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NUREG-2168, Vol. 1

Environmental Impact Statement for an Early Site Permit (ESP) at the PSEG Site

Draft Report for Comment

Chapters 1 to 5

U.S. Nuclear Regulatory Commission
Office of New Reactors
Washington, DC 20555-0001

Regulatory Branch
Philadelphia District
U.S. Army Corps of Engineers
Philadelphia, PA 19107

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Manuscript Completed: June 2014
Date Published: August 2014

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For any questions about the material in this report, please contact: Allen Fetter, Senior Project Manager, U.S. Nuclear Regulatory Commission, Office of New Reactors, Phone: 1-800-368-5642, extension 8556 or Email: Allen.Fetter@nrc.gov

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ABSTRACT

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by PSEG Power, LLC, and PSEG Nuclear, LLC (PSEG), for an early site permit (ESP). The proposed actions requested in the PSEG application are (1) the NRC issuance of an ESP for the PSEG Site located adjacent to the existing Hope Creek Generating Station and Salem Generating Station, Units 1 and 2, in Lower Alloways Creek Township, Salem County, New Jersey, and (2) U.S. Army Corps of Engineers (USACE) permit action on a Department of the Army permit application to perform certain construction activities on the site. The USACE is participating with the NRC in preparing this EIS as a cooperating agency and participates collaboratively on the review team.

This EIS includes the review team's analysis that considers and weighs the environmental impacts of building and operating a new nuclear power plant at the proposed PSEG Site and at alternative sites and mitigation measures available for reducing or avoiding adverse impacts. The EIS also addresses Federally listed species, cultural resources, essential fish habitat issues, and plant cooling system design alternatives.

The EIS includes the evaluation of the proposed action's impacts on waters of the United States pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Appropriation Act of 1899. The USACE will conduct a public interest review in accordance with the guidelines promulgated by the U.S. Environmental Protection Agency under authority of Section 404(b) of the Clean Water Act. The public interest review, which will be addressed in the USACE permit decision document, will include an alternatives analysis to determine the least environmentally damaging practicable alternative.

After considering the environmental aspects of the proposed NRC action, the NRC staff's preliminary recommendation to the Commission is that the ESP be issued as requested. This recommendation is based on (1) the application submitted by PSEG, including Revision 3 of the Environmental Report (ER), and the PSEG responses to requests for additional information from the NRC and USACE staffs; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the public scoping process; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. The USACE permit decision will be made following issuance of the final EIS.

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EXECUTIVE SUMMARY

This environmental impact statement (EIS) presents the results of a U.S. Nuclear Regulatory Commission (NRC) environmental review of an application for an early site permit (ESP) at a proposed site in Salem County, New Jersey. The U.S. Army Corps of Engineers (USACE) participated in the preparation of the EIS as a cooperating agency and as a collaborative member of the review team, which consisted of the NRC staff, its contractor staff, and the USACE staff.

Background

On May 25, 2010, PSEG Power, LLC, and PSEG Nuclear, LLC (PSEG) submitted an application to the NRC for an ESP at the PSEG Site located adjacent to the existing Hope Creek Generating Station (HCGS) and Salem Generating Station (SGS) in Lower Alloways Creek Township, Salem County, New Jersey. On March 31, 2014, PSEG submitted a third revised version of its application, which also included an Environmental Report (ER).

Upon acceptance of PSEG's initial application, the NRC review team began the environmental review process as described in Title 10 of the *Code of Federal Regulations* (CFR) Part 52 by publishing in the *Federal Register* on October 15, 2010, a Notice of Intent to prepare an EIS and conduct scoping. As part of the environmental review, the review team

- considered comments received during the 60-day scoping process that began on October 15, 2010, and conducted related public scoping meetings on November 4, 2010, in Carneys Point, New Jersey;

- conducted site audits from April 17, 2012, through April 19, 2012, and from May 7, 2012, through May 11, 2012;

- reviewed PSEG's ER and developed requests for additional information using guidance from NUREG–1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan*; and

- consulted with Native American tribes and Federal and State agencies such as the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the Advisory Council on Historic Preservation, the New Jersey Department of Environmental Protection, the New Jersey State Historic Preservation Office, and the State of Delaware Office of Historical and Cultural Affairs.

Proposed Action

The proposed actions related to the PSEG application are (1) the NRC issuance of an ESP for the PSEG Site and (2) the USACE issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act [Clean Water Act (CWA)] and Section 10 of the Rivers and Harbors Appropriation Act of 1899, as amended, to perform certain dredge and fill activities on the site.

Purpose and Need for Action

The purpose and need for the NRC proposed action—issuance of the ESP—is to provide for early resolution of site safety and environmental issues, which provides stability in the licensing process. Although no reactor will be built at the PSEG Site under this action (the ESP), to resolve environmental issues the staff assumed in this EIS that one or two reactors with the parameters specified in the plant parameter envelope (PPE) would be built and operated. Any new nuclear plant would provide for additional electrical generating capacity to meet the need for baseload power of at least 2,200 MW(e) in the State of New Jersey by 2021.

The objective of the PSEG-requested USACE action is to obtain a Department of the Army individual permit to perform regulated dredge and fill activities that would affect wetlands and other waters of the United States. The basic purpose of obtaining the Army individual permit is for PSEG to conduct work associated with building a power plant to generate electricity for additional baseload capacity.

Public Involvement

A 60-day scoping period was held from October 15, 2010, through December 14, 2010. On November 4, 2010, the NRC held public scoping meetings in Carneys Point, New Jersey. The review team received many oral comments during the public meetings and a total of 12 written statements, 7 letters, and 1 e-mail during the scoping period on topics such as surface-water hydrology, ecology, socioeconomics, historic and cultural resources, air quality, uranium fuel cycle, energy alternatives, and benefit-cost balance.

Affected Environment

The PSEG Site is located on the southern part of Artificial Island adjacent to the existing HCGS and SGS, Units 1 and 2, in Lower Alloways Creek Township, Salem County, New Jersey. The PSEG Site is on the eastern bank of the Delaware River about 18 mi south of Wilmington, Delaware, and 30 mi southwest of Philadelphia, Pennsylvania. The site is about 7 mi east of Middletown, Delaware; 7.5 mi southwest of Salem, New Jersey; and 9 mi south of Pennsville, New Jersey. Figure ES-1 depicts the location of the PSEG Site in relation to nearby counties and cities within the context of the 50-mi region and the 6-mi vicinity.

Cooling water for any new nuclear units constructed at the PSEG Site would be obtained from the Delaware River. These units would use either mechanical or natural draft cooling towers to transfer waste heat to the atmosphere. A portion of the water obtained from the Delaware River would be returned to the environment via a discharge structure located in the Delaware River on the western side of Artificial Island. The remaining portion of the water would be released to the atmosphere via evaporative cooling.

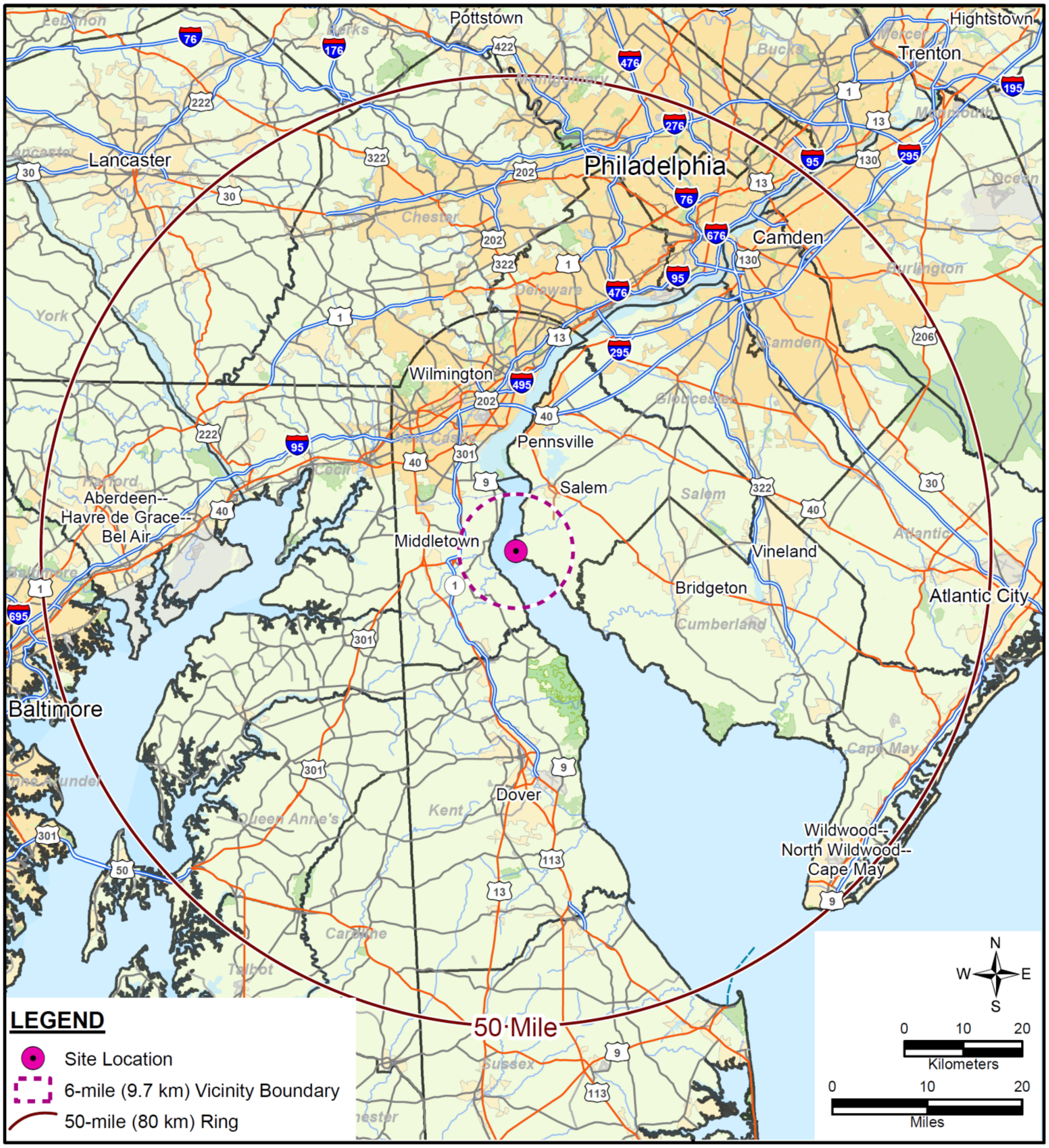


Figure ES-1. PSEG Site Location and Vicinity.

Evaluation of Environmental Impacts

When evaluating the environmental impacts associated with nuclear power plant construction and operations, the NRC's authority is limited to construction activities related to radiological health and safety or common defense and security; that is, under 10 CFR 51.4, the NRC-authorized activities are related to safety-related structures, systems, or components and may include pile driving; subsurface preparation; placement of backfill, concrete, or permanent retaining walls within an excavation; installation of foundations; or in-place assembly, erection, fabrication, or testing. In this EIS, the NRC review team evaluates the potential environmental impacts of the construction and operation of a new nuclear power plant at the PSEG Site for the following resource areas:

- land use,
- air quality,
- aquatic ecology,
- terrestrial ecology,
- surface and groundwater,
- waste (radiological and nonradiological),
- human health (radiological and nonradiological),
- socioeconomics,
- environmental justice, and
- cultural resources.

This EIS also evaluates impacts associated with accidents, the fuel cycle, decommissioning, and transportation of radioactive materials.

The impacts are designated as SMALL, MODERATE, or LARGE. The incremental impacts related to the construction and operations activities requiring the NRC authorization are described and characterized, as are the cumulative impacts resulting from the proposed action when the effects are added to, or interact with, other past, present, and reasonably foreseeable future effects on the same resources.

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.

Table ES-1 provides a summary of the cumulative impacts for the PSEG Site. The review team found that the cumulative environmental impacts would be SMALL for several resource categories, including demography, nonradiological health, radiological health, severe accidents, waste, fuel cycle, decommissioning, and transportation.

Table ES-1. Cumulative Impacts on Environmental Resources, Including the Impacts of a New Nuclear Power Plant at the PSEG Site

Resource Category	Impact Level
Land Use	MODERATE
Water-Related	
—Surface-Water Use	MODERATE
—Groundwater Use	MODERATE
—Surface-Water Quality	MODERATE
—Groundwater Quality	MODERATE
Ecology	
—Terrestrial Ecosystems	MODERATE
—Aquatic Ecosystems	MODERATE to LARGE
Socioeconomic	
—Physical Impacts	SMALL to MODERATE
—Demography	SMALL
—Taxes and Economic Impacts	SMALL (beneficial for the region) to LARGE (beneficial for Salem County)
—Infrastructure and Community Services	SMALL to MODERATE
Environmental Justice	None
Historic and Cultural Resources	MODERATE
Air Quality	SMALL to MODERATE
Nonradiological Health	SMALL
Radiological Health	SMALL
Waste Management	SMALL
Severe Accidents	SMALL
Fuel Cycle, Transportation, and Decommissioning	SMALL

The cumulative impacts for physical impacts, infrastructure and community services, and air quality would be SMALL to MODERATE. The review team found that the cumulative environmental impacts on land use, surface-water use and quality, groundwater use and quality, terrestrial and wetland ecosystems, and historic and cultural resources would be MODERATE. However, the contributions of impacts from the NRC-authorized activities would be SMALL for all of the above-listed resource areas, except for physical impacts and infrastructure and community services impacts. The new cooling towers would contribute to MODERATE cumulative physical impacts associated with aesthetics in certain locations, and traffic impacts

during the peak periods for building a new nuclear plant would contribute to MODERATE cumulative impacts for infrastructure and community services.

The incremental impacts associated with the development of the causeway and the transmission lines would be the principal contributors to the MODERATE cumulative impacts for land use and also to the MODERATE impacts for historic and cultural resources. Extensive past and present use of surface water from the Delaware River would be the primary driver for the MODERATE impacts for surface-water use and quality. Similarly, extensive past and present groundwater withdrawals from the local aquifer system would contribute to the MODERATE cumulative impacts to groundwater resources.

Cumulative terrestrial and wetland ecosystem impacts would be MODERATE because of the loss of habitat from development of the causeway and the transmission line corridors. The significant history of the degradation of the Delaware Bay and Delaware River Estuary has had a noticeable and sometimes destabilizing effect on many aquatic species and communities. Building and operating any new nuclear plant at the PSEG Site, in conjunction with the operations of the existing HCGS and SGS nuclear units, would contribute to MODERATE to LARGE cumulative impacts to aquatic ecosystems.

The cumulative impacts to taxes and the economy would be beneficial and would range from SMALL for the region to LARGE for Salem County. There are few minority populations and/or low-income populations near the PSEG Site. Furthermore, there are no pathways for disproportionately high and adverse impacts on minority or low-income populations.

The SMALL to MODERATE cumulative impact on air quality would result from the existing concentration of greenhouse gases in the atmosphere.

Alternatives

The review team considered the environmental impacts associated with alternatives to issuing an ESP for the PSEG Site. These alternatives included a no-action alternative (i.e., not issuing the ESP), as well as alternative energy sources, siting locations, or system designs.

The **no-action alternative** would result in the ESP not being granted or the USACE not issuing its permit. Upon such a denial, construction and operation of a new nuclear plant at the PSEG Site would not occur, and the predicted environmental impacts would not take place. If no other facility were to be built and no strategy implemented to take its place, the benefits of the additional electrical capacity and electricity generation to be provided would also not occur and the need for baseload power would not be met.

Based on the review team's review of **energy alternatives**, the review team eliminated several energy sources (i.e., wind, solar, and biomass) from full consideration because they are not currently capable of meeting the baseload electricity need. The review team concluded that, from an environmental perspective, none of the viable baseload alternatives (natural gas, coal, or a combination of alternatives) is clearly environmentally preferable to building new baseload nuclear power generating units at the PSEG Site. Table ES-2 provides a comparative summary of the environmental impacts of the viable energy alternatives.

Table ES-2. Comparison of Environmental Impacts of Energy Alternatives

Resource Areas	PSEG Site (Nuclear)	Energy Alternatives[a]		
		Coal	Natural Gas	Combination
Land Use	SMALL to MODERATE	MODERATE	MODERATE	MODERATE
Surface Water	SMALL	SMALL	SMALL	SMALL
Groundwater	SMALL	SMALL	SMALL	SMALL
Terrestrial Ecosystems	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Aquatic Ecosystems	SMALL	SMALL	SMALL	SMALL
Socioeconomics	LARGE (beneficial) to MODERATE (adverse)	LARGE (beneficial) to MODERATE (adverse)	MODERATE (beneficial) to SMALL (adverse)	MODERATE (beneficial) to MODERATE (adverse)
Environmental Justice	None	None	None	None
Historic and Cultural	SMALL	SMALL	SMALL	SMALL
Air Quality	SMALL	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Human Health	SMALL	SMALL	SMALL	SMALL
Waste Management	SMALL	MODERATE	SMALL	SMALL

(a) Impacts taken from Table 9-4 (see Section 9.2.5) in the environmental impact statement. The conclusions for the energy alternatives are compared to those for the NRC-authorized activities at the PSEG Site as reflected in Chapters 4 and 5, as well as in Section 6.1. Note that cumulative impacts are not included in the comparison of energy alternatives.

The review team compared the cumulative effects of the PSEG Site against those of the **alternative sites**. The following four alternatives sites were selected for review (see Figure ES-2).

- Site 4-1 in Hunterdon County, New Jersey
- Site 7-1 in Salem County, New Jersey
- Site 7-2 in Salem County, New Jersey
- Site 7-3 in Cumberland County, New Jersey

Table ES-3 provides a comparative summary of the cumulative impacts for the alternative sites. Although there are differences and distinctions between the cumulative environmental impacts of building and operating a new nuclear power plant at the PSEG Site or at one of the alternative sites, the review team concludes that these differences are not sufficient to determine that any of the alternative sites would be environmentally preferable to the PSEG Site for building and operating a new nuclear power plant. In such a case, the PSEG Site prevails because none of the alternative sites are clearly environmentally preferable.

The review team considered various alternative systems designs, including alternative heat-dissipation systems and multiple alternative intake, discharge, and water-supply systems. The review team identified no alternatives for the PSEG Site that would be environmentally preferable to the systems designs used as the basis for analysis in this EIS. However, if at some time in the future PSEG requests authorization from the NRC (e.g., a combined license) to build and operate a new nuclear power plant, the review team will need to compare the specific heat dissipation design chosen to the other designs that were included in the PPE (Section 9.4.1. provides more detail on this matter).

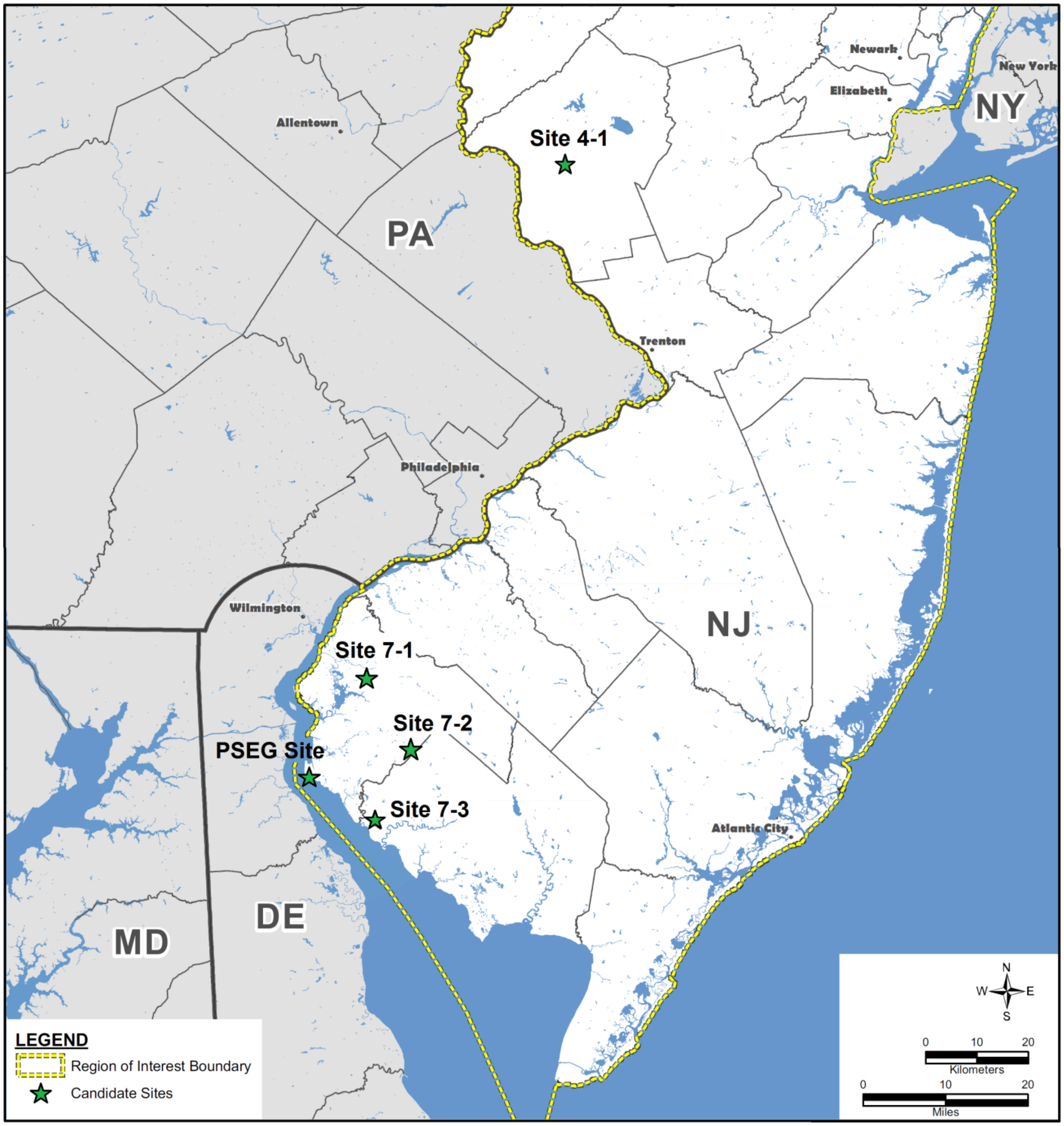


Figure ES-2. Map Showing the Locations of Alternative Sites.
(Note: Site 7-4 is the PSEG Site.)

Table ES-3. Comparison of Environmental Impacts at Alternative Sites

Resource Areas	PSEG Site[a] (Site 7-4)	Alternative Sites[b]			
		Site 4-1	Site 7-1	Site 7-2	Site 7-3
Land Use	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Surface Water	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Groundwater	MODERATE	SMALL	MODERATE	MODERATE	MODERATE
Terrestrial Ecosystems	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Aquatic Ecosystems	MODERATE to LARGE	MODERATE	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE
Socioeconomics	LARGE (beneficial) to MODERATE (adverse)	LARGE (beneficial) to LARGE (adverse)	LARGE (beneficial) to LARGE (adverse)	LARGE (beneficial) to LARGE (adverse)	LARGE (beneficial) to LARGE (adverse)
Environmental Justice	None	None	Potential	None	None
Historic and Cultural	MODERATE	LARGE	MODERATE	MODERATE	MODERATE
Air Quality	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Human Health	SMALL	SMALL	SMALL	SMALL	SMALL
Waste Management	SMALL	SMALL	SMALL	SMALL	SMALL

(a) Cumulative impact determinations taken from Table 7-4 in the environmental impact statement (EIS) (see Section 7.12).
(b) Cumulative impact determinations taken from Table 9-24 in the EIS (see Section 9.3.6).

Benefits and Costs

The review team compiled and compared the pertinent analytical conclusions reached in this EIS. All of the expected impacts from building and operating a new nuclear power plant at the PSEG Site were gathered and aggregated into two final categories: (1) the expected environmental costs and (2) the expected benefits to be derived from approval of the proposed action. Although the analysis in Section 10.6 of this EIS is conceptually similar to a purely economic benefit-cost analysis, which determines the net present dollar value of a given project, the intent of that section is to identify potential societal benefits of the proposed activities and compare them to the potential internal (i.e., private) and external (i.e., societal) costs of the proposed activities. In general, the purpose is to inform the ESP process by gathering and reviewing information that demonstrates the likelihood that the benefits of the proposed activities outweigh the aggregate costs.

On the basis of the assessments in this EIS, the building and operation of a new nuclear power plant at the PSEG Site, with mitigation measures identified by the review team, would accrue benefits that most likely would outweigh the economic, environmental, and social costs. For the NRC-proposed action (i.e., the NRC-authorized construction and operation), the accrued benefits would also outweigh the costs of preconstruction, construction, and operation of a new nuclear power plant at the PSEG Site.

Recommendation

The NRC staff's preliminary recommendation to the Commission related to the environmental aspects of the proposed action is that the ESP should be issued as proposed.

This preliminary recommendation is based on the following:

- the application, including the ER and its revisions, submitted by PSEG;
- consultation with Federal, State, Tribal, and local agencies;
- consideration of public comments received during scoping; and
- the review team's independent review and assessment as detailed in this EIS.

In making its recommendation, the NRC staff determined that none of the alternative sites is environmentally preferable (and therefore, also not obviously superior) to the PSEG Site. The NRC staff also determined that none of the energy or cooling-system alternatives assessed is environmentally preferable to the proposed action.

The NRC staff's determination is independent of the USACE's determination of whether the PSEG Site is the least environmentally damaging practicable alternative pursuant to CWA Section 404(b)(1) Guidelines. The USACE will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

ACRONYMS AND ABBREVIATIONS

°C	degree(s) Celsius
°F	degree(s) Fahrenheit
µg	micrograms
µS/cm	microsievert(s) per centimeter
χ/Q	atmospheric dispersion factor(s)
7Q10	7-day, 10-year low flow (i.e., the lowest flow for 7 consecutive days, expected to occur once per decade)
AADT	annual average daily traffic
ABWR	Advanced Boiling Water Reactor
ac	acre(s)
ac-ft	acre-feet
acfm	actual cubic feet per minute
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
ACW	Alloway Creek Watershed Wetland Restoration
AD	Anno Domini
ADAMS	Agencywide Documents Access and Management System
AE	Atlantic City Electric
ALARA	as low as reasonably achievable
ANL	Argonne National Laboratory
ANS	American Nuclear Society
AP1000	Advanced Passive 1000 (pressurized water) reactor
APE	area of potential effect
AQCR	Air Quality Control Region
ARRA	American Recovery and Reinvestment Act
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute
ASMFC	Atlantic States Marine Fisheries Commission
ASSRT	Atlantic Sturgeon Status Review Team
ATWS	anticipated transient without scram
BA	biological assessment
BACT	Best Available Control Technology
bbl	barrel(s)
BBS	North American Breeding Bird Survey
BC	Before Christ
BEA	Bureau of Economic Analysis
BEIR	Biological Effects of Ionizing Radiation
BGEPA	Bald and Golden Eagle Protection Act
BGS	basic generation service
BLS	Bureau of Labor Statistics (U.S. Department of Labor)

BMP	best management practice
BNL	Brookhaven National Laboratory
BRAC	Base Realignment and Closure
BTS	Bureau of Technical Services
Btu	British thermal unit(s)
BUD	beneficial use determination
BWA	Bureau of Water Allocation
BWR	boiling water reactor
CAA	Clean Air Act
CAES	compressed air energy storage
CAFRA	Coastal Area Facility Review Act
CAIR	Clean Air Interstate Rule
CCS	carbon capture and sequestration
CCW	component cooling water
CDC	Centers for Disease Control and Prevention
CDF	confined disposal facility
CEDE	committed effective dose equivalent
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
cfs	cubic feet per second
CH_4	methane
Ci	curie(s)
cm	centimeter(s)
CMP	Coastal Management Program
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	CO_2 equivalent
COL	combined construction permit and operating license or combined license
COLA	combined license application
CORMIX	Cornell Mixing Zone Expert System
CP	construction permit
CR	County Route
CSAPR	Cross-State Air Pollution Rule
CSP	concentrating solar power
CWA	Clean Water Act (aka Federal Water Pollution Control Act)
CWIS	circulating water intake structure
CWS	circulating water system
CZM	coastal zone management
CZMA	Coastal Zone Management Act
d	day
D/Q	deposition factor(s)
DA	Department of the Army

DAM	Day-Ahead Market
dB	decibel(s)
dBA	decibel(s) on the A-weighted scale
DBA	design basis accident
DBF	design basis flood
DC	direct current
DBT	dry-bulb temperature
DCD	Design Certification/Control Document
DCR	Deed of Conservation Restriction
DDT	Dichlorodiphenyltrichloroethane
DE	Delaware
DEIS	draft environmental impact statement
DFW	Division of Fish & Wildlife
DNL	day-night average sound levels
DNREC	Delaware Department of Natural Resources and Environmental Control
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DPCC	Discharge Prevention, Containment, and Countermeasure
DPS	distinct population segment
DR	demand response
DRBC	Delaware River Basin Commission
DRN	Delaware Riverkeeper Network
DSM	demand-side management
DWDS	demineralized water distribution system
EA	environmental assessment
EAB	exclusion area boundary
ECOS	Environmental Conservation Online System (FWS)
EDC	electric delivery company
EDG	emergency diesel generator
EE	energy efficiency
EEP	Estuary Enhancement Program
EFH	essential fish habitat
EFORd	equivalent demand forced outage rate
EIA	Energy Information Administration
EIF	equivalent impact factor
EIS	environmental impact statement
ELF	extremely low frequency
EMAAC	Eastern Mid-Atlantic Area Council
EMF	electromagnetic field
EMS	emergency medical services
EO	Executive Order
EPA	U.S. Environmental Protection Agency

EPR	Evolutionary Power Reactor
ER	Environmental Report
ESA	Endangered Species Act of 1973, as amended
ESF	engineered safety feature
ESMP	Environmental Surveillance and Monitoring Program
ESP	early site permit
ESPA	early site permit application
ESRP	Environmental Standard Review Plan (NUREG–1555)
ESWS	essential service water system
FEMA	U.S. Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FMP	fishery management plan
FP	fission product
fpm	feet per minute
fps	feet per second
FPS	fire protection system
FR	*Federal Register*
FRN	*Federal Register* Notice
FSAR	Final Safety Analysis Report
ft	foot or feet
ft^2	square foot or feet
ft^3	cubic foot or feet
FWCA	Fish and Wildlife Coordination Act
FWS	U.S. Fish and Wildlife Service
g	gram(s)
gal	gallon(s)
GBq	gigabecquerel
GCRP	U.S. Global Change Research Program
GDP	gross domestic product
GEIS	*Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG–1437)
GEIS-DECOM	GEIS-Decommissioning of Nuclear Facilities (NUREG–0586)
GHG	greenhouse gas
GI-LLI	gastrointestinal lining of lower intestine
GIS	geographic information system
GMP	gross metropolitan product
gpd	gallon(s) per day
gpm	gallon(s) per minute
GSR	geologic survey report
GWh	gigawatt-hour(s)
GWPP	groundwater protection program

Gy	Gray(s)
H1H	high-first-high
H2H	high-second-high
ha	hectare(s)
HAP	hazardous air pollutant
HAPC	Habitat Area of Particular Concern
HCGS	Hope Creek Generating Station
HDA	heat dissipation area
HLW	high-level waste
HPO	historic preservation office
hr	hour(s)
Hz	hertz
I	U.S. Interstate (highway)
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IGCC	integrated gasification combined cycle
in.	inch(es)
IPCC	Intergovernmental Panel on Climate Change
IRM	installed reserve margin
ISFSI	independent spent fuel storage installation
JCPL	Jersey Central Power & Light
kg	kilogram(s)
kHz	kilohertz
km	kilometer(s)
km/hr	kilometer(s) per hour
km^2	square kilometer(s)
kV	kilovolt(s)
kW(e)	kilowatt(s) (electrical)
kWh	kilowatt-hour(s)
L	liter(s)
lb	pound(s)
Ldn	day-night average sound level
LEDPA	least environmentally damaging practicable alternative
Leq	equivalent continuous sound level
LFG	landfill gas
LLC	Limited Liability Company
LLW	low-level waste
LMDCT	linear mechanical draft cooling tower
LMP	locational marginal price

LOCA	loss of coolant accident
LOI	letter of interpretation
LOLE	loss of load expectation
LOS	level of service
LPZ	low population zone
LST	local standard time
LULC	land use and land cover
LWA	Limited Work Authorization
LWCF	Land and Water Conservation Fund
LWR	light water reactor
m	meter(s)
m/s	meter(s) per second
m^2	square meter(s)
m^3	cubic meter(s)
m^3/s	cubic meter(s) per second
MACCS2	Melcor Accident Consequence Code System Version 1.12
MAPP	Mid-Atlantic Power Pathway
MCCI	molten corium-to-concrete interaction
MCWB	mean coincident wet-bulb temperature
MDCT	mechanical draft cooling tower
MEI	maximally exposed individual
MERP	Marsh Ecology Research Program
mg	milligram(s)
Mgd	million gallon(s) per day
mGy	milligray(s)
mi	mile(s)
mi^2	square mile(s)
min	minute(s)
mL	milliliter(s)
MM	million
mm	millimeter(s)
mo	month(s)
MOU	Memorandum of Understanding
MOX	mixed oxides
mph	mile(s) per hour
mrad	millirad(s)
mrem	millirem(s)
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSA	Metropolitan Statistical Area
MSDS	material safety data sheets
MSL	mean sea level
mSv	millisievert(s)
MSW	municipal solid waste

MT	metric ton(nes)
MTU	metric ton(nes) uranium
MUA	municipal utilities authority
MW	megawatt(s)
MW(e)	megawatt(s) (electrical)
MW(t)	megawatt(s) (thermal)
MWd	megawatt-day(s)
MWd/MTU	megawatt-day(s) per metric ton of uranium
MWh	megawatt-hour(s)
N/A	not applicable
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAVD	North American Vertical Datum (sea level reference point used in surveying)
NAVD88	North American Vertical Datum of 1988
NCA	Noise Control Act
NCI	National Cancer Institute
NCP	non-coincident peak
NCRP	National Council on Radiation Protection and Measurements
NDCT	natural draft cooling tower
NEFMC	New England Fishery Management Council
NEI	Nuclear Electric Institute
NEPA	National Environmental Policy Act of 1969, as amended
NEPT	Neptune Regional Transmission System
NERC	North American Electric Reliability Corporation
NESC	National Electric Safety Code
NGCC	natural gas combined cycle
NGVD29	National Geodetic Vertical Datum of 1929
NHD	National Hydrology Dataset
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NJ	New Jersey
NJAC	New Jersey Administrative Code
NJBNE	New Jersey Bureau of Nuclear Engineering
NJBPU	New Jersey Board of Public Utilities
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
NJEMP	New Jersey Energy Master Plan
NJGS	New Jersey Geological Survey
NJLWD	New Jersey Department of Labor and Workforce Development
NJPDES	New Jersey Pollutant Discharge Elimination System
NJSA	New Jersey Statutes Annotated
NJSM	New Jersey State Museum

NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resource Conservation Service
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NSF	National Science Foundation
NSLP	Northeast Supply Link Project
NSPS	new source performance standard
NTU	nephelometric turbidity unit
NUREG	U.S. Nuclear Regulatory Commission technical document
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
NWS	National Weather Service
NY-NJ-CT	New York–Northern New Jersey–Long Island (nonattainment area)
NYB	New York Bight
O_3	ozone
ODCM	Offsite Dose Calculation Manual
ODST	Office of Dredging and Sediment Technology
OL	operating license
OPA	Office of Planning Advocacy
OPSI	Organization of PJM States, Inc.
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PA-NJ-DE	Philadelphia–Wilmington (nonattainment area)
PA-NJ-MD-DE	Philadelphia–Wilmington–Atlantic City (nonattainment area)
PAM	primary amoebic meningoencephalitis
para.	paragraph
Pb	lead
PCB	polychlorinated biphenyl
PECO	PECO Energy
pH	measure of acidity or basicity in solution
PHI	Pepco Holdings Inc.
PIR	public interest review
PIRF	public interest review factor
PJM	PJM Interconnection, LLC
PM	particulate matter
PM_{10}	particulate matter with a mean aerodynamic diameter of 10 μm or less
$PM_{2.5}$	particulate matter with a mean aerodynamic diameter of 2.5 μm or less

PNNL	Pacific Northwest National Laboratory
ppb	part(s) per billion
PPE	plant parameter envelope
ppm	part(s) per million
ppt	part(s) per thousand
PRA	probabilistic risk assessment
PRM	Potomac-Raritan-Magothy (aquifer)
PSD	Prevention of Significant Deterioration
PSE&G	Public Service Electric and Gas Company
PSEG	PSEG Power, LLC, and PSEG Nuclear, LLC
psi	pounds per square inch
psu	practical salinity unit
PSWS	potable and sanitary water system
PTE	potential to emit
PV	photovoltaic
PWR	pressurized water reactor
rad	radiation absorbed dose
RAI	Request for Additional Information
RCRA	Resource Conservation and Recovery Act of 1976, as amended
REC	renewable energy credit(s)
RECO	Rockland Electric Company
rem	Roentgen equivalent man (a unit of radiation dose)
REMP	radiological environmental monitoring program
RERR	Radioactive Effluent Release Report
RFC	Reliability*First* Corporation
RFI	request for information
RG	Regulatory Guide
RGPP	Radiological Groundwater Protection Program
RKM	River Kilometer
RM	River Mile
ROD	Record of Decision
ROI	region of interest
ROW	right-of-way
RPM	reliability pricing model
RPS	Renewable Portfolio Standard
RSA	relevant service area
RSICC	Radiation Safety Information Computational Center
RTEP	Regional Transmission Expansion Plan
RTM	real-time market
RTO	regional transmission organization
RTP	rated thermal power
RV	recreational vehicle
RWS	raw water service

Ryr	reactor-year(s)
s	second(s)
SA	sanitation authority or sewerage authority
SACTI	Seasonal and Annual Cooling Tower Impact (prediction code)
SAFSTOR	Safe Storage
SAMA	severe accident mitigation alternative
SAV	submerged aquatic vegetation
SBO	station blackout (in reference to a diesel generator)
scf	standard cubic feet
SCR	selective catalytic reduction
SE	southeast
SECA	Solid State Energy Conversion Alliance
SEIA	Socioeconomic Impact Area
SEIS	Supplemental Environmental Impact Statement
SER	safety evaluation report
SESC Act	Soil Erosion and Sediment Control Act
SGS	Salem Generating Station, Units 1 and 2
SGTR	steam generator tube rupture
SHPO	State Historic Preservation Office
SIL	significant impact level
SIP	State Implementation Plan
SMC	South Macro-Corridor
SO_2	sulfur dioxide
SO_x	oxides of sulfur
SOARCA	State-of-the-Art Reactor Consequence Analysis
SPCC	spill prevention, control, and countermeasures
SPCCP	spill prevention, control, and countermeasure plan
SRERP	Susquehanna-Roseland Electric Reliability Project
SSAR	Site Safety Analysis Report
SSC	structure, system, or component
STP	sewage treatment plant
Sv	sievert
SWIS	service water intake system
SWPPP	stormwater pollution prevention plan
SWS	service water system
T	ton(s)
T&E	threatened and endangered
TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Office
TIA	traffic impact analysis
TLD	thermoluminescent dosimeter

TPS	third party supplier
tpy	ton(s) per year
TRAGIS	Transportation Routing Analysis Geographic Information System
^{235}U	uranium-235
UA	utilities authority
UHS	ultimate heat sink
UMTRI	University of Michigan Transportation Research Institute
U.S.	United States
U.S. EPR	U.S. Evolutionary Power Reactor
US-APWR	U.S. Advanced Pressurized Water Reactor
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
V	volt
VOC	volatile organic compound
WBT	wet-bulb temperature
WHO	World Health Organization
WMA	Wildlife Management Area
WMC	West Macro-Corridor
WRA	Water Resources Association of Delaware River Basin
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)
yr^{-1}	per year

1.0 INTRODUCTION

On May 25, 2010, the U.S. Nuclear Regulatory Commission (NRC) received an application pursuant to Title 10 of the *Code of Federal Regulations* (CFR), Part 52 (10 CFR 52-TN251), from PSEG Power, LLC, and PSEG Nuclear, LLC (PSEG) for an early site permit (ESP) for a site located adjacent to the existing Hope Creek Generating Station (HCGS) and Salem Generating Station (SGS) in Lower Alloways Creek Township, Salem County, New Jersey. On March 31, 2014, PSEG submitted a third revised version of its application, including the Environmental Report (ER), so unless stated otherwise, any reference in this environmental impact statement (EIS) to the ER refers to Revision 3 (PSEG 2014-TN3452). Under the NRC regulations in 10 CFR 52 (10 CFR 52-TN251) and in accordance with the applicable provisions of 10 CFR 51 (10 CFR 51-TN250), which are the NRC regulations implementing the National Environmental Policy Act of 1969 (NEPA) (42 USC 4321-TN661), the NRC is required to prepare an EIS as part of its review of an ESP application.

Upon issuance of this draft EIS, PSEG plans to submit a Federal and a State application to the U.S. Army Corps of Engineers (USACE) and the New Jersey Department of Environmental Protection (NJDEP) for the Alteration of Any Floodplains, Waterways, or Tidal or Nontidal Wetlands in New Jersey. The USACE application number, the NJDEP Tidal Application number, and the NJDEP Nontidal Application number will all be included in the final EIS.

The proposed actions related to the PSEG application are (1) the NRC issuance of an ESP for the PSEG Site and (2) the USACE permit action on a Department of the Army (DA) permit application pursuant to Section 404 of the Federal Water Pollution Control Act [Clean Water Act (CWA); 33 USC 1251 et seq. (33 USC 1251-TN662)] and Section 10 of the Rivers and Harbors Appropriation Act of 1899 (RHAA) [33 USC 403 et seq. (33 USC 403-TN660)]. The USACE is a cooperating agency with the NRC to verify that the information presented in this EIS is adequate to fulfill the requirements of the USACE regulations found at 33 CFR 320 et seq. and the U.S. Environmental Protection Agency's (EPA's) 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR 230-TN427), hereafter the 404(b)(1) Guidelines. The USACE has the authority to issue permits for proposed work or structures in and under navigable waters and the discharge of dredged and/or fill material into waters of the United States. The USACE regulates activities that would temporarily or permanently impact wetlands and water bodies involved in this project.

1.1 Background

An ESP is a Commission approval of a site or sites for one or more nuclear power facilities. Issuance of an ESP is a process that is separate from the issuance of a construction permit (CP), an operating license (OL), or a combined construction and operating license (combined license or COL) for such a facility. The ESP application and review process makes it possible to evaluate and resolve safety and environmental issues related to siting before the applicant makes a large commitment of resources. If the ESP is approved, the applicant can "bank" the site for up to 20 years for future reactor siting and, if a limited work authorization is also requested and granted, can conduct certain site preparation and preliminary construction activities enumerated in 10 CFR 50.10(e)(1) (10 CFR 50-TN249). An ESP does not, however,

authorize construction and operation of a nuclear power plant. To construct and operate a nuclear power plant, an ESP holder must obtain a CP and an OL, or a COL, which are separate major Federal actions that require their own environmental reviews in accordance with 10 CFR 51 (10 CFR 51-TN250).

As part of its evaluation of the environmental aspects of the action proposed in an ESP application, the NRC prepares an EIS in accordance with 10 CFR 52.18 (10 CFR 52-TN251) and 10 CFR 51 (10 CFR 51-TN250). Because site suitability encompasses construction and operational parameters, the EIS addresses impacts of both construction and operation of reactors and associated facilities. In a review separate from the EIS process, the NRC analyzes the safety characteristics of the proposed site and emergency planning information. These latter two analyses are documented in a safety evaluation report (SER) that presents the conclusions reached by the NRC regarding the following issues:

- whether there is reasonable assurance that a reactor or reactors, having characteristics that fall within the parameters for the site, can be constructed and operated without undue risk to the health and safety of the public;
- whether there are significant impediments to the development of emergency plans; and
- whether site characteristics are such that adequate security plans and measures can be developed.

The NRC staff will issue a separate SER for the PSEG Site in accordance with 10 CFR 52 (10 CFR 52-TN251). In addition, if the applicant proposes either major features of emergency plans or complete and integrated emergency plans, the SER documents whether such major features are acceptable or whether the complete and integrated emergency plans provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency.

1.1.1 Plant Parameter Envelope

The applicant for an ESP need not provide a detailed design of a reactor or reactors and the associated facilities but should provide sufficient bounding parameters and characteristics of the reactor or reactors and the associated facilities so that an assessment of site suitability can be made. Consequently, the ESP application may refer to a plant parameter envelope (PPE) as a surrogate for a nuclear power plant and its associated facilities.

A PPE is a set of values of plant design parameters that an ESP applicant expects will bound the design characteristics of the reactor or reactors that might be constructed at a given site. The PPE values are a bounding surrogate for actual reactor design information. Analysis of environmental impacts based on a PPE approach permits an ESP applicant to defer the selection of a reactor design until the CP or COL stage. The PPE is discussed in more detail in Section 3.2 and Appendix I of this EIS.

1.1.2 Site Preparation and Preliminary Construction Activities

In accordance with 10 CFR 52.25 (10 CFR 52-TN251), if a limited work authorization (LWA) is also requested and granted, the holder of an ESP may perform the site preparation and preliminary construction activities enumerated in 10 CFR 50.10(e)(1) (10 CFR 50-TN249). These preliminary activities can include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. CWA Section 401 (33 USC 1251-TN662) requires that applicants for Federal permits that would allow discharges into navigable waters obtain a certification regarding the discharge or obtain a waiver for such a certification. PSEG submitted an application to the NRC for an ESP that did not include a request for a limited work authorization (LWA). Prior to receiving a CP or COL, the holder of an ESP without an LWA may only perform the preliminary activities not requiring NRC authorization, as enumerated in 10 CFR 50.10(a)(2). These preliminary activities can include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. Because the ESP, if granted, would authorize no activities that would allow discharges into navigable waters, a CWA Section 401 certification is not required prior to the issuance of an ESP. Subsequently, if PSEG applies for a CP, COL, or LWA, a CWA Section 401 certification from the State of New Jersey would be required, and any conditions of the CWA Section 401 certification would be incorporated into the license pursuant to 10 CFR 50.54(aa).The NRC regulations [10 CFR 50.54(aa)] incorporate into the license any conditions in the CWA Section 401 certification.

The purpose of the USACE action is to provide a DA decision on PSEG's permit application to build proposed structures and perform work in and under navigable waters and to discharge dredged and/or fill material into waters of the United States, including jurisdictional wetlands.

1.1.3 NRC ESP Application Review

In accordance with 10 CFR 52.17(a)(2) (10 CFR 52-TN251), PSEG submitted an ER as part of its ESP application (PSEG 2014-TN3452). The ER focuses on the environmental effects of construction and operation of reactors with characteristics that fall within the PPE. The ER also includes an evaluation of alternative sites to determine whether there is an obviously superior alternative to the proposed site. The ER is not required to include, but does include, an assessment of the benefits of the proposed action (e.g., the need for power) and a discussion of energy alternatives.

The NRC staff conducts its reviews of ESP applications in accordance with guidance set forth in review standard RS-002, *Processing Applications for Early Site Permits* (NRC 2004-TN2219). The review standard draws from the previously published NUREG–0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants* (NRC 2007-TN613), and NUREG–1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan* (ESRP) (NRC 1999-TN614). RS-002 provides guidance to the NRC staff reviewers to help ensure a thorough, consistent, and disciplined review of any ESP application. As stated in RS-002, an applicant may elect to use a PPE approach instead of supplying specific design information. The NRC staff's June 23, 2003, responses to comments received on draft RS-002 provide additional insights on the NRC staff's expectations and potential approach to the review of an application using the PPE approach (NRC 2003-

TN2064). Specifically, the NRC staff adapted the ESRP review guidance to the PPE concept. The findings in this EIS reflect the adaptation of the ESRP guidance to the PPE approach.

In addition, the NRC staff also considered the information and analyses provided in NUREG–1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996-TN288; NRC 1999-TN289; NRC 2013-TN2654), in its review. Because GEIS included a review of data from all operating nuclear power plants, some of the information was useful for the environmental review of the proposed action. The NRC staff has identified in the text those areas where this information has been used. Additional guidance on conducting environmental reviews is provided in *Interim Staff Guidance on Environmental Issues Associated with New Reactors* (NRC 2013-TN2595).

Pursuant to 10 CFR 51.75(b) (10 CFR 51-TN250), an EIS prepared by the NRC staff on an application for an ESP focuses on the environmental effects of construction and operation of a reactor, or reactors, that has design characteristics that fall within the site characteristics and design parameters.

Such an EIS must also include an evaluation of alternative sites to determine whether there is any obviously superior alternative to the site proposed. The Commission regulations recognize that certain matters need not be resolved at the ESP stage (e.g., an assessment of the benefits, need for power, energy alternatives) and, thus, may be deferred until an applicant decides to apply for a CP or COL. Nevertheless, this EIS does include an assessment of the need for power (see Chapter 8) and of the energy alternatives (see Section 9.2).

The PSEG ESP application, including its ER, was submitted under oath or affirmation. Applicants use the body of the NRC regulatory guidance (e.g., Regulatory Guides, Review Standards, and Standard Review Plans) and can take advantage of approaches and methods that are acceptable to the NRC to analyze environmental impacts. The NRC staff relied upon the ER as a source of basic information about the plant parameters, the site, the region, and the environment. Subsequent to the acceptance of the application, the NRC staff visited the site; consulted with local, State, Tribal, and Federal agencies; and conducted its own independent review. This draft EIS is the result of the NRC staff's review and properly includes material from various sources including the ER. Ultimately, the NRC is responsible for the reliability of all of the information used in its EIS. If, as part of its independent review, the NRC determines that information presented in the ER is useful and the NRC confirms its accuracy, then the NRC may use the information in its EIS.

If a CP or COL applicant references the ESP, then in accordance with 10 CFR 51.50(c) and 51.92(e) (10 CFR 51-TN250), the ER would contain and the NRC staff would consider any new and significant information for issues related to the impacts of construction and operation of the facility that were resolved in the ESP proceeding. Appendix J of this EIS contains a list of representations and assumptions used by the NRC staff to assess environmental impacts associated with building and operating a new nuclear power plant. The information in Appendix J is meant to aid the staff and the applicant in identifying new and potentially significant information at the COL stage, but it does not replace the analyses in the EIS. As described above, information that is new and significant is subject to reexamination at the COL or CP

stage; however, the alternative site selection process is considered to be resolved through the ESP review process and is not addressed in a supplemental EIS.

As provided by 10 CFR 52.39(a)(2) (10 CFR 52-TN251), the Commission shall treat those matters that are resolved through this EIS as resolved in any later proceeding on an application for a CP or COL referencing the requested PSEG ESP. However, as required by 10 CFR 51.50(c), a CP or COL applicant must identify whether there is new and significant information on these resolved issues. This requirement complements the obligation of a CP or COL applicant referencing an ESP to provide information to resolve any significant environmental issue not considered in the previous proceeding on the ESP. Issuance of either a CP (and OL) or a COL to construct and operate a nuclear power plant is a major Federal action that requires its own environmental review in accordance with 10 CFR 51 (10 CFR 51-TN250). As provided in 10 CFR 52.79 (10 CFR 52-TN251) and under NEPA (42 USC 4321-TN661), the CP or COL environmental review will be informed by the EIS prepared at the ESP stage, and the NRC staff intends to use tiering and incorporation-by-reference whenever it is appropriate to do so. The CP or COL applicant must address any other issue not considered or not resolved in the EIS for the ESP. Moreover, pursuant to 10 CFR 51.70(b) (10 CFR 51-TN250), the NRC is required to independently evaluate and be responsible for the reliability of all information used in the environmental review for a CP or COL application, and the NRC staff may (1) inquire into the continued validity of information disclosed in an EIS for an ESP that is referenced in a COL application and (2) look for any new and potentially significant information that may affect the assumptions, analyses, or conclusions reached in the ESP EIS.

In addition, measures and controls to limit any adverse impact will be identified and evaluated for feasibility and adequacy in limiting adverse impacts at the ESP stage, where possible, and at the CP or COL stage. As a result of the NRC staff's environmental review of the ESP application, the NRC staff may determine that conditions or limitations on the ESP may be necessary in specific areas, as set forth in 10 CFR 52.24 (10 CFR 52-TN251). Therefore, the NRC staff identified in this draft EIS when and how assumptions and PPE values limit its conclusions on the environmental impacts to a particular resource (see also Appendix J).

Following requirements set forth in 10 CFR 51 (10 CFR 51-TN250) and the guidance in RS-002 (NRC 2004-TN2219), the NRC environmental staff (and technical experts from Oak Ridge National Laboratory, Argonne National Laboratory, Brookhaven National Laboratory, and Pacific Northwest National Laboratory retained to assist the NRC staff) visited the alternative sites in April 2012 and the PSEG Site in May 2012 to gather information and to become familiar with the sites and their environs. During these site visits, the NRC staff and its contractor personnel met with the applicant's staff, public officials, Federal and State regulators, local officials, and the public. A list of the organizations contacted is provided in Appendix B. Other documents related to the PSEG ESP application were reviewed and are listed as references where appropriate.

Upon acceptance of the PSEG ESP application for docketing, the NRC began the environmental review process described in 10 CFR 51 (10 CFR 51-TN250) by publishing in the *Federal Register* a Notice of Intent to prepare an EIS and conduct scoping (75 FR 63521-TN1530). The NRC staff held two public scoping meetings on November 4, 2010, in Carneys Point, New Jersey. Subsequent to the scoping meetings and in accordance with NEPA

(42 USC 4321-TN661) and 10 CFR 51 (10 CFR 51-TN250), the NRC staff determined and evaluated the potential environmental impacts of constructing and operating one or two new nuclear power plants at the PSEG Site; preliminary findings are in this draft EIS.

To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts using Council on Environmental Quality (CEQ) guidance [40 CFR 1508.27 (40 CFR 1508-TN428)]. Using this approach, the NRC has established three significance levels—SMALL, MODERATE, or LARGE—which are 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.

This EIS presents the NRC staff's analysis that considers and weighs the environmental impacts of the proposed action at the PSEG Site, including the environmental impacts associated with construction and operation of reactors at the site, the impacts of constructing and operating reactors at alternative sites, the environmental impacts of alternatives to granting the ESP, and mitigation measures available for reducing or avoiding adverse environmental effects. It also provides the NRC staff's recommendation to the Commission regarding the suitability of the PSEG Site for construction and operation of reactors with characteristics that fall within the PPE.

1.1.4 USACE Permit Application Review

The USACE is part of the review team that makes a determination based on the three significance levels established by the NRC. However, the USACE independent Record of Decision (ROD) regarding the aforementioned permit application will reference the analyses in the EIS and present any additional information required by the USACE to support its permit decision. The USACE role as a cooperating agency in the preparation of this EIS is to confirm that the information presented in the EIS is adequate to fulfill the requirements of the USACE regulations and the 404(b)(1) Guidelines (40 CFR 230-TN427) to construct the preferred alternative identified in the EIS. The EIS is intended to present information adequate to fulfill the requirements of the USACE regulations, the 404(b)(1) Guidelines that contain the substantive environmental criteria used by the USACE in evaluating discharges of dredged or fill material into waters of the United States, and the USACE public interest review (PIR) process. The USACE PIR will be part of its permit decision document and thus will not be addressed in the EIS.

The 404(b)(1) Guidelines stipulate that no discharge of dredged or fill material into waters of the United States (including jurisdictional wetlands) shall be permitted if there is a practicable alternative that would have less adverse impact on the aquatic environment so long as the

alternative does not have other significant adverse environmental consequences. Even if an applicant's preferred alternative is determined to be the least environmentally damaging practicable alternative (LEDPA), the USACE must still determine whether the LEDPA is in the public interest. The USACE PIR, described at 33 CFR 320.4 (33 CFR 320-TN424), directs the USACE to consider a number of factors in a balancing process. A permit will be not be issued for an alternative that is not the LEDPA, nor will a permit be issued for an activity that is determined to be contrary to the public interest.

In this EIS, the USACE evaluates certain building and maintenance activities proposed in waters of the United States, including wetlands that would be impacted by the proposed project. The USACE decision will reflect the national concern for both protection and use of important resources. The benefit that reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. Public interest factors that may be relevant to the proposal will be considered such as conservation; economics; aesthetics; general environmental concerns; wetlands; historic and cultural resources; fish and wildlife values; flood hazards; floodplain values; land use; navigation; shore erosion and accretion; recreation; water supply; water quality; energy needs; safety; food and fiber production; mineral needs; and considerations of property ownership, including cumulative impacts thereof and, in general, the needs and welfare of the people. Evaluation of the impact on the public interest will include application of the 404(b)(1) Guidelines promulgated by the EPA administrator under authority of CWA Section 404(b) (40 CFR 230-TN427). The USACE will address all of these issues in its permit decision document.

As part of the USACE permit evaluation process, and upon issuance of this draft EIS, the USACE intends to release a public notice to solicit comments from the public; Federal, State, and local agencies and officials; Native American tribes; and other interested parties in order to consider and evaluate the impacts of the PSEG proposed project. A list of the organizations contacted by the USACE is included in Appendix B.

The timing of the publication of the final EIS versus the timing of the USACE permit decision is such that the USACE will not have completed its evaluation of the proposed project until it fully considers the recommendations of the USACE staff; Federal, State, and local resource agencies; and members of the public and assesses the cumulative impact of the total project and until the following consultations and coordination efforts have been completed: Section 106 of the National Historic Preservation Act (16 USC 470-TN993), including, as appropriate, development and implementation of any Memorandum of Agreement; 16 USC 1531 et seq., the Endangered Species Act of 1973 (16 USC 1531-TN1010); Essential Fish Habitat Assessment (NOAA 1999-TN1845); state water quality certifications; and state coastal zone consistency determinations.

1.1.5 Preconstruction Activities

In a final rule dated October 9, 2007, "Limited Work Authorizations (LWAs) for Nuclear Power Plants" (72 FR 57416-TN260), the Commission defined "construction" [10 CFR 50.10 (10 CFR 50-TN249) and 10 CFR 51.4 (10 CFR 51-TN250)] to be consistent with the NRC's jurisdiction over activities having a nexus to radiological health and safety and/or common defense and security. Many of the activities required to build a nuclear power plant are not part of the NRC

action to license the plant. Activities associated with building the plant that are not within the purview of the NRC action are grouped under the term “preconstruction.” Preconstruction activities include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. These preconstruction activities may take place before the application for a COL is submitted, during the NRC staff review of a COL application, or after a COL is granted. Although preconstruction activities are outside the NRC regulatory authority, nearly all of them are within the regulatory authority of local, State, or other Federal agencies.

Because the preconstruction activities are not part of the NRC action, their impacts are not reviewed as a direct effect of the NRC action. Rather, the impacts of the preconstruction activities are considered in the context of cumulative impacts. In addition, certain preconstruction activities involve placing structures and performing work in and under navigable waters and discharging dredged and/or fill material into waters of the United States (including jurisdictional wetlands) and require permits from the USACE. Such activities are viewed by the USACE as direct effects related to its Federal permitting action. Chapter 4 of this EIS describes the relative magnitude of impacts related to construction and preconstruction activities.

1.1.6 Cooperating Agencies

NEPA (42 USC 4321-TN661) lays the groundwork for coordination between the lead agency preparing an EIS and other Federal agencies that may have special expertise regarding an environmental issue or jurisdiction by law. These other agencies are referred to as “cooperating agencies.” Cooperating agencies have the responsibility to assist the lead agency through early participation in the NEPA process, including scoping; by providing technical input to the environmental analysis; and by making staff support available as needed by the lead agency.

Most proposed nuclear power plants require a permit from the USACE, where impacts are proposed to waters of the United States, in addition to a license from the NRC. Therefore, the NRC and the USACE decided the most effective and efficient use of Federal resources in the review of nuclear power projects would be achieved by a cooperative agreement. On September 12, 2008, the NRC and the USACE signed a Memorandum of Understanding (MOU) regarding the review of nuclear power plant license applications (USACE/NRC 2008-TN637). On June 24, 2011, the USACE Philadelphia District agreed by letter (USACE 2011-TN3305) to become a cooperating agency as defined in 10 CFR 51.14 (10 CFR 51-TN250).

As described in the MOU, the NRC is the lead Federal agency and the USACE is a cooperating agency in the development of the EIS. Under Federal law, each agency has jurisdiction related to portions of the proposed project, as major Federal actions, that could significantly affect the quality of the human environment. The goal of this cooperative agreement is the development of one EIS that serves the needs of the NRC license decision process and the USACE permit decision process. While both agencies must comply with the requirements of NEPA (42 USC 4321-TN661), both agencies also have independent or individual mission requirements that must be met. The NRC makes license decisions under the Atomic Energy Act of 1954, as amended [42 USC 2011 et seq. (42 USC 2011-TN663)], and the USACE makes permit decisions under RHAA (33 USC 403-TN660) and CWA (33 USC 1251-TN662). The USACE is cooperating with the NRC to ensure that the information presented in the NEPA documentation

is adequate to fulfill the requirements of the USACE regulations; the 404(b)(1) Guidelines (40 CFR 230-TN427), which contain the substantive environmental criteria used by the USACE in evaluating discharges of dredged or fill material into waters of the United States; and the USACE PIR process.

As a cooperating agency, the USACE is part of the NRC review team and is involved in all aspects of the environmental review, including scoping, public meetings, public comment resolution, and EIS preparation. The NRC public meeting with the USACE serves the dual purpose of both agencies, with the USACE referring to the NRC-defined public meeting as its public hearing. The USACE district engineer or designee may participate in joint public hearings with other Federal or State agencies in accordance with 33 CFR 327 (33 CFR 327-TN1788) provided the procedures of those hearings meet the requirements of this regulation. In those cases in which the other Federal or State agency allows a cross-examination in its public hearing, the district engineer may still participate in the joint public hearing but shall not require cross-examination as a part of his participation.

The USACE refers to public meetings to acquire information or evidence that will be considered in evaluating a proposed DA permit as hearings, but there is no adjudicatory process involved such as the NRC hearings conducted by the Atomic Safety and Licensing Board. For the purposes of assessment of environmental impact under NEPA (42 USC 4321-TN661), the EIS uses the SMALL/MODERATE/LARGE criteria discussed in Section 1.1.3 of this EIS; this approach has been vetted by CEQ.

A cooperating agency may adopt the EIS of a lead Federal agency without recirculating it when the cooperating agency concludes, after an independent review of the EIS, that its comments and suggestions have been satisfied and issues an ROD. The goal of the process is that the USACE will have all the information necessary to make a permit decision when the final EIS is issued. However, it is possible the USACE may still need some information from the applicant to complete the permit documentation—information that the applicant could not make available by the time of final EIS issuance. Also, any conditions required by the USACE, such as compensatory mitigation, will be addressed in the USACE permit (if issued). Compensation may only be used after all appropriate and practical steps to avoid and minimize adverse impacts to aquatic resources, including wetlands and streams, have been taken. All remaining unavoidable impacts must be compensated to the extent appropriate and practicable. The USACE permit, if issued, would include special conditions to the effect that PSEG must confirm that any wetland compensation efforts have achieved their established goals and requirements in accordance with Compensatory Mitigation for Losses of Aquatic Resources, Final Rule [73 FR 19594-19705 (73 FR 19594-TN1789) and 33 CFR Parts 325 (33 CFR 325-TN425) and 332 (33 CFR 332-TN1472)].

1.1.7 Concurrent NRC Reviews

In reviews that are separate from but parallel to the EIS process, the NRC analyzes the safety characteristics of the proposed site and emergency planning information. These analyses are documented in an SER issued by the NRC. The SER presents the conclusions reached by the NRC regarding (1) whether there is reasonable assurance that a reactor or reactors, having characteristics that fall within the parameters for the site, can be constructed and operated

without undue risk to the health and safety of the public; (2) whether the emergency preparedness program meets the applicable requirements in 10 CFR 50 (10 CFR 50-TN249), 10 CFR 52 (10 CFR 52-TN251), 10 CFR 73 (10 CFR 73-TN423), and 10 CFR 100 (10 CFR 100-TN282); and (3) whether site characteristics are such that adequate security plans and measures as referenced in the above regulations can be developed. The final SER for the PSEG ESP application will be issued following publication of the final EIS. The NRC staff anticipates publication of the final SER for the PSEG ESP application after the issuance of the final EIS.

1.2 The Proposed Federal Actions

The proposed NRC Federal action is the issuance, under the provisions of 10 CFR 52 (10 CFR 52-TN251), of an ESP for the PSEG Site for nuclear power facilities that fall within the PPE that would be operated as a merchant plant to supply baseload electrical power to the State of New Jersey. The proposed USACE Federal action is a permit decision on a DA permit application pursuant to CWA Section 404 (33 USC 1251-TN662) and RHAA Section 10 (33 USC 403-TN660). While PSEG is not proposing construction and operation of a new nuclear power plant under the ESP application, this EIS provides the NRC and USACE analyses of the environmental impacts that could result from building and operating a new nuclear power plant at the PSEG Site or at one of four alternative sites. These impacts are analyzed by the USACE to determine whether the proposed site is the least environmentally damaging practicable alternative that would meet the project purpose and need. These impacts are also analyzed by the NRC to determine whether there is an alternative site that is obviously superior to the proposed site.

The proposed PSEG Site is located adjacent to the existing HCGS and SGS on the southern part of Artificial Island on the east bank of the Delaware River. Of the 819-acre PSEG Site, PSEG owns 734 acres as part of the existing HCGS-SGS site. PSEG developed an agreement in principle with the USACE to acquire through a land exchange an additional 85 acres of the USACE Artificial Island Confined Disposal Facility (CDF) land immediately north of HCGS. Also, during plant construction, PSEG would temporarily lease from the USACE 45 acres of the CDF land north of the proposed site as the location of the concrete batch plant and a construction/laydown area. In this EIS, the proposed land exchange and land lease are addressed to the extent that actions resulting from the exchange or the lease would have direct impacts on the proposed PSEG Site (i.e., from the long-term use of 85 acres and the temporary use of 45 acres to construct and operate a new nuclear power plant on Artificial Island).[1]

For purposes of the ESP application, PSEG has not yet selected a specific reactor technology. PSEG developed its PPE using parameters from the following four reactor technologies.

- Advanced Passive 1000 (AP1000)
- U.S. Evolutionary Power Reactor (U.S. EPR)

[1]The USACE is conducting a separate NEPA analysis for the proposed land exchange and land lease agreements with PSEG. Cumulative impacts between the PSEG proposed project and the exchanged land, if any, will be addressed in Chapter 7 of this EIS.

- Advanced Boiling Water Reactor (ABWR)
- U.S. Advanced Pressurized Water Reactor (US-APWR)

This EIS analyzes the environmental impacts of the PPE surrogate reactor at the proposed PSEG Site. Chapter 3 of this EIS provides detailed information about the site layout and PPE selected by PSEG.

1.3 The Purpose and Need for the Proposed Actions

The purpose and need for the proposed NRC and USACE actions is described below.

1.3.1 NRC Proposed Action

The purpose and need for the NRC proposed action (i.e., ESP issuance) is to provide for early resolution of site safety and environmental issues, which provides stability in the licensing process. Although no reactor would be built at the PSEG Site under this action (the ESP), to resolve environmental issues the staff assumed in this EIS that a reactor with the parameters specified in the PPE would be built and operated. One of the issues addressed by this EIS is the projected shortfall in baseload capacity within the State of New Jersey in 2021. The ESP would resolve site suitability issues related to the building and operation of a new nuclear power plant that would provide up to 2,200 MW of new baseload capacity. This would meet a portion of the expected 2021 power deficit. In the absence of an ESP, safety and environmental reviews of applications for OLs under 10 CFR 50 (10 CFR 50-TN249) would take place during plant construction. Alternatively, all safety and environmental issues would have to be addressed at the time of the NRC staff review of a COL submitted under 10 CFR 52 (10 CFR 52-TN251) if no ESP for the site were referenced. Although actual construction and operation of the facility would not take place unless and until a COL were granted, certain lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, may begin before the COL is granted. As a result, without the ESP review process there could be a considerable expenditure of funds, commitment of resources, and passage of time before site safety and environmental issues are finally resolved.

1.3.2 The USACE Permit Action

The PSEG permit application to the USACE is for work needed to prepare the PSEG Site for a new nuclear power plant. As part of the evaluation of permit applications subject to CWA Section 404 (33 USC 1251-TN662), the USACE must define the overall project purpose in addition to the basic project purpose. The overall project purpose establishes the scope of the alternatives analysis and is used for evaluating practicable alternatives under the 404(b)(1) Guidelines (40 CFR 230-TN427). In accordance with the guidelines and the USACE headquarters guidance, the overall project purpose must be specific enough to define the applicant’s needs but not so narrow and restrictive as to preclude a proper evaluation of alternatives. The USACE is responsible for controlling every aspect of the 404(b)(1) Guidelines (40 CFR 230-TN427) analysis. In this regard, defining the overall project purpose is the sole responsibility of the USACE. While generally focusing on the applicant’s statement, the USACE will, in all cases, exercise independent judgment in defining the purpose and need for the

project from both the applicant's alternatives and the public's perspective [33 CFR 325 Appendix B (9)(c)(4) (33 CFR 325-TN425); see also 33 CFR 230 (33 CFR 230-TN2273)].

Where the activity associated with a discharge is proposed for a special aquatic site [as defined in the 404(b)(1) Guidelines, 40 CFR 230, Subpart E (40 CFR 230-TN427)] and does not require access or proximity to or siting within these types of areas to fulfill its basic project purpose (i.e., the project is not "water dependent"), practicable alternatives that avoid special aquatic sites are presumed to be available unless clearly demonstrated otherwise [404(b)(1) Guidelines, 40 CFR 230.10(a)(3)]. The basic purpose for the PSEG project is to conduct work associated with building a power plant to generate electricity for additional baseload capacity.

Section 230.10(a) of the 404(b)(1) Guidelines (40 CFR 230-TN427) requires that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences." Section 230.10(a)(2) of the 404(b)(1) Guidelines states that "an alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the applicant that could reasonably be obtained, used, expanded, or managed to fulfill the basic purpose of the proposed activity may be considered." Thus, this analysis is necessary to determine which alternative is the LEDPA that meets the project purpose and need. The overall purpose of the project is to construct a nuclear power plant facility to provide for additional baseload electrical generating capacity to meet the growing demand in the State of New Jersey.

1.4 Alternatives to the Proposed Actions

NEPA Section 102(2)(C)(iii) (42 USC 4321-TN661) states that EISs will include a detailed statement on alternatives to the proposed action. The NRC regulations for implementing Section 102(2) of NEPA provide for inclusion of a chapter in an EIS that discusses the environmental impacts of the proposed action and the alternatives [10 CFR 51, Subpart A, Appendix A (10 CFR 51-TN250)]. Chapter 9 of this EIS discusses the environmental impacts of four categories of alternatives: (1) the no-action alternative, (2) energy alternatives, (3) alternative sites, and (4) system design alternatives.

In the no-action alternative, the action would not go forward. The NRC could deny the PSEG request for an ESP. The no-action or permit denial alternative also is available to the USACE. The no-action alternative is one which results in no activities requiring a USACE permit. It may be brought by (1) the applicant electing to modify his proposal to eliminate work under the jurisdiction of the USACE or (2) the denial of the permit. If the request and/or permit were denied, the construction and operation of a new nuclear power plant at the proposed PSEG Site would not occur, nor would any benefits intended by the approved ESP be realized. Energy source alternatives include alternative energy sources, focusing on those alternatives that could meet the purpose and need of the project to generate baseload power. The alternative sites to the proposed site are addressed in the following paragraph. System design alternatives include heat dissipation and circulating water systems, intake and discharge structures, and water use

and treatment systems. Finally, the USACE will continue to review additional efforts to avoid and minimize potential impacts to waters of the United States, including wetlands and cultural and natural resources on the site.

The four alternative sites that are considered in detail in this EIS include Site 4-1 in Hunterdon County, New Jersey, Sites 7-1 and 7-2 in Salem County, New Jersey, and Site 7-3 in Cumberland County, New Jersey. Chapter 9 also includes sections discussing (1) the PSEG region of interest for identification of alternative plant sites, (2) the methods used by PSEG to select the proposed site and alternative sites, and (3) generic issues that are consistent among the alternative sites. Chapter 9 compares the environmental impacts at the proposed PSEG Site to the alternative sites and to the no-action alternative and qualitatively determines whether any one of the alternative sites considered is obviously superior to the proposed site.

As part of the evaluation of permit applications subject to CWA Section 404 (33 USC 1251-TN662), the USACE is required by regulation to apply the criteria set forth in the 404(b)(1) Guidelines (40 CFR 230-TN427). These guidelines establish criteria that must be met for the proposed activities to be permitted pursuant to Section 404. Specifically, the guidelines state, in part, that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem provided the alternative does not have other significant adverse consequences [40 CFR 230.10(a) (40 CFR 230-TN427)]. If it is otherwise a practicable alternative, an area not presently owned by the applicant that could reasonably be obtained, used, expanded, or managed to fulfill the basic purpose of the proposed activity may be considered.

1.5 Compliance and Consultations

Before construction and operation of a new reactor or reactors, PSEG is required to hold certain Federal, State, and local environmental permits and meet relevant Federal and State statutory requirements. In its ER, PSEG provided a list of environmental approvals and consultations associated with the ESP. Because an ESP is limited to establishing the acceptability of the proposed site for future development of a nuclear power facility a number of authorizations PSEG will need from Federal, State, and local authorities for construction and operation are not yet necessary.

Concurrent with its filing of the ESP application to the NRC, PSEG filed an application for a CZMA consistency determination from the State of New Jersey. On July 13, 2010, the NJDEP Division of Land Use Regulation issued its determination that the PSEG ESP application is consistent with the New Jersey Rules on Coastal Zone Management (NJAC 7:7E-TN2272) with one condition:

> “As proposed, the project will require a CAFRA Individual Permit, Coastal Wetlands Permit, Waterfront Development Permit and Freshwater Wetlands Individual Permit from the Division. These permits must be obtained prior to any construction activities on the site related to the project described above” (NJDEP 2010-TN235).

PSEG has not filed an application for a CWA (33 USC 1251-TN662) Section 401 certification from the State of New Jersey.

The NRC staff considered the necessary authorizations and consultations and contacted the appropriate Federal, State, and local agencies to identify any compliance, permit, or significant environmental issues of concern to the reviewing agencies that may impact the suitability of the PSEG Site for the construction and operation of the reactors that fall within the PPE.

1.6 Report Contents

The subsequent chapters of this EIS are organized as follows. Chapter 2 describes the proposed site and discusses the environment that would be affected by the addition of a new nuclear power plant. Chapter 3 examines the power plant characteristics to be used as the basis for evaluation of the environmental impacts. Chapters 4 and 5 examine site suitability by analyzing the environmental impacts of construction (Chapter 4) and operation (Chapter 5) of a new nuclear power plant. Chapter 6 analyzes the environmental impacts of the fuel cycle, transportation of radioactive materials, and decommissioning, while Chapter 7 discusses the cumulative impacts of the proposed action. Chapter 8 discusses the need for power from a new nuclear power plant. Chapter 9 discusses alternatives to the proposed action; analyzes energy sources, alternative sites, and systems design; and compares the proposed action with the alternatives. Chapter 10 summarizes the findings of the preceding chapters and presents the NRC staff's conclusions and recommendations with respect to Commission approval of the proposed site for an ESP based on the NRC staff's evaluation of environmental impacts.

The appendices provide the following additional information.

- Appendix A—Contributors to the Environmental Impact Statement
- Appendix B—Organizations Contacted
- Appendix C—Chronology of NRC and USACE Staff Environmental Review Correspondence Related to the PSEG Power, LLC, and PSEG Nuclear, LLC (PSEG), Application for an Early Site Permit (ESP) at the PSEG Site
- Appendix D—Scoping Comments and Responses
- Appendix E—Draft Environmental Impact Statement Comments and Responses (Reserved)
- Appendix F—Key Consultation Correspondence
- Appendix G—Supporting Information and Data: Population Projections and Radiological Dose Assessment
- Appendix H—List of Authorizations, Permits, and Certifications
- Appendix I—PSEG Site Characteristics and Plant Parameter Envelope Values
- Appendix J—PSEG Representations and Assumptions
- Appendix K—Greenhouse Gas Footprint Estimates for a Reference 1,000-MW(e) Light Water Reactor (LWR)

2.0 AFFECTED ENVIRONMENT

The site proposed by PSEG Power, LLC, and PSEG Nuclear, LLC (PSEG), for an early site permit (ESP) and a U.S. Army Corps of Engineers (USACE) action on a U.S. Department of the Army (DA) Permit is located adjacent to the existing Hope Creek Generating Station (HCGS) and Salem Generating Station (SGS) in Lower Alloways Creek Township, Salem County, New Jersey (Figure 2-1). The proposed site location is described in Section 2.1, followed by descriptions of the land use, water, ecology, socioeconomics, environmental justice, historic and cultural resources, geology, meteorology and air quality, and nonradiological and radiological environment of the site presented in Sections 2.2 through 2.11, respectively. Section 2.12 discusses related Federal projects, and Section 2.13 lists the references for Chapter 2.

2.1 Site Location

The PSEG Site is located on the southern part of Artificial Island in Lower Alloways Creek Township, Salem County, New Jersey. Artificial Island was formed from dredge spoils produced as a result of maintenance dredging of the Delaware River navigation channel by the USACE. The site is approximately 7 mi east of Middletown, Delaware, 7.5 mi southwest of Salem, New Jersey, and 9 mi south of Pennsville, New Jersey. Figure 2-1 depicts the location of the PSEG Site in relationship to nearby counties and cities within the context of the 50-mi region and the 6-mi vicinity.

The PSEG Site is located adjacent to HCGS and SGS on the northwestern portion of the existing PSEG property. Figure 2-2 depicts the proposed site in relation to the existing units. PSEG owns 734 ac of the site and has developed an agreement with the USACE to acquire 85 ac immediately north of the existing PSEG property. Thus, the total PSEG Site would encompass 819 ac. Figure 2-3 presents an aerial photograph of the existing PSEG property. PSEG calculated the center point of a new plant based on a composite drawing of a surrogate plant derived from the four reactor technologies on which PSEG's plant parameter envelope (PPE) is based:

Latitude: 39°28′23.744″ North

Longitude: 75°32′24.332″ West

The Delaware River borders the western and southern sides of the existing PSEG property. Lands developed by the USACE as the Artificial Island Confined Disposal Facility (CDF) for the placement of material dredged from the Delaware River are located immediately north of the PSEG property along the east bank of the river. Lands consisting of tidal marsh are located to the north and east of the PSEG property.

PSEG's proposed site is located 15 mi south of the Delaware Memorial Bridge near Delaware River Mile 52 on the east side of the Delaware River. The portion of the river flowing adjacent to the site is 2.5 mi wide. The site is 18 mi south of Wilmington, Delaware, and 30 mi southwest of Philadelphia, Pennsylvania.

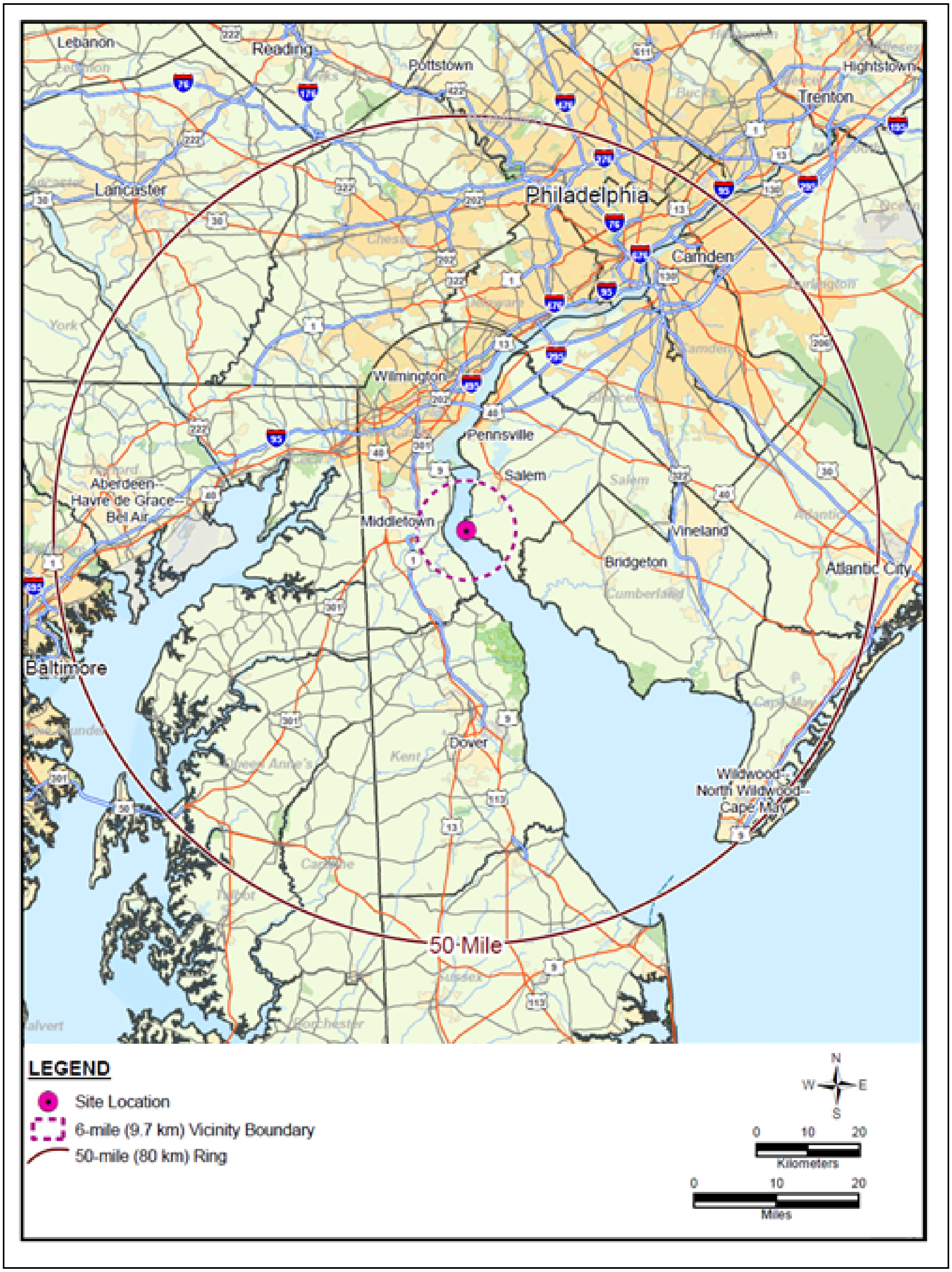


Figure 2-1. PSEG Site Location Vicinity (6-mi boundary) and Region (50-mi ring).
(Source: Modified from PSEG 2014-TN3452)

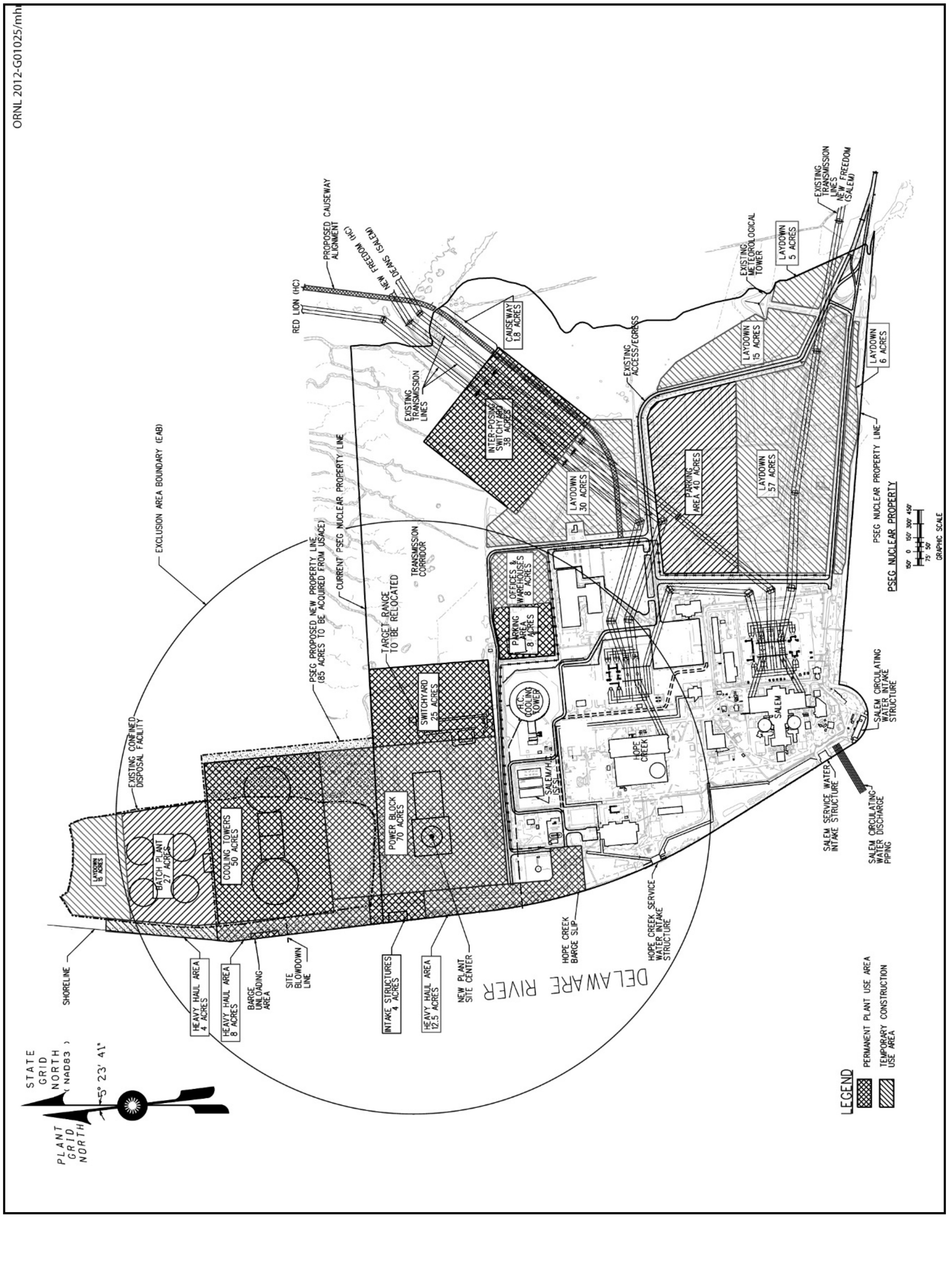


Figure 2-2. PSEG Site Utilization Plan. ***(Source: Modified from PSEG 2012-TN1489)***

Figure 2-3. Aerial View of the Existing PSEG Property. ***(Source: Modified from PSEG 2014-TN3452)***

2.2 Land Use

This section discusses existing land uses and land-related issues for the PSEG Site, including the proposed location for a new nuclear power plant. Section 2.2.1 describes land use on the site and in the vicinity, defined as the area encompassed within a 6 mi radius of the site. Section 2.2.2 discusses land use along the existing transmission line corridors from the PSEG Site, the existing access road corridor for the PSEG Site, and the proposed access road corridor for the PSEG Site. Section 2.2.3 discusses land use in the region, which is defined as the area within 50 mi of the PSEG Site boundary.

2.2.1 The Site and Vicinity

The PSEG Site is located adjacent to HCGS and SGS on the northwestern portion of the existing PSEG property in Lower Alloways Creek Township, Salem County, New Jersey (Figure 2-1). The site is located on the southern part of Artificial Island on the east bank of the Delaware River. The creation of Artificial Island began around 1900, when the USACE began disposing of hydraulic dredge spoils within a diked area established around a naturally occurring sandbar that projected into the river. Over the years, the diked area was enlarged to accommodate additional spoils materials produced as a result of maintenance dredging of the Delaware River navigation channel. As this area was filled in and enlarged, it became known as Artificial Island (PSEG 2014-TN3452).

Of the 819 ac PSEG Site, PSEG owns 734 ac as part of the existing PSEG property. PSEG has developed an agreement in principle with the USACE to acquire an additional 85 ac of the USACE Artificial Island CDF land immediately north of HCGS (Figure 2-2). Therefore, the PSEG Site would total 819 ac. Also, during plant construction, PSEG would temporarily lease from the USACE 45 ac of the Artificial Island CDF land north of the PSEG Site as the location of the concrete batch plant and a construction/laydown area. At the completion of construction, PSEG would return the 45 ac of leased land to the USACE, subject to any required long-term exclusion area boundary (EAB) control conditions from the NRC. The lands to be acquired and leased by PSEG from the USACE are currently part of the 350-ac Artificial Island CDF (PSEG 2014-TN3452).

Of the existing 734 ac PSEG property, a total of 373 ac is used for HCGS (153 ac) and SGS (220 ac). The remaining 361 ac is composed of developed upland areas in industrial use, a variety of wetland types, and maintained stormwater management facilities such as swales and detention basins. Much of this land previously has been developed and disturbed for various power plant uses. The elevation of the terrain across the PSEG Site generally ranges from 5 ft to 15 ft North American Vertical Datum 1988 (NAVD88), and developed areas of the site are nominally 10 ft to 12 ft NAVD88 (PSEG 2014-TN3452). HCGS is a one-unit boiling water reactor (BWR) with a current licensed thermal power of 3,840 MW(t). SGS has two pressurized water reactors (PWR), each with a current licensed thermal power of 3,459 MW(t). An access road connects the existing PSEG property to a secondary road 3.6 mi to the east. The existing PSEG property can also be accessed from the Delaware River; barge access to SGS and HCGS is located at the southern end and western side of Artificial Island, respectively (PSEG 2014-TN3452).

According to the New Jersey Department of Environmental Protection (NJDEP) Land Use and Land Cover (LULC) data cited by PSEG (PSEG 2014-TN3281), major land uses within the PSEG property boundary include industrial, *Phragmites*-dominated coastal and interior wetlands, old field, other urban or built-up, *Phragmites*-dominated old field, and undeveloped rights-of-way. Figures 2-4 and 2-5 present the types and distribution of land use on and around the existing PSEG property, and Table 2-1 lists the area for each land use category within the 819 ac PSEG Site. Dominant land uses on the existing PSEG property are disturbed lands that were previously used to support the construction of SGS and HCGS or wetlands that are dominated by monotypic populations of common reed (*Phragmites australis*). These dominant land uses include industrial (31.9 percent), *Phragmites*-dominated coastal wetlands (17.3 percent), and *Phragmites*-dominated interior wetlands (12.9 percent). Old field land and other urban or built-up land account for 9.5 and 7.0 percent of the PSEG property, respectively. The remaining area of the property includes altered lands, artificial lakes, deciduous brush/shrubland, deciduous scrub/shrub and herbaceous wetlands, disturbed wetlands, recreation land, tidal-related lands, transportation/communication/utilities, wetland and upland rights-of-way, *Phragmites*-dominated urban areas and old field, and managed wetland in maintained lawn greenspace (PSEG 2014-TN3281).

Most of the PSEG Site lies within the current PSEG property boundary. However, as discussed above, PSEG would acquire additional land (85 ac) north of HCGS for locating permanent plant facilities, and would lease additional land (45 ac) north of HCGS for locating temporary construction support facilities. Of the 85 ac to be acquired for permanent plant facilities, 50 ac are now part of the USACE Artificial Island CDF and 35 ac are now part of an adjoining coastal marsh. All of the 45 ac to be leased are part of the Artificial Island CDF (PSEG 2014-TN3452).

NJDEP LULC data indicate the 85-ac parcel to be acquired by PSEG is composed primarily of *Phragmites*-dominated coastal and interior wetlands (61.1 percent), artificial lakes (34.2 percent), and other urban or built-up lands (3.4 percent), as seen in Table 2-1 (PSEG 2014-TN3281). The 45-ac parcel to be leased by PSEG is composed primarily of disturbed and *Phragmites*-dominated coastal and interior wetlands (91.1 percent) (PSEG 2014-TN3452). The entire area to be acquired and leased is highly disturbed, consisting of unvegetated sand and *Phragmites*-dominated vegetation (PSEG 2014-TN3452). The actual acreage of wetland habitat and open water within the existing CDFs at Artificial Island may change because of ongoing dredge disposal operations.

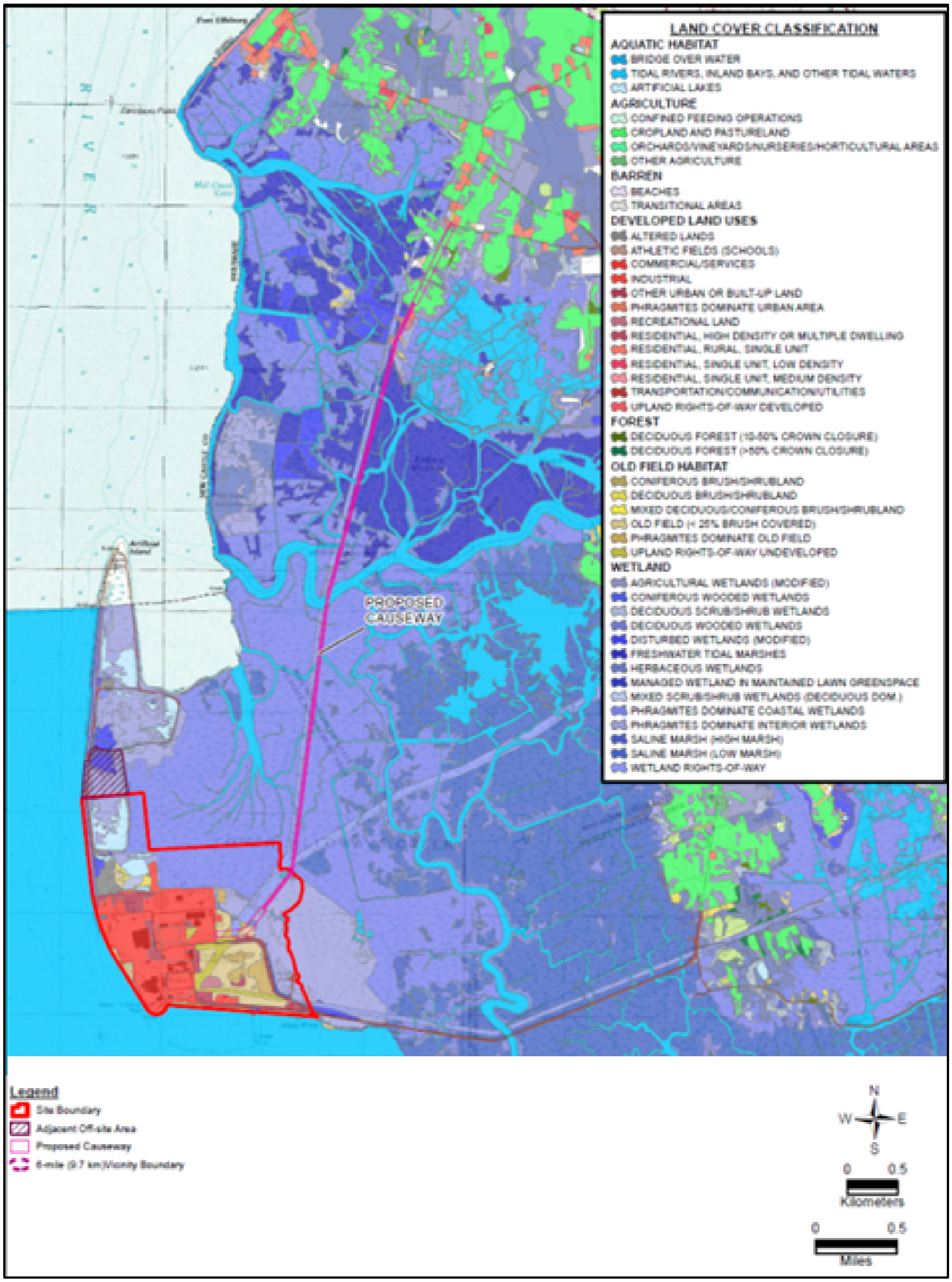


Figure 2-4. PSEG Site and Near Offsite Land Use.
(Source: Modified from PSEG 2014-TN3452)

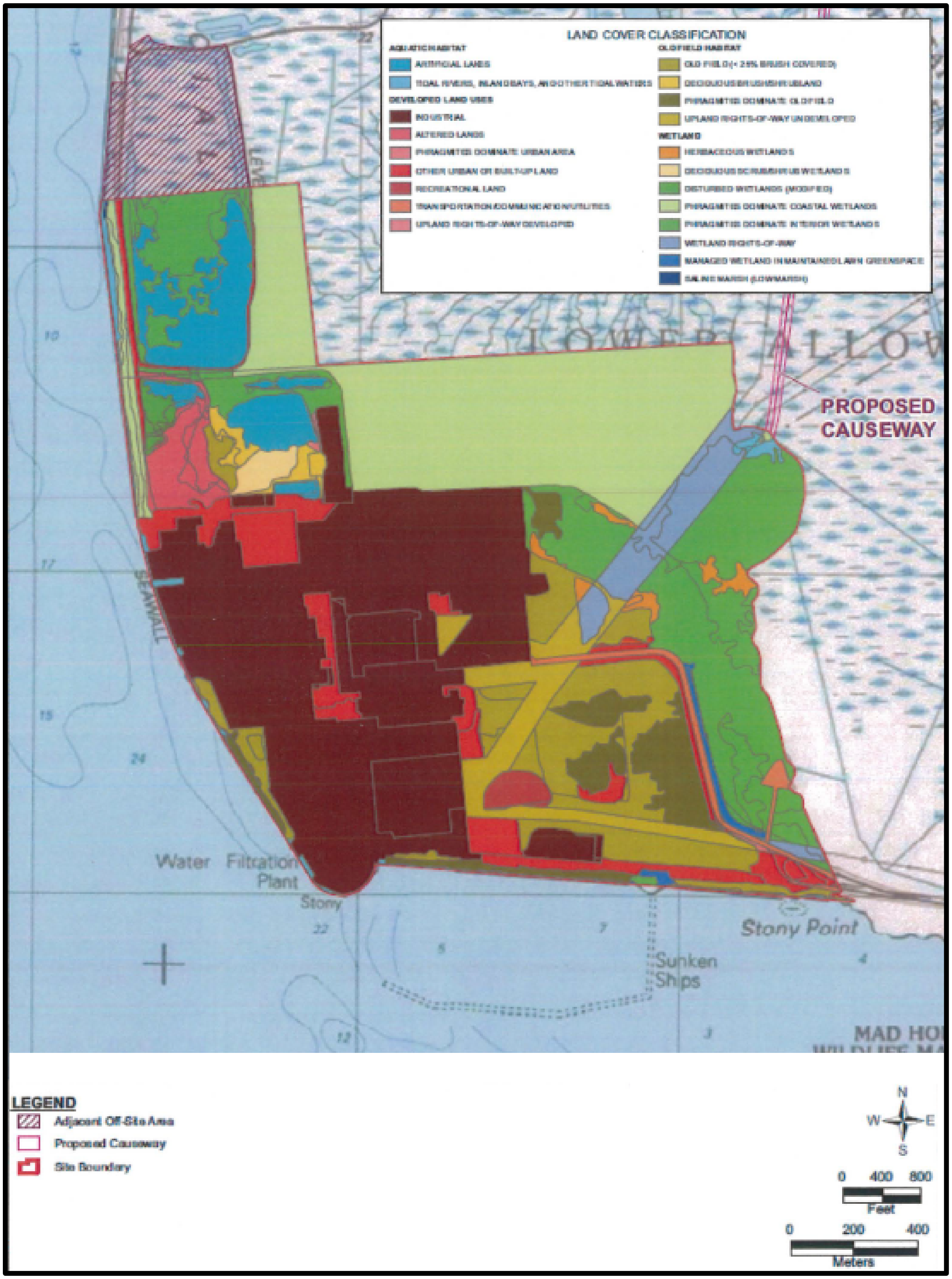


Figure 2-5. NJDEP 2002 Land Use/Land Cover Within the PSEG Site.
(Source: Modified from PSEG 2014-TN3281)

Table 2-1. NJDEP 2002 Land Use/Land Cover (LULC) Within the Proposed PSEG Site

New Jersey LULC Categories	Existing PSEG Property		85-Ac Parcel to be Acquired		PSEG Site Total	
	Area (ac)	Percent	Area (ac)	Percent	Area (ac)	Percent
Urban or Built Up						
Industrial	234.5	31.9%	0.0	0.0%	234.5	28.6%
Transportation/Communication/Utilities	8.5	1.2%	0.0	0.0%	8.5	1.0%
Wetlands Rights-of-Way	23.8	3.2%	0.0	0.0%	23.8	2.9%
Upland Rights-of-Way (developed)	0.5	0.1%	0.0	0.0%	0.5	0.1%
Upland Rights-of-Way (undeveloped)	29.5	4.0%	0.0	0.0%	29.5	3.6%
Other Urban or Built-up Land	51.1	7.0%	4.7	5.5%	55.8	6.8%
Phragmites-Dominated Urban Area	0.5	0.1%	0.0	0.0%	0.5	0.1%
Recreational Land	4.9	0.7%	0.0	0.0%	4.9	0.6%
Subtotal:	**353.3**	**48.1%**	**4.7**	**5.5%**	**358.0**	**43.7%**
Forested Land						
Old Field (<25 percent Brush Covered)	69.4	9.5%	0.0	0.0%	69.4	8.5%
Phragmites-Dominated Old Field	31.9	4.3%	0.0	0.0%	31.9	3.9%
Deciduous Brush/Shrubland	6.0	0.8%	0.0	0.0%	6.0	0.7%
Subtotal:	**107.3**	**14.6%**	**0.0**	**0.0%**	**107.3**	**13.1%**
Water						
Artificial Lakes	14.2	1.9%	26.2	30.8%	40.4	4.9%
Tidal Rivers, Inland Bays, and Other Tidal Waters	3.9	0.5%	1.7	2.0%	5.6	0.7%
Subtotal:	**18.1**	**2.5%**	**27.9**	**32.8%**	**46.0**	**5.6%**
Wetlands						
Saline Marsh	0.0	0.0%	0.2	0.2%	0.2	0.0%
Phragmites-Dominated Coastal Wetlands	127.3	17.3%	28.3	33.3%	155.6	19.0%
Deciduous Scrub/Shrub Wetlands	4.6	0.6%	0.0	0.0%	4.6	0.6%
Herbaceous Wetlands	5.8	0.8%	0.0	0.0%	5.8	0.7%
Phragmites-Dominated Interior Wetlands	95.0	12.9%	23.7	27.8%	118.7	14.5%
Subtotal:	**232.7**	**31.7%**	**52.2**	**61.3%**	**284.9**	**34.8%**
Barren Land						
Altered Lands	14.6	2.0%	0.2	0.2%	14.8	1.8%
Disturbed Wetlands (Modified)	4.2	0.6%	0.1	0.1%	4.3	0.5%
Subtotal:	**18.8**	**2.6%**	**0.3**	**0.4%**	**19.1**	**2.3%**
Managed Wetlands						
Managed Wetland in Maintained Lawn Greenspace	3.8	0.5%	0.0	0.0%	3.8	0.5%
Subtotal:	**3.8**	**0.5%**	**0.0**	**0.0%**	**3.8**	**0.5%**
Total:	**734.0**	**100.0%**	**85.1**	**100.0%**	**819.1**	**100.0%**

Source: Staff, based on PSEG 2014-TN3281.

