concludes that no new and significant information exists for Peach Bottom concerning low-power and reactor shutdown events that would alter the conclusions reached in the 2013 GEIS.

E.3.7 Spent Fuel Pool Accident Information (Section E.3.7 of the 2013 GEIS)

The 2013 GEIS concludes that the environmental impacts from accidents involving spent fuel pools (as quantified in NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants" (NRC 2001)), can be comparable to those from reactor accidents at full power (as estimated in NUREG-1150 (NRC 1990)). Subsequent analyses performed, and mitigative measures employed since 2001, have further lowered the risk of accidents involving spent fuel pools. In addition, even the conservative estimates from NUREG-1738 (published in 2001) are much lower than the impacts from full-power reactor accidents estimated in the 1996 GEIS. Therefore, the environmental impacts stated in the 1996 GEIS bound the impact from spent fuel pool accidents for all plants. For these issues, the GEIS predicts that the impacts would be small for all nuclear plants. There are no spent fuel configurations that would distinguish Peach Bottom from the evaluated plants such that the assumptions in the 2013 and 1996 GEISs would not apply. The NRC staff identified no new and significant information regarding spent fuel pool accidents during its review of Exelon's environmental report, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the NRC staff concludes that no new and significant information exists for Peach Bottom concerning spent fuel pool accidents that would alter the conclusions reached in the 2013 GEIS.

E.3.8 Use of Biological Effects of Ionizing Radiation (BEIR) VII Risk Coefficients (Section E.3.8 of the 2013 GEIS)

In 2005, the NRC staff completed a review of the National Academy of Sciences report, "Health Risks from Exposure to Low Levels of Ionizing Radiation: Biological Effects of Ionizing Radiation (BEIR) VII, Phase 2." The staff documented its findings in SECY-05-0202, "Staff Review of the National Academies Study of the Health Risks from Exposure to Low Levels of Ionizing Radiation (BEIR VII)" (NRC 2005). The SECY paper states that the NRC staff agrees with the BEIR VII report's major conclusion—namely, the current scientific evidence is consistent with the hypothesis that there is a linear, no-threshold, dose–response relationship between exposure to ionizing radiation and the development of cancer in humans. The BEIR VII conclusion is consistent with the hypothesis on radiation exposure and human cancer that the NRC uses to develop its standards of radiological protection. Therefore, the NRC staff has determined that the conclusions of the BEIR VII report do not warrant any change in the NRC's radiation protection standards and regulations because the NRC's standards are adequately protective of public health and safety and will continue to apply during Peach Bottom's subsequent license renewal term. This general topic is discussed further in the NRC's 2007 denial of Petition for Rulemaking (PRM)-51-11, in which the NRC states that it finds no need to modify the 1996 GEIS considering the BEIR VII report. For these issues, the GEIS predicts that the impacts of using the BEIR VII risk coefficients would be small for all nuclear plants.

The NRC staff identified no new and significant information regarding the risk coefficient used in the BEIR VII report during its review of Exelon's environmental report, through the SAMA audit, during the scoping process, or through the evaluation of other available information. Thus, the staff concludes that no new and significant information exists for Peach Bottom concerning the biological effects of ionizing radiation that would alter the conclusions reached in the 2013 GEIS.

E.3.9 Uncertainties (Section E.3.9 of the 2013 GEIS)

Section 5.3.3 in the 1996 GEIS provides a discussion of the uncertainties associated with the analysis in the GEIS and in the individual plant EISs used to estimate the environmental impacts of severe accidents. The 1996 GEIS used 95th percentile upper confidence bound estimates whenever available for its estimates of the environmental impacts of severe accidents. This approach provides conservatism to cover uncertainties, as described in Section 5.3.3.2.2 of the 1996 GEIS. Many of these same uncertainties also apply to the analysis used in the 2013 GEIS update. As discussed in Sections E.3.1 through E.3.8 of the 2013 GEIS, the GEIS update used more recent information to supplement the estimate of environmental impacts contained in the 1996 GEIS. In effect, the assessments contained in Sections-E.3.1 through E.3.8 of the 2013 GEIS provided additional information and insights into certain areas of uncertainty associated with the 1996 GEIS. However, as provided in the 2013 GEIS, the impact and magnitude of uncertainties, as estimated in the 1996 GEIS, bound the uncertainties introduced by the new information and considerations addressed in the 2013 GEIS. Accordingly, in the 2013 GEIS, the NRC staff concluded that the reduction in environmental impacts resulting from the use of new information (since the 1996 GEIS analysis) outweighs any increases in impact resulting from the new information. As a result, the findings in the 1996 GEIS remain valid. The NRC staff identified no new and significant information regarding uncertainties during its review of Exelon's environmental report, the SAMA audit, the scoping process, or the evaluation of other available information. Accordingly, the NRC staff concludes that no new and significant information exists for Peach Bottom concerning uncertainties that would alter the conclusions reached in the 2013 GEIS.