Activities including the discharge of dredge or fill materials into waters of the United States, including wetlands, require permit authorization from the USACE under Section 404 of the Clean Water Act (CWA) (33 USC 1251-TN662). Additionally, the USACE regulates any work or structures affecting waters of the United States, including wetlands, under Section 10 of the Rivers and Harbors Appropriation Act (33 USC 403-TN660). NJDEP regulates coastal wetlands under the New Jersey Wetlands Act of 1970 (NJSA 13:9A-TN3361), and freshwater wetlands are regulated under the New Jersey Freshwater Wetlands Protection Act (PSEG 2012-TN2389).

PSEG submitted an application for line verification letter of interpretation (LOI) to NJDEP for the PSEG Site. Additionally, PSEG submitted a Jurisdictional Determination Request to the USACE to clarify the USACE's jurisdiction on the USACE's 85 ac CDF facility immediately north of the PSEG Site. As part of their request, PSEG submitted results of jurisdictional wetland delineation conducted in accordance with procedures identified in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989) and Corps of Engineers Wetland Delineation Manual (1987) at the PSEG Site. Freshwater wetland complexes were identified, flagged, and surveyed. Hydrophytic vegetation, hydric soils, and wetland hydrology were identified and described at each of the data collection points. Additionally, PSEG submitted a description of the 85 ac CDF facility along with interpretation of USACE Regulatory Guidance and descriptions of the CDF hydrology, hydrophytic vegetation, and hydric soil to support wetland determination (PSEG 2012-TN2389).

Thirty-nine Federal jurisdictional freshwater wetland units covering approximately 158.7 ac were identified by the USACE in a letter dated February 24, 2014, to PSEG. These areas were identified as Block 26, lots 2, 4, 4.01, 5, and 5.01 in Lower Alloways Creek Township, Salem County, New Jersey. Any proposal to perform work, build structures, or discharge dredge or fill material into the identified areas would require prior approval from the Philadelphia District Corps of Engineers. Figure 2-6 depicts the jurisdictional wetlands (considered important terrestrial habitat) on the PSEG Site. The printed version of this figure may not be legible; however, the electronic version is viewable when zoomed in. Figure 2-6 includes wetlands mapped by NJDEP (coastal wetlands) and those delineated on the site as part of the site (USACE CDF facility, PSEG desilt basin, and freshwater wetlands). A total of 164.9 ac of coastal wetlands and 158.68 ac of freshwater wetlands have been mapped on the PSEG Site (PSEG 2014-TN3452; USACE 2014-TN3282). The 39 units were individually identified as A1, AA, B1, BB, CC, CDF3, D, D1, D1a, D1b, D1c, D1d, DD, E, F, F1, G, G1, H, H1, I, I1, J, K, L, N, O, O1, P, Q, R, S, T, U, V, W, X, Y, and Z. USACE jurisdictional freshwater wetlands located in unit CDF3 were identified during a site investigation on December 5, 2013. The remaining USACE jurisdictional wetland units were included in NJDEP LOI (USACE 2014-TN3282).

The only roads and transmission corridors that traverse or are located near the PSEG property are those that serve SGS and HCGS. Also, there are no prime farmland soils within the boundaries of the PSEG Site. Large portions of the PSEG Site were disturbed previously for construction of SGS and HCGS or were used by the USACE for dredge material disposal.

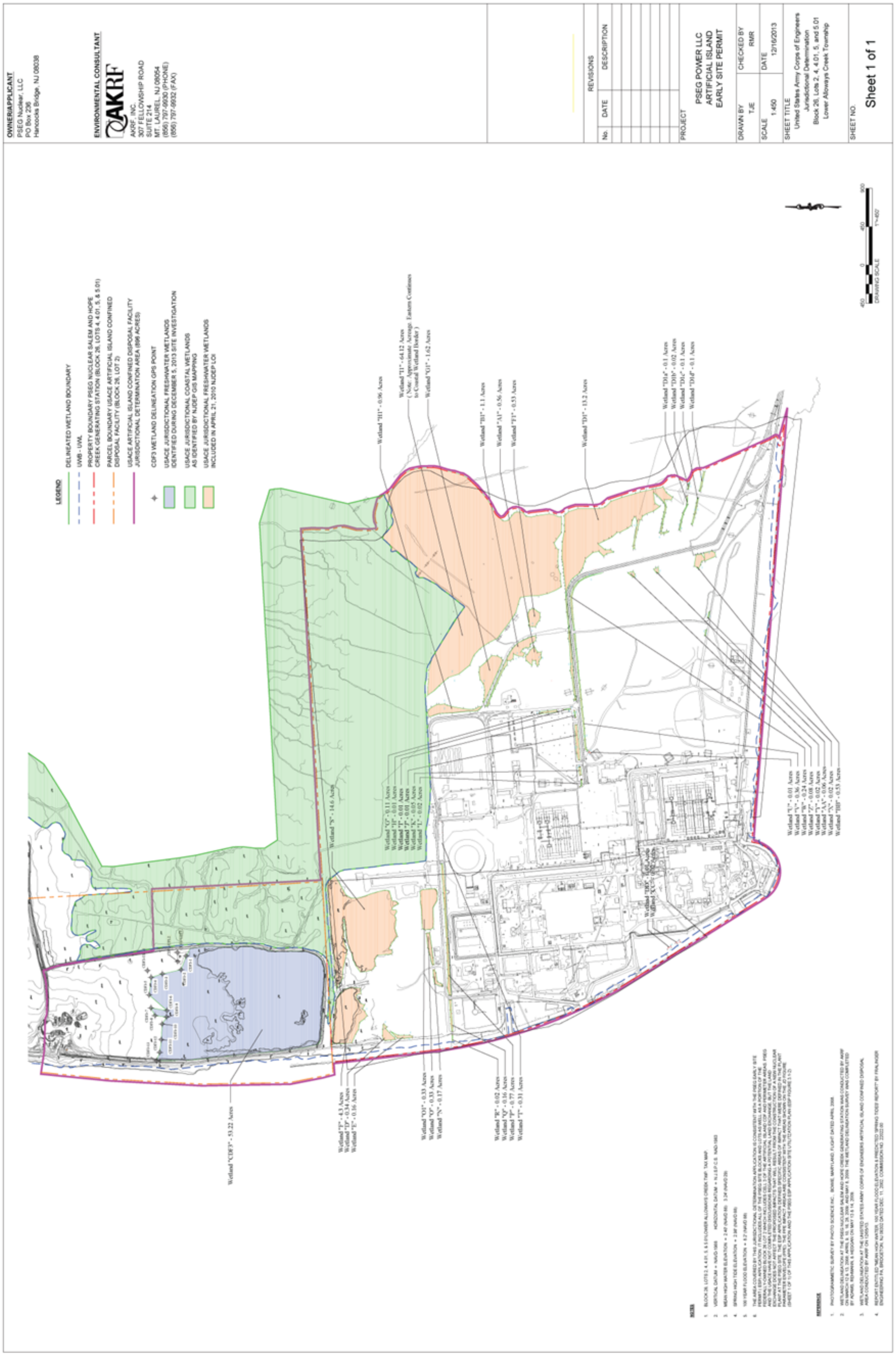


Figure 2-6. USACE Jurisdictional Determination Block 26, Lots 2, 4, 4.01, 5, and 5.01, Lower Alloways Creek Township. ***(Source: USACE 2013-TN3283)***

Salem County is situated within the Atlantic Coastal Plain, which is composed of a sequence of unconsolidated, highly permeable to relatively impermeable quartz-dominated gravel, sand, silt, glauconitic sand (greensand), and clay strata. Therefore, the principal mineral resources within Salem County are sand and gravel, but no gravel or sand mining operations occur on the PSEG Site (PSEG 2014-TN3452).

Cultural resources within the area likely to be affected by construction of a new nuclear power plant at the PSEG Site have been identified, including archaeological sites and architectural resources. Details are provided in Sections 2.7 and 4.6.

Under the Federal Coastal Zone Management Act (16 USC 1451-TN1243), activities of federal agencies affecting coastal zones must be consistent with the approved coastal management program (CMP) of the state or territory to the maximum extent practical. CZMA provisions apply to all actions requiring federal approval (e.g., new plant licenses, license renewals) that affect the coastal zone in a state or territory with a federally approved CMP. The PSEG Site is subject to the provisions of the CZMA, so PSEG filed an application for a CZMA consistency determination from the State of New Jersey. On July 13, 2010, NJDEP's Division of Land Use Regulation issued its determination that PSEG's ESP application is consistent with New Jersey's Rules on Coastal Zone Management as amended to January 20, 2009 (NJAC 7:7E-TN2272) with one condition:

> "As proposed, the project will require a CAFRA Individual Permit, Coastal Wetlands Permit, Waterfront Development Permit, and Freshwater Wetlands Individual Permit from the Division. These permits must be obtained prior to any construction activities on the site related to the project described above" (NJDEP 2010-TN235).

The New Jersey State Planning Commission's State Plan Policy Map delineates a "Heavy Industry–Transportation–Utility Node" on Artificial Island, including 501 ac of the existing 734-ac HCGS/SGS site (PSEG 2012-TN2282). In 2002, NJDEP amended the Coastal Area Facility Review Act (CAFRA) Planning Map to include the Energy Facility Node, recognizing among other things that this designation would enable PSEG to maintain and upgrade its existing nuclear facilities. The "Node" designation allows for increased impervious cover and intensity of use (PSEG 2012-TN2282).

On May 30, 2012, PSEG submitted a petition to the Department of State, Office for Planning Advocacy (OPA), for expansion of PSEG's existing Heavy Industry–Transportation–Utility Node (PSEG 2012-TN2282). The expansion of the Node boundary to the north would include the location of the proposed nuclear power plant and 288 ac of the Artificial Island CDF. In addition to 288 ac of land within the CDF, PSEG also petitioned for an amendment to the existing Node for land currently on PSEG property. This amendment would increase the existing Node on the PSEG Site from 501 ac to 534 ac (PSEG 2012-TN2282).

PSEG's petition for Node change is currently under review at OPA. PSEG anticipates OPA will deem the application complete soon, and the remaining process of acquiring OPA approval and subsequent amendment to New Jersey's Coastal Zone Management Rules (NJAC 7:7E-TN2272) would take 8 to 16 months (PSEG 2012-TN2282).

Salem County, New Jersey, and New Castle County, Delaware, are the only counties located within the 6-mi vicinity of the PSEG Site (Figure 2-7). Most of the land north and east of the PSEG Site is owned by the federal government (under control of the USACE) and the State of New Jersey. Of the USACE land north of the PSEG Site, 305 ac has been developed for use as the Artificial Island CDF (PSEG 2014-TN3452).

The PSEG Site and all surrounding land in the 6-mi vicinity is located in the Coastal Lowlands subregion of the Atlantic Coastal Plain, is at a low elevation, and has little topographical relief. This subregion is characterized by poor drainage, shallow water tables, abundant wetlands, and tidal streams and rivers. Land uses within this subregion included wetlands (46 percent), agriculture (27 percent), forest (20 percent), urban (6 percent), and barren land (1 percent) (PSEG 2014-TN3452).

According to U.S. Geological Survey (USGS) LULC data cited in the ER (PSEG 2014-TN3452), three major land uses (open water, wetlands, and agriculture) account for 94 percent of the total 73,711 ac within the 6-mi vicinity. Table 2-2 presents the acreage for each of 13 land uses within the vicinity. Open water (primarily the Delaware River) represents 36 percent of the total vicinity area, while wetlands (emergent herbaceous and woody wetlands) and agriculture represent 35 percent and 23 percent, respectively. Developed land, forests, and barren land account for the remaining land use (PSEG 2014-TN3452). Figure 2-7 defines the areas within New Jersey and Delaware that are included within the vicinity and depicts the distribution of the land cover and land use within this area.

Figure 2-7 identifies four wildlife management areas (WMAs) within the 6-mi vicinity. Two are located in New Castle County, Delaware (Augustine and Cedar Swamp WMAs), and two are in Salem County, New Jersey (Abbotts Meadow and Mad Horse Creek WMAs). Augustine and Cedar Swamp WMAs total of 8182 ac, and Abbotts Meadow and Mad Horse Creek WMAs total 10,509 ac (PSEG 2014-TN3452).

Figure 2-8 identifies prime farmland and farmland of unique or statewide importance within the vicinity of the PSEG Site. The areas that could be affected by causeway development are identified using soil information (types and slopes) specified as prime by the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) (PSEG 2014-TN3452). Prime farmland of statewide importance is located in uplands east of the PSEG Site. In contrast, farmlands of "unique" importance correspond to lands within the coastal wetlands and may relate to the historical use of some of these areas for salt hay farming. As illustrated in Figure 2-8, upland areas east of the PSEG Site have also been designated by Salem County as "Farm Project Area 3." However, no specific tracts having restrictions as preserved farmlands have been identified within 6 mi of the PSEG Site (PSEG 2014-TN3452).

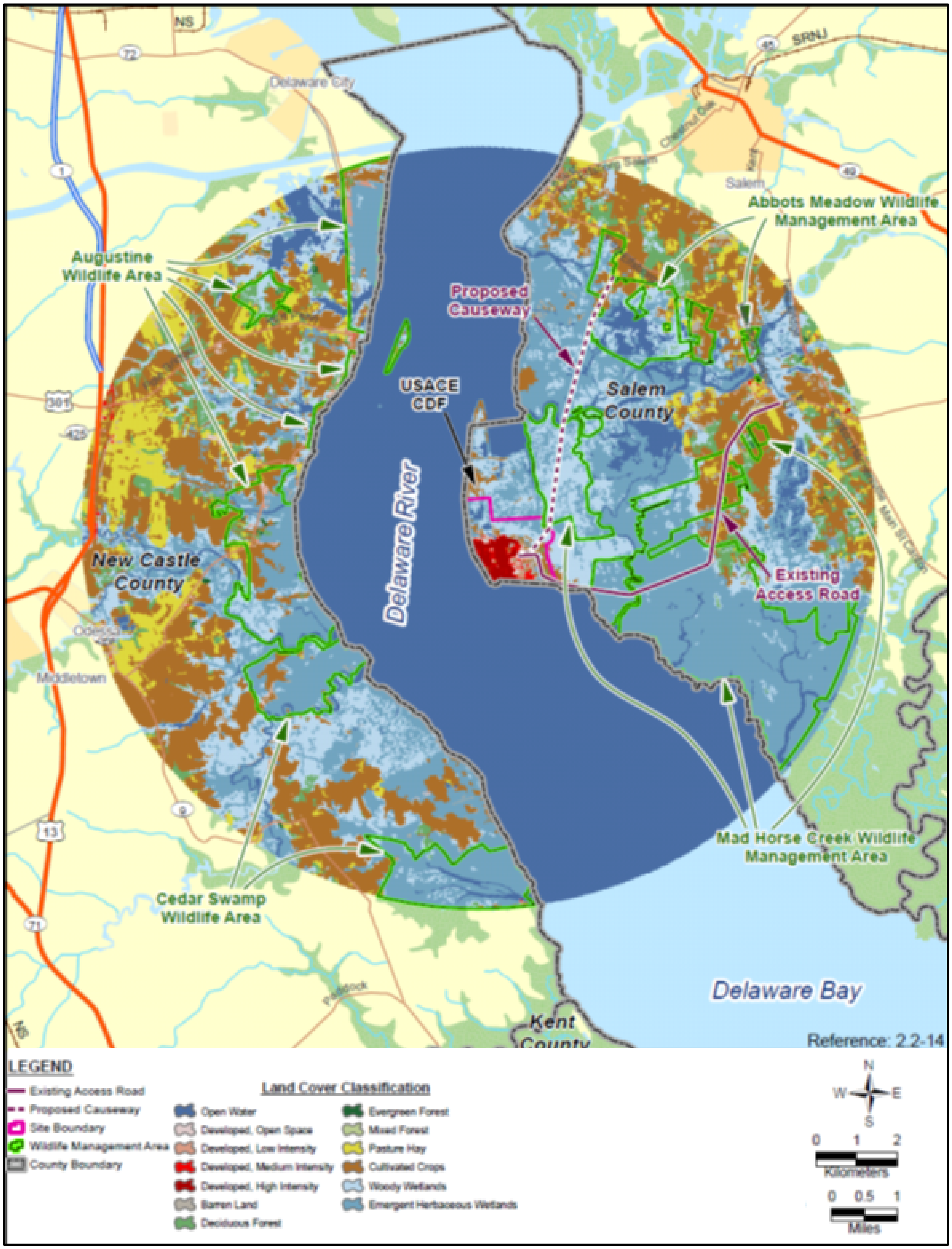


Figure 2-7. Land Use Within the Vicinity of the PSEG Site.
(Source: Modified from PSEG 2014-TN3452)

Table 2-2. Land Use in the Vicinity (6-mi radius) and Region (50-mi radius) of the PSEG Site

USGS Land Use Designation	Vicinity		Region	
	Area (ac)	Percent	Area (ac)	Percent
Open Water	26,837	36.4	791,821	15.7
Developed–Open Space	361	0.5	239,221	4.8
Developed–Low Intensity	274	0.4	212,047	4.2
Developed–Medium Intensity	113	0.1	119,697	2.4
Developed–High Intensity	191	0.2	60,018	1.2
Barren Land	651	0.9	54,142	1.1
Deciduous Forest	2,573	3.5	1,028,552	20.5
Evergreen Forest	67	0.1	156,524	3.1
Mixed Forest	13	0.0	33,828	0.7
Pasture Hay	3,748	5.1	774,432	15.4
Cultivated Crops	13,349	18.1	1,075,101	21.4
Woody Wetlands	8,979	12.2	279,248	5.5
Emergent Herbaceous Wetlands	16,555	22.5	199,603	4.0
Totals	**73,711**	**100.0**	**5,024,234**	**100.0**

Source: PSEG 2014-TN3452.

As shown in Figure 2-7, there are no accessible highways, major airports, or railroads within 6 mi of the PSEG Site. In relation to the PSEG Site, Delaware Route 9 is located 3 mi to the west and Delaware Routes 1 and 13 are located over 5 mi to the west. New Jersey Route 49 is located 7.5 mi to the northeast, and Interstate 295 and the Delaware Memorial Bridge are 15 mi to the north (Figure 2-9). Philadelphia International Airport, the closest major airport, is located 30 mi to the northeast. New Castle County Airport in Delaware is a small regional airport located south of Wilmington that offers a small number of commercial operations. The closest railroad is a Southern Railroad Company of New Jersey rail line located 8 mi to the northeast (PSEG 2014-TN3452).

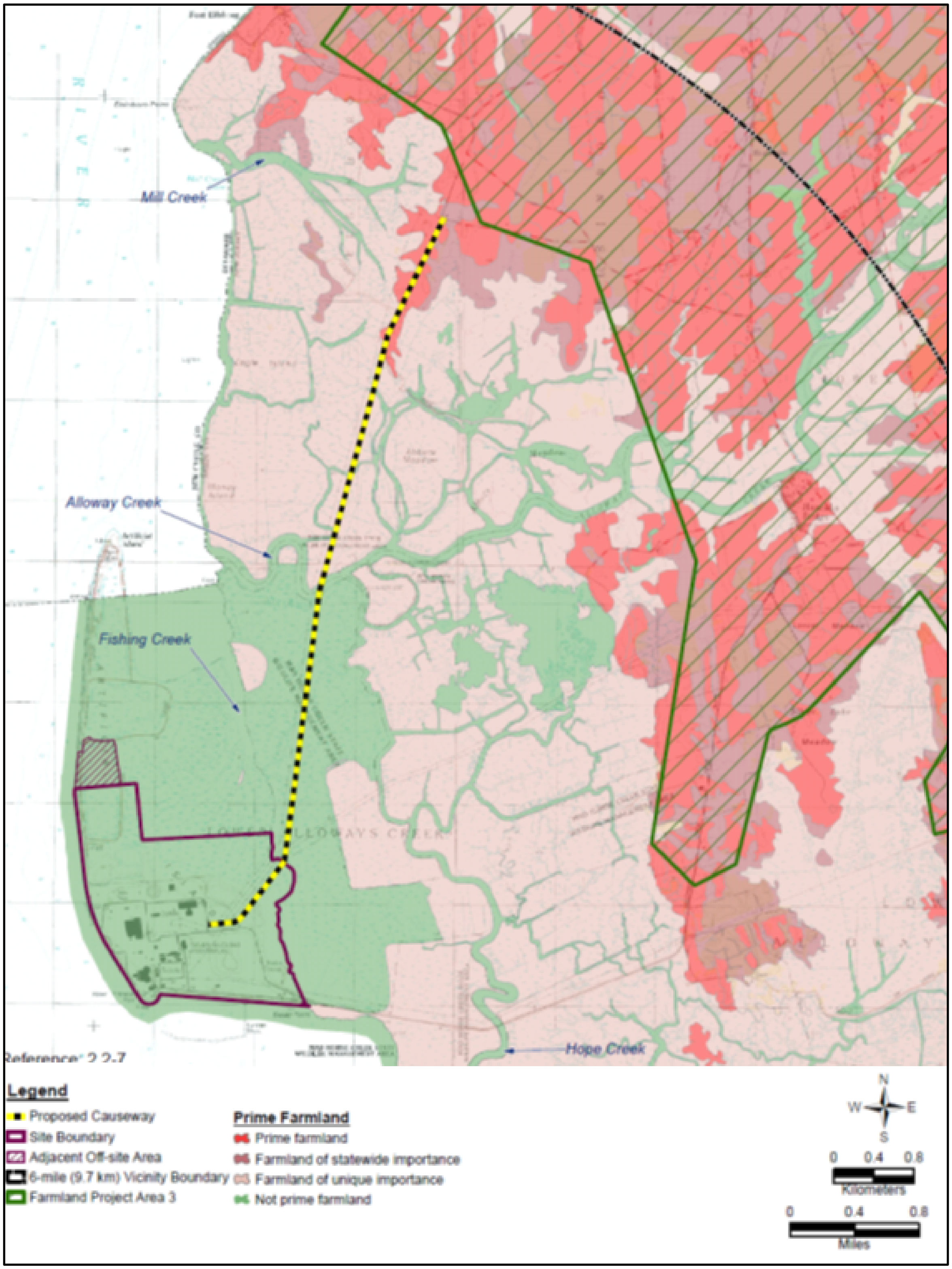


Figure 2-8. Farmland Resources in the Vicinity of the PSEG Site.
(Source: Modified from PSEG 2014-TN3452)

Figure 2-9. Major Transportation Features in the PSEG Site Region.
(Source: Modified from PSEG 2014-TN3452)

2.2.2 Offsite Areas

This section describes land use along the existing transmission line corridors from the PSEG Site (Section 2.2.2.1), the existing access road corridor for the PSEG Site (Section 2.2.2.2), and the proposed access road (i.e., causeway) corridor for the PSEG Site (Section 2.2.2.3).

2.2.2.1 Existing Transmission Lines

There are two 500 kilovolt (kV) transmission lines to the HCGS switchyard from offsite and one 500 kV tie line from HCGS to the SGS switchyard. One of the existing offsite lines is a tie to the Red Lion Substation, located northwest in New Castle County, Delaware, and the other is a tie to the New Freedom Substation, located northeast in Camden County, New Jersey (PSEG 2014-TN3452).

There are also two existing 500 kV transmission lines to the SGS switchyard from offsite and one 500 kV tie line from SGS to the HCGS switchyard. Both offsite lines are ties to the New Freedom Substation in Camden County, New Jersey (PSEG 2014-TN3452).

The transmission corridor rights-of-way on these existing lines range from 200 ft to 350 ft wide. The three corridors cross Camden, Gloucester, and Salem counties in New Jersey and New Castle County in Delaware; they are about 102 mi in total length (one of the corridors is shared by two transmission lines). The transmission line to New Castle County crosses the Delaware River north of the PSEG Site (PSEG 2014-TN3452).

The three transmission line corridors are shown on Figure 2-10 and contain the following lines (PSEG 2014-TN3452).

- Hope Creek–New Freedom: extends northeast from HCGS for 43 mi in a 350-ft-wide corridor to the New Freedom Substation north of Williamstown, New Jersey. This line generally shares the corridor with the Salem–New Freedom line. In 2008, a new substation (Orchard) was installed along this line, dividing it into two segments.

- Salem–New Freedom: extends northeast from SGS for 39 mi in a 350-ft-wide corridor to the New Freedom Substation. This line generally shares the corridor with the HCGS–New Freedom line.

- Hope Creek–Red Lion: extends north from HCGS for 13 mi, then continues west over the Delaware River approximately 4 mi to the Red Lion Substation in Delaware. One-third of the 17-mi corridor is 350 ft wide, and the remainder is 200 ft wide.

- Salem–New Freedom South: extends northeast from SGS for 42 mi in a variable width corridor (generally 350 ft wide) to the New Freedom Substation.

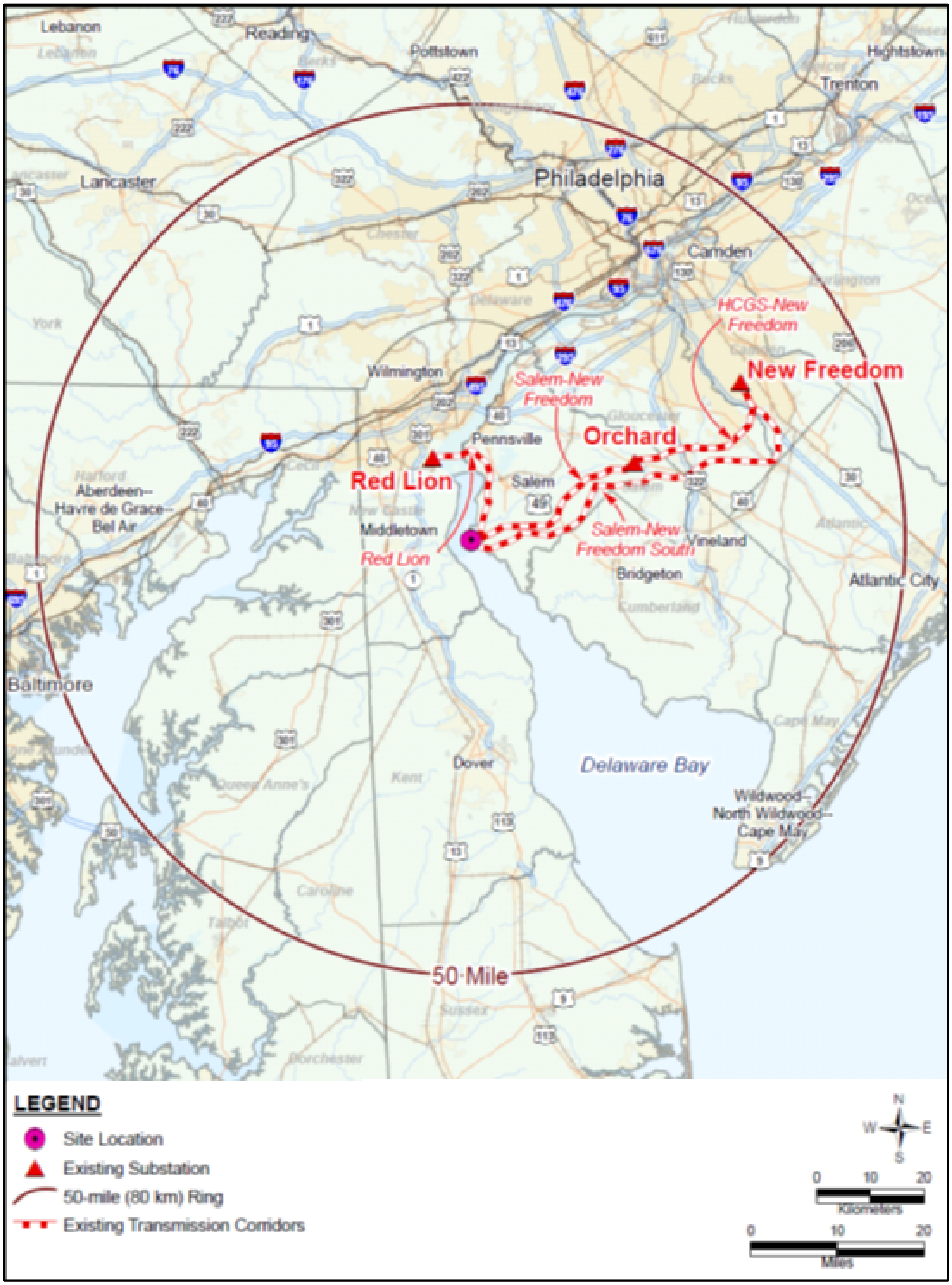


Figure 2-10. Existing PSEG Transmission Corridors.
(Source: Modified from PSEG 2014-TN3452)

PSEG has developed a description of existing land uses along these transmission lines based on an analysis of USGS LULC data (PSEG 2014-TN3452). PSEG used a 500-ft-wide corridor centered on the existing rights-of-way to characterize baseline land uses along the existing corridors. Three major land uses were identified (agriculture, forests, and wetlands) that collectively account for most of the 6,920 ac within the three corridor rights-of-way. Table 2-3 presents the acreage for each of 13 land uses along the existing transmission line corridors. Agriculture (pasture hay and cultivated crops) represents 39 percent of the total right-of-way (ROW) area, while forests (deciduous, evergreen, and mixed), and wetlands (woody and emergent herbaceous) represent 30 percent and 23 percent, respectively. Developed land (2 percent), open water (3 percent), and barren land (2 percent) account for the remaining land use (PSEG 2014-TN3452).

Table 2-3. Land Use in the Existing PSEG Transmission Line Corridors and in the Existing PSEG Access Road Right-of-Way (ROW)

U.S. Geological Survey Land Use Designation	Existing Transmission Corridors		Existing Access Road	
	Area (ac)	Percent	Area (ac)	Percent
Open Water	206	3.0	4	1.0
Developed–Open Space	99	1.4	18	4.7
Developed–Low Intensity	91	1.3	25	6.6
Developed–Medium Intensity	34	0.5	6	1.6
Developed–High Intensity	20	0.3	1	0.3
Barren Land	124	1.8	39	10.3
Deciduous Forest	1,843	26.6	6	1.6
Evergreen Forest	233	3.4		
Mixed Forest	24	0.4		
Pasture Hay	591	8.5	17	4.5
Cultivated Crops	2,091	30.2	117	30.9
Woody Wetlands	1,029	14.9	15	3.9
Emergent Herbaceous Wetlands	535	7.7	131	34.6
Totals	**6,920**	**100.0**	**379**	**100.0**

Note: Transmission line and access road corridor area of analysis is 500 ft. The specific corridors and ROWs are less than this width.

Source: PSEG 2014-TN3452

2.2.2.2 Existing Access Road

The existing access road to the PSEG property extends from the property through coastal wetlands in an easterly and east-northeasterly direction for 3.6 mi, where it connects to Alloway Creek Neck Road, an existing secondary road (Figure 2-7). Alloway Creek Neck Road continues through uplands to the town of Hancock's Bridge (PSEG 2014-TN3452).

2.2.2.3 Proposed Access Road

PSEG has stated that additional access road capacity is necessary to address future transportation needs for the PSEG Site (PSEG 2014-TN3452). To provide this additional access road capacity, PSEG has designed a three-lane causeway that would be constructed on elevated structures for its entire length through the coastal wetlands. The proposed causeway would extend about 5.0 mi northeast from the PSEG Site along or adjacent to the existing Hope Creek–Red Lion transmission corridor ROW to the intersection of Money Island Road and Mason Point Road (Figure 2-7). PSEG's conceptual design for the causeway specifies a 200-ft-wide ROW in upland areas at the northern and southern termini and a 48-ft-wide structure for the elevated portions of the causeway within lowland areas (PSEG 2014-TN3452).

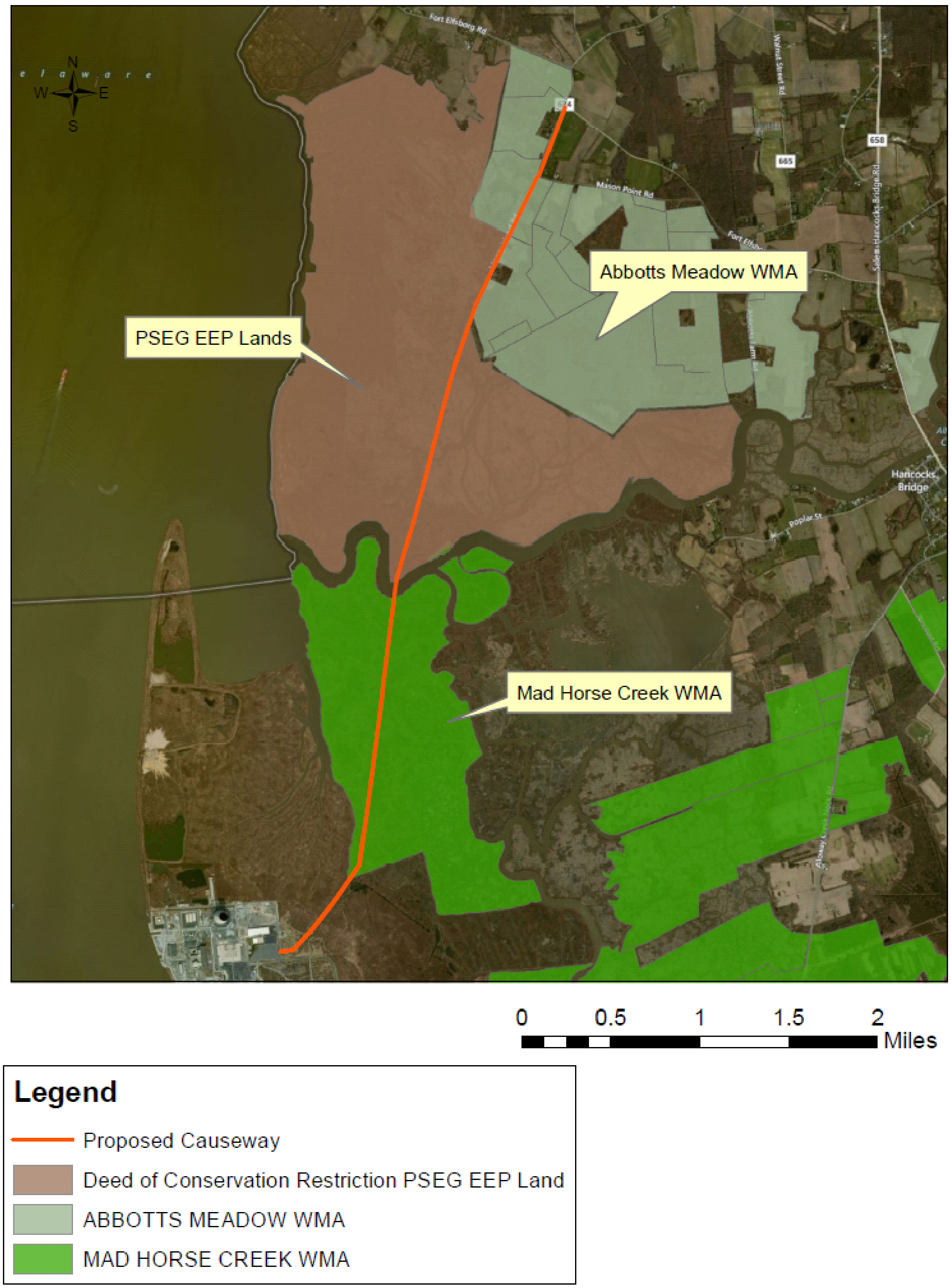
Existing land uses along the proposed causeway alignment are shown in Figure 2-4 and summarized as part of the vicinity in Table 2-2. NJDEP LULC data for the 69-ac area that would be affected by causeway construction indicate that *Phragmites*-dominated coastal and interior wetlands combined represent 41.4 percent, freshwater tidal marshes make up 18.4 percent, and cropland and pastureland represent 15.8 percent. Other minor land uses/land covers along the causeway route include water, developed lands, and forest/old fields (PSEG 2012-TN2282).

The proposed causeway would permanently affect an additional 25.2 ac of offsite wetlands, the impacts of which would be minimized by using an elevated design. The wetland types that would be impacted by the causeway include 11.2 ac of *Phragmites*-dominated coastal wetlands, 6.1 ac of freshwater tidal marshes, 4.4 ac of *Phragmites*-dominated interior wetlands, 1.2 ac of herbaceous wetlands, 1.1 ac of wetlands ROW, 0.9 ac of agricultural wetlands (modified), 0.2 ac of former agricultural wetlands, and 0.1 ac of mixed scrub/shrub wetlands. The causeway would also permanently affect 2.4 ac of tidal rivers, inland bays, and other tidal waters (PSEG 2014-TN3452).

The proposed causeway would cross NJDEP's Mad Horse Creek WMA, NJDEP's Abbotts Meadow WMA, and lands that are part of PSEG's Alloway Creek Watershed Wetland Restoration (ACW) Site, which is part of PSEG's Estuary Enhancement Program (EEP), as shown in Figure 2-11 (PSEG 2012-TN2282). These three properties have different ownership and deed impediments, including some parcels that are under a Deed of Conservation Restriction (DCR), as discussed in Section 4.1.

2.2.3 The Region

The region surrounding the PSEG Site is defined as the area within a 50-mi radius of the new plant centerpoint. The region includes all or parts of 25 counties in four states (three in Delaware, seven in Maryland, seven in New Jersey, and eight in Pennsylvania), as shown in Figure 2-12. The region is within the Coastal Lowlands, Middle Coastal Plain, and Inner Coastal Plain subregions of the Mid-Atlantic Coastal Plain. Section 2.2.1 describes characteristics of the Coastal Lowlands. The Middle Coastal Plain is the other major subregion near the PSEG Site, and it is characterized by variable drainage, abundant forests, low topographic elevations, and low to moderate relief.



Data Source: NJDEP Geographic Information System Clearinghouse

Figure 2-11. Land Management Areas along the Proposed Causeway Route.
(Source PSEG 2012-TN2282)

Figure 2-12. Land Use in the PSEG Site Region.
(Source: Modified from PSEG 2014-TN3452)

Land uses in the Middle Coastal Plain include forest (38 to 60 percent), agriculture (27 to 39 percent), wetlands (9 to 21 percent), urban (3 to 7 percent), and barren land (1 to 2 percent). Similarly, land uses in the Inner Coast Plain include forest (46 to 59 percent), agriculture (23 to 28 percent), urban (10 to 16 percent), wetlands (6 to 7 percent), and barren land (2 to 3 percent) (PSEG 2014-TN3452).

Figure 2-12 delineates the areas within Delaware, Maryland, New Jersey, and Pennsylvania that are included within the region and depicts the distribution of land cover and land use. USGS LCLU data indicate that four major land uses (agriculture, forests, open water, and developed lands) account for 89 percent of the total area (5,024,234 ac) within the region. Table 2-2 presents the acreage for each of 13 land uses within the region. Agricultural uses represent 37 percent of the total region area, while forests (deciduous, evergreen, and mixed) account for 24 percent. Open water (principally the Delaware Bay, Delaware River, and Chesapeake Bay) accounts for 16 percent of the regional area, and developed lands (open space and low- to high-intensity) represent 13 percent. Wetlands (10 percent) and barren land account for the remaining land use (PSEG 2014-TN3452).

As shown in Figure 2-9, major highways in the region include Interstates 76, 95, 276, 295, 476, 495, and 676. Other principal roadways include New Jersey Route 55, the New Jersey Turnpike, the Garden State Parkway, and the Atlantic City Expressway. The Delaware Bay, Delaware River, Chesapeake and Delaware Canal, and Chesapeake Bay represent the major waterways within the region. Major rail lines or rail systems include those owned by Conrail, Southeastern Pennsylvania Transportation Authority, Port Authority Transit Corporation, and Southern Railroad of New Jersey (PSEG 2014-TN3452).

2.3 Water

This section describes the hydrological processes governing movement and distribution of water in the existing environment at the PSEG Site. Water use and monitoring at the PSEG Site are also described. Surface water is used as a cooling fluid for the SGS and HCGS units at the PSEG Site, and would be used for a new nuclear power plant at the PSEG Site. Groundwater is used for SGS and HCGS operations, and additional groundwater withdrawals would be needed for a new plant at the PSEG Site. The following description is limited to only those parts of the hydrosphere that may affect or be affected by building and operating a new nuclear power plant at the PSEG Site.

2.3.1 Hydrology

This section describes the site-specific and regional hydrological features of the existing environment that could be altered by building or operating a new nuclear power plant at the PSEG Site. A description of the site's hydrological features is presented in Section 2.3.1 of PSEG's ER (PSEG 2014-TN3452). The hydrological features of the site related to site safety (e.g., probable maximum flood) are described in PSEG's SSAR (PSEG 2014-TN3453).

A new nuclear power plant at the PSEG Site would withdraw most of the water needed during building and operations from the Delaware River using a new intake structure, and would discharge the blowdown from the circulating water system (CWS) cooling towers to the river

using a discharge pipe. A new causeway would also be built from the PSEG Site toward the northeast and would cross existing water bodies. Development of a new plant would result in building in floodplains on the PSEG Site. Therefore, the environment described in this section includes the following:

- the Delaware River because it would be the source of water withdrawn for building and operating a new nuclear power plant and would be the receiving water body of effluent discharge
- the coastal streams near the PSEG Site because they may be affected by building a new power plant
- the local surface-water features on and adjacent to the site that may receive stormwater runoff
- the 100-year floodplains near the PSEG Site because some building would occur inside the existing 100-year floodplain
- the coastal area along the proposed causeway route because some building activity would occur within this area
- the Delaware River Estuary because conditions in the estuary affect the Delaware River near the PSEG Site
- the Chesapeake and Delaware (C&D) Canal that connects the Chesapeake Bay with the Delaware River because the bidirectional flow in the canal can affect water levels near the PSEG Site
- the local and regional groundwater systems because they are the source of freshwater needed during building and operation of a new plant.

2.3.1.1 Surface-Water Hydrology

The PSEG Site is located on the eastern bank of the Delaware River at Delaware RM 52 (Figure 2-13). The existing SGS and HCGS are located on Artificial Island between Delaware RMs 51 and 52. Artificial Island was created by the USACE's deposition of Delaware River dredged material behind a natural sandbar and bulkhead. The Delaware River is about 2.5 mi wide near the PSEG Site.

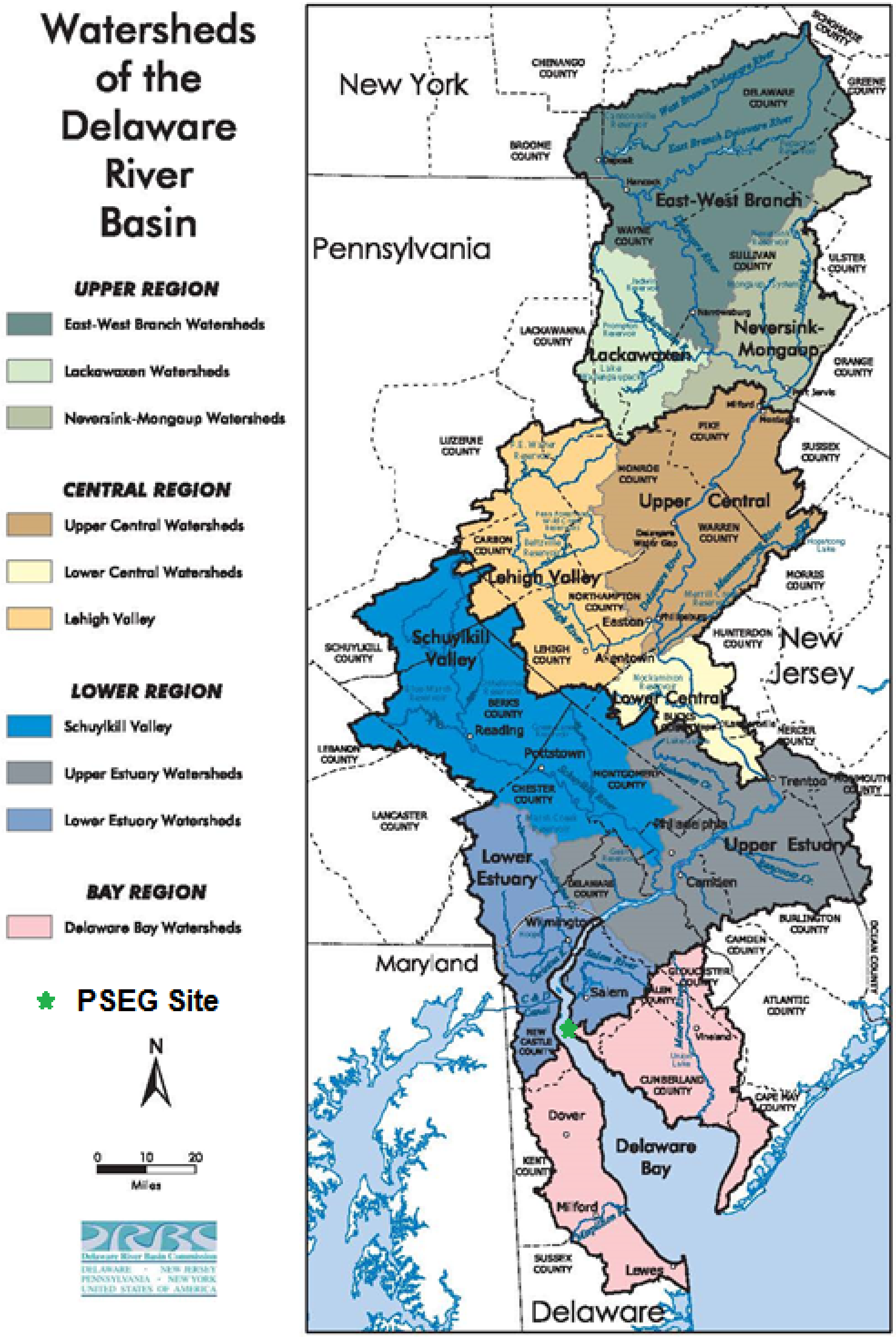


Figure 2-13. The Delaware River Watershed.
(Source: Modified from DRBC 2004-TN3276)

Numerous streams near the PSEG Site flow into the Delaware River from both the New Jersey and the Delaware sides (PSEG 2014-TN3452). St. Georges Creek, Augustine Creek, Silver Run, Appoquinimink River, and Blackbird Creek flow into the Delaware River from the Delaware side at approximately Delaware RMs 56.5, 53.5, 52.5, 51, and 50.5, respectively. Mill Creek, Alloway Creek, Hope Creek, Fishing Creek, and Mad Horse Creek flow into the Delaware River from the New Jersey side at about Delaware RMs 56.5, 54, 48.5, 47.5, and 45, respectively.

Figure 2-14 shows the water bodies (ponds, streams, marsh creeks, and drainage channels) on and immediately adjacent to the PSEG Site. Tidal wetland channels that start on the eastern side of the PSEG Site and the Artificial Island CDF run off toward the east and northeast into Fishing Creek. Starting east of the north end of the Artificial Island, Fishing Creek flows north into the Delaware River at a point south of where Alloway Creek flows into the river.

The Delaware River near the PSEG Site is tidally influenced; therefore, the water surface elevations generated by large storm surge events are generally higher than those produced by riverine floods in the Delaware River. Near the PSEG Site, the Federal Emergency Management Agency (FEMA) prepares flood risk maps and has determined the 1 percent annual exceedance flood water surface elevation from extreme storm surge events. The area inundated by the 1 percent annual exceedance flood water surface elevation is commonly known as the 100-year floodplain. The 1 percent annual exceedance flood water surface elevation at the confluence of the Delaware River and Alloway Creek is 8.9 ft National Geodetic Vertical Datum of 1929 (NGVD29) (FEMA 1982-TN3214). Near the PSEG Site, the NAVD88 is about 0.84 ft above the NGVD29. Therefore, the 1 percent annual exceedance flood water surface elevation at the confluence of the Delaware River and Alloway Creek is 8.1 ft NAVD88.

Because the 100-year floodplain near the PSEG Site is controlled by storm surges, the contiguous floodplain is vast, consisting of the low-lying coastal areas. The applicant estimated that the area of the 100-year floodplain within a 6-mi radius of the PSEG Site is 59,681 ac or 93.5 mi^2 (PSEG 2012-TN2244).

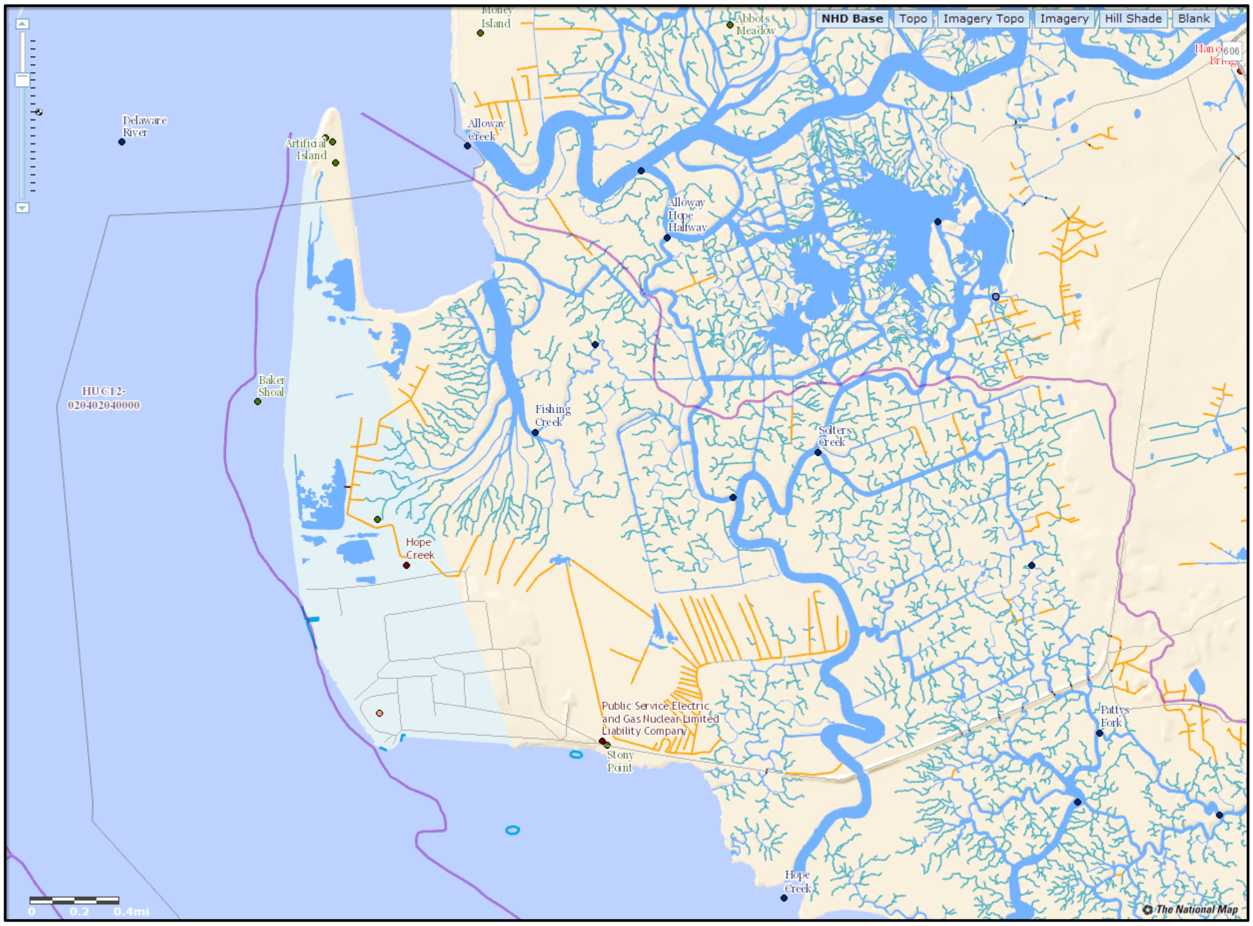


Figure 2-14. Streams on and near the PSEG Site Identified Using the High-Resolution USGS National Hydrography Dataset (NHD). ***(Source: USGS 2014-TN3280)***

The Delaware River Basin

Most of the Delaware River Basin is located within the States of New York, New Jersey, Pennsylvania, and Delaware. A small portion of the northeastern corner of Maryland is also within the basin. The Delaware River Basin is approximately 13,600 mi^2 in area, including the approximately 800 mi^2-area of the Delaware Bay and receives approximately 45 in. of precipitation annually (DRBC 2008-TN2277).

The East Branch Delaware River originates near Roxbury, New York, and flows generally west (see Figure 2-13). The West Branch Delaware River originates near Stamford, New York, and also flows generally west. The East and the West Branches meet to form the Delaware River below Hancock, New York. From this point, the Delaware River flows generally to the south, forming the borders between the States of New York and Pennsylvania, New Jersey and Pennsylvania, and New Jersey and Delaware. The Delaware River expands into the Delaware Bay and discharges into the Atlantic Ocean near Cape Henlopen, Delaware, and Cape May, New Jersey. The Delaware River Basin Commission (DRBC) uses a river mileage system for location and identification along the Delaware River and Bay (DRBC 2011-TN2412). Mile zero in the river mileage system (Delaware RM 0) is located at the mouth of the Delaware Bay on the intersection of the navigation channel with a line

between Capes Henlopen and May. The head of the Delaware River is at Delaware RM 330.7 at the confluence of East and West Branches near Hancock, New York.

Parameters measured daily in the Delaware River by USGS at the stream gages near the PSEG Site are shown in Table 2-4. Discharge is measured only at the Trenton and Lambertville gages. The Trenton gage has a relatively long period of discharge measurements (since 1912 and continuing), but the Lambertville gage has only a 9-year record. Gage heights are measured at several other locations.

The annual discharge of the Delaware River for the period of record at Trenton is shown in Table 2-5. The annual discharge at Trenton varies from 4,708 to 22,040 cfs with a long-term mean of 12,004 cfs. The maximum annual discharge occurred in water year 2011. The next four largest annual discharges—19,810, 18,190, 18,020, and 17,540 cfs—occurred in water years 1928, 2004, 1952, and 1973, respectively. The maximum instantaneous peak discharge measured at Trenton was 329,000 cfs on August 20, 1955 (USGS 2013-TN2405).

Table 2-4. Parameters Measured Daily at U.S. Geological Survey (USGS) Stream Gages in the Delaware River near the PSEG Site

Site Name (USGS Gage Number)	Location	Parameter
Delaware River at Reedy Island Jetty, DE (01482800)	39°30′3″ N 75°34′7″ W	Specific Conductivity (1963-10-03 to 2012-08-29) pH (1970-02-11 to 2012-08-29) Water Temperature (1970-02-11 to 2012-08-29) Dissolved Oxygen (1970-02-11 to 2012-08-29) Turbidity (2009-04-18 to 2011-12-18)
Delaware River at New Castle, DE (01482170)	39°39′24.5″ N 75°33'43.2″ W	Gage Height (2012-04-05 to 2012-04-26)
Delaware River at Delaware Memorial Bridge at Wilmington DE (01482100)	39°41'21″ N 75°31′19″W	Water Temperature (1956-10-01 to 1981-03-18)
Delaware River Below Christina River at Wilmington, DE (01481602)	39°43′00.0″ N 75°31′59.6″ W	Gage Height (2005-10-01 to 2008-06-23)
Delaware River at Chester, PA (01477050)	39°50′33″ N 75°21′28″ W	Specific Conductivity (1963-10-01 to 2012-08-29) pH (1068-01-18 to 2012-08-29) Water Temperature (1961-12-21 to 2012-08-29) Dissolved Oxygen (1961-12-27 to 2012-08-29)
Delaware River at Paulsboro, NJ (01475200)	39°50′42″ N 75°16′09″ W	Gage Height (1986-12-20 to 1988-01-11)

Table 2-4 (continued)

Site Name (USGS Gage Number)	Location	Parameter
Delaware River at Fort Mifflin at Philadelphia, PA (01474703)	39°52′45″ N 75°12′11″ W	Specific Conductivity (1970-07-14 to 2010-11-04) Water Temperature (1972-06-16 to 2010-11-04)
Delaware R at Ben Franklin Bridge at Philadelphia, PA (01467200)	39°57′14″ N 75°08′16″ W	Specific Conductivity (1963-11-08 to 2012-08-29) pH (1967-10-01 to 2012-08-29) Water Temperature (1960-11-10 to 2012-08-29) Dissolved Oxygen (1961-10-03 to 2012-08-29) Turbidity (2008-09-10 to 2011-12-12)
Delaware River at Palmyra, NJ (01467060)	40°01′05″ N 75°02' 16″ W	Gage Height (1986-10-01 to 1991-10-24)
Delaware River at Torresdale Intake at Philadelphia, PA (01467030)	40°01′57″ N 74°59′46″ W	Gage Height (1990-05-28 to 1991-11-17)
Delaware River at Bristol, PA (01464600)	40°04′55″ N 74°51′58″ W	Specific Conductivity (1968-10-02 to 1980-11-26) pH (1968-08-20 to 1980-11-26) Water Temperature (1955-10-02 to 1980-11-26) Dissolved Oxygen (1962-10-02 to 1980-11-26)
Delaware River at Marine Terminal at Trenton, NJ (01464040)	40°11′21″ N 74°45′21″ W	Specific Conductivity (1972-10-02 to 1976-06-30) Water Temperature (1972-10-02 to 1976-06-30)
Delaware River at Trenton, NJ (0146350)	40°13′18″ N 74°46′41″ W	Discharge (1912-10-01 to 2012-08-29) Specific Conductivity (NJ side) (1968-06-25 to 1995-09-30) Specific Conductivity (PA side) (1995-10-01 to 2012-08-29) pH (NJ side) (1968-06-25 to 1995-09-30) pH (PA side) (1995-10-01 to 2012-08-29) Water Temperature (NJ side) (1953-10-01 to 1995-09-30) Water Temperature (PA side) (1995-10-01 to 2012-08-29)

Table 2-4 (continued)

Site Name (USGS Gage Number)	Location	Parameter
		Dissolved Oxygen (NJ side) (1962-01-02 to 1995-09-10) Dissolved Oxygen (PA side) (1995-10-01 to 2012-08-29)
		Dissolved Oxygen percent saturation (PA side) (2001-10-01 to 2012-08-29)
		Suspended Sediment Concentration (1949-09-01 to 1982-03-31)
		Suspended Sediment Discharge (1949-09-01 to 1982-03-31)
		Turbidity YSI6026 (PA side) (1999-11-02 to 2004-05-30)
		Turbidity YSI6136 (PA side) (2004-06-01 to 2012-08-29)
Delaware River near Morrisville, PA (01463450)	40°13′28″ N 74°47′20″ W	Specific Conductivity (2009-05-14 to 2009-10-07)
		pH (2009-05-14 to 2009-10-07)
		Water Temperature (2009-05-14 to 2009-10-07)
		Dissolved Oxygen (2009-05-14 to 2009-10-07)
Delaware River at Washington Crossing, NJ (01462500)	40°17′42″ N 74°52′05″ W	Gage Height (2010-10-19 to 2012-08-29)
Delaware River at Lambertville, NJ (01462000)	40°21′53″ N 74°56′56″ W	Discharge (1897-10-01 to 1906-09-30)
		Gage Height (2008-10-02 to 2012-08-29)

Table 2-5. Annual Discharge in the Delaware River at Trenton, New Jersey

Water Year	Discharge (cfs)	Water Year	Discharge (cfs)	Water Year	Discharge (cfs)
1913	12,420	1946	13,420	1979	13,770
1914	11,590	1947	13,620	1980	10,550
1915	10,260	1948	12,940	1981	7,414
1916	12,630	1949	10,970	1982	10,230
1917	10,420	1950	11,160	1983	12,650
1918	10,210	1951	14,770	1984	15,740
1919	10,910	1952	18,020	1985	6,365

Table 2-5 (continued)

Water Year	Discharge (cfs)	Water Year	Discharge (cfs)	Water Year	Discharge (cfs)
1920	13,220	1953	14,380	1986	13,230
1921	11,850	1954	9,051	1987	11,820
1922	11,680	1955	11,150	1988	9,802
1923	7,956	1956	14,570	1989	10,510
1924	11,070	1957	8,957	1990	12,600
1925	9,705	1958	12,480	1991	10,760
1926	10,090	1959	9,248	1992	8,305
1927	13,160	1960	14,230	1993	12,550
1928	19,810	1961	10,780	1994	14,180
1929	10,150	1962	8,004	1995	8,542
1930	9,591	1963	7,883	1996	15,730
1931	7,826	1964	8,175	1997	14,680
1932	7,926	1965	4,708	1998	12,810
1933	14,860	1966	6,277	1999	7,749
1934	10,150	1967	9,386	2000	12,340
1935	12,140	1968	10,480	2001	9,069
1936	14,590	1969	9,788	2002	7,127
1937	12,390	1970	10,610	2003	17,110
1938	14,010	1971	11,780	2004	18,190
1939	12,660	1972	15,540	2005	15,470
1940	11,820	1973	17,540	2006	16,880
1941	9,184	1974	14,020	2007	14,230
1942	10,770	1975	15,260	2008	15,010
1943	14,790	1976	13,530	2009	13,510
1944	9,119	1977	12,010	2010	12,400
1945	14,760	1978	16,560	2011	22,040

Figure 2-15 shows the annual discharge in the Delaware River at Trenton. The Delaware River Basin experienced the most severe drought during 1961 to 1967 with a mean annual flow of 7,888 cfs at Trenton, approximately 66 percent of long-term mean annual discharge. At Trenton, the annual discharge in the Delaware River fell below the long-term mean annual discharge in 1961 and stayed below 75 percent of the long-term mean until 1968. In 1972, the annual discharge exceeded the long term mean for the first time since 1960. During this extended drought period, the annual discharge at Trenton also reached its historical minimum in 1965, when it fell below 50 percent of the long-term mean annual discharge. Other multiyear

periods when the annual discharge at Trenton was below the long-term mean annual discharge include 1914 to 1915, 1917 to 1919, 1921 to 1926, 1929 to 1932, 1940 to 1942, 1949 to 1950, 1980 to 1982, 1987 to 1989, and 1991 to 1992. The annual discharge fell below 75 percent of the long-term mean during 1921 to 1926, 1929 to 1932, and 1980 to 1982.

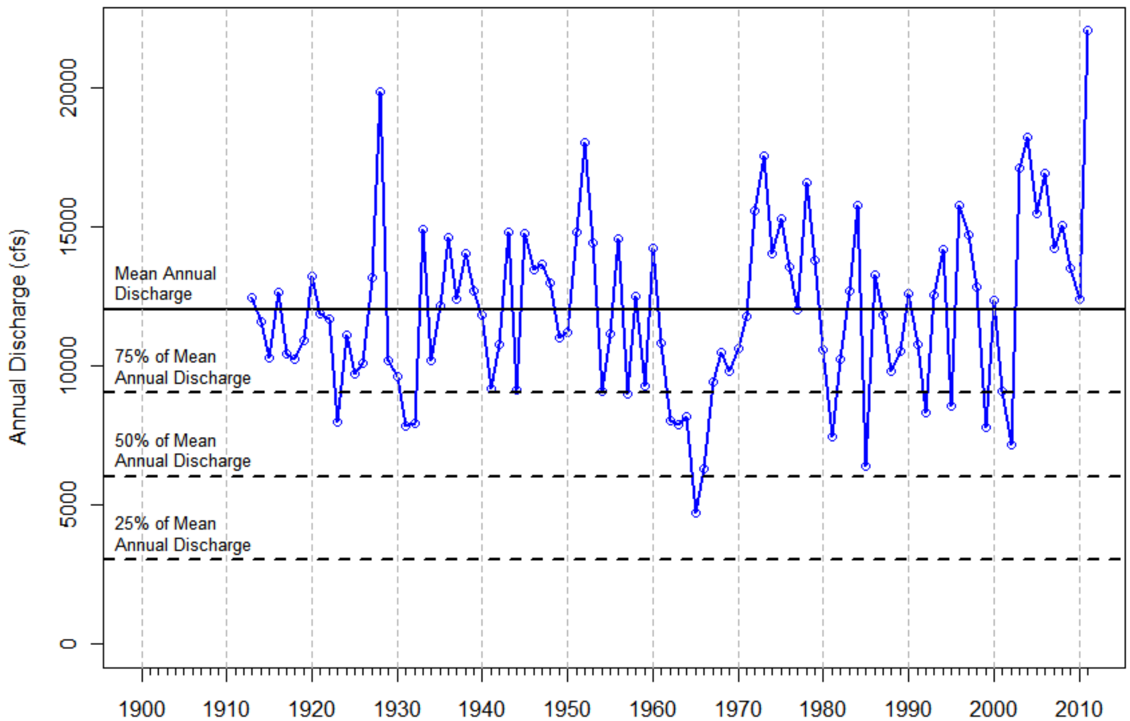


Figure 2-15. Annual Discharge at the Trenton USGS Streamflow Gage.

An analysis of the monthly Delaware River discharge at the Trenton USGS streamflow gage for 1913 to 2011 water years shows that low flows occur in late summer through fall with a late fall peak in December (Figure 2-16). Discharge reduces with the onset of winter before reaching the annual peak in March or April. In late spring through summer, discharge in the Delaware River gradually reduces, reaching annual lows from July through October. The maximum monthly discharge of 60,840 cfs occurred in March 1936, and the minimum monthly discharge of 1,548 cfs occurred in July 1965.

The mainstem Delaware River does not have any reservoirs (DRBC 2008-TN2277). However, there are 24 reservoirs on its tributaries of which nine are water supply reservoirs, two are hydropower reservoirs, three are flood control reservoirs, one is solely used for flow augmentation, and the remaining nine are dual or multipurpose reservoirs used for water supply, flow augmentation, and/or flood control (DRBC 2008-TN2277). According to the USACE National Inventory of Dams (USACE 2013-TN2407), there are more than 1,000 dams in the Delaware River Basin; 19 of these have normal storages exceeding 10,000 ac-ft as listed in Table 2-6).

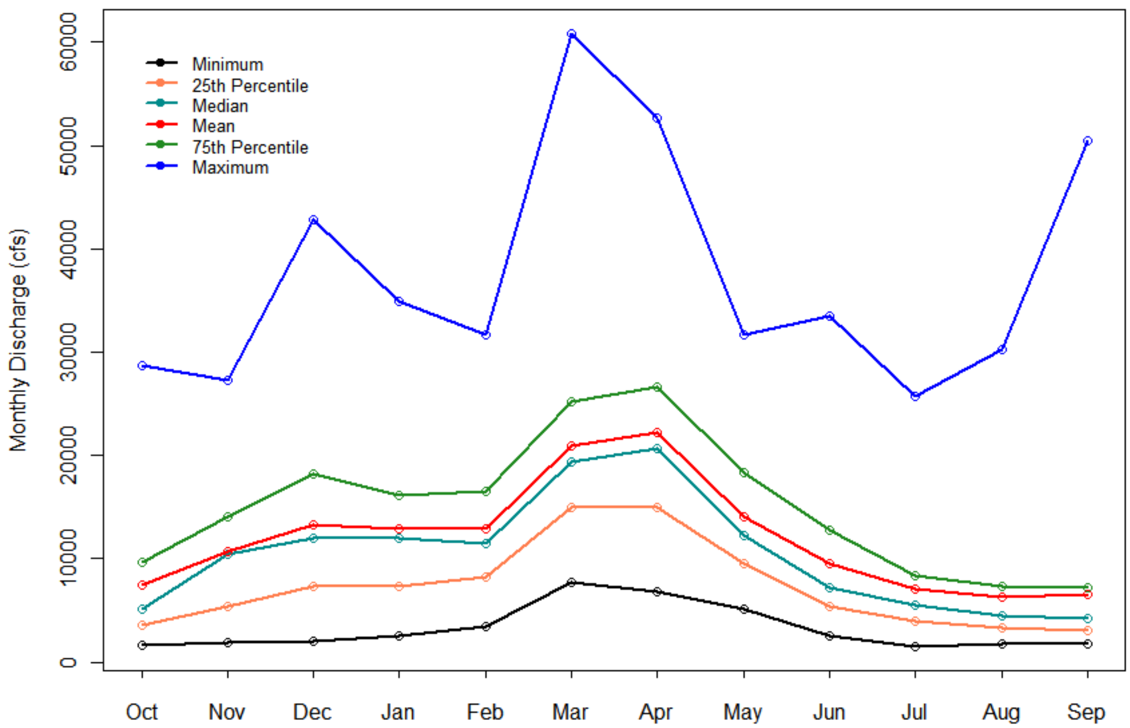


Figure 2-16. Characteristics of the Monthly Discharge During Water Years 1913–2011 at the Trenton USGS Streamflow Gage.

Table 2-6. Reservoirs in the Delaware River Basin with Storages Exceeding 10,000 ac-ft

Name	Owner or Operator	Purpose	Stream or River	Normal (and Maximum) Storage (ac-ft)
Beltzville	USACE	Flood Control, Water Supply, Recreation	Pohopoco Creek	41,220 (103,625)
Blue Marsh	USACE	Flood Control, Recreation, Water Supply	Tulpehocken Creek	22,897 (129,900)
Cannonsville	New York City Department of Environmental Protection	Water Supply	West Branch Delaware River	300,999 (450,000)
Greenlane	(Private)	Water Supply, Recreation	Perkiomen Creek	13,430 (25,114)
Lake Hopatcong	New Jersey Division of Parks and Forestry	Flood Control	Muscontcong River	48,209 (48,209)
Merrill Creek	Merrill Creek Owner's Group	Flow Augmentation	Merrill Creek	46,000 (46,000)
Neversink	New York City Department of Environmental Protection	Water Supply	Neversink River	108,872 (142,000)

Table 2-6 (continued)

Name	Owner or Operator	Purpose	Stream or River	Normal (and Maximum) Storage (ac-ft)
Nocamixon	Pennsylvania Department of Environmental Protection	Recreation	Tohickon Creek	40,000 (71,000)
Penn Forest	Pennsylvania Department of Environmental Protection	Water Supply	Wild Creek	20,000 (27,600)
Pepacton	New York City Department of Environmental Protection	Water Supply	East Branch Delaware River	420,280 (609,740)
Rio	(Utility)	Hydroelectric, Recreation	Mongaup River	15,037 (19,500)
Shohola Marsh	Pennsylvania Department of Environmental Protection	Recreation	Shohola Creek	12,610 (26,450)
Springton	(Private)	Water Supply	Crum Creek	10,740 (13,600)
Swinging Bridge	(Utility)	Hydroelectric, Recreation	Mongaup River	31,848 (67,500)
Tafton Dike	(Utility)	Hydroelectric, Recreation	Lackawaxen River	132,000 (270,000)
Toronto	(Utility)	Hydroelectric	Mongaup River	25,211 (26,500)
Union Lake	New Jersey Department of Environmental Protection	Recreation	Maurice River	11,600 (20,100)
Wallenpaupack	(Utility)	Hydroelectric, Recreation	Lackawaxen River	132,000 (270,000)
Wild Creek	Pennsylvania Department of Environmental Protection	Water Supply	Wild Creek	12,583 (17,143)

The Delaware River Estuary

The Delaware River Estuary extends approximately 134 mi from the mouth of the Delaware Bay upstream to Trenton, New Jersey, the farthest point of tidal influence (Cook et al. 2007-TN2983). The maximum width of the Delaware River Estuary is about 28 mi, and its mean depth is about 26 ft (Garvine et al. 1992-TN2989). The Delaware River Estuary is weakly

stratified with a typical salinity variation of only 1 practical salinity unit[1] (psu) because the tidal flux is large, exceeding 220 times the freshwater discharge from Delaware River (Garvine et al. 1992-TN2989).

The first mention of dredging using man-powered treadmills and disposal in the Delaware River Estuary dates back to 1784 and 1803, respectively, and the first mechanical, steam-powered dredging is described as occurring in 1804 (Snyder and Guss 1974-TN2280). In the early nineteenth century, depths of 12 to 27 ft were adequate in the Delaware River Estuary. In 1853, to improve navigation, it was proposed to employ a combination of dredging and diking the stream banks with spoils dumped behind stone-filled timber dikes (Snyder and Guss 1974-TN2280). After the Civil War and reorganization of the USACE in 1866, the great expansion of maritime traffic for the Philadelphia port and the advent of international shipping lanes into the Delaware River and Bay prompted the need for a permanent shipping channel and its continued maintenance (Snyder and Guss 1974-TN2280). During this time, a depth of 27 ft at low water was considered adequate for the shipping channel. Numerous bars, shoals, and flats interrupted the navigable reaches. In 1879, the first rock removal occurred at Schooner Ledge. The Rivers and Harbors Act of 1899 (33 USC 403-TN660) authorized a survey for creation of a 30-ft-deep channel from Philadelphia to Delaware Bay. Baker and Stony Point shoals were enclosed by bulkheads to create Artificial Island, the principal disposal site for the Lower Delaware, when excavation began for a 30-ft-deep channel in 1900 (Snyder and Guss 1974-TN2280). The shipping channel from the Delaware Bay to the Philadelphia Navy Yard was deepened to 40 ft by dredging conducted from December 1940 to February 1942 (Snyder and Guss 1974-TN2280).

The USACE is currently deepening the existing shipping channel to a depth of 45 ft mean lower low water (USACE 2011-TN2262). Proposed channel side slope is 3 horizontal to 1 vertical. The channel width will be the same as the existing channel width, which is 400 ft in Philadelphia harbor, 800 ft from Philadelphia Navy Yard to Bombay Hook, and 1,000 ft from Bombay Hook to the mouth of Delaware Bay (USACE 2011-TN2262). Approximately 16 million yd^3 of material will be dredged and placed in USACE CDFs and for beneficial uses within the Delaware Bay (USACE 2011-TN2262).

The Delaware River Estuary and the upper Chesapeake Bay are connected via the C&D canal, which is approximately 14 mi long, 450 ft wide, and 35 ft deep (USACE 1997-TN2281). Joining the waters of the Chesapeake Bay and the Delaware River Estuary—an idea envisioned as far back as the 17th century—greatly shortens the 300-mi trip around the coast of Delaware and Maryland (USACE 2012-TN2408). The Chesapeake and Delaware Canal Company built the original canal, which was only 66 ft wide and 10 ft deep, from 1824 to 1829 (USACE 2012-TN2408). The Federal Government purchased the canal in 1919. The canal was expanded to a width of 90 ft and a depth of 12 ft and was converted to operate at sea-level. Another expansion during 1933 to 1938 resulted in a 250-ft-wide and 27-ft-deep canal. A final expansion of the canal during the 1960s and 1970s resulted in its present-day size (USACE 2012-TN2408). Because of

[1]The term practical salinity unit or psu is used to express quantities on the practical salinity scale which was defined in 1978 as the dimensionless ratio of the electrical conductivity of a sample of water to that of a standard potassium chloride solution. Another way to express salinity is the ratio of weight of dissolved salts to the weight of the water as parts-per-thousand or ppt. There is a small numeric difference between salinities of the same water expressed using the two methods.

fluctuations in tides and circulations, the flow in the C&D canal can be in either direction. The Delaware River Estuary end of the C&D canal is at Delaware RM 59. The C&D canal carries 40 percent of the shipping traffic into and out of the Port of Baltimore (USACE 2012-TN2408).

Tides in the Delaware River Estuary are semidiurnal. NOAA maintains several tide gages in the Delaware River and Bay area. At the mouth of the Delaware Bay, NOAA has two tide gages at Lewes, Delaware, and at Cape May, New Jersey. The mean tidal ranges at these stations are 4.1 and 4.9 ft, respectively (NOAA 2014-TN2411). The mean tidal range at the Trenton Marine Terminal, New Jersey, NOAA tide gage is 8.2 ft (NOAA 2014-TN2411). The funnel shape of the estuary and the presence of the shipping channel result in amplification of the tidal range at Trenton, New Jersey (DiLorenzo et al. 1993-TN2979).

2.3.1.2 Groundwater Hydrology

The geology of the PSEG Site and the surrounding region is described in detail in SSAR Section 2.5 (PSEG 2014-TN3453). The PSEG Site is located in the Coastal Plain physiographic province, a region between the Atlantic Ocean and the Fall Line characterized by generally low topographic relief and underlain by semi-consolidated to unconsolidated sediments consisting of clays, silts, sands, and some gravel (Trapp and Horn 1997-TN1865). The Fall Line is a low east-facing cliff, generally parallel to the Atlantic coastline, extending from New Jersey to the Carolinas. It separates the Mesozoic and Tertiary Coastal Plain sediments from the harder Paleozoic metamorphic rocks of the Piedmont physiographic province to the west. The PSEG Site is approximately 18 mi south of the fall line.

Regional Groundwater Description

Regional groundwater hydrology is described in ER Section 2.3.1.2 (PSEG 2014-TN3452) and SSAR Section 2.4.12 (PSEG 2014-TN3453). The hydrogeologic description provided in these documents is consistent with the regional description provided in Segment 11 of the Ground Water Atlas of the United States (Trapp and Horn 1997-TN1865). The PSEG Site is located within the New Jersey Coastal Plain aquifer system, part of the Northern Atlantic Coastal Plain aquifer system. The New Jersey Coastal Plain aquifer system consists of a wedge-shaped mass of unconsolidated sediments of clay, silt, sand, and gravel. The wedge is 6,000 ft thick in Cape May County and thins northwestward to the Fall Line.

The hydrogeologic units within the New Jersey Coastal Plain are described by the USGS as southeast dipping permeable fine-grained to coarse-grained materials separated by less permeable fine-grained materials, resulting in a multiple aquifer system (Zapecza 1989-TN2994; Martin 1998-TN2259). The overlying unconsolidated units reflect the topography of the underlying bedrock and show a corresponding southeasterly dip of 10 to 60 feet per mile (ft/mi) (Spitz and dePaul 2008-TN2998). The aquifers are generally thicker near the ocean and thin progressively toward the northwest and closer to the western borders of New Jersey. In some instances, aquifers may thin out entirely. The major aquifers within the New Jersey Coastal Plain aquifer system, listed from deepest to shallowest, are the Potomac–Raritan–Magothy (PRM) aquifer system, Englishtown aquifer, Wenonah–Mount Laurel aquifer, Vincentown aquifer, Piney Point aquifer, Atlantic City 800-ft sand, and the Kirkwood-Cohansey aquifer system

(Martin 1998-TN2259). Figure 2-17 illustrates the occurrence of these aquifers in the southern New Jersey Coastal Plain and a generalized depiction of groundwater flow in the region.

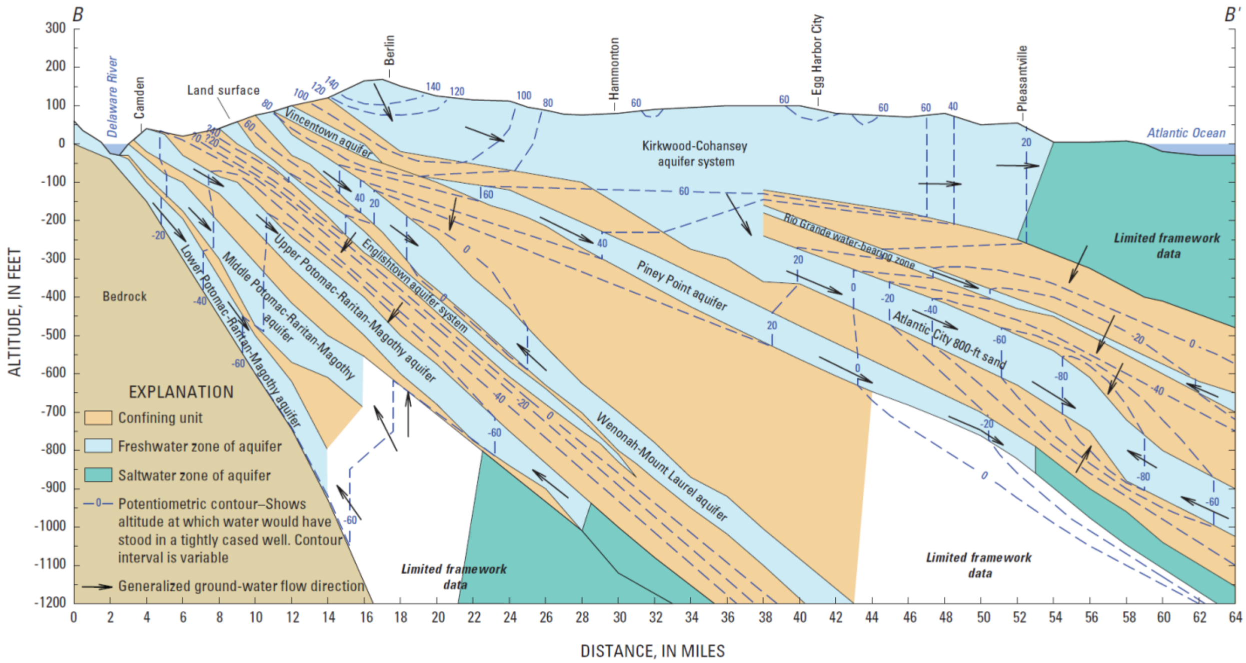


Figure 2-17. Cross-Section Through the Southern New Jersey Coastal Plain Aquifer System. *(Source: dePaul et al. 2009-TN2948)*

Regionally, aquifer recharge primarily occurs from precipitation where the aquifer units outcrop. Additional recharge occurs from adjacent aquifers through leaky confining units. In some areas, aquifers may receive induced recharge from the Delaware River. Using a combination of regional studies and model calibration, average recharge rates for the New Jersey Coast Plain aquifer system were estimated by the USGS to range from 6 to 20 in./year (Voronin 2003-TN2947), with the lower part of this range applicable nearest the PSEG Site. Modeling studies presented in the SSAR used recharge values of 0.15 to 8 in./year for the PSEG Site (PSEG 2014-TN3453).

Prior to significant pumping, groundwater flow in the New Jersey Coastal Plain aquifers generally discharged to the lower reach of the Delaware River, to the Delaware and Raritan Bays, and to the Atlantic Ocean (Martin 1998-TN2259). Simulated pre-pumping groundwater heads in the New Jersey Coastal Plain aquifer system were reported in USGS 1998 (Martin 1998-TN2259). In the middle PRM aquifer, heads were approximately 20 ft (NGVD 1929) in the area of Artificial Island. Large-scale groundwater withdrawals in the 1900s reduced the heads throughout the aquifer system. Groundwater heads in the middle PRM aquifer prior to the initiation of pumping for SGS/HCGS were assumed to be -5 to -6 ft (NGVD 1929) in Dames and Moore 1988 (Dames and Moore 1988-TN3311).This is consistent with a measured head of -4 ft recorded in 1969 by the USGS for a well located on Artificial Island and screened in the undifferentiated PRM aquifer (middle/lower PRM aquifers) (USGS 2013-TN2999). This reduction in head (about 25 ft) reflects the impact of large regional pumping centers located near the PRM outcrop areas in Delaware and New Jersey (Martin 1998-TN2259).

Aquifer pumping has had a significant impact on groundwater heads and groundwater flow patterns, impacting the availability of surface and groundwater supplies and increasing the potential for degradation of groundwater quality through saltwater intrusion (dePaul et al. 2009-TN2948). New Jersey has designated two Water Supply Critical Areas in the New Jersey Coastal Plain in response to long-term declines in groundwater levels where groundwater is a primary water supply (Spitz and dePaul 2008-TN2998). Critical Area 2 is the closest to the PSEG Site and extends into the easternmost portion of Salem County. Withdrawals from the PRM aquifer system are restricted in Water Supply Critical Area 2. In response to these restrictions, some withdrawals in Critical Area 2 were shifted to the Wenonah–Mount Laurel aquifer, resulting in groundwater head reductions in that aquifer (Spitz and dePaul 2008-TN2998). The PSEG Site is approximately 25 mi southwest of Critical Area 2 and is not subject to groundwater withdrawal restrictions except as defined in applicable permits.

The U.S. Environmental Protection Agency (EPA) has determined that the New Jersey Coastal Plain aquifer system is a sole source aquifer (53 FR 23791-TN2987). This decision was based in part on findings that 75 percent of drinking water needs in the area were derived from groundwater and that the various aquifers respond as an interrelated aquifer system.

Onsite Groundwater Description

To characterize the local hydrogeology, existing data from the PSEG Site were combined with results from 16 geotechnical boreholes and 16 observation well pairs completed for the ESP application. Figure 2-18 shows a stratigraphic section for the PSEG Site based on the geotechnical borings. Geologic formations identified at the site correspond to the layered aquifer-confining unit structure described in the regional description provided above. The Piney Point aquifer and Atlantic City 800-ft sand are not present at the site. The description of the PRM aquifer system in SSAR Section 2.4.12 (PSEG 2014-TN3453) differs from the regional description (e.g., in dePaul et al. 2009-TN2948). The SSAR describes the Raritan Formation as part of the Potomac Formation, and identifies the Upper Raritan aquifer as the upper PRM aquifer at the PSEG Site. This is inconsistent with USGS descriptions and with the description in Dames and Moore 1988 (Dames and Moore 1988-TN3311), which associate the Upper Raritan aquifer with the middle PRM aquifer. This EIS follows the USGS description of the aquifers. The deepest geotechnical borings at the site penetrated the upper part of the Potomac Formation (to depths of about 600 ft, as shown in Figure 2-18). The wells supplying the majority of water to HCGS and SGS are screened in the middle PRM aquifer at depths of about 800 ft (PSEG 2014-TN3453).

The surface sediments at the PSEG Site consist of artificial fill from previous construction activities and hydraulic fill from channel dredging of the Delaware River. Plant foundations would be constructed on the sediments of the Vincentown formation (PSEG 2014-TN3452). Elevations of the top of the units and average thicknesses are given in Table 2-7.

At the PSEG Site, the upper Kirkwood is a low permeability unit separating the water-bearing alluvium from the lower Kirkwood and Vincentown aquifers. According to ER Table 2.3-12 (PSEG 2014-TN3452), the 16 observation well pairs were installed with the deeper well accessing the Vincentown aquifer. Thirteen of the upper wells were installed in the alluvium, two were installed in the hydraulic fill, and one upper well was installed at the upper boundary of the Vincentown aquifer due to the absence of the alluvium at that location.

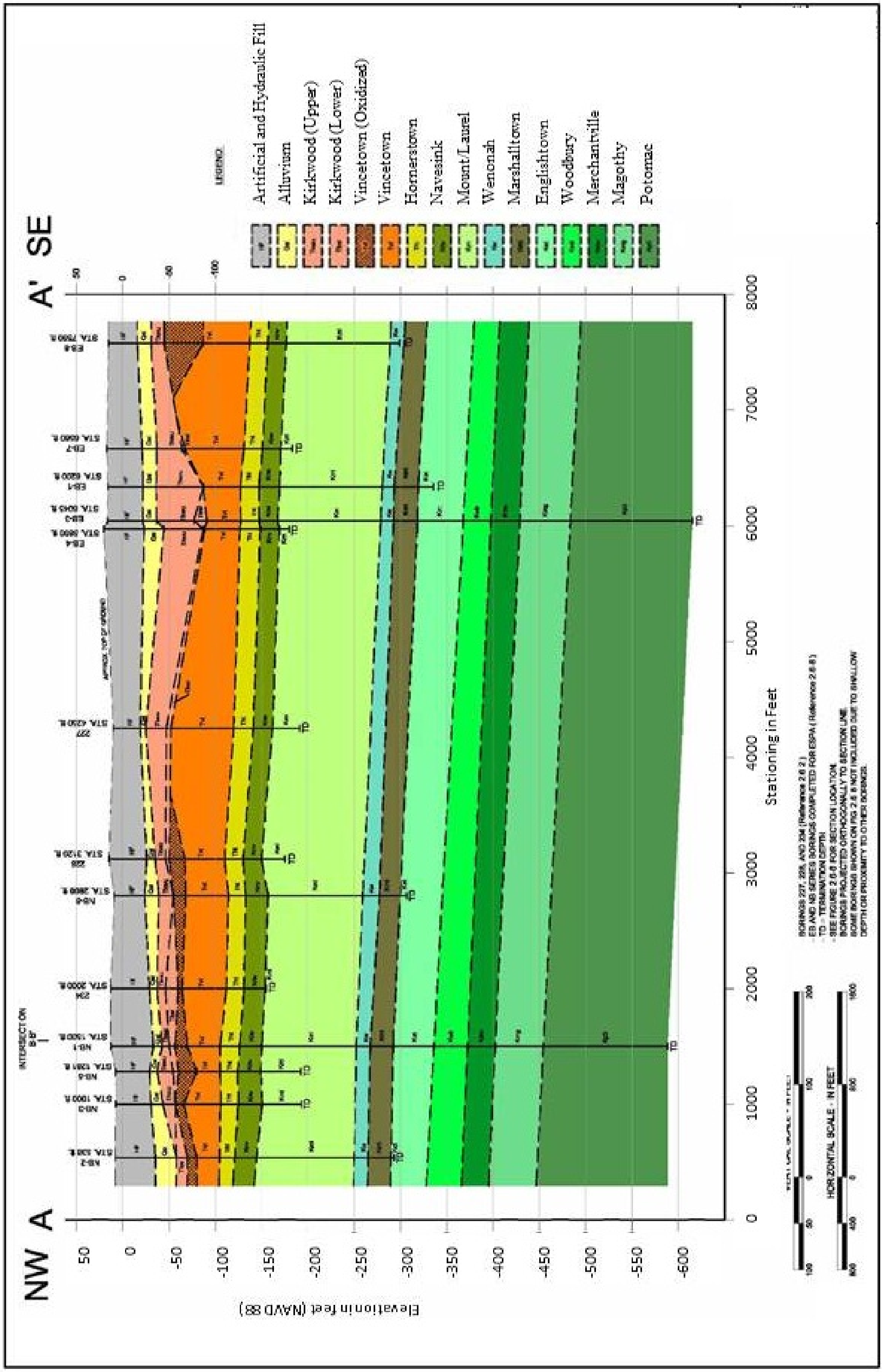


Figure 2-18. Hydrogeologic Units at the PSEG Site. ***(Source: PSEG 2014-TN3452)***

Table 2-7. Approximate Top Elevation and Thickness for Hydrogeologic Units at the PSEG Site (summary of ER Section 2.6.2)

Unit	Approximate Top Elevation (ft NAVD88) (from boreholes near proposed new plant location)	Average Thickness (ft)	Comment
Artificial and Hydraulic Fill	20	22–44	Ground surface; fill material from dredge spoils
Alluvium	–25	15 (highly variable)	Formerly bed of Delaware River
Kirkwood (Lower and Upper)	–38	35 (highly variable)	Upper Kirkwood is an aquitard
Vincentown	–55	50 (highly variable)	Water bearing zone for shallow groundwater transport
Hornestown	–110	20	Generally an aquitard
Navesink	–125	24	Aquitard
Mount Laurel	–150	103	Potable aquifer
Wenonah	–255	15	Potable aquifer
Marshalltown	–270	15	Aquitard
Englishtown	–291	47	Potable aquifer
Woodbury	–336	33	Aquitard
Merchantville	–372	30	Aquitard
Magothy	–402	53	Potable aquifer
Potomac	–454	>200	Primary source of potable water for PSEG Site

PSEG provided time series plots of measured groundwater heads and contour plots of interpolated groundwater heads. Groundwater heads in the two wells installed in the hydraulic fill were higher than the surrounding wells installed in the alluvium, indicating that the groundwater in the fill is likely perched water and not in direct hydraulic contact with the groundwater in the alluvium. Changes over time in the monthly head values were generally less than 2 ft during the 12-month measurement period. There was no clear seasonal variation in heads. High frequency head measurements in two wells located near the Delaware River showed that groundwater head in the Vincentown aquifer was strongly influenced by the tide. Tidal influence was weaker in the alluvium and appeared to decrease rapidly in both hydrogeologic units with increasing distance from the river.

Average horizontal hydraulic gradients were reported in ER Table 2.3-15 and were generally less than 0.001 ft/ft (PSEG 2014-TN3452). Vertical gradients based on average head values in the well pairs were reported in ER Table 2.3-16 (PSEG 2014-TN3452). The majority of these gradients indicated downward flow from the alluvium to the Vincentown aquifer. Where it is present, the low permeability of the intervening Upper Kirkwood unit limits vertical flow between the two units.

Groundwater head contour maps presented in the ER show that groundwater in the alluvium and the Vincentown aquifer generally flows toward the Delaware River. For the September 2009 sampling period, the observation wells located on the HCGS and SGS were included in the set of groundwater head data for the alluvium. The head contours show a slight groundwater mound over the HCGS site, with groundwater flowing outward, generally toward the Delaware River, but also toward the marsh to the northeast of the PSEG Site.

Site-specific groundwater heads in the deeper aquifers were not reported in the ER; however, heads, pumping rates, and salinity data were obtained from NJDEP and evaluated by the review team (NJDEP 2013-TN3223). Regionally, groundwater heads in the deeper aquifers are influenced by the large regional pumping centers in Camden, Gloucester, and Salem Counties, New Jersey, and in New Castle County, Delaware (dePaul et al. 2009-TN2948). At the PSEG Site, groundwater heads in the middle and lower PRM aquifers appear to be affected by the New Castle County withdrawals (Plates 8 and 9, dePaul et al. 2009-TN2948). In addition, there is a local depression of groundwater head in the middle PRM aquifer associated with HCGS and SGS groundwater use for operations (Plate 8, dePaul et al. 2009-TN2948). The head measured in the USGS observation well 33-934 (site observation Well J) at the south end of Artificial Island was -70 ft, a drawdown of about 50 ft below the apparent regional groundwater head.

Aquifer Material Properties

PSEG evaluated saturated hydraulic conductivity by completing a slug test in eight of the observations well pairs on the northern portion of the site (PSEG 2014-TN3452). Average hydraulic conductivity values, reported in ER Table 2.3-17 (PSEG 2014-TN3452), were about 3.8 ft/d in the alluvium and the Vincentown aquifer. A value of 0.2 ft/d was reported for the single well installed in the hydraulic fill. A summary of hydraulic properties based on regional data was provided in SSAR Table 2.4.12-1 for all of the hydrogeologic units identified at the site (PSEG 2014-TN3453).

Groundwater Pathways

A new nuclear power plant at the PSEG Site would be situated in an area of low topographic relief adjacent to the Delaware River, with plant excavation extending into the Vincentown aquifer. Horizontal hydraulic gradients are small in the Vincentown aquifer and in the alluvium. Tidal influence on groundwater heads is prominent near the Delaware River, but the general groundwater flow is toward the river. There is a component of groundwater flow in the alluvium that is directed to the northeast, with likely discharge to the marsh. This marsh drains to the Delaware River via Fishing Creek to the north of the PSEG Site. Average groundwater velocities reported in the ER were 2.9 ft/year (in the northern portion of the site) and 12.9 ft/year (in the eastern portion) for the alluvium, and 3.3 ft/year (in the northern portion of the site) and 1.7 ft/year (in the eastern portion) for the Vincentown aquifer (PSEG 2014-TN3452). Alternative groundwater pathways for an accidental release of liquid radioactive effluents are discussed in SSAR 2.4.13 (PSEG 2014-TN3453). The staff's evaluation of groundwater pathways and radionuclide transport will be documented in the safety evaluation report (SER).