Section E.3.9.2 of Appendix E to the 2013 GEIS discusses the impact of population increases on offsite dose and economic consequences. The 2013 GEIS, in Section E.3.9.2, states the following:

> The 1996 GEIS estimated impacts at the mid-year of each plant's license renewal period (i.e., 2030 to 2050). To adjust the impacts estimated in the NUREGs and NUREG/CRs to the mid-year of the assessed plant's license renewal period, the information (i.e., exposure indexes [EIs]) in the 1996 GEIS can be used. The EIs adjust a plant's airborne and economic impacts from the year 2000 to its mid-year license renewal period based on population increases. These adjustments result in anywhere from a 5 to a 30 percent increase in impacts, depending upon the plant being assessed. Given the range of uncertainty in these types of analyses, a 5 to 30 percent change is not considered significant. Therefore, the effect of increased population around the plant does not generally result in significant increases in impacts.

In its response to an NRC staff RAI regarding population, Exelon estimates that in 2044 (i.e., the midyear of the subsequent license renewal period) the population within the 50-mile radius will be 28 percent higher than in 2010 based on a linear projection of the annual population growth rate calculated using U.S. Census Bureau data for 1990 and 2010. Exelon assumes that a 28 percent increase in population would yield an approximate 28 percent increase in total offsite dose values. Because this estimated increase is within the NRC's 2013 GEIS range determined to be not significant (i.e., a range of zero to 30 percent), Exelon concludes that no new and significant information exists for Peach Bottom concerning offsite dose and economic consequences resulting from population growth within the 50-mile radius surrounding the plant (Exelon 2019). The NRC staff finds this assessment reasonable and further notes that in Section E.3.3 of the 2013 GEIS and in this SEIS, more recent estimates give significantly lower release frequencies and release fractions for the source term than was assumed in the 1996 GEIS. Specifically, the 2013 GEIS states that "a comparison of population dose from newer assessments illustrates a reduction in impact by a factor of 5 to 100 when compared to older assessments, and an additional factor of 2 to 4 due to the conservatism built into the 1996 GEIS values." Thus, the effect of this reduction in total dose impacts far exceeds the effect of a population increase. The staff concludes that the effect of increased population around the plant does not result in significant increases in impacts. Thus, the staff concludes that no new and significant information exists for Peach Bottom concerning population increase that would alter the conclusions reached in the 2013 GEIS.

E.3.10 Summary/Conclusion (Section E.5 of the 2013 GEIS)

The 2013 GEIS categorizes "sources of new information" by their potential effect on the best-estimate environmental impacts associated with postulated severe accidents. These effects can: (1) decrease the environmental impact associated with severe accidents, (2) not affect the environmental impact associated with severe accidents, or (3) increase the environmental impact associated with severe accidents.

Areas of new and significant information that can result in the first effect (decrease the environmental impacts associated with severe accidents) at Peach Bottom include:

- New internal events information (significant decrease)
- New source term information (significant decrease)

Areas of new and significant information that can result in the second effect (no effect on the environmental impact associated with severe accidents) or the third effect (increase the environmental impact associated with severe accidents) include:

- Use of BEIR VII risk coefficients
- Consideration of external events (comparable to internal event impacts)
- Spent fuel pool accidents (could be comparable to full-power event impacts)
- Higher fuel burnup (small to moderate increases)
- Low power and reactor shutdown events (could be comparable to full-power event impacts)
- Population Increase

The 2013 GEIS states, "[g]iven the difficulty in conducting a rigorous aggregation of these results with the differences in the information sources utilized, a fairly simple approach is taken." The GEIS estimated the net increase from the first five areas listed above would be (in a simplistic sense) approximately an increase by a factor of 4.7. At the same time, however, for Peach Bottom, the reduction in risk due to newer internal event information is a decrease in risk by a factor of 17 as described in Section E.3.1. For newer source term, the staff estimates the GEIS lower values of 5 for the population dose impact due to the reduction in source term when compared to older assessments and an additional factor of 2 due to the conservatism built into the 1996 GEIS. Thus, the sum of the reduction factor is estimated to be 24 (i.e.,17+5+2). The net effect of an increase by a factor of 4.7 and a decrease by a factor of 24 would be an overall lower estimated impact (as compared to the 1996 GEIS assessment) by a factor of 19.3. Thus, the NRC staff finds that there is no new and significant information related to the severe accidents at Peach Bottom that would alter the conclusions reached in the 2013 GEIS.

Other areas of new information relating to Peach Bottom severe accident risk, severe accident environmental impact assessment, and cost-beneficial SAMAs are described below. These areas of new information demonstrate additional conservatism in the evaluations in the GEIS and Exelon's environmental report, because they result in further reductions in the impact of a severe accident.

E.4 Other New Information Related to NRC Efforts to Reduce Severe Accident Risk Following Publication of the 1996 GEIS

The Commission considers ways to mitigate severe accidents at a given site more than just in the one-time SAMA analysis associated with a license renewal application. The Commission has considered and adopted various regulatory requirements for mitigating severe accident risks at reactor sites through a variety of NRC programs. For example, in 1996, when it promulgated Table B-1 in Appendix B to Subpart A of 10 CFR Part 51, the Commission explained in a *Federal Register* notice:

> The Commission has considered containment improvements for all plants pursuant to its Containment Performance Improvement (CPI) program…and the Commission has additional ongoing regulatory programs whereby licensees search for individual plant vulnerabilities to severe accidents and consider cost beneficial improvements (Final rule, Environmental Review for Renewal of Nuclear Power Plant Operating Licenses, 61 FR 28467 (June 5, 1996)).

These "additional ongoing regulatory programs" that the Commission mentioned include the IPE and the IPEEE program, which consider "potential improvements to reduce the frequency or consequences of severe accidents on a plant-specific basis and essentially constitute a broad search for severe accident mitigation alternatives." Further, in the same rule, the Commission observed that the IPEs "resulted in a number of plant procedural or programmatic improvements and some plant modifications that will further reduce the risk of severe accidents" (61 FR 28481). Based on these and other considerations, the Commission stated its belief that it is "unlikely that any site-specific consideration of SAMAs for license renewal will identify major plant design changes or modifications that will prove to be cost-beneficial for reducing severe accident frequency or consequences" (61 FR 28481). The Commission noted that it may review and possibly reclassify the issue of severe accident mitigation as a Category 1 issue upon the conclusion of its IPE/IPEEE program but deemed it appropriate to consider severe accident mitigation alternatives for plants for which had not done so previously, pending further rulemaking on this issue (61 FR 28481).

The Commission reaffirmed its SAMA-related conclusions in Table B-1 of Appendix B to Subpart A of 10 CFR Part 51 and 10 CFR 51.53(c)(3)(ii)(L), in *Exelon Generation Co., LLC* (Limerick Generating Station, Units 1 and 2), CLI-13-07, (Oct. 31, 2013) (ADAMS No. ML13304B417). In addition, the Commission observed that it had promulgated those regulations because it had "determined that one SAMA analysis would uncover most cost beneficial measures to mitigate both the risk and the effects of severe accidents, thus satisfying our obligations under NEPA" (NRC 2013d).

The NRC has continued to address severe accident-related issues since the agency published the GEIS in 1996. Combined NRC and licensee efforts have reduced risks from accidents beyond those that were considered in the 1996 GEIS. The 2013 GEIS describes many of those efforts. In some cases, such as the NRC's response to the accident at Fukushima, these activities are still ongoing. In the remainder of Section E.4 of this SEIS, the NRC staff describes efforts to reduce severe accident risk (CDF and LERF) following publication of the 1996 GEIS. Each of these initiatives applies to all reactors, including Peach Bottom Units 2 and 3. Section E.4.1 describes requirements adopted following the terrorist attacks in September 2001 to address the loss of large areas of a plant caused by fire or explosions. Section E.4.2 describes the SOARCA project, which indicates that source term timing and magnitude values may be significantly lower than source term values quantified in previous studies using other analysis methods. Section E.4.3 describes measures adopted following the Fukushima earthquake and tsunami events of 2013. Section E.4.4 discusses efforts that have been made to use plant operating experience to improve plant performance and design features. These are areas of new information that reinforce the conclusion that the probability-weighted consequences of a severe accident are SMALL for all plants, as stated in the 2013 GEIS, and further reduce the likelihood of finding a cost-beneficial SAMA that would substantially reduce the severe accident risk at Peach Bottom.

E.4.1 10 CFR 50.54(hh)(2) Requirements Regarding Loss of Large Areas of the Plant Caused by Fire or Explosions

As discussed on page E-7 of the 2013 GEIS, following the terrorist attacks of September 11, 2001, the NRC conducted a comprehensive review of the agency's security program and made further enhancements to security at a wide range of NRC-regulated facilities. These enhancements included significant reinforcement of the defense capabilities for nuclear facilities, better control of sensitive information, enhancements in emergency preparedness, and implementation of mitigating strategies to deal with postulated events potentially causing loss of large areas of the plant due to explosions or fires, including those that an aircraft impact might create. For example, the Commission issued Order EA-02-026, "Interim Compensatory Measures (ICM) Order." The ICM Order provided interim safeguards and security compensatory measures, and ultimately led to the promulgation of a new regulation in 10 CFR 50.54(hh). This regulation requires commercial power reactor licensees to prepare for a loss of large areas of the facility due to large fires and explosions from any cause, including beyond-design-basis aircraft impacts. In accordance with 10 CFR 50.54(hh)(2), licensees must adopt guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities under circumstances associated with the loss of large areas of the plant due to explosion or fire. Exelon has updated Peach Bottom's guidelines, strategies, and procedures to meet the requirements of 10 CFR 50.54(hh).