2.3.2 Water Use

This subsection describes surface water and groundwater uses that could affect or be affected by the construction and operation of a new nuclear power plant at the PSEG Site. Descriptions of the types of consumptive and nonconsumptive water uses, identification of their locations, and quantification of water withdrawals and returns are included in ER Section 2.3 (PSEG 2014-TN3452). Water use, for the purposes of this subsection, is broadly defined, encompassing human water supply needs for drinking and domestic uses, industrial uses, and agricultural uses. It also includes instream uses that do not involve water diversion such as navigation, recreation, and aquatic habitat needs based on water quality.

2.3.2.1 Surface-Water Use

Water Use near the PSEG Site

The waters of the Delaware River Estuary near the PSEG Site, at approximately Delaware RM 52, are brackish, with salinity varying seasonally from 4 to 20 ppt (PSEG 2014-TN3452). Major consumptive water uses in the vicinity of the PSEG Site are those for HCGS and SGS. HCGS employs a closed-cycle cooling system. The average HCGS withdrawal from the Delaware River is 67 Mgd. SGS uses a once-through circulating water system. The SGS intake flow is limited to a 30-day average of 3,024 Mgd. Because SGS uses a once-through cooling system, almost all of the withdrawn water is returned to the Delaware River (PSEG 2014-TN3452).

Water Use in the Delaware River Basin

As decreed by the United States Supreme Court in 1954, the City of New York has rights to withdraw 800 Mgd of water from the Delaware River Basin via three city-owned headwater reservoirs: Neversink, Pepacton, and Cannonsville (USGS 2004-TN2406). The Neversink, Pepacton, and Cannonsville reservoirs were completed in 1954, 1955, and 1964, respectively (NYCDEP 2013-TN2409). As part of the decree and agreement among the States of New York, New Jersey, Pennsylvania, and Delaware, the three reservoirs are required to release sufficient water to maintain flow objectives of 1,750 and 3,000 cfs at Montague and Trenton, New Jersey, respectively. An out-of-basin, 100 Mgd water supply to central and northeastern New Jersey is also permitted (USGS 2004-TN2406). One purpose of the 3000 cfs target flow at Trenton, New Jersey, is to maintain the salt line at Delaware RM 98, downstream of public water supply intakes (DRBC 2008-TN2277). The salt line in the tidal Delaware River is a location where the seven-day average chloride concentration equals 250 ppm (DRBC 2008-TN2277).

Within the Delaware River Basin, over 8,736 Mgd of water, including surface and groundwater, are used, including an average of 736 Mgd exported to New York City and northeastern New Jersey (DRBC 2008-TN2277). Almost 90 percent of water withdrawn is supplied from surface water (DRBC 2008-TN2277). Within the basin, 65 percent of water is used for thermoelectric power generation, 10 percent is used for public water supply, 7 percent is used for hydroelectric power generation, and 6 percent is used for industrial purposes (DRBC 2008-TN2277). Surface water accounts for 64 percent of potable water supply, and groundwater accounts for the remaining 36 percent (DRBC 2008-TN2277). Ninety percent of the commercial and

residential potable water is supplied by public water supply systems, while private domestic wells account for the remaining 10 percent (DRBC 2008-TN2277).

The DRBC was created in 1961 through signing of the Delaware River Basin Compact among the Federal Government and the four basin States of New York, New Jersey, Pennsylvania, and Delaware (DRBC 2004-TN2278). The DRBC is responsible for protecting water quality, allocating and permitting water supply, conserving water resources, managing drought, reducing flood losses, and developing recreation in the basin (DRBC 2012-TN2279). A resolution by the governors of the four basin states in 1999 directed the development of a comprehensive water resources plan for the Delaware River Basin (DRBC 2004-TN2278). This goal-based plan was developed around five key areas: to manage the quantity and quality of the basin's waters for sustainable use; to manage waterways to reduce flood losses, improve recreation, and protect, conserve, and restore riparian and aquatic ecosystems; to integrate water resource management into land use planning and growth management; to strengthen partnership among stakeholders; and to provide stewardship for protection, improvement, and restoration of water resources (DRBC 2004-TN2278). The plan defines a set of objectives to achieve the stated goals (DRBC 2004-TN2278).

2.3.2.2 Groundwater Use

The New Jersey Coastal Plain is a major source of groundwater for the southern half of New Jersey and is the primary source for public water systems in Salem, Gloucester, and Cumberland counties. A detailed description of the major water users in this region was supplied in the ER (PSEG 2014-TN3452), including a list of groundwater users within a 25-mi radius of the PSEG Site that are permitted for withdrawal of more than 100,000 gpd (PSEG 2014-TN3452). Across the Delaware River in New Castle County, Delaware, about one-quarter of the public water is obtained from a groundwater supply (PSEG 2014-TN3452). The Wenonah–Mount Laurel and PRM aquifer systems are the principal sources of potable water in the southern region of New Jersey and in New Castle County, Delaware (dePaul et al. 2009-TN2948).

The locations of public water supply wells in New Jersey and wellhead protection areas in New Jersey and Delaware within a 25-mi radius of the PSEG Site are reported in ER Figure 2.3-20 (PSEG 2014-TN3452). Water withdrawal rates and well depth information are provided for public water supply wells that do not fall within wellhead protection areas. This information is not available for wells located in a wellhead protection area (PSEG 2014-TN3452).

PSEG stated that, "there are no offsite public water supply wells or private wells within 2 mi of the PSEG Site," (PSEG 2014-TN3452). The nearest groundwater use location shown on ER Figure 2.3-20 is a wellhead protection area approximately 3.0 mi from the PSEG Site, across the Delaware River in New Castle County, Delaware. The nearest groundwater use location in Salem County that is shown on ER Figure 2.3-20 is a public water supply well approximately 5.0 mi from the PSEG Site. The nearest domestic residences in Salem County are located on Alloway Creek Neck Road approximately 3.0 mi from the PSEG Site.

Groundwater is the only source of freshwater at the PSEG Site, and PSEG has authorization from NJDEP (NJDEP 2012-TN3222) and DRBC for consumptive use of up to

43.2 million gallons of groundwater per month (but no more than 300 million gallons per year) to support the combined operations at HCGS and SGS. There is a maximum diversion rate of 2,900 gpm for these two plants. The groundwater is used for potable, industrial process makeup, fire protection, and sanitary purposes.

HCGS derives groundwater from two wells installed to depths of 816 ft in the middle PRM aquifer (referred to in the ER as the Upper Raritan Formation of the PRM aquifer) (PSEG 2014-TN3452). The average combined pumping rate from these wells was 160 gpm for the period 2002 to 2009 (PSEG 2014-TN3452). SGS derives groundwater primarily from two wells installed to depths of 840 ft and 1,135 ft in the middle and lower PRM aquifers (referred to in the ER as the Upper and Middle Raritan Formations of the PRM aquifer). Average pumping rates during 2002 to 2009 were 209 gpm from the middle PRM aquifer and 10 gpm from the Lower PRM aquifer. SGS also has two wells installed in the Wenonah–Mount Laurel aquifer. These wells are classified as standby wells and only a negligible amount of water was pumped from these wells during 2002 to 2009 (PSEG 2014-TN3452).

2.3.3 Water Quality

The following sections describe the quality of surface-water and groundwater resources in the vicinity of the PSEG Site.

2.3.3.1 Surface-Water Quality

Water Quality Near the PSEG Site

The water quality of the Delaware River near the PSEG Site is influenced by tidal action, wind-induced circulation, and freshwater discharges primarily from the Delaware River. Maximum turbidity within the Delaware River Estuary occurs near the location of the PSEG Site (PSEG 2014-TN3452).

PSEG collected quarterly surface water quality samples at 11 locations in the Delaware River, the artificial ponds at the PSEG Site, and Hope and Alloway Creeks (PSEG 2014-TN3452). Figure 2-19 shows these surface water quality sampling locations. The applicant analyzed these samples for suspended solids, total dissolved solids, hardness, biochemical oxygen demand, chemical oxygen demand, phosphorus, various forms of nitrogen, alkalinity, chlorides, inorganics (calcium, sodium, potassium, magnesium, lead, mercury, and zinc), coliform, and phytoplankton PSEG 2014-TN3452).

PSEG also measured temperature, dissolved oxygen, salinity, color, turbidity, pH, and specific conductance in the field at the surface water quality sampling locations (PSEG 2014-TN3452). The applicant also analyzed the samples for tritium (PSEG 2014-TN3452).

PSEG sampled three locations quarterly in the artificial ponds present on the proposed PSEG Site (PSEG 2014-TN3452). Salinity ranged from 1 to 2 ppt with a mean of 1.1 ppt, fecal coliform ranged from 1 to 90 colonies per 100 ml, pH was between 5.9 and 8.1 with a mean of 7.3, and turbidity ranged from 10.1 to 712 nephelometric turbidity unit (NTU) with a mean of

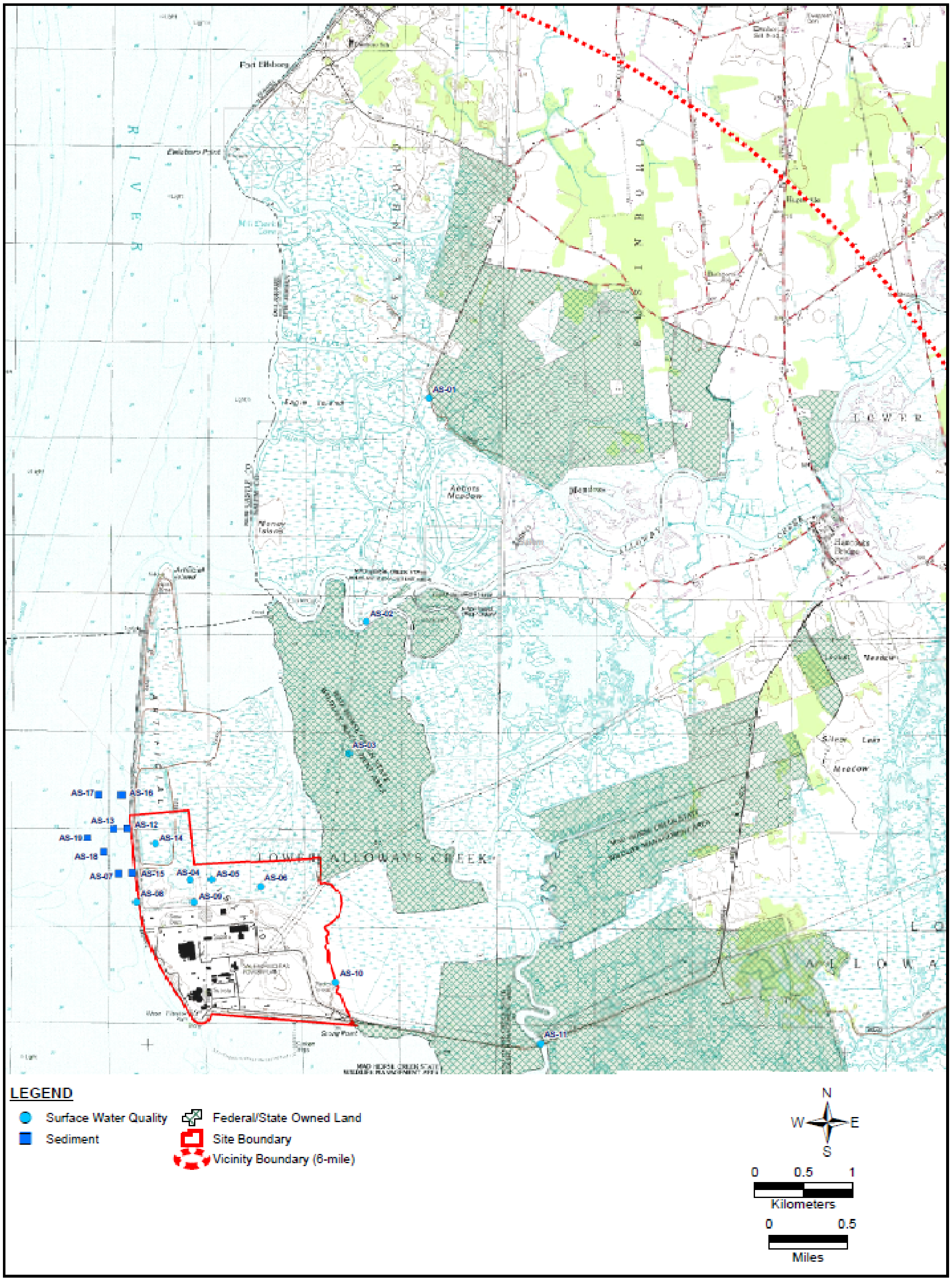


Figure 2-19. Surface Water Quality Sampling Locations on and Near the PSEG Site.
(Source: PSEG 2014-TN3452)

about 124 NTU. All sampled inorganics except mercury were present. Tritium was detected in one sample, but the reported concentration was below the laboratory reporting limit. Tritium was not detected in subsequent samplings, and because the location is not along the migration pathway for HCGS or SGS, the applicant reported the single tritium detection as a false positive (PSEG 2014-TN3452).

The Delaware River and Estuary

The salt line (defined as a chloride concentration of 250 mg/L) is an important indicator to ensure that public water supplies would not be affected by the presence of brackish water. The salt line moves in response to the tides and variations in Delaware River freshwater discharge. During most of the year the salt line is located between the Commodore Barry Bridge at Delaware RM 82 and Reedy Island at Delaware RM 54 (DRBC 2008-TN2277). During the drought of record in the 1960s, the salt line moved to its most upstream historically observed location at Delaware RM 102 (DRBC 2014-TN3211).

As of February 13, 2014, the salt line was approximately at the Delaware Memorial Bridge at RM 70. For comparison, the PSEG Site is at RM 54 in the tidal portion of the Delaware River, and average seawater chloride concentration at the PSEG Site is 35,000 mg/L. The PSEG SSAR reports a range in the chloride concentration in the Delaware estuary of 5,000–15,000 mg/L depending on the season (PSEG 2014-TN3453). Chloride concentrations in the Delaware River vary widely during the course of a year. During wetter times of the year, such as late winter and early spring, the salt line is normally located farther downstream in the river.

The five years between 1999 and 2003 contained a mix of wet periods (2000 and 2003) and dry periods (1999 and 2001–02). During this time, the salt line ranged from below RM 54 (the furthest downstream location the DRBC measures) to as high as RM 89. During the wettest years, the 250 mg/L chloride concentration stayed at or below the normal midmonth locations for most of the year. For example, in 2003, annual rainfall surpluses of more than 20 in. in some parts of the Delaware River Basin kept stream flows above normal for much of the year. As a result, chlorides in the river were kept so diluted that the salt line location was consistently below the normal location (sometimes by as much as 30 mi) from June through December (DRBC 2004-TN3209).

Since 1996, every two years DRBC publishes a water quality assessment report for the Delaware River and Bay (DRBC 2012-TN2279). The most recent of these reports was published in March 2012. These reports contain DRBC's water quality assessment consistent with Section 305(b) of the Clean Water Act and are used by the four basin states for consideration in preparation of their lists of water bodies per Section 303(d) of the Clean Water Act (DRBC 2012-TN2279). The DRBC water quality standards require that all surface waters of the Delaware River Basin should be maintained for six uses: agricultural, industrial, and public water supplies after reasonable treatment except where natural salinity prevents such uses; use by wildlife, fish, and other aquatic life; recreation; navigation; waste assimilation such that other uses are still possible; and other uses that the DRBC's comprehensive plan may specify (DRBC 2012-TN2279).

The DRBC has divided the Delaware River and Bay into a total of 10 water quality management zones: Zones 1A through 1E comprise the nontidal portion of the main stem Delaware River upstream of Trenton, New Jersey; Zones 2 through 5 are located in the tidal portion of the river downstream of Trenton, New Jersey; and Zone 6 is the Delaware Bay (DRBC 2012-TN2279). DRBC designates the use of water quality management Zones 1, 2, and 3 for "public water supplies after reasonable treatment." The DRBC-designated uses for Zones 1A through 1E are aquatic life, public water supply, recreation, and fish consumption. The designated uses in Zones 2 through 5 are aquatic life, recreation, and fish consumption. In Zones 2 and 3, DRBC additionally specifies permissible levels of specific toxics to support drinking water and fish consumption. The designated uses for Zone 6 are aquatic life, recreation, and fish and shellfish consumption (DRBC 2012-TN2279). The PSEG Site is located in Zone 5 that extends from Delaware RM 48.2 to 78.8.

In the 2012 Water Quality Assessment Report, the DRBC lists Zone 5 as not supporting aquatic life designated use (DRBC 2012-TN2279). For Zone 5, DRBC reported that 96 percent of the dissolved oxygen observations met daily mean criterion, and all of the observations met the seasonal mean criterion (DRBC 2012-TN2279). All of the pH observations in Zone 5 met the criterion for Zone 5; however, only 37 percent of the turbidity observations met the instantaneous maximum criterion, and none met the 30-day average criterion for turbidity (DRBC 2012-TN2279). DRBC states the turbidity conditions in Zone 5 may be related to the natural occurrence of the estuary turbidity maximum within the zone. In Zone 5, nearly 99 percent of observations met the temperature criterion, and all of the observations met the alkalinity criterion. Zone 5 does not have a criterion for total dissolved solids. DRBD reported exceedances for copper and methyl mercury in Zone 5 (DRBC 2012-TN2279). The DRBC also reported that Zone 5 met all criteria for primary and secondary contact recreation and therefore supports recreation use (DRBC 2012-TN2279). The State of Delaware issued fish consumption advisories in Zone 5 due to PCBs and mercury (DRBC 2012-TN2279). Overall, DRBC reported in its 2012 water quality assessment report that Zone 5 did not support aquatic life and fish consumption but did support recreation (DRBC 2012-TN2279).

PSEG performed quarterly surface water quality sampling in the Delaware River adjacent to the proposed site, as shown in Figure 2-19 (PSEG 2014-TN3452). Salinity ranged from 4 to 14 ppt with a mean of 8.2 ppt, fecal coliform ranged from 6 colonies per 100 ml to too numerous to count, pH was between 4.7 and 8.4 with a mean of 6.5, and turbidity ranged from 39.5 to 381 NTU with a mean of 150 NTU. Tritium was not detected during the sampling period. Of the inorganics, mercury was not detected during the sampling period (PSEG 2014-TN3452).

Marsh Locations Near the PSEG Site

PSEG performed quarterly surface water quality sampling at seven locations within tidal marshes on and near the PSEG Site. Salinity ranged from 1 to 9 ppt with a mean of 3.4 ppt, fecal coliform ranged from 1 colony per 100 ml to too numerous to count, pH ranged from 4.7 to 8.6 with a mean of 6.8, and turbidity ranged from about 26 to 449 NTU with a mean of about 117 NTU. Of the inorganics, mercury was not detected. Tritium was detected once near the southeastern edge of the PSEG Site, but the reported concentration was below the laboratory reporting limit, and because the location is not along the migration pathway for HCGS or SGS, the applicant reported the single tritium detection as a false positive (PSEG 2014-TN3452).

2.3.3.2 Groundwater Quality

Groundwater quality was measured quarterly during 2009 in the 16 observation well pairs installed in the hydraulic fill and the alluvium and Vincentown formations to support development of the ESP application. These shallow water bearing zones are nonpotable due to their direct connection with the saline Delaware River and are most likely to be impacted by construction and surficial releases. Groundwater analytical results for the ESP application are summarized in ER Tables 2.3-28 to 2.3-31 for the alluvium and Vincentown aquifer samples (PSEG 2014-TN3452). Minimum, maximum, and mean measured values were reported for suspended solids, total dissolved solids, hardness as calcium carbonate ($CaCO_3$), biochemical oxygen demand, chemical oxygen demand, phosphorus, nitrogen forms, alkalinity, chloride, selected inorganics (calcium, iron, sodium, potassium, magnesium, lead and mercury), coliform, carbon dioxide, silica tritium, temperature, dissolved oxygen, salinity, color, turbidity, pH, and specific conductance. The results of these analyses indicate the groundwater in these aquifers is saline and not potable. Chloride concentrations in the alluvium averaged 2,900 mg/L in the northern portion of the PSEG Site and 3,500 mg/L in the eastern portion of the site. Average chloride concentrations in the Vincentown aquifer were 4,500 mg/L (northern wells) and 5,600 mg/L (eastern wells). Since the New Jersey secondary drinking water standard for chloride is 250 mg/L, these wells are considered nonpotable. Tritium was detected in two alluvium water samples at concentrations of 340 pCi/L and 710 pCi/L. These samples were from different wells and at different times, indicating the absence of a persistent or widespread tritium plume. The ER (PSEG 2014-TN3452) states that the positive tritium measurements were likely false positives because the values are very close to the laboratory detection limits. In addition, the EPA Drinking Water Standard for tritium is 20,000 pCi/L.

In addition to the ESP application groundwater monitoring effort, PSEG maintains a Radiological Groundwater Protection Program (RGPP) and Tritium Remediation Monitoring Wells. These wells were installed for the RGPP at HCGS and SGS for tritium remediation monitoring at SGS. They are located in the shallow water-bearing strata and the Vincentown aquifer, consistent with the wells installed in conjunction with the ESP application effort.

Tritium was discovered at concentrations above the drinking water standard (20,000 pCi/L DWS) in the shallow groundwater near SGS Unit 1 in early 2003, and an extraction system was installed. As of December 2011, approximately 3.35 Ci of tritium have been removed by the system, and it is estimated that 0.1 to 1.0 Ci of tritium still remains in groundwater and dead end pore spaces (ARCADIS 2012-TN3310). The source of the release of tritium-contaminated water to the environment was remediated in February 2003 when the SGS Unit 1 telltale drains were cleared and the Spent Fuel Pool water that had accumulated behind its liner was drained.

Since remediation pumping efforts began, the concentrations in wells installed inside and outside the Unit 1 cofferdam have been generally declining and most concentrations are at or below one-half the DWS of 20,000 pCi/L. Several wells remain approximately 10 percent above the DWS, and monitoring and extraction activities are continuing. One well in the center of the tritium plume remains at almost twice the DWS (Well-S). Extracted groundwater is managed according to the current SGS NRC license (ARCADIS 2012-TN3310).

In contrast to SGS Unit 1, SGS Unit 2 has not had a major subsurface release of tritium, but also has a tritium monitoring system of ten wells installed due to elevated tritium concentrations in the shallow aquifer resulting from precipitation capture of vented tritiated water vapor. Monitor well concentrations increased during a high precipitation period from July to August 2011 but have since returned to their historical concentrations of less than one half the DWS (ARCADIS 2012-TN3310).

The deeper aquifers, including the Wenonah–Mount Laurel and the PRM, are used as potable sources at the PSEG Site and are designated by EPA as sole source aquifers. These aquifers are hydraulically separated from the upper aquifers by a series of confining layers, so that the water quality in these aquifers is not likely to be impacted by activities limited to the depth of the Vincentown aquifer. However, saltwater intrusion in the deeper aquifers, which is influenced by large-scale groundwater pumping, is an ongoing concern (Cauller et al. 1999-TN2995). As reported in the ER (PSEG 2014-TN3452), chloride samples are routinely taken from the water withdrawn from the deeper aquifers as part of HCGS and SGS operation, with water quality data reported to the NJDEP in accordance with Water Allocation Permit 120001. Quarterly chloride data reported to the NJDEP for the period 2003 to 2013 were reviewed and are plotted in Figure 2-20. With notable deviations, the chloride concentrations have been stable over time. Water from the lower PRM aquifer (PW-6) has a much higher chloride concentration but has generally been less than 250 mg/L.

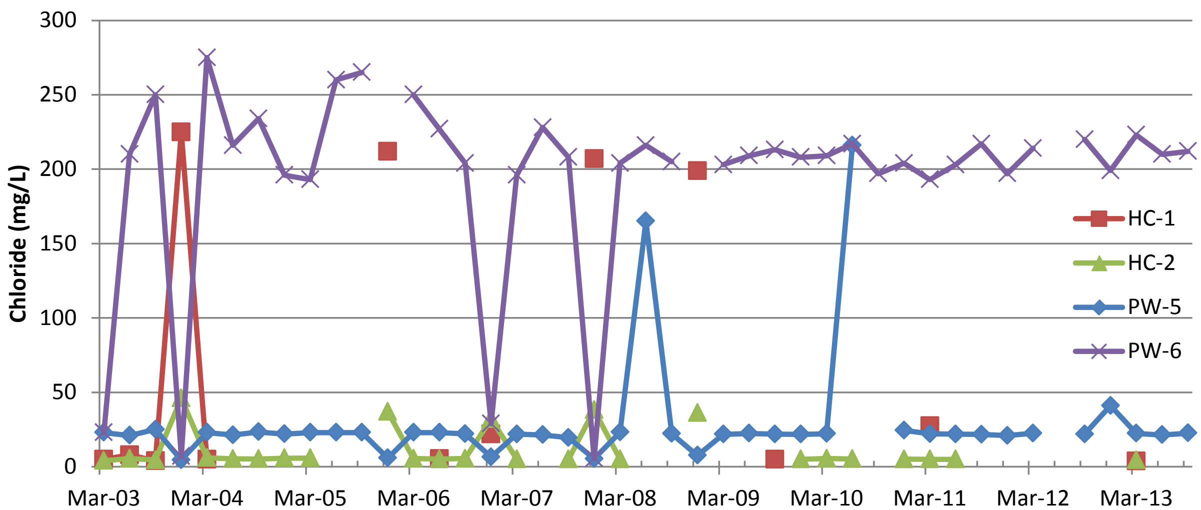


Figure 2-20. Chloride Data for the HCGS and SGS Groundwater Production Wells for the Period 2003–2013. ***(Source: NJDEP 2013-TN3223)***

Actual concentrations at these wells were 10 to 60 percent less than those predicted by Run 4 of the 1987 Dames and Moore modeling effort for the year 2007, after 20 years of pumping at over twice the average historic pumping rate (875 vs. 379 gpm) (Dames and Moore 1988-TN3311). An evaluation of the predicted impacts of increased pumping during construction and operation on salinity is contained in Sections 4.2 and 5.2, respectively.

2.3.4 Water Monitoring

PSEG was able to consider the existing SGS and HCGS monitoring programs as part of the pre-application monitoring program for the PSEG Site (PSEG 2014-TN3452). If a new nuclear power plant is built at the PSEG Site, many of these same monitoring activities would be continued, and additional monitoring near a new plant could be added (PSEG 2014-TN3452).

PSEG performed surface water quality monitoring on and near the PSEG Site as described in Section 2.3.3.1. Monitoring of stream discharges and surface water quality assessments are performed by USGS as described in Section 2.3.1. DRBC performs extensive water quality monitoring as part of its water quality assessment reports as described in Section 2.3.3.1.

PSEG installed 16 observation well pairs in late 2008 through January 2009 to support development of the PSEG Site. The new wells were installed on both the northern portion of the PSEG Site, where a new nuclear power plant would be located, and on the eastern portion of the PSEG Site, which may be used as support and/or laydown areas during construction. Groundwater heads were measured monthly during 2009 in the hydraulic fill, alluvium, and Vincentown aquifer, as described in Section 2.3.1.2. These data were used, in conjunction with existing data from the PSEG Site, to prepare groundwater potentiometric surface maps. Quarterly measurements of groundwater quality were made in 2009, as described in Section 2.3.3.2. Other than this quarterly monitoring event for the ESP application, PSEG continues to monitor the tritium-impacted monitoring wells monthly (ARCADIS 2012-TN3310) and the water supply wells quarterly for chlorides (NJDEP 2012-TN3222).

2.4 Ecology

This section describes the terrestrial, aquatic, and wetland ecology of the PSEG Site and vicinity that could be affected by the building, operation, and maintenance of a new nuclear power plant. Most of the PSEG Site is located on the southern part of Artificial Island on the east bank of the Delaware River adjacent to the existing HCGS and SGS in Lower Alloways Creek Township, Salem County, New Jersey. This county is in southwestern New Jersey, within the Outer Coastal Plain subdivision of the Coastal Plain physiographic province.

Section 2.4.1 provides a general description of the terrestrial environment, while Section 2.4.2 provides a general description of the aquatic environments, on and in the vicinity of the PSEG Site, as well as the corridor for the proposed causeway. Detailed descriptions are provided where needed to support the analysis of potential environmental impacts from building, operating, and maintaining a new nuclear power plant and causeway. These descriptions also support the evaluation of mitigation activities and monitoring programs identified during the assessment to avoid, reduce, minimize, rectify, or compensate for potential impacts.

2.4.1 Terrestrial and Wetland Ecology

This section identifies terrestrial and wetland ecological resources and describes species composition and other structural and functional attributes of the biota that could be affected by building, operating, and maintaining a new nuclear power plant at the PSEG Site and the

proposed causeway. It also identifies important terrestrial resources, such as wildlife sanctuaries and natural areas, which might be affected by the proposed action.

The entire 819-ac PSEG Site is within the Outer Coastal Plain subdivision of the Coastal Plain physiographic province. The site is also within the Middle Atlantic Coastal Plain of the eastern temperate forest ecoregion. This ecoregion is a flat plain, with many swampy or marshy areas (Ator et al. 2005-TN2745). Forest cover in the region is predominantly loblolly and shortleaf pine with patches of oak, gum, and cypress near major streams, as compared to the mainly longleaf and slash pine forests of the warmer Southern Coastal Plain (Wiken et al. 2011-TN2744). Specific ecological communities present in the Outer Coastal Plain in New Jersey include southern mixed oak forest, upland pine forest, upland oak forest, pine plains, red maple and sweet gum forest, Virginia pine successional forest, coastal white cedar forest, pitch pine lowland forest, hardwood swamp, pine barrens shrub swamp, emergent marsh, freshwater tidal marsh, pine barrens savannah, salt marsh, coastal dune grassland, coastal dune shrubland, coastal dune forest, and successional communities (CU 2010-TN2886).

2.4.1.1 Terrestrial and Wetland Resources—Site and Vicinity

Existing Cover Types and Vegetation

Baseline habitat conditions for the PSEG Site and vicinity were developed using historical studies and surveys in support of HCGS and SGS licensing and supplemental information provided by resource agencies and surveys conducted in 2009 to 2010. Floral surveys were conducted during the 2009 growing season on the PSEG Site to confirm the land cover types mapped by NJDEP. The floral surveys were completed along eight walking transects covering each vegetation cover type during the spring, summer, and fall to account for variations in growing seasons. The presence of each plant species was recorded along transects, and the relative abundance was classified (PSEG 2014-TN3452).

Site

Vegetation communities, also referred to as vegetation cover types, were identified from NJDEP LULC data for the PSEG Site and offsite areas that potentially would be affected by the proposed causeway (Figures 2-4 and 2-5). Six vegetative cover types were identified: urban or built-up land, agricultural land, forest land, water, wetlands, barren land, and managed wetlands. Table 2-1 lists the area and percentage of the PSEG Site represented by each LULC type available within the PSEG Site boundary. The listed coverage types are common within the Outer Coastal Plain subdivision (PSEG 2014-TN3452).

PSEG conducted a field survey along eight walking transects during the 2009 growing season in each habitat represented on the PSEG Site, proposed causeway, and existing access road (PSEG 2014-TN3452). Plant species and relative abundance were recorded along each transect. The six cover types are described in the following sections in order of decreasing extent (PSEG 2014-TN3452).

<u>Urban or Built-Up Land (Developed Lands)</u>—Urban and built-up land includes the following cover types identified by NJDEP as occurring on the PSEG Site: industrial,

transportation/communication/utilities, wetlands ROWs, upland ROWs (developed), upland ROWs (undeveloped), other urban or built-up land, *Phragmites*-dominated urban area, and recreational land. Land use in this category is characterized as having been altered by human activities (NJDEP 2010-TN2887). Most of these lands on the PSEG Site are related to power generation at HCGS and SGS and associated structures. The urban or built-up coverage type accounts for 358 ac or 44 percent of the PSEG Site and is located mainly on the west side of Artificial Island and on the north end of the proposed causeway near Money Island Road. Upland ROWs (undeveloped) support shrubby vegetation but are considered under the urban or built-up land category as a result of vegetation maintenance practices (PSEG 2014-TN3452).

Included in this category are two wetlands subcategories: wetland ROWs and *Phragmites*-dominated urban area. Wetland ROWs are included in this category because they exhibit hydric soils, but as a result of alterations may not support vegetation typical of natural wetlands (NJDEP 2010-TN2887). Wetland ROWs account for 23.8 ac or 3 percent of the site, and *Phragmites*-dominated urban areas account for 0.5 ac or less than 1 percent of the site. This type of land use provides limited habitat for wildlife use (PSEG 2014-TN3452).

<u>Wetlands</u>—The wetlands category includes areas inundated or saturated by surface waters or groundwaters at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. This category does not include wetlands that have been modified for recreation, agriculture, or industry that are described under specific use categories (NJDEP 2010-TN2887). This habitat is located predominantly on the north and northeast portions of the PSEG Site. The wetlands category accounts for 284.9 ac or 35 percent of the site's total available habitat (PSEG 2014-TN3452).

Wetlands influenced by the tidal portions of the Delaware River system and the tidal portions of the watercourses draining into the Atlantic Ocean are categorized as coastal wetlands (NJDEP 2010-TN2887). Coastal wetlands found on the site include saline marshes and *Phragmites*-dominated coastal wetlands. Saline marshes are associated with waters with salinities greater than 1 part per thousand and are open graminoid dominated regions. Saltmarsh cordgrass (*Spartina alterniflora*) dominates these wetlands in areas of high salinity. Brackish marshes are co-dominated by big cordgrass (*Spartina cynosuroides*), saltmarsh cordgrass, common reed (*Phragmites australis*), narrowleaf cattail (*Typha angustifolia*), and common threesquare (*Schoenoplectus pungens*). Salt marshes account for 0.2 ac or less than 1 percent of the site (PSEG 2014-TN3452). The introduction of the invasive species *Phragmites australis* displaces native wetland species, degrading habitat diversity. Phragmites-dominated coastal wetlands are marsh areas dominated by *Phragmites australis* (NJDEP 2010-TN2887). *Phragmites*-dominated coastal wetlands are the most common wetland type found on the site, accounting for 155.6 ac or 19 percent of the site's vegetation cover (PSEG 2014-TN3452).

Isolated wetlands and wetlands generally found in nontidal lowlands influenced by primary, secondary, and tertiary courses are categorized as interior wetlands (NJDEP 2010-TN2887). Interior Wetlands found on the PSEG Site include deciduous scrub/shrub wetlands, herbaceous wetlands, and *Phragmites*-dominated interior wetlands. Deciduous scrub/shrub wetlands are composed of young saplings of tree species such as red maple (*Acer rubrum*), ashleaf maple

(*Acer negundo*), sweetgum (*Liquidambar styraciflua*), and shrub species such as silky dogwood (*Cornus amomum*), red-osier dogwood (*C. sericea*), gray dogwood (*C. racemosa*), white meadowsweet (*Spiraea alba*), steeplebush (*S. tomentosa*), arrow-wood (*Viburnum dentatum*), and hazel alder (*Alnus serrulata*). This category also includes bogs that are dominated by Ericaceae species, and the soils are highly acidic. There are 4.6 ac of deciduous scrub/shrub wetlands representing less than 1 percent of the total acreage available (PSEG 2014-TN3452). Herbaceous wetlands are characterized as being dominated by herbaceous species associated with lake edges, open flood plains, and abandoned wetlands agricultural fields. Species that may dominate this cover type include rice cutgrass (*Leersia oryzoides*), reed canartgrass (*Phalaris arundinacea*), yellow cowlilly (*Nuphar lutea*), halberdleaf tearthumb (*Persicaria arifolium*), arrowleaf tearthumb (*P. sagittat*), common cattail (*Typha latifolia*) and *Phragmites* (NJDEP 2010-TN2887). Herbaceous wetlands account for 5.8 ac, or less than 1 percent, of the total acreage at the PSEG Site. *Phragmites*-dominated interior wetlands are dominated by the common reed *Phragmites australis* and account for 118.7 ac or 14.5 percent of the site's acreage.

The most common species observed by PSEG during 2009 to 2010 walking surveys of onsite wetland habitats included groundsel tree/sea myrtle (*Baccharis halimifolia*), Japanese honeysuckle (*Lonicera japonica*), common ragweed (*Ambrosia artemisiifolia*), mugwort (*Artemisia vulgaris*), horseweed (*Conyza canadensis*), Queen Anne's lace (*Daucus carota*), annual fleabane (*Erigeron annuus*), late boneset (*Eupatorium serotinum*), fescue (*Festuca sp.*), Carolina crane's-bill (*Geranium carolinianum*), foxtail barley (*Hordeum jubatum*), white sweet clover (*Melilotus albus*), yellow sweet clover (*Melilotus officinalis*), blue scorpion grass (*Myosotis stricta*), Texas toadflax (*Nuttallanthus texenus*), common reed, American plantain (*Plantago rugelii*), plantain (*Plantago virginica*), Canada bluegrass (*Poa compressa*), mile-a-minute vine (*Persicaria perfoliatam*), red sorrel (*Rumex acetosella*), curly dock (*Rumex crispus*), green foxtail (*Setaria viridis*), goldenrod (*Solidago sp.*), and purpletop (*Tridens flavus*) (PSEG 2014-TN3452).

<u>Forested Land</u>—Old field (<25 percent brush covered), *Phragmites*-dominated old field, and deciduous brush/shrubland identified by NJDEP as occurring on the PSEG Site are categorized under forested land, brushland/shrubland. Vegetation cover could include early successional species to climax species and are between 0 and 20 feet in height. Old field is also covered in this category and can contain shrubs and grasses (NJDEP 2010-TN2887). Forested land covers more than 107.3 ac of the site or 13 percent (PSEG 2014-TN3452).

Old field (<25 percent brushed covered) is predominantly covered by grasses, herbaceous species, tree seedlings, and/or saplings. *Phragmites*-dominated old field contains open fields predominantly covered by the common reed. Natural forested areas covered predominantly with deciduous species less than 20 ft in height are classified under deciduous brush/shrubland. This category can also include agricultural lands that have been overgrown with brush (NJDEP 2010-TN2887).

Walking surveys conducted by PSEG in 2009 to 2010 on brushland/scrubland areas indicated that the most common vegetation species were groundsel tree/sea myrtle, autumn olive (*Elaeagnus umbellata*), multiflora rose (*Rosa multiflora*), Japanese honeysuckle , poison ivy (*Toxicodendron radicans*), annual ragweed (*Ambrosia artemisiifolia*), broomsedge (*Andropogon*

virginicus), thyme-leaf sandwort (*Arenaria serpyllifolia*), mugwort, Queen Anne's lace, common spike rush (*Eleocharis palustris*), late boneset (*Eupatorium*), fescue, Chinese lespedeza (*Lespedeza cuneata*), yellow sweet clover (*Melilotus officinalis*), blue scorpion grass, common reed, plantain, Canada bluegrass, green foxtail grass, Canada goldenrod (*Solidago altissima*), goldenrod, and purpletop (PSEG 2014-TN3452).

Water—The NJDEP LULC category of water includes all areas within the landmass of New Jersey periodically covered by water. This includes the artificial lakes and tidal rivers, inland bays, and other tidal waters found on the PSEG Site. Artificial lakes include water bodies that are 1 ac and larger. Water control structures would be present on these sites. Tidal rivers, inland bays, and other tidal waters include tidal portions of watercourses, enclosed tidal bays, and other tidal water bodies (NJDEP 2010-TN2887). Land cover categorized as water accounts for approximately 46 ac or 5.6 percent of the site (PSEG 2014-TN3452).

Barren Land—Barren lands are in a nonurban setting and are characterized by thin soil, sand, or rocks. These land cover types often are lacking vegetative cover, or the vegetation is sparse (NJDEP 2010-TN2887). The NJDEP LULC data indicates that two subcategories of barren land—altered lands and disturbed wetlands—are present at the site. Altered lands are nonurban areas that have been changed by human activities. Disturbed wetlands are formal natural wetlands that have been altered by clearing, grading, leveling, filling, and/or excavating. The soils are hydric, but the land lacks vegetation or wetland species. Barren lands represent 19.1 ac of the site's total acreage or 2 percent (PSEG 2014-TN3452).

Managed Wetland—Managed wetlands are characterized by hydric soils but do not support typical wetland vegetation. Some examples are stormwater swales, golf fairways and recreational fields, and open lawn areas (NJDEP 2010-TN2887). Managed wetlands account for 3.8 ac, or less than 1 percent, of the site (PSEG 2014-TN3452).

Vicinity

Portions of the State of Delaware and the Delaware River lie within the 6-mi vicinity in addition to portions of the State of New Jersey. The NJDEP LULC database does not provide vegetation cover for areas outside of New Jersey. As a result, the USGS LULC database was used to determine the vegetation communities for areas within the 6-mi vicinity. Table 2-2 quantifies the USGS LULC cover types found on the vicinity of the PSEG Site. The USGS database is composed of nine LULC categories (Anderson et al. 1976-TN2888). Six of these categories are applicable to the PSEG vicinity: urban or built-up land (developed land), agricultural land, forest land, water, wetlands, and barren land. Urban or built-up land accounts for 939 ac or 1.2 percent of the available land use in the vicinity. Agricultural land includes cultivated crops and pasture. Approximately 17,097 ac, or 23.2 percent, of the vicinity's available vegetation cover is agricultural. Forested land in the vicinity includes deciduous, evergreen, and mixed forests and accounts for approximately 2,653 ac or 3.6 percent of the vicinity's available vegetation cover. As a result of the PSEG Site's proximity to the Delaware River and Bay, water is the largest available LULC in the vicinity, accounting for approximately 26,837 ac or 34.7 percent of the vicinity. There are about 16,555 ac of emergent herbaceous wetlands and 8,979 woody wetlands. Together, the wetlands LULC accounts for 34.6 percent,

the second largest vegetation cover type in the vicinity. Barren land makes up nearly 651 ac or less than 1 percent of the LULC (PSEG 2014-TN3452).

The existing access road and the proposed causeway are included as part of the vicinity. The existing access road extends 3.6 mi east–northeast from the PSEG Site to Alloway Creek Neck Road. The ROW is 350 ft wide except where it traverses state owned lands, where it is 450 ft wide (PSEG 2014-TN3452). PSEG holds the deed of easement to the privately owned access road and is responsible for its maintenance and operation (PSEG 2014-TN3452; PSEG 1982-TN2889). Vegetation cover types (Table 2-3) in the existing access road include 134 ac of agricultural land, 146 ac of wetlands, 50 ac of urban or built-up land, 39 ac of barren land, 6 ac of forest land, and 4 ac of water. The total area covered by the existing access road ROW is 379 ac (PSEG 2014-TN3452). Dominant species noted along the access road include common reed and saltmarsh cordgrass (PSEG 1982-TN2889). PSEG conducted a qualitative field survey of the road side vegetation along the existing access road in the 2009 growing season. The survey listed 83 species of plants including 21 tree/sapling species, 9 shrubs, 5 vines, and 48 herb species. No endangered or threatened plant species were observed (PSEG 2014-TN3452).

Wildlife

Historical data in support of HCGS and SGS licensing activities were used as the starting point for baselining wildlife data for the PSEG Site and vicinity. Additional information from biological monitoring reports from HCGS and SGS operations, resource agencies, conservation organizations, and field surveys was used to supplement historical data. Field surveys were completed from 2009 to 2010 (PSEG 2014-TN3452).

Mammals

PSEG initiated a records review that included information about species potentially occurring in the region from New Jersey and Delaware wildlife agencies. The records review was supported by qualitative mammal surveys conducted in 2009 and 2010. Twenty-nine mammal species were observed during the field surveys. The most common species observed were white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), eastern cottontail (*Sylvilagus floridanus*), opossum (*Didelphis virginiana*), and eastern gray squirrel (*Sciurus carolinensis*). Other mammal species observed on site or in the vicinity included groundhog (*Marmota monax*), muskrat (*Ondatra zibethicus*), Norway rat (*Rattus norveigecus*), coyote (*Canis latrans*), river otter (*Lontra Canadensis*), striped skunk (*Mephitis mephitis*), black bear (*Ursus americanus*), and red fox (*Vulpesvulpes*). Mammal species that were not observed during the survey but that have been observed in the past or are known to occur on the site or vicinity include short-tailed shrew (*Blarina brevicauda*), masked shrew (*Sorex cinereus*), big brown bat (*Eptesicus fuscus*), red bat (*Lasiurus borealis*), little brown myotis (*Myotis lucifugus*), keen’s myotis (*M. keenii*), small-footed myotis (*Myotis leibii*), tri-colored bat (*Perimyotis subflavus*), meadow vole (*Microtus pennsylvanicus*), house mouse (*Mus musculus*), marsh rice rat (*Oryzomys palaustris*), white-footed mouse (*Peromyscus leucopus*), southern bog lemming (*Synaptomys cooperi*), meadow jumping mouse (*Zapus hudsonius*), long-tailed weasel (*Mustela frenata*), and gray fox (*Urocyon cinereoargenteus*) (PSEG 2014-TN3452).

Muskrat was the most observed mammal species along the access road during previous surveys. Additionally, house mouse, meadow vole, masked shrew, Norway rat, and marsh rice rat were the most commonly captured mammal species along the access road (PSEG 1982-TN2889). No Federally or State-listed endangered or threatened mammal species were observed during the 2009 qualitative surveys (PSEG 2014-TN3452).

Birds

An initial records review was conducted to identify bird species recorded in the vicinity of the PSEG Site. During 2009 to 2010 field surveys, 15,112 birds of 125 species were observed (PSEG 2014-TN3452). Previous surveys of the existing access road have identified over 180 avian species (PSEG 1982-TN2889). Common passerine species observed during field surveys included red-winged blackbird (*Agelaius phoeniceus*), common grackle (*Quiscalus quiscula*), brown-headed cowbird (*Molothrus ater*), mourning dove (*Zenaida macroura*), northern cardinal (*Cardinalis cardinalis*), American crow (*Corvus brachyrhynchos*), American robin (*Turdus migratorius*), gray catbird (*Dumetella carolinensis*), common yellowthroat (*Geothlypis trichas*), tree swallow (*Tachycineta bicolor*), barn swallow (*Hirundo rustica*), song sparrow (*Melospiza melodia*), and European starling (*Sturnus vulgaris*). Common waterfowl species recorded included Canada goose (*Branta canadensis*), snow goose (*Chen caerulescens*), mallard (*Anas platyrhynchos*), American black duck (*Anas rubripes*), and greater scaup (*Aythya marila*). Shorebird species prevalent during the survey included least sandpiper (*Calidris minutilla*) and lesser yellowlegs (*Tringa flavipes*). Gulls commonly observed during the survey included ring-billed gull (*Larus delawarensis*) and greater black-backed gull (*Larus marinus*) (PSEG 2014-TN3452). Turkey vulture (*Cathartes aura*) was another bird species commonly observed during the survey.

Most of the habitat on the PSEG Site consists of areas dominated by a common reed monoculture. *Phragmites* monocultures have limited structure and provide poor quality foraging, nesting, and cover habitat for most birds. Therefore, any use of this habitat by most birds would probably be of a transitory nature. Marsh wrens (*Cistothorus palustris*) and red-winged blackbirds are two species that could potentially use the fringes of the *Phragmites* areas for breeding/nesting. The northern harrier (*Circus cyaneus*), osprey (*Pandion haliaetus*), and bald eagle (*Haliaeetus leucocephalus*) are three coastal habitat raptor species observed on the site. The adjacent Delaware River bordering the PSEG Site to the west and south provides moderate to good foraging habitat for these species. Ospreys nest on transmission towers within the site vicinity along the existing PSEG access road and proposed causeway corridor. Old field habitat in the southeastern portion of the site contains eastern red cedar and autumn olive and provides some foraging and nesting habitat for songbirds. Typical songbirds observed in this area included northern cardinal, song sparrow, gray catbird, common yellowthroat, and yellow warbler (*Dendroica petechia*) (PSEG 2014-TN3452).

The site and vicinity also provide foraging habitat for wading birds and shorebirds. Species observed in the area included great blue heron (*Ardea herodias*), green heron (*Butorides virescens*), little blue heron (*Egretta caerulea*), great egret (*Ardea alba*), snowy egret (*Egretta thula*), cattle egret (*Bubulcus ibis*), black-crowned night-heron (*Nycticorax nycticorax*), glossy ibis (*Plegadis falcinellus*), black-necked stilt (*Himantopus mexicanus*), greater yellowlegs (*Tringa melanoleuca*), and lesser yellowlegs (*Tringa flavipes*). There are no known colonial

water bird rookeries on the PSEG Site or within the 6-mi vicinity. The closest is approximately 9 mi north of the site on the Delaware River at Pea Patch Island, Fort Delaware State Park. The rookery, located at the northern undeveloped end of the island, is the largest heron and egret rookery on the east coast of the United States. Pea Patch Island supports 5,000 to 12,000 breeding pairs of wading birds. The nine species of colonial water birds that nest at this rookery are the great blue heron, great egret, little blue heron, snowy egret, cattle egret, yellow-crowned night-heron (*Nyctanassa violacea*), black-crowned night-heron, glossy ibis, and tricolored heron (*Egretta tricolor*) (PSEG 2014-TN3452).

New Jersey is located within the Atlantic migratory flyway (Birdnature.com 2013-TN2890). Birds observed in the PSEG Site vicinity that use this flyway include Canada goose, snow goose, mallard, American black duck, greater scaup, least sandpiper, semipalmated sandpiper (*Calidris pusilla*), lesser yellowlegs, and greater yellowlegs (PSEG 2014-TN3452).

Reptiles

Qualitative surveys were conducted on the PSEG Site in the spring, summer, and fall of 2009 to record reptile species found in the various habitats on the site. During the surveys, three turtle species and three snake species were recorded. A records review was conducted before the initiation of field surveys to determine reptile species that potentially could occur in the region. This included gathering information from New Jersey and Delaware WMAs regarding known ranges of reptile species in the vicinity of the site, as well as details on any listed species that may occur in the area. The records searches were supplemented with the field studies conducted in 2009 (PSEG 2014-TN3452).

Reptiles were surveyed through general site reconnaissance and observation, and transect surveys along the same eight study transects used to conduct the bird and mammal surveys. Representative portions of the proposed causeway and areas adjacent to the existing access road were also surveyed qualitatively. Historical data from an intensive study conducted on Artificial Island and vicinity (1972 to 1978) were also used to aid in the characterization of reptile populations and the identification of important species within the PSEG Site (PSEG 2014-TN3452).

The most common reptile species recorded on the PSEG Site during the 2009 field surveys was the eastern painted turtle (*Chrysemys picta picta*). Eleven additional species of turtles, eleven additional species of snakes, and one species of lizard were recorded during the Artificial Island study from 1972 to 1978. Federal and/or New Jersey listed turtles recorded during the Artificial Island study included the bog turtle (*Glyptemys muhlenbergii*). Sea turtles are discussed in Section 2.4.2. The bog turtle was not recorded at the PSEG Site during the 2009 studies (PSEG 2014-TN3452).

Amphibians

Qualitative surveys were conducted on the PSEG Site in the spring, summer, and fall of 2009 to record amphibian species found in the various habitats on the site. During the surveys, five species of frogs and toads were recorded. A records review was conducted before the initiation of field surveys to determine amphibian species that potentially could occur in the

region. This included gathering information from New Jersey and Delaware WMAs regarding known ranges of amphibian species in the vicinity of the site, as well as details on any listed species that may occur in the area. These records searches were supplemented with the field studies conducted in 2009 (PSEG 2014-TN3452).

Amphibians were surveyed through general site reconnaissance and observation, spring night-time anuran (frog and toad) call surveys, and transect surveys along the same eight study transects used to conduct the bird, mammal, and reptile surveys. Representative portions of the proposed causeway and areas adjacent to the existing access road were also surveyed qualitatively. Historical data from an intensive study conducted on Artificial Island and vicinity (1972 to 1978) also were used to aid in the characterization of amphibian populations and the identification of important species within the PSEG Site (PSEG 2014-TN3452).

The most common amphibian species recorded on the site during field surveys conducted in 2009 included the northern spring peeper (*Pseudacris crucifer*) and southern leopard frog (*Lithobates sphenocephalus*). In July 2009, green tree frogs (*Hyla cinerea*) were recorded in ponds within the desilt basins in the northwestern portion of the PSEG Site (PSEG 2014-TN3452). Green tree frogs were also recorded during a survey conducted in June to July 2012 at three onsite locations and numerous locations in the site vicinity (AMEC 2012-TN3187). The green tree frog is a resident species in Delaware; however, this is the first record for the species in New Jersey. Seven additional species of frogs and toads and nine species of salamanders were recorded during the Artificial Island study conducted between 1972 and 1978. This included the New Jersey State-listed eastern tiger salamander (*Ambystoma tigrinum*) (PSEG 2014-TN3452).

Nuisance Species

Nuisance species are disease vectors or pests. These include a large number of terrestrial wildlife species that can be pests in urban/suburban or even rural settings. Wildlife species in this category either recently or previously recorded on the PSEG Site or in the vicinity include coyote, Norway rat, and European starling.

Nuisance species on the PSEG Site also may include insects such as ticks, mosquitoes, and wasps. On the site, the one known disease vector is the blacklegged or deer tick (*Ixodes scapularis*), which transmits the bacterial pathogen (*Borrelia burgdorferi*) from small rodents, squirrels, and deer to humans (PSEG 2014-TN3452).

The PSEG Site has one invasive pest plant species, the invasive strain of common reed, which out-competes native wetland species. Not native to New Jersey, the common reed first appeared in the Delaware River Estuary during the 1950s, following several years of repeated disturbance by hurricanes. It is a wetland species that typically occurs in marshes and along rivers, lakes, and ponds. The plant can tolerate moderate salinity and thrives in disturbed wetland areas. Once established in an area from seed, this reed reproduces mainly through vegetative growth by rhizomes and stolons, forming dense monoculture communities (PSEG 2014-TN3452).

Travel Corridors

Travel corridors provide numerous essential functions needed for the survival of wildlife species. Corridors can be viewed at three scales: (1) local, (2) regional, and (3) migratory. In diverse landscapes, wildlife travel through areas of favorable habitat that connect to other habitats that meet their basic needs of food and shelter. On a local level, typical travel corridors may include brushy or forested hedgerows, fencerows, stream riparian zones, or ridgetops. The PSEG Site is elevated above surrounding coastal habitats (marshland and riverine), making it more of a habitat island than a wildlife travel corridor. Habitats on the PSEG Site are dominated by early successional plant communities that do not act as major wildlife travel corridors. Alloway Creek and associated coastal wetlands are part of an extensive coastal wetland complex that follows the New Jersey coastline. This large area of contiguous habitat may be considered part of a larger corridor that could be used by wildlife for dispersal and seasonal movements within the project vicinity (PSEG 2014-TN3452). Certain species of wildlife may be limited to movement in human-made travel corridors, which include existing transmission lines and an existing access road on the PSEG Site.

The Delaware River, as part of the Atlantic Flyway, acts as the major migratory travel corridor in the vicinity of the PSEG Site. This is one of the four major flyways in North America. The New Jersey coastline is a major stopover and wintering area for a number of waterfowl and shorebird species. New Jersey's latitude places it about midway between the equator and northern forests and Arctic areas. Its central location means it serves many migratory bird populations. It is a major stopover point for northern bird populations during migration southward in the fall and northward in the spring and acts as a wintering endpoint for a number of species (NJ Audubon 2014-TN2896). The Delaware River also is used as a travel corridor by coastal raptors (bald eagles, northern harriers, and ospreys) for foraging and while searching for nest sites (PSEG 2014-TN3452).

Human-Induced Ecological Effects on the Site and Vicinity

The PSEG Site is located on Artificial Island, which was created with dredge spoils from the Delaware River. The southwestern portion of the island is dominated by the roads, parking, and structures associated with HCGS and SGS. Activities related to HCGS and SGS present the most obvious human-induced disturbances on the PSEG Site (PSEG 2014-TN3452).

The existing nuclear generation stations have been operating for 37 years (PSEG 2014-TN3452). The existing SGS Unit 1 began production in 1976, and by 1986, SGS Unit 2 and HCGS Unit 1 were operating. The tallest structure is the HCGS cooling tower, which is 512 ft above the surrounding landscape. This structure has a localized impact on migrating birds in the area. PSEG monitored bird collisions with the HCGS cooling towers over a 3-year period ending in 1986. During that time frame, 30 bird mortalities were noted and attributed to the cooling tower (PSEG 1987-TN2893).

Sources of noise on the PSEG Site include the HCGS cooling tower; vehicle traffic; overhead transmission lines; transformers; heating, ventilation, and air condition units; and aircraft. The highest noise levels, 51.6 dBA, are attributed to the operations of the cooling tower and road traffic on the site. While noise can be a deterrent to wildlife species, many

species on the PSEG Site have adapted. This adaptation is evident by the numerous bird species present near the cooling tower (PSEG 2014-TN3452).

2.4.1.2 Terrestrial and Wetland Resources—Existing Transmission Lines

Four existing 500 kV transmission lines extend approximately 150 mi offsite in support of HCGS and SGS. The existing transmission lines include Hope Creek–New Freedom, Salem–New Freedom, Hope Creek–Red Lion, and Salem–New Freedom South. The Hope Creek–New Freedom line is operated by Public Service Electric and Gas Company (PSE&G) for the extent of its 43 mi length to the New Freedom substation in Williamstown, New Jersey. It lies within a 350-ft-wide ROW and is segmented by the Orchard substation. The Salem–New Freedom line is operate by PSE&G and runs 50 mi northeast to the New Freedom substation. It shares the same ROW as the Hope Creek–New Freedom line. The Hope Creek–Red Lion transmission line extends north for 13 mi, where it then crosses west over the Delaware River for 4 mi to the Red Lion substation in Delaware. The line is operated by PSE&G in New Jersey and Pepco Holdings Inc. (PHI) in Delaware. Most of the ROW is 200 ft wide, while one third is 350 ft wide. The Salem–New Freedom South transmission line is operated by PSE&G and extends to the northeast for 42 mi, where it connects with the New Freedom substation in Williamstown, New Jersey. The ROW is about 350 ft wide but varies along its length (PSEG 2014-TN3452).

Existing Cover Types and Vegetation

Data on the vegetation cover types for the existing transmission ROWs are based on 500-ft corridors and USGS LULC data. The total area covered by existing transmission lines is 6,920 ac, including 2,682 ac of agricultural land, 2,100 ac of forest land, 244 ac of urban/built-up land, 1,564 ac of wetlands, 206 ac of water, and 124 ac of barren land. Forest land includes 1,843 ac of deciduous forest and 233 ac of evergreen forest. Wetlands include 1,029 ac of woody wetlands and 535 ac of emergent herbaceous. Transmission line ROWs supporting the PSEG Site are contained within the 50-mi region. The 50-mi region consists of the Middle Atlantic Coastal Plain, Northern Piedmont, and Atlantic Coastal Pine Barrens. Native vegetation in the Middle Atlantic Coastal Plain consists of swampy, marshy, and frequently flooded areas. Northern Piedmont consists of irregular plains and low hills. Atlantic Coastal Pine Barrens are characterized as low, undulating parts of the Atlantic Coastal Plain (PSEG 2014-TN3452).

Wildlife

Recent surveys for wildlife within transmission line corridors in the region were not conducted. However, wildlife species inhabiting transmission line corridors would consist of those found commonly in the region. This includes approximately 450 species that naturally occur in New Jersey (NJDEP 2012-TN3318). PSEG included portions of the existing transmission line corridors as part of their 2009 to 2010 surveys of the vicinity. Wildlife species along the existing transmission line ROWs within the site and 6-mi vicinity would be similar to those species described in Section 2.4.1.1 (PSEG 2014-TN3452).

Human-Induced Ecological Effects on the Existing Transmission Lines

Transmission line ROWs maintenance, including vegetation removal by mechanical means and herbicides, imposes a stress on terrestrial resources (PSEG 2014-TN3452). Transmission line ROWs fragment forested habitats and act as a barrier to wildlife movements. Additionally, transmission line ROWs may potentially cause avian mortality (NRC 2013-TN2654).

2.4.1.3 Important Terrestrial and Wetland Species and Habitats—Site and Vicinity

This section discusses important species and habitats, as described by the NRC in NUREG–1555, which may occur on and in the vicinity of the PSEG Site. Important species defined under NUREG–1555 include, but are not limited to, commercially and recreationally valuable species; Federally and State-listed, proposed, and candidate threatened and endangered terrestrial species; species essential to the maintenance and survival of rare or commercially or recreationally valuable species; species critical to structure or function of local terrestrial ecosystems; and species that serve as biological indicators (NRC 1999-TN614). Several species in the PSEG Site and vicinity are identified as being commercially and recreationally valuable species as well as Federally and State-listed threatened or endangered species.

“Important habitat” is defined by the NRC in NUREG–1555 as wildlife sanctuaries, refuges or preserves, wetlands, floodplains, and areas identified as critical habitat by the U.S. Fish and Wildlife Service (FWS) (NRC 1999-TN614).

The NJDEP, Delaware Department of Natural Resources and Environmental Control (DNREC), and FWS were consulted for information regarding sensitive species and habitats in the vicinity of the PSEG Site. This included letters of correspondence and phone conversations as well as personal meetings with NJDEP and DNREC to obtain agency input on threatened and endangered species, sensitive habitats, commercial and recreational species, and other characteristics for the site and vicinity. A response has not yet been received from FWS regarding this project. However, FWS did correspond with PSEG in response to a request for information on the presence of threatened and endangered species related to the HCGS and SGS license renewal applications. Information from these consultations, as well as existing federal and state lists available on the internet, was used as the basis for identifying important species and habitats (PSEG 2014-TN3452).

Table 2-8 provides a list of threatened and endangered species identified through correspondence with resource agencies as potentially occurring in the region surrounding the PSEG Site; the list includes updates provided in the revised February 2012 NJDEP threatened and endangered species lists (NJDEP 2012-TN2186). Each listed bird species potentially occurring in the study area is listed by New Jersey and/or Delaware, while none are Federally listed species. Each of these species either has been observed historically in the vicinity of the PSEG Site or has been observed recently as part of the 2009 to 2010 data collection activities. Most of these species are widely foraging (e.g., bald eagle and red-shouldered hawk) or species associated with upland habitats (e.g., Cooper’s hawk and red-headed woodpecker) that are unlikely to nest in the immediate project area. By comparison, ospreys are known to nest on transmission towers along both access corridors. Northern harrier is a ground nesting and widely foraging species that may also nest in the study area. Those species associated with

aquatic habitats include pied-billed grebe, cattle egret, and black-crowned night-heron. The Federally threatened bog turtle was recorded historically for Artificial Island during a study conducted between 1972 and 1978 (PSEG 2014-TN3452).

Table 2-8. Threatened (T), Endangered (E), and Special Concern (SC) Species Potentially Occurring in the Vicinity of the PSEG Site[a]

Genus	Species	Common Name	Federal Status	NJ Status	DE Status
Birds					
Accipiter	*cooperii*	Cooper's hawk		SC	
Accipiter	*gentilis*	Northern goshawk		E[b]/SC[c]	
Accipiter	*striatus*	Sharp-shinned hawk		SC[b,c]	
Actitis	*macularius*	Spotted sandpiper		SC[b]	
Ammodramus	*savannarum*	Grasshopper sparrow		T[b]/SC[c]	
Ardea	*herodias*	Great blue heron		SC[b]	SC[b]
Bubulcus	*ibis*	Cattle egret		T[b]/SC[c]	
Buteo	*lineatus*	Red-shouldered hawk		E[b]/SC[c]	
Buteo	*platypterus*	Broad-winged hawk		SC[b]	
Circus	*cyaneus*	Northern harrier		E[b]/SC[c]	E
Coccyzus	*erythropthalmus*	Black-billed cuckoo		SC[b]	
Dolichonyx	*oryzivorus*	Bobolink		T[b]/SC[c]	
Egretta	*thula*	Snowy egret		SC[b]	
Egretta	*caerulea*	Little blue heron		SC[b,c]	
Eremophila	*alpestris*	Horned lark		T[b]/SC[c]	
Falco	*peregrinus*	Peregrine falcon		E[b]/SC[c]	
Falco	*sparverius*	American kestrel		T	
Oporornis	*formosus*	Kentucky warbler		SC[b,c]	
Haliaeetus	*leucocephalus*	Bald eagle		E[b]/T[c]	E
Helmitheros	*vermivorum*	Worm-eating warbler		SC[b]	
Hylocichla	*mustelina*	Wood thrush		SC[b]	
Icteria	*virens*	Yellow-breasted chat		SC[b]	
Ixobrychus	*exilis*	Least bittern			SC[b]
Melanerpes	*erythrocephalus*	Red-headed woodpecker		T[b,c]	
Nycticorax	*nycticorax*	Black-crowned night-heron		T[b]/SC[c]	
Pandion	*haliaetus*	Osprey		T[b]	
Passerculus	*sandwichensis*	Savannah sparrow		T[b]	
Petrochelidon	*pyrrhonota*	Cliff swallow		SC[b]	
Plegadis	*falcinellus*	Glossy ibis		SC[b]	
Podilymbus	*podiceps*	Pied-billed grebe		E[b]/SC[c]	E[b]
Parula	*americana*	Northern parula		SC[b]	
Wilsonia	*citrina*	Hooded warbler		SC[b]	
Sterna	*hirundo*	Common tern		SC[b]	

1 **Table 2-8 (continued)**

Genus	Species	Common Name	Federal Status	NJ Status	DE Status
Sturnella	*magna*	Eastern meadowlark		SC[b,c]	
Toxostoma	*rufum*	Brown thrasher		SC[b]	
Troglodytes	*hiemalis*	Winter wren		SC[b]	
Tyto	*alba*	Barn owl		SC[b,c]	
Fish					
Acipenser	*brevirostrum*	Shortnose sturgeon	E	E	
Acipenser	*oxyrhynchus*	Atlantic sturgeon	E	E	E
Apeltes	*quadracus*	Fourspine stickleback			SC
Reptiles					
Caretta	*caretta*	Atlantic loggerhead turtle	T	E	E
Chelonia	*mydas*	Atlantic green turtle	T	T	E
Clemmys	*guttata*	Spotted turtle		SC	
Dermochelys	*coriacea*	Leatherback turtle	E	E	
Eretmochelys	*imbricata imbricata*	Atlantic hawksbill	E	E	
Glyptemys	*muhlenbergii*	Bog turtle	T	E	E
Lampropeltis	*getula getula*	Eastern kingsnake		SC	SC
Lepidochelys	*kempii*	Kemp’s ridley turtle	E	E	E
Terrapene	*carolina carolina*	Eastern box turtle		SC	
Thamnophis	*sauritus*	Eastern ribbon snake			SC
Amphibians					
Ambystoma	*maculatum*	Spotted salamander			SC
Ambystoma	*opacum*	Marbled salamander		SC	
Ambystoma	*tigrinum tigrinum*	Eastern tiger salamander		E	E
Anaxyrus	*fowleri*	Fowler's toad		SC	
Mammals					
Myotis	*septentrionalis*	Long-eared bat	PE[d]		
Plants					
Adiantum	*pedatum*	Northern maidenhair-fern			SC
Aeschynomene	*virginica*	Sensitive joint-vetch	T[a]		
Agrimonia	*gryposepala*	Tall hairy groovebur			SC
Carex	*prasina*	Drooping sedge			SC
Carex	*squarrosa*	Squarrose sedge			SC
Carex	*striatula*	Lined sedge			SC
Cynoglossum	*virginianum*	Wild comfrey			SC
Eleocharis	*quadrangulata*	Angled spike-rush		SC	
Helonias	*bullata*	Swamp pink	T[a]		
Iris	*prismatica*	Slender blueflag iris			SC
Isotria	*medeoloides*	Pogonia, small whorled	T		
Limnobium	*spongia*	American frogbite			SC

Table 2-8 (continued)

Genus	Species	Common Name	Federal Status	NJ Status	DE Status
Malaxis	*unifolia*	Green adder's-mouth			SC
Ophioglossum	*vulgatum*	Southern adder's-tongue			SC
Polygonum	*ramosissimum*	Bushy knotweed			SC
Pycnanthemum	*verticillatum*	Whorled mountain-mint			SC
Sagittaria	*calycina*	Long-lobed arrowhead			SC
Setaria	*magna*	Giant fox-tail		SC	
Spartina	*pectinata*	Freshwater cordgrass			SC
Vernonia	*glauca*	Broadleaf ironweed			SC
Insects					
Asterocampa	*celtis*	Hackberry emperor			SC
Cisthene	*tenuifascia*	Lichen moth			SC
Lycaena	*hyllus*	Bronze copper		E	SC
Sympetrum	*ambiguum*	Blue-faced meadowhawk			SC

(a) Potential for occurrence based on agency consultations and habitat types found within the site and 6-mi vicinity and along proposed causeway.
(b) Breeding.
(c) Nonbreeding.
(d) Species proposed for listing and could potentially occur in the 6-mi vicinity of the PSEG Site (Sources: PSEG 2012-TN2389; 78 FR 61046-TN3207).

Commercially and Recreationally Valuable Species

Mammals

Important commercial and recreational mammal species potentially occurring on the PSEG Site and in the vicinity include white-tailed deer, river otter, and muskrat. White-tailed deer are considered important because they are recreationally hunted in the area of the PSEG Site. The river otter and muskrat are considered important because they are commercially trapped in the area of the PSEG Site (PSEG 2014-TN3452).

White-tailed deer were observed in the PSEG Site and vicinity in *Phragmites*-dominated wetland habitat and more frequently in the old field habitat during the 2009 to 2010 field surveys. The only onsite area that provides forage for white-tailed deer is the old field habitat. PSEG allows for limited deer hunting on the PSEG Site under controlled conditions to cull deer populations (PSEG 2014-TN3452).

The river otter and muskrats are considered to be commercially important because they are valued as furbearers. Their habitats include both freshwater and coastal areas such as lakes, rivers, marshes, swamps, and estuaries. River otters were observed at the PSEG Site and vicinity in the spring and summer during the 2009 to 2010 field survey (PSEG 2014-TN3452).

In New Jersey, muskrats occupy a number of estuarine habitats, including impounded and natural tidal and inland marshes, along with freshwater ponds, streams, and lakes. Muskrats were observed at the PSEG Site and in the vicinity in spring and summer during the 2009 to 2010 surveys (PSEG 2014-TN3452). This species was also recorded during past work conducted in the Alloway Creek watershed (PSEG 2004-TN2897).

Birds

Bird species potentially occurring on the site or in the vicinity that are considered important for recreational or commercial value include northern pintail (*Anas acuta*), green-winged teal (*Anas crecca*), mallard, American black duck, ring-necked duck (*Aythya collaris*), greater scaup, bufflehead (*Bucephala albeola*), hooded merganser (*Lophodytes cucullatus*), common merganser (*Mergus merganser*), red-breasted merganser (*Mergus serrator*), American coot (*Fulica americana*), Canada goose , snow goose, and wild turkey (*Meleagris gallopavo*) (PSEG 2014-TN3452). All of these species are common to New Jersey and were observed either on the PSEG Site or in the 6-mi vicinity during the course of the 2009 to 2010 survey. Several recreational species were observed in the existing access road corridor as well, including the Canada goose, mallard, black duck, and green-winged teal (PSEG 2014-TN3452).

Federally and State-Listed Species

Table 2-8 provides a list of threatened, endangered, and special concern species identified through correspondence with resource agencies as potentially occurring in the region surrounding the PSEG Site.

The Federally threatened and endangered species list was developed using the FWS species list for the 6-mi vicinity. Only two counties were identified as within the vicinity: Salem County, New Jersey, and New Castle County, Delaware. Four Federally listed terrestrial species are known or believed to occur on the PSEG Site or in the vicinity. All four species are Federally listed as threatened. One of the species is a reptile, and three are plants. Of the Federally listed species, only the bog turtle has been recorded as occurring on the site or in the vicinity (PSEG 2014-TN3452). The Biological Assessment for the bog turtle is included in Appendix F in support of consultation with FWS.

NJDEP Division of Fish and Wildlife maintains the State's endangered and threatened wildlife species lists. New Jersey endangered and threatened species are those whose prospects for survival in New Jersey either are immediately in danger or may become endangered because of loss of habitat, exploitation, predation, competition, disease, disturbance, or contamination. Other classifications include species of special concern. Additionally, New Jersey distinguishes between breeding and nonbreeding populations for avian species (NJDEP 2014-TN3286).

The State of Delaware Natural Heritage and Endangered Species Program is maintained by the DNREC Division of Fish and Wildlife (DNREC 2013-TN3067). Delaware's Division of Fish and Wildlife ranks species based on their relative rarity in the State and in either of the State's two physiographic provinces (Piedmont or Coastal Plain) (DNREC 2006-TN2899). The ranking system is based on a system used by Nature Serve, a nonprofit conservation organization. The Delaware State status ranks include S1, defined as extremely rare species in Delaware;

S2, very rare; S3, rare to uncommon; and S4, apparently secure. The letter "B" refers to breeding status and nonbreeding status. In response to the applicant, the Division of Fish and Wildlife provided a list of endangered species and species of concern in a letter dated April 7, 2009 (PSEG 2014-TN3452). Table 2-8 provides a list of rare species within the 6-mi vicinity of the PSEG Site within the State of Delaware's boundaries and only in areas that have been surveyed as of March 31, 2009.

Additionally, several State-listed species were observed near the existing access road, such as the cattle egret, black-crowned night-heron, and osprey. These species were noted during the 2009 qualitative surveys, as well (PSEG 2014-TN3452).

Bog turtle

The bog turtle is a nongame species Federally-listed as threatened, New Jersey State-listed as endangered, and Delaware State-listed as endangered. Bog turtles inhabit fens, bogs, and wet meadows characterized by mucky, organic soil that remains saturated by groundwater. Plant communities in bog turtle habitat vary in species composition but are almost always dominated by low-growing grasses, sedges, rushes, ferns, scattered cattails, and forbs. Shrub and tree cover is typically low, and physical features of the habitat include spring-derived rivulets, shallow, mucky pools, and abundant sedge or moss-covered hummocks. Bog turtles spend much of their time hiding in cool, soft muck that provides cover and aids in thermoregulation during warm summer months. After emerging from subterranean hibernacula in the spring, they spend much of that season into early summer basking on hummocks and other areas. Mating occurs primarily in May and June. Females lay their eggs in drier areas of the marsh such as sedge and moss hummocks or rotted tree stumps. The diet of the bog turtle is mainly invertebrates, particularly slugs. They may also feed on carrion, small berries, sedge seeds, young cattail shoots, and duckweed. Once abundant throughout New Jersey, the bog turtle is now restricted to the remaining rural portions of the state, including Sussex, Warren, Hunterdon and Salem Counties. They require large contiguous areas of land for dispersal. Intense land-uses impact bog turtle habitat through direct alteration of wetlands and secondary impacts such as stormwater inputs, water table drawdown and nutrient enrichment (NJDEP 2014-TN3287).

The primary threats to bog turtle populations in New Jersey have been habitat loss due to natural succession, habitat fragmentation, and illegal collection. Vegetation succession has a negative impact on bog turtles by eliminating open areas, resulting in the reduction of suitable nesting sites and basking habitat. Important microclimates may also be eliminated and a monoculture created with the infiltration of invasive plant species such as Phragmites, reed canary grass, or purple loosestrife. Bog turtle colonies are isolated with habitat fragmentation, which has the potential to result in decreased genetic diversity and to impact the colonization of new sites. Bog turtles are also killed when trying to cross roadways that split wetlands (CWFNJ 2014-TN3288).

The bog turtle was recorded historically for Artificial Island and vicinity during a study conducted between 1972 and 1978. There were no records for this species in the latest surveys conducted by PSEG in 2009 to 2010. Methods used for surveying reptiles and amphibians on the PSEG Site during 2009 to 2010 included general site reconnaissance and observation, evening anuran (frog) call surveys in the spring, and transect surveys along eight transects also used for bird and

mammal surveys. Representative portions of the proposed causeway and areas adjacent to the existing access road were also surveyed qualitatively (PSEG 2014-TN3452).

Sensitive joint-vetch

The sensitive joint-vetch (*Aeschynomene virginica*) is Federally-listed threatened. It is a member of the legume family that can grow up to 6 ft tall. It is an annual with yellow flowers that cluster on short lateral branches (FWS 2014-TN3319). Germination occurs in May to June, and it flowers from July to September and sometimes into October.

Habitat for the sensitive joint-vetch includes intertidal zones that are fresh or slightly salty in areas with extensive marshes that are subject to two cycles of flooding a day (FWS 2014-TN3319). The sensitive joint-vetch prefers sediments that are bare or contain sparse vegetation along river banks within 6 ft of the low water mark. It can also occur in tidal marsh interiors, such as those associated with swales or areas of muskrat eat-out and accreting point bars.

Sensitive joint-vetch is threatened by dredging and filling of marshes, dam construction, shoreline stabilization, commercial and residential development, sedimentation, impoundments, water withdrawal projects, invasive plants, introduced insect pests, pollution, recreational activities, agricultural activities, mining timber harvest, and saltwater intrusion due to sea level rise (FWS 2014-TN3319). It is listed as historically occurring in the vicinity of the PSEG Site and may still be present. The 2009 survey did not indicate that it was present on the site or in the vicinity.

Swamp pink

The swamp pink (*Helonias bullata*) is Federally-listed as threatened (FWS 2014-TN3320). It is a perennial member of the lily family with dark green leaves that are smooth and oblong and form an evergreen rosette at its base. The leaves can been seen year round. Its flower stalks can grow over 3 ft tall and are topped with a 1–3 in. long cluster of 30–50 small pink flowers with blue anthers. It flowers in the spring between March and May (FWS 2014-TN3321).

Swamp pink is an obligate wetland species and occurs in a variety of palustrine forested wetlands with canopy closures of 20–100 percent. It can be found co-located with Atlantic white-cedar (*Chamaecyparis thyoides*), red maple, pitch pine (*Pinus rigida*), American larch (*Larix laricina*), black spruce (*Picea mariana*), red spruce (*P. rubens*), sweet pepperbush (*Clethra alnifolia*), sweetbay magnolia (*Magnolia virginiana*), sphagnum mosses (*Sphagnum spp.*), cinnamon fern (*Osmunda cinnamomea*), skunk cabbage (*Symplocarpus foetidus*), and laurels (*Kalmia spp.*). Swamp pink is limited to wetlands that are perennially saturated, but not inundated, by floodwaters. It prefers areas where the water table is at or near the surface with only slight fluctuations during the spring and summer, such as areas with groundwater seepage and lateral movement (FWS 2014-TN3321).

The primary threats to this species are from pollution (such as sediment from construction), invasive species, and changes to the groundwater that could be caused by development or offsite activities. Other threats include wetland clearing, draining, and filling; collection; trampling; and climate change (FWS 2014-TN3321).

It is known to or believed to occur in the following New Jersey counties: Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Middlesex, Monmouth, Morris, Ocean, and Salem. In Delaware, swamp pink is known to or believed to occur in Kent, New Castle, and Sussex counties (FWS 2014-TN3321). Less than 1 percent of the PSEG Site contains habitat suitable to support swamp pink, and its occurrence was not noted in surveys conducted in 2009.

Small whorled pogonia

The small whorled pogonia (*Isotria medeoloides*) is Federally-listed as threatened. It is a perennial member of the orchid family that can grow 2–14 in. in height. It possesses a whorl of five or six milky green leaves near the top of the stem beneath a solitary or paired greenish-yellow flower. It blooms from May to June, and its capsule matures in the fall (FWS 2014-TN3322).

The small whorled pogonia grows in a variety of habitats including upland, mid-successional, and wooded, usually with mixed-deciduous or mixed-deciduous/coniferous forests with canopy trees ranging from 40 to 75 years old. Canopy species in habitat preferred by small whorled pogonia consist of red maple, eastern hemlock (*Tsuga canadensis*), northern red oak (*Quercus rubra*), white oak (*Q. alba*), black oak (*Q. velutina*), scarlet oak (*Q. coccinea*), white pine (*Pinus strobus*), American beech (*Fagus grandifolia*), sweet gum , and tulip poplar (*Liriodendron tulipifera*). Typically, the canopy trees are 8 to 18 in. in diameter.

Small whorled pogonia prefers areas with sparse ground layer vegetation and acid dry soils that lie on a gentle slope. It is associated with the following ground layer species: partridge berry (*Mitchella repens*), Indian cucumber root (*Medeola virginiana*), New York fern (*Thelypteris noveboracensis*), sweet lowbush blueberry (*Vaccinium pallidum*), rattlesnake plantain (*Goodyera pubescens*), red maple seedlings, oak seedlings, Canada mayflower (*Maianthemum canadense*), wintergreen (*Gaultheria procumbens*), starflower (*Trientalis borealis*), running cedar (*Lycopodium digitatum*), Virginia creeper (*Parthenocissus quinquefolia*), cat-brier (*Smilax glauca*), and Christmas fern (*Polystichum acrostichoides*) (FWS 2014-TN3322).

The primary threat to the small whorled pogonia is habitat destruction. Other threats include collection, inadvertent damage, and recreation. It is not known or believed to occur in Salem County, and its nearest known location in New Jersey is Sussex County in the north (FWS 2014-TN3322). The PSEG Site lacks suitable habitat for the small whorled pogonia, and surveys conducted in 2009 did not reveal any on the site or the vicinity. It is listed as having the potential to occur in New Castle County, Delaware, which is within the 6 mi vicinity.

Northern long-eared bat

The northern long-eared bat (*Myotis septentrionalis*) is proposed for Federal-listing as endangered. The northern long-eared bat is distributed in 39 states, including New Jersey. Hibernacula are typically found in small crevices or cracks on cave or mine walls or ceilings, and seven known sites occur within New Jersey. Hibernacula used by northern long-eared bats are typically large, with large passages, constant cool temperatures, high humidity, and no air currents. Additionally, northern long-eared bats have been seen overwintering in railroad tunnels, storm sewer, and other unsuspected retreats. In the summer, northern long-eared bats

roost underneath bark or in crevices or cavities of live trees and snags of various tree species. Tree species include black oak, northern red oak, silver maple (*Acer saccharinum*), black locust (*Robinia pseudoacacia*), American beech, sugar maple (*Acer saccharum*), sourwood (*Oxydendrum arboreum*), and shortleaf pine (*Pinus echinata*). They also have been observed roosting in or under the eaves of human-made structures such as barns, buildings, sheds, and cabins.

Northern long-eared bats are not a long-distance migratory species, and movements between summer and winter hibernacula are between 35 and 55 mi. Breeding occurs between late July and early October. Home ranges are approximately 46–425 ac for females and 161 ac for males. Northern long-eared bats emerge at dusk and fly along hillsides through forest understory gleaning insects from vegetation. Northern long-eared bats have a diverse diet of insects, most commonly beetles, moths, and arachnids. Mature forests are an important habitat for the northern long-eared bat's foraging technique. The primary threat to the northern long-eared bat is attributed to white nose disease caused by the fungus *Geomyces destructans* (78 FR 61046-TN3207).

Maternity roosts and hibernacula for the northern long-eared bat are known to occur in the following New Jersey counties: Atlantic, Bergen, Burlington, Camden, Hunterdon, Mercer, Morris, Ocean, Passaic, Salem, Somerset, Sussex, and Warren (FWS 2014-TN3208). No surveys were conducted on the PSEG Site for bats species. However, suitable habitat for hibernacula and maternity roosts and habitat important for foraging does not exist on the PSEG Site. Northern long-eared bat are known to occur in the northern and central portions of Salem County, New Jersey, within the PSEG Site 6-mi vicinity (78 FR 61046-TN3207).

<u>Northern goshawk</u>

The northern goshawk (*Accipiter gentilis*) is New Jersey State-listed as endangered for breeding population and special concern for nonbreeding population. It is listed because of the limitation of habitat available for breeding (NJDEP 2012-TN3247).

Northern goshawks nest in mature, contiguous forests away from human activity and development. They may also nest in wooded swamps, lower gentle slopes, or flat areas at higher elevations. Nests may be located in either deciduous or coniferous trees, although deciduous trees are used more frequently in New Jersey (NJDEP 2012-TN3247). Northern goshawks breed in areas with large-sized trees, a closed canopy, and an open understory (PSEG 2012-TN2389).

Outside the breeding season, goshawks frequent a wider variety of habitat types. In migration and during winter, they may forage in mature as well as young woods, scrubby areas, and tree lines along marshes or open fields. Forested areas are favored for roosting because they provide protection against the weather. The greatest threat to the northern goshawk is habitat destruction (NJDEP 2012-TN3247). Northern goshawks have been reported in the project vicinity during recent (2008 to 2009) Audubon Society Annual Christmas Bird Counts for Salem County (PSEG 2014-TN3452; Audubon 2013-TN2414). The northern goshawk may use the PSEG Site and vicinity periodically for foraging during migration or during the winter.

Grasshopper Sparrow

The grasshopper sparrow (*Ammodramus savannarum*) is New Jersey State-listed as threatened for the breeding population and special concern for the nonbreeding population. Preferred habitat for the grasshopper sparrow consists of short to medium bunch grasses interspersed with bare ground, shallow litter layer, scattered forbs, and few shrubs (CWFNJ 2012-TN3248).

Grasshopper sparrows prefer to nest in open habitats including agricultural lands and airports that contain suitable habitat. These sparrows breed in grasslands, upland meadows, pastures, hay fields, and old field habitats. They may use small grassland, but they prefer areas greater than 99 ac. Nests are constructed by the females near the base of a clump of grass in a shallow depression. Habitat loss is the primary threat to the grasshopper sparrow (CWFNJ 2012-TN3248).

One grasshopper sparrow was observed in the vicinity of the PSEG Site in the spring during the 2009 to 2010 PSEG survey. Grasshopper sparrows have also been reported in the USGS North American Breeding Bird Survey (BBS) bird count (PSEG 2014-TN3452). The PSEG Site provides some limited habitat for this species, with some higher quality habitat present in the vicinity of the site.

Cattle egret

The cattle egret is New Jersey State-listed as threatened for the breeding population and special concern for the nonbreeding population. Cattle egrets are very common around the United States and the world, but changes in land use from livestock operations have caused their population to decline in New Jersey. This species of egret prefers to forage and roost in agricultural fields and pastures and nest in mixed species colonies on marsh islands (NJDEP 2012-TN3249).

Cattle egrets were observed in fairly good numbers in the vicinity of the PSEG Site during the 2009 to 2010 PSEG survey, mainly in the spring and fall. They also were recorded during the BBS (PSEG 2014-TN3452). The PSEG Site may provide limited foraging habitat for this species, with higher quality foraging habitat being present in the site vicinity.

Red-shouldered hawk

The red-shouldered hawk (*Buteo lineatus*) is New Jersey State-listed as endangered for breeding population and special concern for nonbreeding population. Red-shouldered hawks prefer wetland forests as well as uplands, fragmented woods, small forests, open areas, and edges (NJDEP 2014-TN3254).

Their nesting habitat includes deciduous, coniferous, and mixed woodland remote old growth forests with standing water, closed upper canopies, and open subcanopies. They nest in large deciduous trees and sometimes coniferous trees. Nesting habitats in southern New Jersey include hardwood or mixed hardwood/cedar swamps containing red maple, black gum (*Nyssa sylvatica*), sassafras (*Sassafras albidum*), sweetbay magnolia, and Atlantic white cedar. They require large continuous wooded tracts for breeding, typically 270–838 ac for the eastern

populations, with average distances of about 0.75 to 1.0 mi between nests. Habitat loss is the primary threat to red-shouldered hawks (NJDEP 2014-TN3254).

No red-shouldered hawks were observed during the 2009 to 2010 field survey. However, they have been identified near the site during recent (2009 to 2010) Audubon Society Annual Christmas Bird Counts for Salem County (PSEG 2014-TN3452; Audubon 2013-TN2414). This species was also recorded during past work conducted in the Alloway Creek watershed (PSEG 2004-TN2897). The PSEG Site and vicinity provides foraging habitat for this species, while larger wooded areas in the vicinity provide potential nesting habitat. Preferred nesting habitat is not available on the PSEG Site.

Northern harrier

The northern harrier is New Jersey State-listed as endangered for the breeding population and special concern for the nonbreeding population and Delaware State-listed as endangered. Northern harriers prefer open tidal marshes, emergent wetlands, fallow fields, grasslands, meadows, airports, and agricultural areas. Northern harriers will build nests in brackish or saline marshes along the Delaware Bay shores in salt hay (*Spartina patens*), marsh elder (*Iva frutescens*), or reed grass (*Phragmites communis*). They will also nest in freshwater tidal marshes containing common reed or sedges. However, common reed makes for poor foraging habitat because of the thick stands it forms (NJDEP 2014-TN3255).

Habitat loss is the greatest threat to northern harriers in New Jersey (NJDEP 2014-TN3255). The PSEG Site does contain marsh habitat that may provide nesting and foraging habitat for the northern harrier. During the 2009 to 2010 field survey, northern harriers were commonly observed in all seasons. Sightings were near open areas, both on the site and in the vicinity. They were observed foraging above the marsh. Although northern harriers were not confirmed nesting on the site or in the vicinity, they are ground nesters and could potentially nest near the study area. The northern harrier was also identified near the PSEG Site during BBS and recent (2005 to 2010) Audubon Society Annual Christmas Bird Counts for Salem County (PSEG 2014-TN3452; Audubon 2013-TN2414). This species was also recorded during past work conducted in the Alloway Creek watershed (PSEG 2004-TN2897).

Bobolink

The bobolink (*Dolichonyx oryzivorus*) is New Jersey State-listed as threatened for the breeding population and special concern for the nonbreeding population. In 1979, the bobolink was listed by the state of New Jersey as threatened because of population decline and habitat loss. During the breeding season (early summer), bobolinks frequent low-intensity agricultural areas, including hayfields and pastures. They also may be found in fallow fields and meadows that contain grasses, forbs, and wildflowers. The highest densities of bobolinks are found in larger fields; however, they may also nest in smaller fields of 5–10 ac. Following the breeding season in late June to early July, bobolinks frequent freshwater and coastal marshes where they will stay for several weeks while molting. A second influx of migrating bobolinks occurs along the Atlantic and Delaware Bay coasts in late August (CWFNJ 2012-TN3271).

Females will choose the nest site, which is established on the ground near a large clump of grass. Bobolinks winter in South America. The greatest threat to the bobolink is the loss of preferred habitat such as agricultural fields (CWFNJ 2012-TN3271). One bobolink was observed on the site in the spring during the 2009 to 2010 PSEG survey (PSEG 2014-TN3452). Bobolink nesting habitat is not available on the PSEG Site.

Horned lark

The horned lark (*Eremophila alpestris*) is New Jersey State-listed as threatened for breeding population and special concern for nonbreeding population. This is the only true lark native to the New World (CWFNJ 2012-TN3256).

Horned larks prefer open habitats with short, sparse grasses and wildflowers, bare ground, and few shrubs. They will leave sites as vegetation becomes denser. Horned larks have become increasingly localized in New Jersey. They are most common in the Wallkill River Valley, parts of Warren, Salem, and Cumberland counties, and Lakehurst Naval Station in Ocean County. They will frequent mowed areas around airstrips where suitable agricultural and nonforested habitats are rare (CWFNJ 2012-TN3256).

Horned larks eat mostly weed seeds, grass seeds, and waste grains. Young are fed insects, and adults also eat some insects, such as grasshoppers, caterpillars, ants, and wasps (CWFNJ 2012-TN3256). They also may eat snails, fruits, and berries (PSEG 2012-TN2389).

The horned lark is one of the earliest birds to nest, with males establishing territories in January and February. Females build nests in small depressions on the bare ground next to bunch grasses or other plants, and nests are lined with fine plant materials. The greatest threats to the horned lark include loss of habitat and native plant species (CWFNJ 2012-TN3256).

One horned lark was observed in the vicinity of the PSEG Site in the spring during the 2009 to 2010 PSEG survey. Horned larks also have been reported in the BBS and during recent (2008 to 2010) Audubon Society Annual Christmas Bird Counts for Salem County (PSEG 2014-TN3452; Audubon 2013-TN2414). The PSEG Site provides some limited habitat for this species, with some higher quality habitat present in the vicinity of the site.

Peregrine falcon

The peregrine falcon (*Falco peregrinus*) is New Jersey State-listed as endangered for the breeding population, and special concern for the nonbreeding population. Historically, peregrine falcon nest sites were restricted to cliffs and rock outcroppings. With increased human development, they began to nest on man-made structures. There are no remaining peregrine falcon cliff nests in New Jersey. Artificial nest platforms were erected during the days of peregrine population recovery, and these platforms are still used today. Peregrines favor open areas for foraging and frequently hunt over marshes, beaches, or open water (NJDEP 2014-TN3316).

They feed mainly on birds, including passerines and small geese. They occasionally eat mammals and rarely eat amphibians, fish, or insects (White et al. 2002-TN3329). Peregrine

falcons have been reported in the PSEG Site vicinity during recent (2005 to 2006) Audubon Society Annual Christmas Bird Counts for Salem County (PSEG 2014-TN3452; Audubon 2013-TN2414). The main threats to the peregrine falcon are chemical contaminants such as PCBs and predation from other species such as the great horned owl (*Bubo virginianus*) (NJDEP 2014-TN3316).

American kestrel

The American kestrel (*Falco sparverius*) is New Jersey State-listed as threatened for both breeding and nonbreeding populations. American kestrels frequent large, open areas with low vegetation and are, therefore, attracted to managed areas such as farms, parks, and pastures. Habitat preferences vary between sexes outside the breeding season, with males preferring more forested areas and females still preferring areas that are more open. Kestrels hunt from available perches (branches, utility lines, etc.) or hover, preying on insects, reptiles, mice, voles, and sometimes birds (NJDEP 2012-TN3257).

Kestrels are secondary cavity nesters, utilizing natural cavities and woodpecker holes. They will also use nesting opportunities provided by man, including cavities in the eaves of buildings and barns, and nest boxes. These provide important nesting space for kestrels impacted by snag removal and competition from other species (e.g., squirrels and European starlings). The lack of suitable nest sites is one theory for the decline of kestrel numbers in recent years. Kestrel numbers are particularly experiencing declines in the northeast where lack of nesting sites is thought to be a factor. The shift away from farmland to development and reforestation is a contributing factor to habitat loss. Critical habitat disappears as urban and suburban development fragment large open areas into smaller patches. The increase in raptor species including Cooper's and sharp-shinned hawks may be another factor for the decline. Presence of West Nile virus in this species may also be a concern. Fortunately, nest box programs have been successful in providing viable nesting habitat (NJDEP 2012-TN3257).

American kestrels have been reported in the PSEG Site vicinity by BBS and during recent (2005 to 2010) Audubon Society Annual Christmas Bird Counts for Salem County (PSEG 2014-TN3452; Audubon 2013-TN2414). This species was also recorded during past work conducted in the Alloway Creek watershed (PSEG 2004-TN2897).

Bald eagle

The bald eagle is New Jersey State-listed as endangered for the breeding population and as threatened for the nonbreeding population and Delaware State-listed as endangered. It was removed from the Federal endangered species list in 2007. However, it is still protected federally under the Bald and Golden Eagle Protection Act. By 1970, only one bald eagle nest remained in New Jersey, and the species was listed as endangered. Bald eagles reside year-round in New Jersey and typically remain in the vicinity of their nest site. The largest concentration of bald eagles is along the Delaware Bay in Salem and Cumberland counties. Bald eagles also are present in central and northern New Jersey near lakes, reservoirs, and rivers. They may move southward in winter from the northern parts of their range and may stop over in New Jersey. During the January 2008 midwinter eagle survey, 264 bald eagles were recorded in New Jersey; this was the highest count since surveys began in 1978 (CWFNJ 2012-TN3258).

Bald eagles roost in forested areas but forage near water bodies in areas such as rivers, lakes, and marshes. They nest in the tops of large, mature trees and typically use the same nests year after year. Juvenile birds generally leave the area in late August and may winter in the Chesapeake Bay area, where open water and food are abundant (PSEG 2014-TN3452; CWFNJ 2012-TN3258).

Because of their large size, bald eagles require a large foraging area. The main prey for bald eagles is fish, but they are opportunistic and also will feed on waterfowl, turtles, rabbits, snakes, muskrats, other small animals, and carrion (PSEG 2014-TN3452; CWFNJ 2012-TN3258). Bald eagles use a sit-and-watch foraging behavior from large perch trees near water. In New Jersey, ideal locations for foraging are the Delaware River, Delaware Bay, and associated tidal marshes (PSEG 2014-TN3452).

During the 2009 to 2010 field survey, bald eagles were occasionally observed flying on the site and perched along the Delaware River at the south end of the PSEG Site during all seasons. Bald eagle use of the PSEG Site is most likely for foraging. Bald eagles have been recorded in recent years (2005 to 2010) near the site during the Audubon Society Annual Christmas Bird Count for Salem County (PSEG 2014-TN3452; Audubon 2013-TN2414). In nesting surveys conducted annually by the NJDEP, during the five-year span from 2004 to 2008, bald eagles had nested within a 6-mi radius of the PSEG Site. Two nests were confirmed (one near the town of Elsinboro, and the other along Alloway Creek) (PSEG 2014-TN3452). This species was also recorded during past work conducted in the Alloway Creek watershed (PSEG 2004-TN2897).

Red-headed woodpecker

The red-headed woodpecker (*Melanerpes erythrocephalus*) was listed in New Jersey in 1979 as threatened for both breeding and nonbreeding populations. The decline of red-headed woodpeckers is a result of mortality from vehicle collisions, competition with the European starling for nesting sites, harvesting of feathers for hats, and killing by farmers because of damage to fruit and berry crops. Red-headed woodpecker habitat includes open woods, deciduous forests, forest edges, river bottoms, orchards, grasslands with scattered trees, and clearings. They prefer areas with dead or dying trees that provide cavities for nesting and sparse undergrowth to facilitate foraging (PSEG 2014-TN3452).

Red-headed woodpeckers have an omnivorous diet consisting of insects, spiders, worms, nuts, seeds, berries, fruit, and occasionally small mammals. They may also eat the young and eggs of bluebirds, house sparrows, and chickadees. They search for food from either a perch or the ground. Much of the food found by red-headed woodpeckers is stored in existing natural or man-made cavities or crevices. No red-headed woodpeckers were observed during the 2009 to 2010 field survey, nor have they been reported in the BBS or the Audubon Society Annual Christmas Bird Counts for Salem County. Suitable nesting habitat for the red-headed woodpecker is not available on the PSEG Site (PSEG 2014-TN3452).

Black-crowned night-heron

The black-crowned night-heron is New Jersey State-listed as threatened for the breeding population and as special concern for the nonbreeding population. The black-crowned night-heron was a historically common breeding species along the New Jersey coast. The population decline is attributed to habitat destruction, disturbance of nesting colonies, and contaminants (NJDEP 2012-TN3259).