NRC requirements pertaining to plant security are subject to NRC oversight on an ongoing basis under a plant's current operating license and are beyond the scope of license renewal. As discussed in Section 5.3.3.1 of the 1996 GEIS, the NRC addresses security-related events using deterministic criteria in 10 CFR Part 73, "Physical Protection of Plants and Materials," rather than by risk assessments or SAMAs. However, the implementation of measures that reduce the risk of severe accidents, including measures adopted to comply with 10 CFR 50.54(hh), also have a beneficial impact on the level of risk evaluated in a SAMA analysis, the purpose of which is to identify potentially cost-beneficial design alternatives, procedural modifications, or training activities that may further reduce the risks of severe accidents. Since Exelon has updated Peach Bottom's guidelines, strategies, and procedures to meet the requirements of 10 CFR 50.54(hh), those efforts have contributed to mitigation of the risk of a beyond-design-basis event. Accordingly, actions taken by Exelon to comply with those regulatory requirements have further contributed to the reduction of risk at Peach Bottom.

In sum, the new information regarding actions taken by Exelon to prepare for potential loss of large areas of the plant due to fire or explosions has further contributed to the reduction of severe accident risk at Peach Bottom. Thus, this information does not alter the conclusions reached in the 2013 GEIS regarding the consequences of a severe accident.

E.4.2 State-of-the-Art Reactor Consequence Analysis (SOARCA)

The 2013 GEIS notes that a significant NRC effort is ongoing to re-quantify realistic severe accident source terms under the State-of-the-Art Reactor Consequence Analysis (SOARCA) project. Preliminary results indicate that source term timing and magnitude values quantified using SOARCA may be significantly lower than source term values quantified in previous studies using other analysis methods (NRC 2008). The NRC staff plans to incorporate this new information regarding source term timing and magnitude using SOARCA in future revisions of the GEIS.

The NRC has completed a SOARCA study for Peach Bottom (NRC 2013g). The Peach Bottom SOARCA study used integrated modeling of accident progression and offsite consequences using both state-of-the-art computational analysis tools and best modeling practices drawn from the collective wisdom of the severe accident analysis community. This study focused on providing a realistic evaluation of accident progression, source term, and offsite consequences for Peach Bottom. SOARCA includes system improvements, improvements in training and emergency procedures, offsite emergency response, and security-related improvements, as well as plant changes such as power uprates and higher core burnup. The Peach Bottom SOARCA study concludes that with SOARCA, the NRC has achieved its objective of developing a body of knowledge regarding detailed, integrated, state-of-the-art modeling of the more important severe accident scenarios for Peach Bottom. SOARCA analyses indicate that successful implementation of existing mitigation measures can prevent reactor core damage or delay or reduce offsite releases of radioactive material. All SOARCA scenarios, even when unmitigated, progress more slowly and release much less radioactive material than the potential releases cited in the 1982 Siting Study (NUREG/CR-2239, “Technical Guidance for Siting Criteria Development”). The 1982 Siting Study calculated 92 early fatalities for Peach Bottom whereas the Peach Bottom SOARCA study shows essentially zero risk of early fatalities even in the unmitigated scenario. As a result, the calculated risks of public health consequences of severe accidents modeled in SOARCA are very small. This new information regarding the SOARCA study’s findings has further contributed to the reduction of the calculated severe accident risk at Peach Bottom, as compared to the 1996 GEIS and the 2001 Peach Bottom SAMA analysis for the initial license renewal application. Thus, the NRC staff concludes that there is no new and significant information related to Peach Bottom SAMAs that would alter the conclusions reached in the 2013 GEIS.

E.4.3 Fukushima-Related Activities

As discussed in Section E.2.1 of the 2013 GEIS, on March 11, 2011, a massive earthquake off the east coast of the main island of Honshu, Japan, produced a tsunami that struck the coastal town of Okuma in Fukushima Prefecture. This event damaged the six-unit Fukushima Dai-ichi nuclear power plant, causing the failure of safety systems needed to maintain cooling water flow to the reactors. Because of the loss of cooling, the fuel overheated, and there was a partial meltdown of fuel in three of the reactors. Damage to the systems and structures containing reactor fuel resulted in the release of radioactive material to the surrounding environment.

As further discussed in Section E.2.1 of the 2013 GEIS, in response to the earthquake, tsunami, and resulting reactor accidents at Fukushima Dai-ichi (hereafter referred to as the Fukushima events), the Commission directed the NRC staff to convene an agency task force of senior leaders and experts to conduct a methodical and systematic review of NRC regulatory requirements, programs, and processes (and their implementation) relevant to the Fukushima event. After thorough evaluation, the NRC required significant enhancements to

U.S. commercial nuclear power plants. The enhancements included: adding capabilities to maintain key plant safety functions following a large-scale natural disaster, updating evaluations on the potential impact from seismic and flooding events, adding new equipment to better handle potential reactor core damage events, and strengthening emergency preparedness capabilities. Further information regarding this matter is presented in the 2013 GEIS and on the NRC's Web page for Fukushima-related actions at https://www.nrc.gov/reactors/operating/ops-experience/post-fukushima-safety-enhancements.html.

In sum, the Commission has imposed additional safety requirements on operating reactors, including Peach Bottom, following the Fukushima accident (as described in the preceding paragraphs). The new regulatory requirements have further contributed to the reduction of severe accident risk at Peach Bottom. Therefore, the NRC staff concludes that there is no new and significant information related to the Fukushima events that would alter the conclusions reached in the 2013 GEIS.

E.4.4 Operating Experience

Section E.2 of the 2013 GEIS mentions the considerable operating experience that supports the safety of U.S. nuclear power plants. As with the use of any technology, greater user experience generally leads to improved performance and improved safety. Additional experience at nuclear power plants has contributed to improved plant performance (e.g., as measured by trends in plant-specific performance indicators), a reduction in adverse operating events, and new lessons learned that improve the safety of all the operating nuclear power plants.

In sum, the new information related to NRC efforts to reduce severe accident risk described above contribute to improved safety as do safety improvements not related to license renewal, including generic safety issues. Thus, the performance and safety record of nuclear power plants operating in the United States, including Peach Bottom, continue to improve. This improvement is also confirmed by analysis that indicates that, in many cases, improved plant performance and design features have resulted in reductions in initiating event frequency, CDF, and containment failure frequency (NRC 2013a).

Conclusion

As discussed above, the NRC and the nuclear industry have addressed and continue to address numerous severe accident-related issues since the publication of the 1996 GEIS and the 2001 Peach Bottom SAMA analysis. These actions reinforce the conclusion that the probability-weighted consequences of a severe accident are SMALL for all plants, as stated in the 2013 GEIS, and further reduce the likelihood of finding a cost-beneficial SAMA that would substantially reduce the severe accident risk at Peach Bottom.

E.5 Exelon's Evaluation of New and Significant Information Pertaining to SAMAs Using NEI 17-04, "Model SLR New and Significant Assessment Approach for SAMA"

In its evaluation of the significance of new information, the NRC staff considers that new information is significant if it provides a seriously different picture of the impacts of the Federal action under consideration. Thus, for mitigation alternatives such as SAMAs, new information is significant if it indicates that a mitigation alternative would substantially reduce an impact of the Federal action on the environment. Consequently, with respect to SAMAs, new information may be significant if it indicates a given potentially cost-beneficial SAMA would substantially reduce the impacts of a severe accident or the probability or consequences (risk) of a severe accident occurring (NRC 2011, 2013a).

As discussed earlier in Section E.2.2, Exelon stated in its environmental report submitted as part of its subsequent license renewal application that it used the methodology in NEI 17-04, “Model SLR New and Significant Assessment Approach for SAMA,” dated June 29, 2017 (NEI 2017) to evaluate new and significant information as it relates to the Peach Bottom subsequent license renewal SAMAs. By letter dated January 31, 2018, the staff reviewed NEI 17-04 and found it acceptable for interim use, pending formal NRC endorsement of NEI 17-04 by incorporation in Regulatory Guide 4.2, Supplement 1, “Preparation of Environmental Reports for Nuclear Power Plant License Renewal Applications” (NRC 2018e). In general, the NEI 17-04 methodology (NEI 2017) does not consider a potential SAMA to be significant unless it reduces by at least 50 percent the maximum benefit as defined in Section 4.5, “Total Cost of Severe Accident Risk/Maximum Benefit,” of NEI 05-01, Revision A, “Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document.” NEI 05-01 is endorsed in NRC Regulatory Guide 4.2, Supplement 1 (NRC 2013a).

NEI 17-04, “Model SLR New and Significant Assessment Approach for SAMA,” describes a three-stage process for determining whether there is any new and significant information relevant to a previous SAMA analysis.

- **Stage 1**: The subsequent license renewal applicant uses PRA risk insights and/or risk model quantifications to estimate the percent reduction in the maximum benefit associated with (1) all unimplemented “Phase 2” SAMAs for the analyzed plant and (2) those SAMAs identified as potentially cost beneficial for other U.S. nuclear power plants and which are applicable to the analyzed plant. If one or more of those SAMAs are shown to reduce the maximum benefit by 50 percent or more, then the applicant must complete Stage 2. (Applicants that can demonstrate through the Stage 1 screening process that there is no potentially significant new information are not required to perform the Stage 2 or Stage 3 assessments.)
- **Stage 2**: The subsequent license renewal applicant develops updated averted cost-risk estimates for implementing those SAMAs. If the Stage 2 assessment confirms that one or more SAMAs reduce the maximum benefit by 50 percent or more, then the applicant must complete Stage 3.
- **Stage 3**: The subsequent license renewal applicant performs a cost-benefit analysis for the “potentially significant” SAMAs identified in Stage 2.