Nesting, roosting, and foraging habitat for black-crowned night-herons includes forests, shrub/scrub, marshes, and ponds. Heronries may be located in wooded swamps, coastal dune forests, vegetated dredge spoil islands, scrub thickets, or mixed *Phragmites* marshes that are close to water. Black-crowned night-herons forage in marshes and along pond edges and creeks. Shallow tidal pools, tidal channels, mudflats, and vegetated marsh also provide foraging habitat in coastal salt marshes (NJDEP 2012-TN3259).

The black-crowned night-heron is an opportunistic feeder that prefers foraging in shallow water. The diet of this species consists primarily of fish; the diet also may include leeches, earthworms, and aquatic and terrestrial insects. These herons also eat crayfish, mussels, squid, amphibians, lizards, snakes, rodents, birds, eggs, carrion, plant materials, and garbage and refuse from landfills (PSEG 2012-TN1489).

Black-crowned night-herons were observed in low numbers in the vicinity of the site along Alloway and Hope Creeks in spring and summer during the 2009 to 2010 PSEG survey. They were also recorded during BBS (PSEG 2014-TN3452). This species also was recorded during past work conducted in the Alloway Creek watershed (PSEG 2004-TN2897).

Osprey

The osprey is New Jersey State-listed as threatened for the breeding population. The loss of nesting sites and contamination of food by persistent pesticides (mainly DDT) caused the decline of this species in New Jersey and throughout the eastern United States. Nest platforms have been installed by PSEG in the ACW site as part of the PSEG EEP program (PSEG 2014-TN3452).

Ospreys frequent areas in close proximity to water including coastal rivers, marshes, bays, and inlets, as well as inland rivers and lakes. Ospreys nest on live or dead trees, man-made nesting platforms, light poles, channel markers, abandoned duck blinds, and other artificial structures close to water offering unobstructed views of the surrounding area. The osprey’s acceptance and use of these artificial nesting sites has played a key role in the recovery of this species (PSEG 2014-TN3452). Ospreys in New Jersey arrive on their breeding grounds in late March. Nests are constructed of sticks and lined with softer vegetation. Breeding begins in April or May. Ospreys leave New Jersey for their wintering grounds in late August to early September (PSEG 2014-TN3452; CWFNJ 2012-TN3260).

Ospreys in New Jersey nest along the Atlantic Coast from Sandy Hook to Cape May and on the Delaware Bay and River in Cumberland, Salem, and Gloucester counties. In addition,

reintroduction efforts on northern New Jersey lakes have resulted in ospreys nesting along the upper Delaware River (CWFNJ 2012-TN3260).

The osprey's main diet consists of fish. Ospreys are opportunistic and will eat whatever fish species are accessible. However, given the abundance of fish in a given area, their diet may consist of only two to three species. Ospreys hunt for prey while in flight (PSEG 2014-TN3452).

During the 2009 to 2010 field survey, ospreys were occasionally observed in the spring and summer both on the site and in the vicinity of the PSEG Site. Active osprey nests were observed on transmission towers along the current PSEG access road from the plant north toward Money Island Road. Nests were also observed on man-made nesting platforms along Alloway Creek. Ospreys have also been identified near the site in the BBS. In an osprey nesting and productivity study conducted annually (beginning in 2006) by the New Jersey Division of Fish and Wildlife, it was reported that the number of young per nest in the Salem County–Artificial Island area has averaged between 1.7 and 2.0 birds from 2006 to 2008. Additionally, The Nature Conservancy has conducted an annual nesting and productivity study on PSEG EEP wetland restoration sites since 1999. The Alloway Creek wetland restoration site is the only site within the 6-mi vicinity of the PSEG Site. Nesting platforms have been monitored at this wetland site since 2001, and the number of young per nest has ranged from zero to three for 2001 to 2009. There are four nesting platforms on the ACW site. The number of active nests each year has varied (PSEG 2014-TN3452).

Savannah Sparrow

The savannah sparrow (*Passerculus sandwichensis*) is New Jersey State-listed as threatened for the breeding population. This species breeds in the ridge and valley and highlands regions of northern New Jersey and in the inner coastal plain of southwestern New Jersey. The savannah sparrow is a common migrant through New Jersey from mid-September through early November in the fall and from mid-March through late April in the spring. This sparrow is an uncommon winter resident seen in small flocks along the coast, inland grasslands, and fields (CWFNJ 2012-TN3261).

Savannah sparrows nest in a variety of open habitats. For a field to be suitable for savannah sparrows, it must include a mix of short and tall grasses, a thick litter layer, dense ground vegetation, and scattered shrubs, saplings, or forbs. Savannah sparrows require large grasslands of approximately 20–40 ac. Near the ocean they may also frequent tidal salt marshes and estuaries. Savannah sparrows depend on seasonally abundant food sources. During the nesting season, savannah sparrows feed on invertebrates such as insects, larvae, and caterpillars. In coastal areas, they may eat tiny crustaceans. The young are fed invertebrates, along with fruit and berries. A cup nest constructed by the female is concealed by vegetation in a slight depression on the ground. The nest is located in clumps of grass or at the base of a shrub and is woven of thick grasses and lined with thinner grasses (CWFNJ 2012-TN3261).

Habitat loss and modern agricultural practices are a threat to nesting savannah sparrows in New Jersey. The amount of suitable habitat has experienced a reduction with the decline in farming, succession, and the development of open space (CWFNJ 2012-TN3261). Two

savannah sparrows were observed on the site in the spring during the 2009 to 2010 PSEG survey. They have also been reported during recent (2009 to 2010) Audubon Society Annual Christmas Bird Counts for Salem County (PSEG 2014-TN3452).

Pied-billed grebe

The pied-billed grebe (*Podilymbus podiceps*) is New Jersey State-listed as endangered for breeding population and as special concern for nonbreeding population and Delaware State-listed as endangered for breeding population. There are only two known breeding sites in New Jersey. The New Jersey Natural Heritage Program considers the pied-billed grebe to be "critically imperiled in New Jersey" (NJDEP 2012-TN3262).

The greatest threats to pied-billed grebe populations in New Jersey are habitat degradation and destruction resulting from the draining, dredging, filling, pollution, and siltation of wetlands. The breeding habitat for this species (palustrine emergent wetlands, inland wetlands such as marshes and swamps without flowing water, and less than 0.5 percent ocean-derived salinity) is one of the most threatened wetland types in the United States. Pied-billed grebes nest in freshwater marshes associated with ponds, bogs, lakes, reservoirs, or slow moving rivers and, infrequently, in coastal estuaries that receive minimal tidal fluctuations. These grebes typically frequent areas with emergent or aquatic vegetation, which provides good locations for nesting sites. Nests float and are anchored to marsh vegetation in shallow water. Clutch sizes range from 2 to 10 eggs, with an incubation period of 23–27 days. The breeding season starts in April and runs through October. They frequent a greater variety of habitats outside the breeding season, including brackish marshes, estuaries, inlets, tidal creeks, and coastal bays. Pied-billed grebes eat small fish, crustaceans, and aquatic insects and their larvae (NJDEP 2012-TN3262; PSEG 2012-TN2389).

The PSEG Site does contain marshes that may be suitable for nesting pied-billed grebes. However, pied-billed grebes were not observed during the 2009 to 2010 PSEG survey. They have been recorded in low numbers during Audubon Society Annual Christmas Bird Counts for Salem County (2006 to 2007 and 2008 to 2009) (PSEG 2014-TN3452; Audubon 2013-TN2414).

Eastern tiger salamander

The eastern tiger salamander is New Jersey State-listed as endangered and Delaware State-listed as endangered. Tiger salamanders are the largest salamander species in New Jersey. Life requirements include both upland and wetland habitat that contain ponds suitable for breeding, forested areas, and soil types that allow burrowing (loamy sand and sandy loams are preferred). Tiger salamanders remain underground much of the year in tunnels and burrows or under logs. They emerge from their burrows from late October to March during mild temperatures and rain that trigger nocturnal movement. Most juvenile tiger salamanders will emerge in July and disperse to underground tunnels and burrows. With the loss of natural breeding ponds, tiger salamanders have used gravel pits and farm ponds. Ponds must have clean water and be free of fish that prey on salamander eggs and larvae. Tiger salamanders require ponds that hold water long enough for metamorphosis to be completed, yet have a dry period that will prevent predatory fish from inhabiting the pond. Therefore, breeding ponds are usually only two to four feet deep (CWFNJ 2012-TN3263).

Terrestrial habitats that may be frequented by tiger salamanders include old fields and deciduous or mixed woodlands (e.g., oak and pine or oak and holly). Vegetation around the ponds, including sedges and sphagnum moss, and aquatic vegetation in the pond itself provide cover for these salamanders. Losses of habitat and pond pollution have led to tiger salamander declines in New Jersey. High road mortality while crossing roads to breeding ponds is also a significant impact. The New Jersey Natural Heritage Program considers this species to be imperiled in New Jersey because of rarity. The tiger salamander has avoided localized extinction because it has the ability to use man-made pools for breeding ponds. Surveys of this species conducted in 1995 revealed that the tiger salamander occurred at only a limited number of sites in Atlantic and Cumberland Counties (CWFNJ 2012-TN3263). The eastern tiger salamander was not observed on the site or in the vicinity during the 2009 to 2010 PSEG survey. However, tiger salamanders were recorded during an ecological survey conducted on Artificial Island, 1972–1978 (PSEG 2014-TN3452).

Important Habitats

No areas on the PSEG Site are federally designated as critical habitat for any Federally-listed threatened or endangered species. This section includes important wetlands, wildlife sanctuaries, refuges, and preserves.

Wetlands

Activities including the discharge of dredge or fill materials into waters of the United States, including wetlands, require permit authorization from the USACE under Section 404 of the CWA. Additionally, the USACE regulates any work or structures affecting waters of the United States, including wetlands, under Section 10 of the Rivers and Harbors Appropriation Act. NJDEP regulates coastal wetlands under the New Jersey Wetlands Act of 1970, and freshwater wetlands are regulated under the New Jersey Freshwater Wetlands Protection Act (PSEG 2012-TN2389).

PSEG submitted an application for line verification to NJDEP for the PSEG Site. Additionally, PSEG submitted a Jurisdictional Determination Request to the USACE to clarify the USACE's jurisdiction on the USACE's 85 ac CDF facility immediately north of the PSEG Site. As part of its request, PSEG submitted results of jurisdictional wetland delineation conducted in accordance with procedures identified in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (1989) and Corps of Engineers Wetland Delineation Manual (1987) at the PSEG Site. Freshwater wetland complexes were identified, flagged, and surveyed. Hydrophytic vegetation, hydric soils, and wetland hydrology were identified and described at each of the data collection points. Additionally, PSEG submitted a description of the 85 ac CDF facility along with interpretation of USACE Regulatory Guidance and descriptions of the CDF hydrology, hydrophytic vegetation, and hydric soil to support wetland determination (PSEG 2012-TN2389).

Thirty-nine Federal jurisdictional freshwater wetland units covering approximately 158.7 ac were identified by the USACE in a letter dated February 24, 2014, to PSEG. These areas were identified as Block 26, lots 2, 4, 4.01, 5, and 5.01 in Lower Alloways Creek Township, Salem County, New Jersey. Any proposal to perform work, build structures, or discharge dredge or fill

material into the identified areas would require prior approval from the Philadelphia District USACE. Figure 2-6 depicts the jurisdictional wetlands (considered important terrestrial habitat) on the PSEG Site. The printed version of this figure may not be legible; however, the electronic version is viewable when zoomed in. Figure 2-6 includes wetlands mapped by NJDEP (coastal wetlands) and those delineated on the site as part of the site (USACE CDF facility, PSEG desilt basin, and freshwater wetlands). A total of 164.9 ac of coastal wetlands and 158.68 ac of freshwater wetlands have been mapped on the PSEG Site (PSEG 2014-TN3452; USACE 2014-TN3282). The 39 units were individually identified as A1, AA, B1, BB, CC, CDF3, D, D1, D1a, D1b, D1c, D1d, DD, E, F, F1, G, G1, H, H1, I, I1, J, K, L, N, O, O1, P, Q, R, S, T, U, V, W, X, Y, and Z. The USACE jurisdictional freshwater wetlands located in unit CDF3 were identified during a site investigation on December 5, 2013. The remaining USACE jurisdictional wetland units were included in the NJDEP line verification (USACE 2014-TN3282).

Most of the PSEG Site is surrounded by tidal marsh dominated by near monocultures of the invasive common reed. This is also the case for most of the tidal marsh surrounding Hope Creek, Alloway Creek, and associated smaller marsh creeks. Most of the coastal wetlands occur within the northern portion of the PSEG Site and connect to the contiguous Alloway Creek and Hope Creek coastal wetland systems (marshes) (PSEG 2014-TN3452).

The eastern portion of the PSEG Site contains primarily freshwater wetlands dominated by monocultures of Phragmites. They are predominantly tidal wetland systems that are contiguous with coastal wetlands mapped by the New Jersey Wetlands Act of 1970. Functionally, these wetlands are similar to the coastal wetlands and are tidally influenced systems. Some areas on Artificial Island, such as the CDF and the PSEG Site desilt basins, have been diked and are no longer tidally influenced (PSEG 2014-TN3452).

The PSEG EEP manages the ACW site just north of Alloway Creek. The restoration program has successfully restored several common reed-dominated wetlands with *Spartina alterniflora*, *Spartina cynosuroides*, *Spartina patens*, *Persicaria hydropiper*, and *Sagittaria latifolia* as part of the program since 1995, encompassing an area of more than 14,550 ac throughout the Delaware River Estuary in New Jersey and Delaware in accordance with site-specific NJDEP-approved management plans. Common reed communities are treated using herbicides, or tidal exchange is reestablished that allows native marsh species (e.g., saltmarsh cordgrass) to repopulate the wetland sites. Monitoring is conducted in accordance with an NJDEP approved Improved Biological Monitoring Work Plan program. Each site is monitored yearly to ensure a successful restoration (PSEG 2014-TN3452). Restoration programs such as the Alloway Creek program could increase the functionality of degraded wetlands.

Wildlife Sanctuaries, Refuges, and Preserves

There are numerous wildlife sanctuaries, refuges, and preserves within the Atlantic Coastal Plains Ecoregion. In Delaware, portions of three counties within the Atlantic Coastal Plains Ecoregion include two National Wildlife Refuges (NWRs) (Bombay Hook and Prime Hook, with a combined 25,978 ac) and 12 state parks (totaling 7,469 ac). New Castle County in Delaware has 11 state parks totaling 7,403 ac (PSEG 2014-TN3452).

Portions of seven counties in Maryland fall within the Atlantic Coastal Plains Ecoregion. This area includes two NWRs (Susquehanna and Eastern Neck), one national trust, three private parks, and six state parks. A total of 39,711 ac of recreational lands occur in these seven Maryland counties (PSEG 2012-TN1489).

New Jersey has the largest land area within the Atlantic Coastal Plains Ecoregion dedicated to recreational use (217,197 ac). These lands include two NWRs (Cape May and Supawna Meadows), which together total 15,600 ac. Other recreational resources in New Jersey within the 50 mi radius include three land trusts (8,365 ac) and eight state parks (193,231 ac). The National Park Service has designated a 300-mi-long area along the coastline as the New Jersey Coastal Heritage Trail extending from Deepwater on the Delaware River to Raritan Bay on the Atlantic Ocean. Within the four-county region in New Jersey, Cumberland County has 7,756 ac committed to two natural land trusts (Glades Wildlife Refuge and Peak Reserve). Salem County has 17,775 ac that are mainly associated with the Supawna Meadows NWR (4,600 ac), four state parks (12,566 ac), the Burdon Hill Preserve (609 ac), Mad Horse Creek WMA (9,498 ac), and Abbott Meadows (1,011 ac). A portion of the Delsea Region of the New Jersey Coastal Heritage Trail is located in Salem and Cumberland Counties, including a welcome center at Fort Mott State Park (PSEG 2014-TN3452).

Pennsylvania has the lowest amount of acreage dedicated to recreational land within the Atlantic Coastal Plains Ecoregion. For the eight Pennsylvania counties, there are 17,775 ac of recreational land within the Atlantic Coastal Plains Ecoregion. This includes 200 ac of the John Heinz NWR at Tinicum; 3,500 ac at Valley Forge National Historical Park; 9,718 ac within six state parks; and 4,357 ac within 17 land trusts (PSEG 2014-TN3452).

Figure 2-7 in Section 2.2 shows wildlife management areas and other wildlife areas within a 6-mi radius of the PSEG Site. The following is a brief discussion of those areas:

Cedar Swamp Wildlife Area (Delaware)

Cedar Swamp Wildlife Area, managed by the Delaware Division of Fish and Wildlife, consists of four large land tracts totaling over 5,500 ac of wilderness near Townsend, Delaware, and the mouth of Delaware Bay. The site offers wildlife watching and hunting opportunities, including waterfowl hunting, deer hunting (including categories for firearms, archery, and disabled hunters), and small game hunting opportunities (EcoDelaware 2014-TN3265; DNREC 2012-TN3264).

Augustine Wildlife Area (Delaware)

Augustine Wildlife Area consists of four large land tracts totaling almost 2,700 ac of wilderness near Port Penn and the Delaware River. The site contains the Port Penn Trail, a 1-mi path that winds its way between a tidal marsh and the Delaware River. This trail is located across the street from the Port Penn Interpretive Center, and it is open from October 1 to February 1. Near the trail head are an authentic floating cabin and a historic muskrat-skinning shack. The site offers wildlife watching along with a number of hunting opportunities. These hunting

opportunities include waterfowl hunting, deer hunting (including categories for firearms, archery, and disabled hunters), small game hunting, and falconry (EcoDelaware 2014-TN3266; DNREC 2012-TN3267).

<u>Abbotts Meadow Wildlife Management Area (New Jersey)</u>

Abbotts Meadow is a 1,468-ac WMA in Salem County, New Jersey. It is a hotspot for viewing birds of grasslands and early successional habitats. The farm fields, marsh edge and meadows, and hedgerows that separate them provide a perfect habitat for a variety of species. Baltimore and orchard orioles are often seen darting through the hedgerows, along with northern cardinals and field sparrows. In the winter waterfowl and wading birds can be seen in the marsh, and raptors such as northern harriers can sometimes be seen. Ospreys are common during late spring and summer, while bald eagles are more often seen during the colder months. Groundhogs are commonly seen along the roads and fields of the WMA. Muskrat dens are found throughout the marsh. The site also provides hiking, fishing and hunting opportunities (NJDEP 2012-TN3269).

<u>Mad Horse Creek Wildlife Management Area (New Jersey)</u>

The Mad Horse Creek WMA in Lower Alloways Creek Township, Salem County, is 9,498 ac. It offers opportunities for boating, saltwater fishing, hunting, and bird watching (waterfowl and other birds). The area has foraging and nesting habitat for bald eagles, ospreys, and great blue herons. There is parking as well as a boat ramp at the end of Stowneck Road. The area contains both tidal marsh and upland habitat (PSEG 2012-TN1489; OTWNJ 2012-TN3270).

Important Terrestrial and Wetland Species and Habitats—Existing Transmission Lines

Important Species

Important species having the potential to occur in the existing transmission line corridors are similar to those species that could potentially occur on the PSEG Site and in the 6-mi vicinity as described above. Federally and State-listed species in transmission line ROWs are the same species as listed above.

Important Habitats

Important habitats having the potential to occur in the existing transmission line corridors and access road are similar to those habitats that occur on the PSEG Site and in the 6-mi vicinity as described above. The existing transmission ROWs servicing HCGS and SGS are not known to extend through Federally designated critical habitat. However, wetland habitats exist along their route. In addition to important wetland habitat, existing transmission ROWs are routed through Mad Horse Creek WMA and Abbotts Meadow WMA.

2.4.1.4 Terrestrial and Wetland Monitoring

PSEG conducts vegetation cover and geomorphology monitoring as part of its EEP. This program has been ongoing since 1995 and includes four wetland restoration sites and two reference sites. The objective of these programs is to restore Phragmites dominated

communities with native marsh species. The monitoring program is subject to the NJDEP approved *Biological Monitoring Work Plan* (PSEG 2014-TN3452).

2.4.2 Aquatic Ecology

This section describes the aquatic environments and their associated biological resources in the vicinity of the PSEG Site that could be affected by building, operating, or maintaining a new nuclear power plant at the site. It describes the spatial and temporal distribution, abundance, life history stages, and attributes of biotic assemblages that could be affected by building and operating a new nuclear power plant, and identifies "important" or irreplaceable aquatic natural resources that could be affected. The surface water hydrology and water quality that support these aquatic resources in vicinity of the PSEG Site are described in Section 2.3.

The principal aquatic systems that could be affected include the onsite freshwater ponds and small marsh creeks, the extensive area of marsh creeks north of the PSEG Site where the proposed causeway would be constructed, and the Delaware River Estuary (Figure 2-21).

2.4.2.1 Aquatic Resources of the Site and Vicinity

Artificial ponds and onsite small marsh creeks

Aquatic systems in the PSEG Site vicinity include small, man-made freshwater ponds within dredged material containment berms and wetland ecosystems with their extensive network of interconnected marsh creeks. The ponds are located in the northwestern area of the existing PSEG Site, have a combined surface area of 40 ac (Figure 2-21), and function as perched water bodies hydrologically isolated from the adjacent coastal wetlands (PSEG 2014-TN3452). The aquatic habitats associated with these ponds are considered poor for sustaining balanced indigenous biotic communities because they are shallow, have silt and sand substrates, and lack adequate physical structure, nutrient regimes, and hydrodynamic flow for maintaining high levels of in situ biological productivity (PSEG 2014-TN3452). These man-made systems are part of the USACE CDF facility and PSEG's active, licensed desilt basin, and are therefore transitory and subject to use as a disposal area for material dredged as part of ongoing maintenance activities.

The biological communities of these artificial ponds and onsite small marsh creeks consist primarily of fish communities and benthic invertebrates, and these are listed by species in Tables 2-9 and 2-10, respectively. Fish were collected from small onsite creeks using weirs and seines set at high tide and retrieved at low tide. Recent sampling in 2009 showed that diversity and standing stock biomass of the fish community is relatively low, with six to seven species typically dominating during most seasons of the year (PSEG 2013-TN2586). Basically, four levels of the food chain are represented in these ponds, including (1) small fish that are considered top-water insectivores (Sheepshead Minnow, *Cyprinodon variegatus;* Banded Killifish, *Fundulus diaphanus;* and Mummichog, *Fundulus heteroclitus*); (2) detritivores/bottom feeders represented by Common Carp (*Cyprinus carpio*); (3) omnivores represented by Pumpkinseed (*Lepomis gibbosus*) and Bluegill (*Lepomis macrochirus*); planktivores represented by Inland Silverside (*Menidia beryllina*); and (4) piscivores (Largemouth Bass*, Micropterus salmoides*). Relative abundance of fish in these systems is higher in the spring and summer, reflecting recruitment of young-of-the-year into the populations during these periods.

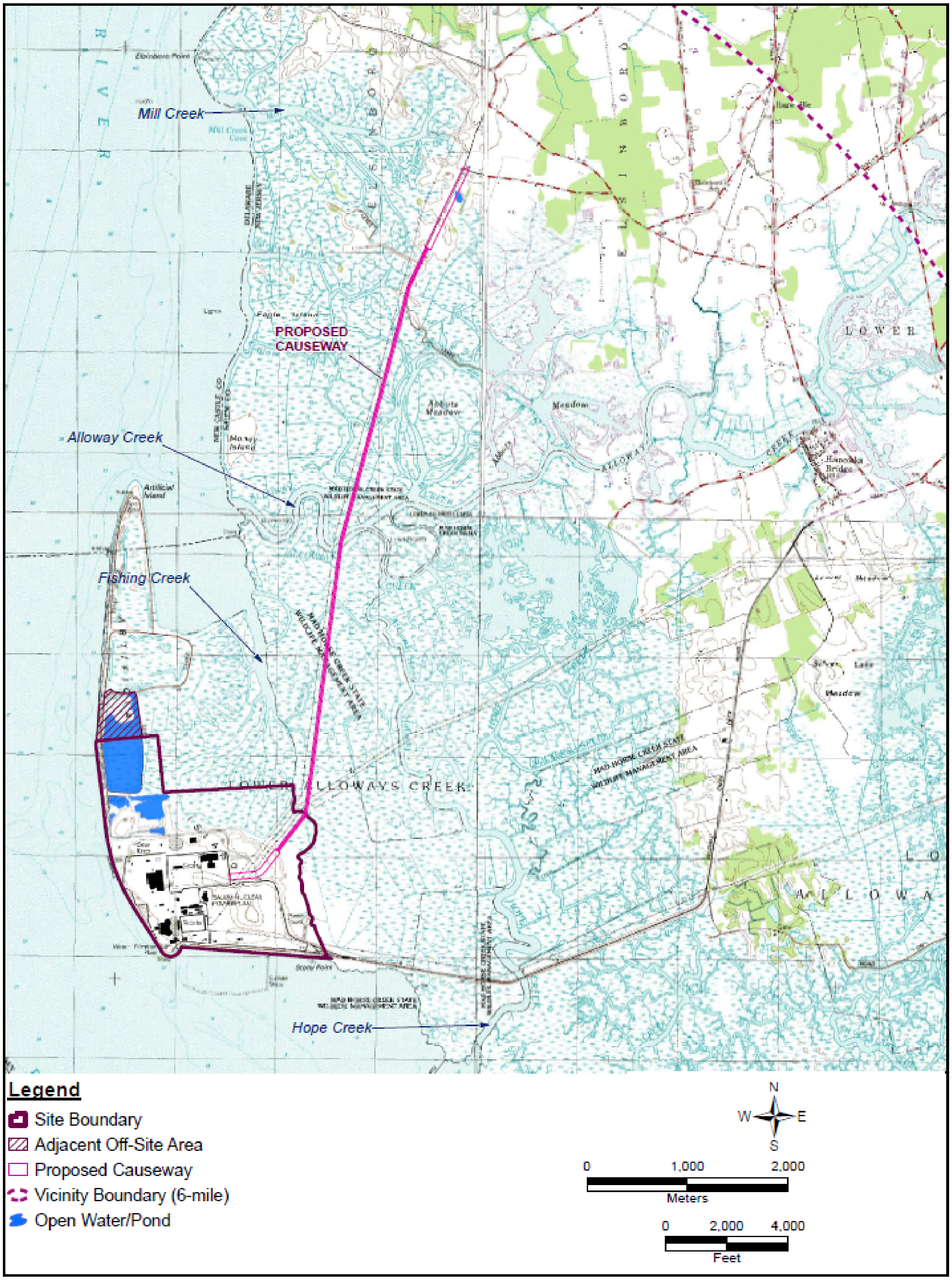


Figure 2-21. Surface Waters and Ponds On and Near the PSEG Site Providing Habitat for Aquatic Resources. ***(Source: PSEG 2014-TN3452)***

Macroinvertebrates were sampled using a ponar dredge in onsite ponds, onsite small marsh creeks, offsite large marsh creeks, and the Delaware River Estuary near the PSEG shoreline (PSEG 2014-TN3452). Assessment of the macroinvertebrate community in 2009 also displayed low diversity of the benthic macroinvertebrates in these artificial ponds, with primarily only two phyla, the annelids and the arthropods, being represented as shown in Table 2-10 (PSEG 2013-TN2586). The oligochaete worms in the family Tubificidae (*Limnodrilus* spp.) and one insect genus, the non-biting midge (i.e., *Chironomus*), are the dominant organisms in terms of biomass and relative abundance (PSEG 2014-TN3452). The most abundant invertebrate species in the benthic community of the smaller marsh creeks are oligochaetes (*Limnodrilus* and other tubificids) and amphipods (*Gammarus daiberi* and *Leptocheirus* sp.) (PSEG 2013-TN2586). The low diversity, biomass, and abundance of the macroinvertebrate community in these ponds are probably major regulators of the structure and function of the fish communities because these food sources provide relatively poor bioenergetic and nutritive value.

Marsh Creek Drainages

The onsite interconnected system of marsh creeks is represented by four major drainages including Mill Creek, Alloway Creek, Fishing Creek, and Hope Creek along with a large number of small to medium size interconnected streams throughout the area north and east of the existing PSEG Site (Figure 2-21). All but the most upstream intermittent segments of these streams are tidally influenced because of their hydrologic connection to the Delaware River Estuary (PDE 2012-TN2191). Physicochemical conditions such as salinity and temperature can fluctuate rather widely in these streams over periods of hours or weeks, depending upon climatic conditions, freshwater discharge at the headwaters, and tidal height and influence. Typically, in the upper reaches of these streams, salinity conditions are considered oligohaline (salinity range from 0.5 to 5 ppt) while the lower reaches, which are more tidally influenced, are classified as mesohaline (salinity range of 5 to 18 ppt) (PSEG 2013-TN2586). The spatial gradients along the streams of physicochemical factors (salinity, temperature, dissolved oxygen, nutrients) influence the composition, productivity, relative abundance, and spatial distribution of the resident biological communities.

Fish communities were sampled in small and large reference creek habitats and in habitats that were restored by PSEG. Monthly sampling between May and November was achieved using otter trawls in large marsh creeks and weir sampling in small marsh creeks (PSEG 2004-TN2565). The marsh creek segments in the lower bay included Dennis Township, Commercial Township, and Moores Beach, and upper bay sites included Browns Run, Mill Creek, Mad Horse Creek, and Alloway Creek (PSEG 2014-TN3452).

The marsh creeks nearest the PSEG Site are Mill Creek, Alloway Creek, and Mad Horse Creek, and they show different fish assemblages between 2003 and 2010 from those sampled in the small PSEG onsite ponds and onsite drainage creeks (Table 2-9). Mad Horse Creek occurs to the south of the PSEG Site and is not depicted on Figure 2-21.

The smaller segments of the nearest marsh creek systems were dominated in all seasons by the Mummichog, with both Atlantic Silverside (*Menidia menidia*) and Bay Anchovy (*Anchoa mitchilli*) also being present on a consistent basis (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513;

PSEG 2010-TN2570; PSEG 2011-TN2571). The Mummichog is typically found in tidal creek systems from New England to the South Atlantic coast and is characterized by having a relatively high physiological tolerance to varying physicochemical factors and also displaying high site fidelity and residing all or most of their lives in tidal creek systems (Sweeney et al. 1998-TN2205). As is typical of most small marsh creek systems, fish community diversity is low, varying from one to five species depending on the season, and fish biomass is almost always dominated by one or two species.

The fish collection data of the larger marsh creek segments are shown in Table 2-9 and are composed of a higher total number and diversity of species between 2003 and 2010 than the small marsh creek segments. Several of these species normally are associated with tidal estuaries and higher salinity regimes. The most consistently abundant species present in these larger creek segments are the Bay Anchovy, Atlantic Menhaden (*Brevoortia tyrannus*), and White Perch (*Morone americana*). Other species that are generally common and occasionally abundant include the Weakfish (*Cynoscion regalis*), Striped Bass (*Morone saxatilis*), Hogchoker (*Trinectes maculatus*), Atlantic Silverside, Atlantic Croaker (*Micropogonias undulatus*), and Spot (*Leiostomus xanthurus*). Several of these estuarine-associated species such as juvenile Atlantic Menhaden, Weakfish, and Atlantic Croaker use the larger marsh creek segments as feeding and nursery areas before migrating back to higher salinity and more open waters as more developed juveniles or adults (MDNR 2013-TN2156).

However, as with the macroinvertebrate communities in the ponds and small marsh creeks, diversity in these larger marsh creeks is also low (see Table 2-10). Amphipods are the most dominant group of invertebrates, being represented by *Corophium* sp. and *Gammarus daiberi* (PSEG 2013-TN2586).

Table 2-9. Fish Species Sampled in Ponds and Marsh Creeks in the Vicinity of the PSEG Site in 2009 and Between 2003 and 2010

Scientific Name	Common Name	Abundance in Onsite Freshwater Ponds and Small Marsh Creeks (2009)[a]	Abundance in Small Marsh Creek Segments (2003–2010)[b]	Abundance in Large Marsh Creek Segments (2003–2010)[b]
Alosa aestivalis	Blueback Herring		239	57
Alosa mediocris	Hickory Shad		3	41
Alosa pseudoharengus	Alewife		319	243
Alosa sapidissima	American Shad			116
Ameiurus catus	White Catfish		6	167
Ameiurus nebulosus	Brown Bullhead	2	223	847
Anchoa hepsetus	Striped Anchovy			2
Anchoa mitchilli	Bay Anchovy		2,228	7,571
Anguilla rostrata	American Eel	3	62	253
Bairdiella chrysoura	Silver Perch		1	106
Brevoortia tyrannus	Atlantic Menhaden	44	925	5,900
Carassius auratus	Goldfish		4	15
Catostomus commersonii	White Sucker		1	
Clupeidae species	Unidentified herring		6	7
Cynoscion regalis	Weakfish		14	996
Cyprinodon variegatus	Sheepshead Minnow	148		
Cyprinus carpio	Common Carp	142	15	51
Dorosoma cepedianum	Gizzard Shad		177	664
Etheostoma olmstedi	Tessellated Darter			1
Etropus microstomus	Smallmouth Flounder			6
Fundulus diaphanus	Banded Killifish	64		
Fundulus heteroclitus	Mummichog	754	30,359	169
Fundulus majalis	Striped Killifish		1	1
Gambusia affinis	Mosquitofish	1		
Gobiosoma bosc	Naked Goby	1	241	61

Table 2-9 (continued)

Scientific Name	Common Name	Abundance in Onsite Freshwater Ponds and Small Marsh Creeks (2009)[(a)]	Abundance in Small Marsh Creek Segments (2003–2010)[(b)]	Abundance in Large Marsh Creek Segments (2003–2010)[(b)]
Gobiesox strumosus	Skilletfish		1	
Hybognathus regius	Eastern Silvery Minnow		23	26
Ictalurus punctatus	Channel Catfish		2	464
Leiostomus xanthurus	Spot		123	2,575
Lepomis cyanellus	Green Sunfish			1
Lepomis gibbosus	Pumpkinseed	320	1	1
Lepomis macrochirus	Bluegill	99	2	1
Lucania parva	Rainwater Killifish		1	
Menidia beryllina	Inland Silverside	145		
Menidia menidia	Atlantic Silverside		1,260	1,279
Menticirrhus saxatilis	Northern Kingfish			1
Micropogonias undulatus	Atlantic Croaker		16	2,391
Micropterus salmoides	Largemouth Bass	83		1
Morone americana	White Perch	12	582	20,543
Morone saxatilis	Striped Bass	5	18	2,096
Morone sp.	unidentified percithyid		1	130
Mugil curema	White Mullet			2
Notemigonus crysoleucas	Golden Shiner	1	1	
Notropis hudsonius	Spottail Shiner			1
Opsanus tau	Oyster Toadfish			1
Paralichthys dentatus	Summer Flounder		5	48
Perca flavescens	Yellow Perch			95
Pogonias cromis	Black Drum		18	310
Pomatomus saltatrix	Bluefish		3	62
Pomoxis nigromaculatus	Black Crappie			2
Sciaenidae species	Unidentified drum		1	4

Table 2-9 (continued)

Scientific Name	Common Name	Abundance in Onsite Freshwater Ponds and Small Marsh Creeks (2009)[a]	Abundance in Small Marsh Creek Segments (2003–2010)[b]	Abundance in Large Marsh Creek Segments (2003–2010)[b]
Scophthalmus aquosus	Windowpane Flounder			1
Stenotomus chrysops	Scup			1
Symphurus plagiusa	Blackcheek Tonguefish			7
Syngnathus fuscus	Northern Pipefish			15
Trinectes maculatus	Hogchoker			1,984
Urophycis regia	Spotted Hake			4

(a) Source: PSEG 2013-TN2586.
(b) Sources: PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571.

Table 2-10. Macroinvertebrates Sampled in Ponds, Onsite Marsh Creeks, Offsite Large Marsh Creeks, and Nearshore Delaware River Estuary in the Vicinity of the PSEG Site in 2009 (PSEG 2013-TN2586)

Scientific Classification	Abundance in Ponds and Small Creeks Onsite	Abundance in Large Marsh Creeks	Abundance in the Nearshore Delaware River Estuary
Phylum Nematoda	1	–	–
Phylum Nemertea	–	1	–
Phylum Annelida			
Oligochaetes	635	3	4
Polychaetes	23	33	52
Phylum Mollusca	–	4	2
Phylum Arthropoda			
Amphipods	291	965	37
Isopods	3	14	27
Decapods	–	2	–
Mysids	–	6	5
Insects	200	–	–
Total number of taxa	24	21	19

Delaware River Estuary

The Delaware River and Delaware Bay are a part of the larger Delaware Estuary and River Basin that extends from headwaters in New York to the coastal plains near Cape Henlopen in Delaware (PDE 2012-TN2191). The Delaware Bay extends from the confluence of the Delaware River with the Atlantic Ocean from Delaware River Kilometer (RKM) 0 to RKM 87 [River Mile (RM) 0 to RM 54]. The Delaware River Estuary includes the Delaware Bay and extends up the tidal Delaware River, which is characterized by brackish water between Delaware RKM 87 and RKM 129 (RM 54 to RM 80) and becomes freshwater at Delaware RKM 129 (RM 80) (BBL and Integral 2007-TN2126). The PSEG Site near the mouth of Alloway Creek is at Delaware RKM 84 (RM 52) (DRBC 2011-TN2412) and is considered to be in the lower estuary watershed unit of the Delaware Estuary and River Basin (PDE 2012-TN2191). Characterization of the region dates back to pre-Revolutionary War times when shipping and trading at developing ports from the mouth of the Delaware River Estuary to inland Delaware, Pennsylvania, and New Jersey increased use of the watershed (Berger et al. 1994-TN2127). Increasing urbanization and industrialization of the region from 1840 to present day have significantly contributed to the degradation of the watershed with habitat alteration, water diversion, and increased pollution of the Delaware Estuary and River Basin ecosystems as no environmental policies were established until the 1960s and later (Berger et al. 1994-TN2127). According to the most recent status report on the Delaware Estuary and River Basin, the region continues to see some decline in environmental health indicators such as removal of estuary sediments and increases in nitrogen and contaminant levels. However, environmental conditions such as technology implementation to increase fish passage and restoration of

targeted aquatic habitats have improved the aquatic ecology for the watershed (PDE 2012-TN2191). The DRBC stated in the State of the Delaware River Basin report for 2013 that increases in temperature and salinity are expected with future sea level rise and climate change (DRBC 2013-TN2609). These potential changes are likely to result in movement of populations of more marine and euryhaline species farther up the Delaware River Estuary.

The biological communities of the Delaware River Estuary in the area of the PSEG Site are typical of those that exist all along the main reaches of the Delaware Bay system. To mitigate egg and larval fish loss through the cooling system for SGS, PSEG proposed and established an estuary enhancement program (EEP) to restore salt marshes and provide monitoring and other structural enhancements to mitigate losses of aquatic species through impingement and entrainment at SGS (Balletto and Teal 2011-TN2612). The EEP established an ongoing biological monitoring program, in addition to habitat restoration, to track the success of the mitigation actions. Because of the biological monitoring surveys that have been conducted in this area of the Delaware Bay since the mid-1980s in support of the environmental requirements for the construction and operation of the SGS and the HCGS, an extensive long-term data set exists on the fishery and benthic macroinvertebrate communities of this area.

Submerged aquatic vegetation has not historically been observed in the Delaware River Estuary primarily because of the high levels of turbidity (Miller et al. 2012-TN2686), and there is little to no submerged aquatic vegetation observed in the sampling areas near the PSEG Site (PSEG 2014-TN3452). Phytoplankton and zooplankton studies between 1973 and 1976 identified over 100 genera of phytoplankton in the area of the site, with three diatom taxa dominating the phytoplankton community: *Skeletonema costatum*, *Melosira* spp., and *Chaetoceros* spp. (IAI 1980-TN2608). The primary production contributed by the phytoplankton community is highest during the warmer months and lowest during the winter. Because estuarine systems are typically characterized by a shallow euphotic zone and high turbidity, contribution of organic carbon to the base of the food web by phytoplankton production is relatively small compared to that supplied by organic detritus and other primary producers such as benthic algae, periphyton, and submergent and emergent macrophytes (IAI 1980-TN2608). Surveys of zooplankton communities in the Delaware River Estuary near the site have identified over 100 taxa of microzooplankton (IAI 1980-TN2608). Dominant taxa consisted of rotifers and copepods (largely nauplii). Macroinvertebrate plankton samples were composed of 46 taxa (32 arthropods), with the dominant groups being amphipods (*Gammarus* spp.), the mysid shrimp (*Neomysis americana*), crab larvae (*Rhithropanopeus harrisii* and *Uca minax*), and an isopod (*Chiridotea almyra*). Seasonal variations in total density of zooplankton were not as consistent as that observed for the phytoplankton community and were generally related to short-lived differential abundances of a few dominant taxa (IAI 1980-TN2608).

Biological monitoring and characterization of the fish communities of the Delaware River Estuary and near the PSEG Site are based on trawling and seining surveys which have been conducted annually for several years and also on power plant impingement and entrainment data sets for SGS (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). Table 2-11 lists the diversity of species from the combined trawling and seining sampling efforts between 2003 and 2010 for the entire Delaware River Estuary region from

RKM 0 to RKM 117 (RM 0 to RM 73) and for sampling zone 7 (nearest the PSEG Site) from RKM 80 to RKM 100 (RM 50 to RM 62). Species collected from seining efforts are listed only as being present. Bottom trawls using a semi-balloon otter trawl were used to collect samples once per month from April through November (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571), and between 2003 and 2004, pelagic trawl studies were also conducted (PSEG 2004-TN2565; PSEG 2005-TN2566). Seining was performed twice a month between July and October and once per month in June and November using a 100 ft long by 6 ft deep bagged haul seine (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Trawling and seining species abundance and diversity reflect the variable salinity levels with the lower bay zones near the mouth of the Delaware River Estuary showing the highest salinity levels and the salinity gradually decreasing through the mid-bay zone to the upper bay zones near the PSEG Site (see Figure 2-22). Predominantly marine species and anadromous species dominated the mouth of the bay with a transition to more euryhaline species in the mid- and upper-bay zones. Trawling and seining surveys in 2003 and 2004 examined zones further upriver from the upper bay zones and collected primarily freshwater and anadromous species (PSEG 2004-TN2565; PSEG 2005-TN2566).

Table 2-11. Fish Species and Blue Crab Abundance from Bottom and Pelagic[(a)] Trawl and Seining Sampling in the Delaware River Estuary and Near the PSEG Site Between 2003 and 2010

Scientific Name	Common Name	Abundance in All Zones Between RKM 0 and 117, 2003–2010	Abundance in Zone 7 Between RKM 80 and 100, 2003–2010
Alosa pseudoharengus	Alewife	328	74[(b)]
Anguilla rostrata	American Eel	1,263	367[(b)]
Alosa sapidissima	American Shad	113	13[(b)]
Micropogonias undulatus	Atlantic Croaker	134,074	12,259[(b)]
Trichiurus lepturus	Atlantic Cutlassfish	5	0
Clupea harengus	Atlantic Herring	131	1
Brevoortia tyrannus	Atlantic Menhaden	375	43[(b)]
Selene setapinnis	Atlantic Moonfish	56	0
Strongylura marina	Atlantic Needlefish	3	0[(b)]
Menidia menidia	Atlantic Silverside	410	4[(b)]
Chaetodipterus faber	Atlantic Spadefish	3	0
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	3	0
Fundulus diaphanus	Banded Killifish	0	0[(b)]
Anchoa mitchilli	Bay Anchovy	392,617	9,922[(b)]
Pogonias cromis	Black Drum	91	15

Table 2-11 (continued)

Scientific Name	Common Name	Abundance in All Zones Between RKM 0 and 117, 2003–2010	Abundance in Zone 7 Between RKM 80 and 100, 2003–2010
Centropristis striata	Black Sea Bass	131	1
Symphurus plagiusa	Blackcheek Tonguefish	78	3
Callinectes sapidus	Blue Crab	11,998	909
Caranx crysos	Blue Runner	10	0
Alosa aestivalis	Blueback Herring	236	33[(b)]
Pomatomus saltatrix	Bluefish	83	4[(b)]
Dasyatis say	Bluntnose Stingray	3	0
Ameiurus nebulosus	Brown Bullhead	13	12[(b)]
Myliobatis freminvillei	Bullnose Ray	32	0
Peprilus triacanthus	Butterfish	1,515	3
Cyprinus carpio	Common Carp	1	0[(b)]
Ictalurus punctatus	Channel Catfish	1,984	194[(b)]
Raja eglanteria	Clearnose Skate	104	0
Conger oceanicus	Conger Eel	75	0
Rhinoptera bonasus	Cownose Ray	4	0
Hybognathus regius	Eastern Silvery Minnow	10	3[(b)]
Dorosoma cepedianum	Gizzard Shad	15	3[(b)]
Peprilus alepidotus	Harvestfish	3	0
Alosa mediocris	Hickory Shad	4,014	1,351
Trinectes maculatus	Hogchoker	30,909	9,221[(b)]
Synodus foetens	Inshore Lizardfish	2	0
Hippocampus erectus	Lined Seahorse	39	0
Raja erinacea	Little Skate	27	0
Selene vomer	Lookdown	5	0
Fundulus heteroclitus	Mummichog	0	0[(b)]
Gobiosoma bosc	Naked Goby	500	141
Menticirrhus saxatilis	Northern Kingfish	677	221[(b)]
Syngnathus fuscus	Northern Pipefish	275	12
Sphoeroides maculatus	Northern Puffer	13	0
Prionotus carolinus	Northern Searobin	572	5
Astroscopus guttatus	Northern Stargazer	52	1
Opsanus tau	Oyster Toadfish	664	8
Orthopristis chrysoptera	Pigfish	4	0
Lagodon rhomboides	Pinfish	4	0
Lepomis gibbosus	Pumpkinseed	3	0
Urophycis chuss	Red Hake	330	0
Dasyatis centroura	Roughtail Stingray	5	0
Stenotomus chrysops	Scup	2,353	0

Table 2-11 (continued)

Scientific Name	Common Name	Abundance in All Zones Between RKM 0 and 117, 2003–2010	Abundance in Zone 7 Between RKM 80 and 100, 2003–2010
Petromyzon marinus	Sea Lamprey	2	0
Acipenser brevirostrum	Shortnose Sturgeon	4	0
Merluccius bilinearis	Silver Hake	18	0
Bairdiella chrysoura	Silver Perch	420	29[(b)]
Gobiesox strumosus	Skilletfish	6	0
Etropus microstomus	Smallmouth Flounder	186	19
Mustelus canis	Smooth Dogfish	350	0
Scomberomorus maculatus	Spanish Mackerel	11	0
Gymnura altavela	Spiny Butterfly Ray	2	0
Squalus acanthias	Spiny Dogfish	24	0
Leiostomus xanthurus	Spot	4,115	176[(b)]
Urophycis regia	Spotted Hake	8,721	196
Anchoa hepsetus	Striped Anchovy	599	0[(b)]
Morone saxatilis	Striped Bass	1,221	426[(b)]
Chilomycterus schoepfii	Striped Burrfish	22	0
Ophidion marginatum	Striped Cusk-Eel	733	17
Fundulus majalis	Striped Killifish	0	0*
Prionotus evolans	Striped Searobin	190	0
Paralichthys dentatus	Summer Flounder	349	8[(b)]
Tautoga onitis	Tautog	2	0
Etheostoma olmstedi	Tessellated Darter	2	0
Sciaenidae	Unidentified drum	5	0
Cynoscion regalis	Weakfish	27,028	7,312[(b)]
Ameiurus catus	White Catfish	33	16
Morone americana	White Perch	9,953	2,354[(b)]
Scophthalmus aquosus	Windowpane Flounder	635	2
Pseudopleuronectes americanus	Winter Flounder	65	0
Raja ocellata	Winter Skate	28	0

Note: To convert river kilometers (RKMs) to river miles (RMs), multiply RKMs by 0.62.
(a) Pelagic trawling only in 2003 and 2004.
(b) Species present in seine sampling.

Sources: PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571.

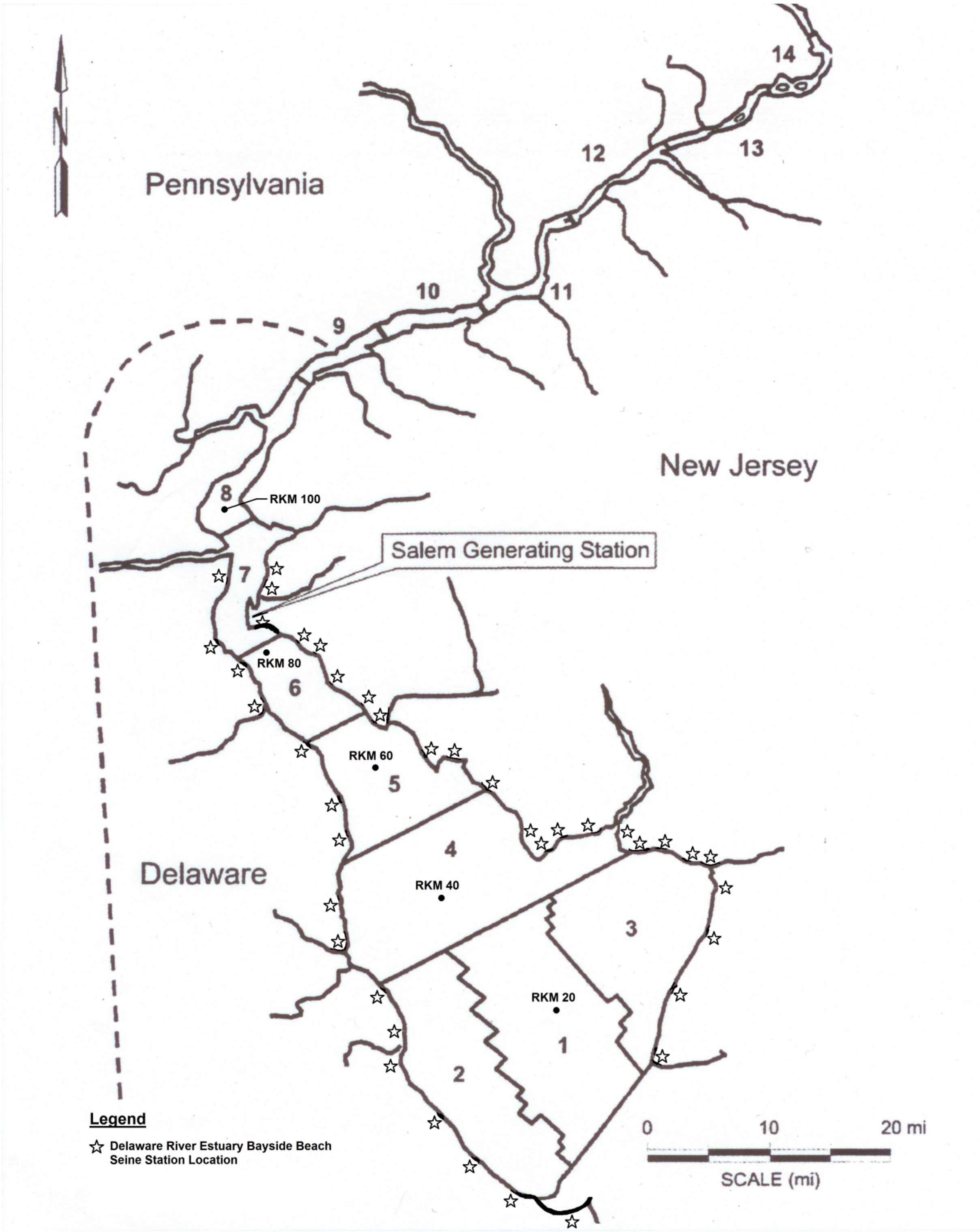


Figure 2-22. Delaware Bay and River Sampling Zones: Zones 1, 2, and 3 lower bay; Zones 4, 5, and 6 middle bay; Zones 7 and 8 upper bay; Zones 9 through 14 Delaware River. ***(Source: Modified from PSEG 2004-TN2565)***

Based on the most recent 8 years of trawling and seining surveys, the species richness of the fish community in the Delaware River Estuary lower bay sampling zone 7 and seining sites between RKM 80 and RKM 100 near the PSEG Site was relatively high, with over 30 different species over the 8-year span representing a variety of freshwater, marine, and anadromous species (see Table 2-11).

Over the 8-year data collection period, the dominant species near the PSEG Site were Hogchoker, Bay Anchovy, Atlantic Croaker, Weakfish, White Perch, and Hickory Shad (*Alosa mediocris*), while other commonly abundant species included Striped Bass and American Eel (*Anguilla rostrata*).

As mentioned previously, additional sampling studies include the impingement and entrainment studies at SGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572) and 2003 to 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2014-TN3452). An additional impingement study was performed between 1986 and 1987 for HCGS (VJSA 1988-TN2564; ECS 1989-TN2572). Results of 8 years of SGS impingement studies between 2003 and 2010 confirm the diversity and composition of the fish communities in the Delaware River Estuary near the PSEG Site are similar to those demonstrated by the trawling and seining results (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). Small differences in species composition between surveys based on active (i.e., trawling, seining) and passive (i.e., impingement) collection methods could be due to a combination of factors such as sampling methodology, gear types, and location and orientation of intake structures (PSEG 2014-TN3452).

In the Delaware River Estuary near the PSEG Site, fish density, richness, and species composition vary seasonally; densities are highest in the fall and lowest in the spring. Fish species richness is also highest in the fall, followed by summer, spring, and winter, as is common in bay and river habitats along the Atlantic coast (PSEG 2014-TN3452). Summer samples were numerically dominated by Weakfish, which averaged over 50 percent of the total collection period between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). Other relatively common species that displayed variations in seasonal abundance were Atlantic Croaker and Blueback Herring (*Alosa aestivalis*) (most abundant in winter), Bay Anchovy (spring), and Striped Bass (summer and fall). Based on the impingement collections from both SGS and HCGS, there are no evident long-term temporal patterns in either fish community richness or abundance, although specific species such as White Perch have increased in abundance in impingement sampling at SGS between the mid-1980s and the 2000s, while Bay Anchovy has decreased (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; VJSA 1988-TN2564; ECS 1989-TN2572; PSEG 2014-TN3452).

Ichthyoplankton diversity was characterized most recently in 2003 and 2004 (PSEG 2004-TN2565; PSEG 2005-TN2566). Nocturnal sampling was conducted twice a month between April and July using a 1.0 m diameter, 500-micron mesh plankton net that was towed over

10-ft depth intervals. Samples were sorted and identified to the lowest taxon level practical. In the sampling zone nearest the PSEG Site, post-yolk sac larval Striped Bass, Weakfish eggs, and Bay Anchovy eggs were the most abundant species and life stages collected over the 2-year period (PSEG 2004-TN2565; PSEG 2005-TN2566).

The benthic macroinvertebrate community in the Delaware River Estuary near the PSEG Site was characterized during two periods, 1971 to 1976, and again during the spring and fall of 2009, as shown in Table 2-10 (Connelly et al. 1977-TN2588; PSEG 2013-TN2586). The composition and species richness of the macroinvertebrate community in the Delaware River Estuary near the site is similar to those benthic communities in other areas of the Delaware Bay within several miles of the site. A total of 19 invertebrate taxa were identified during the 2009 sampling period by ponar dredge, but only a few species dominated the composition of the benthic community in numerical abundance and standing crop biomass. These species included polychaetes, amphipods, and isopods (PSEG 2014-TN3452; PSEG 2013-TN2586).

2.4.2.2 Aquatic Resources—Offsite Areas

Three existing transmission lines convey power from SGS and HCGS. The existing 102 mi of transmission corridors cross Salem, Gloucester, and Camden Counties in New Jersey, and New Castle County in Delaware (PSEG 2014-TN3452). The Delaware River Estuary is the only major water body crossed by transmission lines as described in Section 2.2.2.1.

The proposed causeway would be built in the area of numerous medium- to large-sized marsh creek segments directly north and east of the PSEG Site.

2.4.2.3 Important Aquatic Species and Habitats

Important species include those that are commercially and recreationally important species; Federally listed threatened, endangered, or candidate species; and those species listed by the States of New Jersey and Delaware as threatened, endangered, or of special concern that could be affected by building, operating, or maintaining a new nuclear power plant at the PSEG Site. Species essential to the maintenance or survival of the above species or critical to the structure and function of the aquatic ecosystem are also included.

Important aquatic habitats include wildlife sanctuaries, refuges and preserves, critical habitats for listed species, and essential fish habitat.

Commercially and Recreationally Important Species

In the Delaware River Estuary near the PSEG Site vicinity, 21 species of fish are considered as being commercially or recreationally important in New Jersey or Delaware. In addition to these fish species, three species of invertebrates occurring in the region are commercially harvested in New Jersey and Delaware: blue crab (*Callinectes sapidus*), eastern oyster (*Crassostrea virginica*), and northern quahog clam (*Mercenaria mercenaria*) (PSEG 2014-TN3452). A fourth invertebrate species, the horseshoe crab (*Limulus polyphemus*), is harvested in Delaware. Since 2008 there has been a moratorium in place on the harvest of horseshoe crabs in New Jersey (ASMFC 2014-TN3511).

American Eel

The American Eel (*Anguilla rostrata*) is a catadromous species that spawns in the Sargasso Sea and migrates to fresh inland waters as juveniles and young adults. Females continue migration upstream to freshwater habitats that are highly oxygenated and provide sufficient food resources. Males tend to stay in brackish, estuarine waters. Migration for reproductively active adults begins in the fall, and spawning occurs in midwinter (FWS 2011-TN2145). The American Eel prefers soft mud or sand substrates and is widespread throughout the mid Atlantic in estuaries, rivers, creeks, lakes, and ponds. Commercial harvests in New Jersey and Delaware totaled 129,065 lb and 90,631 lb, respectively, in 2011 (NOAA 2013-TN2174). Recreational harvests in 2011 totaled 31,898 individuals in New Jersey and 15,313 in Delaware (NOAA 2013-TN2175).

In 2011, the FWS issued a 90-day finding on a petition to consider listing the American Eel as a threatened species under the Endangered Species Act and initiated a review of the status of the species to determine if listing is warranted (76 FR 60431-TN2079). Trawling, seining, and weir surveys between 2003 and 2010 indicate American Eel were commonly caught in Delaware River Estuary waters near the PSEG Site and in the offsite small and large marsh creeks on and near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). American Eel were also collected in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). One American Eel was also collected in one of the onsite ponds in 2009 (PSEG 2013-TN2586).

American Shad

The American Shad (*Alosa sapidissima*) is an anadromous fish that spends most of its adult life in the open ocean, returning to natal freshwater streams for spawning activities. The spawning season begins in March and ends in May, and the young migrate downriver to estuary habitat following hatching where they wait for water temperatures to begin to decrease before moving offshore (Rohde et al. 1994-TN2208). American Shad complete adulthood development in the ocean where they feed on plankton, small crustaceans, and small fish. Adults return to natal freshwater sources to spawn between 4 and 6 years of age (DRBC 2011-TN2140). Commercial harvests in New Jersey and Delaware totaled 1,886 lb and 8,967 lb, respectively, in 2011 (NOAA 2013-TN2174).

Trawling, seining, and weir surveys between 2003 and 2010 indicate American Shad are commonly found in Delaware River Estuary waters near the PSEG Site and in the large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Atlantic Shad also were collected in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG

2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Atlantic Croaker

The Atlantic Croaker (*Micropogonias undulatus*) is a member of the drum family (Sciaenidae) and is caught both commercially and for sport. The Atlantic Croaker ranges along the Atlantic coast and Gulf of Mexico waters and estuaries characterized by muddy and sandy mud bottoms (MDNR 2013-TN2156). The Atlantic Croaker spawns over the continental shelf over a protracted spawning season starting in early July and extending to March in warmer waters (Miller et al. 2003-TN2613). Larvae drift into coastal estuaries and mature to feed on small crustaceans, polychaete worms, and mollusks (MDNR 2013-TN2156). Commercial harvests in New Jersey and Delaware totaled 465,117 lb and 11,346 lb, respectively, in 2011 (NOAA 2013-TN2174). Recreational harvests in 2011 totaled 203,324 individuals in New Jersey and 277,222 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Atlantic Croaker are one of the most abundant finfish species caught in Delaware River Estuary waters near the PSEG Site and were also observed in the offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Atlantic Croaker were routinely present in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572) and were more abundant at SGS between 2003 and 2010 than in the mid-1980s (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Atlantic Menhaden

The Atlantic Menhaden (*Brevoortia tyrannus*) is a marine fish harvested extensively in the United States for use as a bait fish and for nutrient value (NOAA 2012-TN2176). Atlantic Menhaden are found in coastal and estuarine waters along the Atlantic coast. Spawning occurs in continental shelf waters between March and May and again between September and October (NOAA 2012-TN2176). Larvae mature to juveniles in estuarine habitats, and then migrate in schools to marine waters while filter-feeding on zooplankton and phytoplankton (NOAA 2012-TN2176). Commercial harvests in New Jersey and Delaware totaled 74,324,485 lb and 64,566 lb, respectively, in 2011 (NOAA 2013-TN2174).

Trawling, seining, and weir surveys between 2003 and 2010 observed consistent abundance of Atlantic Menhaden in Delaware River Estuary waters near the PSEG Site and in the onsite small creeks and offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Atlantic Menhaden were abundant in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Black Drum

Black Drum (*Pogonias cromis*) is a long-lived fish that ranges along the western Atlantic coasts of North and South America and the Gulf of Mexico (Sutter et al. 1986-TN2206). Black Drum is a bottom feeder that feeds on small crustaceans, marine worms, and small fishes found in sandy or soft bottom habitats in estuaries and coastal rivers (Jones and Wells 1998-TN2212). Adults move inshore to spawn in the spring and overwinter offshore. Juveniles occupy tidal creeks and salt marsh habitats (Jones and Wells 1998-TN2212). Black Drum is an important species in terms of commercial and recreational fisheries and is a valued food fish. Commercial harvests in New Jersey and Delaware totaled 3,130 lb and 49,604 lb, respectively, in 2011 (NOAA 2013-TN2174). Recreational harvests in 2011 totaled 25,244 individuals in New Jersey and 936 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 found Black Drum in Delaware River Estuary waters near the PSEG Site and in the offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Black Drum were collected in low abundance in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Black Sea Bass

The Black Sea Bass (*Centropristis striata*) is a member of the sea bass family (Serranidae) and has an unusual life history. Black Sea Bass start out as females with full reproductive capability and then switch to become fertile males sometime around 6 years of age. Off coastal New Jersey, spawning occurs between May and June. Adults overwinter in deep offshore waters and move inshore in the spring. Both juveniles and adults feed on benthic invertebrates such as crustaceans and squid (MDMF 2006-TN2159). Black Sea Bass are highly valued by both commercial and recreational fishermen throughout the mid Atlantic as a food fish. Commercial harvests of Black Sea Bass in New Jersey and Delaware totaled 293,609 lb and 3,524 lb, respectively, in 2011 (NOAA 2013-TN2174). Recreational harvests in 2011 totaled 1,568,503 individuals in New Jersey and 326,358 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Black Sea Bass are more commonly abundant in Delaware River Estuary waters to the south of the PSEG Site. A single fish was collected in Delaware River Estuary waters near the PSEG Site, and none were collected in the marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 recorded minimal occurrences of Black Sea Bass (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Bluefish

The Bluefish (*Pomatomus saltatrix*) is found worldwide in both tropical and temperate waters. Bluefish are found in schools along both inshore and offshore habitats characterized by high energy wave action, estuaries or brackish waters (MDMF 2006-TN2160). Along the Atlantic coast, Bluefish spawn between June and August offshore over the continental shelf. Juveniles remain offshore and feed on crustaceans, small fish, and mollusks (MDMF 2006-TN2160). Adults form large schools and migrate along coastal waters while feeding on fish, crustaceans, and cephalopods. Bluefish are fished commercially but are a popular recreational species because of their abundance, good flavor, and reputation as a sport fish (Pottern et al. 1989-TN2193). Commercial harvests in New Jersey and Delaware totaled 709,418 lb and 10,449 lb, respectively, in 2011 (NOAA 2013-TN2174). Recreational harvests in 2011 totaled 3,448,169 individuals in New Jersey and 240,574 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 found Bluefish commonly abundant in Delaware River Estuary waters south of the PSEG Site and less abundant in Delaware River Estuary waters near the PSEG Site and in the offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Bluefish were observed in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Butterfish

The Butterfish (*Peprilus triacanthus*) is a forage fish for other fish species such as Silver Hake (*Merluccius bilinearis*), Bluefish, and Swordfish (*Xiphias gladius*). Butterfish range along the Atlantic coast from Newfoundland southward to eastern Florida and the Gulf of Mexico. Butterfish migrate in schools to inshore habitats in the summer and offshore in the winter (Overholtz 2006-TN2189). Spawning occurs offshore from May through October. Adults feed mainly on jellyfish, squids, marine worms, and crustaceans (Overholtz 2006-TN2189). Commercial harvests in New Jersey and Delaware totaled 64,717 lb and 101 lb, respectively, in 2011 (NOAA 2013-TN2174).

Trawling, seining, and weir surveys between 2003 and 2010 detected only three Butterfish in Delaware River Estuary waters near the PSEG Site and none in the marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Butterfish were observed at low numbers in impingement sampling at SGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). No Butterfish were detected in impingement samples at HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572).

Channel Catfish

The Channel Catfish (*Ictalurus punctatus*) is a freshwater species that is also commonly found in estuarine waters (MDNR 2013-TN2157). In New Jersey, the Channel Catfish inhabits clear, warm lakes and moderate to large rivers characterized by clean sand, gravel, or rock/rubble substrate (NJDEP 2013-TN2187). Spawning occurs in late spring when females lay eggs in nest sites along depressions, crevices, or undercut banks. Adults feed on plant material and prey on other fish, insects, and crustaceans (MDNR 2013-TN2157). Channel Catfish are harvested recreationally and commercially, with a commercial harvest in Delaware of 17,329 lb in 2011 (NOAA 2013-TN2174). Recreational harvests in 2007 totaled 24,245 individuals in New Jersey and 26,800 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 collected Channel Catfish in Delaware River Estuary waters near the PSEG Site, in the offsite large marsh creeks near the PSEG Site, and rarely in the small offsite marsh creeks (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Channel Catfish were observed at low abundance in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572) but were more abundant in impingement sampling at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Conger Eel

The Conger Eel (*Conger oceanicus*) is similar to the American Eel in appearance and life history. Conger Eels occur along the Atlantic coast from Massachusetts to northern Florida, as well as the northern Gulf of Mexico, where they occupy coastal portions of estuaries and waters over the continental shelf (Levy et al. 1988-TN2211). Spawning adults migrate to the Sargasso Sea from late summer through winter (Hood et al. 1988-TN2213). Larvae metamorphose into juveniles and feed primarily on decapod crustaceans, whereas larger eels prefer fish (Levy et al. 1988-TN2211). Commercial harvests of Conger Eels in New Jersey and Delaware totaled 14,447 lb and 85 lb, respectively, in 2011 (NOAA 2013-TN2174).

Trawling, seining, and weir surveys between 2003 and 2010 indicate no Conger Eel in Delaware River Estuary waters near the PSEG Site and in any of the marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Conger Eels were rarely collected in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Northern Kingfish

The Northern Kingfish (*Menticirrhus saxatilis*) ranges along the western Atlantic from Massachusetts to southern Florida and the Gulf of Mexico. Northern Kingfish occupy shallow coastal waters and estuaries characterized by muddy-sand substrates (Corbett 2004-TN2136). Spawning occurs between April and August in bays and sounds, just outside of estuary habitats. Northern Kingfish prey on crustaceans, small mollusks, marine worms, other fish, and crabs (Corbett 2004-TN2136). The Northern Kingfish fishery is primarily recreational, although there is a small commercial fishery. Commercial harvests in Delaware totaled 21 lb in 2011 (NOAA 2013-TN2174). Recreational harvests in 2011 totaled 330,062 individuals in New Jersey and 10,145 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Northern Kingfish are commonly abundant in Delaware River Estuary waters near the PSEG Site, but rare in the off-site large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Northern Kingfish were collected at low abundance in impingement sampling at SGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and were more prevalent at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). Northern Kingfish were not collected at HCGS in impingement sampling between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572).

Northern Searobin

The Northern Searobin (*Prionotus carolinus*) is a bottom-dwelling fish that prefers habitats characterized by sandy flats. Adults move to offshore waters to spawn between late spring and summer (CBP 2012-TN2135). The adults prey actively on a variety of crustaceans, mollusks, annelid worms, and small fish (Bigelow and Schroeder 1953-TN2129). The commercial harvest in New Jersey for all searobins in 2011 totaled 27,370 lb (NOAA 2013-TN2174). Recreational harvests for all searobins in 2011 totaled 1,568,503 individuals in New Jersey and 38,658 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Northern Searobin are commonly abundant in Delaware River Estuary waters, but less common near the PSEG Site and rare in the offsite large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Northern Searobin were collected at low abundance in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Scup

The Scup (*Stenotomus chrysops*), also known as the Porgy, ranges along the continental shelf of North America and is most common between Cape Cod, Massachusetts, and Cape Hatteras, North Carolina (MDMF 2006-TN2161). Scup form schools in offshore waters to overwinter and move to inshore habitats characterized by smooth bottom substrate in the spring and summer. Adults spawn every year, with spawning occurring between May and August. Adults feed on small crustaceans, mollusks, annelid worms, jellyfish, and sand dollars (MDMF 2006-TN2161). Scup is fished commercially and recreationally. The commercial harvest totaled 3,726,460 lb in New Jersey and 8 lb in Delaware in 2011 (NOAA 2013-TN2174). Recreational harvests in 2011 totaled 89,882 individuals in New Jersey and 1,258 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Scup are not found in Delaware River Estuary waters near the PSEG Site and only a single fish was collected in the offsite large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Scup were not observed in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and were detected at low abundance in impingement sampling at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Silver Hake

The Silver Hake (*Merluccius bilinearis*), also known as Whiting, is distributed primarily along the northern Atlantic coast from Newfoundland to South Carolina (Col and Traver 2006-TN2148). Silver Hake feed nocturnally on cephalopods and crustaceans and move down the water column to rest during the day on sandy, muddy, or pebbly substrate (Col and Traver 2006-TN2148). Silver Hake spawn in offshore waters between May and June, and juveniles may migrate into the shallower waters of estuaries in late spring or early summer (Col and Traver 2006-TN2148). Silver Hake have been harvested commercially since the 1960s due to their abundance. However, overfishing resulted in much reduced landings, and this fishery now has declined to a fraction of historical landings (Col and Traver 2006-TN2148). The commercial harvest in New Jersey totaled 3,037,593 lb in 2011 (NOAA 2013-TN2174).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Silver Hake are not found in Delaware River Estuary waters near the PSEG Site and were not detected in any marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Silver Hake were detected at low abundance in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Spot

Spot (*Leiostomus xanthurus*) occupy estuarine and coastal habitats characterized by sandy or muddy bottoms up to depths of 60 m (197 ft). Juveniles move closer to inshore habitats during the winter and move offshore in late fall as they mature and prepare for spawning activities. The diet of the juvenile and adult Spot includes crustaceans, polychaetes, and mollusks (Phillips et al. 1989-TN2192). The commercial harvests in New Jersey and Delaware totaled 54,890 lb and 81,868 lb, respectively, in 2011 (NOAA 2013-TN2174). A total of 347,596 Spot in Delaware and 1,484 in New Jersey were harvested recreationally in 2011 (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Spot are found in Delaware River Estuary waters near the PSEG Site and were detected in offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Spot were detected in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Striped Bass

The Striped Bass (*Morone saxatilis*) is an anadromous fish that ranges along the Atlantic coast of North America and in the Gulf of Mexico from western Florida to Louisiana. The mid-Atlantic coastal waters are considered the major spawning grounds for this species, with spawning occurring between April and June in or near freshwater (Fay et al. 1983-TN2144). Juveniles prey on small crustaceans, annelid worms, and insects, while adults feed on a variety of other fishes and invertebrates (Fay et al. 1983-TN2144). The commercial harvest in Delaware in 2011 totaled 185,298 lb (NOAA 2013-TN2174). Recreational harvest in 2011 totaled 1,287,598 individuals in New Jersey and 126,949 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Striped Bass are common in Delaware River Estuary waters near the PSEG Site, in the onsite small marsh creeks, and in the offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Striped Bass were collected at low abundance in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), but were highly abundant in impingement sampling at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Summer Flounder

The Summer Flounder (*Paralichthys dentatus*) ranges along the Atlantic coast from Maine to northern Florida. The Summer Flounder prefers sandy substrate for burrowing but may also use mud or silt substrates found in estuary habitats (Grimes et al. 1989-TN2150). Spawning

behaviors are not clearly understood but are assumed to occur sometime between late fall and early spring in bottom habitats along continental shelf waters (Grimes et al. 1989-TN2150). Larvae drift into estuarine habitats where juvenile development takes place. Adults feed on smaller fish, squids, crustaceans, mollusks, marine worms, and sand dollars (Grimes et al. 1989-TN2150). It is an excellent food fish and an important species in both recreational and commercial harvests. Commercial harvests in New Jersey and Delaware totaled 2,830,403 lb and 836 lb, respectively, in 2011 (NOAA 2013-TN2174). Recreational harvests in 2011 totaled 9,101,622 individuals in New Jersey and 808,442 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Summer Flounder are not commonly found in Delaware River Estuary waters near the PSEG Site but have been detected in offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Summer Flounder were detected in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Weakfish

The Weakfish (*Cynoscion regalis*) is a member of the drum family (Sciaenidae). Weakfish range along the Atlantic coast of the United States and are most abundant between New York and North Carolina (MDNR 2013-TN2158). Spawning occurs between May and mid-July following a northern migration to nearshore coastal waters and estuarine areas in the Delaware Bay (Mercer 1989-TN2162). Larvae and juveniles primarily feed on small crustaceans and anchovies. Adults prey on other fish such as the Atlantic Menhaden and Bay Anchovy (MDNR 2013-TN2158). Weakfish are harvested recreationally and commercially and are an important food fish. Commercial harvests in New Jersey and Delaware totaled 13,324 lb and 795 lb, respectively, in 2011 (NOAA 2013-TN2174). Recreational harvests in 2011 totaled 209,616 individuals in New Jersey and 10,740 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Weakfish are abundant in Delaware River Estuary waters and offsite large marsh creeks near the PSEG Site but are less abundant in offsite small marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Weakfish had high impingement rates at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

White Perch

The White Perch (*Morone americana*) has a native range that includes Atlantic slope drainages from Canada to South Carolina (Stanley and Danie 1983-TN2195). Spawning occurs primarily in freshwater habitats in estuaries, rivers, lakes, and marshes but also can occur occasionally in

brackish water between May and July. The eggs attach to bottom substrates, and larvae and juveniles remain in the inshore areas of these areas for up to 1 year (Stanley and Danie 1983-TN2195). White Perch return to brackish waters to overwinter in deep pools of tidal creeks or tributaries and bays. Adults prey on fish eggs and larvae/juveniles of other fish species, young squids, and crustaceans (Stanley and Danie 1983-TN2195). White Perch are harvested commercially and recreationally and are trophically important as both prey and predator. Commercial harvests in Delaware totaled 152,400 lb in 2011 (NOAA 2013-TN2174). Recreational harvests in 2011 totaled 731,360 individuals in New Jersey and 320,605 in Delaware (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 indicate White Perch are abundant in Delaware River Estuary waters and offsite small and large marsh creeks near the PSEG Site but are less abundant in onsite small marsh creeks and ponds near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). White Perch had high impingement density rates at SGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Windowpane Flounder

The Windowpane Flounder (*Scophthalmus aquosus*) is found in estuaries, nearshore waters, and waters along the continental shelf of the northwestern Atlantic from the Gulf of St. Lawrence in Canada to northern Florida (Hendrickson 2006-TN2153). Adults prefer muddy or fine-grain sandy substrates in waters within a salinity range of 5.5 to 36 ppt (Chang et al. 1999-TN2133). Spawning starts in February or March and peaks in May over inner continental shelf waters (Chang et al. 1999-TN2133). Adults prey on small crustaceans, annelid worms, sea cucumbers, squids, and other small mollusks. Although it is not currently a major target of the commercial fishing industry, a total of 11,902 lb were harvested commercially in New Jersey in 2009 (NOAA 2013-TN2174).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Windowpane Flounder are not commonly found in Delaware River Estuary waters near the PSEG Site and are rare in off-site large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Windowpane Flounder were detected at low abundance in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Winter Flounder

The Winter Flounder (*Pseudopleuronectes americanus*) ranges along the Atlantic coast from Labrador, Canada, to Georgia. Winter Flounder prefer a variety of bottom substrates in inshore bays and estuaries during the winter and migrate to deeper water in the summer (Hendrickson

et al. 2006-TN2154). Winter Flounder spawn in inshore waters at night between November and June (Grimes et al. 1989-TN2150). Eggs adhere to each other to form large clumps on the bottom. Juveniles remain in their natal shallow waters during their first summer and feed on diatoms, small crustaceans, and mollusks. Adults prey on small crustaceans, annelid worms, small mollusks, and fish (Hendrickson et al. 2006-TN2154). The Winter Flounder is a major commercial species and is the most important recreationally caught flounder in inshore waters of the mid Atlantic (Grimes et al. 1989-TN2150). The commercial harvest in New Jersey totaled 6,051 lb in 2011 (NOAA 2013-TN2174). The recreational harvest totaled 83,086 individuals in New Jersey in 2007 (NOAA 2013-TN2175).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Winter Flounder are not found in Delaware River Estuary waters near the PSEG Site or in offsite marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Winter Flounder were detected at low abundance in impingement sampling at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Harvested Invertebrates

Three species of invertebrates occurring in the region have been harvested commercially in New Jersey and Delaware. These species are blue crab, eastern oyster, and northern quahog clam (NOAA 2013-TN2174). A fourth species, the horseshoe crab, is harvested in Delaware. Since 2008 there has been a moratorium in place on the harvest of horseshoe crabs in New Jersey (ASMFC 2014-TN3511).

Blue Crab

The blue crab (*Callinectes sapidus*) ranges along coastal waters of the Atlantic coast from Massachusetts to South America, including the Gulf of Mexico. Blue crabs reside in benthic estuarine habitats characterized by low salinity waters in bays and estuaries to higher salinities in ocean waters (Hill et al. 1989-TN2155). After mating, females migrate to salinity habitats of greater than 20 ppt. The female broods the fertilized eggs and then releases the larvae, which are carried away with the current. The juveniles return to the estuarine habitat for further growth and development. Blue crabs feed on bivalves and a variety of detrital matter (Hill et al. 1989-TN2155). The blue crab is the most common edible crab along the east coast of the United States and in the Gulf of Mexico. The blue crab is a major commercial species nationally and in the mid-Atlantic region, with harvests of 9,599,249 lb in New Jersey and 3,501,968 lb in Delaware in 2011 (NOAA 2013-TN2174).

Trawling, seining, and weir surveys between 2003 and 2010 indicate blue crabs are abundant in Delaware River Estuary waters near the PSEG Site and in offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Blue crab had high impingement density rates at

SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and while still commonly impinged at SGS between 2003 and 2010, the density rate declined compared with density rates in the mid-1980s (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Eastern Oyster

The eastern, or American, oyster (*Crassostrea virginica*) is a marine bivalve that settles in shallow saltwater bays, lagoons, and estuaries along the Atlantic coast from Canada to the Florida Keys and in the Gulf of Mexico (Stanley and Sellers 1986-TN2196). Oysters settle in waters with a salinity at least as high as 10 ppt and attach to hard substrates in aggregations known as oyster reefs. Adults tolerate a wide range of salinity conditions, but optimal embryo development requires a salinity range of 15 to 23 ppt. The eastern oyster reproduces by broadcast spawning of sperm and eggs into the water column from late spring into the fall (Stanley and Sellers 1986-TN2196).

Larvae typically settle on established oyster reefs or where shell substrate is present. Oysters filter feed to collect planktonic diatoms, ostracods, and small eggs (Stanley and Sellers 1986-TN2196). Under optimum conditions, oysters can live for up to 20 years (Stanley and Sellers 1986-TN2196). The eastern oyster supports a commercial fishery along the Atlantic coast and in the Gulf of Mexico. The commercial fishery for eastern oyster reported a harvest of 62,349 lb in 2011 for Delaware, and the last reported commercial fishery in New Jersey reported a harvest of 550,086 lb in 2008 (NOAA 2013-TN2174).

In Delaware Bay, oyster harvest has been an important industry. Natural populations were quickly overharvested, leading to establishment of aquaculture and fishery management practices in the early 1900s. However, increasing industrial pollution and lack of public health sanitation practices led to declines in the fishery as well as the contribution of protozoan parasites that further reduced commercial oyster landings (Canzonier 2004-TN2132). Significant efforts have been made to restore oyster habitat and conditions for propagation in the Delaware River Estuary to re-establish this fishery (PDE 2011-TN2190).

Trawling surveys between 2003 and 2010 found no eastern oysters in Delaware River Estuary waters near the PSEG Site or in offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586).

Horseshoe Crab

The horseshoe crab (*Limulus polyphemus*) is a marine arthropod that occupies both shallow sandy aquatic habitats and deeper nearshore coastal waters. Horseshoe crabs occur in the Gulf of Mexico and along the northern Atlantic coast of North America. Spawning involves onshore migration that starts in the spring and concludes in the summer, usually during evening high tides (CBP 2013-TN2134). Females lay eggs in the sand that take about a month to incubate before hatching. Horseshoe crabs are scavengers and feed on small mollusks,

worms, dead fish, and algae (CBP 2013-TN2134). The horseshoe crab is also a major commercial species in the region, with a harvest of 292,704 lb in Delaware in 2011 (NOAA 2013-TN2174).

There have been no reports of horseshoe crab in Delaware River Estuary waters near the PSEG Site or in offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586).

Northern Quahog Clam

The northern quahog clam (*Mercenaria mercenaria*), also known as the hard clam, is a heavily cultured species along the Atlantic coast (FAO 2004-TN2141). The northern quahog clam ranges along the Atlantic coast from Canada to southern Florida and along the coastal Gulf of Mexico. Northern quahog clams prefer the intertidal zone of coastal lagoons and estuaries on mud and sand flats with a salinity range between 12 and 30 ppt (FAO 2004-TN2141). Broadcast spawning occurs for external fertilization, and juveniles secrete byssal threads to assist in attaching to the bottom. As is common in bivalves, the northern quahog clam feeds by filtering water for phytoplankton (FAO 2004-TN2141). The northern quahog clam is harvested commercially in the region, with harvests of 1,516,071 lb in New Jersey in 2008 and 38,512 lb in Delaware in 2011 (NOAA 2013-TN2174).

There have been no reports of northern quahog clam in Delaware River Estuary waters near the PSEG Site, or in offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586).

Ecologically Important Species

The Alewife (*Alosa pseudoharengus*), Atlantic Silverside, Bay Anchovy, and Blueback Herring are considered important species because they are (1) essential to the maintenance and survival of rare or commercially or recreationally valuable species; (2) critical to the structure and function of the local aquatic ecosystems; or (3) both.

Alewife

The Alewife (*Alosa pseudoharengus*) is an anadromous fish closely related to the Blueback Herring. Alewife range along Atlantic coastal, riverine, and estuarine habitats. Broadcast spawning occurs during spring and early summer months in freshwater habitats characterized by gravel, sand, or submerged vegetation substrate (Fay et al. 1983-TN2142). Juveniles remain in freshwater nursery habitats until fall, when they migrate to brackish and marine waters (Fay et al. 1983-TN2142). Alewife form schools and feed on crustaceans, insects, small fishes, and fish eggs, and they are forage prey for larger marine species (Fay et al. 1983-TN2142).

In 2011, the National Marine Fisheries Service (NMFS) published a petition to consider listing the Alewife under the Endangered Species Act (76 FR 67652-TN2080). However, NOAA

determined in August of 2013 that listing the Alewife as threatened or endangered was not warranted at the time (78 FR 48944-TN2607).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Alewife are common in Delaware River Estuary waters and in offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Alewife were commonly impinged at SGS and less frequently impinged at HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572) and commonly impinged at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Atlantic Silverside

The Atlantic Silverside (*Menidia menidia*) is a schooling fish that occupies the shore zone of salt marshes, estuaries, and tidal creeks along the eastern United States and is a key forage species for Striped Bass, Atlantic Mackerel, and Bluefish (Fay et al. 1983-TN2143). In the mid-Atlantic region, spawning occurs between late March and June during daylight hours coinciding with high tide. Eggs adhere to substrates in estuarine intertidal zones such as submerged aquatic vegetation. Adults are omnivorous and prey on a number of small marine invertebrates, insects, algae, and diatoms (Fay et al. 1983-TN2143).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Atlantic Silverside are not common in Delaware River Estuary waters near the PSEG Site but are abundant in the offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Atlantic Silverside were commonly impinged at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and at SGS between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Bay Anchovy

The Bay Anchovy (*Anchoa mitchilli*) is a small schooling fish. Bay Anchovy occupy euryhaline, estuarine, and connected freshwater habitats and can tolerate relatively anoxic conditions in pollution-stressed areas. Spawning occurs in waters less than 20 ft deep from early spring through late summer (Morton 1989-TN2164), and females spawn every 4 to 5 days during the spawning season (Zastrow et al. 1991-TN2670). The Bay Anchovy is a key species in aquatic food webs where juveniles and adults feed primarily on zooplankton, small crustaceans, and detritus and are food sources for predatory fish (Robinette 1983-TN339).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Bay Anchovy are highly abundant in Delaware River Estuary waters and in offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-

TN2571; PSEG 2013-TN2586). Bay Anchovy had high impingement density rates at SGS and HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572), and while still commonly impinged at SGS between 2003 and 2010, had lower density impingement rates than compared to the mid-1980s (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Blueback Herring

The Blueback Herring (*Alosa aestivalis*), like the Alewife, is an anadromous fish that lives primarily in marine and estuarine waters but returns to freshwater to spawn (Fay et al. 1983-TN2142). The Blueback Herring ranges along the Atlantic Coast from Canada to Florida. Blueback Herring spawn in the spring in flowing freshwater habitats characterized by hard substrate (Fay et al. 1983-TN2142). Juveniles migrate to brackish and marine waters and mature to adulthood, when they form schools and prey on plankton and small crustaceans and are forage prey for larger marine species (Fay et al. 1983-TN2142).

Blueback Herring are commercially harvested in Delaware, with 728 lb taken in 2011 (NOAA 2013-TN2174). In 2011, NMFS published a petition to consider listing the Blueback Herring under the Endangered Species Act (76 FR 67652-TN2080). However, NOAA determined in August 2013 that listing the Blueback Herring as threatened or endangered was not warranted at the time (78 FR 48944-TN2607).

Trawling, seining, and weir surveys between 2003 and 2010 indicate Blueback Herring are common in Delaware River Estuary waters and in offsite small and large marsh creeks near the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571; PSEG 2013-TN2586). Blueback Herring had a high density rate of impingement at SGS between 1986 and 1987 and between 2003 and 2010 but were less frequently impinged at HCGS between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572; PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Non-native and Nuisance Species

The high turbidity in the Delaware River Estuary precludes the development of algal blooms near the PSEG Site (Miller et al. 2012-TN2686). No Asian clams (*Corbicula* spp.) or invasive blue mussels (*Mytilus* spp.) have been encountered near Artificial Island in studies from the 1980s to 2009 (IAI 1980-TN2608; PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571.

A single Asian shore crab (*Hemigrapsus sanguineus*) was collected in surveys at one marsh creek sampling station in May 2009 (PSEG 2013-TN2586). Three other invasive species—the Chinese mitten crab (*Eriocheir sinensis*), the Northern Snakehead (*Channa argus*), and the Flathead Catfish (*Pylodictis olivaris*)—also have been reported in the Delaware River Estuary. Mitten crabs are considered potential competitors with blue crabs and can damage estuarine

and stream habitat by extensive burrowing. Four mature male mitten crabs were captured in commercial crab pots in late May 2007 from waters near New Castle County, Delaware, and 10 more were captured in 2010 in Delaware Bay (USGS 2012-TN2200). The Northern Snakehead prefers stagnant waters (shallow ponds, swamps) and slow streams and has a wide temperature tolerance. Northern Snakehead have been observed in New Jersey Delaware River Estuary tributaries starting in 2009 but are not believed to be established in Delaware (USGS 2012-TN2201). Flathead Catfish are reported to occur in the Delaware River Basin, primarily in the main stem of the Delaware River (NJDEP 2012-TN2185). Like the Northern Snakehead, Flathead Catfish are voracious predators that could hinder the shad, sturgeon, American Eel, and Striped Bass restoration efforts in the Delaware River Estuary.

Federally and State-Listed Species

The NRC requested information from the FWS by letters dated October 26, 2010 (NRC 2010-TN2202), and July 31, 2013 (NRC 2013-TN2805) regarding endangered, threatened, candidate, and proposed species, as well as designated and proposed critical habitat that may be in the vicinity of the PSEG Site. A response from FWS is pending. However, in support of the HCGS and SGS license renewal applications, FWS provided information on June 29, 2010, regarding protected species in the vicinity. Information from these consultations was used as the basis for identifying important species and habitats (FWS 2010-TN2204).

Four unionid mussel species that may occur or have the potential to be present in the site vicinity are listed State endangered or threatened by New Jersey and/or Delaware (Table 2-12).

By letters dated October 26, 2010 (NRC 2010-TN2203), the NRC initiated Endangered Species Act Section 7 consultation with NMFS and requested a list of endangered, threatened, candidate, and proposed species, and designated and proposed critical habitat that may be in the vicinity of the PSEG Site. NMFS provided the requested information for marine species by letters dated December 9, 2010 (NMFS 2010-TN2171) and October 25, 2013 (NMFS 2013-TN2804). Based on this correspondence and review of NMFS, Delaware, and New Jersey electronic sources, two fish and five sea turtle species were identified that occur, or have the potential to be present, in the site vicinity and are Federally and State-listed (Table 2-12).

Table 2-12. Federally and State-Listed Species in the Vicinity of the PSEG Site and Existing Transmission Corridors

Scientific Name	Common Name	Federal Status[(a)]	Delaware/New Jersey State Status[(b)]
		Reptiles	
Caretta caretta	Loggerhead sea turtle	FT	SE/SE
Chelonia mydas	Atlantic green sea turtle	FT	SE/ST
Dermochelys coriacea	Leatherback sea turtle	FE	SE/SE
Eretmochelys imbricata	Hawksbill sea turtle	FE	-/SE
Lepidochelys kempii	Kemp’s ridley turtle	FE	SE/SE

Table 2-12. (continued)

Scientific Name	Common Name	Federal Status[(a)]	Delaware/New Jersey State Status[(b)]
	Fish		
Acipenser brevirostrum	Shortnose Sturgeon	FE	SE/SE
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	FE	SE/SE

(a) Federal status rankings determined by the NMFS under the Endangered Species Act; FE = Federally endangered, FT = Federally threatened (NMFS 2013-TN2614; FWS 2013-TN2147).
(b) State status rankings determined by DNREC for Delaware and NJDEP for New Jersey; SE = State endangered, ST = State threatened (DNREC 2013-TN3067; NJDEP 2012-TN2186).

Sea Turtles

Three sea turtle species listed as Federally and State endangered include the leatherback (*Dermochelys coriacea*), the hawksbill (*Eretmochelys imbricata*), and Kemp's ridley (*Lepidochelys kempii*). The Federally threatened loggerhead sea turtle (*Caretta caretta*) is listed as State endangered for both New Jersey and Delaware, while the Atlantic green sea turtle (*Chelonia mydas*) is listed as threatened at both the Federal and State of New Jersey levels but is listed as endangered in the State of Delaware. All sea turtles have certain life history similarities in that females swim ashore to sandy beaches and deposit eggs in nesting pits that are covered to allow incubation. Juveniles hatch, struggle out of the sandy nest, and make their way to their respective ocean habitats. Although there are no known records of sea turtles nesting along Delaware Bay beaches, sea turtles have been observed to forage in Delaware Bay waters. A brief overview is provided for the sea turtle species, with more discussion of life history attributes and potential for impacts in Appendix F as part of the biological assessment.

Loggerhead Turtle

Loggerhead turtles have extensive migration habits that allow them to range along coastal Atlantic and Gulf of Mexico habitats in the United States (NMFS and FWS 2008-TN360). During the summer, Atlantic loggerhead turtles migrate from their nesting beaches from south of Virginia northward to estuary habitats and shelf waters. Subadult and adult loggerheads are primarily bottom feeders, foraging in coastal waters for benthic mollusks and crustaceans (NMFS and FWS 2008-TN360). It is unclear whether the turtles over-winter in Delaware Bay, but both Delaware Bay and Chesapeake Bay are important summer habitat for juveniles. There is no reported loggerhead turtle nesting along Delaware Bay beaches, though they do forage in the bay. Loggerhead turtles are the most commonly observed sea turtle species in the vicinity of SGS. In 1991, 23 loggerhead sea turtles were recovered from the SGS cooling water intake area. Mitigation measures to reduce incidental intake of sea turtles at the SGS were implemented between 1992 and 1993 (NMFS 1999-TN2711). Between 1992 and 2001, 16 loggerhead turtles were stranded at the SGS; none have been stranded since 2001, and none have been reported stranded at HCGS (NRC 2010-TN2811). The conditions of the animals and reasons for their take are not known. In the early 1990s, sonic and satellite tracking studies of loggerhead sea turtles incidentally taken at the SGS were conducted (PSEG 2007-TN3122). These studies indicate the released turtles did not show a particular

affinity for the SGS intake but rather moved throughout the estuary. Further discussion of the potential impacts of a new nuclear power plant at the PSEG Site is provided in Appendix F under biological assessment.

Atlantic Green Turtle

The green turtle is a circumglobal species found in tropical and subtropical waters along continental coasts and islands. In the United States, green sea turtles primarily nest from along the eastern coastline of Florida to the Georgia border (NMFS and FWS 1991-TN358). For nesting, females require the high-energy (wave-active), sandy beaches of barrier islands and mainland shores above the high-water line. Upon emergence, hatchlings immediately seek out the shore and open water (NMFS and FWS 1991-TN358). Juvenile green sea turtles drift with the prevailing surface-water currents until they reach a size of 12 to 16 in. at 1 to 3 years; then they return to shallow coastal waters, where they spend most of their lives in shallow benthic feeding grounds. Adult green turtles feed almost exclusively on sea grass and algae (NMFS and FWS 1991-TN358).

The green turtle is not reported to nest along Delaware Bay beaches but may move into the bay to feed. Green turtles are occasionally observed in Delaware Bay. A total of three Atlantic green turtles have been captured at SGS since it began operations, all between the years of 1980 and 1992. Further discussion of the potential impacts of a new nuclear power plant at the PSEG Site is provided in Appendix F under biological assessment.

Leatherback Turtle

Leatherback sea turtles are a largely pelagic species but also forage in coastal waters. Juveniles and adults feed throughout the water column to depths of at least 3,900 ft, consuming jellyfish and other gelatinous zooplankton such as salps, ctenophores, and siphonophores (NMFS and FWS 1992-TN2168). Only a small fraction of the Gulf of Mexico and North Atlantic leatherback populations nest on beaches of the continental United States, mostly in Florida and the U.S. Virgin Islands, where nesting occurs from April to July (NMFS and FWS 1992-TN2168). Little is known about the behavior or distribution of hatchling and juvenile leatherback sea turtles. The leatherback turtle is not reported to nest along Delaware Bay beaches, but may move into the bay to feed (NMFS and FWS 1992-TN2168). However, they have not been taken at SGS since initiation of preoperational and operational monitoring studies. Further discussion of the potential impacts of a new nuclear power plant at the PSEG Site is provided in Appendix F under biological assessment.

Hawksbill Turtle

Hawksbill turtles are rarely sighted north of Georgia along the Atlantic coast, although there are records of this species as far north as Massachusetts. Juveniles and subadults tend to remain and feed on coral reefs near their natal beaches. Hatchling hawksbills congregate in Sargassum rafts to feed and grow for a year or more after emerging from the nest (NMFS and FWS 1993-TN359). While in the Sargassum rafts, they consume pelagic fish eggs and larvae, small invertebrates associated with the floating algae, and the Sargassum itself. Subadults and adults are omnivorous scavengers. They seem to have a preference for benthic invertebrate

prey, particularly sponges and biofouling organisms (Meylan 1989-TN2163). Because of their food preferences, they tend to be most abundant in shallow coral- and rocky-reef habitats. The hawksbill turtle does not nest along Delaware Bay beaches and has not been documented in Delaware Bay waters. They have not been taken at the SGS since preoperational and operational monitoring studies were initiated. Therefore, further discussion of the potential impacts of a new nuclear power plant at the PSEG Site to hawksbill turtles is not considered.

Kemp's Ridley Turtle

In the continental United States, the Kemp's ridley turtle is found throughout the Gulf of Mexico and United States Atlantic seaboard from Florida to New England (NMFS et al. 2011-TN2169). Nearly all reproduction of Kemp's ridley turtles takes place along a single 9.3-mi stretch of beach near Rancho Nuevo, Tamaulipas, Mexico, about 200 mi south of Brownsville, Texas (NMFS et al. 2011-TN2169). Hatchlings migrate rapidly down the beach and out to sea, where they spend a period of perhaps 2 years in the pelagic zone. During the pelagic period, they presumably feed on zooplankton and floating matter, including Sargassum weed and the associated biotic community. After a pelagic feeding stage, the juvenile ridleys move into shallow coastal waters to feed and grow. The young subadults often forage in water less than 3 ft deep, but they tend to move into deeper water as they grow and are observed associated with portunid crabs (*Callinectes* spp.), their favorite prey.

The Kemp's ridley turtle is not reported to nest along Delaware Bay beaches, but it has been observed foraging in Delaware Bay. In 1992, two live and two dead Kemp's ridley turtles were found at the SGS cooling water intake; the cause of mortality was not reported (PSEG 1992-TN3173). In 1993, a live Kemp's ridley turtle was found at the SGS cooling water intake (PSEG 1999-TN2787). Implementation of mitigation measures in 1993 reduces the likelihood of additional turtle strandings; however, two Kemp's ridley turtles were stranded at the SGS in 2013 (PSEG 2013-TN2690; PSEG 1992-TN3173). There have been no records of impingement for Kemp's ridley turtles at HCGS (NRC 2010-TN2811). Further discussion of the potential impacts of a new nuclear power plant at the PSEG Site is provided in Appendix F under biological assessment.