The following sections describe Exelon’s application of the NEI 17-04 methodology to Peach Bottom SAMAs. Exelon determined that none of the SAMAs evaluated in Stage 1 reduced the maximum benefit by 50 percent or more. As a result, Exelon concluded it is not required to perform the Stage 2 or Stage 3 evaluations for any SAMAs.

E.5.1 Data Collection

NEI 17-04 Section 3.1, “Data Collection,” explains that the initial step of the assessment process is to identify the “new information” relevant to the SAMA analysis and to collect and develop those elements of information that will be used to support the assessment. The guidance document states that each applicant should collect, develop, and document the information elements corresponding to the stage or stages of the SAMA analysis performed for the site. For Peach Bottom subsequent license renewal, the NRC staff reviewed the onsite information during an audit at NRC headquarters and determined that Exelon had considered the appropriate information (NRC 2019c).

E.5.2 Stage 1 Assessment

Section 4.15.2.2, “Consideration of SAMAs Is Not Required For PBAPS,” of Exelon’s environmental report describes the process Exelon used for identifying any potentially new and significant SAMAs from the 2001 SAMA analysis. In Stage 1 of the process, Exelon used PRA risk insights and/or risk model quantifications to estimate the percent reduction in the maximum benefit associated with the following two types of SAMAs:

1) Peach Bottom Phase 2 SAMAs
2) Those SAMAs identified as potentially cost beneficial for other U.S. nuclear power plants and which are applicable to Peach Bottom

As discussed below, Exelon found through the qualitative and quantitative Stage 1 screening that the potential cost-beneficial SAMAs would not reduce the maximum benefit by more than 50 percent, and they were therefore screened out from further evaluation. Therefore, neither entering Stage 2 of the NEI methodology or updating the Peach Bottom Level 3 PRA was necessary.

E.5.3 Exelon’s Evaluation of Unimplemented “Phase 2” SAMAs for Peach Bottom

In its 2001 environmental report for the initial Peach Bottom license renewal, Exelon considered 204 potential SAMA candidates. Exelon then performed a qualitative screening of those SAMAs, eliminating SAMAs that were not applicable to Peach Bottom, had already been implemented at Peach Bottom, or were similar to other SAMAs being considered. This screening left 30 unique SAMA candidates listed in Table G.4-2 of Exelon’s 2001 environmental report that were potentially applicable to Peach Bottom and were of potential value in averting the risk of severe accidents. Section G.5 of Exelon’s 2001 environmental report describes the process Exelon used to disposition the remaining SAMAs and the results. Table G.6-1 of the 2001 environmental report summarizes the results of Exelon’s detailed analyses of the SAMA candidates. Ultimately, Exelon concluded that there were no potentially cost-beneficial SAMAs associated with the initial Peach Bottom license renewal (Exelon 2001).

As part of its subsequent license renewal application, Exelon examined the Peach Bottom initial 2001 environmental report again for insights. The purpose was to determine if there was any new and significant information regarding the SAMA analyses that were performed to support issuance of the initial renewed operating licenses for Peach Bottom. Exelon re-evaluated the 30 SAMAs it had considered in connection with initial license renewal using the NEI 17-04 process with an additional screening criterion relating to very high-cost SAMAs. In response to an NRC staff RAI relating to this additional screening criterion, Exelon explained that the subject SAMAs would have been eliminated in the Phase 1 evaluation had it used the guidance of NEI 05-01 (Exelon 2019). The staff reviewed and confirmed that the subject SAMAs that were screened using the NEI 05-01 approach are not likely to reduce the maximum benefit by 50 percent and also be cost beneficial. Based on the Phase 1 qualitative and quantitative screening results, Exelon found that all the plant-specific SAMAs were not new and significant. Therefore, Exelon concluded that there is no new and significant information that would alter the conclusions of Peach Bottom’s SAMA analysis for initial license renewal.

E.5.4 Exelon Evaluation of SAMAs Identified as Potentially Cost Beneficial at Other U.S. Nuclear Power Plants and Which Are Applicable to Peach Bottom

The 2013 GEIS considered the plant-specific supplemental EISs that document potential environmental impacts and mitigation measures for severe accidents relevant to license renewal for each plant. Some of these plant-specific supplements had identified potentially cost-beneficial SAMAs. Exelon reviewed the SEISs of boiling-water reactors (industry SAMAs) to identify potentially cost-beneficial SAMAs. Section 4.15.2.2 of Exelon's subsequent license renewal environmental report describes the Peach Bottom Stage 1 screening evaluation, using the methodology in NEI 17-04 "Model SLR New and Significant Assessment Approach for SAMA." Exelon qualitatively screened from further evaluation any SAMAs that were not applicable to Peach Bottom, SAMAs that were already implemented at Peach Bottom, and SAMAs that had excessive implementation costs. Exelon grouped the remaining SAMAs based on similarities in mitigation equipment or risk-reduction benefits. Exelon then evaluated the remaining SAMAs for the impact they would have assuming those SAMAs were implemented at Peach Bottom.

Consideration of the prescreening criteria for the Phase 2 SAMAs and industry SAMAs left 24 SAMAS (4 plant-specific and 20 industry) to be further evaluated. For each of the 24 unscreened SAMAs, Exelon performed a Stage I analysis to determine an estimated reduction in the CDF and Level 2 release frequencies. Exelon demonstrated that the 24 SAMAs would reduce neither the CDF nor the total release category frequency by 50 percent. Thus, none of the SAMAs can correlate to an averted cost-risk that equals or exceeds 50 percent of the maximum benefit (i.e., SAMA implementation cannot result in a "significant" change in plant risk). Exelon concluded that none of the unscreened SAMAs significantly reduced plant core damage frequency or the release category frequency leading to the conclusion that no new and significant information relevant to the Peach Bottom SAMA analysis exists.

Since Exelon found that none of the SAMAs reduced the maximum benefit by at least 50 percent, Exelon determined that the SAMAs are not potentially significant and a Stage 2 assessment was not needed. Therefore, Exelon concluded it was not required to proceed to a Stage 2 assessment for any SAMAs. As stated in NEI 17-04, "if a plant is able to demonstrate that none of the SAMAs evaluated in the Stage 1 assessment are potentially significant, then the Stage 2 inputs, such as the projected population within a 50-mile radius of the plant, should be listed as 'new information,' but no work to estimate the actual 50-mile population is required." Accordingly, consistent with NEI 17-04, there was no need for Exelon to conduct a quantitative assessment of the effect of an increase in population numbers relative to the population considered in its initial license renewal SAMA analysis.

The NRC staff reviewed Peach Bottom's onsite information and its SAMA identification and screening process during an in-office audit at NRC headquarters (NRC 2019c). The staff found that Exelon had used a methodical and reasonable approach to identify any SAMAs that might reduce the maximum benefit by at least 50 percent and therefore could be considered potentially significant. Therefore, the NRC staff finds that Exelon properly concluded, in accordance with the NEI 17-04 guidance, that it did not need to conduct a Stage 2 assessment.

E.5.5 Other New information

As discussed in Exelon's subsequent license renewal application environmental report and in NEI 17-04, there are some inputs to the SAMA analysis that are expected to change or to potentially change for all plants. Examples of these inputs include the following:

- Updated Level 3 PRA model consequence results, which may be impacted by multiple inputs, including, but not limited to, the following:
    - population, as projected within a 50-mile (80-km) radius of the plant
    - value of farm and nonfarm wealth
    - core inventory (e.g., due to power uprate)
    - evacuation timing and speed
    - Level 3 PRA methodology updates
    - cost-benefit methodology updates

In addition, other changes that could be considered new information may be dependent on plant activities or site-specific changes. These types of changes (listed in NEI 17-04) include the following:

- Identification of a new hazard (e.g., a fault that was not previously analyzed in the seismic analysis).
    - Updated plant risk model (e.g., a fire probabilistic risk assessment that replaces the individual plant examination of external events (IPEEE) analysis).
- Impacts of plant changes that are included in the plant risk models will be reflected in the model results and do not need to be assessed separately.
- Nonmodeled modifications to the plant.
    - Modifications determined to have no risk impact need not be included (e.g., replacement of the condenser vacuum pumps), unless they impact a specific input to SAMA (e.g., new low-pressure turbine in the power conversion system that results in a greater net electrical output).

Offsite consequence codes used in SAMA analyses consider plant-specific inputs as provided above. A detailed SAMA analysis would be able to analyze numerous plant-specific variables and the sensitivity of a SAMA analysis to these variables. However, since a thorough SAMA analysis was previously performed for Peach Bottom's initial license renewal, a new SAMA analysis is not required by 10 CFR 51.53(c)(3)(ii)(L) or 10 CFR Part 51, Table B-1. Rather, as explained above, the licensee is required to consider new and significant information (i.e., new information that provides a seriously different picture of the consequences of the Federal action under consideration). With respect to SAMAs, new information may be significant if it indicates a cost-beneficial SAMA would substantially reduce the probability or consequences of a severe accident.