Shortnose Sturgeon

The Shortnose Sturgeon (*Acipenser brevirostrum*) was initially listed as a Federally endangered species in 1967 and is designated as a New Jersey and Delaware State endangered species (NOAA 2012-TN2173; NJDEP 2012-TN2186; DNREC 2013-TN3067). Adult Shortnose Sturgeon use freshwater for spawning and estuarine and marine habitats for feeding. Juveniles migrate downriver to estuarine waters and may go back and forth between freshwater and estuarine habitats for several years before maturing to adults. Adults sometimes migrate to marine habitats for feeding but live the majority of their life cycle in estuarine habitats (Rohde et al. 1994-TN2208; NOAA 2012-TN2173). Migration to spawning habitat occurs in late winter and spring, and adults return to estuarine waters in May and June (Gilbert 1989-TN2149). Spawning occurs in freshwaters characterized by low-to-moderate velocities and over substrates that include clay, sand, gravel, and woody debris. Eggs are adhesive and survival is reportedly dependent on water having little turbidity (Rohde et al. 1994-TN2208). Sturgeon feed on benthic invertebrates such as snails, insect larvae, crustaceans, and worms (Gilbert 1989-

TN2149). Shortnose Sturgeon occur in the Delaware River Estuary system (NOAA 2012-TN2173). A Shortnose Sturgeon was collected in a bottom trawl from the Delaware River Estuary just to the south of the PSEG Site in 2004 (PSEG 2005-TN2566). Two Shortnose Sturgeon were collected in 2008 and one was collected in 2010 from bottom trawl sampling between RKM 100 and RKM 120 to the north of the PSEG Site (PSEG 2009-TN2513; PSEG 2011-TN2571). From the commencement of operations in 1977 through 2013, there have been 26 Shortnose Sturgeon impingements reported at SGS, but no reported impingements at HCGS (NRC 2010-TN2811; PSEG 2011-TN3365; PSEG 2011-TN3146; PSEG 2013-TN2707; PSEG 2013-TN2691; PSEG 2013-TN2692; PSEG 2013-TN2695; PSEG 2013-TN2704). Further discussion of the potential impacts of a new nuclear power plant at the PSEG Site is provided in Appendix F under biological assessment.

Atlantic Sturgeon

The Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) is currently listed as a Federally endangered species for the New York Bight distinct population segment, which includes the Delaware River Estuary (77 FR 5880-TN2081). It is also listed as an endangered species at the State level in both Delaware and New Jersey (Table 2-12). Atlantic Sturgeon share many life history characteristics with the Shortnose Sturgeon in that adults migrate to freshwater to spawn and feed on benthic invertebrates such as worms, crustaceans, and aquatic insects (Gilbert 1989-TN2149). Unlike Shortnose Sturgeon, adult Atlantic Sturgeon prefer more marine habitats and make extensive migrations away from natal estuaries beginning as subadults (Gilbert 1989-TN2149). Historically, the Delaware River supported the largest population of Atlantic Sturgeon along the Atlantic coast (Secor and Waldman 1999-TN2207). Tagging studies in 2005 and 2006 indicated that Atlantic Sturgeon followed similar migration patterns as Shortnose Sturgeon with spawning potentially occurring mid-to-late June in the upper tidal Delaware reaches between Philadelphia, Pennsylvania, and Trenton, New Jersey (Simpson and Fox 2007-TN2194). Gill net surveys by the Delaware Division of Fish and Wildlife collected over 1,700 juveniles near Artificial Island and the Cherry Island Flats (slightly upstream) between 1991 and 1998 (ASSRT 2007-TN2082). A single Atlantic Sturgeon was collected in 2004 and 2009 in bottom trawl sampling in Delaware River Estuary waters between RKM 100 and RKM 120, which is north of the PSEG Site (PSEG 2005-TN2566; 2010-TN2570). An additional single Atlantic Sturgeon was collected in bottom trawl surveys in 2006 near the mouth of the Delaware River Estuary (PSEG 2007-TN2568). Atlantic Sturgeon were not reported at the SGS intake screens until after this species was Federally listed as endangered. During 2012 and 2013, 14 live and 7 dead Atlantic Sturgeon were reported at the SGS intake system, and no impingements were reported at HCGS (PSEG 2012-TN3142; PSEG 2012-TN3143; PSEG 2013-TN2693; PSEG 2013-TN2694; PSEG 2013-TN2696; PSEG 2013-TN2697; PSEG 2013-TN2698; PSEG 2013-TN2699; PSEG 2013-TN2700; PSEG 2013-TN2701; PSEG 2013-TN2702; PSEG 2013-TN2703; PSEG 2013-TN2705; PSEG 2013-TN3138; PSEG 2013-TN3139; PSEG 2013-TN3140; PSEG 2013-TN3141, PSEG 2013-TN3198). Further discussion of the potential impacts of a new nuclear power plant at the PSEG Site is provided in Appendix F under biological assessment.

State-Listed Species

Three New Jersey threatened freshwater mussel species, tidewater mucket (*Leptodea ochracea*), triangle floater (*Alasmidonta undulata*), and eastern pondmussel (*Ligumia nasuta*), are listed as occurring in Salem County, New Jersey (NatureServe 2012-TN2182; NatureServe 2012-TN2183; and NatureServe 2012-TN2184, respectively). As these are freshwater species, they are unlikely to occur in the brackish marsh creeks that would be crossed by the proposed causeway. In addition, there is no documented occurrence of these unionid mussels in the vicinity of the PSEG site (NJDEP 2013-TN3476). Therefore, these species will not be discussed further.

Essential Fish Habitat

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801-TN1061) identified the importance of habitat protection to healthy fisheries. The amendments, known as the Sustainable Fisheries Act of 1996 (Public Law 104-297), strengthened the authority of governing agencies to protect and conserve the habitat of marine, estuarine, and anadromous animals. Essential fish habitat (EFH) is defined as the waters and substrate necessary for spawning, breeding, feeding, or growth to maturity. Identifying EFH is an essential component in the development of fishery management plans to evaluate the effects of habitat loss or degradation on fishery stocks and take actions to mitigate such damage.

NMFS considers the estuarine portion of the Delaware River Estuary and tidal waters near the PSEG Site to be EFH for 15 species (PNNL 2013-TN2687). Appendix F contains an EFH assessment that considers new building and operation activities associated with a new nuclear power plant at the PSEG Site.

2.4.2.4 Aquatic Monitoring

Extensive biological monitoring data exist to characterize the fish and macroinvertebrate communities in the Delaware River Estuary near the PSEG Site. Ecological studies near Artificial Island have been performed since the late 1960s to characterize the aquatic communities. In compliance with the NJPDES permit for SGS, ongoing annual ecological monitoring studies include impingement and entrainment sampling at the SGS circulating water intake structure; fish monitoring in the Delaware River Estuary and marsh creeks with trawls, seines and weirs; and monitoring of fish ladders in Delaware River Estuary tributaries (NRC 2011-TN3131). More recent surveys of the benthic macroinvertebrates and fish inhabiting the ponds and the smaller marsh creeks on or near the PSEG Site were performed from winter 2009 through winter 2010 (PSEG 2013-TN2586) to characterize the potential area of immediate impact for building a new nuclear power plant at the PSEG Site.

2.5 Socioeconomics

This section describes socioeconomic resources that could be affected by building, operating, and decommissioning a new nuclear power plant at the PSEG Site. It is organized into two major subsections providing details on demographics and community characteristics. These

subsections include discussions on spatial (e.g., regional, vicinity, and site) and temporal (e.g., 10-year increments of population growth) considerations, where appropriate.

The review team's baseline discussion focuses on the 50-mi region surrounding the PSEG Site. The review team particularly focuses on the area where the majority of operational employees of a new plant would reside. The review team assumes this area would coincide with the area where employees of the SGS and HCGS reside. Approximately 1,300 people are employed at SGS and HCGS. Approximately 82.6 percent of these employees live in four counties in two states. These counties are Salem County (41.0 percent), Gloucester County (14.6 percent), and Cumberland County (10.0 percent) in New Jersey and New Castle County (17.0 percent) in Delaware (PSEG 2014-TN3452). The review team expects the construction and operations workers for a new nuclear power plant would likely settle in these same areas. The remaining 17.4 percent of the workers would be scattered across neighboring counties and cities and would not have a discernible impact.

Based on experience with construction of SGS and HCGS, PSEG believes approximately 84.5 percent of the workforce required to build a new nuclear power plant would come from within the 50-mi region surrounding the proposed site. PSEG assumes the remaining 15.5 percent of workers would relocate to the region from outside and would choose to reside in the same four counties that house the majority of the operations workers (PSEG 2014-TN3452). Thus, both adverse and beneficial socioeconomic impacts of building and operating a new plant would not be noticeable except in these four counties. After reviewing the PSEG ER and other information provided by the applicant, and based on the results of the review team's independent analysis, the staff's socioeconomic analysis focuses on Salem, Gloucester, and Cumberland Counties in New Jersey and New Castle County in Delaware. This area is known as the economic impact area.

2.5.1 Demographics

This section describes the population of the PSEG economic impact area, focusing first on residents who live in the area permanently, then on transients who may temporarily live in or visit the area, and finally on migrant workers who travel into the area to work and then leave after their jobs are done.

The review team evaluated the demographic characteristics of resident populations, transient populations, and migrant workers within the 50-mi region of the PSEG Site. Because the focus of the review team's analysis is on the economic impact area, the data presented focuses on Salem, Gloucester, and Cumberland Counties in New Jersey and New Castle County in Delaware. For definitional purposes, "residents" live permanently in the area, while "transients" may temporarily live in the area but have permanent residences elsewhere, and "migrant workers" are employed seasonally in the area. "Transients" are not defined by the U.S. Census, which generally only captures individuals residing in the area during the time of the census.

The data used in this section were derived by the review team from the 2000 and 2010 censuses; other estimates are from the U.S. Census Bureau (USCB), including the 2008, 2011, and 2012 American Community Survey (ACS) 5-Year Summary Files; and the U.S. Department of Agriculture's 2007 Census of Agriculture. Census data and ACS estimates were used to

make comparisons across the region (by sector), among counties, and with the states of Delaware and New Jersey. Data regarding transient populations were drawn from evacuation time estimates prepared for PSEG in 2009 by KLD Engineering (KLD 2009-TN2734).

The review team relied on population projections prepared by the Delaware Population Consortium and the New Jersey Department of Labor and Workforce Development.

2.5.1.1 Resident Population

As shown in Table 2-13, the combined population of the four counties in the economic impact area was 1,045,640 in 2011. More than half of this population (51.31 percent) lives in New Castle County; 6.31 percent reside in Salem County, the host county of the PSEG Site; 14.93 percent live in Cumberland County; and 27.45 percent live in Gloucester County (USCB 2002-TN2297; USCB 2009-TN2344; USCB 2012-TN2743). Table 2-14 lists the population of municipalities and townships within 10 mi of the site. The largest population centers are Middletown, Delaware, with 17,608 residents, and Pennsville Township, New Jersey, with 13,405 residents. Salem, New Jersey, located about 8 mi north of the site, has a population of 5239 (USCB 2012-TN2743).

Table 2-13. Recent Population and Growth Rates of Counties in the Economic Impact Area

	2000	2008	2011	Annual Growth Rate, 2008–2011 (%)
Salem County, New Jersey	64,285	66,141	65,984	–0.08
Cumberland County, New Jersey	146,438	156,830	156,142	–0.15
Gloucester County, New Jersey	254,673	287,860	287,036	–0.10
New Castle County, Delaware	500,265	529,641	536,478	0.43
Total Economic Impact Area	965,661	1,040,472	1,045,640	0.17

Sources: USCB 2002-TN2297; USCB 2009-TN2344; USCB 2012-TN2743.

Table 2-14. Population of Counties, Townships and Municipalities Within 10 mi of PSEG

Township/Municipality	Population, 2011
Salem County, New Jersey	65,984
Lower Alloways Creek Township	1,859
Quinton Township	2,676
Elsinboro Township	1,111
Salem	5,239
Mannington Township	1,632
Pennsville Township	13,405
Cumberland County, New Jersey	156,142
Stow Creek Township	1,458
Greenwich Township	878

Table 2-14. (continued)

Township/Municipality	Population, 2011
New Castle County, Delaware	536,478
Odessa	296
Townsend	1,950
Middletown	17,608
Delaware City	1,822

Source: USCB 2012-TN2743.

Table 2-13 indicates the population of the economic impact area increased at a rate of 0.97 percent per year between 2000 and 2008, with average annual growth ranging from 0.36 percent in Salem County to 1.63 percent in Gloucester County. Between 2008 and 2011, population growth in the economic impact area slowed to a rate of 0.17 percent per year, with New Castle County adding residents, while the three New Jersey counties experienced population declines (USCB 2002-TN2297; USCB 2009-TN2344; USCB 2012-TN2743).

Table 2-15 presents longer-term population trends and projections for counties in the economic impact area. The U.S. Census projects the population of the overall area will continue growing, although at a slower rate than in recent decades. New Jersey forecasts Gloucester County will grow at the highest rate, with the lowest rate of growth predicted for Salem County. According to Delaware's projections, New Castle County will continue to account for slightly more than half of the population of the economic impact area (USCB 2002-TN3474; DPC 2013-TN2317; NJLWD 2012-TN3096).

Table 2-16 provides the age and gender distribution of the resident population within the four counties of the economic impact area. Women account for more than half of the population in all the counties except Cumberland. Delaware is 51.5 percent female, and New Jersey is 51.3 percent female. Overall, Cumberland County has the youngest population in the economic impact area with a median age of 36.7 years, and Salem County has the oldest with a median age of 40.8 years. Delaware's average age is 38.6 years, and New Jersey's average age is 38.7 years (USCB 2011-TN2424).

In 2012 in New Castle County, 10.7 percent of the population has income below the poverty level, slightly lower than the 11.2 percent for residents of the State of Delaware. In the New Jersey portion of the economic impact area, Gloucester County has a significantly lower portion of residents below the poverty level (7.7 percent) than the statewide average (9.4 percent), while Cumberland and Salem County have greater percentages of the population below the poverty level (16.1 percent and 11.2 percent, respectively) than the average for the state (USCB 2012-TN3095). The median household income was $71,133 for Delaware and $71,180 for New Jersey. Table 2-17 provides household income data.

Table 2-15. Historical and Projected Populations in the Economic Impact Area and the States of Delaware and New Jersey, 1970–2040

	1970	1980	1990	2000	2010	2020	2030	2040
New Castle County	385,856	398,115	441,946	500,265	538,479	571,579	595,583	607,450
% Change		3.2	11.0	13.2	7.6	6.1	4.2	2.0
Delaware	548,104	594,338	666,168	783,600	899,776	981,806	1,041,687	1,080,872
% Change		8.4	12.1	17.6	14.8	9.1	6.1	3.8
Cumberland County	121,374	132,860	138,053	146,438	156,898	165,200	173,200	NA
% Change		9.5	3.9	6.1	7.1	5.3	4.8	—
Gloucester County	172,681	199,917	230,082	254,673	288,288	310,300	332,600	NA
% Change		15.8	15.1	10.7	13.2	7.6	7.2	—
Salem County	60,346	64,676	65,294	64,285	66,083	67,700	69,400	NA
% Change		7.2	1.0	-1.5	2.8	2.5	2.5	—
New Jersey	7,171,112	7,365,011	7,730,188	8,414,350	8,791,894	9,241,900	9,648,100	NA
% Change		2.7	5.0	8.9	4.5	5.1	4.4	—
Economic Impact Area	740,257	795,574	875,375	965,661	1,049,748	1,121,500	1,199,402	—
% Change		7.5	10.0	10.3	8.7	6.8	6.3	—

Sources: USCB 2002-TN3474; NJLWD 2012-TN3096.

Table 2-16. Percentage Age and Gender Distribution in the Economic Impact Area

	New Castle County	Cumberland County	Gloucester County	Salem County
Total Population	536,478	156,142	287,036	65,984
Male Population	260,004	80,224	139,322	32,077
Under 10 yr (%)	13.3	13.1	13.7	13.3
10 to 19 yr (%)	14.8	13.6	15.2	14.5
20 to 29 yr (%)	14.8	14.8	12.8	11.6
30 to 39 yr (%)	13.4	16.0	12.3	11.8
40 to 49 yr (%)	14.8	15.2	16.2	14.7
50 to 59 yr (%)	13.3	12.6	14.1	14.7
60 to 69 yr (%)	8.5	7.8	9.1	10.7
70 to 79 yr (%)	4.4	4.3	4.2	5.6
80 to 84 yr (%)	1.5	1.4	1.6	1.6
85 yr and older (%)	1.2	1.1	0.9	1.4
Female Population	276,474	75,918	147,714	33,907
Under 10 yr (%)	12.3	13.8	12.1	10.6
10 to 19 yr (%)	13.2	13.4	13.9	14.3
20 to 29 yr (%)	14.0	12.9	11.8	10.7
30 to 39 yr (%)	12.9	12.4	13.1	10.9
40 to 49 yr (%)	14.9	14.1	15.8	16.0
50 to 59 yr (%)	13.7	12.7	14.2	15.0
60 to 69 yr (%)	9.2	9.8	9.0	10.1
70 to 79 yr (%)	5.5	6.2	5.8	6.7
80 to 84 yr (%)	2.1	2.2	2.3	3.1
85 yr and older (%)	2.1	2.6	2.0	2.5
Median Age (years)	37.0	36.7	38.5	40.8

Source: USCB 2002-TN3474.

Table 2-17. Household Income Distribution (Percent of Households) Within the Economic Impact Area in 2011 Inflation-Adjusted Dollars

Income Range	New Castle County	Cumberland County	Gloucester County	Salem County
Total Households	202,188	49,716	103,725	25,656
Less than $10,000	5.4	5.8	3.2	6.9
$10,000 to $14,999	4.1	4.8	3.2	4.5
$15,000 to $24,999	8.0	11.8	8.0	12.4
$25,000 to $34,999	9.0	11.2	8.4	7.3
$35,000 to $49,999	13.0	14.8	11.1	15.0
$50,000 to $74,999	17.9	18.4	17.4	18.2
$75,000 to $99,999	13.8	15.8	15.0	13.5

Table 2-17. (continued)

Income Range	New Castle County	Cumberland County	Gloucester County	Salem County
$100,000 to $149,999	16.4	12.4	18.9	16.1
$150,000 to $199,999	6.5	2.9	9.7	3.7
$200,000 or more	5.8	2.0	5.2	2.5
Median Household Income	$63,716	$51,548	$71,850	$53,926

Source: USCB 2012-TN2743.

Table 2-18 provides the racial and ethnic distribution of residents within the economic impact area. African-American residents make up 20 percent of the population within the economic impact area, ranging from 11.1 percent of the population of Gloucester County to 24.8 percent of the population of New Castle County. Hispanic residents represent less than 10 percent of the population of the four-county economic impact area. Gloucester County has the lowest proportion of Hispanic residents (4.6 percent), and Cumberland County the highest (26.2 percent). The population of Cumberland County also includes 10.2 percent who self-identified as “some other race,” much higher than the 3.3 percent average for the economic impact area as a whole. White residents are the most prominent race in all four counties, composing more than two-thirds of the population in each (USCB 2002-TN3474).

Table 2-18. Racial and Ethnic Distribution Within the Economic Impact Area

Racial or Ethnic Category	New Castle County	Cumberland County	Gloucester County	Salem County	Economic Impact Area
Total population	536,478	156,142	287,036	65,984	1,045,640
White	373,858	105,573	244,953	54,221	778,605
Black or African-American	132,891	34,352	31,974	10,209	209,426
American Indian and Alaska Native	3,984	3,223	1,996	611	9,814
Asian	25,657	2,447	9,048	724	37,876
Native Hawaiian and Other Pacific Islander	716	60	153	20	949
Some other race	11,272	15,944	5,841	1,417	34,474
Two or more races	10,929	5,141	6,509	1,197	23,776
Hispanic or Latino	45,186	40,892	13,165	4,295	103,538
Not Hispanic or Latino	491,292	115,250	273,871	61,689	942,102

Source: USCB 2012-TN2743.

2.5.1.2 Transient Population

Transient populations include people from outside the area who work in or visit large workplaces, schools, hospitals and nursing homes, correctional facilities, hotels and motels,

recreational areas, or special events in the area. A study published in 2009 included surveys to estimate the 2008 transient population within 10 mi of the PSEG Site (KLD 2009-TN2734). Table 2-19 summarizes the study's findings. Based on the surveys, the transient population within 10 mi is estimated to be 12,085, with 66 percent of this population occurring in Delaware and 34 percent in New Jersey. Almost all of this population occurs 5 to 10 mi from the PSEG Site and includes primarily school students (34 percent), employees (other than those at SGS and HCGS) (34 percent), tourists and recreationists (26 percent), and people undergoing medical care (5 percent). The study did not determine where these transient populations originated, and some of them may reside within the 10-mi area.

Table 2-19. Estimates of the Transient and Migrant Worker Populations in the Economic Impact Area

Category	Percent of Total
Transient Population (12,085 people)	
Students	34
Employees (non HCGS/SGS)	34
Tourists/recreationists	26
Medical patients	5
Migrant Workers (up to 5570 people)	
Outage workers at HCGS/SGS	24
Agricultural workers	76

Source: KLD 2009-TN2734.

2.5.1.3 Migrant Labor

The USCB defines a migrant laborer as someone who works seasonally or temporarily and moves one or more times per year to perform seasonal or temporary work. Migrant labor in the economic impact area consists mainly of refueling outage workers at SGS and HCGS and migrant farm laborers. Table 2-19 presents data on transient and migrant workers in the economic impact area.

Scheduled outages to carry out fuel reloading, equipment maintenance, and other projects occur every 18 months for each of the three units at SGS and HCGS. For the combined sites, this results in one outage every 6 months (PSEG 2014-TN3452). Between 1,034 and 1,361 additional workers were employed during the most recent outages (PSEG 2012-TN3099). Because each outage lasts for approximately three weeks, it is unlikely the workers would be accompanied by their families. If 1,361 workers migrate into the economic impact area during an outage, the population of the economic impact area would increase by about one-tenth of one percent. For bounding purposes, if all of the workers stayed in the economic impact area county with the smallest population (Salem County) during the outage, the county's population would increase by 2.1 percent.

The agricultural sector can be another source of migrant workers due to seasonal fluctuations in labor requirements. The 2007 Census of Agriculture indicates 164 farms in the economic

impact area employ migrant labor, but the Census of Agriculture does not directly count the number of migrant workers. Assuming the upper bound (i.e., that all 2,471 outage workers from outside the region of interest are migrant workers), the population of migrant agricultural workers is negligible compared to the resident population of the economic impact area. Even if each of these workers in-migrated with two additional family members (resulting in a total of 7,413 people), the 2011 population of the economic impact area would increase only by less than one quarter of one percent (PSEG 2012-TN3099; USDA 2007-TN3112).

2.5.2 Community Characteristics

This section characterizes the communities that could be affected by building and operating a new nuclear power plant at the PSEG Site. The following subsections describe the socioeconomic conditions in the area, including the economy, tax-based revenue, transportation, aesthetics and recreation, housing, and public services.

2.5.2.1 Economy

The review team expects the majority of direct impacts from building and operating a new plant would occur in Salem County, where the PSEG Site is located. Unemployment data presented in this section suggest the economy of the economic impact area grew from 2002 through 2007, experienced a downturn between 2008 and 2010, and recovered modestly in 2011. The economy of each county is described below.

This section presents information on the labor force, employment, and income within the economic impact area. Because of the significant national economic changes that have occurred in recent years, some key data are presented for a 10-year period to illustrate the disruptions experienced in the economic impact area and its steps toward recovery.

Table 2-20 lists the labor force size, number of employed and unemployed persons, and the unemployment rate for 2011 for each county in the economic impact area and for the states of New Jersey and Delaware. Table 2-21 chronicles the change in the unemployment rates for each area for the 10-year period between 2002 and 2011.

The data in Table 2-20 show that New Castle County, Delaware, is the largest employment center of the economic impact area, accounting for more than half the labor force and employed persons in the area in 2011. The county also has the lowest unemployment rate in the economic impact area. Within the New Jersey portion of the economic impact area, Gloucester County is the largest employment center and has the lowest rate of unemployment. The unemployment rate of New Castle County matches that of Delaware, while the unemployment rates of the New Jersey counties exceed that of the state as a whole (BLS 2013-TN2342).

Table 2-21 indicates that all counties in the economic impact area experienced gradually declining rates of unemployment from 2002 through 2007. By 2010, however, unemployment rates increased significantly in all the counties, ranging from increases of 4.5 percentage points for New Castle County to 7.0 percentage points for Cumberland County. During 2011, unemployment rates again declined slightly in all the counties (BLS 2013-TN2394; BLS 2013-TN2342).

Table 2-20. 2011 Annual Average Labor Force, Employment, and Unemployment in Counties of the Impact Area and in the States of New Jersey and Delaware

	Civilian Labor Force	Employed	Unemployed	Unemployment Rate
New Jersey	4,545,181	4,120,017	425,164	9.4
Cumberland County	70,761	61,294	9,467	13.4
Gloucester County	157,955	142,463	15,492	9.8
Salem County	31,654	28,249	3,405	10.8
Delaware	440,523	407,772	32,751	7.4
New Castle County	271,024	251,111	19,913	7.3
Economic Impact Area	*531,394*	*483,117*	*48,277*	*9.08*

Sources: BLS 2013-TN2394; BLS 2013-TN2342.

Table 2-21. Annual Unemployment Rates (percent) for Counties of the Economic Impact Area and the States of New Jersey and Delaware, 2002 to 2011

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
New Jersey	5.8	5.9	4.9	4.5	4.6	4.3	5.5	9.0	9.6	9.3
Cumberland	7.6	7.9	6.6	6.4	6.9	6.6	8.1	12.4	13.6	13.4
Gloucester	5.2	5.4	4.7	4.4	4.7	4.3	5.4	9.2	10.2	9.8
Salem	5.8	6.0	5.2	4.8	5.0	5.0	6.3	10.5	11.5	10.8
Delaware	4.0	4.2	3.9	4.0	3.5	3.5	4.8	7.9	8.0	7.3
New Castle	4.1	4.3	4.1	4.2	3.7	3.6	4.8	7.9	8.1	7.3

Sources: BLS 2013-TN2394; BLS 2013-TN2342.

Table 2-22 presents data on total employment by industry type in the economic impact area in 2012. In Salem County, the host county for the PSEG Site, the top four employment sectors include educational services (22.8 percent of the workforce), manufacturing (12.3 percent), retail trade (10.4 percent), and processional and scientific services (9.3 percent). The three remaining counties in the economic impact area exhibit similar patterns, although the rank ordering may change slightly (USCB 2013-TN3113).

Table 2-23 shows the residential locations of operations workers at SGS and HCGS in 2008. According to these data, 41 percent of the workforce resides in Salem County, and 82.6 percent resides in the economic impact area (including Salem County). Nearly 97 percent of the workforce resides in the economic impact area plus five additional counties (Burlington and Camden Counties, New Jersey; Chester and Delaware Counties, Pennsylvania; and Cecil County, Maryland). Only 1.1 percent of the operations workers

reside more than 50 mi from SGS and HCGS (PSEG 2014-TN3452). The review team expects operations workers for a new plant would follow a similar residential pattern.

The three reactors at HCGS and SGS are each shut down for refueling every 18 months, resulting in an outage of one reactor every 6 months at the site. At these times workers come into the area to refuel the reactors and perform equipment maintenance and other projects. PSEG employment records indicate that between 1,034 and 1,361 workers were involved in each of the most recent three outages (one for each reactor) (PSEG 2014-TN3452). Table 2-24 summarizes the permanent residential locations of workers participating in the largest of these outages. The data indicate that on average, about 29 percent of the outage workers employed at HCGS and SGS live in the economic impact area, and more than half live within the 50-mi region surrounding the PSEG Site (PSEG 2012-TN3099). The percentage of workers coming from outside the 50-mi region is higher for outage workers than for the workers expected to be involved in building a new plant at the PSEG Site because outage work requires a higher percentage of specialty workers who may come from other parts of the country, while building a new plant would involve a higher percentage of general construction workers who are more likely to be available within the region.

Table 2-25 presents per capita income data for the counties of the economic impact area and the states of New Jersey and Delaware for the period 2002 to 2011. The data indicate income levels are higher in New Castle and Gloucester Counties, which have larger populations and labor forces than Cumberland and Salem Counties. The per capita income of New Castle County is higher than that of the State of Delaware, while the income levels of the New Jersey counties within the economic impact area are lower than for the State of New Jersey (USDC 2013-TN3114).

Table 2-25 also shows per capita incomes grew steadily in all counties of the economic impact area from 2003 through 2008 before falling for most counties in 2009. Growth resumed in 2010 and continued through 2012 (USDC 2013-TN3114).

Table 2-22. Total Employment by Industry Type in the Economic Impact Area (2012)

	Cumberland, NJ		Gloucester, NJ		Salem, NJ		New Castle, DE	
	Employees	Percent	Employees	Percent	Employees	Percent	Employees	Percent
Total:	**63,675**	**100.0%**	**141,184**	**100.0%**	**29,316**	**100.0%**	**264,387**	**100.0%**
Agriculture, forestry, fishing and hunting, and mining	1,942	3.0%	541	0.4%	653	2.2%	1,244	0.5%
Construction	3,731	5.9%	8,028	5.7%	2,382	8.1%	14,858	5.6%
Manufacturing	7,821	12.3%	12,250	8.7%	3,620	12.3%	25,616	9.7%
Wholesale trade	2,181	3.4%	5,596	4.0%	982	3.3%	6,024	2.3%
Retail trade	7,212	11.3%	17,939	12.7%	3,037	10.4%	28,115	10.6%
Transportation and warehousing, and utilities	3,449	5.4%	8,891	6.3%	2,740	9.3%	12,411	4.7%
Information	608	1.0%	3,000	2.1%	379	1.3%	5,367	2.0%
Finance and insurance, and real estate and rental and leasing	2,717	4.3%	10,635	7.5%	1,567	5.3%	33,217	12.6%
Professional, scientific, and management, and administrative and waste management services	4,608	7.2%	14,948	10.6%	2,724	9.3%	29,174	11.0%
Educational services, and health care and social assistance	17,439	27.4%	36,595	25.9%	6,674	22.8%	64,043	24.2%
Arts, entertainment, and recreation, and accommodation and food services	4,933	7.7%	9,830	7.0%	1,733	5.9%	21,716	8.2%
Other services, except public administration	2,380	3.7%	5,716	4.0%	1,264	4.3%	10,888	4.1%
Public administration	4,654	7.3%	7,215	5.1%	1,561	5.3%	11,714	4.4%

Source: USCB 2013-TN3113.

Table 2-23. HCGS and SGS Employee Distribution by State and County as of 2008

Residence State and County	Number of Employees	Percent of Total (%)
New Jersey	**1,140**	**72.4**
Atlantic	5	0.3
Burlington	37	2.4
Camden	56	3.6
Cape May	5	0.3
Cumberland	157	10.0
Gloucester	230	14.6
Salem	645	41.0
(Other)	5	0.3
Delaware	**269**	**17.1**
New Castle	268	17.0
Kent	1	0.1
Pennsylvania	**122**	**7.8**
Berks	4	0.3
Bucks	1	0.1
Chester	56	3.6
Delaware	39	2.5
Lancaster	5	0.3
Montgomery	9	0.6
Philadelphia	2	0.1
(Other)	6	0.4
Maryland	**38**	**2.4**
Cecil	33	2.1
Howard	3	0.2
(Other)	2	0.1
Other States	**5**	**0.3**
Total	**1,574**	**100.0**
Total for economic impact area	1,300	82.6
Total of leading nine counties[(a)]	1,521	96.8
Outside 50-mi radius	18	1.1

(a) Burlington, Camden, Cumberland, Gloucester, and Salem Counties, New Jersey; New Castle County, Delaware; Chester and Delaware Counties, Pennsylvania; and Cecil County, Maryland.

Source: PSEG 2014-TN3452.

Table 2-24. Residential Locations of Outage Workers for the Largest Recent Outage at the HCGS/SGS Site

Location of Permanent Residence	Number of Outage Workers	Percent of Outage Workforce (%)
Within economic impact area	388	28.5
New Castle County	55	4.0
Cumberland County	73	5.4
Gloucester County	155	11.4
Salem County	105	7.7
Within 50-mi region	728	53.5
Delaware	63	4.3
Maryland	11	0.8
New Jersey	547	40.2
Pennsylvania	107	7.9
Outside 50-mi region	633	46.5
Total	1,361	100.0

Source: PSEG 2012-TN3099.

Table 2-25. Per Capita Income for Counties of the Impact Area and the States of New Jersey and Delaware, 2002 to 2011

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Delaware	**35,516**	**37,236**	**38,404**	**40,350**	**41,030**	**41,490**	**40,841**	**41,072**	**42,805**	**44,224**
New Castle	39,588	41,413	42,654	45,146	45,469	45,904	44,791	45,170	47,435	49,144
New Jersey	**41,229**	**43,117**	**44,785**	**48,098**	**50,636**	**51,831**	**50,303**	**51,010**	**53,333**	**54,987**
Cumberland	27,200	27,962	28,683	29,974	31,159	32,735	33,429	34,589	35,560	36,551
Gloucester	32,340	34,143	35,694	37,630	39,052	40,898	41,072	41,663	43,658	44,868
Salem	31,405	33,302	33,824	35,507	37,158	39,254	39,138	39,889	41,192	42,350

Source: USDC 2013-TN3114.

2.5.2.2 Taxes

Table 2-26 summarizes state and local tax rates relevant to the PSEG Site. Because the plant would be located entirely within the State of New Jersey, PSEG would be obligated to pay New Jersey an annual energy receipts tax of 9 percent of the new plant's total net income. In addition, the plant would be subject to annual property taxes at rates established for Salem County, currently $1.207 for each $100 of assessed value (NRC 2013-TN3116).

Table 2-26. Tax Rates for Counties in Economic Impact Area and States

Location	Tax Rates				
	Energy Receipts (%)	Income ($)	Property		Sales (%)
			County (%)	Local (%)	
Delaware	NA	$0–$2,943.50 + 6.75% of income > $60,000	–	–	–
New Castle County	–	–	0.7006	1.8236–3.9901	–
New Jersey	9.0	1.4–8.97	–		7
Cumberland County	–	–	–	1.733–5.503	–
Gloucester County	–	–	–	2.232–6.626	–
Salem County	–	–	0.01207		–
Lower Alloways Creek Township	–	–	–		–
Salem City	–	–	–	3.688	–
Pennsylvania	NA	3.07			6
Philadelphia County	–	–	–	–	2

Sources: DEDO 2012-TN3121; DEDO 2012-TN2390; NJ Treasury 2010-TN2337; NJ Treasury 2010-TN2338; NJ Treasury 2010-TN2340; NJ Treasury 2013-TN2341; PDOR 2013-TN2331.

Sales Taxes

PSEG also would pay sales taxes on purchases of materials and services. As shown in Table 2-26, applicable sales tax rates are 7 percent in New Jersey and 6 percent in Pennsylvania, with purchases within Philadelphia County, Pennsylvania, assessed an additional 2 percent tax. Delaware does not have a sales tax. Table 2-27 summarizes the operation-related payroll and total purchases in support of operations at HCGS and SGS between 2005 and 2008 in each of the relevant jurisdictions (PSEG 2014-TN3452). The review team expects purchases associated with a new plant at the PSEG Site would be distributed similarly. Thus, the review team expects approximately 65.0 percent of the materials and services purchases for a new plant would be subject to New Jersey sales tax. About 31.1 percent of materials and services purchases would be subject to Pennsylvania sales tax, with approximately 10.2 percent of the purchases subject to Philadelphia County's additional sales tax. New Jersey sales and excise taxes brought in $11.7 billion in revenue, and Pennsylvania's sales and excise taxes brought in $15.1 billion in revenue in 2011 (USGR 2013-TN2652).

Table 2-27. Operation-Related Payroll and Purchases for Materials and Services (2005 to 2008) for HCGS and SGS

State/County	2005 to 2008 Total Payroll[(a)]		2005 to 2008 Total Purchases[(a)]		2011 Gross Domestic Product[(b)]
	Amount ($)	Percent (%)	Amount ($)	Percent (%)	Millions ($)
Delaware	113,345,839	18.5	30,474,596	1.0	65,755
New Castle	112,544,189	18.3	27,092,454	0.9	
New Jersey	433,607,381	70.5	2,013,454,403	65.0	486,989
Cumberland	60,774,838	9.9	9,143,649	0.3	
Gloucester	92,672,170	15.1	33,405,305	1.1	
Salem	234,000,031	38.1	23,116,205	0.8	
Pennsylvania	50,637,062	8.2	963,982,798	31.1	578,839
Philadelphia	139,441	<0.1	314,559,594	10.2	353,323
Other States	16,662,371	2.7	87,773,591	2.8	
TOTAL	614,252,652	100	3,095,685,388	100.0	
Total economic impact area	499,991,227	81.4	92,757,613	3.0	

(a) PSEG 2014-TN3452.
(b) USGR 2013-TN2652.

Corporate and Income Taxes

Employees of a new plant would contribute income taxes and property taxes to the jurisdictions where they reside and sales taxes where they make purchases. Based on data presented in Table 2-23, 72.4 percent of the operations workers at the plant would be expected to live in New Jersey, 17.1 percent in Delaware, and 7.8 percent in Pennsylvania. As shown in Table 2-26, the wages and salaries of employees living in New Jersey would be subject to state income tax rates of between 1.4 and 8.97 percent, and those living in Pennsylvania would be subject to a rate of 3.07 percent (PSEG 2014-TN3452). Employees residing in Delaware would be subject to state income tax rates ranging from 0.0 percent (for incomes under $2,000) to $2,943.50 plus 6.75 percent of the amount of income over $60,000. Table 2-27 indicates how the operations payroll for HCGS and SGS was distributed among the counties where employees resided between 2005 and 2008. The review team expects that the payroll for a new plant would be similarly distributed. In 2011, New Jersey received $10.6 billion, Pennsylvania received $9.8 billion, and Delaware received $1.0 billion in income tax revenue. PSEG has a 9 percent energy receipts tax rate in New Jersey. New Jersey received $2.2 billion in revenue in 2011 from corporate income taxes (USGR 2013-TN2652).

Property Taxes

Employees who own their residences would pay property taxes to the counties and/or municipalities in which their homes were located. In the New Jersey portion of the economic impact area, property tax rates vary from one township to another and are assessed at rates per

$100 of assessed value. As shown in Table 2-26, rates range from $1.268 to $3.688 in Salem County, $1.733 to $5.503 in Cumberland County, and $2.232 to $6.626 in Gloucester County (NJ Treasury 2013-TN2341). Employees residing in New Castle County, Delaware, would pay a county property tax at a rate of 0.7006 in addition to a municipal or school district property tax at rates ranging from 1.8236 to 3.9901 (DEDO 2012-TN3121).

2.5.2.3 Transportation

The transportation system of the economic impact area reflects its location near the edge of the nation's fifth largest metropolitan area, the Philadelphia Metropolitan Statistical Area (MSA) (USCB 2012-TN3119). Available transportation resources include a diverse road network, rail lines, airports, waterways, and public transportation. This section describes each of these resources.

Roads and Highways

The roads in the economic impact area are an extensive network ranging from major interstate highways in the northwest, to urban street networks in local population centers, to open highways and roads in more rural areas. Figure 2-8 in Section 2.2.1 shows major highways in the region. Interstate 95, which connects major population centers on the East Coast from Miami, Florida, to the Canadian border, passes through northern New Castle County near the western edge of the economic impact area. Interstate 295 diverges from Interstate 95 in northern New Castle County, crosses the Delaware River via the Delaware Memorial Bridge, and traverses the northwestern portions of Salem and Gloucester Counties. The New Jersey Turnpike, a major north-south connector in the state, also passes through western Salem and Gloucester Counties. At their closest points, Interstate 295 and the New Jersey Turnpike are approximately 14.0 mi north of the PSEG Site.

In the vicinity of the PSEG Site, major highways include New Jersey State Routes 49 and 45, which cross the New Jersey portion of the economic impact area in northwest-to-southeast and southwest-to-northeast directions, respectively. These highways intersect in the City of Salem, approximately 7.5 mi northeast of the site. Delaware Route 9 is located about 3.1 mi west of the PSEG Site, and Delaware Routes 1 and 13 are just over 5 mi to the west. However, these routes are located on the other side of the Delaware River from the site and would not be affected by building or operating a new plant at the PSEG Site.

Figure 2-23 depicts the local road network in the vicinity of the PSEG Site. The only land access to HCGS and SGS is provided by Alloway Creek Neck Road, which enters the southeast corner of the existing PSEG property and ends at an intersection with Hancocks Bridge Road approximately 7 mi to the east. From this intersection, some workers from Cumberland County follow Harmersville Peck's Corner Road (County Highway 657) east to reach New Jersey State Route 49. However, most workers travel north on Hancocks Bridge Road (County Highway 658) to the City of Salem. At that point, they may choose among several routes through the town to proceed to destinations to the north, northeast, or northwest towards the rest of the economic impact area. The most prominent of these routes are New Jersey State Routes 49 and 45, Grieves Parkway, Chestnut Street, and Oak Street. Annual traffic volumes at critical locations on these routes are shown in Table 2-28.

Figure 2-23. Local Road Network in the Vicinity of the PSEG Site.
(Source: Modified from PSEG 2014-TN3452)

Table 2-28. Annual Average Daily Traffic Counts on Selected Roads Near the PSEG Site

Map ID[(a)]	Roadway and Location	Annual Average Daily Traffic	Year of Count
1	**NJ 49**, between NJ 45 and York Street	9,936	2008
2	**NJ 45**, between CR 657 and Howell Street	9,255	2010
3	**Alloway Creek Neck Road**, between Grosscup Road and Pancoast Road	3,388	2009
4	**Fort Elfsborg Road**, between CR 627 and Mason Point Road	320	2010
5	**Money Island Road**, just south of CR 627	409	2009
6	**Chestnut Street**, between Grieves Parkway and Maple Avenue	1,787	2008
7	**Grieves Parkway**, between CR 625 (Chestnut) and CR 665 (Walnut)	3,401	2010
8	**Oak Street**, between Chestnut Street and Wesley Street	1,443	2010

(a) Traffic count locations are depicted on Figure 2-23.

Source: NJDOT 2013-TN2330.

The New Jersey Department of Transportation's FY 2012 to 2021 Statewide Transportation Improvement Program (NJDOT 2012-TN2324) includes two proposed projects for Salem County that could affect the accessibility of the PSEG Site:

- resurfacing of Commissioners Pike from Woodstown Road (CR 603) to Watson Mill Road (CR 672) (approximately 11.7 mi northeast of the site) and
- reconstruction and/or widening of Hancocks Bridge Road (CR 658) from Fort Elfsborg Road (CR 624) to Hancocks Bridge.

In conjunction with a new plant at the site, PSEG would build a causeway from the site to the intersection of Money Island Road and Masons Point Road, a distance of approximately 4.8 mi (see Figure 2-23). The northern portion of the causeway would follow the existing alignment of Money Island Road. The workforces for building and operating a new plant at the site would be expected to use the causeway instead of the existing access to the PSEG Site. Data in Table 2-28 indicate traffic volumes on the roads at the northern terminus of the proposed causeway (Fort Elfsborg Road and Money Island Road) are much lower than those on other roads in the vicinity where traffic counts were conducted (NJDOT 2012-TN2324).

Rail

Rail lines in the economic impact area and the region are shown on Figure 2-8 in Section 2.2.1. Lines include Norfolk Southern in Delaware and Southern Railroad New Jersey, Conrail, and Winchester and Western in New Jersey. The railroad closest to the PSEG Site is a Southern Railroad New Jersey line that serves industries in the City of Salem. Only freight rail service is

available in the New Jersey portion of the economic impact area. The nearest Amtrak stations are in Newark and Wilmington, Delaware, 17 and 18 mi northwest of the PSEG Site, respectively.

Air

Table 2-29 lists airports serving the economic impact area. The New Castle County Airport in Delaware provides limited commercial and private air services connecting to other major airports in the region. Two additional airports—one each in New Castle County, Delaware, and Cumberland County, New Jersey—serve general aviation uses only. The Philadelphia International Airport in Pennsylvania, approximately 31.5 mi northeast of the PSEG Site, is the nearest airport that provides commercial flights (PSEG 2014-TN3452).

Table 2-29. Business and General Aviation Airports Serving the Economic Impact Area

Airport Name	County	Closest City	State	Type of Airport
New Castle Airport	New Castle	Wilmington	DE	Local Business
Summit Airport	New Castle	Middletown	DE	General Aviation
Millville Municipal Airport	Cumberland	Millville	NJ	General Aviation
Philadelphia International Airport	Philadelphia	Philadelphia	PA	Regional Business

Source: PSEG 2014-TN3452.

Water

The Delaware River, which separates the Delaware and New Jersey portions of the economic impact area, is a major navigable waterway of the eastern United States. Twelve ports and harbors are located along the river, including four within the economic impact area: Delaware City and the Port of Wilmington in New Castle County, Delaware; Deepwater Point in Salem County, New Jersey; and the Port of Paulson in Gloucester County, New Jersey (WPS 2013-TN2353). The existing PSEG property is located at Delaware RM 52 and includes barge slips at the southern end and western side of the site.

Public Transportation

Public transportation is available throughout the economic impact area. The Cumberland Area Transit System provides a shared ride curb-to-curb bus transportation service to county residents who are at least 60 years old, disabled, veterans, blind, and the general public. Fares are based on the funding source that is available to the client and the purpose of the trip being provided (Cumberland County 2013-TN2309). The Gloucester County Transportation Service provides a similar service to Gloucester County residents, with an added category for low income families (Gloucester County 2014-TN3123), and the Salem County Specialized Transportation Services is available to residents who are 60 and over or disabled (Salem County 2013-TN2333). New Castle County public transportation is provided by the Delaware Transit Corporation, which has its principal hub in Wilmington. This transit corporation provides full-service busing, including paratransit services (individualized, non-fixed routes), and has

fixed bus routes available throughout much of New Castle County (NCATA 2014-TN3124). The New Jersey Transit has several bus routes that serve local needs, as well as service to Philadelphia and Atlantic City. New Jersey Transit provides one local bus route in Salem County and four bus routes that provide service between points in the economic impact area and Philadelphia (New Jersey Transit 2014-TN3126).

2.5.2.4 Aesthetics and Recreation

The economic impact area is located primarily in the Coastal Plain physiographic province, which is characterized by gently rolling hills and valleys. The extreme northwestern corner of New Castle County is in the Piedmont province and exhibits considerably more topographic relief (NJDEP 2013-TN2329; USGS 2013-TN2352). Elevations in the economic impact area range from sea level to about 400 ft in the Piedmont province.

The immediate visual environment of the PSEG Site is dominated by the Delaware River, which borders the site to the west and south, and coastal marshes to the east and north of the site. The Delaware River is approximately 2.7 mi wide at this point and consists of open water with occasional commercial and recreational water craft. The coastal marshes extend about 2.4 mi to the east and 4.1 mi to the north and consist of watercourses meandering through marsh grasses. Just beyond the marshes, the topographic character changes to upland agricultural areas dominated by cultivated fields, deciduous wooded areas, and rural residential development.

The industrial visual character of the existing HCGS and SGS facilities contrasts with the river and coastal marsh surroundings. The structures on the site, particularly the HCGS 512-ft tall cooling tower and its associated plume, are prominently visible, particularly from the Delaware River and from the opposite shore in New Castle County. While these features are also visible from the surrounding coastal marshes, trees screen them from view from the upland areas.

The economic impact area offers numerous opportunities for outdoor recreation. The Delaware River immediately west of the PSEG Site is used for recreational boating and fishing. In addition, a number of wildlife management areas, state parks, and other protected areas provide settings for diverse outdoor recreation, including boating, fishing, hunting, bird watching, hiking, and camping. According to the License Renewal EIS for Salem/Hope Creek and discussions with local officials, muskrat trapping is a popular recreational activity in the vicinity of the site (NRC 2012-TN2499; NRC 2011-TN3131).

New Castle County, Delaware, is home to 25 state parks wildlife areas, and other recreational areas. Several recreation areas in the county are located along the banks of the Delaware River and offer views of the existing structures on the PSEG Site. These areas include Augustine Beach Access Area (169 ac), Augustine Wildlife Management Area (2,667 ac), and Cedar Swamp State Wildlife Management Area (4,840 ac) (DNREC 2011-TN3179; DNREC 2013-TN2314; Delaware Greenways-TN2316).

Cumberland County, New Jersey, hosts two natural land trusts (Glades Wildlife Refuge and Peak Reserve) that occupy 7,756 ac. In Salem County, New Jersey, 17,775 ac are devoted to recreation and wildlife protection, including four state parks (12,566 ac), Supawna Meadows

National Wildlife Refuge (4,600 ac), Burdon Hill Preserve (609 ac), Mad Horse Creek WMA (9,500 ac), and Abbots Meadow WMA (1,011 ac). A portion of the New Jersey Coastal Heritage Trail runs through Salem and Cumberland Counties.

According to PSEG's ER, 5.97 million people visit the five National Wildlife Refuges and two national parks annually. Also, there are 27 recreational facilities within 10 mi of the PSEG Site with approximately 3,100 daily visitors (PSEG 2014-TN3452).

PSEG allows public recreational use on lands it owns in its EEP, including marsh and upland areas along the Delaware Bay in New Jersey and Delaware. These include two wildlife observation platforms in the marsh area northeast of the PSEG Site. Access to these sites is provided by Money Island Road, and facilities include parking areas and boardwalks to the observation decks.

2.5.2.5 Housing

Approximately 83 percent of the workforce employed at HCGS and SGS reside in the economic impact area. An additional 16 percent live within 50 mi of the site in 25 counties in New Jersey, Delaware, Pennsylvania, and Maryland (PSEG 2014-TN3452). Workers involved in building and operating a new plant at the PSEG Site are expected to follow a similar residential pattern. Thus, this section concentrates on providing housing data for the economic impact area, while providing less detail for the 50-mi region.

Table 2-30 provides data describing the housing environment in the economic impact area. In 2012, there were 410,558 housing units in the economic impact area, of which approximately 92.6 percent were occupied. Of the occupied units, approximately 72 percent were owner-occupied, and the remainder were rental units (USCB 2010-TN3132).

Table 2-30. Housing Data for Counties in the Economic Impact Area (2012)

	New Castle County, Delaware	Cumberland County, New Jersey	Gloucester County, New Jersey	Salem County, New Jersey	Economic Impact Area
Total Housing Units	217,357	55,880	109,884	27,437	410,558
Occupied	200,618	50,733	104,091	24,950	382,434
Owner-occupied	140,751	34,439	83,949	17,941	277,080
Renter-occupied	59,867	16,294	20,142	7,009	103,312
Vacant Units	15,239	6,174	6,453	2,712	30,578
Median Monthly Rent ($)	1,003	958	1,034	936	–
Vacancy Rate (%)	7.7	9.2	5.3	9.1	6.9
Median Value ($)	251,200	174,400	232,400	197,200	–

Source: USCB 2010-TN3132.

Table 2-30 indicates that 30,578 vacant housing units were available for purchase or rent in all counties of the economic impact area and that every county had a significant supply of vacant

units. The median value of homes in the economic impact area ranged from $174,400 in Cumberland County to $251,200 in New Castle County, while the average monthly rent for rental units ranged from $936 in Salem County to $1,034 in Gloucester County (USCB 2010-TN3132).

Temporary housing is available at many hotels, motels, and campgrounds in the economic impact area. In 2007, the area hosted 107 hotels, including 60 in New Castle County, 17 in Cumberland County, 21 in Gloucester County, and 9 in Salem County. In addition, 10 campgrounds and RV parks were located in the four-county area, including 2 in New Castle County, 4 in Gloucester County, and 4 in Salem County; and seven bed and breakfast or rooms, including three each in New Castle and Cumberland and one in Gloucester (USCB 2007-TN3133).

2.5.2.6 Public Services

The following subsections provide information about public services provided to residents of the economic impact area. The public services discussed include water and wastewater; police, fire, and medical services; social services; and education.

Water and Wastewater

Residents of the economic impact area obtain drinking water from both communal water systems and individual wells. The New Castle County 2012 Comprehensive Plan Update (NCCDE 2012-TN3151) reports the county is served by six water systems, including four public systems and two private systems. In addition, numerous private wells are used by individual homeowners and businesses. Surface water provides 75 percent of the county's drinking water, with groundwater providing the remaining 25 percent. The comprehensive plan estimates there are approximately one billion gallons of surplus drinking water available within the county.

The comprehensive plan update estimates the water supply of the northern portion of New Castle County at approximately 127 Mgd, including 94 Mgd surface water and 33 Mgd groundwater. This portion of the county is considered to have a healthy surplus of water for peak drought demands through 2020 and beyond. In the southern portion of New Castle County, which draws all its water from aquifers, the available groundwater is estimated to be 20 to 30 Mgd. In this area, the comprehensive plan update expects water supplies to be adequate through 2030 and beyond, based on conservative projections (NCCDE 2012-TN3151).

Drinking water in the New Jersey portion of the economic impact area comes from a number of public and private water systems and from individual private wells. Table 2-31 lists the water systems in Cumberland, Gloucester, and Salem Counties, along with information about the capacity and peak demand of these systems. Capacity exceeds peak demand in every system.

Table 2-31. Major Water Supply Systems (Serving 5,000 or More People) in New Jersey Counties of the Economic Impact Area

Water System Name	Population Served	Primary Water Source	Total Daily Capacity (Mgd)	Peak Daily Demand (Mgd)	Demand as % of Capacity	Excess Capacity (Mgd)
Cumberland County						
Bridgeton Water Department	22,700	Ground	5.062	4.006	79.1	1.056
Millville Water and Sewer Utility	27,500	Ground	7.828	5.853	74.8	1.975
Vineland Water and Sewer Utility	33,000	Ground	15.624	14.660	93.8	0.964
Subtotal	83,200		28.514	25.519	86.0	3.995
Gloucester County						
Clayton Water Department	7,155	Ground	1.216	0.990	81.4	0.226
Deptford Municipal Water Authority	26,000	Purchased Surface	8.800	4.763	54.1	4.037
East Greenwich Township Water Department	9,654	Purchased Surface	3.104	2.677	86.2	0.427
Glassboro Water Department	24,238	Purchased Surface	6.622	4.103	70.0	2.519
Greenwich Water Department	4,921	Ground	1.728	1.029	60.0	0.699
Mantua Municipal Water Authority	11,713	Ground	2.664	2.180	81.8	0.484
Monroe Municipal Water Authority	26,145	Purchased Surface	7.152	5.391	75.4	1.761
NJ American Water Company—Harrison	9,450	Purchased Surface	3.805	2.877	74.7	0.928
NJ American Water Company—Logan	6,650	Purchased Surface	3.080	2.386	77.5	0.712
Paulsboro Water Department	6,200	Ground	2.160	1.325	61.3	0.835
Pitman Water Department	9,445	Purchased Surface	1.590	1.112	69.9	0.478
Washington Municipal Water Authority	48,000	Ground	12.924	7.992	61.8	5.002
West Deptford Water Department	20,000	Purchased Surface	7.034	4.372	32.1	2.662
Westville Water Department	6,000	Ground	1.728	0.620	35.9	1.108
Woodbury Water Department	11,000	Purchased Surface	4.500	1.645	36.6	2.855
Subtotal	226,571		68.107	43.462	63.8	24.733
Salem County						
NJ American Water Company—Penns Grove	14,406	Ground	2.396	1.950	81.4	0.446
Pennsville Water Department	13,500	Ground	1.872	1.482	79.1	0.390
Salem Water Department	6,199	Surface	3.360	1.550	46.1	1.810
Subtotal	34,105		7.628	4.982	65.3	2.646
Total	343,876		104.249	72.963	70.0	31.374

Source: NJDEP 2013-TN3154.

In Cumberland County combined peak demand is 86 percent of combined capacity, with an excess capacity of 3.995 Mgd. The peak demand for drinking water in Gloucester County is 63.8 percent of combined capacity, leaving an excess capacity of 24.733 Mgd. In Salem County peak demand is 65.3 percent of combined capacity, with an excess capacity of 2.646 Mgd. Overall, peak demand for water in the New Jersey portion of the economic impact area is 70 percent of the combined capacity of the water systems, leaving an excess capacity of 31.374 Mgd (NJDEP 2013-TN3154). Cumberland County officials confirm water systems in the county are near capacity, while Salem County officials state their county has available capacity above current usage rates (NRC 2012-TN2499).

According to data in Table 2-32, wastewater treatment systems in New Castle County had significant excess capacity in 2008, with current usage amounting to 69.20 percent of their total capacities and 32.36 Mgd of capacity remaining. However, the county's 2012 comprehensive plan update (NCCDE 2012-TN3151) notes that the northern portion of the county (north of the Chesapeake and Delaware Canal) is served by the Wilmington Wastewater Treatment Plant and that a number of areas in this part of the county have little or no remaining available capacity. In these areas, unimproved property owners desiring to develop their land must defer development until sufficient capacity becomes available, make system repairs or upgrades that provide sufficient capacity to accommodate the proposed development, or provide onsite sewage treatment.

The New Castle County 2012 plan update states there are three public wastewater treatment plants in the southern portion of the county, one in the Town of Middleton and two controlled by the county. The 2008 data in Table 2-32 indicates these systems are small (with capacities ranging from 0.05 Mgd to 1.70 Mgd) and have relatively little excess capacity remaining (0.01 Mgd to 0.5 Mgd) (NCCDE 2012-TN3151).

In Salem County, seven wastewater treatment plants serve 34,059 people. The capacity of these plants ranges from 0.05 Mgd to 1.8 Mgd, and the total capacity of all the plants is 5.93 Mgd. Current flows into the plants total 3.88 Mgd, leaving an excess capacity of 2.05 Mgd or 34.57 percent of the total capacity. Average daily use rates for the individual systems range from 40 percent of capacity for two plants serving the Lower Alloways Creek area to 88 percent for the Penns Grove Sewer Authority (EPA 2012-TN3162).

Three wastewater treatment plants in Cumberland County serve 85,311 people. The plants have a combined capacity of 20.20 Mgd and an average daily flow of 11.36 Mgd, resulting in an excess capacity of 8.84 Mgd (43.76 percent of total capacity). Usage-to-capacity ratios for the individual plants range from 48.72 percent for the Cumberland County Utility Authority plant to 65.37 percent for the Landis Sewerage Authority plant (EPA 2012-TN3162). Cumberland County officials confirm that extra capacity is available within the county (NRC 2012-TN2499). Gloucester County has five wastewater treatment plants serving 190,369 people. The combined capacity of the plants is 28.25 Mgd, and the total average daily flow is 22.12 Mgd, leaving an excess capacity of 6.13 Mgd (27.71 percent of total capacity). Average daily use rates for the individual plants range from 50 percent for the Harrison sewage treatment plant to 91 percent for the Greenwich sewage treatment plant (EPA 2012-TN3162). County officials note most of the public wastewater systems serve the northern portion of the county, while the southern portion relies mostly on individual septic systems (NRC 2012-TN2499).

Table 2-32. Public Wastewater Treatment Systems in the Economic Impact Area (2008)

Wastewater Treatment System	Population Served	Design Total Flow (Mgd)	Existing Total Flow (Mgd)	Existing Flow as % of Design	Excess Capacity (Mgd)
New Castle County, Delaware					
Wilmington STP	522,140	102.77	71.23	69.31	31.54
Delaware City STP	1,879	0.50	0.25	50.00	0.25
Port Penn STP	262	0.05	0.04	80.00	0.01
Water Farm STP	6,223	1.70	1.20	70.59	0.50
Subtotal	530,504	105.05	72.69	69.20	32.30
Cumberland County, New Jersey					
Cumberland Co. UA-Cohansey RV STP	22,771	7.00	3.414	48.77	3.59
Landis Sewerage Authority	34,307	8.20	5.36	65.37	2.84
City of Millville STP	28,233	5.00	2.59	51.78	2.41
Subtotal	85,311	20.20	11.36	56.25	8.84
Gloucester County, New Jersey					
Gloucester County Utilities Authority	166,211	24.10	19.00	78.84	5.10
Greenwich Township STP	4,511	1.00	0.906	91.00	0.09
Harrison Township STP	6,246	0.80	0.40	50.00	0.40
Logan Township MUA	11,393	2.00	1.54	77.00	0.46
Swedesboro Consolidated STP	2,008	0.35	0.273	78.00	0.08
Subtotal	190,369	28.25	22.12	78.30	6.13
Salem County, New Jersey					
Carneys Point Township SA	7,816	1.30	0.715	55.00	0.58
Penns Grove SA	3,633	0.75	0.66	88.00	0.09
Pennsville SA	12,083	1.875	1.582	84.37	0.29
Salem Wastewater Treatment Facility	5,678	1.40	0.579	41.36	0.82
Woodstown STP	3,260	0.50	0.303	60.60	0.20
Lower Alloways Creek–Hancock STP	817	0.05	0.017	34.00	0.03
Lower Alloways Creek–Canton STP	772	0.05	0.02	40.00	0.03
Subtotal	34,059	5.93	3.88	65.42	2.05
Total	840,243	159.40	110.08	69.06	49.32

Note: STP = sewage treatment plant; UA = utilities authority, RV = recreational vehicle; MUA = municipal utilities authority; SA = sanitation authority or sewerage authority.

Source: EPA 2012-TN3162.

Gloucester County and Salem County are engaged in planning for a regional wastewater treatment system that would link to a treatment plant at Carneys Point with a capacity of 20 Mgd. The new system would allow the two counties to replace the individual septic systems that provide service to more rural areas (NRC 2012-TN2499).

Police, Fire, and Medical Services

Police protection in the economic impact area is provided by the four county governments and the municipalities within them. Table 2-33 presents information on the number of law enforcement personnel in each jurisdiction. Salem County has 311 law enforcement personnel, including 268 officers and 43 employees. The county itself employees 194 of the personnel, and municipalities within the county employ the remaining 117. Cumberland County has 447 law enforcement personnel, including 382 officers and 65 civilian employees. Most (383) of the personnel work for municipalities, and the remaining 64 are employed by the county government. Gloucester County has 706 law enforcement personnel, including 647 officers and 59 civilian employees. Municipalities employ 604 of the staff, and the county employs 102. There are 1,041 law enforcement personnel in New Castle County, including 836 officers and 205 civilian employees. The county employs 464 of the personnel, while municipalities employ the remaining 577 (USDOJ 2011-TN3111). The 2010 ratios of residents per officer are 246.6 in Salem County, 410.7 in Cumberland County, 445.6 in Gloucester County, and 644.1 in New Castle County.

Fire protection in the economic impact area is provided by 97 fire departments with 4,461 firefighters. Salem County has 19 fire departments with 407 firefighters, Cumberland County has 25 departments and 695 firefighters, Gloucester County has 57 departments with 1,343 firefighters, and New Castle County has 34 departments and 1,740 firefighters.[3] The ratios of residents per firefighter are 112.2 in Salem County, 200.2 in Cumberland County, 212.1 in Gloucester County, and 308.3 in New Castle County. Departments in Wilmington, Delaware, Bridgeton, New Jersey, and Bridgeport, New Jersey, are staffed by career or mostly career (i.e., 51 to 99 percent are career) firefighters, while the remaining departments rely mostly or entirely on volunteers (FD 2014-TN3164).

There are 10 hospitals in the economic impact area with a total of 2,697 hospital beds. Cumberland County has one hospital with 331 beds, Gloucester County has two hospitals with a combined total of 256 beds, Salem County has two hospitals with a combined total of 198 beds, and New Castle County has four hospitals with a combined total of 1,171 beds. Of the hospitals in New Castle County, one serves only veterans (120 beds), and another is a children's hospital (192 beds) (AHD 2013-TN2306; AHA 2013-TN2305). Salem County officials note that Memorial Hospital of Salem County, the closest hospital to the proposed site, has significant unused capacity (NRC 2012-TN2499).

[3]Some stations are substations and do not have separate staff.

Table 2-33. Local Law Enforcement Personnel in Counties of the Economic Impact Area

Jurisdiction	Total Law Enforcement Personnel	Officers	Civilians
New Castle County	464	351	113
Delaware City	3	3	0
Elsmere	12	11	1
Middletown	31	27	4
Newark	80	64	16
New Castle	19	17	2
Newport	7	7	0
Smyrna	29	22	7
Wilmington	396	334	62
Total for New Castle County	**1,041**	**836**	**205**
Cumberland County	64	58	6
Bridgeton	74	63	11
Hopewell Township	39	31	8
Millville	89	77	12
Vineland	181	153	28
Total for Cumberland County	**447**	**382**	**65**
Gloucester County	102	88	14
Clayton	18	17	1
Deptford Township	72	67	5
East Greenwich Township	22	20	2
Elk Township	13	12	1
Franklin Township	31	28	3
Glassboro	44	40	4
Greenwich Township	19	18	1
Harrison Township	18	17	1
Logan Township	20	19	1
Mantua Township	28	26	2
Monroe Township	73	66	7
Newfield	6	6	0
Paulsboro	20	19	1
Pitman	16	15	1
South Harrison Township	5	5	0
Washington Township	87	80	7
Wenonah	8	8	0
West Deptford Township	44	41	3
Woodbury	31	28	3
Woodbury Heights	8	7	1
Woolwich Township	21	20	1
Total for Gloucester County	**706**	**647**	**59**

Table 2-33 (continued)

Jurisdiction	Total Law Enforcement Personnel	Officers	Civilians
Salem County	194	169	25
Carneys Point Township	25	20	5
Elmer	2	2	0
Lower Alloways Creek Township	16	12	4
Penns Grove	16	12	4
Pennsville Township	23	22	1
Salem	25	22	3
Woodstown	10	9	1
Total for Salem County	**311**	**268**	**43**

Source: USDOJ 2011-TN3111.

Social Services

The New Jersey Department of Health is responsible for social services in the state. All counties in the state are required to have public health facilities meeting state standards. Cumberland and Salem counties share a joint facility located in Salem City. In addition, Cumberland County's Department of Health is located in Millville. Gloucester County is served by a Department of Health and Senior Services in Sewell (NJDOH 2013-TN2391). Each county also hosts an office of the New Jersey Department of Human Services that provides financial support, transportation, health and wellness support, and other services. In addition, this department operates a development center in Cumberland County to provide care and training for people with developmental disabilities (NJDHS 2013-TN2392).

Social services in Delaware are provided by the Department of Health and Social Services. The department provides a variety of services through an office in New Castle County, a campus in Delaware City providing long-term intermediate care and alcohol and drug rehabilitation, the Delaware Psychiatric Center in New Castle, a long-term care facility in Wilmington, a Child Support Enforcement facility, and numerous service centers and community mental health facilities (DHSS 2013-TN2388).

Education

Table 2-34 lists public school districts in the economic impact area along with their enrollments, number of teachers, and student-to-teacher ratios. New Castle County has 116 public schools in 15 public school districts serving 75,058 students. There are about 14 students per teacher in the county, a rate that is slightly better than the statewide rate of 15 students per teacher. New Castle County also has 17 charter schools with an enrollment of 6,811 students (EducationBug 2014-TN3168).

In the New Jersey portion of the economic impact area, Cumberland County has 26,527 students attending 56 public schools in 18 districts, Gloucester County has

42,352 students in 82 public schools in 30 districts, and Salem County has 11,187 students in 31 schools in 15 districts. Student-to-teacher ratios for the three counties are 12:1, 13:1, and 13:1, respectively, all well below the statewide rate of 15:1 (Table 2-34) (Public School Review 2014-TN3165) .

Table 2-34. Public School Enrollment, Teachers, and Student-to-Teacher Ratios in the Economic Impact Area and State

Public School District	Number of Students (full-time equivalents)	Number of Teachers (full-time equivalents)	Number of Students per Teacher
New Castle County, Delaware[a]	76,135	4,995	15.24
State of Delaware[a]	130,610	8,594	15.20
Cumberland County, New Jersey[b]	27,195	2,262.6	12.02
Gloucester County, New Jersey[b]	49,079.5	3,795.2	12.93
Salem County, New Jersey[b]	11,225	999.1	11.24
State of New Jersey[b]	1,364,494.5	94,329.7	14.47

(a) Data for 2011 to 2012 school year.
(b) Data for 2010 to 2011 school year.

Sources: DDOE 2013-TN2311; DDOE 2013-TN2310; NJDOE 2013-TN2327; NJDOE 2013-TN2328.

According to public officials in the economic impact area, the public school system in Cumberland County is functioning near capacity. The Greenwich, Logan, Woolwich, and Paulsboro school districts in Gloucester County and the Appoquinimink district in New Castle County are at or over capacity. Local officials in Salem County indicate schools in Elsinboro Township and Lower Alloways Creek Township have available capacity (NRC 2012-TN2499). New Jersey has a program called the New Jersey Interdistrict Public School Choice Program that allows districts to enroll students who may not necessarily reside within the same district. This program does not cost parents extra. For the 2014–15 school year, there were 136 districts taking part in this program (NJDOE 2014-TN3166). Six districts in Salem County, four in Cumberland County, and nine in Gloucester County take part in the program. Delaware has a similar program called Delaware School Choice Program that has 193 schools take part throughout the state (Delaware 2014-TN3167).

There are 10 colleges and universities in the economic impact (CollegeStats 2014-TN3109). Salem Community College in Carneys Point is the institution closest to the PSEG Site (approximately 15 mi north–northeast). The largest college or university in the economic impact area is the University of Delaware, located in Newark, approximately 18 mi northwest of the site.

2.6 Environmental Justice

Environmental justice requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health and environmental effects of its programs, policies, and activities on minority and low-income populations (59 FR 7629-TN1450). The USCB defines minority categories as the following: American Indian or Alaskan Native; Asian;

Native Hawaiian, or other Pacific Islander; Black races; Hispanic ethnicity; and "other," which may be considered a separate minority category. Low income refers to individuals living in households meeting the official poverty measure (USCB 2013-TN2363). Executive Order (EO) 12898 established requirements for environmental justice. The Council on Environmental Quality (CEQ) has provided guidance for addressing environmental justice (CEQ 1997-TN452). Although the Commission is not required to comply with EO 12898, the Commission has voluntarily committed to undertake environmental justice reviews. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040-TN1009).

This section describes the existing demographic and geographic characteristics of the PSEG Site and its surrounding communities. It offers a general description of minority and low-income populations within a 50-mi region surrounding the site. The characterization in this section forms the analytical baseline from which the determination of potential environmental justice impacts will be made. The characterization of populations of interest also includes an assessment of populations of particular interest or unusual circumstances, such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements.

2.6.1 Methodology

The review team first examined the geographic distribution of minority and low-income populations within 50 mi of the PSEG Site using data from the U.S. Census American Community Survey 5-year summary files (2006–10) to identify minority and low-income populations. The review team then verified its analysis by conducting field inquiries of numerous agencies and groups (see Appendix B for the list of organizations contacted and NRC 2012-TN2499, for the field notes).

The first step in the review team's environmental justice review is to examine each census block group that is fully or partially included within the 50-mi region to determine whether it should be considered a population of interest. Census block groups are the smallest defined area for which minority and low-income populations are disaggregated. USCB defines census block groups as "statistical divisions of census tracts … generally defined to contain between 600 and 3,000 people" (USCB 2013-TN2363). If either of the two criteria discussed below identifies a census block group, that census block group is considered a population of interest. The two criteria are whether

- the population of interest exceeds 50 percent of the total population for the block group, or
- the percentage of the population of interest is 20 percentage points (or more) greater than the same population's percentage in the block group's county.

The identification of census block groups that meet either of the above criteria is not, in and of itself, sufficient for the review team to conclude that disproportionately high and adverse impacts would occur. Likewise, the lack of census block groups meeting either of the above criteria cannot be construed as conclusive evidence of no disproportionately high and adverse impacts to a population of interest. To reach an environmental justice conclusion, the review team must

investigate all populations in greater detail to determine if there are potentially significant environmental impacts that may have disproportionately high and adverse effects on minority or low-income communities. To determine whether disproportionately high and adverse effects may occur, the review team considers the following:

Health Considerations

1. Are the radiological or other health effects significant or above generally accepted norms?

2. Is the risk or rate of hazard significant and appreciably in excess of the general population?

3. Do the radiological or other health effects occur in groups affected by cumulative or multiple adverse exposures from environmental hazards?

Environmental Considerations

1. Is there an impact on the natural or physical environment that significantly and adversely affects a particular group?

2. Are there any significant adverse impacts on a group that appreciably exceed or are likely to appreciably exceed those of the general population?

3. Do the environmental effects occur in groups affected by cumulative or multiple adverse exposure from environmental hazard? (NRC 2007-TN2487)

If the greater detail investigation does not yield any potential pathways for disproportionately high and adverse impacts on populations of interest, the review team may conclude there are no disproportionately high and adverse effects. If, however, the review team finds any potential pathways for disproportionately high and adverse impacts, the review team would fully characterize the nature and extent of those impacts and consider possible mitigation measures to lessen those impacts. The remainder of this section discusses the results of the search for potentially affected populations of interest.

Drawing on data presented in Section 2.5.1, this section presents the demographics of the minority and low-income populations that reside within a 50-mi radius of the PSEG Site, including the economic impact area consisting of Salem, Gloucester, and Cumberland Counties in New Jersey, and New Castle County, Delaware. The consideration of a 50-mi comparative geographic area surrounding the site is based on guidance provided by NUREG–1555 (NRC 1999-TN614).

The review team evaluated all census block groups within the 50-mi region to identify minority and low-income populations. In accordance with the threshold criteria described above, the review team identified block groups where minority or low-income populations either exceeded 50 percent of the block group total population or were at least 20 percentage points higher than the corresponding population for the county in which the block group was located. Table 2-35

presents, for the 50-mi region, the percentage of minority category populations in each state and the associated threshold values for the second (20 percent) criterion.

In addition to the minority definitions stated above, the review team also considered Hispanic ethnicity in identifying minority populations. According to the USCB, Hispanic ethnicity is not a race; therefore, a Hispanic individual can be counted in any of the race categories as well as the Hispanic ethnicity category (USCB 2000-TN2488). The review team did not include Hispanic ethnicity in its aggregate race estimate because the Federal government considers race and Hispanic origin to be two separate and distinct concepts.

Figures 2-24 and 2-25 show the census block groups with minority populations, as defined above, within the 50-mi region. There are 4,139 census block groups in the region, of which 35.3 percent had an "Aggregate Minority" (i.e., all minority groups combined) population that exceeded one of the above criteria and 7.0 percent had Hispanic population that exceeded one of the above criteria. The most intense concentrations of both Aggregate Minority and Hispanic populations in the region occur in Philadelphia and Delaware Counties, Pennsylvania; Camden County, New Jersey; and New Castle County, Delaware. Most of the block groups exceeding the threshold criteria for minority populations do so because of the number of Black residents (see Figure 2-26).

Table 2-36 presents data on census block groups exceeding the environmental justice thresholds in the four-county economic impact area. New Castle County, Delaware, has the largest number of block groups exceeding the thresholds for the Black, Aggregate Minority, and Hispanic block categories. Cumberland County, New Jersey, has a greater share of block groups exceeding the Aggregate Minority and Hispanic criteria than its share of total block groups. None of the four counties record any block groups exceeding the threshold criteria for the categories of Asian, Other race, or Two or more races. The census block groups closest to the PSEG Site that meet the minority population criteria are the three block groups that make up the City of Salem, approximately 8 mi north of the site. These block groups exceed the thresholds for the Black and Aggregate Minority categories.

Figure 2-27 shows the census block groups with low-income populations, as defined above, within the 50-mi PSEG region. Approximately 12.8 percent of the 4,139 census block groups in the region had a low-income population that exceeded one of the above criteria. The greatest concentrations of block groups exceeding the low-income criteria are located in Philadelphia County, Pennsylvania, and Camden County, New Jersey.

Within the four-county economic impact area, the data in Table 2-36 show more than half of the census block groups with low-income populations exceeding the threshold criteria are located in New Castle County, Delaware. In addition, the proportion of such block groups in Cumberland County, New Jersey, is significantly greater than the county's share of total block groups. The closest census block group to the site with a low-income population as defined above is located in the southern portion of Salem City, about 8 mi north of the PSEG Site.

Table 2-35. Statewide Percent Minority Populations and Associated 20 Percentage Point Threshold Criteria for the 50-mi Region

Minority Category	Delaware		Maryland		New Jersey		Pennsylvania	
	Percent of Population	Threshold Criterion	Percent of Population	Threshold Criterion	Percent of Population	Threshold Criterion	Percent of Population	Threshold Criterion
Black	20.8	40.8	29.0	49.0	12.8	32.8	10.4	30.4
American Indian or Native Alaskan	0.3	20.3	0.2	20.2	0.1	20.1	0.1	20.1
Asian	3.2	23.2	5.5	25.5	8.2	28.2	2.7	22.7
Native Hawaiian or Other Pacific Islander	0.0	20.0	0.0	20.0	0.0	20.0	0.0	20.0
Some Other Race	0.2	20.2	0.2	20.2	0.3	20.3	0.1	20.1
Multiracial	2.0	22.0	2.2	22.2	1.5	21.5	1.4	21.4
Aggregate[(a)]	34.7	54.7	45.3	65.3	40.7	60.7	20.5	40.5
Hispanic	8.2	28.2	8.2	28.2	17.7	37.7	5.7	25.7

(a) Aggregate minority race is calculated by subtracting the percentage of reported “White, not Hispanic or Latino” from the total population.

Source: USCB 2010-TN2361.

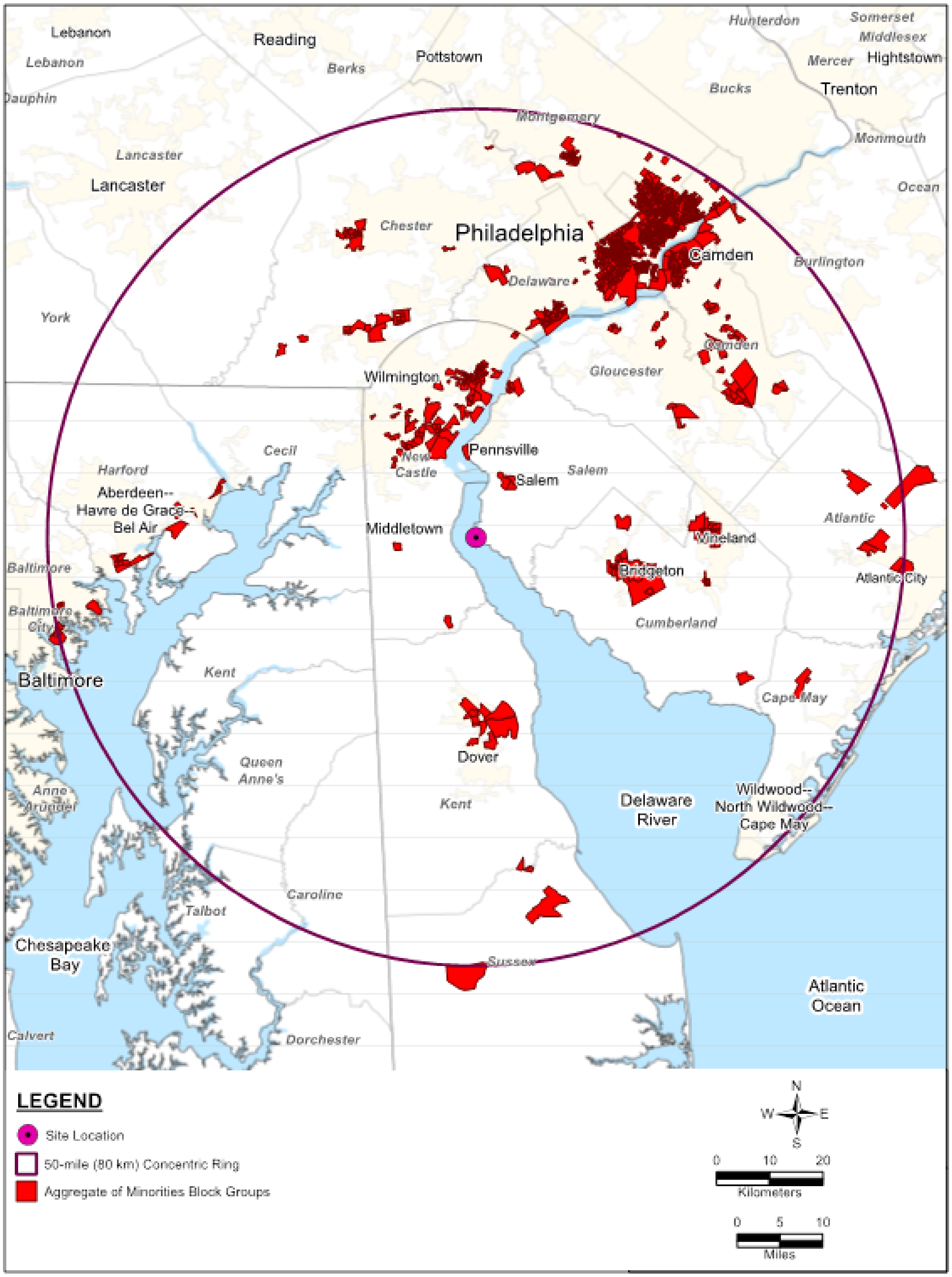


Figure 2-24. Aggregate of Minorities Block Groups Within 50 Mi of the PSEG Site.
(Source: Modified from PSEG 2012-TN2450)

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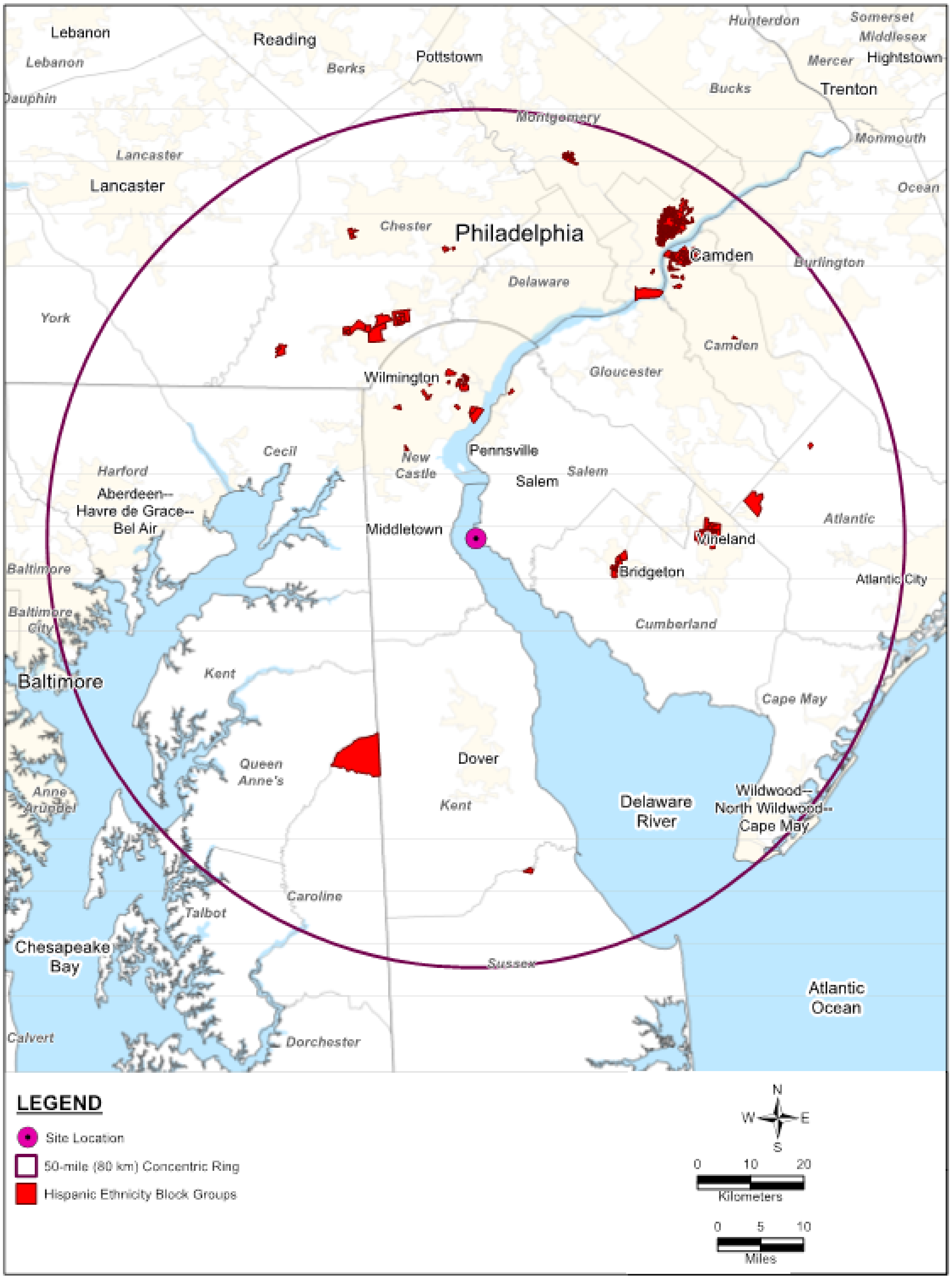

2 **Figure 2-25. Hispanic Ethnicity Block Groups Within 50 Mi of the PSEG Site.**
3 ***(Source: Modified from PSEG 2012-TN2450)***

4

Table 2-36. Distribution of Census Block Groups Exceeding Environmental Justice Thresholds in the Economic Impact Area

	New Castle County, Delaware		Cumberland County, New Jersey		Gloucester County, New Jersey		Salem County, New Jersey		Total Economic Impact Area	
	Number of Block Groups	% of Total	Number of Block Groups	% of Total	Number of Block Groups	% of Total	Number of Block Groups	% of Total	Number of Block Groups	% of Total
Number of block groups	366	52.0	98	13.9	191	27.1	49	7.0	704	100
Black	74	71.8	12	11.7	11	10.7	6	5.8	103	100
Asian	0	—	0	—	0	—	0	—	0	—
Other race	0	—	0	—	0	—	0	—	0	—
Two or more races	0	—	0	—	0	—	0	—	0	—
Aggregate Minority	106	65.0	37	22.7	11	6.7	9	5.5	163	100
Hispanic	23	52.3	20	45.5	0	0.0	1	2.3	44	100
Low Income	27	56.3	11	22.9	8	16.7	2	4.2	48	100

Sources: USCB 2010-TN2361; USCB 2012-TN2362.

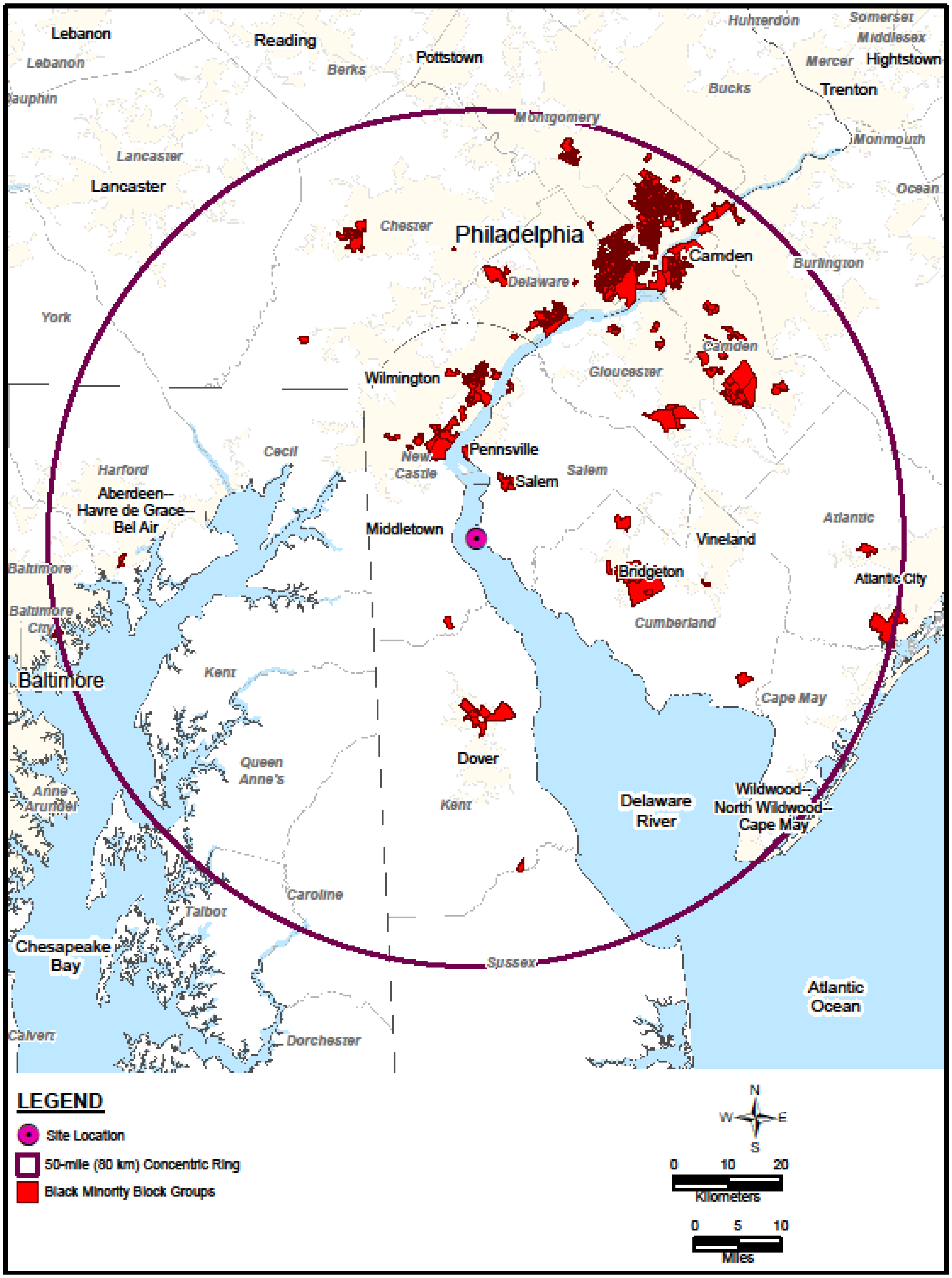

Figure 2-26. Black Minority Block Groups Within 50 Mi of the PSEG Site.
(Source: Modified from PSEG 2012-TN2450)

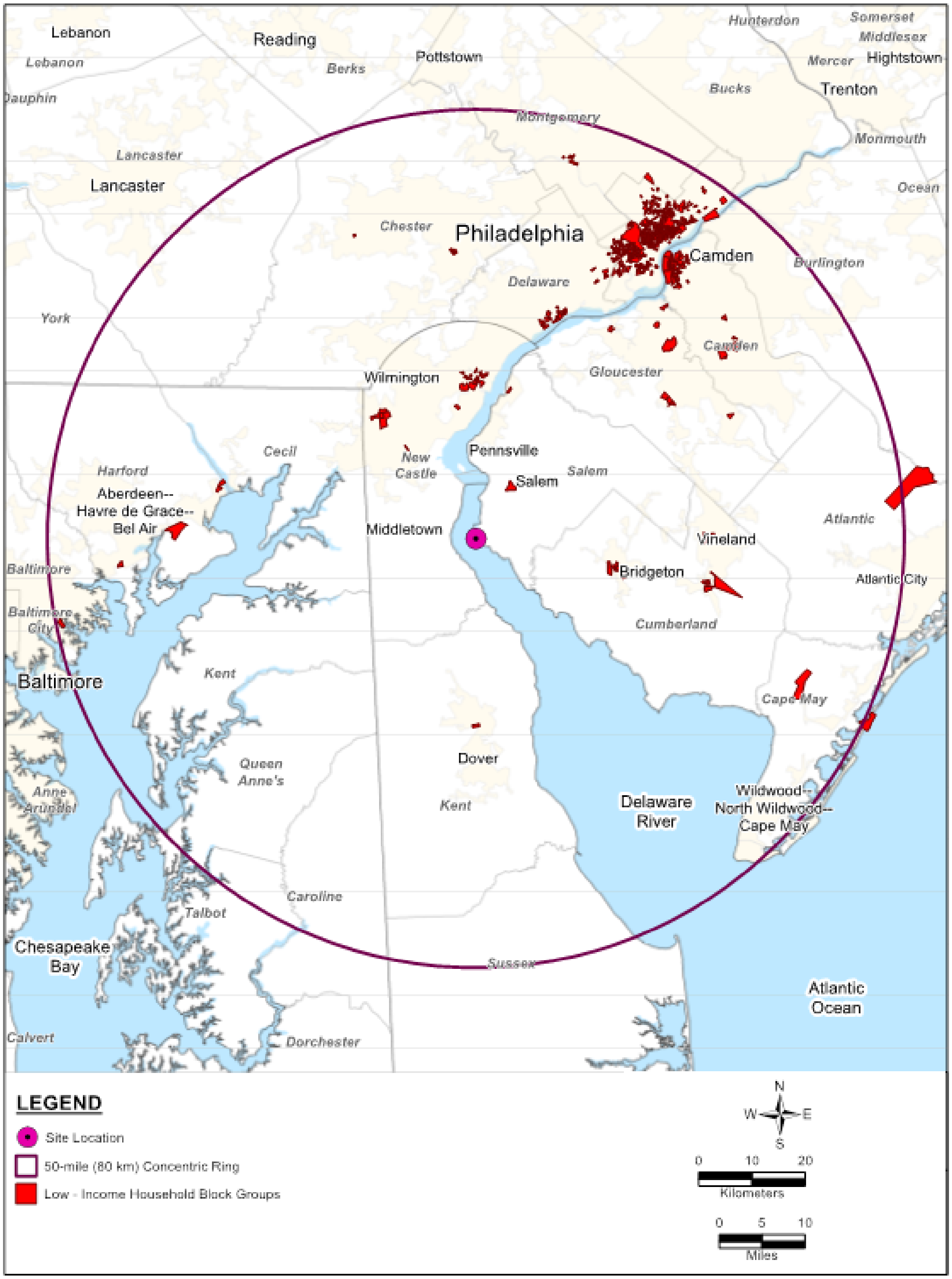

Figure 2-27. Low-Income Household Block Groups Within 50 Mi of the PSEG Site.
(Source: Modified from PSEG 2012-TN2450)

The figures and tables used in this section are modified from the PSEG ER (PSEG 2014-TN3452) and additional information provided by PSEG, as referenced. The methods used by PSEG and the output of the PSEG analysis have been verified by independent analysis by the review team and from the May 7–9, 2012, site audit.

2.6.2 Scoping and Outreach

NRC staff issued advance notice of public EIS scoping meetings in accordance with Commission guidance and conducted two public scoping meetings in Carneys Point, Salem County, New Jersey, on November 4, 2010. Also, during May 7–9, 2012, members of the review team met with elected officials of each county in the economic impact area as well as mayors of townships in the immediate vicinity of the PSEG Site. One purpose of these meetings was to identify and assess the potential for disproportionately high and adverse effects on minority and low-income populations. Through these meetings, the review team did not identify any additional groups of minority or low-income populations that might be affected by the proposed project.

2.6.3 Special Circumstances of the Minority and Low-Income Populations

The NRC environmental justice methodology includes an assessment of “pockets” of populations that have unique characteristics that may not be discerned by the census but might receive a disproportionately high and adverse impact from building and operation of a project. Examples of unique characteristics might include lack of vehicles, sensitivity to noise, close proximity to the plant, or subsistence activities, but such unique characteristics need to be demonstrably present in the population and relevant to the potential effects of the plant. If the impacts from the proposed action could affect an identified minority or low-income population more than the general population because of one of these or other unique characteristics, then a determination is made whether the impact on the minority or low-income population is disproportionately high and adverse when compared to the general population.

High-Density Communities

High-density communities are minority or low-income “pockets” of populations that are not discerned by the census but might suffer a disproportionately high and adverse impact from building or operation of a project. Examples include densely populated low-income housing projects such as public housing or HUD rental assistance.

Salem County has five public housing projects, two in Penns Grove (approximately 12 mi from the site) and three in Salem City (approximately 8 mi from the site) (Salem County 2010-TN2486). There are none in the communities closest to the PSEG Site (Elsinboro and Lower Alloways Creek Townships). The review team identified no other high-density communities.

Subsistence

The review team also thoroughly searches for populations that may have common subsistence behaviors including gardening, gathering plants, fishing, and hunting. These behaviors are used to supplement store-bought foodstuffs or medications for budgetary purposes or for

ceremonial and traditional cultural purposes. Subsistence information is typically site-specific, and the review team must take care to differentiate between subsistence and recreational uses of natural resources. The review team relied on a study conducted for PSEG that reports on interviews with local government officials, staff of social welfare agencies, and community-based aid programs concerning subsistence living near the PSEG Site (PSEG 2012-TN2370). According to the study, these interviews “identified no unusual resource dependencies or practices such as subsistence agriculture, hunting, or fishing.” The results of this study were independently verified May 7–9, 2012, by interviews conducted by the review team with local officials reporting that gardening, hunting, and fishing were practiced for their recreational value rather than as subsistence activities.

Through its review of the PSEG ER (PSEG 2014-TN3452), its own outreach and research, and scoping comments, the review team did not identify any communities with unique characteristics that would require further consideration.

2.6.4 Migrant Populations

The USCB defines a migrant laborer as someone who works seasonally or temporarily and moves one or more times per year to perform seasonal or temporary work. Section 2.5.1.3 discusses the two largest migrant populations within the economic impact area: those associated with outages at HCGS and SGS and those associated with agricultural activities in the area. That discussion finds that (1) up to 1,361 workers come to the area every 6 months to perform refueling and maintenance at the existing nuclear plants and (2) 4,209 farm workers are employed in the economic impact area for less than 150 days per year, some or all of whom may be migrant workers. Local officials indicate migrant agricultural workers are employed seasonally in Cumberland County (residing primarily in the Bridgeton area) and in Gloucester County. An official of the township where the PSEG Site is located indicates no migrant farm laborers are employed in the township (NRC 2012-TN2499).

2.6.5 Environmental Justice Summary

As discussed above, the review team found that 35.3 percent of the census block groups in the 50-mi PSEG region had an Aggregate Minority population that exceeded one of the criteria established for environmental justice analyses and that 7.0 percent had a Hispanic population that exceeded one of the criteria. The review team found that 12.8 percent of the census block groups in the region had a low-income population that exceeded one of the criteria.

The review team found that, within the four-county economic impact area, more than half of the block groups with Aggregate Minority, Hispanic, or low-income populations exceeding the environmental justice thresholds were located in New Castle County, Delaware. The block groups nearest to the PSEG Site with populations exceeding the criteria are located within the City of Salem, approximately 8 mi north of the site. These block groups were over the thresholds for Black, Aggregate Minority, and low-income populations.

The review team performed analyses in greater detail before making a final environmental justice determination. These analyses can be found in Chapter 4 for building-related activities and in Chapter 5 for project operations.

2.7 Historic and Cultural Resources

Historic and cultural resources refer to archaeological sites, historic buildings, shipwrecks, and other resources considered through the National Historic Preservation Act (NHPA) (16 USC 470-TN993) of 1966, as amended. The process for considering these resources during a Federal undertaking is identified in Section 106 of the NHPA (36 CFR 800-TN513). In accordance with Title 36 of the *Code of Federal Regulations* (CFR) Part 800.8(c), the NRC and the USACE have elected to use the National Environmental Policy Act of 1969, as amended (NEPA) (42 USC 4321-TN661) process to comply with NHPA. As a cooperating agency, the USACE is part of the review team. The USACE and the NRC each have their own areas of regulatory responsibility and are consulting on the areas of the project that are within their regulatory authority. Because of the limited regulatory authority of each agency, neither agency could consult on the entire project. The NRC is consulting on the impact (including visual impacts) of construction and operation of a new nuclear power plant on Artificial Island. The USACE is consulting on areas of the project that would impact wetlands, specifically the proposed causeway from Money Island Road to the PSEG Site and potential dredge areas (barge facility and water intake).