The NEI methodology described in NEI 17-04 uses "maximum benefit" to determine if SAMA-related information is new and significant. Maximum benefit is defined in Section 4.5 of NEI 05-01, Revision A, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document" (NEI 2005b), as the benefit a SAMA could achieve if it eliminated all risk. The total offsite dose and total economic impact are the baseline risk measures from which the maximum benefit is calculated. The NEI methodology in NEI 17-04 considers a cost-beneficial SAMA to be potentially significant if it reduces the maximum benefit by at least 50 percent. The NRC staff finds the criterion of exceeding a 50-percent reduction in the maximum benefit a reasonable significance value because its correlates with significance determinations in the American Society of Mechanical Engineers and American Nuclear Society PRA standard (cited in Regulatory Guide 1.200)(ASME/ANS 2009,NRC 2009b), NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants" (endorsed in Regulatory Guide 1.160)(NEI 2018,NRC 2018m) and NEI 00-04, "10 CFR 50.69 SSC Categorization Guideline," (endorsed in Regulatory Guide 1.201)(NEI 2005a, NRC 2006) which have been cited or endorsed by the NRC. It is also a reasonable quantification of the qualitative criteria, "New information is significant if it presents a seriously different picture of the impacts of the Federal action under consideration." Furthermore, it is consistent with the criteria the NRC staff accepted in the Limerick Generating Station license renewal FSEIS (NRC 2014f). The NRC staff finds the approach in NEI 17-04 to be reasonable because, with respect to SAMAs, new information may be significant if it indicates a potentially cost-beneficial SAMA could substantially reduce the probability or consequences (risk) of a severe accident occurring. The implication of this statement is that "significance" is not solely related to whether a SAMA is cost beneficial (which may be affected by economic factors, increases in population, etc.), but also depends on a SAMA's potential to significantly reduce risk to the public. In its environmental report for subsequent license renewal, Exelon demonstrated that none of the SAMAs it evaluated in the Stage 1 assessment are potentially significant because none will reduce the maximum benefit by at least 50 percent. Thus, as specified in NEI 17-04, a further evaluation to determine actual benefits (such as may result from considering increases in population above the population estimated in a prior SAMA analysis) is not required.

E.5.6 Conclusion

As described above, Exelon evaluated a total of 180 SAMAs for Peach Bottom subsequent license renewal and did not find any SAMAs that would reduce the maximum benefit by 50 percent or more. Exelon concluded that further SAMA analysis was not required based on the guidance in NEI 17-04. The NRC staff reviewed Exelon's evaluation and concludes that Exelon's methods and results were reasonable. Based on Peach Bottom's Phase 1 qualitative and quantitative screening results, Exelon demonstrated that none of the plant-specific and industry SAMAs that it considered constitute new and significant information in that none changed the conclusion of Peach Bottom's previous SAMA analysis. Further, the NRC staff did not otherwise identify any new and significant information that would alter the conclusions reached in the previous SAMA analysis for Peach Bottom. Therefore, the NRC staff concludes that there is no new and significant information that would alter the conclusions of the SAMA analysis performed for Peach Bottom's initial license renewal.

The NRC staff reviewed Exelon's new and significant information analysis for severe accidents and SAMAs at Peach Bottom during the subsequent license renewal period and finds Exelon's analysis and methods to be reasonable. Given the low residual risk at Peach Bottom, the substantial decrease in CDF at Peach Bottom from the previous SAMA analysis, and the fact that no potentially cost-beneficial SAMAs were identified during Peach Bottom's initial license renewal review, the staff considers it unlikely that Exelon would have found any potentially cost-beneficial SAMAs for subsequent license renewal. Further, Exelon's implementation of actions to satisfy the NRC's orders and regulatory requirements regarding beyond-design-basis events after the September 11, 2001 terrorist attacks and Fukushima events, as well as the conservative assumptions used in earlier severe accident studies and SAMA analyses, also made it unlikely that Exelon would have found any potentially significant cost-beneficial SAMAs during its subsequent license renewal review. For all the reasons stated above, the NRC staff concludes that Exelon reached reasonable SAMA conclusions in its subsequent license renewal environmental report and that there is no new and significant information regarding any potentially cost-beneficial SAMA that would substantially reduce the risks of a severe accident at Peach Bottom.

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10. SUPPLEMENTARY NOTES

D. Drucker

11. ABSTRACT (200 words or less)

The U.S. Nuclear Regulatory Commission (NRC) staff prepared this draft supplemental environmental impact statement in response to Exelon Generation Company's application to renew the operating licenses for Peach Bottom Atomic Power Station Units 2 and 3 (Peach Bottom) for an additional 20 years. This draft SEIS includes the NRC staff's preliminary analysis that evaluates the environmental impacts of the proposed action and alternatives to the proposed action. Alternatives considered include: (1) new nuclear power, (2) supercritical pulverized coal, (3) natural gas combined-cycle, and (4) combination alternative of natural gas combined-cycle, wind, solar, and purchased power. The NRC staff's preliminary recommendation is that the adverse environmental impacts of subsequent license renewal for Peach Bottom are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable. The NRC staff based its recommendation on the following factors: (1) the analysis and findings in NUREG-1437, (2) the environmental report submitted by Exelon, (3) the NRC staff's consultation with Federal, State, Tribal, and local agencies, (4) the NRC staff's independent environmental review, and, (5) the NRC staff's consideration of public comments.

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