The USACE regulations at 33 CFR 325, Appendix C (33 CFR 325-TN425), describe the USACE obligation to comply with the regulations of NHPA (36 CFR 800-TN513). In addition to any specific conditions regarding known historic and cultural resources identified through coordination with the SHPOs and THPOs, every USACE DA permit includes a general condition that advises and requires the permittee to immediately notify the USACE if any previously unknown resources are encountered during construction.

The NRC has determined that the direct, physical area of potential effect (APE) within its authority for this review is the area at the PSEG Site on Artificial Island and its immediate environs that may be impacted by activities associated with building and operating a new nuclear power plant (Figure 2-28). The indirect APE that encompasses potential visual impacts for this review is located within the PSEG Site vicinity and is defined as a zone within 4.9 mi of the tallest structures associated with a new nuclear power plant. The USACE permit areas are the Money Island Access Road and the dredge area (Figures 2-28 and 2-29, respectively).

For the purposes of NHPA Section 106 review, the NRC and the USACE conducted consultation with the New Jersey and Delaware SHPOs, appropriate THPOs, and PSEG for onsite and offsite activities.

Consultation efforts are described in Section 2.7.3. Additional information on consultation is found in Appendixes C and F. Assessments of effects from construction are provided in Section 4.6; associated assessments relative to operations are provided in Section 5.6. Cumulative effects are discussed in Section 7.5.

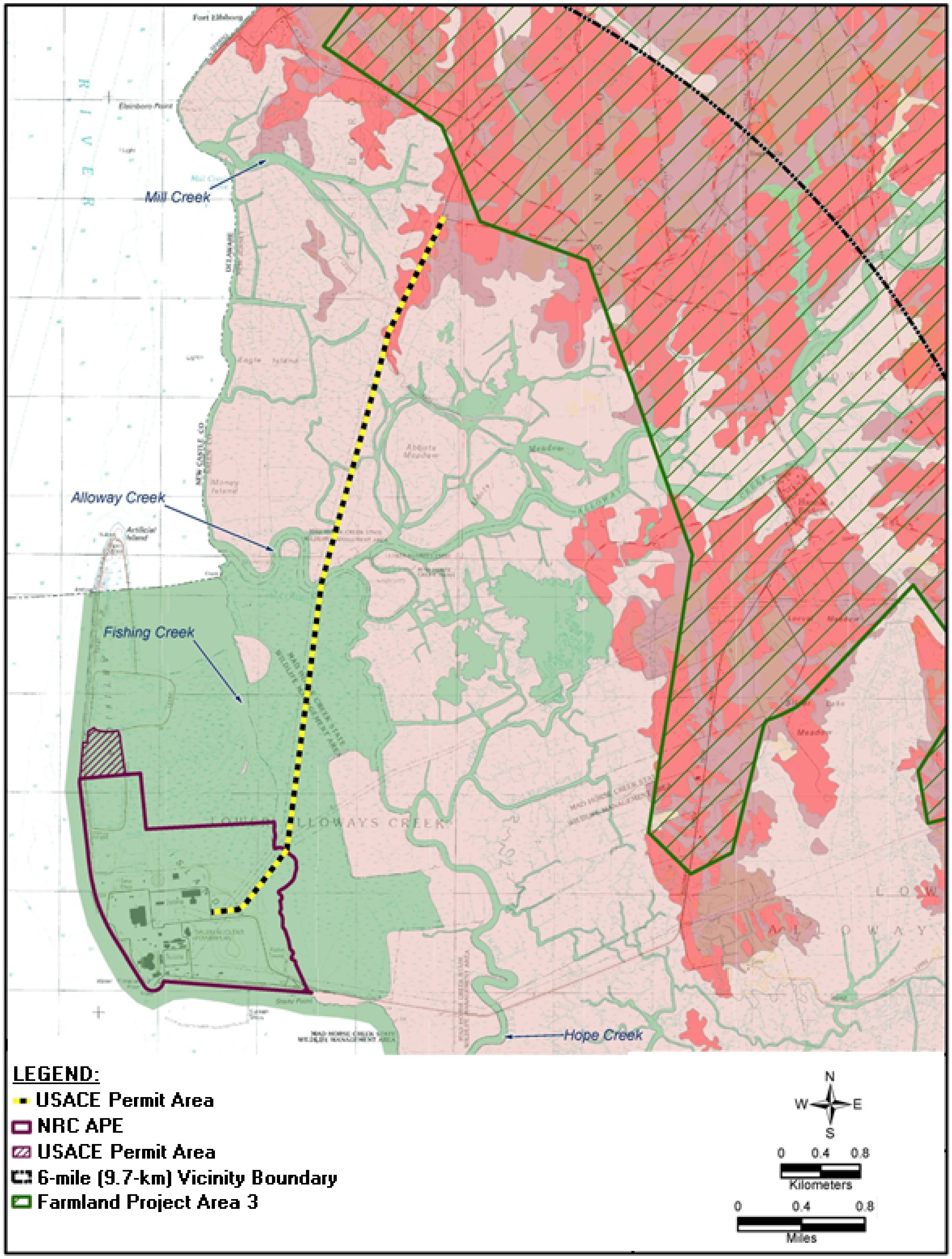

Figure 2-28. The USACE Permit Area and NRC Area of Potential Effect for Section 106 review. ***(Source: Modified from PSEG 2014-TN3452)***

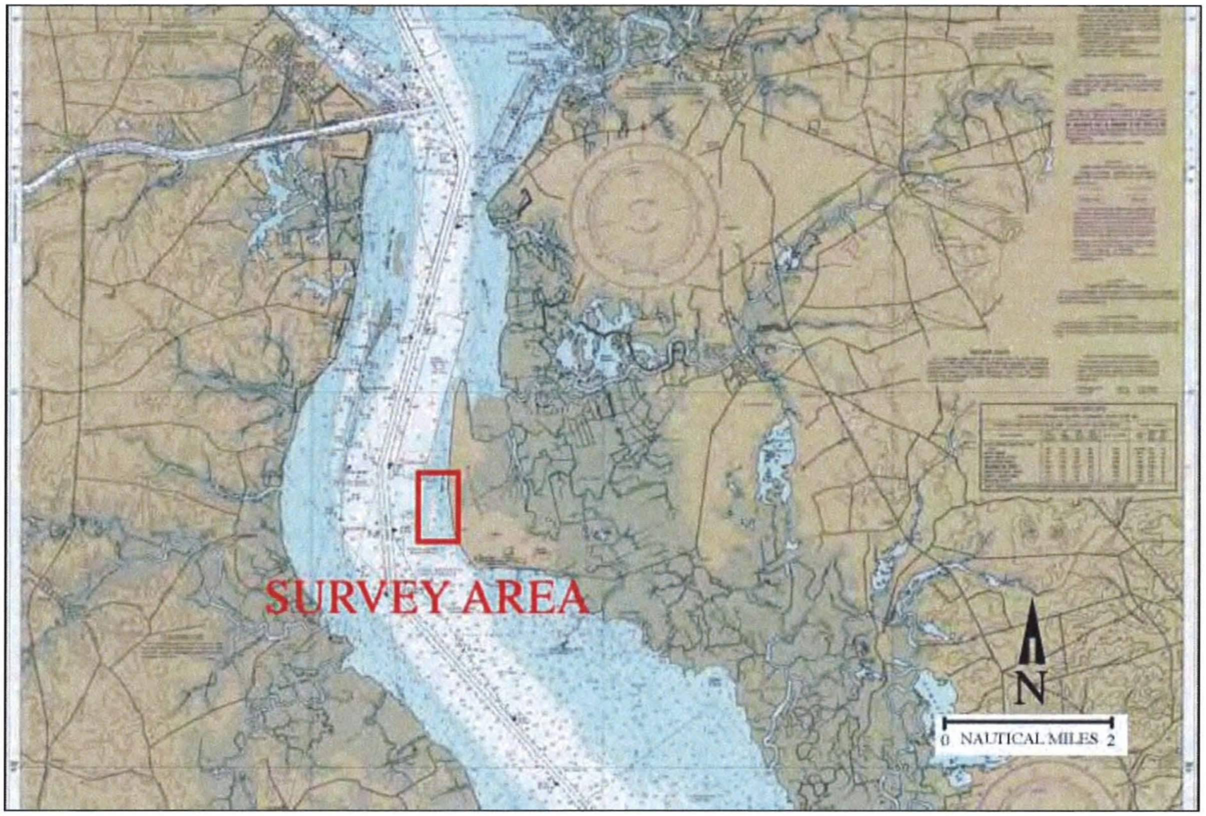

Figure 2-29. Underwater Portion of the USACE Permit Area.
(Source: PCI 2009-TN2544)

2.7.1 Cultural Background

This section provides an overview of the historic and cultural background of the PSEG Site and region, including the identification of historic properties and cultural resources within the APEs. The PSEG Site is located in Lower Alloways Creek Township, one of the nine townships in Salem County. The project area is located on Artificial Island, an island created by the USACE early in the 20th century. The island is an amalgamation of hydraulic dredge spoils. The PSEG Site is adjacent to the existing SGS/HCGS site on Artificial Island. A small portion of the north end of Artificial Island is within the State of Delaware.

Paleo-Indian Period

The first conclusive evidence of people in North America is associated with the Paleo-Indian Period, which dates from about 12000 BC to 8000 BC. This was a period of major climatic changes as the glacial conditions that persisted during the last age abated (ASNJ 2013-TN2399). Climatic conditions in New Jersey during this period would have been much cooler and wetter than today. Tundra and spruce/pine vegetation would have predominated (Chesler 1982-TN2398). During this period ocean levels were lower due to the large amounts of water trapped in the ice sheets that covered North America; therefore, New Jersey's coastlines were further out on the continental shelf than they are today. Paleo-Indian cultures are identified by the large fluted points associated with the Clovis culture that are found

throughout North America, including New Jersey. As the climate moderated toward the end of this period, people adapted their behavior to accommodate increasing population pressure, which resulted in more intensive use of game and plant life.

Archaic Period

The Archaic Period covers the 7,000-year period between about 8000 BC and about 1000 BC. Due to the extensive amount of time covered by the Archaic Period, it is often refined into the Early Archaic Period (around 8000 to 6500 BC), the Middle Archaic Period (around 6500 to 4000 BC), and the Late Archaic Period (4000 to 1000 BC). The division between the Early, Middle, and Late archaic periods is partially demarcated through changing spear and dart point styles. The environment during the Early Archaic was still transitioning away from the glacial conditions that previously existed. Glacial features such as frost thaw basins and pingos (upthrusts of ice and earth) still were found on the landscape and were used by early archaic peoples (ASNJ 2013-TN2399). In the Middle Archaic Period, temperatures continued to increase and the sea level rose accordingly. It is assumed that many of the coastal camps used by earlier peoples (Paleo-Indian and Early Archaic peoples) were inundated by the rising ocean during this period (ASNJ 2013-TN2399). Middle Archaic sites in New Jersey show evidence of more intensive use of food sources (ASNJ 2013-TN2399). The first evidence of use of an atlatl (a spear or dart thrower that increased the velocity of projectiles) appears during the Middle Archaic. By the Late Archaic Period (4000 to 1000 BC) environmental conditions became similar to modern conditions. The intensification of the use of food sources continued throughout this period and, presumably, population pressures also increased (ASNJ 2013-TN2399). Stones for grinding nuts are found in sites dating to this period. There is also evidence of seasonal exploitation of resources.

Woodland Period

The Woodland Period (1000 BC to AD 1000) is usually defined by the introduction of pottery, the first evidence of horticulture, and the bow and arrow. This 2,000-year period is also commonly divided by archaeologists into an Early (1000 BC to AD 1), Middle (AD 1 to 1000) and Late Woodland Period (AD 1000 to 1600). The Early Woodland Period is defined by the introduction of pottery. This period is characterized mainly by changes in pottery styles and projectile point styles (Mounier 2003-TN2716). The Middle Woodland is not well represented in New Jersey. An increase in permanent settlements occurred during the Late Woodland Period. Pottery styles become more localized, and cache pits for storing food are used more heavily (Mounier 2003-TN2716). More decorative pottery and ceramic pipes also are found associated with Late Woodland sites. The Late Woodland Period ends with the coming of Europeans to North America.

Contact Period

The Contact Period refers to when Europeans first arrived and interacted with Native American populations. New Jersey was first seen by Europeans sailing along the coast. In 1524 Giovanni da Verrazzano sailed past what would become New Jersey (Chesler 1982-TN2398). The local population at the time of contact was composed of Algonquian-speaking people called the Lenape (also known as the Delaware) by Europeans (Veit 2002-TN2715). Verrazzano was

followed in 1609 by Henry Hudson, who was exploring the area on behalf of the Dutch. The Dutch established a post at New Amsterdam (present-day New York City) in the 1610s. The first permanent European settlements in New Jersey were established by the Dutch in the 1620s.

Historic Period

The Dutch, Swedes and English all laid claim to the Delaware River; however, it was the English who eventually gained control. The colony of New Jersey was established in 1664. The colony was founded on principles of religious tolerance. Many of the earliest settlers in the colony were members of the Society of Friends, also known as Quakers. New Jersey was primarily a rural colony composed of agricultural communities (New Jersey 2013-TN2718).

During the American Revolution of the 1770s, New Jersey was a key location with more than 100 battles being fought in the state. After the war, New Jersey became the third state in the union in 1787. New Jersey became an industrial center with textiles, clay products, and iron and steel as the major industries (New Jersey 2013-TN2718). During the American Civil War, New Jersey fought to preserve the Union. After the war, the state continued on its course of industrialization. Immigration and industrialization led to issues of worker rights and inspired the election of progressive politicians, such as Woodrow Wilson, who was elected governor of New Jersey in 1910 and president of the United States in 1913. The Great Depression of the 1930s significantly affected the industrial base in New Jersey. However, during World War II the economy rallied with expansions in the electronics and chemical industries (New Jersey 2013-TN2718).

Salem County is located in the southwestern portion of the state and is bordered by the Delaware River on the west. Most of the land along the Delaware River is low tidal marshland. Some of the earliest European settlements in New Jersey were in Salem County because the county controlled the Delaware River. Fort Elfsborg was established by Swedish settlers south of the town of Salem in 1642 (Harrison 1988-TN2714). English control of the area was solidified in the 1660s to 1670s. The economy of Salem County revolved around timber, agriculture, and the shipping of materials between Philadelphia and New York. Salt hay was a major commodity for the region, where residents relied on the extensive system of meadow banks and dykes that made farming of the marshlands possible. Many of the patterned brick homes found in the region were constructed during these early agriculturally focused years. Glass works centered in Wistarburg were established in 1739 as one of the earliest industrial ventures in the region. These basic components of the local economy remained relatively uniform until the Americans introduced railroads into the area during the 1830s. At that point, the industrial presence in the region expanded. During the 19th and early 20th centuries, manufacturing, agriculture, and canning developed into the mainstays of the local economy. World War II saw a marked increase in chemical plants in southern New Jersey. The local economy remained consistent until the construction of the PSEG nuclear power plant in 1985 (Harrison 1988-TN2714).

2.7.2 Historic and Cultural Resources at the PSEG Site and Offsite Areas

The information presented in this section was collected from area repositories, the New Jersey SHPO, the NJSM, the Delaware SHPO, and the PSEG ER (PSEG 2014-TN3452). Historic

properties (resources eligible or potentially eligible for nomination to the NRHP) and other cultural resources identified as a result of these efforts are included in the discussion.

To identify the historic and cultural resources at the PSEG Site and the associated offsite areas, the staff reviewed the following information.

- PSEG Early Site Permit Application; Part 3, Environmental Report (PSEG 2014-TN3452).
- Historic Properties Visual Impact Assessment, PSEG Early Site Permit Application, Salem County, New Jersey, MACTEC Engineering and Consulting Inc., Dec. 2009, ML12290A159 (MACTEC 2009-TN2543).
- Draft Addendum to Historic Properties Visual Impact Assessment, PSEG Early Site Permit Application, Salem County, New Jersey, AKRF 2012, ML13310A546 (AKRF 2012-TN2876).
- Report of Phase I Archaeological Survey for Selected Portions of Two Access Road Alternatives, PSEG Early Site Permit Application, Salem County, New Jersey, MACTEC Engineering and Consulting Inc., Dec. 2009, ML12290A151 (PSEG 2009-TN2550) (nonpublic).
- New Jersey's Archaeological Resources, accessed on April 12, 2012. Available at http://www.state.nj.us/dep/hpo/1identify/arkeo_res.htm (Chesler 1982-TN2398).
- Submerged Cultural Resources Survey of a Proposed Barge Facility and Water Intake, PSEG Early Site Permit Environmental Review Delaware River, Salem County, New Jersey, Panamerican Consultants, Inc., Dec. 2009, ML12290A158 (PCI 2009-TN2544).
- NJAS (New Jersey Archaeological Society). 2013. New Jersey Archaeological Timeline. Available at http://www.asnj.org/p/resources.html (ASNJ 2013-TN2399).
- NRHP (National Register of Historic Places). 2013. National Register of Historic Places listings for Salem County, New Jersey. Available at http://www.nationalregisterofhistoricplaces.com/nj/Salem/state.html (NPS 2013-TN2400).
- Archaeological Investigation and Evaluation Sites 28SA179, 28SA180, 28SA182, and 28SA186, PSEG Early Site Permit Application for Salem County, New Jersey, AKRF April 2013, ML13252A317 (nonpublic) (AKRF 2013-TN2653).
- Submerge Cultural Resources Phase II Investigation of Three Anomaly Cluster Targets Located Within a Proposed Barge Facility and Water Intake Area, Delaware River, Salem County, New Jersey, February 2013, ML13252A319 (PCI 2013-TN2749).
- AKRF (AKRF Inc.), 2011, Field Verification of Key Resources at PSEG Alternatives Sites, prepared for PSEG, April 25. AKRF 2011-TN2869. (redacted)

Because of the limits placed on the agencies by their regulatory authorities, each agency is responsible for a distinct APE. The APE for the NRC consists of the PSEG Site on Artificial

Island, which would be the location of a new nuclear power plant, and the area affected by the visual impact of a new plant. The USACE permit area is that area that would be affected by the proposed causeway from Money Island Road to the PSEG Site and the area affected by dredging the Delaware River.

NJSM houses the archaeological site files for the State, and the New Jersey SHPO houses information on historic resources such as buildings and houses, including information concerning the National or State Register eligibility status of these resources. Online sources were used to identify properties listed in the NRHP in Salem County, New Jersey, and New Castle County, Delaware (NPS 2013-TN2400).

Twenty-three properties are listed on the NRHP in Salem County, New Jersey. The closest property to the PSEG Site is the Joseph Ware House, 3.54 mi to the northeast of the site.

NRC Area of Potential Effect

Artificial Island

Artificial Island is a 1,500-ac island created by the USACE beginning in the early 20th century. The island began as buildup of hydraulic dredge spoils within a progressively enlarged diked area established around a natural sandbar that projected into the river (NRC 2011-TN3131). A review of NJSM files shows that there are no previously recorded archaeological or above ground historic architectural resources identified on the PSEG Site. Because of the use of hydraulic fill to construct the island, intact archaeological deposits are considered unlikely within the fill material. PSEG reviewed the soil borings collected as part of a geotechnical investigation of the PSEG Site to determine if intact prehistoric soils were buried during the construction of Artificial Island. The soil borings reveal a soil stratigraphy consisting of 40 to 50 ft of hydraulic fill material overlying a rocky streambed deposit. The PSEG soil borings revealed no evidence to support the presence of buried prehistoric soils underneath Artificial Island (PSEG 2014-TN3452). The staff determined that there is no potential for intact archaeological material to be present on the PSEG Site. Therefore, the staff determined that there is no effect for the Artificial Island APE because there are no NRHP listed or eligible historic properties on Artificial Island.

Visual Resource Review from the Plant Structures

The NRC evaluated and consulted under Section 106 of the NHPA with the New Jersey and Delaware SHPOs on the impacts of the existing SGS and HCGS in the final environmental impact statement for license renewal for SGS and HCGS (NRC 2011-TN3131). The tallest structure on Artificial Island is the 514-ft tall HCGS natural draft cooling tower (NDCT), which can be seen from many miles away (particularly the cooling tower and the plume it produces). The existing SGS/HCGS complex can easily be seen from the marsh areas and the river itself, while in the more populated areas, it is often blocked by trees or houses and can be seen only from certain angles. In NUREG–1437 Supplement 45 for license renewal for SGS and HCGS, consultation resulted in a determination of no adverse effect to any property listed on or eligible for listing on the NRHP.

The NRC evaluated the visual impact analysis performed by PSEG for the ESP application. The analysis was aided by using the cooling tower for the existing HCGS. The PPE value for the height of the proposed cooling towers (590 ft) is higher than the existing towers (514 ft).

PSEG conducted two visual impact assessments for the project, and the applicable reports have been submitted to the New Jersey and Delaware SHPOs (MACTEC 2009-TN2543; AKRF 2012-TN2876). The assessments focused on NRHP-listed or eligible properties within 4.9 mi of the site and from which the PSEG Site would be visible. The visual impact analysis identified several historic properties located in the vicinity of the PSEG Site that have the potential to be visually affected by building and operating a new nuclear power plant at the site, including six NRHP-listed or eligible architectural resources in New Jersey and 18 in Delaware (see Table 2-37) (AKRF 2012-TN2876). Two potentially eligible resources were identified in New Jersey, and one was noted in Delaware (AKRF 2012-TN2876). Most of the resources identified were historic houses; however, the cooling tower on the PSEG Site would be visible from two historic districts in Delaware (Port Penn and Ashton historic districts). Additionally, one of the resources identified, the Abel and Mary Nicholson House in New Jersey, has National Historic Landmark (NHL) status.

USACE Permit Area

Money Island Access Road

The closest property to the proposed causeway is the Abel and Mary Nicholson House, less than 1 mi from the northern terminus of the causeway. The closest listed property in New Castle County, Delaware, is the Augustine Beach Hotel, 3 mi northwest of the project area.

The Phase I archaeological survey conducted by the applicant for the proposed causeway identified six archaeological sites (PSEG 2009-TN2550). The sites identified were 28SA179, 28SA180, 28SA181, 28SA182, 28SA183, and 28SA186. Sites 28SA179, 28SA180, 28SA181, 28SA182, and 28SA183 are all multicomponent sites containing both prehistoric material dating to the Archaic/Woodland Period and historic material dating to the 18th and 19th centuries. Site 28SA186 contains material only from the 18th and 19th centuries. The New Jersey Historic Preservation Officer stated the following in response to scoping comments: “If avoidance is not possible, Phase II archaeological survey will be necessary for each site to assess their eligibility for listing on the National Register of Historic Places.” (See Appendix D.)

Table 2-37. Historic Properties within the 4.9-mi Area of Potential Effect that are Visible from the PSEG Site

State	Property Name	Address	National Register of Historic Places Status
New Jersey			
	Samuel Union/Yerkes Farmstead	Lighthouse Road, Supawna National Wildlife Refuge	Eligible
	Nathaniel Chambless House	Alloway Creek Neck Road	Listed
	Ware–Shourds House	134 Poplar Street	Listed
	Abel and Mary Nicholson House	Junction of Hancocks Bridge and Fort Elfsborg Road	Listed, NHL
	Benjamin Holmes House	West of Salem on 410 Fort Elfsborg Road	Listed
	John Mason House	63 Money Island Road	Eligible
	Denn House	112 Poplar Street	Potential
	349 Fort Elfsborg Road House	349 Fort Elfsborg Road	Potential
Delaware			
	Short's Landing Hotel Complex	6180 Fleming Island Road, Northeast of Smyrna	Listed
	Port Penn Historic District	DE 9	Listed
	Liston Range Front Lighthouse	1600 Belts Road, Bay View Beach	Listed
	Augustine Beach Hotel	South of Port Penn on DE 9	Listed
	Reedy Island Range Rear Light	Junction of DE 9 and Road 453	Listed
	Ashton Historic District	North of Port Penn on Thornton Road, Port Penn	Listed
	Higgins Farm	Rt. 423, Oddessa	Listed
	Robert Grose House	1000 Port Penn Road, Port Penn	Listed
	Dilworth House	Off DE 9, Port Penn	Listed
	Commander Thomas MacDonough House	North of Odessa on US 13, Odessa	Listed
	Hill Island Farm	3379 DuPont Parkway (US 13)	Listed
	Hart House	East of Taylors Bridge on DE 453, Taylors Bridge	Listed
	Johnson Home Farm	County Road 453 East of junction with DE 9	Listed
	Liston House	East of Taylors Bridge on DE 453	Listed
	9 West Market	9 West Market Street, Port Penn	Eligible
	Elmer Bender House	7 West Market Street, Port Penn	Eligible
	Charles Hickman Dwelling Complex	5 West Market Street, Port Penn	Eligible
	David Corbit House	3 West Market Street, Port Penn	Eligible
	Riverdale	Off Bay View and Silver Run Rds., Odessa	Listed
	50 Cedar Swamp Road House	50 Cedar Swamp Road	Potential

The applicant conducted the Phase II survey and submitted it to the New Jersey SHPO (AKRF 2013-TN2653). The Phase II survey found that the limited portions of Sites 28SA179, 28SA180, 28SA182, and 28SA186 that could be affected by the proposed improvements to Money Island Road did not appear to possess sufficient integrity or significance to be considered individually eligible for the State or NRHP or to be considered eligible as contributing resources to either the Elsinboro–Lower Alloway Creek Rural Agricultural District or the John Mason House. The New Jersey SHPO recommends that additional work is necessary to for a determination to be made (NJDEP 2013-TN2742).

The visual impact on the Abel and Mary Nicholson House from the Money Island access road was evaluated. The applicant found that no visual impacts would result from the project to the Abel and Mary Nicholson House (AKRF 2012-TN2542). However, consultation among the USACE, the New Jersey SHPO, and PSEG is ongoing to determine the effects of the Money Island access road on historic properties.

Dredging Area

A Phase I survey was conducted in the submerged area off of Artificial Island that could be affected by dredging activities for the barge facility and the water intake area (PCI 2009-TN2544). This survey identified three locations that may represent shipwrecks. At the request of the New Jersey SHPO, the applicant conducted a Phase II survey and determined the material appears to be modern debris and of no historical significance (PCI 2013-TN2749). The New Jersey SHPO concurred by letter dated October 28, 2013 (NJDEP 2013-TN2742) (see Appendix C). The USACE has yet to issue its determination on the material found. Consultation with the USACE is ongoing.

2.7.3 Consultation

In October 2010, the NRC initiated consultation with the New Jersey and Delaware SHPOs, the Advisory Council on Historic Preservation, and the Native American tribes listed below. The letters informed the consulting parties that the NRC is coordinating compliance with Section 106 of the NHPA through NEPA. No Federally recognized tribes are located within the state of New Jersey. However, New Jersey and Delaware maintain lists of tribal groups that have an interest in the region. In acknowledgement of their interest in the region, the NRC has contacted the Cherokee Nation of New Jersey, the Ramapough Mountain Indians, The Delaware Nation, the Taino Tribal Council of Jatibonicu, the Powhatan Renape Nation, the Nanticoke Tribe Association, the Nanticoke Lenni-Lenape Indians of New Jersey, the Eastern Lenape Nation of Pennsylvania, the Eastern Delaware Nation, and Delaware Tribe of Indians, Oklahoma. All letters are presented in Appendix F. No responses to these letters were received from the Native American tribes.

The NRC conducted a public scoping meeting at Salem Community College in Carneys Point, N.J., on November 4, 2010. A comment was received regarding the new access road affecting the view shed of the historic 1722 Abel and Mary Nicholson brick house. The Swedish Colonial Society commented that it was their intention to discover the location of Fort Elfsborg, which had once stood in southern New Jersey along the Delaware River. Although the society stated that it does not appear that the Mill Creek area, where it is believed Fort Elfsborg was located, will be affected, the society requested a Phase 1 survey of the area to ensure that the Fort Elfsborg historical site is not impacted, compromised, or obliterated. The Mill Creek area where the

society believes Fort Elfsborg is located is west of Money Island Road. Those portions of Money Island Road that would be affected by the project were investigated during the archaeological survey conducted for that portion of the project. No evidence of Fort Elfsborg was discovered during the archaeological survey.

The New Jersey SHPO provided a comment during scoping that it was currently in consultation with the NRC and other interested parties, pursuant to Section 106 of the National Historic Preservation Act. The NRC also consulted with the Delaware SHPO. As discussed in the visual assessment section above, the applicant conducted two visual assessments. The Delaware SHPO reviewed the reports and issued a finding of "no adverse effect" for the PSEG ESP project on any properties listed on or eligible for listing on the NRHP (DDHCA 2013-TN2639) (see Appendix C). Consultation is completed with the Delaware SHPO. The New Jersey SHPO concurred that there will be no effects to historic properties from dredging in the Delaware River from the project (NJDEP 2013-TN2742). Likewise, the New Jersey SHPO concurred that there would be no adverse effects to historic properties from the visual intrusion of a new plant (NJDEP 2013-TN2870). Consultation between the NRC and the New Jersey SHPO is concluded for those portions of the project under the NRC's jurisdiction. Consultation between the New Jersey SHPO and the USACE is ongoing.

2.8 Geology

The PSEG ER (PSEG 2014-TN3452) provides a description of the geological, seismological, and geotechnical conditions at the PSEG Site. The site lies within the coastal plain physiographic province, which extends from the Fall Line eastward to the Atlantic Ocean. Through the Fall Line, the larger streams cascade off the resistant igneous and metamorphic rocks down to sea level. Large tidal rivers, such as the Delaware, flow southeastward across the coastal plain to the Atlantic Ocean. The topography of the coastal plain is a terraced landscape that gently stair-steps down to the coast and to the major rivers. The risers are former shorelines, and the treads are emergent bay and river bottoms. The higher, older plains in the western part of the coastal plain are more dissected by stream erosion than the lower, younger terrace treads. This landscape was formed over the last few million years as sea level rose and fell in response to the repeated melting and growth of large continental glaciers and as the coastal plain slowly uplifted (PSEG 2014-TN3452).

The New Jersey coastal plain is underlain by a thick wedge of sediments that increases in thickness from a feather edge near the Fall Line to more than 19,685 ft at the coast near Cape May, New Jersey. These sediments rest on an eroded surface of Precambrian to early Mesozoic rock. They range in age from Holocene at the surface to Cretaceous at depth (PSEG 2014-TN3452). The stratigraphic section for PSEG Site is shown in Figure 2-30. This figure details the geologic era, period, and epoch; stratigraphic unit; lithology; and hydrogeologic properties at the PSEG Site.

Era	Period	Epoch	Formation/Unit	Primary Lithologies	Geologic Conditions	Unit Thickness	Occurrence in Site Area
CENOZOIC	Quaternary	Holocene	Quaternary Marsh deposits	muck and peat; silt, sand and clay	aggradation of Delaware Bay estuary	variable thickness	present over most of the site area in low lying areas
			~~ unconformity ~~~~~~~~~~~				
		Pleistocene	DELAWARE: Delaware Bay Group: Scotts Corners Formation ~~ unconformity ~~ Lynch Heights Formation; NEW JERSEY: Cape May Formation	estuarine terrace deposits with coarse to fine sand and pebbles with concentrations of heavy minerals; peat; isolated fluvial deposits?	transgressive and regressive cycles	variable thickness	outcrops in eastern and western portions of the site area
			~~ unconformity ~~~~~~~~		regression and erosion		
	Tertiary	Upper Tertiary (Miocene)	Kirkwood Formation	clay silt and sand deposited in two or three marine cycles	polycyclic transgression and regression phases	90 feet at southern portions of site area; pinches out northward	subcrop only
			~~ unconformity ~~~~~~~~		regression and erosion		
		Lower Tertiary	Shark River Formation	glauconitic sand and mudstone	low sediment input	70 feet (Reference 2.6-10)	subcrop only
			~~ unconformity ~~~~~~~~		regression and erosion		
			Manasquan Formation	lower glauconitic member; upper clayey sand to silt member	low sediment input and bioturbation	40 feet (Reference 2.6-10)	subcrop only
			~~ unconformity ~~~~~~~~		regression and erosion		
			Vincentown Formation	quartz sand to quartz-rich calcareous sand with bryozoans and foraminifera	low sediment input and extreme bioturbation	90 feet (Reference 2.6-10)	outcrops in NW site area
			Hornerstown Formation	highly glauconitic sand with distinctive green color		30 feet (Reference 2.6-10)	
MESOZOIC	Cretaceous	Upper Cretaceous	Navesink	fossiliferous, clayey glauconitic sand	transgression to midshelf conditions	20 feet (Reference 2.6-10)	subcrop only
			Mount Laurel Formation	thinly bedded clays and sands with cross-bedding; thin pebbly sands	regressive pulse; low sediment input	100 feet (Reference 2.6-10)	subsurface only
			Wenonah Formation	clayey, silty, slightly glauconitic fine sand			
			Marshalltown Formation	intensely burrowed, very silty fine sand with glauconite	transgression; low sediment input	20 feet (Reference 2.6-10)	
			Englishtown Formation	micaceous silt to very fine sand	regressive pulse	25 feet (Reference 2.6-10)	
			Woodbury Formation	micaceous, chloritic, silty clay			
			Merchantville Formation	glauconitic sand to micaceous silty clay	transgression and establishment of widespread marine conditions; low sediment rates	120 feet (Reference 2.6-10)	
			Magothy Formation	beach and estuarine deposits of cross-bedded sand, with clay and silt layers; some lignite	transition to marine conditions	50 feet, pinches out north of site location (Reference 2.6-10)	
			~~ unconformity ~~~~~~~~		regression and erosion		
		Lower Cretaceous	Potomac Group (Formation)	white, gray and red interbedded silts, clays, and quartose sand	aggrading alluvial plain; thermal subsidence	800 to 1650 feet (Reference 2.6-10)	
			~~ pre-Cretaceous unconformity ~~~~~~~~		uplift and erosion		
			Basement Complex				
	Triassic	Upper Triassic	Triassic Basin?	Fanglomerates and lacustrine sediments; diabase volcanics	Amalgamation of Pangea followed by rifting to form North America	undetermined	
PRECAMBRIAN? PALEOZOIC?	Proterozoic? Paleozoic?	NeoProterozoic to Silurian?	Carolina Superterrane?	meta mafic to felsic plutons and volcanics with sediments, and ultramafic components			
			Philadelphia Terrane?	aluminous to quartz-rich schist with interbedded amphibolites (Wissahickon Formation) with ultramafic components; Wilmington Complex felsic to mafic arc complex			

Figure 2-30. Stratigraphic Section of the PSEG Site. ***(Source: PSEG 2014-TN3452)***

PSEG borings from the site identified 14 stratigraphic layers, most of which can be correlated to the regional geologic strata. The stratigraphic layers are grouped into the following four time periods according to geologic age (from oldest to youngest).

- Cretaceous (Lower and Upper)
- Paleogene (Lower Tertiary)
- Neogene (Upper Tertiary)
- Quaternary (Pleistocene and Holocene)

The Lower Cretaceous strata encountered during the geotechnical investigation at the PSEG Site is composed of a single unit, the Potomac Formation, which is recognized in only the deepest borings performed at the PSEG Site. This unit forms the base of the shallow subsurface (less than 500 ft) profile at the site. The borings at the PSEG Site were not deep enough to determine the depth of the Potomac Formation at the site (PSEG 2014-TN3452).

The Upper Cretaceous strata encountered during the geotechnical investigation at the PSEG Site is composed of the following eight formations, listed from oldest to youngest:

- Magothy Formation
- Merchantville Formation
- Woodbury Formation
- Englishtown Formation
- Marshalltown Formation
- Wenonah Formation
- Mount Laurel Formation
- Navesink Formation.

The Paleogene strata (Lower Tertiary) encountered during the investigation at the PSEG Site is composed of two formations, listed from oldest to youngest:

- Hornerstown Formation (Lower Tertiary and Upper Cretaceous)
- Vincentown Formation.

The Neogene strata (Upper Tertiary) encountered during the geotechnical investigation at the PSEG Site is composed of the Kirkwood Formation. The Kirkwood Formation is subdivided at the site into upper and lower units based on variations in lithology (PSEG 2014-TN3452).

The Quaternary stratum encountered at the PSEG Site is alluvium. The uppermost layer at the site is artificial and hydraulic fill. The thickness and depth to the tops of each layer and the hydraulic characteristics are discussed in Section 2.3 of this EIS.

2.9 Meteorology and Air Quality

The area surrounding the PSEG Site is a continental climate and includes extremes, but because of the proximity of the Delaware Bay, the site experiences a coastal marine influence. Elevations in the southwest portion of New Jersey are between sea level and 30.5 m (100 ft) above sea level. The southwest region of New Jersey is the warmest and driest part of the state. In the southwest region, prevailing winds vary depending on the orientation and distance to water bodies, except for the predominance of west-to-northwest (rotating clockwise) winds in winter. High humidity is common in this portion of New Jersey, and moderate temperatures prevail when winds flow from the south or the east. As described above, elevation variations at the southern end of the state, including the PSEG Site region, are minor. Therefore, the primary remaining factors that control local variation of the continental climate in the region are the moderating influences of the Delaware Bay and Atlantic Ocean (PSEG 2014-TN3453).

2.9.1 Climate

2.9.1.1 Wind

The PSEG Site lies within the very broad, midlatitude prevailing westerly wind belt. There is some variation of prevailing winds across southern New Jersey from the Atlantic Ocean shoreline to the Delaware River Valley. During the 2006 to 2008 period, the prevailing annual wind direction for the site was from the northwest (continental polar air mass) and accounted for about 11 percent of the time. There was also a secondary maximum from the southeast (Delaware Bay breeze), which accounted for about nine percent of the time. Winds from the northwest predominate during the winter months; southeasterly winds predominate followed by northwesterly winds during the spring months; and the winds from minor directions show somewhat higher frequencies than prevailing northwest–southeast directions during the summer and autumn months. No calm winds were recorded at the site because of the sensitivity of the onsite sonic wind sensor and the open exposure of the flat terrain and Delaware Bay (PSEG 2014-TN3453).

2.9.1.2 Temperature

The area surrounding the PSEG Site is characterized by normal and extreme temperatures based on 10 representative surrounding observation stations. The extreme maximum temperature recorded in the vicinity of the site is 108°F at the Marcus Hook, Pennsylvania, cooperative monitoring station 26 mi to the north–northeast of the PSEG Site. The extreme minimum temperature recorded in the vicinity of the site is -15°F at Millington, Maryland, located 23 mi to the southwest of the PSEG Site. Because of its location near the Delaware Bay, the PSEG Site typically experiences temperatures that are more moderate than the cooperative monitoring stations located farther inland (PSEG 2014-TN3453).

2.9.1.3 Atmospheric Water Vapor

Wet-bulb temperature, dew point temperature, and relative humidity data summaries were determined from the Wilmington, Delaware, National Weather Service (NWS) observation station to characterize the typical atmospheric moisture conditions near the PSEG Site.

For a 25-year period of record, the mean annual wet-bulb temperature was 48.9°F at the Wilmington, Delaware, NWS site. The highest monthly mean wet-bulb temperature was 69.0°F during July, and the lowest monthly mean wet-bulb temperature was 29.0°F during January. The mean annual dew point temperature was 44.6°F at Wilmington, which also reaches its maximum during summer and minimum during winter. The highest monthly mean dew point temperature was 66.1°F during July, and the lowest monthly mean dew point temperature was 24.1°F during January (PSEG 2014-TN3453).

Based on a 30-year period of record from the data recorded at the Wilmington, Delaware, NWS site, the relative humidity averages 68 percent on an annual basis. The average nighttime [at 0100 local standard time (LST)] relative humidity levels exceed 80 percent from June through October. Typically, the relative humidity values reach their diurnal maximum in the early morning (at 0700 LST) and diurnal minimum during the early afternoon (at 1300 LST) (PSEG 2014-TN3453).

2.9.1.4 Precipitation

Based on data from the surrounding monitoring stations, the mean annual total rainfall for the PSEG Site area ranges from 36.04 in. at the site to 46.28 in. at Dover, Delaware. The mean annual snowfall recorded at the surrounding stations ranges from 7.5 in. at Glassboro, New Jersey, located 26 mi to the northeast, to 19.3 in. at the Philadelphia International Airport located 30 mi to the north–northeast. Maximum recorded 24-hour snowfall of 30.7 in. was measured at the Marcus Hook monitoring station located approximately 26 mi north–northeast of the PSEG Site. The highest 24-hour rainfall total in the area was 11.68 in. on September 16, 1999, at the Marcus Hook, Pennsylvania, monitoring station. The highest monthly rainfall total in the site area was 16.13 in. recorded during September 1999 at the same monitoring station. The maximum monthly snowfall from records for regional stations is 40.0 in. at Hammonton, New Jersey, during February 1899 (PSEG 2014-TN3453).

The estimated weight of the 100-year return period ground level snowpack for the PSEG Site is approximately 24 lb/ft^2. The 48-hour probable maximum winter precipitation is 21 in. of water, which corresponds to 109 lb/ft^2 (PSEG 2014-TN3453).

2.9.1.5 Severe Weather

Thunderstorms and Lightning

On average, approximately 28 days with thunderstorm occurrences happen per year at the Wilmington, Delaware, reporting station. The majority of the storms recorded (73 percent) occurred between May and August. The frequency of lightning strikes to earth per square mile per year is approximately 8.6 for the PSEG Site and surrounding area. The power block area of a new nuclear power plant at the PSEG Site is an area of approximately 70 ac or 0.11 mi^2. Given the annual average lightning strike to earth frequency of 8.6 per mi^2/year, the frequency of lightning strikes in the power block area is about one strike per year (PSEG 2014-TN3453).

Extreme Winds

Basic wind speed is used for design and operating bases. Basic wind speed is defined by the American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) 7-05, "Minimum Design Loads for Buildings and Other Structures," as the "3-second gust wind speed at 33 ft (10 m) above the ground in Exposure Category C." Exposure Category C relies on the surface roughness categories as defined in Chapter 6, "Wind Loads," of ASCE/SEI 7-05. Exposure Category C is acceptable at the PSEG Site because of scattered obstructions of various sizes in the immediate site area. Exposure Category B specifies that there must be "urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger" prevailing "in the upwind direction for a distance of at least 2,600 ft (792 m) or 20 times the height of the building, whichever is greater." Neither Exposure Category B nor Exposure Category D accurately describes the conditions at the PSEG meteorological tower. The basic wind speed for the PSEG Site is 90 mph, based on the plot of basic wind speeds in Figure 6-1C of ASCE/SEI 7-05. Basic wind speeds reported for hourly weather monitoring stations in the site area are as follows: 100 mph for Dover Air Force Base, Delaware; 110 mph for Philadelphia, Pennsylvania; and 100 mph for Wilmington, Delaware. Therefore, the highest of the four basic wind speed values selected is 110 mph for the return period, which is determined by multiplying the 50-year return period value by a factor of 1.07, listed in ASCE/SEI 7-05. That approach produced a 100-year return period 3-second gust wind speed for the PSEG Site area of 117.7 mph (PSEG 2014-TN3453).

Tornadoes

Total tornadoes and waterspouts recorded in a surrounding 8-county area (New Castle and Kent in Delaware; Cumberland, Salem, and Gloucester in New Jersey; and Queen Anne's, Kent, and Cecil in Maryland) during a nearly 60-year period of record were 82 and 1, respectively. The strongest tornadoes found in the database for Salem County, New Jersey, were both rated F2. The first F2 tornado occurred on July 14, 1960, and damaged or destroyed several rural and residential structures. The tornado had a path length of 8 mi and a width of 450 yd. The second F2 tornado in Salem County occurred on August 17, 1988, and had a path length of 2 mi and a width of 400 yards. The strongest tornado found in the database for New Castle County, Delaware, is rated F3 and occurred on April 28, 1961. That storm damaged a warehouse and had a path length of 0.25 mi and a width of 30 yd (PSEG 2014-TN3453).

Per Regulatory Guide 1.76 (NRC 2007-TN3294), the site is located in tornado-intensity Region II, for which design-basis tornado characteristics are presented in the following. The maximum wind speed resulting from passage of a tornado having a probability of occurrence of 10^{-7} per year is 200 mph. The translation and rotation components of the maximum tornado wind speed are 40 mph and 160 mph, respectively. The distance from the center of the tornado at which the maximum rotational wind speed occurs is 150 ft. The maximum pressure drop from normal atmospheric pressure resulting from passage of the tornado is 0.9 psi, and the rate of pressure drop is 0.4 psi/s (PSEG 2014-TN3453).

Hail, Snowstorms, and Ice Storms

Hail can accompany severe thunderstorms and can be a major weather hazard, causing significant damage to crops and property. Hail events have increased significantly over time, primarily as a result of increased reporting efficiency and confirmation skill. This increase in hail reports is also likely caused by the increased number of targets because of urbanization. This is because there are more targets damaged by hail in urban areas than in rural areas. Estimates of hail size can range widely based on the surrounding area's population density and the years considered. The NOAA "Climate Atlas of the United States" was used to estimate that the annual mean number of days with hail 1.0 in. or greater in diameter is approximately 0.5 per year at the PSEG Site. During the 60-year period covered in the NOAA reference, large hail events (i.e., those with hail having a diameter greater than 1.75 in.) occurred on three occasions each in Salem County, New Jersey, and New Castle County, Delaware (PSEG 2014-TN3453).

On average during the period from 1961 to 1990, snowfall occurred at the PSEG Site and within the surrounding area during 2.5 to 5.4 days per year. Freezing precipitation occurred in the site area on an average of 5.5 to 10.4 days per year. Annual snowfall is highly variable across the region and ranges from 10 in. to 50 in. Occasionally, these snow events are accompanied by, or alternate with, sleet and freezing rain as the weather system moves over the area. As discussed in Section 2.9.1.4, the largest recorded daily snowfall for the site climate region is 30.7 in. at Marcus Hook, Pennsylvania, on January 8, 1996. The highest monthly total of 40.0 in. occurred at Hammonton, New Jersey, during February 1899 (PSEG 2014-TN3453).

Freezing precipitation events in Salem County, New Jersey, and New Castle County, Delaware, indicate that freezing precipitation events tend to occur each year. Based on the period of 1950 through the winter of 2008–2009, the maximum thicknesses of ice accumulation are typically 0.1 or 0.2 in. The maximum observed ice thickness in the two counties was approximately 0.5 in. (PSEG 2014-TN3453).

Tropical Cyclones

According to the National Hurricane Center online historical database, between 1851 and 2008, 109 tropical cyclone centers passed within a 115-mi radius of the PSEG Site. Of the 109 tropical cyclone centers, 31 were extra-tropical depressions, 9 were tropical depressions, 60 were tropical storms, 6 were Category 1 hurricanes, and 3 were Category 2 hurricanes (PSEG 2014-TN3453). Tropical cyclones have occurred within this area as early in the year as May and as late as November. The highest frequency of storms occurs during September (PSEG 2014-TN3453).

Most recently, Hurricane Sandy came through the PSEG Site in Salem County on October 29, 2012, bringing heavy rain and wind and causing severe flooding throughout New Jersey, Delaware, New York, and nearby areas. This storm resulted in PSEG workers requiring several days to restore power caused by damage to transmission systems (Gopinath 2012-TN3375).

2.9.1.6 Atmospheric Stability

Stability class is based on the HCGS and SGS onsite primary meteorological tower 150–33 ft vertical temperature difference (delta-T), and winds are based on 33-ft level measurements (PSEG 2014-TN3453). Table 2.3-27 in the PSEG SSAR (PSEG 2014-TN3453) provides the annual mean joint frequency distributions of wind direction and wind speed versus Pasquill atmospheric stability class for the period 2006 to 2008. Atmospheric stability is a critical parameter for estimating atmospheric dispersion characteristics.

There is a predominance of slightly stable (Pasquill stability class E) and neutral (Pasquill stability class D) conditions at the proposed PSEG Site. Extremely unstable conditions (Pasquill stability class A) occur about 12 percent of the time, while extremely stable conditions (Pasquill stability class G) occur about 7 percent of the time. Based on past experience with stability data at various sites, a predominance of slightly stable (Pasquill stability class E) and neutral (Pasquill stability class D) conditions at the proposed PSEG Site is generally consistent with expected meteorological conditions (PSEG 2014-TN3453).

2.9.2 Air Quality

The discussion of air quality includes the six common "criteria pollutants" for which the EPA has set National Ambient Air Quality Standards (NAAQS) (EPA 2011-TN1975): ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$, which are particulate matter with a mean aerodynamic diameter of less than or equal to 10 microns and 2.5 microns, respectively), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb). The air quality discussion also includes heat-trapping greenhouse gases (GHGs), primarily carbon dioxide (CO_2), which have been the principal factor causing climate change over the last 50 years (GCRP 2014-TN3472).

The EPA designated the entire state of New Jersey as nonattainment for the 8-hour ozone NAAQS (NJDEP 2013-TN2493). Every county in New Jersey is part of a multi-state nonattainment area, separated into northern and southern counties. The northern New Jersey counties are part of the New York–Northern New Jersey–Long Island (NY-NJ-CT) nonattainment area, and the southern New Jersey counties are part of the Philadelphia-Wilmington-Atlantic City (PA-NJ-MD-DE) nonattainment area (NJDEP 2013-TN2493). The PSEG Site is located in Salem County, New Jersey. Salem County is in the PA-NJ-MD-DE nonattainment area for 8-hour O_3 NAAQS [40 CFR 81.331 (40 CFR 81-TN255)] and administratively in the Metropolitan Philadelphia Interstate Air Quality Control Region [40 CFR 81.15 (40 CFR 81-TN255)]. With the exception of the 8-hour ozone NAAQS, air quality in Salem County is in attainment with or better than national standards for criteria pollutants. Emissions from new sources in attainment areas are evaluated by the State of New Jersey through the Prevention of Significant Deterioration program. In nonattainment areas, the emissions of pollutants that are precursors to O_3 are regulated by the State of New Jersey. The primary precursors to O_3 are oxides of nitrogen (NO_x) and volatile organic compounds (VOCs). In the State of New Jersey, evaluation of new sources in nonattainment areas is through the nonattainment New Source Review Program (NJAC 7:27-TN3290).

New Castle County, Delaware, is located to the north and west of the PSEG Site. New Castle County is in attainment for all criteria pollutants except the 8-hour ozone and

$PM_{2.5}$ NAAQS, which are in the PA-NJ-MD-DE and the Philadelphia-Wilmington (PA-NJ-DE) nonattainment areas, respectively [40 CFR 81.308, (40 CFR 81-TN255)].

The closest mandatory Class 1 Federal area to the PSEG Site is Brigantine Wilderness Area at the Edwin B. Forsythe National Wildlife Refuge north of Brigantine, New Jersey, about 60 mi east of the PSEG Site [40 CFR 81.420, (40 CFR 81-TN255)]. Federal Class I areas are afforded additional protection under Section 169A of the Clean Air Act for visibility criteria.

Climate changes are under way in the United States and globally, and their extent is projected to continue to grow substantially over the next several decades unless concerted measures are taken to reverse this trend. Climate-related changes include rising temperatures and sea levels; increased frequency and intensity of extreme weather (e.g., heavy downpours, floods, and droughts); earlier snowmelts and associated frequent wildfires; and reduced snow cover, glaciers, permafrost, and sea ice. Climate changes are closely linked to increases in GHGs (GCRP 2014-TN3472). GHGs are transparent to incoming short-wave radiation from the sun but are opaque to outgoing long-wave (infrared) radiation from the earth's surface. The net effect over time is a trapping of absorbed radiation and a tendency to warm the earth's atmosphere, which together constitute the "greenhouse effect." Since the onset of the Industrial Revolution in the mid-1700s, human activities have contributed to the production of GHGs, primarily through the combustion of fossil fuels (such as coal, oil, and natural gas) and deforestation. The principal GHGs that enter the atmosphere because of human activities include CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. However, some GHGs such as CO_2, CH_4, and N_2O are emitted to the atmosphere through natural processes as well.

2.9.3 Atmospheric Dispersion

Projected Air Quality

Generation of electricity at a new nuclear power plant at the PSEG Site would not be a source of criteria or toxic pollutants. However, supporting equipment such as cooling towers, auxiliary boilers, emergency diesel generators, and/or combustion turbines would emit criteria pollutants. Air quality impacts of these sources are discussed in Section 5.7. Impacts of air emissions during development of the PSEG Site are discussed in Section 4.7.

Restrictive Dispersion Conditions

Stagnation conditions, which restrict the atmospheric dispersion and can contribute to pollution episodes, occur at the PSEG Site approximately 11 days per year (PSEG 2014-TN3453). The potential for air pollution also is related to atmospheric mixing heights and wind speeds through the mixing layer (Holzworth 1972-TN3024). Table 2-38 summarizes approximate mean seasonal and annual morning and afternoon mixing heights. Lowest morning mixing heights occur during summer, and highest morning mixing heights occur during winter. Afternoon mixing heights are lowest during winter and highest during summer. Lowest mean wind speeds occur during summer mornings, while highest mean wind speeds occur during spring afternoons.

Table 2-38. Mean Seasonal and Annual Morning and Afternoon Mixing Heights and Wind Speeds at the PSEG Site

Parameter	Winter	Spring	Summer	Autumn	Annual
Morning Mixing Height (m)	825	750	600	725	700
Morning Wind Speed (mph)	18.5	15.1	10.1	12.3	12.9
Morning Wind Speed (m/s)	8.3	6.8	4.5	5.5	5.8
Afternoon Mixing Height (m)	1,000	1,650	1,700	1,250	1,350
Afternoon Wind Speed (mph)	18.5	19.0	13.4	15.7	16.8
Afternoon Wind Speed (m/s)	8.3	8.5	6.0	7.0	7.5

Source: PSEG 2014-TN3452.

Short- and Long-Term Dispersion Estimates for Criteria Pollutants from Power Plant Operation

Atmospheric dispersion consists of two components: (1) atmospheric transport due to organized or mean wind flow in the atmosphere and (2) atmospheric diffusion due to disorganized or random air movements. The magnitude of the atmospheric dispersion is a function of the wind speed, wind direction, and atmospheric stability class. The lower the alphabetic atmospheric class designation (Class A) in *NRC Regulatory Guide* 1.145 (NRC 1983-TN279), the more unstable the atmosphere and the more rapid the atmospheric dispersion. The air quality analyses for emissions from supporting facilities (boilers, diesel generators, etc.) are described in Section 5.7.

2.9.3.1 Short-Term Dispersion Estimates

PSEG calculated short-term dispersion estimates using 3 years of onsite meteorological data (January 1, 2006, through December 31, 2008). These estimates were based on distances to the exclusion area boundary (EAB) and outer boundary of the low population zone (LPZ) as defined in Section 2 of the ER (PSEG 2014-TN3452).

The NRC staff's short-term dispersion estimates for use in design basis accident calculations are listed in Table 2-39. They are based on the PAVAN computer code (Bander 1982-TN538) calculations of 1-hour and annual average atmospheric dispersion (χ/Q) values from a joint frequency distribution of wind speed, wind direction, and atmospheric stability. These values were calculated for the shortest distances from a release boundary envelope that encloses the PSEG Unit 1 or Unit 2 release points to the EAB and to the LPZ. The 50-percent EAB χ/Q value listed in Table 2-39 is the median 1-hour χ/Q, which is assumed to persist for 2 hours. The 50-percent LPZ χ/Q values listed in Table 2-39 were determined by logarithmic interpolation between the median 1-hour χ/Q, which was assumed to persist for 2 hours, and the annual average χ/Q following the procedure described in Regulatory Guide 1.145 (NRC 1983-TN279).

Table 2-39. Atmospheric Dispersion Factors for Proposed Units 1 and 2 Design Basis Accident Calculations

Time Period[a]	Boundary	χ/Q (s/m^3)
0 to 2 hr	Exclusion Area Boundary	9.82×10^{-5}
0 to 8 hr	Low Population Zone	1.37×10^{-6}
8 to 24 hr	Low Population Zone	1.06×10^{-6}
1 to 4 days	Low Population Zone	6.16×10^{-7}
4 to 30 days	Low Population Zone	2.82×10^{-7}

(a) Times are relative to beginning of the release to the environment.

Source: NRC Confirmatory Calculations.

2.9.3.2 Long-Term Dispersion Estimates

Long-term dispersion estimates for use in evaluation of the radiological impacts of normal operations were calculated by PSEG using the XOQDOQ computer code (Sagendorf et al. 1982-TN280) and 3 years of onsite meteorological data (January 1, 2006, through December 31, 2008) (PSEG 2014-TN3453). This code implements the guidance set forth in Revision 1 of Regulatory Guide 1.111 (NRC 1977-TN91) for estimation of χ/Q and deposition factors (D/Q) for use in evaluation of the consequences of normal reactor operations. The results of the PSEG calculations are presented in Table 2-40 for receptors of interest, including the nearest point of the EAB, the LPZ, the nearest residence, the nearest milk cow, the nearest milk goat, the nearest meat animal, and the nearest vegetable garden.

Table 2-40. Maximum Annual Average Atmospheric Dispersion (χ/Q) and Deposition Factors (D/Q) for Evaluation of Normal Effluents for Receptors of Interest

			χ/Q (s/m^3)			
Receptor	Downwind Sector	Distance (mi)	No Decay Undepleted	2.26-Day Decay Undepleted	8-Day Decay Depleted	D/Q (1/m^2)
Nearest Site Boundary	ENE	0.24	1.0×10^{-5}	1.0×10^{-5}	9.5×10^{-6}	4.1×10^{-8}
Nearest Meat Animal[a]	NW	4.90	1.1×10^{-7}	1.1×10^{-7}	8.2×10^{-8}	3.5×10^{-10}
Nearest Milk Producing Animals[a][b]	NW	4.90	1.1×10^{-7}	1.1×10^{-7}	8.2×10^{-8}	3.5×10^{-10}
Nearest Residence	NW	2.80	2.4×10^{-7}	2.4×10^{-7}	1.9×10^{-7}	9.6×10^{-10}
Nearest Vegetable Garden[a]	NW	4.90	1.1×10^{-7}	1.1×10^{-7}	8.2×10^{-8}	3.5×10^{-10}

(a) Meat animals, milk producing animals, and vegetable gardens are assumed to exist at the closest farm.
(b) Goats are assumed to be the milk producing animal.

Source: PSEG 2014-TN3453.

2.9.4 Meteorological Monitoring

The PSEG Site consists of 819 ac located on the southern part of Artificial Island on the east bank of the Delaware River. The existing PSEG meteorological tower is located due east of SGS and southeast of the proposed location of the power block for a new nuclear power plant at the PSEG Site. The surrounding terrain is essentially mixed marsh, cropland, and woodland with only an occasional grouping of low trees. Distances between the existing meteorological tower and significant features in the area are as follows (PSEG 2014-TN3453):

- 5,470 ft southeast of the power block area for a new nuclear power plant at the PSEG Site,
- at least 4,500 ft from the SGS and HCGS reactor buildings,
- 4,700 ft southeast of the existing 512-ft tall NDCT at HCGS,
- 6,800 ft southeast of the cooling towers for a new nuclear power plant at the PSEG Site, and
- about 1,180 ft due north of the closest portion of the Delaware Bay.

The PSEG Site is located on Artificial Island, a man-made portion of land that is relatively flat (Figure 2-31). There are no discernible changes in elevation or vegetation near the meteorological tower that would adversely affect meteorological measurements. The elevation of the meteorological tower is 11.9 ft NAVD. The site grade elevation for a new nuclear power plant at the PSEG Site is expected to be 36.9 ft (PSEG 2014-TN3453).

The meteorological tower is a 300-ft guyed, triangular, open-lattice tower with a solid cement base. As shown in Figures 2-32 and 2-33, instrumentation booms extend outward into the prevailing wind, which is from the northwest. The sensors are mounted on the booms at distances equal to more than twice the tower maximum horizontal width. Ground cover around the tower is light colored gravel surrounded by low lying marsh land. There are no trees of any consequence in the tower vicinity (PSEG 2014-TN3453).

PSEG maintains a backup meteorological tower consisting of a 33-ft utility pole (seen in foreground of Figure 2-32). This backup tower is located 386 ft south of the primary tower and is surrounded by vegetation and gravel similar to that surrounding the primary tower (PSEG 2014-TN3453).

Instrumentation

The instrumentation on the existing meteorological tower is as follows (PSEG 2014-TN3453).

- 300-ft level—wind speed and direction, sigma theta, 300 – 33 ft delta temperature, dry bulb temperature, relative humidity
- 197-ft level—wind speed and direction, sigma theta, 197 – 33 ft delta temperature
- 150-ft level—wind speed and direction, sigma theta, 150 – 33 ft delta temperature

- 33-ft level—wind speed and direction, sigma theta, dry bulb temperature, dew point temperature, relative humidity
- surface—barometric pressure, precipitation, solar radiation
- backup tower (33 ft)—wind speed and direction, sigma theta

The meteorological monitoring system uses a Met One instrumentation package and data recording system located in a 12-ft high meteorological building adjacent to the tower, as seen in Figure 2-32. The data recording system is a state-of-the-art digital system with displays in the meteorological building. The wind speed and direction and sigma theta sensors are Met One 50.5H Sonic Wind Sensors, while the temperature sensors are Met One Model 060A-2 thermistors. Delta temperature measurements are recorded by matched pairs of Met One Model 062MP instruments. The dew point measurements are made by an Edge Tech 200M Chilled Mirror Sensor at the 33-ft level. The precipitation measurements are made at ground level by a Met One Model 375 Tipping Rain/Snow Gauge (PSEG 2014-TN3453). See Table 2-41 for instrumentation specifications.

Figure 2-31. View of SGS and HCGS Looking West-Northwest from the Existing PSEG Meteorological Tower Unit. ***(Source: NRC staff photograph)***

Figure 2-32. Existing PSEG Meteorological Tower and Meteorological Building with Backup Meteorological Tower in Foreground.
(Source: NRC staff photograph)

Figure 2-33. Close-up View of 33-ft Instrument Boom (dew-point sensor can be seen near top left corner of image; dry-bulb temperature, wind speed, wind direction, and delta-temperature instruments are at the end of the boom on the right side of the image). ***(Source: NRC staff photograph)***

Data Recording

Tower sensors are digitally sampled once per second. Fifteen minute and hourly averages are calculated and stored in separate 15-min and hourly average files. Precipitation is totaled hourly. The hourly data are stored to be later used in χ/Q and dose assessment calculations (PSEG 2014-TN3453).

Instrument Maintenance

Full system calibrations are done on a 3-month basis. These calibrations include everything from the meteorological sensors to the data acquisition system. Wind sensors are swapped out and returned to Met One for a wind tunnel calibration on an annual basis (during every fourth calibration) (PSEG 2014-TN3453).

Table 2-41. Existing PSEG Meteorological Instrumentation Performance Specifications

Parameter	Sensor	Range	Threshold	Accuracy	Resolution
Wind Speed	Met One Model 50.5H Sonic Wind Sensor	0 to 111.8 mph	0.22 mph (0.1 m/s)	±0.33 mph for < 11 mph ±2.0% for > 11 mph	0.1 mph
Wind Direction	Met One Model 50.5H Sonic Wind Sensor	0–360°	0.22 mph (0.1 m/s)	±3°	1.0°
Sigma Theta	Met One Model 50.5H Sonic Wind Sensor	–	–	–	1.0° (0.1° for upgraded equipment)
Ambient Temperature	Met One Model 060A-2	–58°F to +122°F (–50°C to +50°C)	–	±0.2°F (±0.1°C)	0.2°F (0.1°C)
Dew Point	Edge Tech 200M Chilled Mirror Sensor	–103°F to +140°F (–75°C to +60°C)	–	±0.50°F (±0.25°C)	0.2°F (0.1°C)
Delta-Temperature	Met One Model 062MP	–5°C to 10°C	–	±0.02°C for matched sets; Up to ±0.1ºC for 15ºC max delta-T	0.02°F (0.01°C)
Barometric Pressure	Met One Model 090D	26 to 32 in. Hg	–	–	0.01 in.
Precipitation	Met One Model 375 Tipping Rain/Snow Gauge	0.00 to 1.00 in./hr	–	±1% at 1 to 3 in./hr	0.01 in.
Solar Radiation	Met One Model 95	0.00 to 2.00 Langleys	–	–	0.01 Langley

Source: PSEG 2014-TN3453.

The maximum height of influence of a structure wake generally does not exceed 2.5 times the structure height for a squat building (width greater than height) such as the meteorological building at the base of the primary meteorological tower. The meteorological building is 12 ft high. Based on that height, the upper limit of the meteorological building aerodynamic wake will not exceed a height of 30 ft, which is below the height of the lowest 33 ft wind measurements on the primary tower. Therefore, the meteorological building aerodynamic wake does not affect meteorological tower wind measurements. Additionally, the 10:1 distance/height ratio criterion does not apply to the meteorological building because its height (12 ft) does not exceed one half the height of the lowest wind measurement (33 ft).

Overall, the topography (including raising the grade for a portion of the site) and existing and new plant structures in the vicinity of the onsite meteorological towers are not expected to

adversely affect meteorological measurements. Similarly, vegetation and minor structures in the vicinity of the meteorological towers, such as the meteorological building, will not adversely affect meteorological measurements.

2.10 Nonradiological Health

This section describes aspects of the environment at the PSEG Site and the vicinity of the site associated with nonradiological human health impacts. The section provides the baseline for evaluation of impacts to human health from building and operating a new nuclear power plant at the PSEG Site. Building activities have the potential to affect public and occupational health, create impacts from noise, and impact health of the public and workers from transportation of construction materials and workers to the building site. Operation of a new plant has the potential to impact the public and workers at the PSEG Site from operation of the cooling system; noise generated by operations; electromagnetic fields (EMF) generated by transmission systems; and transportation of operations and outage workers to and from the site.

2.10.1 Public and Occupational Health

This section describes public and occupational health at the PSEG Site and vicinity associated with air quality, occupational injuries, and etiological agents (i.e., disease-causing microorganisms).

2.10.1.1 Air Quality

Public and occupational health can be impacted by changes in air quality from activities that contribute to fugitive dust, vehicle and equipment exhaust emissions, and automobile exhaust from commuter traffic (NRC 1996-TN288). Air quality near the PSEG Site is discussed in Section 2.9.2. As discussed in that section, Salem County, New Jersey, and New Castle County, Delaware, are designated as attainments area for all criteria pollutants except 8 hour ozone. New Castle County also is in nonattainment for $PM_{2.5}$. Fugitive dust and other particle material (including PM_{10} and $PM_{2.5}$) can be released into the atmosphere during any site excavations and grading. Most of the activities that generate fugitive dust would be short in duration, cover a small area, and controllable using watering, application of soil adhesives, seeding, and other best management practices employed by PSEG (PSEG 2014-TN3452).

Exhaust emissions during normal plant operations associated with onsite vehicles and equipment as well as from commuter traffic can affect air quality and human health. Nonradiological supporting equipment (e.g., diesel generators, fire pump engines), and other nonradiological emission-generating sources (e.g., storage tanks) or activities at the PSEG Site are not a significant source of criteria pollutant emissions. Diesel generators and supporting equipment would be in place for emergency use only but would be started regularly to test that the systems are operational. Emissions from nonradiological air pollution sources are permitted by the Clean Air Act and the New Jersey Department of Environmental Protection (NJDEP).

2.10.1.2 Occupational Injuries

In general, occupational health risks to workers and onsite personnel engaged in activities such as building, maintenance, testing, excavation, and modifications are expected to be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) or occupational illnesses. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates, with a 2009 average incidence rate of 0.6 per 100 workers (BLS 2010-TN2427). The annual incidence rates (the number of injuries and illnesses per 100 full-time workers) for the State of New Jersey and the United States for electrical power generation, transmission, and distribution workers are 3.9 and 3.6, respectively (BLS 2010-TN2428; BLS 2010-TN2731). These statistics are used to estimate the likely number of occupational injuries and illnesses for operation of the existing SGS and HCGS and to predict the likely number of cases for a new nuclear power plant at the PSEG Site.

Occupational injury and fatality risks are reduced by strict adherence to the NRC and Occupational Safety and Health Administration (OSHA) safety standards, practices, and procedures required to minimize worker exposures. Appropriate state and local statutes also must be considered when assessing the occupational hazards and health risks associated with the PSEG Site. Currently, the existing PSEG Site has programs and personnel to promote safe work practices and respond to occupational injuries and illnesses at SGS and HCGS. PSEG has implemented procedures at SGS and HCGS providing personnel who work at the existing plants with an effective means of preventing accidents due to unsafe conditions and unsafe acts. They include safe work practices to address hearing protection; personal protective equipment; electrical safety; chemical handling, storage, and use; and other industrial hazards. In addition, personnel are provided with training on safety procedures (PSEG 2014-TN3452).

2.10.1.3 Etiological Agents

Public and occupational health can be compromised by activities at the PSEG Site that encourage the growth of disease-causing microorganisms (etiological agents). Thermal discharges from the water circulation system at a new nuclear power plant to the Delaware River have the potential to increase the growth of thermophilic microorganisms. The types of organisms of concern for public and occupational health include enteric pathogens (such as *Salmonella* spp., *Shigella* spp., and *Pseudomonas aeruginosa*), thermophilic fungi, bacteria (such as *Legionella* spp.), and free-living amoeba (such as *Naegleria fowleri* and *Acanthamoeba* spp.). These microorganisms could give rise to potentially serious human health concerns, particularly at high exposure levels.

Available data assembled by the Centers for Disease Control and Prevention (CDC) for the years 2000 to 2010 (CDC 2002-TN2444; CDC 2002-TN2438; CDC 2003-TN2437; CDC 2004-TN2435; CDC 2004-TN2436; CDC 2005-TN2442; CDC 2006-TN2445; CDC 2006-TN2441; CDC 2007-TN2440; CDC 2008-TN2439; CDC 2008-TN557; CDC 2010-TN2447; CDC 2011-TN2446; CDC 2011-TN2448; CDC 2011-TN558; CDC 2012-TN2378; CDC 2013-TN2377) were reviewed for outbreaks of Legionellosis, Salmonellosis, or Shigellosis. Outbreaks that occurred in Delaware or New Jersey from 2000 to 2010 were within the range of national trends in terms of cases per 100,000 population or total cases per year, and the outbreaks were associated with pools, spas, or lakes. The Salem County Department of Health and the New Jersey and

Delaware state health agencies have not recorded any major waterborne disease outbreaks in the Delaware River in proximity to the PSEG Site (PSEG 2014-TN3453). The CDC Council of State Territorial Epidemiologists *Naegleria* Work Group, after reviewing the data from different sources, identified 123 fatal cases of primary amebic meningoencephalitis (PAM, caused by *Naegleria fowleri*) in the United States between 1962 and 2011; most cases occurred in southern states during the months of July and September (CDC 2013-TN2375).

2.10.2 Noise

Any pressure variation that the human ear can detect is considered as sound, and noise is defined as unwanted sound. Sound is described in terms of amplitude (perceived as loudness) and frequency (perceived as pitch). Sound pressure levels are typically measured by using the logarithmic decibel (dB) scale A-weighting (denoted by dBA) (ASA 1983-TN2836; ASA 1985-TN2837). The dBA measure, which is widely used to account for human sensitivity to frequencies of sound (i.e., less sensitive to lower and higher frequencies and most sensitive to sounds between 1 and 5 kHz), correlates well with a human's subjective reaction to sound. Several sound descriptors have been developed to account for variations of sound with time. L90 is the sound level exceeded 90 percent of the time, called the residual sound level (or background level) or fairly steady lower sound level on which discrete single sound events are superimposed. The equivalent continuous sound level (Leq) is a sound level that, if it were continuous during a specific time period, would contain the same total energy as a time-varying sound. (Unless designated otherwise, all sound levels are instantaneous or Leq values measured over short time periods, such as one minute.) In addition, human responses to noise differ depending on the time of the day (e.g., higher sensitivity to noise during nighttime hours because of lower background noise levels). The day-night average sound level (Ldn or DNL) is a single dBA value calculated from hourly Leq over a 24-hour period, with the addition of 10 dBA to sound levels from 10 p.m. to 7 a.m. to account for the greater sensitivity of most people to nighttime noise. Generally, a 3-dBA change over existing noise levels is considered to be a "just noticeable" difference, while a 10-dBA increase is subjectively perceived as a doubling in loudness and almost always causes an adverse community response (ASA 1983-TN2836; ASA 1985-TN2837).

The noise around the PSEG Site is typical of a commercial operation in a mostly rural area because there are no schools, businesses, or commercial buildings within 5 mi of the site (PSEG 2014-TN3452). The primary operational noise sources associated with SGS and HCGS and a new nuclear power plant at the PSEG Site are the switchyard, transformers, and cooling towers [NDCTs, mechanical draft cooling towers (MDCTs), and fan-assisted NDCTs]. Fan-assisted NDCTs are continuous noise sources during plant operation, with an estimated noise emission of 60 A-weighted decibels (dBA) at 1,000 ft. The estimated noise emissions for the MDCTs and NDCTs are 58 and 50 dBA at 1,000 ft, respectively (PSEG 2014-TN3453). These operational noises mix with those from traffic, residential activities, and natural sources. While noise is diminished by distance, foliage, and geographic features, it will be attenuated much less over water.

In 2009, PSEG conducted a baseline noise survey and concluded that the noise from sources at SGS and HCGS met the New Jersey and Delaware industrial standards of 65 dBA for daytime at the PSEG Site property boundary (PSEG 2014-TN3452). Based on natural attenuation of

noise over distance, noise levels estimated for the onsite cooling towers at a new plant at the PSEG Site would not exceed the Delaware and New Jersey nighttime noise standards of 55 and 50 dBA, respectively, at the property boundary of the nearest residence. The estimated fan-assisted NDCT noise level at 10,000 ft is 41 dBA, with the nearest residences located 14,700 ft to the west and 15,900 ft to the east (PSEG 2014-TN3452).

2.10.3 Transportation

The transportation network surrounding the PSEG Site consists of access roads for SGS and HCGS, New Jersey state and county highways, and a railway. Most traffic is personal vehicle and over-the-road tractor/trailer transport. Plant workers from the surrounding areas primarily travel toward SGS and HCGS on a variety of interstate, state, and secondary roads where they converge on the existing access road, which is the only land access to the existing PSEG property (PSEG 2014-TN3452). A new plant at the PSEG Site would have an additional 4.8-mi causeway to the north-northeast that would connect with CR 672 (PSEG 2014-TN3453). The construction and operations workforces for a new plant would be expected to use this causeway instead of the existing PSEG property access road. A new plant would also have direct access to the Delaware River via a barge unloading facility.

Preconstruction and construction activities for a new nuclear power plant at the PSEG Site could have impacts to traffic patterns along roadways and intersections in the Salem County area. In 2009, PSEG conducted a traffic impact analysis to determine improvements to mitigate traffic problems (including potential traffic accidents) associated with increased traffic volume during development of a new nuclear power plant, as the traffic volume is projected to increase to approximately 2,200 cars during building and to 1,200 cars during operation and refueling outages (PSEG 2014-TN3452). It is anticipated that installation of traffic controls and additional turn lanes as part of the preconstruction and construction activities would improve the overall traffic patterns during building of a new plant as well as afterwards when traffic volume supports operations and refueling activities (PSEG 2014-TN3452).

2.10.4 Electromagnetic Fields

Transmission lines generate both electric and magnetic fields, referred to collectively as EMFs. Public and worker health can be compromised by acute exposure to electrical sources associated with power transmission systems, including switching stations (or substations) on the site and transmission lines connecting the plant to the regional electrical distribution grid. Transmission lines operate at a frequency of 60 Hz (60 cycles per second), which is considered to be extremely low frequency (ELF). In comparison, television transmitters have frequencies of 55 to 890 MHz, and microwaves have frequencies of 1,000 MHz and greater (NRC 1996-TN288). The existing transmission corridors from the PSEG property are described in Section 3.2.2.2. HCGS and SGS are interconnected with the regional power grid via four transmission lines extending to the Red Lion substation in Delaware and the New Freedom substation in New Jersey as part of the PJM power grid. PSEG has evaluated transmission requirements, and a new offsite transmission line may be needed, dependent upon the specific reactor technology selected and other transmission projects planned within the PJM regional transmission system.

Electric shock resulting from direct access to energized conductors or from induced charges in metallic structures is an example of an acute effect from EMF associated with transmission lines (NRC 1996-TN288). Objects near transmission lines can become electrically charged by close proximity to the electric field of the line. An induced current can be generated in such cases, where the current can flow from the line through the object into the ground. Capacitive charges can occur in objects that are in the electric field of a line, storing the electric charge, but insulated from the ground. A person standing on the ground can receive an electric shock from coming into contact with such an object because of the sudden discharge of the electrical charge through the person's body to the ground. Such acute effects are controlled and minimized by conformance with the National Electrical Safety Code (NESC) of the Organization of PJM States, Inc. (OPSI), which organizes the statutory regulatory agencies in the 13 states and District of Columbia where PJM operates transmission systems.

Long-term or chronic exposure to power transmission lines have been studied for a number of years. These health effects were evaluated in NUREG–1437, which concluded

> "The chronic effects of electromagnetic fields (EMFs) associated with nuclear plants and associated transmission lines are uncertain. Studies of 60-Hz EMFs have not uncovered consistent evidence linking harmful effects with field exposures. EMFs are unlike other agents that have a toxic effect (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be forced and longer-term effects, if real, are subtle. Because the state of the science is currently inadequate, no generic conclusion on human health impacts is possible" (NRC 1996-TN288).

2.11 Radiological Environment

A radiological environmental monitoring program (REMP) has been conducted around HCGS and SGS since operations began in 1977 (SGS Unit 1), 1981 (SGS Unit 2), and 1986 (HCGS). This program measures radiation and radioactive materials from all sources, including the SGS Unit 1 and SGS Unit 2 PWRs and the HCGS Unit 1 BWR. The REMP includes the following exposure pathways: direct (dosimeters), airborne (iodine and particulates), waterborne (surface water and groundwater, drinking water, and sediment), and ingestion (milk, vegetation, fish, and invertebrates). A pre-operational environmental monitoring program was conducted from 1973 to 1976 to establish a baseline to observe fluctuations of radioactivity in the environment after operations began (PSEG 2014-TN3452). After routine operation of SGS Unit 1 started in 1977, SGS Unit 2 started in 1981, and HCGS started in 1986, the monitoring program continued to assess the radiological impacts to workers, the public, and the environment. The results of this monitoring are documented in the annual environmental operating report for HCGS and SGS titled *2011 Annual Radioactive Effluent Release Report for the Salem and Hope Creek Generating Stations* (PSEG 2012-TN2724). Administrative controls and physical barriers are in place to monitor and minimize dose from the operational independent spent fuel storage installation (ISFSI).

During an 8-year period from 2004 to 2012, PSEG reported the annual direct radiation exposure [annual thermoluminescent dosimeter (TLD) readings] at the three conservative locations close to unrestricted areas ranged from 41.2 to 63.0 mrem for the existing PSEG Site

(PSEG 2005-TN2725; PSEG 2006-TN2726; PSEG 2007-TN2728; PSEG 2008-TN2747; PSEG 2009-TN2730; PSEG 2010-TN2737; PSEG 2011-TN2738; PSEG 2012-TN2724). Trending graphs in the 2012 *Annual Radioactive Effluent Release Report* show the annual total body doses due to liquid and gaseous effluents from SGS and HCGS released in the years 2007 to 2012 were equal to or less than approximately 0.16 mrem (liquid) and equal to or less than 0.011 mrem (gaseous) (PSEG 2012-TN2724).

As part of the REMP, PSEG evaluated the maximum dose to a member of the public each year using effluent concentration and historical meteorological data for the existing PSEG Site. For the 8 years reviewed, the maximum annual total body doses to a member of the public from operation of SGS Units 1 and 2 and HCGS Unit 1 were approximately 1.13 mrem/year inside the site boundary (2006) and 0.99 mrem/year outside the site boundary (2005) (PSEG 2006-TN2726; PSEG 2007-TN2728). These data show that doses to the maximally exposed individuals around the existing PSEG Site were a small fraction of the limits specified in Federal environmental radiation standards (10 CFR 20-TN283; 10 CFR 50-TN249; Appendix I; and 40 CFR 190-TN739).

In September 2002, SGS personnel found evidence of contaminated water leakage through a wall into the Unit 1 Auxiliary Building Mechanical Penetration Room (NRC 2006-TN1000). Upon further investigation, it was determined that the contamination was due to SGS Unit 1 Spent Fuel Pool water that had leaked into a narrow seismic gap between SGS Unit 1 Auxiliary Building and SGS Unit 1 Fuel Handling Building and then had entered the Mechanical Penetration Room. The root cause for the leakage was determined to be the drain system for the SGS Unit 1 spent fuel pool: the drain system had become obstructed, resulting in a buildup of contaminated water between the spent fuel pool liner and the concrete structure. This water then migrated through a wall and penetrations.

As discussed in the *U.S. Nuclear Regulatory Commission's Lessons Learned Task Force Report* (NRC 2006-TN1000) and PSEG's ER (PSEG 2014-TN3452), the SGS Unit 1 licensee (PSEG) initiated several actions to remediate and monitor the migration of spent fuel pool water to the groundwater, such as

- initiated drilling wells;
- identified tritium contamination in nonpotable groundwater near the SGS Unit 1 fuel handling building in February 2003;
- initiated an extensive groundwater sampling program to fully characterize the contamination (maximum tritium levels of 15,000,000 pCi/L were identified in the groundwater near the seismic gap);
- established in 2004, in conjunction with the State of New Jersey, the Remedial Investigation Work Plan, an extensive groundwater remediation program that includes ongoing remediation of the seismic gap (PSEG 2014-TN3452); and
- by December 2005, extracted about 1.6 Ci of tritium with approximately 2–4 Ci remaining to be extracted.

PSEG's evaluations did not identify any immediate health and safety consequences to onsite workers or members of the public (NRC 2006-TN1000). No contamination is believed to have migrated to the unrestricted area. The remediation efforts have created an in-gradient of water, causing the water to flow toward the plant instead of offsite. No other plant-related radionuclides have been identified in the groundwater.

The *U.S. Nuclear Regulatory Commission's Lessons Learned Task Force Report* (NRC 2006) made recommendations regarding potential unmonitored groundwater contamination at U.S. nuclear plants. In response to that report, the Nuclear Energy Institute (NEI) developed the Ground Water Protection Initiative (NEI 2007-TN1913). Based on the NEI guidance, PSEG initiated the RGPP in 2006 (PSEG 2014-TN3452). The status of the RGPP was reported in PSEG's annual Radiological Environmental Operating Reports through 2011 and is now included as Appendix C of PSEG's Annual Radiological Effluent Release Reports to fully comply with the NEI guidance (PSEG 2014-TN3452). While approximately 15 RGPP wells had occasional tritium levels above the lower limit of detection of approximately 300 pCi/L (PSEG 2014-TN3452), the detected tritium concentrations were far below the EPA drinking water standard of 20,000 pCi/L (41 FR 28402-TN2746).

2.12 Related Federal Projects and Consultation

This section describes Federal activities within the 50-mi region that could warrant consideration along with the building and operation of a new nuclear power plant at the PSEG Site as part of a cumulative effects analysis in accordance with 40 CFR 1508.25 (40 CFR 1508-TN428). This section does not include a description of the existing HCGS and SGS, as the environmental effects of these facilities and their ongoing operations are included as part of the baseline conditions characterized earlier in this chapter. Relevant information regarding the operations of the existing HCGS and SGS plants is discussed further in the cumulative impact analysis in Chapter 7 of this EIS.

According to the guidance in NUREG–1555 (NRC 1999-TN614), Federal project activities meeting the following criteria should be identified and described:

- project activities related to the acquisition and/or use of the site and transmission corridors or of any other offsite property needed for the proposed project
- project activities required either to provide an adequate source of plant cooling water or to ensure an adequate supply of cooling water over the operating lifetime of the plant
- project activities completed as a condition of plant construction or operation
- project activities that result in significant new power purchases within the applicant's service area that have been used to justify the need for power
- planned Federal projects that are contingent on the new plant construction and operation.

According to the guidance in NUREG–1555 (NRC 1999-TN614), the identification of other Federal activities related to the granting of licenses, permits, or other approvals by other Federal

agencies is not included as these activities are subject to their own independent environmental review process.

There are two Federal project activities identified within the region:

- the USACE Delaware River Main Channel Deepening
- the proposed land exchange between the USACE and PSEG involving a portion of the USACE Artificial Island CDF that abuts the northern boundary of the existing PSEG property.

USACE Delaware River Main Channel Deepening

The USACE actively maintains the Federal shipping/navigation channel in the Delaware River and Bay to a depth of approximately 40 ft, specific to the various reaches of the channel. In 1992, the USACE completed a feasibility study for deepening the Delaware Bay and River main channel from 40 ft to 45 ft. This feasibility study found that the proposed deepening project was environmentally sound, economically justified, and technically feasible. As a result of the feasibility study findings, Congress authorized the proposed channel deepening project. Since 1992, there have been additional authorized modifications to the project. The USACE issued an additional supplemental EIS in 1997 (USACE 1997-TN2281) and EAs in 2009 and 2011 (USACE 2009-TN2663; USACE 2011-TN2262). A Project Partnership Agreement was signed by the USACE and the Philadelphia Regional Port Authority in 2008.

The deepening project would affect a stretch of the Delaware Bay and Delaware River extending from the Philadelphia Harbor (including Camden, New Jersey) to the mouth of the Delaware Bay. The deepening project follows the existing 40-ft-deep Federal main shipping channel alignment. No change is proposed to the existing authorized widths in the straight portions of the channel, including the 400-ft-wide channel in Philadelphia Harbor, the 800-ft-wide channel from the Philadelphia Navy Yard to Bombay Hook, and the 1,000-ft-wide channel from Bombay Hook to the mouth of the Delaware Bay. However, 11 of the 16 existing bends in the channel will be widened for safer navigation. In addition, the Marcus Hook Anchorage will be deepened to 45 ft (USACE 1997-TN2281; USACE 2009-TN2663; USACE 2011-TN2262).

The USACE estimates that 16 million yd^3 of material may be dredged as part of this project. The dredged material from the river portion will be placed within existing Federal upland CDFs in New Jersey and Delaware (USACE 2011-TN2262).

Project activities in the vicinity of a new nuclear power plant at the PSEG Site include deepening the main channel and widening two bends on the Delaware side of the river. Following the completion of the deepening project, normal channel maintenance dredging operations will help ensure the new channel configuration. The discharge and intake structures for a new nuclear power plant at the PSEG Site would not be located in areas that will be dredged by the USACE as part of its deepening project and/or impact the Federal shipping/navigation channel.

The environmental impacts of the deepening project and associated follow up maintenance dredging are discussed as part of cumulative impacts in Chapter 7 of this EIS.

Proposed Land Exchange Between the USACE and PSEG

The USACE owns approximately 305 ac of land north of the existing PSEG property that are used as a CDF for dredge material from Delaware River channel maintenance operations. This CDF, known as the Artificial Island CDF, is composed of three cells, and the southernmost cell abuts the northern boundary of the existing PSEG property. This cell is used intermittently and currently consists of fill material that is overgrown by common exotic, invasive reed (*Phragmites australis*) (PSEG 2014-TN3452).

PSEG has developed a plant layout for a new nuclear power plant that would use this previously disturbed CDF and limited adjoining marsh areas as part of its plant facility and construction area. PSEG has developed an agreement in principle with the USACE to acquire an additional 85 ac immediately north of HCGS (see Section 2.2 and Figure 2-3). Therefore, with the land acquisition, the entire PSEG Site would be 819 ac. Subsequent to the agreement in principle with the USACE, PSEG would develop a lease agreement for an additional 45 ac of USACE CDF land north of the PSEG Site for the concrete batch plant and temporary construction/ laydown use. At the completion of construction, the 45 ac of leased land would be returned to the USACE, subject to any required long-term EAB control conditions (PSEG 2014-TN3452). The environmental impacts of the PSEG land acquisition and lease from the USACE are assessed as part of cumulative impacts in Chapter 7 of this EIS.

3.0 SITE LAYOUT AND PLANT PARAMETER ENVELOPE

The PSEG Power, LLC, and PSEG Nuclear, LLC (PSEG) Site for which an early site permit (ESP) application has been submitted is located adjacent to the existing Hope Creek Generating Station (HCGS) and Salem Generating Station (SGS), Units 1 and 2, in Lower Alloways Creek Township, Salem County, New Jersey. The PSEG Site is located on the southern part of Artificial Island on the east bank of the Delaware River, about 15 mi south of the Delaware Memorial Bridge, 18 mi south of Wilmington, Delaware, 30 mi southwest of Philadelphia, Pennsylvania, and 7.5 mi southwest of Salem, New Jersey.

Of the 819-ac PSEG Site, PSEG owns 734 ac as part of the existing HCGS-SGS site. PSEG has developed an agreement in principle with the U.S. Army Corps of Engineers (USACE) to acquire through a land exchange an additional 85 ac of the USACE Artificial Island Confined Disposal Facility (CDF) land immediately north of HCGS. Therefore, with the land acquisition, the PSEG Site would total 819 ac. Also, during plant construction PSEG would temporarily lease from the USACE 45 ac of the CDF land north of the proposed site as the location of the concrete batch plant and a construction/laydown area.

This chapter describes the approach PSEG used to identify the key plant parameters and site characteristics needed to assess the environmental impacts of the proposed action (PSEG 2014-TN3452). The external appearance and plant layout are discussed in Section 3.1; plant parameters and construction and preconstruction activities are discussed in Sections 3.2 and 3.3, respectively; and operational activities are discussed in Section 3.4.

3.1 External Appearance and Site Layout

The PSEG Site is located adjacent to the existing HCGS and SGS, Units 1 and 2 (Figures 2-2 and Figure 3-1). The site is located on the southern part of Artificial Island on the east bank of the Delaware River in Lower Alloways Creek Township, Salem County, New Jersey. Artificial Island was created, beginning early in the twentieth century, when the USACE began disposing of hydraulic dredge spoils within a progressively enlarged diked area established around a natural bar that projected into the river. The existing HCGS-SGS site is generally developed, and surrounding habitats are best characterized as tidal marsh and grassland. Figure 3-1 provides an aerial photograph of the existing PSEG property, and the PSEG Site is located in the undeveloped area to the left of the HCGS unit and cooling tower in the figure.

SGS consists of two pressurized water reactors (PWRs), each with a rated power level of 3,459 MW(t) generating capacity. Unit 1 began producing electricity in 1976, and Unit 2 began producing electricity in 1980. HCGS is located just north of SGS and has a single 3,840 MW(t) boiling water reactor (BWR) nuclear plant. HCGS was originally designed as a two-unit plant, but during the construction phase the project was scaled back to one unit. HCGS began operation in 1986.

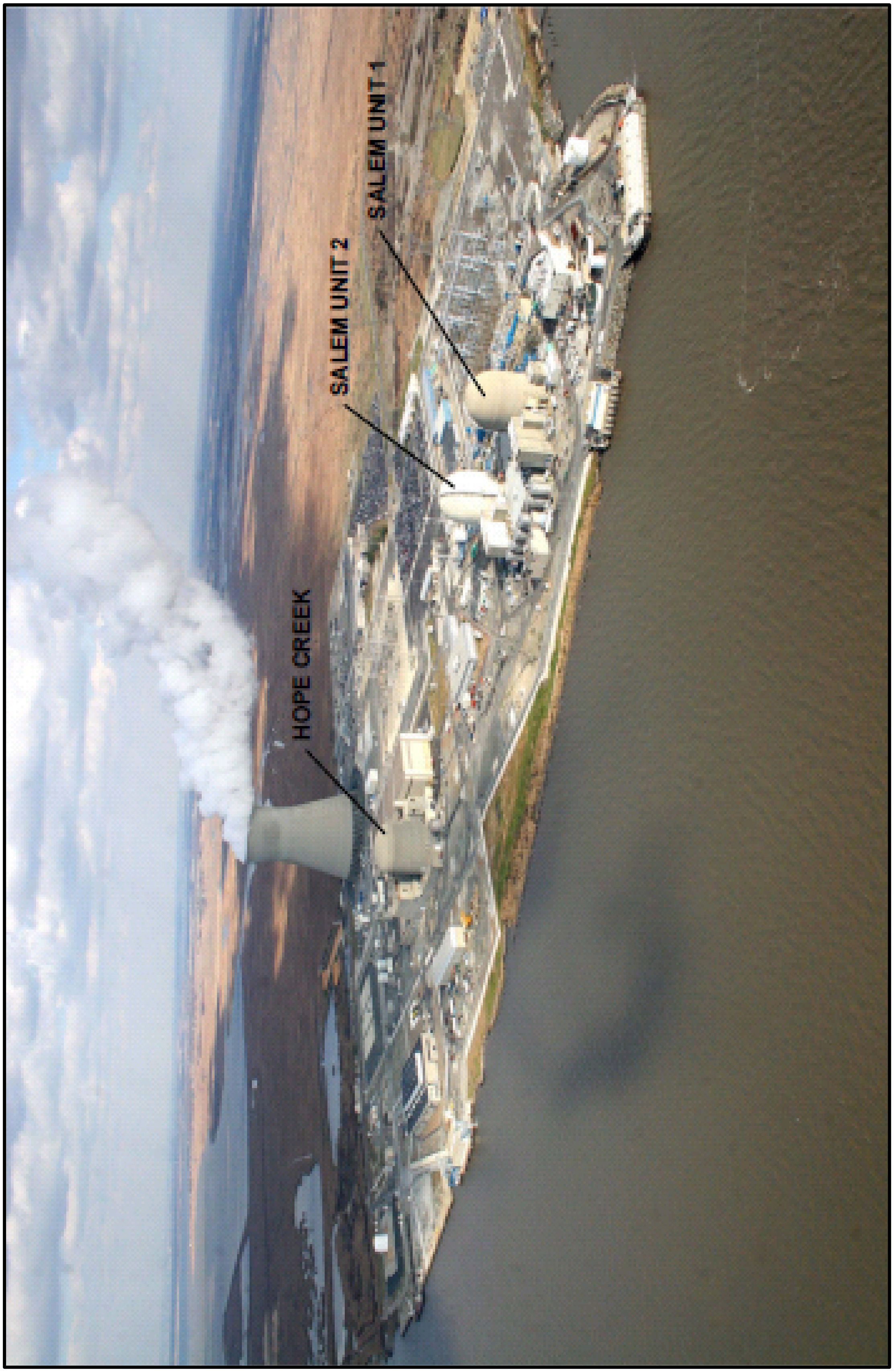

Figure 3-1. Existing Salem Generating Station and Hope Creek Generating Station Site.
(Source: Modified by staff from PSEG 2014-TN3452)

The existing PSEG property totals 734 ac, of which 373 ac are used for HCGS (153 ac) and SGS (220 ac). The minimum distance from the SGS reactor containment buildings to the nearest exclusion area boundary (EAB) formed by land is 1,270 m (4,166 ft). The minimum distance from the HCGS accident release point to the nearest EAB formed by land is 900 m (2,953 ft).

Both SGS units have steel-lined concrete containment vessels consisting of a reinforced concrete cylindrical wall, a hemispherical dome, and a reinforced concrete base. Supporting structures include a common auxiliary building, service building, turbine generator building, administration building, circulating and service water intake structures, station switchyard, and separate fuel handling buildings for each unit.

The HCGS primary containment is a steel shell enclosed in reinforced concrete interconnected to a torus type steel suppression chamber. Supporting structures for HCGS include an auxiliary building, turbine building, administration building and warehouse, service water intake structure, switchyard, and natural draft cooling tower (NDCT).

The PSEG Site is located adjacent to HCGS and SGS. A new nuclear power plant would require about 225 ac as delineated in the PSEG Site Utilization Plan, included in this environmental impact statement (EIS) as Figure 2-2. As discussed in Section 3.0, PSEG has developed an agreement with the USACE to acquire an additional 85 ac directly north of the current PSEG property line. Therefore, with the existing 734 ac and the 85-ac land acquisition, the PSEG Site would total 819 ac.

For purposes of the ESP application, a specific plant design has not been selected; instead, a set of plant parameter values was chosen for the staff evaluation of the development of the PSEG Site. This plant parameter envelope (PPE) is based on the addition of one or two new power generating units. Table I-2 in Appendix I of this EIS lists the PPE values used by the staff. PSEG states that the reactor types considered in developing the PPE are the Advanced Boiling Water Reactor (ABWR), Advanced Passive 1000 (AP1000), U.S. Evolutionary Power Reactor (U.S. EPR), and U.S. Advanced Pressurized Water Reactor (US-APWR) (PSEG 2014-TN3452).

This EIS analyzes the environmental impacts at the PSEG Site of building and operating a surrogate reactor derived from the parameters of four reactor technologies: U.S. EPR, ABWR, US-APWR, or AP1000. Because a specific reactor technology has not been selected, the environmental impact analyses in this EIS are based on reactor bounding conditions derived from detailed reactor information supplied by the vendors to PSEG and not on any specific reactor design. For this EIS, the total bounding PPE value for the new plant is 6,830 gross MW(t) and 2,200 MW(e).

The proposed plant location and layout on the PSEG Site are shown in the PSEG Site Utilization Plan (Figure 2-2). The EAB minimum distance of 600 m (1,970 ft) is measured from the perimeter of the power block envelope. The PSEG Site Utilization Plan was prepared by first establishing site layouts for each of the four reactor technology configurations considered for the site. The primary power generation areas (power block area, switchyard, cooling tower area, etc.) would be located in the same general area on the site for each layout considered.

Once the layouts were established, the bounding footprint for each specific area (e.g., power block area) was developed by determining the maximum east/west and north/south dimensions. For example, to define the power block area, the east/west dimension of the U.S. EPR and north/south dimension of the dual unit AP1000 were used to establish the power block rectangle area. This approach provides a bounding estimate of overall land use on the PSEG Site.

Permanent land impact is indicated on the PSEG Site Utilization Plan in Figure 2-2 as a crosshatched area. The land that would be used during construction is indicated by diagonal hatching. The specific areas used for permanent and construction support features would not be defined until after a reactor technology is selected but would be within the overall established PSEG Site Utilization Plan boundary.

The new plant power block structure height would vary depending upon the reactor design chosen. The bounding structure height (excluding any cooling towers) from finished grade to the top of the tallest power block structure would be 234 ft.

The new plant circulating water system (CWS) would include one or two natural draft, mechanical draft, or fan-assisted natural draft wet cooling towers. The new plant would also include smaller mechanical draft cooling towers for service water system (SWS) cooling. Water from the Delaware River would be used for makeup water for the cooling water systems. The new river intake and discharge structures are described in Section 3.2.2.1.

Existing infrastructure would be modified to integrate a new nuclear power plant with the existing HCGS/SGS units; however, none of the existing unit structures or facilities that directly support power generation would be shared or modified. As described in Section 3.2.2.3, depending on the reactor technology selected, up to two new switchyards would be required for a new nuclear power plant, and the existing onsite transmission lines would be modified as required to incorporate the new generation capacity into the electric grid. One new offsite transmission line may be required depending on future studies by the regional transmission organization, PJM Interconnection, LLC (PJM). The existing security perimeter would be expanded to include a new plant. The existing sewage treatment facility, training and administrative buildings, warehouses, and other support facilities would be used, expanded, or replaced to support a new plant based on economic and operational considerations.

During construction, the laydown area and temporary construction support facilities would require 205 ac. After new plant construction is complete, areas used for construction support would be restored where appropriate to match the overall site appearance or used for other necessary site or industrial support purposes. These areas include equipment laydown and module fabrication areas, batch plant area, areas around completed structures, and construction parking.

3.2 Plant Parameter Envelope

An applicant for an ESP need not provide a detailed design of a reactor or reactors and the associated facilities but should provide sufficient values for parameters for the reactor or

reactors and the associated facilities so that an assessment of site suitability can be made. Consequently, the ESP application may refer to a PPE as a surrogate for a nuclear power plant and its associated facilities.

A PPE is a set of values for plant design parameters that an ESP applicant expects would bound the design characteristics of the reactor or reactors that might be constructed at a given site. The PPE values are surrogates for actual reactor design information. The analysis is based on the values in the PPE and not on any specific reactor design. Analysis of environmental impacts based on a PPE approach permits an ESP applicant to defer the selection of a reactor design until the construction permit (CP) or combined construction permit and operating license (combined license or COL) stage. The PPE reflects the value of each parameter that it encompasses rather than the characteristics of any specific reactor design.

For purposes of the ESP application, PSEG is using a PPE approach that includes plant design parameters derived from four different reactor technologies.

- AP1000
- U.S. EPR
- ABWR
- US-APWR

This EIS analyzes the environmental impacts of the PPE surrogate derived from the four reactor technologies using either one unit (U.S. EPR, ABWR, or US-APWR) or two units (AP1000) at the PSEG Site. PSEG would not be required to use any of these designs if it elected to proceed with a CP or COL application. For example, PSEG could reference one of the large light-water reactors listed above or a small modular reactor (SMR) such as the Holtec SMR-160[4] or any other reactor design. However, a CP or COL applicant referencing an ESP would have to address whether the characteristics of the reactor ultimately selected fell within the values of the design parameters specified in the ESP.

Review Approach

NUREG–1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan* (ESRP) (NRC 1999-TN614), and review standard RS-002, *Processing Applications for Early Site Permits* (NRC 2004-TN2219), provide guidance to the staff of the U.S. Nuclear Regulatory Commission (NRC) to help ensure a thorough, consistent, and disciplined review of any ESP application. The staff's June 23, 2003, response to comments received on draft RS-002 (NRC 2003-TN2064) provides additional insights into the staff's approach to the review of an application using the PPE approach.

Because PPE values were used as a surrogate for design-specific values, the staff expected PSEG to provide information sufficient for the staff to develop a reasonable independent

[4]The review team is aware that PSEG is providing technical support to Holtec International (Holtec International 2013-TN2807). However, this information is not material to the review of the ESP application because the review is based on PPE values rather than a specific reactor design.

assessment of potential impacts to specific environmental resources. In some cases, the design-specific information called for in the ESRP (NRC 1999-TN614) was not provided in the PSEG ESP application because it did not exist or was not available. Therefore, the NRC staff could not apply the ESRP guidance in those review areas. In such cases, the NRC staff used its experience and judgment to adapt the review guidance in the ESRP and to develop assumptions necessary to evaluate impacts to certain environmental resources to account for this missing information. These assumptions are discussed in the appropriate sections of this EIS and are summarized in Appendix J of this EIS.

Because the PSEG PPE values do not reflect a specific design, they were reviewed for reasonableness. The NRC staff made a determination that the application was sufficient to enable the staff to conduct its required environmental review and that the PPE values are not unreasonable for consideration by the staff when making its finding on the application in accordance with Title 10 of the *Code of Federal Regulations* (CFR) Part 52.18 (10 CFR 52-TN251). During its environmental review, the staff used its judgment to determine whether PSEG provided information sufficient for the staff to perform its independent assessment of the environmental impacts of construction and operation of a new nuclear power plant. PSEG expects that the PPE values will bound the design characteristics of a reactor or reactors that might be constructed at the PSEG Site. At the COL stage, as required by 10 CFR 52.79 (10 CFR 52-TN251), the applicant must, in addition to the information and analysis otherwise required, submit information sufficient to demonstrate that the design of the facility falls within the parameters specified in the ESP. In accordance with 10 CFR 51.92(e)(7) (10 CFR 51-TN250), the COL supplemental EIS must analyze new and significant information demonstrating that the design of the facility falls outside the design parameters specified in the ESP.

Tables 3.3-1, 3.4-1, and 3.4-2 from the PSEG Environmental Report (ER) (PSEG 2014-TN3452) and Table 1.3-1 from the PSEG Site Safety Analysis Report (SSAR) (PSEG 2014-TN3453) provide information from various reactor designs that were used to develop the bounding site-specific PPE values. The PPE values provided in these tables are used in the staff’s analysis and are reproduced in Appendix I of the EIS unless specifically noted otherwise.

Throughout the PSEG ER (PSEG 2014-TN3452), PSEG provides

- statements of plans to address certain issues in the design, construction, and operation of the facility;
- statements of planned compliance with current laws, regulations, and requirements;
- statements of plans for future activities and actions that it will take should it decide to apply for a CP or COL;
- descriptions of the PSEG estimate of the environmental impacts resulting from the construction and operation of a new nuclear power plant at the PSEG Site; and
- descriptions of PSEG estimates of future activities and actions of others and the likely environmental impacts of those activities and actions that would be expected should PSEG decide to apply for a CP or COL.

The activities described include, but are not limited to, actions such as the following:

- considering the results of testing and monitoring during the development of a CP or COL application;
- complying with the NRC regulations and those of other agencies, including obtaining appropriate permits from other agencies;
- taking actions to mitigate adverse environmental impacts (e.g., best management practices); and
- addressing certain issues at the CP or COL stage that were not addressed in the ESP application.

Some of these future actions are those that PSEG would be required to implement because they are currently required by law, and others are actions that PSEG has indicated that it would implement without the legal obligation to take such actions.

The staff performed its evaluation of the impacts of constructing and operating a new nuclear power plant at the PSEG Site assuming that these activities and actions would be undertaken by PSEG and others during future licensing activities. As discussed previously, the staff developed assumptions necessary to evaluate impacts to certain environmental resources to account for missing detailed information. In addition to other sources of information obtained independently, the staff considered future activities and actions, estimates of expected environmental impacts that were identified in the PSEG ER (PSEG 2014-TN3452), and the PPE values listed in Appendix I of this EIS when developing the inputs and assumptions used in the NRC staff's independent review of the environmental impacts of constructing and operating a new plant at the PSEG Site.

3.2.1 Plant Water Use

This EIS assesses the impacts of plant water use based on the values of design parameters provided in the PSEG ER (PSEG 2014-TN3452). At the ESP stage, the staff's review of the design parameters is limited to an evaluation of whether the parameter values are not unreasonable. At the CP or COL stage, a CP or COL applicant referencing the ESP is required to demonstrate that the specific plant design would fall within the design parameters in the ESP. The following sections describe both the consumptive and nonconsumptive water uses of a new nuclear power plant and the associated plant water treatment systems.

Water would be required to support a new nuclear power plant during construction and operation, including the cooling water systems for plant auxiliary components (e.g., SWS) and makeup water for the ultimate heat sink (UHS) cooling system. The majority of the water would be withdrawn from the Delaware River via an intake structure. The bounding cooling water systems flows were determined for site-specific Delaware River water quality and PSEG Site meteorological conditions, and the bounding SWS flows were modified for site-specific river water quality. The freshwater aquifer would supply water for general site purposes including the

potable and sanitary water system (PSWS), demineralized water distribution system (DWDS), fire protection system (FPS), and other miscellaneous systems.

3.2.1.1 Plant Water Consumption

The average and maximum water consumption and discharge by the various cooling and other water systems is given in Table 3-1. This includes maximum and average makeup water flow rates, evaporation rates, drift rates, and blowdown rates for the CWS and SWS and water supply for the PSWS, DWDS, and FPS. Also included is the discharge flow rate for applicable systems, including miscellaneous drains and liquid radwaste. The average values are the expected limiting values for normal plant operation, and the maximum values are those expected for upset or abnormal conditions. The makeup water supply source for the CWS and the SWS/UHS is the Delaware River. For the PSWS, DWDS, FPS, and other miscellaneous systems, plant makeup flows are from an onsite freshwater aquifer. The blowdown and discharge water flow is discharged to the Delaware River. Figure 3-2 provides a water balance diagram. The total intake from the Delaware River would be 78,196 gpm (average) and 80,600 gpm (maximum). The total intake from the freshwater aquifer would be 210 gpm (average) and 953 gpm (maximum).

The CWS and SWS/UHS cooling towers would lose water from evaporation, blowdown, and drift. Evaporation, blowdown, and drift estimates for the CWS and SWS/UHS cooling towers are shown in Table 3-1. Cooling tower performance curves have not yet been generated; thus a single design point is used to determine CWS parameters. The normal operating design point for the cooling tower is based on a 1 percent maximum annual non-coincident wet bulb temperature of 76.6°F. No seasonal variability is evaluated in the water consumption values presented. Seasonal variability in wet and dry bulb temperature and relative humidity results in changes to cold water temperature, system flow rates, and, ultimately, evaporation rates from the cooling tower. Historically, the NDCT that provides heat dissipation for the HCGS CWS produces higher evaporation rates in the summer months than the winter months. The design point noted above is representative of a 1 percent exceedance summer condition at the PSEG Site. As such, the normal operating design values presented for water use at the new plant are conservative when considered from an annual use perspective.

The combined plant blowdown would consist of CWS blowdown, SWS/UHS blowdown, PSWS blowdown, DWDS blowdown, miscellaneous drain blowdowns, liquid radwaste blowdown, and SWS/UHS makeup filter backwash. The combined plant blowdown flows would discharge into the Delaware River at a flow rate of 51,946 gpm (average) and 53,222 gpm (maximum).

The CWS functions as the heat sink for normal plant processes and is essential to power generation. It provides a continuous supply of cooling water from the normal plant heat sink to the main condensers to remove the heat rejected by the turbine cycle. The main condenser receives exhaust steam from the turbines and cooled water is pumped from the cooling tower through the main condenser and back to the cooling tower, where heat is rejected to the atmosphere by evaporation. The CWS also accommodates heat loads associated with turbine auxiliary equipment.

Table 3-1. Plant Water Use

System	Average Flow (gpm)	Maximum Flow[(a)] (gpm)	PPE Item (SSAR Table 1.3-1)
	River Water Streams		
Circulating Water System			
Evaporation	25,264	25,264	2.4.7, 2.5.7, 2.6.7
Drift[(b)]	12	12	2.4.17, 2.5.17, 2.6.17
Makeup	75,792	75,792	2.4.9, 2.5.9, 2.6.9
Blowdown	50,516	50,516	2.4.4, 2.5.4, 2.6.4
Service Water/UHS System			
Evaporation	1,142	2,284	3.3.7a and 3.3.7b
Drift[(c)]	2	4	3.3.17
Makeup (before filter)	2,404	4,808	3.3.9a and 3.3.9b
Makeup (after filter)	2,284	4,568	[(d)]
Blowdown	1,140	2,280	3.3.4a and 3.3.4b
Makeup Filter Backwash	120	240	[(d)]
UHS Makeup (emergency only)	4,568	4,568	[(d)]
	Freshwater Aquifer Streams		
Plant Makeup			
PSWS Makeup	93	216	5.2.2 and 5.2.1
DWDS Makeup	107	107	6.2.2 and 6.2.1
FPS Makeup	5	625	7.1.2 and 7.1.1
Floor Wash Drain Makeup	5	5	8.2.2 and 8.2.1
	Discharge Streams		
Plant Blowdown			
PSWS Blowdown	93	93	5.1.1 and 5.1.2
DWDS Blowdown	27	27	6.1.1
Misc. Drains Blowdown	39	55	8.1.1 and 8.1.2
Liquid Radwaste Flow	11	11	10.2.1
Combined Plant Blowdown (includes CWS blowdown, SWS/UHS blowdown, SWS/UHS makeup filter backwash, and plant blowdown)	51,946	53,222	[(d)]

(a) These flows are not necessarily concurrent.
(b) The cooling tower drifts are 0.001% of the tower circulating water flow.
(c) The cooling tower drifts are <0.005% of the tower circulating water flow.
(d) Values shown on Figure 3-2.

Source: PSEG 2014-TN3452; PSEG 2014-TN3453.

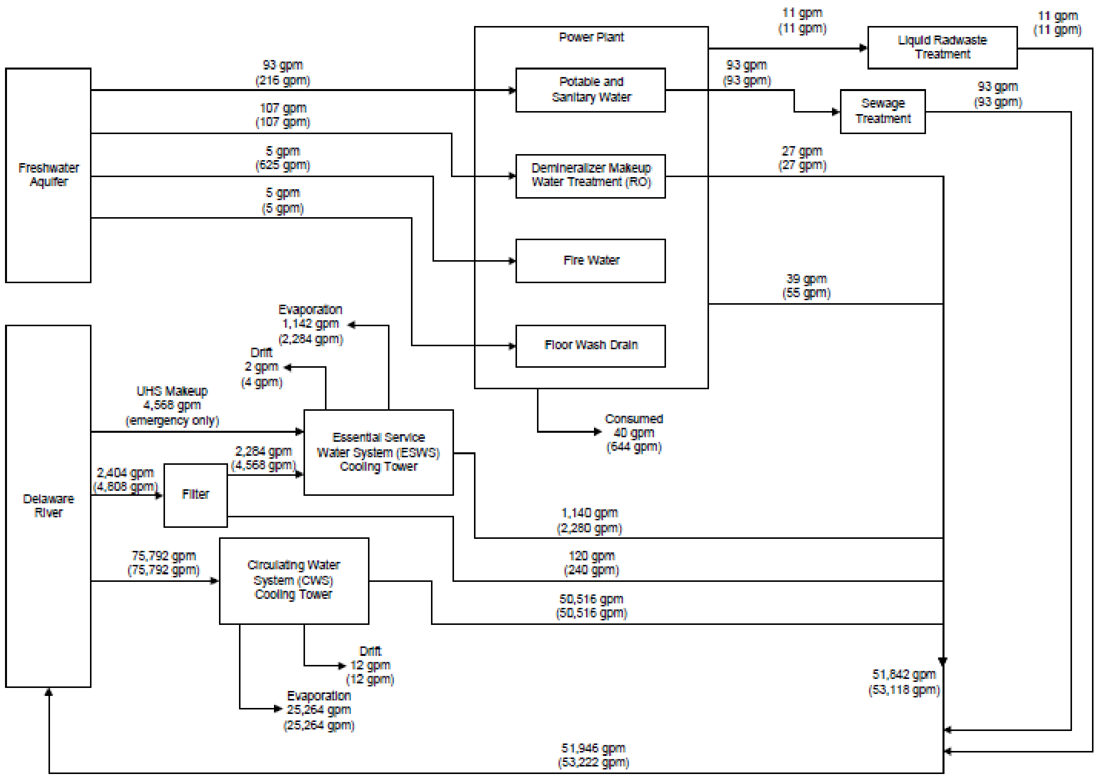

Figure 3-2. Plant Water Use. ***(Source: Modified by staff from PSEG 2014-TN3452)***

For those plant designs (i.e., ABWR, US-APWR, U.S. EPR) that use active safety-related SWS and UHS cooling towers, the SWS provides essential cooling to safety-related equipment and may also cool non-safety-related auxiliary components used for normal plant operation. It removes heat from plant components by providing cooling water flow during normal operation, during safe shutdown of the reactor, and following a design basis accident. Cooling water from the UHS cooling towers is provided to the component cooling water system heat exchangers, emergency diesel generator heat exchangers, and pump room coolers that are necessary for normal safe shutdown and cooldown, anticipated operational events, and accident conditions. The AP1000 design does not require an active external safety-related UHS system to reach safe shutdown. It uses a non-safety-related SWS to accommodate plant heat loads.

Additional plant systems require freshwater. The PSWS supplies water needed for plant operation, including potable water, sanitary water, and miscellaneous systems. The DWDS supplies makeup water of reactor coolant quality and treated water for other station operating requirements, including reactor coolant makeup. The FPS supplies water to the wet system type fire suppression systems.

Plant water use during construction activities would require freshwater for potable and sanitary use, concrete mixing and curing, and dust control. The total freshwater requirement for construction would be 171,932 gpd or 119 gpm. Of this, the sanitary discharge would be 123,000 gpd or 85 gpm. The remainder of the supply would be consumed. These construction flows are bounded by the higher total freshwater requirements and potable and sanitary flows during operation.

3.2.1.2 Plant Water Treatment

Treatment systems are required for systems supplied by surface water and groundwater, including circulating water makeup, reactor water makeup, service water makeup, condensate, potable water, radwaste, and fire protection. The majority of the water would be withdrawn from the Delaware River via the intake structure. The intake structure would be located at Delaware River River Mile (RM) 52, situated in the tidal estuary zone of the Delaware River where it would be subject to tidal saltwater intrusion and at the turbidity maxima on the Delaware River. The water is hard and brackish with elevated levels of total dissolved solids and chlorides, elevated levels of both calcium and magnesium, and moderately high suspended solids levels.

The source of raw water makeup for the CWS would be the Delaware River. Sulfuric acid would be used to control calcite scale as required, and acid addition would maintain a slightly alkaline pH level. This is typical when using tidal estuary water makeup and is consistent with the operational experience at the adjacent HCGS. The combination of low cycles of concentration and acid addition would be used so that other scale inhibitors would not be needed. Chlorination would control microbial growth in the piping and condenser to prevent biofouling and microbiological deposits. Sodium hypochlorite solution would be used to control biofouling and would be limited by New Jersey Pollutant Discharge Elimination System (NJPDES) permit requirements. Dechlorination of CWS cooling tower blowdown may be required by the NJPDES permit. A sodium bisulfite solution or equivalent would be injected as necessary to react with residual chlorine before discharge.

The source of raw water makeup for the SWS/UHS would be the Delaware River. The river water would be treated to remove suspended solids by settling in clarifiers. The influent would be coagulated and flocculated with polyelectrolyte addition to increase sedimentation rates and improve effluent quality. Settled sludge would be dewatered for disposal using mechanical dewatering facilities or in a managed impoundment. Media filters, downstream of the clarifiers, and filter backwash may be used to provide additional suspended solids removal. More comprehensive chemical treatment would be provided for the SWS/UHS. The river water would require control of calcite scale and control of iron and sediment deposition. Treatment chemicals would include sulfuric acid, an additional blended deposit control agent, and an oxidizing biocide. Sulfuric acid would be used for pH reduction to aid in calcium carbonate scale control. A deposit control agent would be used to control calcium carbonate scaling, to protect against calcium phosphate scaling, and to control silt and iron deposition. Sodium hypochlorite solution would be used to control biofouling. Dechlorination of SWS/UHS cooling tower blowdown may be required by the NJPDES permit. A sodium bisulfite solution or equivalent would be injected as necessary to react with residual chlorine before discharge.

The source for plant makeup flows to the PSWS, DWDS, FPS, and other miscellaneous systems would be the onsite freshwater aquifer. Makeup flows to the PSWS and FPS would not be treated. Chlorination would be provided for the PSWS. The DWDS makeup flow would use a demineralization treatment system such as a dedicated reverse osmosis system to reduce solids, salts, organics, and colloids in the treated water.

3.2.2 Proposed Plant Structures

This EIS assesses the impacts of proposed plant structures based on the values of design parameters provided in the PSEG ER (PSEG 2014-TN3452). At the ESP stage, the staff's review of the design parameters is limited to an evaluation of whether the parameter values are not unreasonable. At the CP or COL stage, a CP or COL applicant referencing the ESP is required to demonstrate that the specific plant design would fall within the design parameters in the ESP. The following sections describe each of the major plant structures: the reactor power conversion system, structures that would have a significant interface with the environment during operation, and the balance of plant structures. All of these structures are relevant in the Chapter 4 discussion of the impacts of building a new nuclear power plant. Only the structures that interface with the environment are important to the operational impacts discussed in Chapter 5.

3.2.2.1 Reactor Power Conversion System

This section provides a general discussion of the reactor, engineered safety features (ESFs), and the power conversion system. Reactor-specific design parameters such as fuel assembly description, core fuel capacity, and condenser total heat transfer area would be provided during the COL application phase following reactor technology selection. Bounding parameters from the PPE and site-specific characteristics within the SSAR (PSEG 2014-TN3453) are used to establish conceptual reactor descriptions.

The four reactor types considered for the new plant are the ABWR, the AP1000, the U.S. EPR, and the US-APWR. The AP1000 plant consists of two units and associated turbines and power conversion equipment, and the ABWR, U.S. EPR, and US-APWR consist of one unit and associated turbine and power conversion equipment. The ABWR is a BWR, and the AP1000, U.S. EPR, and US-APWR are PWRs. The design life for a new facility is 60 years (PSEG 2014-TN3453), and the initial licensed operating life is 40 years based on the Atomic Energy Act (42 USC 2011-TN663) and current regulations.

The rated thermal power (RTP) of 4,590 MW(t) is the bounding RTP for one unit and 6,800 MW(t) for two units (PSEG 2014-TN3453). The approximate gross and net electrical outputs for one unit are 1,710 MW(e) and 1,600 MW(e), respectively, for the bounding design. The bounding design gross and net electrical outputs for two units are about 2,400 MW(e) and 2,200 MW(e), respectively.

All proposed reactor designs use uranium as the fissile material. The maximum uranium enrichment is 5 weight percent of uranium-235 for the initial fuel load (PSEG 2014-TN3453). The maximum average assembly discharge burnup is 54,200 MWd/MTU (PSEG 2014-TN3453). The peak fuel rod burnup is 62,000 MWd/MTU (PSEG 2014-TN3453). Each of these values is within acceptable NRC limits.

The proposed reactor designs use active and/or passive types of ESF systems. Active systems rely on active components such as pumps to move coolant to the needed locations, while passive systems use gravity and thermal convection to achieve equivalent results. Active systems are typically powered by redundant power sources such as emergency diesel

generators or gas turbine generators. Passive systems use gravity to move coolant, and valves are typically actuated by safety-related dc power. The selected design would rely on a UHS to remove heat from safety-related systems and discharge it to the atmosphere.

The power conversion system for each of the advanced reactor designs under consideration uses a steam turbine to generate power by converting the reactor heat to mechanical energy. The turbines reject exhaust heat to the normal plant cooling water system. The tube material for the condenser or turbine exhaust cooling heat exchangers has not been selected.

3.2.2.2 Structures with a Major Environmental Interface

The NRC staff divided the plant structures into two primary groups: those that interface with the environment and those that are internal to the reactor and associated facilities but without direct interaction with the environment. Examples of interfaces with the environment are withdrawal of water from the environment at the intake structure, release of water to the environment at the discharge structure, and release of excess heat to the atmosphere. The structures or locations with environmental interfaces are considered in the staff's assessment of the environmental impacts of facility construction and preconstruction and facility operation in Chapters 4 and 5, respectively. The power-production processes that would occur within the plant itself and that did not affect the environment are not relevant to a National Environmental Policy Act (42 USC 4321-TN661) review and are not discussed further in this EIS. However, such internal processes are considered by the NRC in reactor-specific design certification documentation and in the NRC safety review of COL applications.

Cooling Water System

The cooling water system for the new plant would consist of a CWS and an SWS. The CWS would provide cooling water for the normal heat sink that would consist of a closed-loop system composed of wet cooling towers, water pumps, and cooling tower basins. The circulating water flow rate for the bounding CWS configuration is 1.2 million gpm. The CWS heat dissipation would be 1.508×10^{10} Btu per hour. The CWS cooling towers would use mechanical draft, natural draft, or fan-assisted natural draft design. The cooling towers would be located north of the power block area of the plant in a 50-ac area (Figure 2-2). The CWS makeup water average and maximum flow would be 75,792 gpm, and the CWS blowdown average and maximum flow rate would be 50,516 gpm.

The SWS for the new plant would remove heat from the balance of plant auxiliary equipment and heat exchangers that were not cooled by the CWS. All reactor designs being considered by PSEG for the site contain an SWS. The SWS for the ABWR, US-APWR, and U.S. EPR designs performs both safety and nonsafety cooling, whereas the SWS for the AP1000 design only performs nonsafety cooling. The SWS design is specific to reactor design but generally consists of cooling towers, water pumps, dedicated water basins, and heat exchangers. Because PSEG has used a PPE approach, a safety-related SWS using mechanical draft cooling towers would be the bounding PPE design in use for the plant. The SWS cooling towers would be located in the power block area. The UHS heat removal requirement is 2.06×10^8 Btu per hour during normal conditions, 4.72×10^8 Btu per hour during cooldown conditions, and 3.95×10^8 Btu per hour during accident conditions. The SWS makeup water average and

maximum flow rates would be 2,404 and 4,808 gpm, respectively, and the SWS blowdown average and maximum flow rates would be 1,140 and 2,280 gpm, respectively. The UHS makeup water flow rate during emergencies would be 4,568 gpm.

The combined makeup water withdrawal from the Delaware River would average 78,196 gpm with a maximum of 80,600 gpm. The combined plant blowdown, including CWS and SWS blowdowns, SWS makeup filter backwash, and plant blowdown, would average 51,946 gpm with a maximum flow rate of 53,222 gpm.

Operational Modes

The CWS would provide cooling functions during the power generation mode. The CWS would operate at its maximum heat dissipation capacity because the plant would normally operate at 100 percent of its thermal rating.

The SWS would provide cooling functions during power generation, cooldown, refueling, and plant start-up modes. In addition, the SWS may also provide cooling for the spent fuel pool heat load during a full core offload condition. Because the power generation mode uses the most makeup water, all other mode water uses are bounded by the power generation mode.

Station Capacity Factor

The annualized capacity factor for the plant would be between 85 and 96.3 percent. These values are bounding for the purposes of different analyses performed for the environmental review.

Cooling-Water Intake System

A new makeup water intake structure would be located west of the plant on the Delaware River shoreline about 2,800 ft north of the HCGS service water intake structure (Figure 2-2). To meet the bounding CWS and SWS combined makeup water demands for the reactor designs being considered for the PSEG Site, the intake structure would be about 200 ft wide (facing the Delaware River shoreline) and 110 ft deep (extending from the shoreline landward). The Delaware River in front of the intake structure would need to be dredged to an elevation of −19 ft 10 in. NAVD88 (North American Vertical Datum of 1988) to allow sufficient depth for water withdrawal. A bar rack would prevent debris from entering the intake bays, and a trash rake would clean the debris accumulated on the bar rack. A traveling screen would prevent small debris from reaching farther into the bays. The intake structure bay and screens would be sized such that the average intake through-screen velocity would be less than 0.5 fps to meet the requirements of the Clean Water Act Section 316(b) Phase I rule (66 FR 65256-TN243).

Discharge System

The plant discharge would consist of CWS and SWS blowdowns, SWS makeup filter backwash, and other wastewater streams including those from PSWSs, demineralized water systems, miscellaneous drains blowdowns, and liquid radwaste flow. The combined plant discharge would average 51,946 gpm with a maximum of 53,222 gpm. An NJPDES permit for the plant would specify volumes and constituent concentrations of the plant discharge.

The discharge system would consist of a 48-in.-diameter pipe located about 8,000 ft north of the existing SGS discharge, 2,500 ft north of the existing HCGS discharge, and 1,000 ft north of the makeup water intake structure of the plant. The discharge pipe would extend out 100 ft into the Delaware River from the shoreline and would rest on a layer of geotextile fabric and granular bedding. The outlet of the discharge pipe would be elevated 3 ft above the river bed, and the depth of water at the outlet would be 12 ft 10 in. below mean low water. The discharge pipe would be overlaid with geotextile fabric and a three-layered granular material for stability.

Cooling Towers

The plant would use one or two wet cooling towers to dissipate waste heat. As described above, the CWS cooling towers would use mechanical draft, natural draft, or fan-assisted natural draft design. Makeup water to offset the losses from evaporation, blowdown, and drift would be provided from the Delaware River via the new intake system. Blowdown from the cooling towers would be discharged to the Delaware River via the new discharge system. The PPE values for the CWS average and maximum evaporation loss are 25,264 gpm and the average and maximum drift loss are 12 gpm.

As described above, the SWS cooling towers would be a mechanical draft design. Makeup water for the SWS cooling towers would also be provided from the Delaware River via the new intake system, and blowdown from the towers would be discharged to the Delaware River using the new discharge system. The SWS average and maximum evaporation losses would be 1,142 and 2,284 gpm, respectively, and the average and maximum drift losses would be 2 and 4 gpm, respectively.

Water Treatment

The surface water withdrawn from the Delaware River to offset evaporation, blowdown, and drift losses in the cooling system would require treatment. Near the intake structure at Delaware River RM 52, the Delaware River is subject to tidal fluctuations and turbidity maxima. The water of the Delaware River at this location is hard and brackish and would have elevated levels of suspended and total dissolved solids, chlorides, calcium, and magnesium.

For the CWS, sulfuric acid would be added to the raw water withdrawn from the Delaware River to control calcite scale formation. Chlorination would be used to control microbial growth and biofouling. Sodium hypochlorite would also be used to control biofouling and would be subject to NJPDES permit requirements. The NJPDES permit may also require dechlorination of the CWS blowdown before discharge, which may be carried out using a sodium bisulfite solution or equivalent to control residual chlorine.

For the SWS, the raw water withdrawn from the Delaware River would be passed through clarifiers to remove suspended solids. The clarifiers may use polyelectrolyte to increase coagulation and flocculation. Media filters may be used to remove additional suspended solids after the raw water passes through the clarifiers. Sulfuric acid, additional blended deposit control agent, and sodium hypochlorite would be used to reduce pH for scaling control, to control calcium carbonate and calcium phosphate scaling, and to control biofouling.

A sodium bisulfite solution or equivalent may be used to control residual chlorine before discharge of the blowdown from the SWS cooling towers.

Plant makeup water to the PSWS, DWDS, FPS, and other miscellaneous uses would be provided by onsite freshwater withdrawn from the aquifer. Makeup water for the PSWS and FPS would not be treated except for chlorination for the PSWS. Makeup water for the DWDS would use a demineralization treatment system such as a reverse osmosis system to reduce solids, salts, organics, and colloids from the raw freshwater.

Power Transmission System

The new plant would be located adjacent to the existing HCGS and SGS. The electric power systems for these existing plants generate and transmit power into the PJM power grid. PJM is a regional transmission organization that manages the high voltage power grid and coordinates the movement of wholesale electricity in a market that serves 13 states and the District of Columbia.

HCGS and SGS have separate, dedicated switchyards. Both switchyards operate nominally at 500 kV. The switching station designs at each plant incorporate a breaker-and-a-half scheme for high reliability. A new plant switchyard would be required to support new plant operation. The new plant switchyard would be electrically integrated with the existing switchyards via a site interposing switchyard to provide 500-kV connections. Electric power generated by the new plant would be fed through isolated phase buses to main transformer banks where it would be stepped up to 500 kV and delivered to the new plant switchyard. The bounding land use required within the PSEG Site for the switchyards is 63 ac (SSAR Table 1.3-1, Item 15.1.1) (PSEG 2014-TN3453). The PSEG Site Utilization Plan shown in Figure 2-2 depicts the relative locations of the switchyards.

The configuration of the new switchyards is dependent on the reactor technology, number of units, and approach for integration with the existing HCGS and SGS switchyards. The new switchyards would require additional support services and structures for grounding, lightning protection, switchyard control power, and area lighting.

Presently, there are two 500-kV transmission lines to the HCGS switchyard from offsite locations and one 500-kV tie line from HCGS to the SGS switchyard. One offsite line is a 17-mi tie to the Red Lion Substation, located northwest near Newark, Delaware, and the other line is a 43-mi tie to the New Freedom Switching Station, located northeast in Camden County, New Jersey. All three lines are capable of providing physically independent sources of offsite power to HCGS.

In addition, there are two 500-kV transmission lines to the SGS switchyard from off the site and one 500-kV tie line from SGS to the HCGS switchyard. One offsite line is a 42-mi tie to the New Freedom Switching Station. The second offsite line is a 50-mi tie to the New Freedom Switching Station. In 2008, a new substation (Orchard) was installed along this line, dividing it into two segments. All three lines are capable of providing physically independent sources of offsite power to SGS and are available for either or both units.

The existing transmission lines servicing the HCGS/SGS site have adequate thermal capacity to accommodate the additional generation from a new nuclear power plant at the PSEG Site. Independent of this project, however, PJM is evaluating grid improvements to address congestion and grid stability and additional offsite transmission lines may be required.

Access Road

PSEG has stated that additional access road capacity is necessary to address future transportation needs for the PSEG Site. To provide this additional access road capacity, PSEG has designed a new three-lane causeway that would be constructed on elevated structures for its entire length through the coastal wetlands. The proposed causeway would extend northeast for about 5.0 mi from the PSEG property along or adjacent to the existing transmission corridor right-of-way (ROW) to the intersection of Money Island Road and Mason Point Road (Figure 2-5). The alignment would run roughly 200 ft east of, and parallel to, the existing Hope Creek-Red Lion transmission line for most of its length. The PSEG conceptual design for the causeway specifies a 200-ft-wide ROW in upland areas at the northern and southern termini and a 48-ft-wide structure for the elevated portions of the causeway within lowland areas. Figure 3-3 provides a photo simulation of the existing Hope Creek-Red Lion transmission line paralleled by the proposed causeway through the Money Island Estuary.

Because PSEG has determined the proposed causeway would be needed to support the new plant, the review team evaluated the impacts of the proposed causeway as part of the project (Chapters 4, 5, and 7 of this EIS).

Figure 3-3. Photo Simulation Showing the Existing Hope Creek Generating Station Cooling Tower (Left), the Existing Hope Creek-Red Lion Transmission Line (Left), the Two Potential New Cooling Towers (Right), a Potential New Transmission Line (Right), and the Potential New Causeway as Viewed from the Money Island Estuary Platform. ***(Source: PSEG 2012-TN1489)***

3.3 Construction and Preconstruction Activities

The NRC authority is limited to construction activities that have a "reasonable nexus to radiological health and safety or common defense and security" (72 FR 57416-TN260), and the NRC has defined "construction" within the context of its regulatory authority. Examples of construction activities [defined at 10 CFR 50.10(a) (10 CFR 50-TN249)] for safety-related structures, systems, or components (SSCs) include driving of piles; subsurface preparation; placement of backfill, concrete, or permanent retaining walls within an excavation; installation of foundations; or in-place assembly, erection, fabrication, or testing.

Other activities related to building a new nuclear power plant that do not require NRC approval, but which may require a permit from the USACE, may occur before, during, or after the NRC-authorized construction activities. These activities are termed "preconstruction" in 10 CFR 51.45(c) (10 CFR 51-TN250) and may be regulated by other local, State, Tribal, or Federal agencies. Preconstruction includes activities such as preparation of the site (e.g., site clearing and grading, erosion control, and other environmental mitigation measures); erection of fences; excavation; erection of support buildings; creation of building service facilities (e.g., roads, pipelines, transmission lines); and procurement or fabrication of components occurring at other than the final, in-place location at the site. Further information about the delineation of construction and preconstruction activities is presented in Chapter 4 of this EIS.

This section describes the structures and activities associated with building a new nuclear power plant at the PSEG Site. This section also characterizes the major activities for the principal structures to provide the requisite background for the assessment of environmental impacts. However, it does not represent a discussion of every potential activity or a detailed engineering plan.

For analysis, PSEG has assumed a construction schedule based on the two-unit AP1000 reactor technology with a 2016 construction start date and a 68-month construction schedule ending in 2021 (Table 3-2) (PSEG 2012-TN1489; PSEG 2014-TN3452). PSEG has assumed a targeted commercial operating date of 2021 for the first unit and 2022 for the second unit (PSEG 2012-TN1489). The description of preconstruction and construction activities in this section assumes that construction on the PSEG Site would begin following site preparation for the first unit and that construction of the second unit would begin 12 months later.

PSEG has not yet selected a specific reactor technology for the site, so it used technical information from the four reactor designs covered by the PPE to develop bounding parameters on which assessments could be based (PSEG 2012-TN1489). These bounding parameters envelope the characteristics of the proposed facility and allow for an evaluation of the suitability of the site for future construction and operation of a nuclear power plant. Therefore, the preconstruction and construction activities discussed in this section and the areas depicted on the PSEG Site Utilization Plan (Figure 2-2) are intended to bound the assessment of onsite and near offsite impacts.

Table 3-2. Anticipated Schedule for Preconstruction and Construction at the PSEG Site

	Start	Finish	Duration
Preconstruction Work			
Clearing, Grubbing, Grading	2Q 2015	3Q 2015	3 months
Access Road/Causeway Construction	2Q 2015	2Q 2017	24 months
Implement Environmental Management System	2Q 2015	2Q 2017	24 months
Construct Interposing Switchyard (evaluate for construction power)	2Q 2015	3Q 2016	13 months
Upgrade Area Roads and Bridges	2Q 2015	4Q 2016	18 months
Install Construction Security Infrastructure	2Q 2015	3Q 2015	3 months
Install Temporary Utilities	2Q 2015	2Q 2017	24 months
Install Temporary Construction Facilities	2Q 2015	4Q 2016	18 months
Construct New Barge Facility	2Q 2015	3Q 2016	13 months
Install Cofferdam for New Intake	2Q 2015	4Q 2015	5 months
Construct Heavy Haul Road	1Q 2017	2Q 2017	4 months
Excavate to Kirkwood Formation (both units)	3Q 2015	4Q 2016	15 months
PSEG Site Unit 1 Construction			
Excavate to Vincentown Formation (both units)	4Q 2016	1Q 2017	4 months
Backfill/First Concrete	1Q 2017	2Q 2017	4 months
Site Construction	2Q 2017	2Q 2021	48 months
Fuel Load	2Q 2021	4Q 2021	6 months
Commercial Operation	4Q 2021		
PSEG Site Unit 2 Construction			
Backfill/First Concrete	1Q 2018	2Q 2018	4 months
Site Construction	2Q 2018	2Q 2022	48 months
Fuel Load	2Q 2022	4Q 2022	6 months
Commercial Operation	4Q 2022		

Source: PSEG 2012-TN1489.

3.3.1 Site Preparation

Site preparation would include clearing, grubbing, and grading the site; installing erosion control measures; building access and haul roads; installing construction security infrastructure; installing temporary utilities and facilities (e.g., storage warehouses, concrete batch plant); preparing the laydown, fabrication, and shop areas; relocating existing facilities within the PSEG Site; staging equipment; and preparation activities to support power plant construction. Figure 2-2 depicts the locations of many of these activities based on the PSEG Site Utilization Plan.

Clearing and grubbing the site would begin with removing the vegetation. The site grade would then be made uniform to ensure access to all areas of the construction site. The crosshatched areas depicted in Figure 2-2 illustrate the areas that would be cleared, grubbed, and graded (PSEG 2012-TN1489).

Erosion control measures such as silt fences would be installed around the various work areas to prevent surface-water and sediment runoff. Best management practices, including the establishment of a stormwater management plan, would be implemented to control and contain surface runoff (PSEG 2012-TN1489). To support construction at the PSEG Site, PSEG would begin building the proposed causeway (Section 2.2.2.3 and Section 3.2.2.2, *Access Road*) 24 months before plant construction (PSEG 2012-TN1489). Building the causeway would primarily consist of driving piles from a top-down or parallel temporary structure with prefabricated roadway spans set in place between pile clusters. Most of the causeway structure would be made of prefabricated elevated sections set in place from an elevated crane to minimize impacts along the causeway route. PSEG would also build a heavy haul road along the length of the riverfront west of the site (Figure 2-2) to support the transport of heavy modules and components from the existing HCGS barge facility and from the proposed parallel barge facility. PSEG would build temporary construction parking lots on PSEG property in areas near the construction site. Construction laydown and fabrication areas would be cleared, grubbed, graded, and graveled or paved with a road system to accommodate the site construction traffic (PSEG 2012-TN1489).

Structures and equipment needed for construction site security would include access control points, fencing, lighting, physical barriers, and guardhouses. These construction-level security features would be installed during the early part of site preparation activities (PSEG 2012-TN1489).

Temporary utilities needed for plant construction would include aboveground and underground infrastructure for power, communications, potable water, wastewater and waste treatment facilities, fire protection, and construction gas and air systems. These temporary utilities would support the entire construction site and associated activities, including construction offices, warehouses, storage and laydown areas, fabrication and maintenance shops, the power block, the batch plant facility, measuring and testing equipment, and the intake and discharge areas. Temporary construction facilities needed would include offices, warehouses for receiving and storage, temporary workshops, toilets, training facilities, and personnel access facilities. The site of the concrete batch plant would be prepared for aggregate unloading and storage, and the cement storage silos and concrete batch plant would be erected (PSEG 2012-TN1489).

Activities to support the preparation of the laydown, fabrication, and shop areas would include a construction survey to establish local coordinates and benchmarks for horizontal and vertical control; grading, stabilizing, and preparing the laydown areas; installing construction fencing; installing shop and fabrication areas, including the concrete slabs for formwork laydown, module assembly, equipment parking and maintenance, fuel and lubricant storage, and rigging loft; and installing concrete pads for cranes and crane assembly (PSEG 2012-TN1489).

Preconstruction activities at the PSEG Site would include some limited excavation work as structural support for construction excavation would be installed at the lateral limits of the excavation for the entire power block. Structural support for construction excavation could consist of cellular cofferdams, sheet pile/tie-back walls, or other methods that would be specified in a COL. Excavation work conducted as a preconstruction activity would be to a depth of about 50 ft below site grade (to the Kirkwood formation layer) (PSEG 2012-TN1489).

As described in the PSEG ER (PSEG 2014-TN3452), the proposed project would permanently affect 58.3 ac of *Phragmites*- (common reed-) dominant coastal wetlands; 44.1 ac of *Phragmites*-dominant interior wetlands; 11.7 ac of wetlands ROW; 4.6 ac of deciduous scrub/shrub wetlands; 4.0 ac of disturbed wetlands (modified); 2.9 ac of tidal rivers, inland bays, and other tidal waters; 0.9 ac of herbaceous wetlands; and 0.1 ac of saline marsh. The project would also permanently affect 40.3 ac of artificial lakes.

Building materials would be brought to the site and stored in laydown areas. PSEG expects to use six temporary laydown areas in various locations on the site. These laydown areas would potentially affect 9.1 ac of coastal wetlands. This would include impacts to 288 linear ft of creek channel (canal ditch) associated with one laydown area (PSEG 2014-TN3452).

PSEG would build a temporary concrete batch plant on the 45-ac parcel to be leased from the USACE. Building this batch plant would potentially affect 19.1 ac of coastal wetlands (PSEG 2014-TN3452).

PSEG would build a heavy haul road along the Delaware River shoreline to support the movement of materials from the temporary laydown/batch plant area within the 45-ac leased parcel to other areas of the construction site. Developing this haul road would potentially affect 9.6 ac of coastal wetlands. Of the total wetlands affected by the haul road, 2.3 ac would only be temporarily affected (PSEG 2014-TN3452).

Building the proposed causeway would potentially affect 1.8 ac of coastal wetlands on the PSEG Site. Of the total onsite wetlands affected by the causeway, 0.9 ac would be temporarily affected. Potential offsite impacts of the proposed causeway would include 39.6 ac of coastal wetlands and 1.4 ac of freshwater wetlands. Of the total offsite wetlands affected by the causeway, 20.1 ac would be temporarily affected. Included within the area are potential impacts to 30 linear ft of creek channel (stream) on the site and 2,123 linear ft of creek channel (stream/artificial path) off the site. Actual impacts to stream channels would be limited to pier locations only, and stream channels would most likely be avoided in the final design (PSEG 2014-TN3452).

3.3.2 Power Block Construction

The power block is defined as all SSCs which perform a direct function in the production, transport, or storage of heat energy, electrical energy, or radioactive wastes. Also included are SSCs that monitor, control, protect, or otherwise support the above equipment (PSEG 2014-TN3453). PSEG states that 70 ac would be required to provide space for the power block facilities on the PSEG Site (PSEG 2014-TN3453).

The PSEG Site power block would consist of an area encompassing the nuclear island and turbine island areas, which would include the following buildings for each unit:

- reactor building, including concrete containment vessel;
- power source buildings;
- UHS-related structures;

- auxiliary building;
- access building; and
- turbine building.

PSEG developed the PPE as a surrogate plant design based on design parameters from the AP1000, U.S. EPR, ABWR, and US-APWR, under consideration for the site (PSEG 2014-TN3453) (Table I-2 of this EIS). Based on the PPE, PSEG developed a general layout for the limits of excavation for the new plant location. The general layout identifies a power block area within which all Seismic Category 1 structures for any of the four technologies would be located, excluding the outlying Category 1 river intake structure (if required by the specific technology). As a preconstruction activity, PSEG would install structural support for excavation at the lateral limits of the construction excavation for the entire power block (PSEG 2012-TN1489).

Construction excavation (i.e., safety-related excavation for Seismic Category 1 structures) would be to the Vincentown formation foundation level (about 70 ft below site grade) and would implement a second set of structural supports. About 5 million yd^3 of soil would be excavated during both preconstruction and construction of the two-unit plant. Material that cannot be reused in the excavation would be retained on the site. PSEG would try to achieve beneficial reuse of the excavated material (PSEG 2012-TN1489).

After the subsurface preparations have been completed and the subgrade has been geologically mapped, the foundations would be installed. The reactor building basemat would be installed first because it is the deepest structure. The detailed steps of installing the reactor building basemat would include the following:

- placement of backfill;
- installing the grounding grid;
- forming the mud-mat concrete work surface; and
- reinforcing steel and civil, electrical, mechanical/piping embedded items (basemat module) and forming, concrete placement, and curing (PSEG 2012-TN1489).

Earthwork for the construction phase at the PSEG Site would involve removing unsuitable materials (soils), both from the overall power block area and from below the Seismic Category 1 structures, and replacing them with suitable backfill materials. Two categories of backfill would be used: Category-1 and Category-2. Category-1 materials would be placed below the basemat bearing grades of the Category 1 structures and adjacent to the below-grade walls of the Category 1 structures. Category 2 materials would extend laterally beyond the Category 1 backfill areas out to the lateral limits of the power block area. The lateral and vertical extent of the excavation for the Category 1 structures within the roughly 70-ac power block area would depend on the plant technology chosen (PSEG 2012-TN1489).

The major activities associated with reactor building construction (which would have the longest construction duration of any project facility) would include

- erecting the reactor concrete containment vessel shell;
- placing the walls, slabs, and reactor pedestal;
- installing the reactor vessel, pool modules, and primary loop components; and
- setting the upper reactor building roof structure.

The mechanical; piping; heating, ventilation, and air conditioning; and electrical installations would begin in the lower elevations of the reactor building and would continue to the upper elevations (PSEG 2012-TN1489).

Turbine building construction would begin with the pedestal basement and buried circulating water piping installation followed by installation of the pedestal columns, condenser modules, and pedestal deck. The building exterior to the turbine pedestal would be erected, and then the turbine building crane and the exterior walls and roof would be installed. The turbine and generator would be assembled inside the building (PSEG 2012-TN1489).

Support facilities that would be constructed within the power block include

- circulating water intake and discharge structures,
- safety-related piping and electrical tunnels,
- UHS structure,
- basin and pump houses,
- machine shop,
- fire protection pump house,
- makeup water treatment building,
- various yard tanks, and
- laboratories for radiological and chemical analyses to support plant operations (PSEG 2012-TN1489).

Power block construction would require clearing and grading 39.4 ac of coastal wetlands. This would include 1,335 linear ft of creek channel (canal ditch) (PSEG 2014-TN3452).

Clearing and grading an area for the proposed cooling tower would potentially permanently affect 48.0 ac of coastal wetlands. This would include 1,280 linear ft of creek channel (canal ditch) and 1,187 linear ft of creek channel (stream) (PSEG 2014-TN3452).

Construction of two switchyards would require clearing and grading that would potentially permanently affect 53.7 ac of coastal wetlands. Included in this area are 2,297 linear ft of creek channel (canal ditch) and 848 linear ft of creek channel (stream) (PSEG 2014-TN3452).

Construction of the new cooling water intake structure would require lowering the Delaware River bottom by 4.5 ft over an area of 31 ac. The total area to be dredged would be 92 ac, extending out from the shoreline 1,700 ft, or 13 percent of the total river width of 2.5 mi in this location. Construction of the intake structure features along the Delaware River shoreline would result in the conversion of 9.5 ac of riparian zone and shallow water habitat to industrial uses. The intake structure would potentially permanently affect 1.5 ac of coastal wetlands (PSEG 2014-TN3452).

3.3.3 Construction Workforce

PSEG states that about 3,950 to 4,100 workers would be on the site for construction of a new nuclear power plant at the PSEG Site (PSEG 2014-TN3453). The analyses in the ER (PSEG 2014-TN3452) assume 2016 as the construction start date and a 68-month construction schedule ending in 2021.

3.3.4 Summary of Resource Commitments During Construction and Preconstruction

Table 3-3 provides a list of the significant resource commitments associated with construction and preconstruction. The values in the table combined with the affected environment described in Chapter 2 provide the basis for the impacts assessed in Chapter 4. These values were stated in the PSEG ER and SSAR (PSEG 2014-TN3452; PSEG 2014-TN3453), and the review team has confirmed that the values are not unreasonable.

Table 3-3. Summary of Resource Commitments Associated with Preconstruction and Construction at the PSEG Site

Parameter Description	Value
Duration of preconstruction and construction activities	68 months (5.67 yr)
Centerpoint of the new plant	Latitude: 39°28′23.744″ North Longitude: 75°32′24.332″ West
Total acreage PSEG Site	819 ac
Acreage of PSEG Site currently owned by PSEG	734 ac
Acreage of PSEG Site to be obtained from the USACE	85 ac
Acreage of PSEG Site to be leased (temporary) from the USACE	45 ac
Disturbed area footprint (temporary) for laydown and construction support area	205 ac
Disturbed area footprint (permanent) total	225 ac
Disturbed area footprint (permanent) for power block	70 ac
Disturbed area footprint (permanent) for intake	Intake dimensions would be 110 ft × 200 ft

Table 3-3 (continued)

Parameter Description	Value
Dredged depth for intake	19 ft 10 in. NAVD
Disturbed area footprint (permanent) for onsite switchyard	63 ac
Width of causeway right-of-way in upland areas at the northern and southern termini	200 ft
Width of elevated causeway in lowland areas	48 ft
Disturbed area for causeway construction	69 ac 45.5 ac (permanent) 23.5 ac (temporary)
Tallest power block structure, from finished grade to top	234 ft
Water from onsite freshwater aquifer for construction uses: potable and sanitary use, concrete mixing and curing, and dust control	119 gpm
Peak construction workforce	4,100 workers
Peak noise level at 50 ft from activity	102 dBA
Peak noise level at 1,500 ft from activity	58 dBA

Source: PSEG 2014-TN3452.

3.4 Operational Activities

The operational activities considered in the staff's environmental review are those associated with structures that interface with the environment. Examples of operational activities are withdrawing water for the cooling system, discharging blowdown water and sanitary effluent, and discharging waste heat to the atmosphere. Safety activities within the plant are discussed by PSEG in the SSAR portion of its application (PSEG 2014-TN3453) and are reviewed by the NRC in its safety evaluation report (in progress).

The following sections describe the operational activities, including the cooling system and its operational modes (Section 3.4.1), the plant-environmental interfaces of importance during operation (Section 3.4.2), and the radioactive and nonradioactive waste management systems (Sections 3.4.3 and 3.4.4).

3.4.1 Description of Cooling System Operational Modes

The operational modes for a new nuclear power plant considered in the assessment of operational impacts on the environment (Chapter 5 of this EIS) are normal operating conditions and emergency shutdown conditions. These are the nominal conditions under which maximum water withdrawal, heat dissipation, and effluent discharges occur. Cooldown, refueling, and accidents are alternative modes to normal plant operation during which water intake, cooling tower evaporation water discharge, and radioactive releases may change from nominal conditions. The primary plant cooling shifts from the CWS to the essential SWS (ESWS) during these alternate modes.

3.4.2 Plant-Environmental Interfaces During Operation

When in operation, the new plant would produce electrical energy from nuclear fuel using a steam turbine system as described in Section 3.2.1. Waste heat is a by-product of normal power generation at a nuclear power plant. The excess heat that remains in the closed loop steam system after it passes through the turbines would be transferred to the atmosphere through evaporation using cooling towers, as described in Section 3.2.2.1. Water for the new cooling towers would be obtained from a new intake structure to be built on the Delaware River, as described in Section 3.2.2.1. The following sections describe the proposed plant environmental interfaces during operation in terms of its CWS (Section 3.4.2.1), landscape and drainage (Section 3.4.2.2), ESWS or UHS (Section 3.4.2.3), and emergency diesel generators (Section 3.4.2.4).

3.4.2.1 Circulating Water System

As discussed in Sections 3.2.1 and 3.2.2, a new makeup water intake structure would be located west of the plant on the Delaware River shoreline about 2,800 ft north of the HCGS service water intake structure (Figure 2-2). The intake structure bay and screens would be sized such that the average intake through-screen velocity would be less than 0.5 fps to meet the requirements of the Clean Water Act Section 316(b) Phase I rule (33 USC 1251-TN662).

The plant discharge would consist of CWS and SWS blowdowns, SWS makeup filter backwash, and other wastewater streams, including those from PSWSs, demineralized water systems, miscellaneous drains blowdowns, and liquid radwaste flow (Sections 3.2.1 and 3.2.2). The combined plant discharge would average 51,946 gpm with a maximum of 53,222 gpm. An NJPDES permit for the plant would specify volumes and constituent concentrations of the plant discharge.

The plant would use one or two wet cooling towers to dissipate waste heat (Sections 3.2.1 and 3.2.2). The CWS cooling towers would use mechanical draft, natural draft, or fan-assisted natural draft design, and the SWS cooling towers would be a mechanical draft design.

3.4.2.2 Landscape and Drainage

At the ESP stage, PSEG has not selected a single reactor design that would be used for a new nuclear power plant. Therefore, detailed site layout and drainage system features are not available. However, PSEG has provided a general description of landscape and drainage in Chapter 2, Section 2.4, of the ESP SSAR (PSEG 2014-TN3453). The following discussion summarizes the information provided in the SSAR.

The design basis flood (DBF) elevation would be 35.9 ft NAVD88. The floor elevation of safety-related SSCs for the new plant, other than a potentially safety-related portion of the intake structure, would be 1 ft above the DBF elevation to comply with the design control document of the selected reactor design. The site would be graded such that runoff from the site and power block area would be directed to a system of swales and pipes that would discharge to the Delaware River. At this stage, PSEG has stated that most of the area of the new plant would drain to the north and west, away from existing facilities at SGS and HCGS.

The new plant would require a stormwater management system. However, the detailed design of the stormwater system is not yet complete because the site layout is currently not known in the absence of a selected reactor design. PSEG would be required to follow applicable Federal, State, and local stormwater management regulations and to implement best management practices to minimize adverse effects on water quality.

3.4.2.3 Essential Service Water System

As discussed in Sections 3.2.1 and 3.2.2, and shown in Table 3-1, the UHS makeup water flow rate during emergencies would be 4,568 gpm.

3.4.2.4 Emergency Diesel Generators

Diesel generators would be used during emergency conditions to provide electricity for water pumping and support for other emergency activities. When in use, these diesel generators would emit criteria pollutants [as defined under the U.S. Environmental Protection Agency (EPA) National Ambient Air Quality Standards (EPA 2013-TN1975)]. Based on the bounding assumptions for the PPE (PSEG 2014-TN3453), the PSEG Site would have six backup generators (four emergency and two normal) as part of the emergency power supply system. The anticipated annual auxiliary boiler and diesel generator air emissions, which include nitrogen oxides, sulfur oxides, carbon monoxide, hydrocarbons in the form of volatile organic compounds, and particulate matter, are provided in Table 3-4. Modifications to the SGS and HCGS Title V Operating Permit under the Clean Air Act (42 USC 7401-TN1141), addressing emissions and compliance with State and Federal regulations, would be required for a new plant.

Table 3-4. Annual Estimated Pollutant Emissions from Cooling Towers, Auxiliary Boilers, and Stationary Fuel-Burning Emergency Power Equipment at a New Nuclear Power Plant at the PSEG Site

Emission Effluent	Cooling Towers (lb/yr)[(a)]	Auxiliary Boilers (lb/yr)[(b)]	Diesel Generators (lb/yr)[(c)]	Total Emissions	
				(lb/yr)	(ton/yr)
Nitrogen Oxides	NA[(d)]	76,088	28,968	105,056	52.5
Carbon Monoxide	NA	6,996	4,600	11,596	5.8
Sulfur Oxides	NA	460,000	5,010	465,010	232.5
Volatile Organic Compounds[(e)]	NA	400,800	3,070	403,870	201.9
Particulates (PM_{10})	122,000	138,000	1,620	261,620	130.8

(a) Based on 8,760 hr of operation at 13.9 lb/hr.
(b) Based on 120 days of operation; PPE values are based on 30 days/year operation—to obtain emissions for 120 days, the value in the PPE is multiplied by 4.
(c) Based on 4 hr of operation per month.
(d) NA = not applicable.
(e) Volatile organic compounds as total hydrocarbon.

Source: PSEG Environmental Report Table 5.8-1 (PSEG 2014-TN3452), which is based on PSEG Site Safety Analysis Report Tables 1.3-4 through 1.3-6 (PSEG 2014-TN3453).

3.4.3 Radioactive Waste Management Systems

Liquid, gaseous, and solid radioactive waste management systems would be used to collect and treat the radioactive materials produced as by-products of operating a new nuclear power plant at the PSEG Site. These systems would process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits and to levels as low as reasonably achievable before releasing them to the environment. Waste processing systems would be designed to meet the design objectives of 10 CFR 50 (10 CFR 50-TN249), "Domestic Licensing of Production and Utilization Facilities," Appendix I (*Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radiological Material in Light Water-Cooled Nuclear Power Reactor Effluents*), and 10 CFR 20 (10 CFR 20-TN283), "Standards for Protection Against Radiation."

Radioactive material in the reactor coolant would be the primary source of gaseous, liquid, and solid radioactive wastes in light water reactors. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products would be contained in the sealed fuel rods, but small quantities escape the fuel rods into the reactor coolant. Neutron activation of the primary coolant system would also be responsible for coolant contamination and for induced radioactivity in reactor components.

PSEG has not identified specific radioactive waste management systems for a new nuclear power plant on the PSEG Site. The PPE concept was used to provide an upper bound on liquid radioactive effluents, gaseous radioactive effluents, and solid radioactive waste releases. Adequate design information to estimate liquid and gaseous radioactive effluents was available for all four reactor designs considered in establishing the PPE values. Bounding effluent concentrations were determined based on a composite of the highest activity content of the individual isotopes for single unit U.S. EPR, single unit ABWR, single unit US-APWR, and dual unit AP1000. Bounding liquid effluent releases and gaseous effluent releases are provided in Table 1.3-8 and Table 1.3-7, respectively, of the PSEG SSAR (PSEG 2014-TN3453).

Solid radioactive wastes produced from operation of a new plant would be either dry or wet solids. The solid radioactive waste management system would receive, collect, and store solid wastes before onsite storage or shipment off the site. PSEG has indicated that low-level solid waste for the site would be coordinated with storage from the existing HCGS and SGS. The estimated bounding annual volume of radioactive solid waste is 16,721.5 ft^3 per year with an estimated bounding radioactive material activity of 1.18×10^6 Ci per year (PSEG 2014-TN3453; Table 1.3-1 for the volume and Table 1.3-3 for the activity).

3.4.4 Nonradioactive Waste Management Systems

The following sections provide descriptions of the nonradioactive waste systems for a new nuclear power plant at the PSEG Site, including systems for chemical, biocide, and sanitary waste streams and other effluents. Detailed information regarding nonradioactive waste management and effluent control systems, process/instrumentation diagrams, and system process flow diagrams would be provided during the COL application phase following reactor technology selection. Bounding parameters from the PPE, described in the PSEG SSAR (PSEG 2014-TN3453), and site-specific characteristics are used to establish conceptual nonradioactive waste system descriptions.

3.4.4.1 Effluents Containing Chemicals or Biocides

This section describes the nonradioactive waste systems and the chemical and biocidal characteristics of the nonradioactive waste streams collected by the wastewater treatment system before discharge. Water chemistry for various plant water uses would be controlled with the addition of biocides, algaecides, corrosion inhibitors, scale inhibitors, and dehalogenators. The new plant at the PSEG Site would use chemicals and biocides similar to those currently used for the existing operations at HCGS and SGS, including sodium hypochlorite, sodium silicate, and sodium bisulfite. The following nonradioactive wastewater constituents may be generated in the secondary systems associated with a new plant at the PSEG Site:

- sodium and sulfate salts from neutralized sodium hydroxide and sulfuric acid used for regeneration of resins,
- sulfuric acid for calcite scale control in cooling water systems,
- phosphate from cleaning liquids,
- chloride,
- biocides used for defouling purposes,
- residual oxidants,
- boiler blowdown chemicals, and
- oil and grease from plant floor drains.

Table 3-5 provides the estimated concentrations of impurities in the blowdown water and other plant flows which contribute to cooling water and plant effluent discharge to the Delaware River (PSEG 2014-TN3453). The chemical concentrations within the new plant effluent streams would be controlled through engineering and operational controls to meet NJPDES requirements as well as requirements set by Federal, regional, or local regulatory agencies at the time of construction and operation.

Table 3-5. Blowdown Constituents and Concentrations in Liquid Effluent Discharge

Constituents (mg/L)	CWS Blowdown	SWS/UHS Blowdown	SWS Water Treatment Discharge	Sanitary System Discharge	Other Plant Discharge	Combined Discharge
pH	7.6	7.5	7.1	8.1	8.1	7.6
Alkalinity ($CaCO_3$)	70	64	47.1	283	293	71
Suspended Solids	180	30	30	30	30	176
TDS	9,860	13,150	6,280	624	545	9,894
Total Hardness ($CaCO_3$)	2,020	2,700	1,330	134	120	2,027

Table 3-5 (continued)

Constituents (mg/L)	CWS Blowdown	SWS/UHS Blowdown	SWS Water Treatment Discharge	Sanitary System Discharge	Other Plant Discharge	Combined Discharge
Calcium	146	195	96	29	27	147
Magnesium	403	537	264	15	12	404
Sodium	3,020	4,030	1,980	120	99	3,030
Chloride	5,490	7,330	3,725	52	26	5,508
Sulfate	748	1,030	507	33	16	751
Bicarbonate	83	77	56.4	310	357	84
Ammonia	0.5	0.6	0.313	25	—	0.5
Phosphate (ortho)	0.5	0.7	0.35	5	—	0.5
Silica (SiO_2)	1.0	1.3	0.67	12	10	1.0

Source: PSEG Site Safety Analysis Report, Table 1.3-2 (PSEG 2014-TN3453).

3.4.4.2 Sanitary System Effluents

This section briefly describes the anticipated volumes generated during construction or operation and the method for ultimate disposal of treated wastes.

The sewage treatment system that treats the daily flow from the existing PSEG Site would be upgraded to accommodate a new power plant. Conceptually, the new plant could include two units, each with a capacity of 70,000 gpd, and be equipped with an extended aeration activated sludge system. Each unit would include an aeration tank and clarifier followed by a chlorine contact chamber. A single surge tank would be provided to equalize variations in influent flows to the treatment units. A sludge holding tank would be provided for waste sludge. Residuals would be disposed off the site in a manner similar to current practices at the existing PSEG plants.

PSEG reports the bounding influent flow to the sanitary treatment system for operating the new plant on average would be 93 gpm, which equates to an average daily flow rate of 134,000 gpd. The bounding influent flow during construction is 123,000 gpd (85 gpm average) based on the peak construction workforce of 4,100 persons (PSEG 2014-TN3453) and a flow of 30 gal per capita per day (PSEG 2014-TN3452).

New plant effluent discharges would be regulated under the provisions of the Clean Water Act (33 USC 1251-TN662), and the conditions of discharge, including total suspended solids and 5-day biochemical oxygen demand, would be specified in the NJPDES permit. The estimated operational normal and maximum effluent flow rate from the sanitary waste water system is 93 gpm (PSEG 2014-TN3452).

3.4.4.3 Other Nonradioactive Waste Effluents

Gaseous Emissions

Nonradioactive gaseous emissions would result from the cooling towers, the seasonal and intermittent operation of the auxiliary boilers, and the intermittent testing and operation of the standby power system generators. The primary sources of emissions would be the auxiliary boilers, standby power units such as diesel generators or gas turbines, and engine-driven emergency equipment. The auxiliary boilers would be used for heating the new plant buildings, primarily during the winter months, and for process steam during plant start-ups. The standby diesel generators, standby gas-turbine generators, and engine-driven emergency equipment would be used intermittently and for brief durations. Low sulfur fuels would be used for all equipment, minimizing gaseous and particulate emissions during the periods when the equipment operated. The cooling towers would be the primary source of particulate emissions. These emissions commonly include particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides (PSEG 2014-TN3452).

The auxiliary boiler would exhaust from an elevation of 150 ft above grade, the standby diesel generators' exhaust would be at an elevation of 50 ft above grade, and the gas-turbines' exhaust would be at an elevation of 50 ft above grade. Table 3-4 in Section 3.4.2.4 summarizes pollutant emissions from the cooling towers, gas turbine generators, diesel generators, and auxiliary boilers. PSEG states that gaseous releases will comply with Federal, State, and local emissions standards.

PSEG states that the site is within an ozone nonattainment area (Salem County, New Jersey) and adjacent to a nonattainment area for particulate matter smaller than 2.5 microns in diameter (New Castle County, Delaware). The new plant would comply with all regulatory requirements of the Clean Air Act (42 USC 7401-TN1141), including requirements of the NJDEP Division of Air Quality and Delaware Department of Natural Resources and Environmental Control, Division of Air Quality, thereby minimizing any impacts on state and regional air quality. Modifications to the SGS and HCGS Air Operating Permit under Title V of the Clean Air Act from the NJDEP would be required for the plant, addressing emissions and compliance with State and Federal regulations.

Small amounts of volatile organic compounds would also be generated from the use of common building maintenance materials such as paints, adhesives, and caulk; from mechanical maintenance materials such as oils and solvents; and periodically from activities such as asphalt resealing.

Liquid Effluents

Nonradioactive liquid effluents that potentially drain to the Delaware River would be limited under the NJPDES permit. These liquid effluents would primarily be discharges from site storm drainage outfalls and plant drains and other power block discharges such as CWS and SWS blowdown and the sanitary water system. Existing site storm drainage outfalls may be modified, and new outfalls to the Delaware River may be constructed to accommodate adjusted flow paths or volumes created by building and operating a new nuclear power plant at the PSEG Site

(PSEG 2014-TN3452). Liquid effluents from the power block of the new plant would be combined with the cooling tower blowdown and sanitary system effluent, treated in the wastewater treatment facility, and routed to the common plant outfall that discharges to the Delaware River. Table 3-5 provides a summary of the combined discharge from the five primary flows. The design of the stormwater systems for a new plant would comply with relevant Federal, State, and local stormwater regulations. The total residual chemical concentrations in the discharges to the Delaware River watershed are subject to limits established by the NJDEP which are deemed protective of the water quality of the Delaware River (PSEG 2014-TN3452).

Solid Effluents

Nonradioactive solid wastes would include typical industrial wastes such as metal, wood, and paper and process wastes such as nonradioactive resins and sludge. PSEG is currently a conditionally exempt small-quantity hazardous waste generator, generating less than 100 kg per month (220 lb/month). PSEG maintains the programs required of a small-quantity generator and monitors the amount of hazardous waste generated each month. Hazardous waste is disposed of through licensed disposal facilities. Universal waste, such as paint waste, lead-acid batteries, used lamps, and mercury-containing switches, is segregated and disposed of off the site through licensed disposal facilities.

Normal station waste (e.g., paper, plastic, glass, river vegetation) is segregated and, as much as possible, processed for recycling. Currently, about two-thirds of the normal station waste is transferred to recycling vendors and the remainder either incinerated or placed in a landfill (PSEG 2014-TN3452). Normal station waste generated by a new plant would be accommodated by existing practices at the SGS and HCGS sites.

Other Effluents

Mixed waste is a combination of hazardous waste and low level radioactive material, special nuclear material, or byproduct materials. Mixed waste could be created during activities such as routine maintenance, refueling, and radiochemical laboratory work. The NRC (10 CFR) and EPA (40 CFR) regulations govern generation, management, handling, storage, treatment, disposal, and protection requirements associated with these wastes. Management of these wastes would conform to applicable Federal and State requirements in a manner similar to that for existing PSEG operations. The quantities expected from a new plant would be small (PSEG 2014-TN3452).

4.0 CONSTRUCTION IMPACTS AT THE PROPOSED SITE

This chapter examines the environmental issues associated with building a new nuclear power plant at the PSEG Power, LLC, and PSEG Nuclear, LLC (PSEG) Site as described in the application for an early site permit (ESP) submitted by PSEG to the U.S. Nuclear Regulatory Commission (NRC). As part of its application, PSEG submitted (1) an Environmental Report (ER) (PSEG 2014-TN3452), which discusses the environmental impacts of building, operating, and decommissioning a new nuclear power plant, and (2) a Site Safety Analysis Report (SSAR) (PSEG 2014-TN3453), which addresses safety aspects of building and operating a new nuclear power plant. PSEG will also submit a Joint Federal-State Application for the Alteration of Any Floodplain, Waterway, or Tidal or Nontidal Wetland in New Jersey to the U.S. Army Corps of Engineers (USACE) and to the New Jersey Department of Environmental Protection (NJDEP).

As discussed in Section 3.3 of this environmental impact statement (EIS), the NRC authority related to building new nuclear units is limited to construction “activities that have a reasonable nexus to radiological health and safety and/or common defense and security” (72 FR 57416-TN260). The NRC has defined “construction” within the context of its regulatory authority. Many of the activities required to build a nuclear power plant do not fall within the NRC regulatory authority and, therefore, are not “construction” as defined by the NRC. Such activities are referred to as “preconstruction” activities in Title 10 of the *Code of Federal Regulations* (CFR) Part 51.45(c) (10 CFR 51-TN250). The NRC staff evaluates the direct, indirect, and cumulative impacts of the construction activities that would be authorized if the holder of an ESP applied for and was issued a combined construction permit (CP) and operating license [(OL); i.e., a combined operating license or COL] for the site. The environmental effects of preconstruction activities (e.g., clearing and grading, excavation, and erection of support buildings) are included as part of this EIS in the evaluation of cumulative impacts.

As described in Section 1.1.6, the USACE is a cooperating agency on this EIS consistent with the updated Memorandum of Understanding (MOU) signed with the NRC (USACE/NRC 2008-TN637). The NRC and USACE established this cooperative agreement because both agencies concluded it is the most effective and efficient use of Federal resources in the environmental review of a proposed new nuclear power plant. The goal of this cooperative agreement is the development of one EIS that provides all the environmental information and analyses needed by the NRC to make a license/permit decision and all the information needed by the USACE to perform analyses, draw conclusions, and make a permit decision in the USACE Record of Decision documentation. To accomplish this goal, the environmental review described in this EIS was conducted by a joint NRC-USACE team. The review team was composed of the NRC staff and its contractors and staff from the USACE.

The USACE is responsible for ensuring that the information presented in this EIS is adequate to fulfill the requirements of the USACE regulations; the U.S. Environmental Protection Agency’s (EPA’s) 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (40 CFR 230-TN427), hereafter the 404(b)(1) Guidelines, which contains the substantive

environmental criteria used by the USACE in evaluating discharges of dredged or fill material into waters of the United States; and the USACE public interest review process. The USACE will decide whether to issue a permit based on an evaluation of the probable impact including cumulative impacts of the proposed activity on the public interest. By guidelines, no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impact on the aquatic ecosystem provided the alternative does not have other significant adverse consequences. That USACE decision will reflect the national concern for both protection and use of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. Factors that may be relevant to the proposal will be considered including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, historic and cultural resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and, in general, the needs and welfare of the people.

Many of the impacts the USACE must address in its analysis are the result of preconstruction activities. Also, most of the activities conducted by a COL applicant that would require a permit from the USACE would be preconstruction activities. PSEG plans to submit an application to the USACE for a permit to conduct the following activities: filling, dredging, grading, and building structures.

While both the NRC and the USACE must meet the requirements of the National Environmental Policy Act of 1969, as amended (NEPA) [42 USC 4321 et seq. (42 USC 4321-TN661)], both agencies also have mission requirements that must be met in addition to the NEPA requirements. The NRC regulatory authority is based on the Atomic Energy Act of 1954, as amended [42 USC 2011 et seq. (42 USC 2011-TN663)]. The USACE regulatory authority related to the proposed action is based on Section 10 of the Rivers and Harbors Appropriations Act of 1899 (33 USC 403-TN660), which prohibits the obstruction or alteration of navigable waters of the United States without a permit from the USACE, and Section 404 of the Clean Water Act (CWA) (33 USC 1344-TN1019), which prohibits the discharge of dredged or fill material into waters of the United States without a permit from the USACE. Therefore, the applicant may not commence preconstruction or construction activities in jurisdictional waters, including wetlands, without a USACE permit. The USACE will complete its evaluation of the proposed project after it fully considers the recommendations of the USACE staff; Federal, State, and local resource agencies; and members of the public and assesses the cumulative impact of the total project and after the following consultations and coordination efforts are completed: Section 106 of the National Historic Preservation Act (16 USC 470-TN993), including, as appropriate, development and implementation of any Memorandum of Agreement; 16 USC 1531 et seq., the Endangered Species Act of 1973 (16 USC 1531-TN1010); Essential Fish Habitat Assessment (NOAA 1999-TN1845); State forest conservation plans; State water-quality certifications; and State coastal zone consistency determinations. Because the USACE is a cooperating agency under the MOU for this EIS, the USACE decision of whether to issue a permit will not be made until after public comment has been received on this NRC-USACE draft EIS and the final EIS is issued.

The collaborative effort between the NRC and the USACE in presenting the discussion of the environmental effects of building a new nuclear power plant, in this chapter and elsewhere, must serve the needs of both agencies. Consistent with the MOU, the NRC and USACE staffs collaborated in the (1) review of the ESP application and information provided in response to requests for additional information (developed by the NRC and the USACE) and (2) development of the EIS. The NRC regulations [10 CFR 51.45(c) (10 CFR 51-TN250)] require that the impacts of preconstruction activities be addressed by the applicant as cumulative impacts in its ER. Similarly, the NRC analysis of the environmental effects of preconstruction activities on each resource area would be addressed as cumulative impacts, normally presented in Chapter 7 of the EIS. However, because of the collaborative effort between the NRC and the USACE in the environmental review, the combined impacts of construction activities that would be authorized by the NRC with the eventual issuance of a COL and preconstruction activities are presented in this chapter. For each resource area, the NRC also provides an impact characterization solely for construction activities that meet the NRC definition of construction at 10 CFR 50.10(a) (10 CFR 50-TN249). The combined impacts of construction and preconstruction activities are considered in the description and assessment of cumulative impacts in Chapter 7 of this EIS.

For most environmental resource areas (e.g., terrestrial ecology), the impacts are not solely the result of either preconstruction or construction activities. Rather, the impacts are attributable to a combination of preconstruction and construction activities. For most resource areas, the majority of the impacts would occur as a result of preconstruction activities.

This chapter is divided into 12 sections. In Sections 4.1 through 4.11, the review team evaluates the potential impacts on land use, water use and quality, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological health effects, radiological health effects, nonradioactive waste, and applicable measures and controls that would limit the adverse impacts of building a new nuclear power plant. An impact category level—SMALL, MODERATE, or LARGE—of potential adverse impacts has been assigned by the review team for each resource area using the definitions for these terms established in Chapter 1. In some resource areas, for example, in the socioeconomic area where the impacts of taxes are analyzed, the impacts may be considered beneficial and would be stated as such. The review team determination of the impact category levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and county governments, such as infrastructure upgrades (discussed throughout this chapter), are implemented. Failure to implement these upgrades might result in a change in the impact category level. Possible mitigation of adverse impacts, where appropriate, is presented in Section 4.11. A summary of the construction impacts is presented in Section 4.12. The technical analyses provided in this chapter support the results, conclusions, and recommendations presented in Chapters 7, 9, and 10.

The review team evaluation of the impacts of building a new nuclear power plant at the PSEG Site draws on information presented in the PSEG ER and SSAR (PSEG 2014-TN3452, and PSEG 2014-TN3453, respectively) and supplemental documents, the USACE permitting documentation, and other government and independent sources.

4.1 Land-Use Impacts

This section provides information on land-use impacts associated with site-preparation activities (preconstruction) and construction of a new nuclear power plant at the PSEG Site. The breakdown of activities into preconstruction and construction categories is provided in Section 3.3 and discussed in Section 4.1.1. Topics discussed in this section include land-use impacts at the PSEG Site and in the vicinity of the site (Section 4.1.1) and at offsite areas, especially the proposed causeway alignment (Section 4.1.2).

4.1.1 The Site and Vicinity

As discussed in Section 2.2.1, the PSEG Site includes 819 ac, of which PSEG owns 734 ac as the existing PSEG property. For a new nuclear power plant, PSEG would acquire from the USACE an additional 85 ac north of Hope Creek Generating Station (HCGS) (Figure 2-2). During construction, PSEG would temporarily lease from the USACE an additional 45 ac north of the PSEG Site as the location of the concrete batch plant and a construction/laydown area (PSEG 2014-TN3452).

Land-use impacts associated with building a new nuclear power plant on the PSEG Site would result from land disturbance and changes in land use during both preconstruction and construction activities. Preconstruction activities would include site clearing and grading, implementing erosion control and other environmental mitigation measures, erecting fences, excavation, erecting support buildings, and building onsite roads and transmission lines. Construction activities for safety-related structures, systems, or components would include driving piles; subsurface preparation; placing backfill, concrete, or permanent retaining walls within an excavation; installing foundations; or assembling, erecting, fabricating, or testing those structures in place.

As described by PSEG, these preconstruction and construction activities would disturb up to 431 ac on the PSEG Site and in the immediate vicinity (excluding the proposed causeway). Of this total, 225 ac on the PSEG Site would be permanently disturbed to support developed or industrial land uses associated with a new nuclear power plant (including 70 ac for the power block), and 205 ac would be temporarily disturbed for laydown and construction areas (160 ac on the PSEG Site and 45 ac off the site) (Table 4-1) (PSEG 2014-TN3452).

The 225 ac that would be permanently disturbed to support urban or built-up land uses includes 108 ac of wetland [primarily *Phragmites*- (common reed–) dominated coastal and interior wetlands], 47 ac of urban or built-up land associated with HCGS and Salem Generating Station (SGS), 43 ac of water (artificial lakes and tidal waters), 19 ac of barren land, and 9 ac of forestland (Table 4-1 and Figure 4-1). More than one third of the area that would be permanently disturbed (85 ac of the total 225 ac) is currently part of the USACE Artificial Island Confined Disposal Facility (CDF). The urban or built-up lands on the PSEG Site that would be permanently disturbed have been or are being used for construction and operation of HCGS and SGS (PSEG 2014-TN3452).

Table 4-1. Land-Use Changes from Preconstruction and Construction Activities on the PSEG Site

	PSEG Site			Adjacent Offsite Areas[(a)]
New Jersey Land-Use Category	**Total Onsite Area (ac)**	**Permanent Use (ac)**	**Temporary Use (ac)**	**Temporary Use (ac)**
Urban or Built-Up Land				
Industrial	234.5	26.4	5.1	0.0
Transportation/Communication/Utilities	8.5	0.0	0.0	0.0
Wetlands Right-of-Way	23.8	11.7	5.9	0.0
Upland Right-of-Way Developed	0.5	0.0	0.2	0.0
Upland Right-of-Way Undeveloped	29.5	0.0	19.6	0.0
Other Urban or Built-Up Land	55.8	8.1	9.5	2.4
Phragmites-Dominated Urban Area	0.5	0.5	0.0	0.0
Recreation Land	4.9	0.0	4.4	0.0
Subtotal:	**358.0**	**46.7**	**44.7**	**2.4**
Forestland				
Old Field (<25 percent brush covered)	69.4	2.6	54.3	0.0
Phragmites-Dominated Old Field	31.9	0.1	26.0	0.0
Deciduous Brush/Shrubland	6.0	6.0	0.0	0.0
Subtotal:	**107.3**	**8.7**	**80.3**	**0.0**
Water				
Artificial Lakes	40.4	40.3	0.0	0.0
Tidal Rivers, Inland Bays, and Other Tidal Waters	5.6	2.9	0.3	0.1
Subtotal:	**46.0**	**43.2**	**0.3**	**0.1**
Wetlands				
Saline Marsh	0.2	0.1	0.0	0.8
Phragmites-Dominated Coastal Wetlands	155.6	58.3	5.1	2.1
Herbaceous Wetlands	5.8	0.9	2.5	0.0
Deciduous Scrub/Shrub Wetlands	4.6	4.6	0.0	0.0
Phragmites-Dominated Interior Wetlands	118.7	44.1	24.2	27.3
Subtotal:	**284.9**	**108.0**	**31.8**	**30.2**
Barren Land				
Altered Lands	14.8	14.8	0.0	0.7
Disturbed Wetlands (modified)	4.3	4.0	0.1	11.8
Subtotal:	**19.1**	**18.8**	**0.1**	**12.5**
Managed Wetlands				
Managed Wetland in Maintained Lawn Green Space	3.8	0.0	2.7	0.0
Subtotal:	**3.8**	**0.0**	**2.7**	**0.0**
Total:	**819.1**	**225.4**	**159.9**	**45.2**

(a) Located in the USACE Artificial Island Confined Disposal Facility and include batch plant, heavy haul road, and construction laydown area.

Source: Modified from PSEG 2014-TN3452.

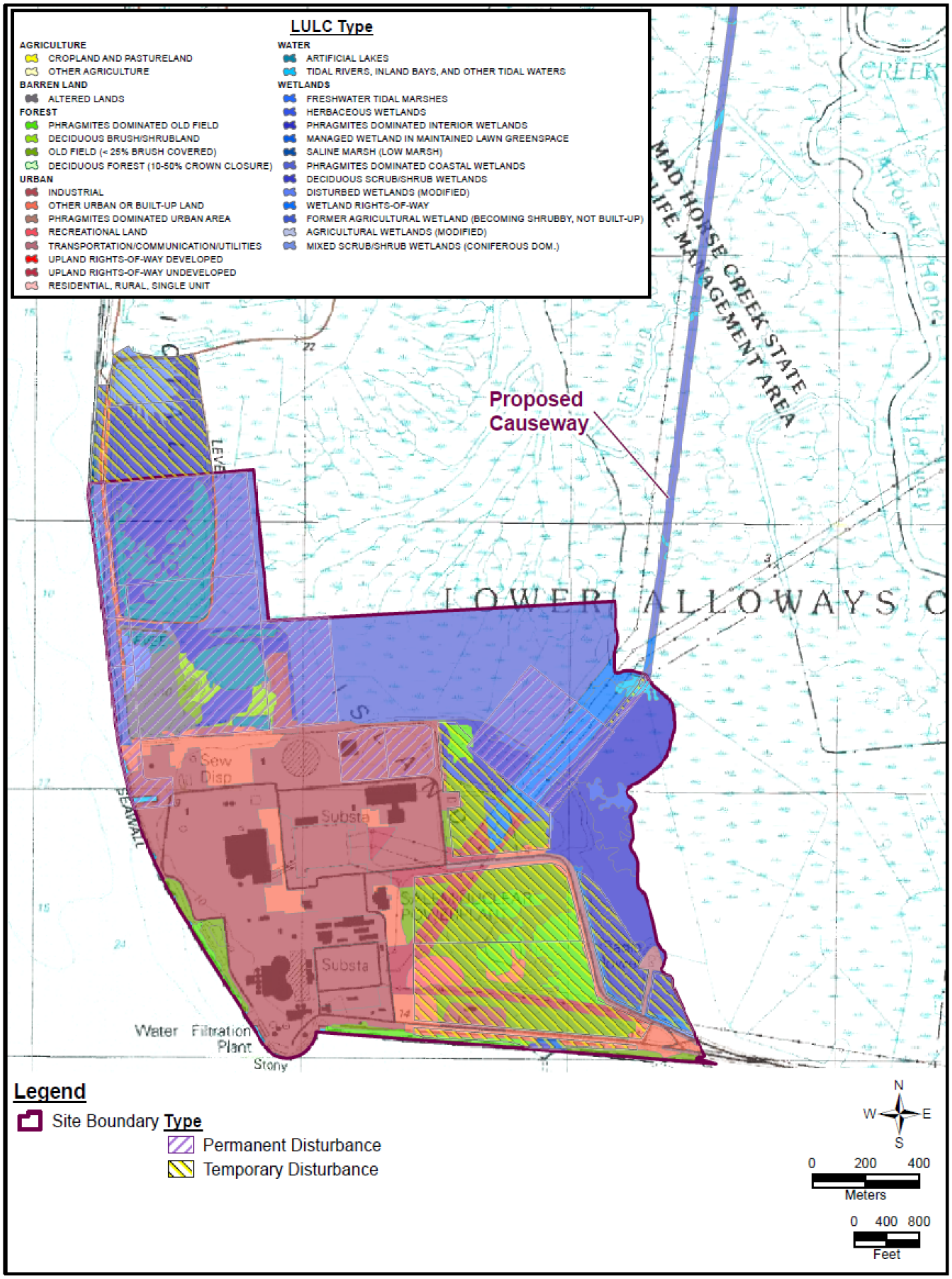

Figure 4-1. Land Use/Land Cover Impacted by Preconstruction and Construction at the PSEG Site and in the Vicinity. ***(Source: Modified from PSEG 2014-TN3452)***

The 160 ac that would be temporarily disturbed on the PSEG Site includes 80 ac of old field and *Phragmites*-dominated old field, 27 ac of wetlands (primarily *Phragmites*-dominated interior wetlands), and 45 ac of urban or built-up land. Most of the old field and wetlands that would be temporarily disturbed are currently part of the Artificial Island CDF. The urban or built-up lands on the PSEG Site that would be temporarily disturbed have been or are being used for construction and operation of HCGS and SGS (PSEG 2014-TN3452).

The 45-ac offsite parcel that would be temporarily disturbed is part of the Artificial Island CDF and includes 30 ac of wetlands (primarily *Phragmites*-dominated interior wetlands), 13 ac of barren land, and 2 ac of urban or built-up land) (PSEG 2014-TN3452).

PSEG stated that fill material would be needed to elevate a new nuclear power plant and associated structures to final grade at the PSEG Site (PSEG 2014-TN3452). During the Environmental Site Audit, PSEG stated that as much as 7.5 million yd^3 of fill material could be needed at the PSEG Site and that, to the extent possible, this material would come from the existing PSEG property. If additional fill material were needed from off the site, PSEG stated that it would come from existing permitted borrow areas and identified numerous potential borrow sites in New Jersey, Delaware, and Maryland (PSEG 2012-TN2282).

Of the 819-ac PSEG Site, both the 734-ac parcel owned by PSEG and the 85-ac parcel to be acquired by PSEG are zoned for “Industrial Use” by Lower Alloways Creek Township (LACT 1999-TN2416). Thus, building a new nuclear plant on the PSEG Site would be consistent with existing land uses at HCGS and SGS and with current land-use zoning.

As discussed in Section 2.2.1, the NJDEP Division of Land Use Regulation has determined that the PSEG ESP application is consistent with State of New Jersey Rules on Coastal Zone Management as amended to January 20, 2009, with one condition:

> *“As proposed, the project will require a CAFRA Individual Permit, Coastal Wetlands Permit, Waterfront Development Permit, and Freshwater Wetlands Individual Permit from the Division. These permits must be obtained prior to any construction activities on the site related to the project described above”* (NJDEP 2010-TN235).

The New Jersey State Planning Commission State Plan Policy Map delineates *a “Heavy Industry-Transportation-Utility Node”* on Artificial Island, including 501 ac of the existing 734-ac PSEG property (see Section 2.2.1). PSEG has submitted a petition to expand this existing node from 501 ac to 534 ac (to include the location of a new nuclear power plant) and to add 288 ac of the USACE Artificial Island CDF. The PSEG petition is currently under review by the State (PSEG 2012-TN2282). If approved, this node expansion would facilitate the development of a new nuclear power plant on the PSEG Site.

There are no prime farmlands or farmlands of unique or statewide importance on the PSEG Site (PSEG 2014-TN3452), and building a new nuclear power plant on the site would not affect any such farmlands in the vicinity. Likewise, there are no lands under Deeds of Conservation Restriction (DCRs) or Wildlife Management Areas (WMAs) on the PSEG Site, and building a new nuclear power plant on the site would not affect any of the lands under DCRs or lands in WMAs in the vicinity of the site (PSEG 2012-TN2282).

Overall, the land-use impacts of building a new nuclear power plant on the PSEG Site would be sufficient to alter noticeably, but not to destabilize, important attributes of existing land uses on the site. Much of the land disturbance (205 ac of a total of 430 ac) would be temporary, and the land would return to its existing use once preconstruction and construction activities were completed. However, most of the permanent land disturbance (143 ac of a total of 225 ac) would occur on *Phragmites*-dominated wetlands and artificial lakes, and much of this area (85 ac) is in the parcel that PSEG would acquire from the USACE. Land-use impacts on this 85-ac parcel would be somewhat larger than those on the existing PSEG property because it supports the USACE dredging operations as part of the Artificial Island CDF. The Artificial Island CDF provides the USACE with dredge spoil disposal capacity adjacent to the Delaware River, and the USACE would need to replace some or all of this disposal capacity by using an existing CDF or developing a new CDF at another location. Combined, the change in land use of 143 ac from *Phragmites*-dominated wetlands and artificial lakes to developed and industrial uses and the USACE loss of dredge spoil disposal capacity at the Artificial Island CDF would alter noticeably, but not destabilize, existing land uses on the PSEG Site.

Based on the information provided by PSEG and the review team independent review, the review team concludes that the combined land-use impacts of preconstruction and construction activities on the PSEG Site would be MODERATE, primarily because of the USACE loss of dredge spoil disposal capacity at the Artificial Island CDF. Based on this analysis, and because the NRC-authorized construction activities (i.e., power block construction) would occur on the 85-ac parcel that PSEG would acquire from the USACE, the NRC staff concludes that the land-use impacts of the NRC-authorized construction would also be MODERATE.

4.1.2 Offsite Areas

As discussed in Section 2.2.2.3, PSEG proposes to build a three-lane elevated causeway from the northeast corner of the PSEG property along or adjacent to the existing Hope Creek-Red Lion transmission corridor to the intersection of Money Island Road and Mason Point Road (Figure 2-7). Portions of the causeway could potentially affect jurisdictional wetlands and would be subject to USACE review and permit approval. The causeway would be about 5.0 mi long, have 200-ft-wide rights-of-way (ROWs) in upland areas at the northern and southern termini, and have a 48-ft-wide structure for the elevated portions within lowland areas (PSEG 2014-TN3452).

Land-use impacts associated with building the proposed causeway would result from land disturbance and changes in land use due to preconstruction activities. Preconstruction activities would be associated with road building at each end of the causeway and with building the piers on which the elevated causeway would be installed. Permanent impacts would result from the placement of structures (piers, pilings, or other support structures) and shading from the 50-ft-wide causeway. Temporary impacts would result from the temporary placement of work mats to support equipment, materials, and personnel.

As described by PSEG, these preconstruction activities would disturb up to 69.0 ac along the proposed causeway corridor. Of this total, 45.5 ac would be permanently disturbed to support developed land uses associated with the causeway, and 23.5 ac would be temporarily disturbed for laydown and construction areas (Table 4-2). These areas of disturbance are based on a

50-ft-wide permanent ROW and an additional 50-ft-wide area along the elevated portion to be temporarily affected during causeway construction (PSEG 2014-TN3452).

Table 4-2. Offsite Land-Use Changes from Building the Proposed Causeway

New Jersey Land-Use Category	Total Acres	Permanent Use (ac)	Temporary Use (ac)
Urban or Built-Up Land			
Residential, Rural, Single Unit	1	0.7	0.3
Wetlands Rights-of-Way	1.6	1.1	0.5
Upland Rights-of-Way Undeveloped	2	2	0
Recreational Land	1	0.4	0.6
Subtotal:	**5.6**	**4.2**	**1.4**
Agricultural Land			
Cropland and Pastureland	10.9	10.7	0.2
Agricultural Wetlands (modified)	0.9	0.9	0
Former Agricultural Wetlands (becoming shrubby, not built-up)	0.2	0.2	0
Other Agriculture	0.6	0.6	0
Subtotal:	**12.6**	**12.4**	**0.2**
Forestland			
Deciduous Forest (10–50 percent crown closure)	0.1	0.1	0
Old Field (<25 percent brush covered)	3.5	3.4	0.1
Subtotal:	**3.6**	**3.5**	**0.1**
Water			
Tidal Rivers, Inland Bays, and Other Tidal Waters	4.6	2.4	2.2
Subtotal:	**4.6**	**2.4**	**2.2**
Wetlands			
Freshwater Tidal Marshes	12.7	6.1	6.6
Phragmites-Dominated Coastal Wetlands	22.3	11.2	11.1
Herbaceous Wetlands	1.2	1.2	0
Mixed Scrub/Shrub Wetlands (coniferous dominated)	0.1	0.1	0
Phragmites-Dominated Interior Wetlands	6.3	4.4	1.9
Subtotal:	**42.6**	**23**	**19.6**
Total:	**69**	**45.5**	**23.5**

Source: Modified from PSEG 2014-TN3452.

The 45.5 ac that would be permanently disturbed for the causeway includes 23 ac of wetlands (primarily *Phragmites*-dominated coastal wetlands), 12.4 ac of agricultural land (cropland and pastureland), 3.5 ac of forestland, 2.4 ac of water, and 4.2 ac of urban or built-up land (associated with HCGS and SGS and lands along Money Island Road) (Table 4-2). The wetlands that would be permanently disturbed are located in areas that are part of the PSEG

Estuary Enhancement Program (EEP), the Abbott's Meadow WMA, and the Mad Horse Creek WMA. The agricultural land that would be affected is no longer available for farming because it is too wet for agriculture (e.g., coastal marsh areas that were prime farmland when historically drained and used for salt hay production). The developed lands that would be affected include 1.0 ac of residential land on Money Island Road (owned by PSEG with a structure used as a PSEG environmental project office) and 1.0 ac of recreational land (composed of several small areas located within the Abbott's Meadow WMA and Mad Horse Creek WMA) (PSEG 2014-TN3452).

The 23.5 ac that would be temporarily disturbed for the causeway includes 19.6 ac of wetland (primarily *Phragmites*-dominated coastal wetlands and freshwater tidal marshes) and 2.2 ac of tidal waters. The wetlands that would be temporarily disturbed are located in areas that are part of the PSEG EEP, the Abbott's Meadow WMA, and the Mad Horse Creek WMA (PSEG 2014-TN3452).

The land area that would be disturbed for the proposed causeway from the PSEG property north to Lower Alloways Creek is zoned for Industrial Use by Lower Alloways Creek Township (LACT 1999-TN2416). However, the land area that would be disturbed from Lower Alloways Creek north to Money Island Road is zoned for Conservation by Elsinboro Township, while the land area that would be disturbed along Money Island Road is zoned Rural Residential (Elsinboro 2007-TN2417). Thus, building the causeway would be consistent with current zoning in Lower Alloways Creek Township but inconsistent with part of the current zoning (i.e., Conservation) in Elsinboro Township. PSEG could request a zoning variance from Elsinboro Township to build the proposed causeway in the area zoned for Conservation (PSEG 2014-TN3452).

As discussed in Sections 2.2.1 and 4.1.1, the NJDEP Division of Land Use Regulation has determined that the PSEG ESP application, including the proposed causeway, is consistent with State of New Jersey Rules on Coastal Zone Management (NJDEP 2010-TN235).

About 34 ac of land designated as prime and unique farmlands or farmlands of unique importance (based on soil type) would be affected by causeway construction (PSEG 2012-TN2282).

Most of the proposed causeway route (4.0 mi or 21.0 ac of impact) is protected under DCRs held by the State of New Jersey (PSEG 2012-TN2282). These DCRs would have to be released by the State for the causeway to be built. About 2.0 mi (10.5 ac of impact) of the causeway route is located within the Alloway Creek Watershed Wetland Restoration (ACW) site, which is part of the PSEG EEP (Figure 2-11) and subject to a DCR held by NJDEP. These ACW site lands are privately owned by PSEG and were not purchased with funds from the State Green Acres Program, so approval from the NJDEP commissioner would be required to release the DCR. Before any release of the DCR, the NJDEP would conduct a public hearing and the NJDEP commissioner would review recommendations by NJDEP staff and consider the public interest in preserving the lands under the DCR. PSEG anticipates that it would have to provide the State with compensatory lands for any ACW site lands released from the DCR (PSEG 2012-TN2282).

About 0.4 mi (0.8 ac of impact) of the causeway route is located within the Abbott's Meadow WMA, which is located at the northern end of Money Island Road (Figure 2-11) (PSEG 2012-TN2282). The Abbott's Meadow WMA is owned by the State of New Jersey and is subject to the DCR release provisions of the State Green Acres Program, the program used by NJDEP to acquire land for state parks, forests, natural areas, and WMAs. To release a DCR on land that is owned by the State and/or purchased with Green Acres Program funds, NJDEP would need to apply to the State House Commission for a disposal of land. Compensation for a major disposal of land is required under the Green Acres Program, and all such compensation must meet certain minimum requirements. The application for disposal must include an appraisal of the land to be disposed of (based on the highest value of the land) and an appraisal of the replacement land proposed as compensation. For successful applications, the State House Commission executes a release of the land to be disposed of and executes with the applicant an agreement releasing Green Acres Program restrictions on the land disposed and subjecting the replacement land to the Green Acres restrictions, if applicable (PSEG 2012-TN2282).

For the DCR to be released on lands in the Abbott's Meadow WMA, PSEG has identified compensatory lands at the Mason's Point Site in Elsinboro Township, Salem County, near Alloway Creek, 2.5 mi upstream from the creek confluence with the Delaware River. Although most of the potential compensatory site is currently owned by the State, PSEG would purchase additional contiguous lands to offset the loss of deed restricted and/or State-owned land associated with the proposed causeway (PSEG 2012-TN2282).

About 1.6 mi (9.7 ac of impact) of the causeway route is located within the Mad Horse Creek WMA (Figure 2-11), which is owned by the State of New Jersey (PSEG 2012-TN2282). PSEG has stated that there is no readily available record of the source of funding for the Mad Horse Creek WMA and no record of funding through the New Jersey Green Acres Program. PSEG has also stated that the diversion of lands for development of the causeway would be subject to essentially the same process as lands that had been purchased with Green Acres Program funding (PSEG 2012-TN2282).

Overall, the land-use impacts of building the proposed causeway would be sufficient to alter noticeably, but not destabilize, important attributes of existing land uses. Some of the land disturbance (23.5 ac of a total of 69.0 ac) would be temporary, and the land would return to its existing use once the causeway was completed. However, most of the land disturbance (45.5 ac of a total of 69.0 ac) would be permanent and would have a noticeable impact because it would occur on undeveloped wetlands protected under DCRs within the ACW Site, the Abbott's Meadow WMA, and the Mad Horse Creek WMA. Releasing these lands from the existing DCRs would require NJDEP to take various procedural actions and, for the WMAs, would require that PSEG provide compensatory land elsewhere. The change in land use to developed lands in these protected areas would alter noticeably, but not destabilize, existing land uses along the causeway route.

Based on the information provided by PSEG and the review team's independent review, the review team concludes that the land-use impacts of building the proposed causeway would be MODERATE, primarily because of the permanent change in land use within areas protected by DCRs. Because building the proposed causeway would not be part of the NRC-authorized

construction activities at the PSEG Site, the NRC staff concludes that there would be no land-use impacts along the causeway route due to the NRC-authorized construction.

4.2 Water-Related Impacts

Water-related impacts involved in building a new nuclear power plant at the PSEG Site would be similar to impacts that would be associated with any large industrial construction project and not much different than those seen during construction of the SGS and HCGS.

Before initiating building activities, including any site-preparation work, PSEG would be required to obtain the appropriate authorizations regulating alterations to the hydrological environment. These authorizations would likely include, but not be limited to, the following. Additional detail regarding the items listed is contained in Appendix H.

- CWA Section 404 Permit. This permit would be issued by the USACE, which governs discharge of dredged and/or fill material into waters of the United States. This permit requires both New Jersey and Delaware Coastal Zone Management Program concurrence.
- Section 10 of the Rivers and Harbors Appropriations Act of 1899 Permit. This permit would be issued by the USACE to regulate any structure or work in, over, under, or affecting waters of the United States, such as construction and maintenance of intake, discharge, and barge structures in navigable waters of the Delaware River. This permit requires both New Jersey and Delaware Coastal Zone Management Program concurrence.
- Section 9 of the Rivers and Harbors Appropriations Act of 1899 Permit. This permit would be issued by the U.S. Coast Guard to regulate construction of the causeway across Alloway Creek.
- Coastal Zone Management Act (CZMA) (16 USC 1451-TN1243). Federal Consistency Determination has been made with conditions by NJDEP stating that the project submitted for NRC review is consistent with New Jersey's Rules on Coastal Zone Management (NJDEP 2010-TN235). Delaware concurrence would be required for the USACE permit action.
- CWA Section 401 Water Quality Certification. This certification would be issued by NJDEP and ensures that the project would not conflict with State and Federal water-quality management programs. This includes dewatering activities.
    - CWA Section 402(p) National Pollutant Discharge Elimination System (NPDES) Permit. This permit regulates limits of pollutants in liquid discharges to surface water. EPA has delegated the authority for administering the NPDES program in the State of New Jersey to NJDEP. A stormwater pollution prevention plan (SWPPP) and activities related to construction dewatering would be covered as part of the New Jersey Pollutant Discharge Elimination System (NJPDES) permit.
    - NJDEP permits would be required for temporary dewatering and for the associated drilling of dewatering wells.

- NJDEP permits would be required for construction in the 100-year floodplain, in wetlands, and below the mean high water line.

- A local permit would be required to construct and operate a system for treating dewatering effluent.

4.2.1 Hydrological Alterations

This section (1) identifies and describes proposed preconstruction and construction activities, including site preparation, onsite activities, and offsite activities that could result in hydrologic alterations; (2) describes and analyzes the resulting hydrologic alterations and the physical effects of these alterations on other water users; (3) analyzes the practices proposed to minimize hydrologic alterations having adverse impacts; and (4) assesses compliance with applicable Federal, State, regional, local, and affected Native American tribal standards and regulations.

Activities that could produce hydrologic alterations include the following.

- Raising the plant grade to the 36.9-ft North American Vertical Datum of 1988 (NAVD88) elevation, including filling of 40 ac of artificial ponds in the PSEG desilting basin and the Artificial Island CDF.
- Clearing land at the project site and building infrastructure such as roads and stormwater conveyance and retention systems.
- Building new structures (reactor containment structures, turbine buildings, cooling towers, electrical substations, subgrade piping and systems), roads/rails, and parking lots.
- Building cooling water intake and discharge structures on the Delaware River shoreline.
- Dredging near-shore areas of the Delaware River for water intake, water discharge, and barge access areas.
- Modifying the existing HCGS barge slip.
- Temporary disturbance of currently vegetated areas and wetlands for construction laydown areas, concrete batch plants, sand/gravel stockpiles, and construction-phase parking areas.
- Dewatering foundation excavations during construction.
- Building the proposed causeway.

4.2.1.1 Surface Water

Hydrologic alterations potentially affecting surface-water resources at and near the PSEG Site may occur from filling of shallow artificial ponds, building activities, filling of coastal marshes and

creeks, building activities within the Delaware River, and building in floodplains. These activities are described in the following sections.

Artificial Ponds

About 40 ac of shallow artificial ponds that exist on the PSEG Site and the Artificial Island CDF would be filled. These ponds, which are described in Section 2.3.1.1, are normally hydrologically isolated from the surrounding landscape (i.e., have no surface-water flow to downstream areas). The ponds currently provide some retention of rainfall and stormwater runoff, and the retained water is lost from the ponds by infiltration and evaporation. As a result of filling these ponds, runoff from this area would increase. The runoff would be collected in engineered stormwater detention basins and would be released to the Delaware River in a controlled manner (PSEG 2014-TN3452). Because of the small area of these ponds compared to the area of the Delaware River Basin near the PSEG Site, the increased runoff from the filled-pond area is expected to be minor compared to the discharge of the Delaware River. Therefore, filling these ponds is not expected to affect any downstream areas noticeably.

The artificial ponds are identified in the jurisdictional determination of wetlands conducted by the USACE (USACE 2013-TN3283). Impacts to wetlands are described in Section 4.3.1.

Land Disturbance

Preconstruction and construction activities related to a new nuclear power plant at the PSEG Site would result in permanent structures occupying about 225 ac. This would include 108 ac of lands mapped as wetland cover type and 43 ac of open water areas associated with artificial ponds. *Phragmites*- (*Phragmites australis*–) dominated coastal and interior (nontidal) wetlands account for 102 ac of the 108 ac of wetlands within permanent use areas. Actual disturbance of these wetland areas would be further refined and minimized during the detailed design phase subsequent to the selection of a reactor technology (PSEG 2014-TN3452).

In addition to permanent changes in land use within the PSEG Site, preconstruction and construction activities would also result in temporary changes in land use to 160 ac within the PSEG Site and 45 ac in adjacent offsite areas. Lands impacted by these temporary use areas would include 45 ac of developed lands, 80 ac of disturbed old field or *Phragmites*-dominated old field, and 27 ac of lands mapped by NJDEP as wetland. *Phragmites*-dominated interior wetlands (24 ac) account for the majority of wetland impacts in these temporary use areas (PSEG 2014-TN3452).

The 45 ac in the adjacent offsite Artificial Island CDF would also be used temporarily to support building activities. A total of 42 ac of lands mapped as wetlands by NJDEP would be used to support the batch plant and other temporary uses. The primary land uses impacted in this area include *Phragmites*-dominated wetlands (coastal and interior, 27 ac) and disturbed wetlands (modified, 12 ac) (PSEG 2014-TN3452).

The proposed causeway would provide vehicular access to a new plant at the PSEG Site. A total of 69 ac would be impacted by building this causeway, 45.5 ac permanently and 23.5 ac temporarily. Permanent impacts would result from the placement of structures (piers, pilings, or

other support structures) in the wetlands and shading from the 50-ft-wide causeway. Temporary impacts would result from the temporary placement of work mats on the wetlands to support equipment, materials, and personnel. The majority of the impacts would be to open water and wetlands. Impacts to lands mapped as agricultural lands would account for 12.6 ac of the 69 ac, while open water, forest, and urban land use would account for the remaining acreage (PSEG 2014-TN3452).

Potential erosion and sedimentation from preconstruction and construction activities would be controlled using appropriate best management practices (BMPs) as specified by the PSEG SWPPP (PSEG 2014-TN3452). The SWPPP contains an inspection and monitoring plan for verifying that BMPs are working following rainfall events during preconstruction and construction. Preconstruction activities would include the development of features that function as permanent stormwater management systems. Such features would be developed in the detailed site design and would include permanent grading and drainage features to manage stormwater runoff. Surface-water discharges would be managed using sediment traps and sedimentation basins to remove suspended solids before discharge to the Delaware River. BMPs, including both structural and nonstructural BMPs, would be implemented as required in NJDPES construction activity permits and regulations to reduce erosion and minimize risk of discharges of all pollutants (PSEG 2014-TN3452).

Coastal Wetland and Marsh Creeks

Coastal streams and marsh creeks would be altered by filling that would result in elimination of 7,265 ft of creek channels and isolation of 2,320 ft of creek channels from tidal connection. Additionally, the proposed causeway would cross 2,123 ft of creek channels. PSEG would use BMPs during preconstruction and construction activities, and those activities would be temporary (PSEG 2014-TN3452). The elimination of 7,265 ft of creek channels represents a 0.7 percent decrease in total creek length within the PSEG EEP area and an even smaller percentage if all creeks in the vicinity of the PSEG Site are considered.

Because the marsh creeks are within the 100-year floodplain, filling them would result in alterations of the surface-water pathways and surface runoff volume and discharge. These alterations could affect the flood-carrying capacity of the floodplain. However, as stated in Section 2.3.1.1, the 100-year floodplain near the PSEG Site is controlled by storm surges, and therefore, the contiguous floodplain is vast, consisting of low-lying coastal areas. The applicant estimated that the area of the 100-year floodplain within a 6-mi radius of the PSEG Site is 59,681 ac or 93.5 mi^2 (PSEG 2012-TN2244). Because the creek channels that would be eliminated make up a small percentage (not exceeding 0.7 percent) of the total creek length in the vicinity of the PSEG Site, the loss of floodplain adjacent to the eliminated marsh creek channels would result in alteration to a correspondingly small area of the 100-year floodplain. Therefore, the review team determined that the effect on the 100-year floodplain would not be noticeable. Stormwater runoff from this area would be collected in engineered detention basins and would be released to the Delaware River in a controlled manner (PSEG 2014-TN3452). Because the filling of marsh creeks is expected to result in alteration of a small area compared to the area of the 100-year floodplain near the PSEG Site, and because stormwater runoff

would be released to the Delaware River in a controlled manner, the effect of this alteration on the 100-year floodplain and the Delaware River, both in terms of water quantity and quality, would be minimal.

Isolation of marsh creeks from tidal connection would reduce the discharge to the tidal areas. However, because the tidal area is vast and the expected area altered by isolation of marsh creek is also small compared to the contiguous floodplain near the PSEG Site, the effect on the tidal areas near the PSEG Site would be minimal.

The proposed causeway would cross marsh creeks and would have landing areas for piers to support the elevated roadway. These landing areas are expected to be few and would also be very small in size compared to the tidal areas and the 100-year floodplain near the PSEG Site (PSEG 2012-TN2244). Because the crossing of the marsh creeks by the proposed causeway would only alter small areas compared to the tidal areas and the 100-year floodplain near the PSEG Site, and because BMPs would be in use during preconstruction activities, the effect of this alteration on the tidal areas and the 100-year floodplain would be minimal.

Delaware River

The Delaware River near the PSEG Site would be altered by installation of the new intake structure and the new barge facility and by dredging needed for installation of the new structures and the existing HCGS barge slip (PSEG 2014-TN3452). About 9.5 ac of coastal wetlands and shallow water areas would be filled along the Delaware River shoreline near the PSEG Site. The altered shoreline would be protected from erosion using placement of concrete or riprap. The shoreline and shallow water areas would be dredged to provide adequate depth for the new intake and the new barge facility. The bottom of the Delaware River near the new intake and the new barge facility would be deepened 4.5 ft over a 31-ac area, and 4.5 ft over a 61-ac area, respectively. The dredged area would extend about 1,700 ft laterally from the shoreline into the river. The dredging is expected to enlarge the cross-sectional area of the Delaware River by 2.5 to 3.5 percent, which could result in a proportionally reduced average velocity (PSEG 2014-TN3452). However, these changes are expected to be minimal because they are a small percentage of the total area.

The material dredged from the Delaware River is estimated to be 665,000 yd^3 in volume and would be disposed on the site or at another approved upland disposal site. PSEG could use both mechanical and hydraulic dredging methods. PSEG would be required to comply with requirements of CWA Sections 10 and 404 and NJDEP permits. PSEG would also use BMPs to minimize disturbance of bottom sediment and its delivery farther out into the Delaware River (PSEG 2014-TN3452). These preconstruction activities would be temporary and localized. Because (1) the disturbance to the Delaware River would be controlled by CWA Sections 10 and 404 and NJDEP permits that are protective of the environment and (2) PSEG would use BMPs and the preconstruction activities would be temporary and localized, the review team concludes that the effects of these alterations to the Delaware River would be minimal.

Floodplains

Preconstruction and construction activities would alter the 100-year floodplain near the PSEG Site by placing fill material in about 152 ac of onsite and offsite areas. As described in Section 2.3.1.1, the 1 percent annual exceedance flood water surface elevation at the confluence of the Delaware River and Alloway Creek is 8.9 ft National Geodetic Vertical Datum of 1929 (FEMA 1982-TN3214) or 8.1 ft NAVD88. Because the 100-year floodplain near the PSEG Site is controlled by storm surges, the contiguous floodplain is vast, consisting of the low-lying coastal areas. PSEG estimated that the area of the 100-year floodplain within a 6-mi radius of the PSEG Site is 59,681 ac or 93.5 mi^2 (PSEG 2012-TN2244).

The filling of 152 ac on and off the site in the 100-year floodplain could change the flood carrying capacity of the floodplain. However, because the 100-year floodplain at and near the PSEG Site is controlled by storm surges and has a very large, contiguous area several hundred times larger than the filled area in the vicinity of the PSEG Site, the review team concludes that the effects of this alteration on the 100-year floodplain would be minimal.

4.2.1.2 Groundwater

Building activities that are expected to alter groundwater hydrology at the PSEG Site are placement of high hydraulic conductivity structural fill in safety-related excavations (including the nuclear island), placement of fill to raise the plant grade to 36.9 ft NAVD88, placement of impervious surfaces, and stormwater rerouting. In addition, a low permeability curtain wall would be placed from the land surface partway into the nuclear island excavation to reduce inflow during dewatering operations. These activities are expected to minimally alter the spatial and temporal pattern of infiltration and recharge at the site and to alter groundwater flow directions in the shallow aquifers in the immediate vicinity of the site. Building activities that are expected to alter the groundwater hydrology over a wider area are dewatering of the construction excavation and use of groundwater to support construction needs.

Dewatering would be required during construction of the nuclear island and would reduce groundwater heads in the hydrogeologic units affected by the excavation. The nuclear island would be excavated to an elevation of −67 ft. NAVD88, which is through the hydraulic fill, the alluvium, and the Kirkwood Formation and into the top of the Vincentown Formation (see Figure 2-18). The review team expects that the effects of dewatering would be confined to the shallow alluvium and Vincentown aquifer due to the low permeability formations underlying the Vincentown aquifer. The applicant has confirmed plans to use vertical low permeability barriers to limit horizontal inflow into the excavation (PSEG 2014-TN3453), which would also limit the horizontal extent of the effects of the dewatering. In addition, a drop in shallow groundwater elevation as a result of dewatering is not expected to affect water levels in local wetlands because of the poor hydraulic connection between the shallow aquifers and the wetlands and because the wetlands are hydraulically connected (tidal) to the Delaware River (PSEG 2014-TN3452).

Groundwater from four production wells within the middle and lower Potomac-Raritan-Magothy (PRM) aquifers is currently used to supply water for operation of the SGS and HCGS units at the PSEG Site. There are also two unused backup wells in the Wenonah-Mount Laurel aquifer.

To support construction of a new nuclear power plant, an additional 119 gpm of groundwater would be pumped from two new production wells, which the applicant has reported would be located within the PRM aquifers (PSEG 2014-TN3452). Based on current permitted pumping limits, the applicant has flexibility to locate the new wells in the upper, middle, or lower PRM aquifers. Water for construction would be for potable use, for dust suppression, and to supply water to the concrete batch plant. This additional groundwater use would lower groundwater heads and has the potential to affect salinity levels within the PRM aquifers. However, these effects would be limited due to several factors: NJDEP water management practices, which have reduced groundwater use within the PRM aquifers over time; the small contribution of site use to overall regional aquifer use and aquifer capacity; limited hydraulic communication between the PRM aquifers and the overlying Wenonah-Mount Laurel aquifer; and distance to other nearby water supply wells.

4.2.2 Water-Use Impacts

This section describes, analyzes, and assesses the potential water-use impacts of building a new nuclear power plant at the PSEG Site. It includes analysis and evaluation of proposed practices to minimize adverse impacts on water use.

4.2.2.1 Surface-Water-Use Impacts

Surface water would not be used to support building activities at the PSEG Site. The brackish nature of the Delaware River near the PSEG Site makes the surface water undesirable for building. Small amounts of water from stormwater retention ponds might be used for dust suppression during building of a new nuclear power plant (PSEG 2014-TN3452). Because the amount of water used from these retention ponds would be relatively small, the review team determined that the water-use impacts on the surface-water resource would be SMALL.

4.2.2.2 Groundwater-Use Impacts

As described in Section 4.2.1.2, there are a number of construction-related activities that could alter groundwater hydrology at and near the site. Placement of fill to raise the plant grade, placement of structural fill in safety-related excavations, placement of impervious surfaces, and stormwater rerouting would affect infiltration and recharge at the site and alter groundwater flow directions within the shallow aquifers in the vicinity of the site. However, impacts on groundwater use would be limited because the construction period would be temporary and the aquifers affected are hydraulically isolated by the Delaware River and the tidally influenced wetlands. In addition, the nearest groundwater users are 3 to 5 mi from the site, and the shallow aquifers affected by construction are not used as a water supply due to their salinity.

The greatest potential effects of construction on groundwater uses and users would be from two primary activities: (1) dewatering to facilitate power block construction and (2) groundwater pumping for preconstruction and construction support (including concrete batch plant supply, potable water, and dust suppression).

Dewatering

During construction, excavation would occur over the entire plant area. The deepest excavation would occur at the nuclear island foundation where the hydraulic fill, alluvium, and Kirkwood Formation would be completely removed. The nuclear island excavation would extend to a competent, low permeability unit within the top of the Vincentown Formation at about 30 ft below the static water table at an elevation of 67 ft NAVD88 below sea level. There would be two sets of dewatering wells: a shallow set (into the Kirkwood aquitard) along the perimeter of the plant area excavation and a deeper set installed along the perimeter of the deeper nuclear island excavation. Dewatering flow rates would be reduced by the installation of low permeability soil retention barriers along both the shallow and deep excavation perimeter walls (PSEG 2014-TN3453).

The applicant used groundwater flow modeling to determine dewatering rates and the effects of dewatering on existing structures important to safety at the HCGS and SGS. The applicant's dewatering model (MACTEC 2009-TN3323) was based on site-specific geology and either site-specific (when available) or regional values for hydraulic conductivity and other hydraulic parameters. The dewatering model considered all geologic layers from the hydraulic fill at the land surface to the Wenonah-Mount Laurel aquifer, which is underlain by the Marshalltown aquitard. The groundwater dewatering model domain covered the PSEG Site and extended 7,520 ft in a north-south direction and 7,000 ft in an east-west direction. The model was bounded to the west and south by the Delaware River and to the north and east by tidally recharged wetland areas. Because the domain of the model was constrained to the site vicinity, the review team concluded that the results could not be used as the sole basis for estimating impacts to groundwater beyond the tidally recharged wetland areas.

The model results were used by the review team to inform the evaluation of offsite impacts. Based on the results of modeling, PSEG estimated that initial dewatering rates would be between 5,200 and 5,600 gpm, but as the shallow groundwater system adjusted to pumping, the rate would diminish over time to between 3,400 and 5,400 gpm. These rates do not include influx of water from storm events, which would be temporary and involve a relatively small volume of water (PSEG 2014-TN3453). The greatest drawdown in groundwater head is predicted to occur within the Vincentown aquifer. The extent of drawdown would be limited west and south of the site because the Vincentown aquifer is hydraulically connected to the Delaware River. If drawdown extends beyond the site boundary to the north and east, the review team concludes that the impact on groundwater use would be limited because salinity within the Vincentown aquifer is well above drinking water standards and the aquifer is not used as a source of potable water near the site. Because the nearest offsite groundwater use is 3 to 5 mi from the site, and the most significant drawdown is largely confined to the site, dewatering during construction is not expected to affect other uses and users of groundwater near the site.

During dewatering, it is possible that pumping might induce flow upward from the Wenonah-Mount Laurel aquifer through the Navesink-Hornerstown aquitard and into the Vincentown aquifer. The applicant's model did not specify the amount of potential upwelling from the Wenonah-Mount Laurel aquifer, but potential flow amounts could be inferred based upon the applicant's sensitivity analysis. In this analysis, when vertical conductivity of the Navesink aquitard was reduced by a factor of 2 and all other parameters were held constant, total flow out

of the wells was reduced by about 200 gpm (PSEG 2014-TN3453). This indicated that during pumping, 200 gpm or more could be pulled upward from the Navesink aquitard and the underlying Wenonah-Mount Laurel aquifer.

The review team performed calculations to independently verify the amount of potential upward flow induced by dewatering. Based on the drawdown contours shown in Figure 2.4.12-27 of the PSEG SSAR (PSEG 2014-TN3453) and a vertical hydraulic conductivity of the Navesink-Hornerstown confining unit of 0.005 ft/d, consistent with SSAR Table 2.4.12-1 and information provided by the U.S. Geological Survey (USGS) (Voronin 2003-TN2947), upward flow during dewatering was estimated to be 150 gpm. This relatively small amount of upward flow is not likely to significantly affect flows in the Wenonah-Mount Laurel aquifer, particularly since the impact would be temporary. In addition, the nearest wells potentially within the Wenonah-Mount Laurel aquifer are the HCGS and SGS standby potable water supply wells, which are not routinely pumped. As discussed in Section 2.3, the nearest offsite well in this aquifer is several miles away and within an area not likely to be affected by the groundwater drawdown resulting from current HCGS/SGS pumping (dePaul et al. 2009-TN2948).

The shallow hydraulic fills act as an aquitard that currently creates perched conditions. The applicant has stated that during completion of the nuclear island the excavation would be completely backfilled with a structural fill that would form a permeable hydraulic conduit connecting the perched groundwater with the Vincentown aquifer. As a result, the potentiometric surface in this area in these aquifers would be similar, and dewatering might induce flow from the river and nearby wetlands. Any potential impact on wetlands would be localized and would be offset by the twice daily tidal recharge.

Groundwater Pumping for Preconstruction and Construction Support

Water-use requirements for construction of a new nuclear plant are similar to those for other large industrial construction projects. Building a new nuclear power plant at the PSEG Site would use on average 119 gpm of groundwater to support concrete batch plant operations, dust suppression, and potable use (PSEG 2014-TN3452). The existing water supply system currently provides 379 gpm to support HCGS and SGS operations. The existing water allocation permits allow for an additional withdrawal of sufficient capacity to provide the groundwater needed to support new plant construction (PSEG 2014-TN3452).

Water-use impacts from the withdrawal of groundwater to support plant operations are evaluated in Section 5.2.2.2 and are determined to be SMALL. The same wells would be used to supply groundwater for construction and for plant operation. Because the construction-related groundwater use (119 gpm) would be less than the proposed use for plant operation (210 gpm) and construction withdrawals would occur for a shorter period of time, water-use impacts from construction would be bounded by the impacts from operation. The review team therefore concludes that water-use impacts from groundwater withdrawals to support construction would be minor.

Groundwater-Use Impacts Summary

Factors that would limit the impacts of construction and preconstruction activities on groundwater use in the area are (1) the temporary nature of excavation dewatering and the planned use of low permeability soil retention barriers to limit inflow from surrounding shallow formations; (2) the alluvium and Vincentown aquifer have salinity levels above drinking water standards, are not potable, and are not used near the site; and (3) potential impacts to shallow water-bearing units may be offset by inflows from the Delaware River and tidally influenced wetlands. In addition, impacts from construction pumping in the middle PRM aquifer are bounded by the impacts from pumping to support plant operation, which were determined by the review team to be SMALL (Section 5.2.2.2). As a result, the review team concludes that the groundwater-use impacts of construction and preconstruction would be SMALL and no further mitigation would be warranted.

4.2.3 Water-Quality Impacts

The water-quality impacts of building a new nuclear power plant are similar to those associated with the development of any large industrial site. This section includes identification of the activities associated with preconstruction and construction activities related to a new nuclear power plant at the PSEG Site that could affect surface and groundwater quality and analysis and evaluation of proposed practices to minimize adverse impacts on water quality by these activities. The impacts on surface water and groundwater are discussed in Section 4.2.3.1 and Section 4.2.3.2, respectively.

4.2.3.1 Surface-Water-Quality Impacts

As with any similar large building project, building a new nuclear power plant at the PSEG Site could affect nearby surface water bodies during site preparation and building activities. The site preparation and building activities that could affect surface water include clearing vegetation, disturbing the land surface, inadvertent release of contaminants associated with building materials and equipment, activities in the tidal marsh and tidal stream areas during building of the proposed causeway, and dredging activities in the Delaware River. Because of alteration of the land surface, alteration of surface cover, and changes to drainage patterns, both the quantity and quality of the surface runoff from the site may change and result in impacts to the quality of the surface-water resources near the site.

Because a reactor design for the PSEG Site has not been finalized, the details of site layout, grading plan, and drainage design have not been determined. However, PSEG estimates that a new nuclear power plant would require permanent development of about 50 ac of onsite land and temporary use of about 39 ac of onsite and 3 ac of offsite lands (PSEG 2014-TN3452). These areas would be cleared and regraded and would host construction material and equipment. As stated in Section 3.4.2.2, the site would be graded such that runoff from the site and power block area would be directed to a system of swales and pipes that would discharge to the Delaware River. The site would drain to the north and west, away from the existing SGS and HCGS facilities. PSEG would be required to obtain an NJPDES permit for stormwater discharges resulting from the building activities and to develop an SWPPP that defined BMPs (PSEG 2014-TN3452).

BMPs could consist of structural (such as the use of sedimentation basins) and nonstructural (such as erosion control) methods to meet discharge water-quality requirements. The nature of the PSEG Site, the building methods used, available sediment, and potential contaminants related to building activities are not substantially different from any other large-scale project. BMPs have been successfully used in SWPPPs to mitigate the effects of runoff from building sites and to minimize contaminants that adversely affect water quality. The Delaware River would receive the stormwater discharge from the PSEG Site. The Delaware River near the PSEG Site is influenced by tidal action, with the tidal flux greatly exceeding the freshwater discharge (PSEG 2014-TN3452). Therefore, the review team has determined that the controlled release of stormwater discharge would have minimal impact on the Delaware River near the PSEG Site.

To support building the new intake structure, the new discharge pipeline, and the new barge slip, dredging and fill within the Delaware River would be required. In addition, the existing barge slip would also be deepened and therefore would require dredging. These dredging activities would occur in the Delaware River and would require permits under Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 USC 403-TN660) for dredging and filling in the navigable waters of the United States and Section 404 of the CWA [33 USC 1251 et seq. (33 USC 1251-TN662)] for dredging and filling in waters of the United States. Dredging and filling activities would be temporary and occur during the building, placement, or improvement of the facilities. To build the new barge facility and the new intake structure, the Delaware River bottom would be lowered 4.5 ft over a 92-ac area, requiring dredging 665,000 yd^3 of sediment (PSEG 2014-TN3452). The dredged area would extend 1,700 ft into the Delaware River from the shoreline. The dredged material would be disposed of at an onsite or other approved upland disposal facility (PSEG 2014-TN3452). Sediment disturbed during these activities would settle after the activities were completed and is not expected to have a long-term impact. The area of these activities would be a small fraction of the area of the Delaware Bay and Delaware River Estuary, and the dredged and deepened area would increase the Delaware River cross section by less than 3.5 percent. BMPs would be used during the dredging activity. Use of silt curtains or cofferdams is also anticipated to limit the transport of the disturbed sediment (PSEG 2014-TN3452). Therefore, the review team has determined that dredging and filling activities in the Delaware River for building new facilities and improvement of existing facilities would cause only a minor and temporary impact to surface-water quality.

The proposed causeway would be an elevated structure, but the landing sites of piers would require building activities in coastal wetlands and marshes. The building activities would be limited to the landing sites of piers and to any needed access roads. Because of the elevated, spanned nature of the causeway, placement of fill in the coastal area would be minimized. The causeway would cross 2,123 ft of marsh creeks (PSEG 2014-TN3452). Building the causeway would be similar to building any other elevated roadway, and building techniques for pier landing areas would also be similar and use sediment erosion and delivery control methods similar to other construction activities. Because the causeway would cross navigable waters, PSEG would be required to obtain a permit from the U.S. Coast Guard under Section 9 of the Rivers and Harbors Appropriation Act of 1899 (33 USC 403-TN660) and a permit from the USACE under Section 404 of the CWA [33 USC 1251 et seq. (33 USC 1251-TN662)]. The potential

impact to water quality due to sediment delivery from building areas for the causeway would also be temporary and localized. Because building techniques would help reduce the volume of fill, sediment erosion and delivery controls would be used, appropriate permits would require the applicant to minimize impacts to water quality, and any potential impacts would be localized and temporary, the review team has determined that the impacts to water quality from building the proposed causeway would be minor.

Because engineering controls (BMPs, silt fences, detention basins, etc.) regulated by a combination of NJPDES and USACE permitting would be in use during building activities, the building-related impacts on surface-water quality would be controlled, localized, and temporary. Therefore, the review team has determined that the impacts on surface-water quality would be SMALL.

4.2.3.2 Groundwater-Quality Impacts

The site preparation and building activities that could affect groundwater include inadvertent chemical spills, excavation dewatering, discharge of groundwater to adjacent surface water bodies, and use of groundwater from the PRM aquifers. Potential groundwater-quality impacts from these activities are discussed below.

During preconstruction and construction, gasoline, diesel fuel, hydraulic lubricants, and other similar products would be used for construction equipment. BMPs would be used to minimize potential discharges to the environment. NJDEP requires that chemical discharges to the soils and groundwater be reported and subsequently remediated to prevent longer term impacts to groundwater quality (PSEG 2014-TN3452). Based on the use of BMPs and NJDEP remediation requirements, the review team concludes that the effect on groundwater quality of an inadvertent chemical spill would be localized and temporary. As a result, the impacts to groundwater quality would be minor.

Dewatering the power block area would alter the shallow groundwater flow patterns, but it is not anticipated to alter groundwater quality. Because the two upper water-bearing zones, the alluvium and the Vincentown aquifer, are in hydraulic communication with the Delaware River, saline water from the river may be drawn into the groundwater as a result of the dewatering. However, the alluvium and Vincentown aquifer are currently too saline to be used as a potable water source in the vicinity of the PSEG Site (PSEG 2014-TN3452). Likewise, any upward groundwater flow from the Wenonah-Mount Laurel aquifer induced by the dewatering would not adversely affect the water quality of the saline water in the Vincentown aquifer.

Other potential effects associated with the dewatering of the power block area pertain to the release of the excess water to adjoining water bodies. Groundwater pumped from dewatering wells within the construction areas would be free of fine materials due to the use of well screens and would be discharged directly to the Delaware River. Water withdrawn from open surface excavations would be pumped to an on-site settling basin before discharge through a permitted NJPDES outfall. PSEG would develop BMPs for soil erosion control as required by applicable Federal and State permits and regulations. Once dewatering is no longer needed, the water table is expected to return to static conditions.

As discussed in Section 4.2.2.2, during construction of a new nuclear power plant, an additional 119 gpm of groundwater for potable use, dust suppression, and the concrete batch plant would be supplied from two new production wells within the PRM aquifer zones (PSEG 2014-TN3452). This additional groundwater use has the potential to impact salinity levels within the PRM aquifers. Because the construction-related groundwater use (119 gpm) is less than the proposed use for plant operation (210 gpm), and construction withdrawals would occur for a shorter period of time, water-quality impacts from construction would be bounded by the impacts from operation. Groundwater-quality impacts from plant operation are discussed in Section 5.2.3.2 and are determined to be SMALL. The review team therefore concludes that water-quality impacts from groundwater withdrawals to support construction would be minor.

Factors that would limit the impacts of preconstruction and construction activities on groundwater quality in the area are (1) the use of PSEG BMPs for spill prevention and cleanup; (2) the temporary nature of excavation dewatering and construction-related pumping; and (3) the fact that the alluvium and Vincentown aquifer have salinity levels above drinking water standards, are not potable water sources, and are not used near the site. In addition, impacts from construction pumping in the middle PRM aquifer are bounded by the impacts from pumping to support plant operation, which were determined by the review team to be SMALL (Section 5.2.3.2). As a result, the review team concludes that the impacts of the proposed action on groundwater quality would be limited in magnitude, localized, and temporary and therefore SMALL.

4.2.4 Hydrological Monitoring

Proposed hydrological and chemical monitoring during preconstruction and construction are described in Sections 6.3.2 and 6.6.2 of the PSEG ER (PSEG 2014-TN3452). Water discharges during building activities would be monitored in accordance with applicable NJPDES permit requirements and State water-quality standards (PSEG 2014-TN3452). Stormwater and dewatering discharges would be monitored. PSEG would be required to develop an SWPPP that would specify the inspection methods and BMPs used to limit the impacts of construction discharges to surface water (PSEG 2014-TN3452). In addition, any known chemical, fuel oil, or hydraulic fluid spills would be reported to NJDEP and remediated according to New Jersey spill response requirements (PSEG 2014-TN3452). Delaware River monitoring required by HCGS and SGS permits would continue during preconstruction and construction activities.

Groundwater levels would be monitored in existing shallow wells to confirm that the HCGS and SGS facilities are not adversely affected by dewatering and to evaluate any changes in water quality to the alluvium and Vincentown aquifer. Monitoring of the Wenonah-Mount Laurel and PRM aquifers required by the HCGS and SGS water allocation permit would continue during preconstruction and construction activities, providing data on groundwater heads and salinity in these aquifers.

Water-quality samples would be collected, preserved (if applicable), and transported according to NJDEP chain of custody requirements and those of the analytical laboratory performing the analyses (PSEG 2014-TN3452). The NRC staff has verified that the analytical laboratories used by PSEG are certified by NJDEP.

4.3 Ecological Impacts

If a new nuclear power plant were to be constructed at the PSEG Site, preconstruction activities would start with site mobilization, including building the causeway, barge facility, laydown areas, heavy haul road, and temporary utility supply systems. This preconstruction/site mobilization phase would continue for 1 to 3 years, during which time most impacts to onsite terrestrial habitats, wetlands, marsh creeks, and artificial ponds would occur. Construction phase impacts would occur over a period of about 5 years, when site activities would include site excavation and construction of safety-related structures (PSEG 2014-TN3452).

Section 4.3.1 provides a discussion of the potential environmental impacts of preconstruction and construction upon terrestrial resources, while Section 4.3.3 provides a discussion of the potential impacts upon aquatic resources.

4.3.1 Terrestrial and Wetland Impacts

This section describes potential impacts to terrestrial resources resulting from preconstruction and construction activities, which are also referred to as building activities, at the PSEG Site.

4.3.1.1 Terrestrial and Wetland Resources—Site and Vicinity

Impacts on Habitats

Proposed ground-disturbing activities at the PSEG Site and offsite areas are based on the site utilization plan (Figure 2-2) in Section 2.1. Permanent land impacts are depicted as crosshatched and temporary land impacts are diagonally hatched in Figure 2-2. Potential areas of impact include the power block, cooling tower, concrete batch plant, intake structure, switchyard, offices and warehouses, heavy haul road, temporary laydown areas, parking areas, and proposed causeway. Building activities include clearing, grubbing, and grading the site; installing erosion control measures; building access and haul roads; installing construction security infrastructure; installing temporary utilities and facilities (e.g., storage warehouses, concrete batch plant); preparing the laydown, fabrication, and shop areas; relocating existing facilities within the PSEG Site; staging equipment; and preparation activities associated with power plant construction support. The applicant has not determined the type of reactor to be built on the site and is using a plant parameter envelope (PPE) to bound associated construction and preconstruction impacts. The terrestrial ecology impacts represented in this section are based on the PPE, and the actual limits of disturbance (particularly wetlands and jurisdictional streams) may be further minimized during the design phase after a specific reactor technology is selected. PSEG anticipates that once a design is selected, and if the NRC approves of a CP or COL, construction and preconstruction activities could take 68 months to complete (PSEG 2014-TN3452).

Building activities would result in the permanent or temporary disturbance of about 385 ac of the PSEG Site, 45 ac of adjacent offsite areas, and 69 ac of the habitat in the area of the proposed causeway (see Figure 4-1, Table 4-1, and Table 4-2). The 45-ac offsite area is currently owned by the USACE and is used as a CDF for disposal of dredge materials. In addition, the permitted disposal facility on the PSEG Site is used for disposal of materials dredged from the intake

structures of HCGS and SGS. Preconstruction and construction activities that would impact terrestrial habitats include clearing and grubbing, site grading of upland areas, excavation, and filling of various site areas to achieve design grades (PSEG 2014-TN3452).

A total of 205 ac of the impacted area is considered temporary (Table 4-1). This includes 159.9 ac on the site, 45.2 ac on adjacent offsite areas, and land disturbances during development of the proposed causeway (PSEG 2014-TN3452).

Urban or Built-Up Land (Developed Land)

About 91 ac or 26 percent of urban or built-up land on the PSEG Site would be used during construction and preconstruction activities. Temporary uses would account for almost 45 ac. Permanent use would account for about 47 ac or 13 percent of the urban or built-up land used on the site (PSEG 2014-TN3452).

Offsite impacts to urban or built-up land would also occur in the adjacent offsite areas and along the proposed causeway route. Building activities in the adjacent offsite areas would temporarily make use of 2.4 ac of urban or built-up lands. The proposed causeway would permanently use 4.2 ac and temporarily use 1.4 ac of developed lands (PSEG 2014-TN3452).

A total of 271 ac of the affected terrestrial habitat on the PSEG Site and vicinity would be permanently converted to developed land uses containing structures or pavement or other intensively maintained exterior grounds. There is about 939 ac of developed land in the vicinity and 630,938 ac in the region. The proposed action would add an additional 23 percent of developed land uses to the vicinity and make use of about 6 percent of the available developed lands (PSEG 2014-TN3452). These land areas on the site or in the vicinity have limited value for wildlife.

Forestland

Forestland cover type is mainly present in the southeast portion of the PSEG Site. Scattered old field communities consisting of one or more land cover types also occur sporadically in the north and west portions of the PSEG Site. Construction and preconstruction activities would disturb about 89 ac. of the available forestland on the site. Permanent use would result in the loss of 8.7 ac of forestland, and 80.3 ac would be temporarily disturbed. The permanent change of land use would result in the loss of about 8 percent of the available forestland on the site. The majority of the onsite forestland to be permanently lost is designated as deciduous brush/shrubland habitat (6 ac) and old field (<25 percent brush covered) (2.6 ac) under the New Jersey land use and land cover (LULC) system (PSEG 2014-TN3452).

Less than 1 ac of forestland would be temporarily disturbed and 3.5 ac would permanently change with building the proposed causeway. No forestland would be disturbed in adjacent offsite areas during building activities (PSEG 2014-TN3452).

There are about 2,653 ac of forestland available in the 6-mi vicinity of the PSEG Site, and construction and preconstruction activities would permanently remove less than 1 percent of

that available habitat (PSEG 2014-TN3452). The impact to forestland from construction and preconstruction activities at the PSEG Site would not result in a noticeable impact to forestlands in the vicinity.

Water

The proposed construction and preconstruction activities would disturb about 44 ac of water habitats on the PSEG Site. About 40 ac of artificial lakes and nearly 3 ac of tidal rivers, inland bays, and other tidal waters would be permanently disturbed. The permanent loss represents about 94 percent of the available water habitats on the site. Less than 1 ac on the site would be temporarily disturbed (PSEG 2014-TN3452).

Building activities on adjacent offsite areas and the proposed causeway would disturb about 5 ac of available water habitat in these areas. Temporary disturbances include less than 1 ac in adjacent offsite areas and about 2 ac in the causeway. Permanent losses off the site would occur only in the proposed causeway area, and losses would be about 2 ac (PSEG 2014-TN3452).

There are about 26,837 ac of water habitat in the vicinity. The permanent loss of this habitat on the site and in the vicinity represents less than 1 percent of the total available habitat (PSEG 2014-TN3452). The loss of these areas would not have a noticeable effect on the available habitat in the vicinity.

Wetlands

Wetlands are mainly located in the extreme eastern and northern portions of the PSEG Site and represent one of the largest available habitats on the site. Building a new nuclear power plant would permanently disturb 108 ac of wetlands, including 0.1 ac of saline marsh, 58.3 ac of *Phragmites*- (*Phragmites australis*–) dominated coastal wetlands, 0.9 ac of herbaceous wetlands, 4.6 ac of deciduous scrub/shrub wetlands, and 44.1 ac of *Phragmites*-dominated interior wetlands. There would be 31.8 ac of temporary impacts on the site, including 5.1 ac of *Phragmites*-dominated coastal wetlands, 2.5 ac of herbaceous wetlands, and 24.2 ac of *Phragmites*-dominated interior wetlands (PSEG 2014-TN3452).

Offsite impacts to wetlands from building activities in the offsite adjacent areas and the proposed causeway would total 72.8 ac. A permanent loss of 23 ac would occur in the wetlands associated with the proposed causeway and include losses of 6.1 ac of freshwater tidal marsh, 11.2 ac of *Phragmites*-dominated coastal wetlands, 1.2 ac of herbaceous wetlands, 0.1 ac of mixed scrub/shrub wetlands (coniferous dominated), and 4.4 ac of *Phragmites*-dominated interior wetlands. A total of 49.8 ac would be temporarily disturbed, including 6.6 ac of freshwater tidal marshes, 13.2 ac of *Phragmites*-dominated coastal wetlands, 29.2 ac of *Phragmites*-dominated interior wetlands, and 0.8 ac of saline marsh (PSEG 2014-TN3452).

Potential impacts to wetland plant communities may consist of actual direct damage to plants, compaction of wetland soils, and short-term reductions in productivity. The proposed causeway would be designed as an elevated structure to minimize potential impacts to plant communities. Permanent impacts to wetland plant communities along the causeway would be limited to

placement of piers and direct shading. Shading could potentially result in some alteration of plant community makeup under the causeway and a reduction in primary productivity. The building method for the proposed causeway has not yet been determined, but construction work mats are expected to be used within a 50-ft-wide easement (PSEG 2014-TN3452). Reductions in primary productivity due to causeway development should be minimal overall, considering the large area of adjacent coastal wetlands within the project vicinity.

A total of 131 ac of wetlands would be lost as a result of building activities on the PSEG Site and vicinity. This represents less than 1 percent of the 25,534 ac of wetlands available in the vicinity. Most of these wetlands are dominated by near monocultures of the common reed (*Phragmites australis*), a nonnative aggressive invasive plant species that significantly impacts wetland diversity and habitat structure with resultant significant impacts to wildlife habitat quality (PSEG 2014-TN3452). However, wetlands are an important habitat and the alteration of these wetlands would be noticeable. Further discussion of wetland habitats can be found in Section 4.3.1.2, which discusses important species and habitats.

Barren Land

About 19 ac of barren land would be disturbed on the site from construction and preconstruction activities. This includes permanent impacts to nearly all of the 15 ac of altered lands and 4 ac of disturbed wetlands (modified). Temporary impacts to barren land on the site include less than 1 ac of the available disturbed wetlands (modified) (PSEG 2014-TN3452).

Offsite barren land disturbances in the vicinity include about 13 ac of temporary impacts in the adjacent offsite areas. There are no barren land disturbances expected for the building activities associated with the proposed causeway (PSEG 2014-TN3452).

Disturbances to barren lands represent about 3 percent of the available 651 ac of barren land in the vicinity and less than 1 percent of the 54,142 ac of barren lands available in the region (PSEG 2014-TN3452). Construction and preconstruction impacts on barren land would not noticeably affect barren land habitats in the vicinity.

Managed Wetlands

The applicant proposes to temporarily disturb 2.7 ac or 71 percent of the available managed wetlands on the PSEG Site. There would be no permanent impacts to managed wetlands, and there are no managed wetlands available in offsite areas or along the proposed causeway route (PSEG 2014-TN3452). This disturbance would not noticeably affect managed wetlands in the vicinity.

Agricultural Land

Agricultural lands that would be potentially impacted by building activities include near offsite areas along the proposed causeway route. These agricultural land cover types are located at the north end of the proposed causeway in Elsinboro Township. These plant communities consist of cultivated crops and adventitious weedy species. The proposed causeway would permanently disturb 12.4 ac and temporarily disturb 0.2 ac of agricultural land in the vicinity.

No permanent or temporary impacts to agricultural lands would result from onsite building activities at the PSEG Site. The affected agricultural lands represent less than 1 percent of agricultural lands available in the vicinity (PSEG 2014-TN3452). These impacts would not noticeably affect the available agricultural habitats in the vicinity.

Impacts to Wildlife

Habitat Loss Impacts

Loss of habitat as a result of building activities on the PSEG Site would impact terrestrial wildlife species currently inhabiting the site. Some direct loss of less mobile species and displacement of more mobile species to adjacent areas would be expected. Less mobile species may include small rodents, amphibians, and turtles. It is expected that larger species (e.g., raccoons, skunks, groundhogs, foxes, coyotes, and deer) and other more mobile species (e.g., birds) would be capable of easily moving off the site. However, displacement of species into surrounding areas would likely cause increased competition for resources (i.e., food, cover, and nesting sites) in those areas, resulting in some negative overall impacts to species populations where habitat carrying capacity is exceeded. Due to the extensive permanent and temporary impacts to onsite wetland resources, wildlife species that are dependent on this habitat for foraging, cover, and reproduction have the potential to be adversely effected. However, ample available habitat of similar structure and function exists in the vicinity and region.

The proposed causeway would be built on piers, preserving wildlife travel corridors. By allowing wildlife travel below the causeway, this elevated design would minimize the possibility for wildlife-vehicle collisions and wildlife mortality compared with conventional roadways built on embankments. Wildlife species potentially impacted from building activities are generally common in the region, as described in Section 2.4.1. The surrounding area includes large tracts of land that would be suitable for most displaced species, with competition from existing resident species in those areas being the greatest challenge for displaced species (PSEG 2014-TN3452).

Potential Noise and Fugitive Dust Impacts

Preconstruction and construction activities on the PSEG Site and in the vicinity that produce noise and fugitive dust would likely displace wildlife into habitat surrounding the work areas. The peak noise level associated with preconstruction and construction activities would be 102 dBA 50 ft away from work areas, attenuated to 58 dBA 1,500 ft away (Table 3-3). Behavioral impacts attributed to noise could decrease chances for wildlife survival and successful reproduction. Impacts to wildlife can range from nonexistent to serious depending on the species and the situation (Larkin 1996-TN772). In past studies on frequent noise events exceeding 80 dBA, waterfowl activities demonstrated only minimal responses to individual events with no noticeable disruptions of typical behavior patterns, indicating that avian species quickly accommodate to the noise events (Fleming et al. 2001-TN2419). It is anticipated that general noise levels from preconstruction and construction would dissipate to ambient levels within a short distance, which is well below that which would normally cause a response in wildlife (NRC 2013-TN2654).

PSEG proposes to suppress fugitive dust on the PSEG Site and offsite preconstruction and construction areas by using water from local stormwater retention ponds. The impact of fugitive dust to wildlife species would be negligible.

Potential for Collisions with Human-Made Structures

Avian and bat collisions with human-made structures can be attributed to numerous factors related to species characteristics such as flight behavior, age, habitat use, and seasonal and diurnal habitats and environmental characteristics such as weather, topography, land use, and orientation of the structures. This is a particular concern in the area of the PSEG Site because it is in the Atlantic Flyway, a major bird migration route. Additionally, bat hibernacula (shelters occupied by dormant bats) are known to occur in Salem County, New Jersey. Bird and bat collisions with construction equipment, such as cranes or new structures, have the potential to occur at the PSEG Site. Studies of avian and bat collisions with elevated construction equipment are lacking. However, surveys conducted in the vicinity of other human-made structures such as natural draft cooling towers indicate that avian mortalities as a result of collisions could occur. The findings of NUREG–1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, (NRC 2013-TN2654) demonstrated that mortalities as a result of avian collisions with existing structures at nuclear power plants are minor and typically occur with structures greater than 300-ft tall. In addition, a study on bat collisions with wind turbine towers indicated that only a small fraction of bats collide with towers and the number was not sufficient to alter populations (Erickson et al. 2002-TN771). The tallest structure on the PSEG Site is the natural draft cooling tower associated with HCGS (512 ft) (PSEG 2014-TN3452). During a year-long study from 1985 to 1986, PSEG counted a total of 30 avian mortalities with no Federal- or State-listed endangered or threatened species noted (PSEG 1987-TN2893). Therefore, the impacts of such collisions during preconstruction and construction at the PSEG Site are expected to be negligible.

Potential Impacts of Artificial Light

Nighttime artificial lighting has the potential to impact wildlife during preconstruction and construction activities. Frogs, for example, have been found to inhibit their mating calls when exposed to excessive light at night. The feeding behavior of some bat species may also be affected by artificial lighting (PSEG 2014-TN3452). In addition, artificial lighting could create or magnify the incidence of avian collisions if tall cranes are illuminated for nighttime work. According to Evans Ogden (Evans Ogden 1996-TN3284), the largest proportion of migrating birds affected by human-built structures is composed of songbirds. This is apparently because they typically migrate at night, exhibit low flight altitudes, and have a tendency to be trapped and disoriented by artificial light. This makes them vulnerable to collisions with obstructions. Wildlife species on the PSEG Site and in the 6-mi vicinity are acclimated to the artificial lighting associated with the operating nuclear power plants and support structures. As previously mentioned, avian collisions at the PSEG Site are negligible and no bat species mortalities have been noted. Therefore, artificial light impacts to wildlife species are expected to be minimal.

Summary of Impacts to Terrestrial Habitats and Wildlife

The construction and preconstruction impacts on terrestrial habitats and wildlife of building a new nuclear power plant at the PSEG Site are projected to be minimal. This does not include impacts to important species and important wetlands, wildlife sanctuaries, refuges, and preserves. Important species and important wetlands, wildlife sanctuaries, refuges, and preserves are discussed further in Section 4.3.1.2. Habitat available for terrestrial wildlife that currently exists at the PSEG Site where construction and preconstruction activities would occur is more common elsewhere in the vicinity. Avian collisions with building equipment and temporary facilities would be minimal. Noise impacts would be localized and attenuate with distance. Artificial lighting and fugitive dust would not be expected to disrupt the behaviors of terrestrial wildlife beyond the building area. Therefore, the review team concludes that preconstruction and construction impacts to terrestrial habitats and wildlife would be negligible.

4.3.1.2 Important Terrestrial and Wetland Species and Habitats

Important Species—PSEG Site and Vicinity

This section describes the potential impacts on important species from construction and preconstruction activities associated with building at the PSEG Site. Important species considered in this section include Federally proposed, threatened, or endangered terrestrial species; State-listed species; and other ecologically important species. As part of the NRC's responsibilities under Section 7 of the Endangered Species Act of 1973 (16 USC 1531-TN1010), the NRC will prepare a biological assessment before issuance of the final EIS that evaluates potential impacts of preconstruction and construction activities on Federally listed (or proposed), threatened, or endangered aquatic and terrestrial species (Appendix F). Section 2.4.1 describes the important terrestrial species and habitats located within the PSEG Site and vicinity. Impacts to terrestrial species are discussed in greater detail below.

Terrestrial Species of Recreational or Commercial Value

Northern river otters (*Lontra canadensis*) were observed in the Delaware River at the PSEG Site during the 2009 to 2010 field survey. They are an economically important furbearer species because of their thick and very durable fur. The species is generally most abundant in food-rich coastal areas such as the lower portions of streams, rivers, and estuaries (Chapman and Feldhamer 1982-TN3274). Although some temporary displacement of river otters may occur during preconstruction or construction at the PSEG Site, suitable habitat would remain abundant in the Delaware River, Alloway Creek, Hope Creek, and various unnamed tidal creeks in the vicinity.

Muskrats (*Ondatra zibethicus*) generally prefer coastal marshes and marshy areas around lakes, sloughs, streams, and rivers. However, they are very adaptable and can also be found in a wide range of habitats, including strip-mined ponds, ditches, canals, and pits. They are considered to be the most valuable fur animal in North America (Chapman and Feldhamer 1982-TN3274). Muskrats are abundant in the coastal and freshwater wetlands surrounding the PSEG Site and were observed during the 2009 to 2010 field survey. Building at the PSEG Site would permanently impact a little less than 127 ac of potential muskrat habitat on

the site and a little more than 25 ac off the site. This would result in the displacement of some animals, which could result in increased competition for resources in surrounding areas. Although a new nuclear power plant and the associated causeway would result in loss of some habitat for this species, more than 25,000 ac of wetlands would remain in surrounding areas (PSEG 2014-TN3452).

White-tailed deer (*Odocoileus virginianus*) are an important game species and have significant economic value, offering major recreational hunting opportunities. White-tailed deer are found throughout New Jersey and are absent only from the most urbanized areas. Deer hunters in New Jersey spend more than $100 million a year, benefiting a wide variety of businesses.

White-tailed deer are abundant in the upland agricultural areas in the vicinity of the PSEG Site and were commonly observed during the 2009 to 2010 ecological field studies. On the site, white-tailed deer were occasionally observed in the upland old field habitat east of HCGS and SGS (PSEG 2014-TN3452). Building at the PSEG Site would permanently impact almost 9 ac and temporarily impact almost 100 ac of potential white-tailed deer habitat on the site in undeveloped upland ROWs and forest/old field land cover types. Impacts to potential white-tailed deer habitat within the proposed causeway (agriculture, forest/old field, upland ROWs undeveloped, agricultural wetlands, and former agricultural wetlands) include almost 18 ac of permanent impacts and 0.3 ac of temporary impacts. Portions of the impacted area are located near the existing HCGS and SGS facilities, where buildings, pavement, and the noise of operations result in marginal or unsuitable habitat conditions (PSEG 2014-TN3452).

Preconstruction and construction activities may also temporarily increase the potential for white-tailed deer mortality due to vehicle collisions associated with displacement and movement of deer toward upland habitat to the east of the site. More than 16,000 ac of agricultural habitat and more than 2,500 ac of forest/old field habitat would remain in the vicinity of the site (PSEG 2014-TN3452). Displacement of animals could result in increased competition for resources in surrounding areas.

The northern pintail (*Anas acuta*), green-winged teal (*Anas crecca*), mallard (*Anas platyrhynchos*), American black duck (*Anas rubripes*), ring-necked duck (*Anas collaris*), greater scaup (*Aythya marila*), bufflehead (*Bucephala alboela*), hooded merganser (*Lophodytes cucullatus*), common merganser (*Mergus merganser*), and red-breasted merganser (*Mergus* serrator) ducks; Canada goose *Branta canadensis*); and snow goose (*Chen caerulescens*) are all waterfowl that have been identified as important species at or near the PSEG Site (PSEG 2014-TN3452). These 12 species of waterfowl, plus the American coot (*Fulica americana*), are considered important species based on their recreational value as game species that are hunted in the vicinity of the PSEG Site. Although protected by the Migratory Bird Treaty Act (16 USC 703-TN3331), these species are commonly harvested during yearly hunting seasons.

The PSEG Site and vicinity contains relatively abundant waterfowl habitat. However, the invasion of the exotic *Phragmites australis* has transformed habitat that was a historically diverse marsh ecosystem into a habitat of limited structure and function, with altered nutrient cycles and hydrological regimes. Of specific concern are negative impacts to habitat quality and diversity for waterfowl. Dense, monotypic stands of *Phragmites* provide only marginal habitat

for resident, migratory, and wintering species of waterfowl. Although waterfowl may occasionally nest in this habitat, most are migratory, using the area as a stopping point or wintering area along the Atlantic Flyway. These birds primarily use open water areas present on the PSEG Site, including the CDF/disposal basins and tidal creeks. Preconstruction- and construction-related impacts would include 65.2 ac of unmapped coastal–CDF/disposal basin wetlands. These basins are mostly surrounded by nearly impenetrable monotypic stands of *Phragmites* and are generally shallow, supporting only minimal aquatic vegetation and benthic macroinvertebrate communities. Limited habitat structure and plant species diversity in these areas provide very little foraging opportunity for waterfowl, and they are primarily used as resting areas. Building activities may result in displacement of waterfowl; however, tidal creeks and more than 25,000 ac of wetland habitat would remain abundant in the vicinity of the PSEG Site (PSEG 2014-TN3452).

The wild turkey (*Meleagris gallopavo*) is an important game bird species that has been recorded on and in the vicinity of the PSEG Site. Wild turkeys were observed during the 2009 to 2010 field survey. A total of 8.7 ac of suitable turkey habitat (i.e., deciduous brush/shrubland, old field, and upland ROWs undeveloped) would be permanently converted to developed land cover types on the PSEG Site as a result of preconstruction and construction activities. A total of 80.3 ac of this habitat would be temporarily eliminated. Also, a total of 16.8 ac of turkey habitat (i.e., cropland, pastureland, or other agriculture; forest/old field; and upland ROWs undeveloped) would be permanently impacted by building the proposed causeway. Wild turkeys are mobile birds capable of dispersing to adjacent areas with suitable habitat. More than 16,000 ac of agricultural land and more than 2,500 ac of forest/old field would remain available to turkeys in the vicinity of the PSEG Site after building activities were completed (PSEG 2014-TN3452). Increased competition for limited resources and increased competition for females by males would probably be the two largest impacts. However, a fairly limited amount of habitat would be permanently impacted in comparison to vast areas of habitat in the immediate vicinity.

Federally or State-Listed Terrestrial Species

<u>Reptiles and Amphibians</u>

The bog turtle (*Glyptemys muhlenbergii*) is listed as threatened Federally and State-listed as endangered by both New Jersey and Delaware. This species was recorded historically for Artificial Island and the vicinity during a study conducted between 1972 and 1978. There were no records for this species in the latest surveys conducted by PSEG in 2009 to 2010 (PSEG 2014-TN3452). Although the most recent distribution for bog turtles includes Salem County, the PSEG Site does not currently contain suitable habitat for this species. Bog turtles require large contiguous areas of land for dispersal, and intense land uses such as those found on the PSEG Site are not favorable to this species. Furthermore, monocultures of invasive species such as *Phragmites* are not conducive to bog turtle presence. Therefore, building a new nuclear power plant on the PSEG Site would not be expected to impact this species.

The eastern tiger salamander (*Ambystoma tigrinum tigrinum*) is listed as endangered by New Jersey. This species was recorded historically during the Artificial Island study from 1972 to 1978. There were no records for this species in the latest surveys conducted by PSEG from

2009 to 2010 (PSEG 2014-TN3452). Although tiger salamanders will use human-made ponds, it is not believed that the PSEG Site contains sufficient habitat to fulfill all life requirements to sustain this species. Life requirements include both upland and wetland habitat that contain ponds suitable for breeding, forested areas, and soil types that allow burrowing (loamy sand and sandy loams are preferred). Vegetation around the ponds used by this species normally includes sedges and sphagnum moss, and sufficient aquatic vegetation is needed in the pond itself for cover. The altered habitat present on the PSEG Site would not appear to be conducive to supporting tiger salamander populations. In addition, surveys of this species conducted in 1995 revealed that the tiger salamander occurred at only a limited number of sites in Atlantic and Cumberland counties (PSEG 2014-TN3452). Therefore, building a new nuclear power plant would not be expected to impact this species.

Birds

The eight birds of prey identified as important species include the Cooper's hawk (*Accipiter cooperii*), northern goshawk (*Accipiter gentilis*), red shouldered hawk (*Buteo lineatus*), northern harrier (*Circus cyaneus*), bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), American kestrel (*Falco sparverius*) and peregrine falcon (*Falco peregrinus*). The Cooper's hawk is listed as special concern in New Jersey. Cooper's hawks prefer large tracts of forested land, where they nest in large mature trees. One was observed in a small tree on the site in the fall of 2009. Preferred habitat for this species is not present on the site, and Cooper's hawks are more likely residents of forested habitat in the vicinity of the PSEG Site. Use of habitat at the PSEG Site by this species is most likely of a transient nature during foraging. Year-round, migrating and wintering birds would all be expected to use the site in this manner. Preconstruction- and construction-related impacts to Cooper's hawks are expected to be minimal.

Northern goshawks, listed as endangered for the breeding population and special concern for the nonbreeding population in New Jersey, have been reported in the project vicinity during recent (2008 to 2009) Audubon Society Annual Christmas Bird Counts for Salem County (Audubon 2013-TN2414). This species breeds in mature forests, and the PSEG Site contains no potential breeding habitat. However, goshawks frequent a wider variety of habitats outside the breeding season during foraging. These habitats include scrubby areas and tree lines along marshes or open fields. Potential foraging habitat in the form of forest/old fields and wetlands would be impacted by building at the PSEG Site. However, more than 27,000 ac of such habitat are present in the vicinity of the site (Audubon 2013-TN2414). Therefore, impacts to potential foraging habitat for this species are expected to be minimal.

Although the red-shouldered hawk, a New Jersey-listed endangered species, has been identified in recent years near the PSEG Site during the Audubon Society Annual Christmas Bird Counts (Audubon 2013-TN2414), as discussed in Section 2.4.1, no red-shouldered hawks were observed on the site during the 2009 to 2010 field survey (PSEG 2014-TN3452). Preferred habitat, deciduous and mixed forest communities adjacent to water, is absent on the site but available in the vicinity. Only transient use of the site would be expected for this species. Therefore, preconstruction- and construction-related impacts to red-shouldered hawks are expected to be minimal.

The northern harrier, a State-listed endangered species in New Jersey and Delaware, has been commonly observed foraging in the coastal wetlands on and in proximity to the site. Nests were not observed on the site during the 2009 to 2010 field survey; however, nesting habitat in the coastal marsh is present on the site and in the vicinity. Onsite habitat potentially used by the northern harrier that could be impacted by preconstruction and construction activities includes 26.1 ac of *Phragmites*-dominated old field, 63.4 ac of *Phragmites*-dominated coastal wetlands, 68.3 ac of *Phragmites*-dominated interior wetlands, 56.9 ac of old field, and 0.1 ac of saline marsh. Northern harrier habitat within the proposed causeway that could be permanently impacted includes 11.3 ac of agricultural lands, 3.4 ac of old field habitats, and 25.1 ac of wetlands. The vast majority of impacts would be incurred in areas consisting of near monocultures of the invasive reed *Phragmites australis*, which generally offers habitat of limited structure and function because it forms dense, impenetrable stands (PSEG 2014-TN3452). However, there are records of harriers nesting in *Phragmites*-dominated habitats (NJDEP 2014-TN3255). The carrying capacity of the areas for nesting harriers could be impacted, thereby decreasing the number of pairs that could nest in the area. However, abundant higher quality foraging and nesting habitat for this species would remain in the vicinity of the PSEG Site. Because impacts incurred would be to habitat of limited structure and function and ample high-quality northern harrier habitat would remain, impacts to the northern harrier are expected to be minimal.

Due to its successful recovery, the bald eagle is no longer a Federally listed species by the U.S. Fish and Wildlife Service. The bald eagle was identified as important because of its status as a Federally protected species (16 USC 703-TN3331; Bald and Golden Eagle Protection Act, 16 USC 668-TN1447) and as a State-listed endangered species for both New Jersey and Delaware. Although bald eagles were occasionally observed during the 2009 to 2010 onsite field survey, there are no known bald eagle nests or suitable roosting habitat at the PSEG Site. This is primarily due to the absence of large trees or suitable structures that could support nesting activities (PSEG 2014-TN3452). Therefore, building a new nuclear power plant and causeway are not anticipated to impact bald eagle nesting, foraging, or roosting habitat, so impacts to the bald eagle are expected to be minimal.

Osprey, a New Jersey State-listed threatened species, were occasionally observed both on and in the vicinity of the PSEG Site during the 2009 to 2010 field survey. Active osprey nests were observed on transmission towers along the current access road, on the transmission towers that run from the plant north toward Money Island Road, and on human-made nesting platforms constructed by PSEG along Alloway Creek. Natural osprey nesting sites such as large trees are not present on the site (PSEG 2014-TN3452). Impacts to osprey, if any, would be considered minor because nesting platforms are not expected to be impacted by preconstruction or construction. Furthermore, food and foraging habitat (i.e., in the Delaware River) would remain abundant during and after development of a new nuclear power plant. Consequently, impacts on osprey are expected to be minimal.

American kestrels, State-listed as threatened in New Jersey, have been reported in the PSEG Site vicinity by the USGS North American Breeding Bird Survey (BBS) and during recent Audubon Society Annual Christmas Bird Counts for Salem County (PSEG 2014-TN3452; Audubon 2013-TN2414). This species was also recorded during past work conducted in the Alloway Creek Watershed (PSEG 2004-TN2897). This is a species that prefers open country.

Building on the PSEG Site would permanently disturb less than 3 ac and temporarily disturb a little more than 54 ac of old field habitat that could serve as potential habitat. In addition, permanent loss of agricultural lands due to building the causeway would be 11.3 ac. However, there are more than 2,500 ac of forest/old field habitat and more than 16,000 ac of cropland-pastureland and other agriculture habitat in the vicinity of the site. In addition, this would be expected to be higher quality habitat and more conducive habitat for kestrels then what currently exists on the PSEG Site. Consequently, impacts of preconstruction and construction on kestrels are expected to be minimal.

Peregrine falcons, State-listed as endangered for the breeding population and special concern for the nonbreeding population in New Jersey, have been reported in the PSEG Site vicinity during recent Audubon Society Annual Christmas Bird Counts for Salem County (Audubon 2013-TN2414). There are no records for nesting peregrine falcons in Salem County. Any expected use of the PSEG Site by peregrines would be for foraging, which would most likely occur in the winter. This species favors open areas for hunting, frequently hunting over marshes, beaches, and open water. Although there would be some loss of wetlands as a result of building a new nuclear power plant (127 ac permanently, 41 ac temporarily) and the causeway (25.1 ac permanently, 20.1 ac temporarily), there are more than 25,000 ac of wetlands remaining in the vicinity of the site. Therefore, impacts to any potential foraging habitat for this species are expected to be minimal.

A number of wading birds have been documented on and/or adjacent to the PSEG Site during past surveys (Table 2-8). Several of these species have listed status in New Jersey and/or Delaware. These species include several State-designated species of concern including the great blue heron (*Ardea herodias*), little blue heron (*Egretta caerulea*), snowy egret (*Egretta thula*), and glossy ibis (*Plegadis falcinellus*). State-listed endangered and threatened species include both black-crowned night-heron (*Nycticorax nycticorax*) and cattle egret (*Bubulcus ibis*). An additional State-listed species, the pied-billed grebe (*Podilymbus podiceps*), has been observed in low numbers during Audubon Society Annual Christmas Bird Counts in Salem County. Common terns (*Sterna hirundo*), State-designated species of concern, has also been recorded at the site and in the vicinity. Spotted sandpipers (*Actitis macularius*), New Jersey State-designated species of concern, may also frequent such areas. There are no known heron/egret rookeries or tern colonies on the PSEG Site. However, the PSEG Site does contain potential foraging habitat that would be permanently impacted by building a new nuclear power plant. This includes 40 ac of artificial lakes (mainly in the northeastern portion of the site) and 3 ac of tidal rivers, inland bays, and other tidal waters (Table 4-1). However, more than 26,000 ac of tidal rivers, inland bays, and other tidal waters would remain in the vicinity of the site (PSEG 2014-TN3452). Therefore, impacts on wading birds and terns are expected to be minimal.

A number of New Jersey and/or Delaware State-listed bird species that typically frequent old fields and other open habitats have been recorded on or in the vicinity of the PSEG Site. These include State-designated species of concern including brown thrasher (*Toxostoma rufum*), eastern meadowlark (*Sturnella magna*), and yellow-breasted chat (*Icteria virens*). Additionally, State-listed endangered and threatened species such as horned lark (*Eremophila alpestris*), bobolink (*Dolichonyx oryzivorus*), grasshopper sparrow (*Ammodramus savannarum*) and savannah sparrow (*Passerculus sandwichensis*) are known to occur in these habitats. Building

on the PSEG Site would permanently disturb less than 3 ac and temporarily disturb a little more than 54 ac of old field habitat (Table 4-1). However, there is more than 2,500 ac of forest/old field habitat and more than 16,000 ac of cropland, pastureland, and other agriculture habitat in the vicinity of the site (PSEG 2014-TN3452). In addition, this would be expected to be higher quality habitat than what currently exists at the PSEG Site. Therefore, impacts to these species are expected to be minimal.

The red-headed woodpecker (*Melanerpes erythrocephalus*) breeding and nonbreeding populations are listed by New Jersey as threatened. No red-headed woodpeckers were observed during the 2009 to 2010 field survey, nor have they been reported in USGS BBS or the Audubon Society Annual Christmas Bird Count. In addition, the site and vicinity lack suitable habitat for this species [i.e., open woods, deciduous forests, forest edges, river bottoms, orchards, grasslands with scattered trees and clearings, dead or dying trees (Section 2.4.1)]. Therefore, it is not expected that there would be any preconstruction- or construction-related impacts to this species.

The northern parula (*Parula americana*) and hooded warbler (*Wilsonia citrina*), New Jersey State-designated species of concern, are two warbler species recorded by USGS BBS in the vicinity of the site. These species would not be impacted by building because the site contains very little viable habitat to support these species. Only transient use of the site would be expected for these species.

Bats

Typical hibernacula and maternity roosting habitat suitable for the northern long-eared bat (*Myotis septentrionalis*) does not exist on the PSEG Site, and the bat has not been recorded on the site. The nearest known hibernacula and maternity roost are in northern and central Salem County, New Jersey. The northern long-eared bat is not expected to be affected by preconstruction and construction activities on the PSEG Site.

Plants

Sensitive joint-vetch (*Aeschynomene virginica*) is a Federally threatened plant species that is known to occur in intertidal zones that are fresh or slightly salty in areas with extensive marshes subject to two cycles of flooding a day. It prefers sediments that are bare or contain sparse vegetation along river banks within 6 ft of the low water mark. It can also occur in tidal marsh interiors. It has historically occurred within the vicinity of the PSEG Site but has not recently been recorded on the site. Suitable habitat is not expected to occur on the PSEG Site.

Swamp pink (*Helonias bullata*) and small whorled pogonia (*Isotria medeoloides*) are Federally listed as threatened. Swamp pink is an obligate wetland species that occurs in palustrine forested wetlands with canopy closures of 20 to 100 percent. Although it is believed to occur in the vicinity of the PSEG Site, suitable habitat does not exist. Small whorled pogonia grows in upland, mid-successional, wooded habitats, usually with mixed deciduous or mixed deciduous/coniferous forest with canopy trees ranging from 40 to 75 years old. Like the swamp pink, suitable habitat on the PSEG Site is not available.

Other Important Terrestrial Species

Green tree frogs (*Hyla cinerea*) were observed on the site within small isolated impounded areas within the PSEG desilt basin during the 2009 to 2010 survey (PSEG 2014-TN3452). A survey conducted in June and July 2012 also detected this species in the same general onsite location and numerous offsite locations in the vicinity (AMEC 2012-TN3187). This was a new species record for New Jersey, although its range does extend throughout the Delmarva Peninsula to the south and west. The range of this species appears to be expanding, and it is not listed on the New Jersey special concern or threatened and endangered species lists. Based on the overlay of the Site Utilization Plan shown in Figure 4-1, habitats in which green tree frogs were observed would be altered or eliminated as part of preconstruction and construction activities. However, based on the prevalence of records for the green tree frog at numerous offsite locations during the 2012 survey (AMEC 2012-TN3187), there is viable habitat for this species in a number of areas in the vicinity of the PSEG Site.

Summary of Impacts on Important Terrestrial Species at the PSEG Site

The construction and preconstruction impacts on important species of building a new nuclear power plant at the PSEG Site are projected to be minimal with no additional mitigation needed. Habitat available for important species that currently exist at the PSEG Site where construction and preconstruction activities would occur is more common elsewhere in the vicinity. Avian collisions with building equipment and temporary facilities would be minimal. Noise impacts would be localized and attenuate with distance. Artificial lighting and fugitive dust would not be expected to disrupt important species behaviors beyond the building area. Therefore, the review team concludes that preconstruction and construction impacts to important species would be negligible.

Important Habitats

Wetlands

Jurisdictional wetlands [i.e., those that are regulated by the USACE under Section 404 of the CWA (33 USC 1251-TN662)] are often more narrowly defined than wetlands identified as part of the NJDEP LULC classification system and are subject to the USACE permitting requirements. Therefore, jurisdictional wetlands are evaluated separately from the LULC analysis presented in Section 4.3.1.1.

There would be unavoidable impacts to waters of the United States and State waters as a result of preconstruction and construction activities associated with a new nuclear power plant and related facilities. This would include both direct and indirect impacts to wetland resources at the PSEG Site and along the proposed causeway. Direct impacts would be related to direct alteration of the habitat as the result of fill placement, shading, and other preconstruction and construction activities. There would also be the potential for indirect impacts to areas outside the wetlands. These indirect impacts might include pollutant loading (oil and grease) from cars traveling along the proposed causeway and erosion/sedimentation caused by additional runoff due to increases in impervious surfaces (PSEG 2014-TN3452).

Specific site use areas where direct impacts to wetlands might occur include, but are not limited to, the power block, cooling tower, switchyard, batch plant, heavy haul road, parking, intake structure, and temporary laydown areas, as illustrated in Figure 4-1. Direct impacts are generally associated with the placement of fill material in support of construction activities. As discussed in Section 4.3.1, the limits of the site use areas represent a bounded configuration of the lands potentially affected by building activities (PSEG 2014-TN3452).

Onsite building activities would impact a total of 63.4 ac of coastal wetlands and 122.5 ac of unmapped coastal wetlands. Of the 122.5 ac of unmapped coastal wetlands potentially impacted, 90 ac are situated in active land disposal areas (i.e., the USACE CDF and PSEG desilt basin). A total of 151.2 ac of wetlands are in proposed onsite permanent use areas, and 36.5 ac are in onsite and adjacent offsite temporary use areas (the USACE CDF). The impacts to all of these use areas are considered to be permanent, and mitigation for losses would occur in other areas of the site or in offsite areas (Section 4.3.1.4) (PSEG 2014-TN3452).

An additional 39.6 ac of coastal wetlands and 1.4 ac of unmapped coastal/freshwater wetlands off the site would be impacted by building the proposed causeway. Offsite impacts associated with the causeway would be minimized through the use of an elevated road and bridge design that would reduce the width and magnitude of impact when compared to building on fill. Within a 50-ft-wide corridor, wetland impacts resulting from fill would be limited to areas directly affected by pier placement. Some plant community alteration is expected due to shading effects, as described in Section 4.3.1. Because of this, the 50-ft-wide corridor was assumed to be permanently impacted. It was also assumed that construction methods would include the use of low-ground-pressure equipment and work mats to support heavy equipment (e.g., pile drivers). Work mats would be used within a 50-ft-wide easement and removed once the causeway is completed (PSEG 2014-TN3452). Temporary impacts within these areas would therefore be minimized, with limited compaction and disturbance to wetland soils and substrates. Therefore, disturbance is anticipated to be temporary in these areas, and recovery following the building phase is expected to be rapid.

Indirect impacts would occur within adjacent wetlands and surface waters, including localized siltation and sedimentation. Preconstruction- and construction-related secondary impacts to site wetlands would be minimized and controlled with the use of BMPs. This would include the use of silt fences, temporary and permanent vegetative stabilization, mulching, erosion control blankets, stormwater detention basins, and other soil erosion and sediment control practices, as appropriate. These measures would reduce the risk of sediment runoff into wetlands adjoining the site. Grading plans would also be used to control site runoff from developed lands and prevent discharge of stormwater into adjacent wetlands (PSEG 2014-TN3452).

In total, 104.8 ac of coastal, 122.5 ac of unmapped coastal, and 1.4 ac of freshwater wetlands are expected to be impacted by building a new nuclear power plant and the proposed causeway. Because of the abundance of wetland land-cover types within the vicinity (25,534 ac) and the quality of the impacted resource (i.e., the dominance of *Phragmites* and the large amount of onsite acreage represented in CDFs), the potential impacts to this cover type are expected to be noticeable and may warrant mitigation (additional discussion in Section 4.3.2.2 regarding mitigation) (PSEG 2014-TN3452).

Mad Horse Creek WMA and Abbotts Meadow WMA

Portions of the proposed causeway would traverse sections of the Mad Horse Creek WMA and Abbotts Meadow WMA. About 1 ac of these WMAs would be impacted. Mad Horse Creek WMA consists of 9,500 acres of wildlife habitat and recreational land, and Abbotts Meadow WMA contains 1,000 acres of wildlife habitat and recreational land. The impact represents less than 1 percent of the combined available habitat at these WMAs.

4.3.2 Summary of Impacts to Important Habitats

Preconstruction- and construction-related impacts to important habitats as a result of building a new nuclear power plant and associated support structures would be noticeable. The impacts to about 229 ac of wetlands would be noticeable, but not destabilizing. These impacts may warrant mitigation, as prescribed by the USACE. Although the loss of about 1 ac of WMA would not be noticeable, it would have a localized effect on species dependent on the resources.

4.3.2.1 Terrestrial Monitoring

PSEG has not proposed terrestrial monitoring during construction or preconstruction activities associated with a new nuclear power plant. However, PSEG conducts ecological monitoring as part of the EEP near the site in conjunction with its NJPDES permit for SGS. These ecological studies include vegetation cover and geomorphology monitoring for four restoration sites and two reference sites. Additionally, the USACE could require PSEG to conduct short- and long-term monitoring of wetland mitigation activities in association with a new nuclear power plant and support structures as part of compliance with the USACE-issued permits.

4.3.2.2 Potential Mitigation Measures for Terrestrial Impacts

Mitigation of unavoidable impacts to terrestrial and wetland resources may include restoration of habitats disturbed by preconstruction and construction activities, creation of new habitat in previously disturbed areas, and enhancement of other natural habitat. PSEG has indicated that any mitigation plans would be developed in consultation with the applicable Federal, State, and local agencies. Additionally, PSEG-proposed mitigation would be done both on the site and off the site in the immediate vicinity to the extent practicable (PSEG 2014-TN3452). PSEG's proposed mitigation measures are described in the following sections for both upland areas and wetlands.

Upland Terrestrial Habitats

The mitigation of temporary impacts to terrestrial resources and associated wildlife populations could include restoration of these areas with native cover types. Many of the areas identified for temporary use are previously disturbed habitats that have become reestablished as natural areas. Mitigation of impacts in these areas to stabilize soils and reestablish habitat may include grading and planting with native plant species. The adjacent lands to be temporarily leased from the USACE could be restored to a use and cover type agreed upon with the USACE (PSEG 2014-TN3452). These measures, in combination, could restore quality habitat for resident wildlife populations.

Wetlands

Wetlands are considered to be an important terrestrial resource on the PSEG Site and provide habitat for wildlife that frequent the area. The quality of the habitat provided by wetlands at the site is impacted by the fact that much of the area is dominated by the invasive common reed (*Phragmites australis*). These wetlands are regulated under the authority and jurisdiction of the USACE and NJDEP (Section 2.4.1).

The USACE approach is that mitigation may only be used after all appropriate and practical steps to avoid and minimize adverse impacts to aquatic resources, including nontidal wetlands and streams, have been taken. Further, the USACE requires all remaining unavoidable impacts to be compensated to the extent appropriate and practicable. The USACE could monitor or require monitoring for compliance with the USACE-issued permits. The USACE permit could include special conditions that could require PSEG to ensure that the created and enhanced wetlands meet the Federal wetland criteria outlined in the report entitled *Corps of Engineers Wetlands Delineation Manual* (USACE 1987-TN2066). If the USACE did not find the wetlands and stream mitigation satisfactory, it could determine whether adverse impacts to the waterway and wetlands were more than minimal and any project modifications could be warranted. Also, the USACE would require PSEG to assume all liability for accomplishing the corrective work in accordance with Compensatory Mitigation for Loses of Aquatic Resources (73 FR 19594-TN1789; 33 CFR 320-TN424; 33 CFR 325-TN425).

PSEG could take measures to avoid or minimize impacts to jurisdictional wetlands to the maximum extent possible. A new nuclear power plant on the PSEG Site would be located adjacent to the existing HCGS and SGS facilities on Artificial Island. Mitigation measures to be taken to avoid or minimize adverse impacts to waters of the United States could include the following: minimizing encroachment into coastal wetlands; minimizing encroachment into NJDEP-regulated freshwater wetlands; use of already existing sediment disposal basins for plant development (i.e., the PSEG permitted disposal facility and the USACE CDF); refinement of the PSEG Site Utilization Plan (Figure 2-3) to avoid various wetland areas throughout the PSEG Site; and a causeway built on elevated piers or bridges, instead of on fill, to minimize direct impacts to tidal wetlands and to avoid impacts to tidal creeks (PSEG 2014-TN3452).

Additional measures to avoid or minimize potential impacts to wetlands could be formulated following the selection of a reactor technology and could continue to be devised throughout the design phase as detailed site layouts were developed. This could include the evaluation of soil management and use options aimed at reducing the limits of construction (i.e., fill areas) to reduce the impact footprint from that shown on the PSEG Site Utilization Plan (Figure 2-2). The options available would depend on the technology chosen. The process of determining the most environmentally sensitive and practicable alternatives could continue throughout the permitting process (PSEG 2014-TN3452).

Compensatory Actions

Following the implementation of reasonable measures to avoid or minimize impacts to wetlands, compensation for unavoidable adverse impacts could be undertaken with the execution of an approved wetland restoration and/or rehabilitation program. In selecting a site for wetland

mitigation, the following factors are typically considered: existing land use (historic and current), property ownership or potential for acquisition, hydrologic potential, proximity to other wetland sites, site topography, connectivity to adjacent natural habitats, site accessibility, and the presence of or potential to develop hydric soils (PSEG 2014-TN3452).

Opportunities for wetland mitigation exist at various locations throughout the PSEG Site and vicinity. Factors that may influence site selection for wetland creation include topography, soil types, watershed size, and the presence of adjacent streams as a source of additional water (PSEG 2014-TN3452).

Once a candidate mitigation site has been selected, wetland mitigation could be achieved through a series of rehabilitation and/or restoration methods. These methods could be site-specific and might include the control of *Phragmites*, restoration of the hydrologic state (levee removal, channel design, and reestablishing a connection of upland areas to tidal influences), and wetland enhancement that included the restoration of desirable and native vegetation (PSEG 2014-TN3452).

Wetland mitigation plan details would primarily be guided by conditions established under CWA Section 404 permits issued by the USACE or the NJDEP Land Use Regulation Program and Section 401 water-quality certifications issued by NJDEP. Therefore, specific wetland mitigation efforts could be determined as part of such authorizations (PSEG 2014-TN3452).

Several candidate mitigation areas that have the potential to meet some or all of PSEG wetland mitigation needs were identified during the ESP application process. These candidate mitigation areas include portions of the existing PSEG Site, Mannington Meadow, Mason's Point, and additional areas of the PSEG ACW site (PSEG 2014-TN3452).

Wetland mitigation concepts for each area are outlined below and include the enhancement and/or development of coastal and freshwater wetland systems. A network of marsh creeks is integral to the restoration of coastal marsh and would address the loss of creeks within the existing marsh.

Onsite

The PSEG Site includes about 149 ac of *Phragmites*-dominated wetlands that could be used for wetlands mitigation. There are plans to purchase additional land to the north of the site, a significant portion of which is mapped coastal wetlands dominated by *Phragmites*. Once acquired, this area could be considered for onsite mitigation. Most onsite wetlands are tidally influenced coastal wetlands where *Phragmites* control may allow *Spartina* (cordgrass) and other native marsh species to revegetate (PSEG 2014-TN3452).

Mannington Meadow

Mannington Meadow is a brackish estuary located on the Salem River in Salem County, New Jersey. It provides significant habitat for numerous species of migrating, wintering, and breeding birds, including waterfowl, shorebirds, and raptors. The area also supports a brackish- and freshwater-based fishery. Mannington Meadow contains open water, emergent

wetlands, and adjacent farmland. The presence of degraded marsh in this area provides the potential for restoration opportunities for conversion into a functional tidal brackish ecosystem. The keys to successful restoration in this area could include increasing the incoming freshwater flow from the Salem River and reducing the coverage of *Phragmites* to allow *Spartina* and other desirable marsh species to revegetate the area. Mannington Meadow is a large enough area (3,800 ac) to provide good mitigation opportunities; however, much of it is in private, State, or Federal ownership (PSEG 2014-TN3452).

Mason's Point

Mason's Point, located in Elsinboro Township near Alloway Creek, is 2.5 mi upstream from the creek confluence with the Delaware River. Mason's Point existed as an impounded coastal marsh with near monotypic stands of *Phragmites* in the mid-1990s. Levee failure after that time opened the system to limited and inefficient tidal flow from Alloway Creek into portions of the site. There is the potential for full salt marsh restoration through levee removal and channel installation that could restore the natural daily tidal exchange. In addition, *Phragmites* control could promote the revegetation of the site by *Spartina* and other desirable marsh species. Mason's Point is owned by the State of New Jersey and is 1,000 ac in area (PSEG 2014-TN3452).

Alloway Creek Watershed

The western portion of the PSEG ACW site is not part of the PSEG EEP restoration area. The ACW is located in Elsinboro and Lower Alloways Creek Townships in Salem County, New Jersey. The ACW was originally part of the more than 2,800-ac Alloway Creek site in the PSEG EEP. Therefore, herbicide control was applied at the beginning of the program. Afterward, the Alloway Creek EEP site was reduced in size. This left more than 1,400 ac in the western portion of the ACW unrestored outside the PSEG EEP restoration area. Currently, this western portion is a non-impounded coastal marsh with monotypic stands of *Phragmites*. The key component of restoration would consist of *Phragmites* control to allow *Spartina* and other desirable marsh species to revegetate (PSEG 2014-TN3452).

4.3.2.3 Summary of Construction Impacts on Terrestrial and Wetland Resources

Preconstruction and construction activities associated with building a new nuclear power plant on the PSEG Site would have a negligible impact on most terrestrial resources. Also, building activities are expected to have a minimal effect on important species on the PSEG Site. However, the permanent loss of 108 ac and the temporary loss of about 62 ac would have a noticeable, but not destabilizing, effect on wetland resources at the PSEG Site. Additionally, preconstruction activities would temporarily affect about 30 ac of offsite wetland resources. Mitigation of wetland resources may be warranted.

Based on the above information, the review team concludes that impacts on terrestrial resources from building a new nuclear power plant at the PSEG Site would be MODERATE. The MODERATE impact level is associated with the loss of 108 ac of important wetland resources, and the NRC-authorized activities would be significant contributors to the noticeable impact. However, given the amount of wetland resources in the area, the review team determined that the habitat loss would not destabilize wetland resources in the vicinity.

4.3.3 Aquatic Impacts

Before initiating any site preparation or development activities, PSEG would be required to obtain the appropriate authorizations regulating alterations to waters of the United States, including ponds and creeks. The list of probable authorizations is presented in Section 4.2, with additional detail in Appendix H. Building activities that could directly affect onsite and offsite aquatic ecosystems include site preparation for installing plant structures and cooling towers, switchyards, and the temporary laydown area; making improvements to the HCGS barge slip; building the barge storage area and unloading facility; installing the cooling water system intake and discharge structures; and building the proposed causeway. Aquatic habitats potentially affected include the onsite artificial ponds and small marsh creeks, habitats associated with the Delaware River Estuary, and the interconnected system of tidal wetlands and marsh creeks primarily north of the PSEG Site. Potential direct impacts on aquatic resources as a result of building activities would involve physical alteration of habitat (e.g., infilling, cofferdam placement, dredging, pile driving) including temporary or permanent removal of associated benthic organisms, sedimentation, changes in hydrological regimes, and changes in water quality. Potential indirect impacts include increased runoff from impervious surfaces and subsequent erosion and sedimentation and isolation of marsh creek segments due to infilling (PSEG 2014-TN3452).

4.3.3.1 Aquatic Resources—Site and Vicinity

Artificial Ponds and Onsite Marsh Creeks

The artificial ponds located on the PSEG Site have an estimated combined surface area of 40 ac (PSEG 2014-TN3452). The artificial ponds within the proposed power block and cooling tower areas are perched water bodies used for rainfall and stormwater management and have no surface-water connection to the Delaware River Estuary or adjacent small marsh creeks on the site. Site preparation and building activities for a new nuclear power plant and cooling towers would involve filling in the artificial ponds and thus would result in complete conversion of these artificial ponds to industrial land use. Sampling surveys of these ponds and other nearby small onsite marsh creeks for fish and macroinvertebrates indicate low-diversity communities characterized by resident fish and macroinvertebrate species that are generally ubiquitous in shallow aquatic freshwater systems of the mid-Atlantic coastal region, as described in Section 2.4.2.1. In addition, the ponds and small marsh creeks do not provide unique aquatic habitat or support populations of important aquatic species. Erosion and runoff mitigation practices would be used to prevent siltation from building activities in nearby small marsh creeks on the site (PSEG 2014-TN3452). Although loss of all aquatic species in the ponds would occur, the loss would have a negligible effect on aquatic resources in the vicinity.

The most dominant and biologically productive of the aquatic ecosystems in the vicinity of the site and those areas north of the site are the tidally influenced wetlands and their interconnected system of marsh creeks. Potential building impacts to marsh creeks located on the site include infilling and elimination of portions of the marsh creek system. Although some small and localized areas of habitat would be lost or impaired by building activities, large amounts of similar habitat exist throughout the site. Fish and mobile macroinvertebrates could relocate to other areas of the marsh creek system not affected by building activities. The marsh creek and

channelized stream segments that would be affected by building activities are not known to support any Federally or State-listed species, nor do they provide unique aquatic habitats that are not available nearby. Stormwater control, erosion control, stream crossing, and sedimentation BMPs would be followed in accordance with Federal and New Jersey permitting requirements for water quality (PSEG 2014-TN3452). PSEG estimates permanent loss of 7,265 linear ft of creek channels and potential isolation of 2,320 linear ft of marsh creek channels from their tidal connection due to placement of fill from the switchyard, power block, temporary laydown, causeway, and cooling tower areas (PSEG 2014-TN3452). Within the nearby ACW site there are a total of 16,343 channelized streams with a total estimated length of 1,105,485 ft (see Figure 2-21). Therefore, the permanent loss of onsite marsh creeks due to site preparation and building a new nuclear power plant would be equivalent to only 0.7 percent of the total marsh creek density within this one wetland restoration area (PSEG 2014-TN3452). PSEG plans to consider reconnection of any isolated onsite marsh creeks as part of the site-wide restoration and mitigation designs (PSEG 2014-TN3452).

Offsite Marsh Creek Drainages

An estimated 2,123 linear ft of marsh creek channels off the site would be crossed by the proposed causeway (PSEG 2014-TN3452). Installation of the elevated causeway would require permanent pier placement for support structures. However, PSEG plans to avoid placement in stream channels (PSEG 2014-TN3452). Runoff from disturbed areas would be temporary and controlled through the use of BMPs required for water quality in compliance with Federal and New Jersey permitting (PSEG 2014-TN3452). Pile driving for pier placement would create short-term noise disturbances. The marsh creek system within the coastal wetlands surrounding the site is characterized by a high density of channelized streams that have low biological diversity and productivity, as described in Section 2.4.2.1. However, aquatic organisms in the vicinity are mobile and would likely avoid the area of installation.

Delaware River Estuary

Installation activities with the potential to affect the aquatic resources of the Delaware River Estuary include improvements to and use of the existing HCGS barge slip, a new barge storage area and unloading facility, an adjacent heavy haul road, and the intake and discharge structures along the eastern shore of the Delaware River Estuary (Figure 2-2). Shoreline installation and site preparation activities would require an SWPPP, developed as part of the NJPDES stormwater permit, which would describe BMPs to control sedimentation and erosion and provide stormwater management. Shoreline structures would be hardened to protect from shoreline erosion using placement of concrete or riprap (PSEG 2014-TN3452).

Improvements to the HCGS barge slip would include deepening the existing barge slip by another 2 ft to accommodate equipment-carrying barges (Cook 2009-TN2713). An estimated 1,350 yd^3 of dredged material would be removed within the existing HCGS barge slip to allow for additional clearance of barges carrying equipment for the PSEG Site. If the final plant designs indicate modules larger than 54 ft in width are required, the existing 60-ft-wide HCGS barge slip may be widened an additional 20 ft along the south side of the barge slip and dredged an additional 2 ft below current barge slip depth. A double row of sheet piling would need to be placed before removal of excess earth by dredging. An estimated 5,800 yd^3 of

material would be removed, and the existing riprap at the front end of the slip would be removed and then replaced at the widened river end of the slip (Cook 2009-TN2713).

The new barge storage area and unloading facility would require dredging about 440,000 yd^3 of sediment to lower the river bottom by 4.5 ft over 61 ac (PSEG 2014-TN3452). An additional 0.05 ac of river bottom habitat would be removed for installation of seven 20-ft diameter barge mooring caissons. Installation of a new intake structure would require dredging of about 150,000 yd^3 of sediment to lower the river bottom by 4.5 ft over 31 ac (PSEG 2014-TN3452). Dredging would also be required for installation of a new discharge structure; however, specific details on the amount of material to be dredged for discharge structure placement would likely depend on final design and placement criteria. Dredged material disposal would be either on the site or in another approved upland disposal facility (PSEG 2014-TN3452).

The installation of the barge storage and unloading facilities and intake and discharge structures would result in temporary disturbances to the aquatic habitat in those portions of the Delaware River Estuary. An increase in suspended sediments could occur during dredging activities; however, PSEG would comply with the NJDEP and USACE permitting regulations regarding type of dredge used, timing and duration of dredging, and appropriate BMPs to minimize sedimentation effects. Fish and sea turtles might swim into this portion of the Delaware River Estuary, but they would be able to swim away or likely would avoid the area due to vibratory noise from pile-driving activities. Mobile macroinvertebrates in this area might be able to occupy adjacent habitat in the Delaware River Estuary as the species composition and abundance of the macroinvertebrate community in the Delaware River Estuary near the site are similar to those of benthic communities in adjacent benthic areas of the southern portion of the Delaware River Estuary. Although permanent alteration of at least 92 ac of river bottom habitat would occur, the impacts to aquatic communities in the vicinity are expected to be minimal.

The HCGS barge slip and the new barge storage and unloading facility, once completed, are expected to be in use to transport large plant components to the site during building activities. Propeller wash may cause localized scouring and sedimentation within the barge slip. Because this area would have been previously disturbed during site preparation, it is unlikely that the temporary habitat disruption would have adverse effects on the aquatic communities in the area (PSEG 2014-TN3452). Adjacent, undisturbed habitat is available, and mobile aquatic organisms would likely avoid the barge slip area.

4.3.3.2 Important Aquatic Species and Habitats

This section describes the potential impacts on important aquatic species resulting from site preparation for a new nuclear power plant at the PSEG Site, including the HCGS barge slip, barge storage area and unloading facility, intake and discharge structures, and causeway. The review team has determined that building impacts on aquatic resources would be limited to the onsite artificial ponds and small marsh creeks, marsh creek and stream drainages, and a small portion of the Delaware River Estuary. The general life histories of these species are presented in Section 2.4.2. The review team prepared a biological assessment and an essential fish habitat (EFH) assessment (see Appendix F) documenting the impacts on the Federally listed threatened and endangered aquatic species for the biological assessment and managed species for the EFH assessment, described in National Marine Fisheries Service correspondence

(NMFS 2010-TN2171; NMFS 2013-TN2804). The review team impact determinations based on the biological assessment and EFH assessment are reiterated in this section.

Commercial/Recreational Species

American Eel (*Anguilla rostrata*) and White Perch (*Morone americana*) have been observed in the onsite ponds and marsh creeks, and the Atlantic Menhaden (*Brevoortia tyrannus*) and Striped Bass (*M. saxatilis*) were observed in the marsh creeks (PSEG 2014-TN3452). Infilling the onsite ponds and onsite marsh creeks would remove this habitat and result in a loss of all species present in these water bodies. However, only a few American Eel and White Perch were observed in the onsite ponds and onsite marsh creeks, where harvesting is not permitted, and these species are abundant elsewhere in the offsite marsh creek drainages and in the Delaware River Estuary (see Tables 2-9 and 2-11 in Section 2.4.2.1). Thus, removal of onsite pond and marsh creek habitats would not noticeably affect population abundances for the commercial or recreational fishery of these species.

All commercial and recreational species listed in Section 2.4.2.1 with the exception of the Silver Hake (*Merluccius bilinearis*), the eastern oyster (*Crassostrea virginica*), the horseshoe crab (*Limulus polyphemus*), and the northern quahog clam (*Mercenaria mercenaria*) have been observed in the Delaware River Estuary in the vicinity of the PSEG Site between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). Building and dredging activities associated with the HCGS barge slip improvements, barge storage area and unloading facility, intake structure, and discharge structure may affect local habitat use by these species due to noise avoidance and sediment dispersion. These impacts are expected to be temporary and minimized with the use of BMPs as described in Section 4.3.3.1 to minimize sedimentation and erosion. It is expected that fish and blue crabs would use nearby unaffected habitat and would resume use of the habitats within the Delaware River Estuary near the PSEG Site after completion of these activities. In addition, these species are present throughout the Delaware River Estuary region, and any effects on commercial or recreational fisheries due to installation activities in the Delaware River Estuary associated with a new nuclear power plant at the PSEG Site are not expected to be noticeable.

Ecologically Important Species

All four ecologically important species described in Section 2.4.2.3 are present in the Delaware River Estuary in the vicinity of the PSEG Site: Blueback Herring (*Alosa aestivalis*), Alewife (*A. pseudoharengus*), Atlantic Silverside (*Menidia menidia*), and Bay Anchovy (*Anchoa mitchilli*) (PSEG 2014-TN3452). Building and dredging activities associated with improvements to the HCGS barge slip, the new barge storage area and unloading facility, intake structure, and discharge structure may affect the presence of or habitat use by these species in the vicinity of these activities due to noise avoidance and increased sedimentation. These impacts are expected to be temporary and minimized with the use of BMPs to reduce sedimentation and erosion. It is expected that these fish would use nearby unaffected habitat and would resume use of the habitats within the Delaware River Estuary near the PSEG Site after completion of building activities.

Federally and State-Listed Species

As part of the NRC responsibilities under Section 7 of the Endangered Species Act of 1973 (116 USC 1531-TN1010), the review team prepared a biological assessment documenting potential impacts on Federally listed threatened or endangered aquatic species as a result of building activities at the PSEG Site. The biological assessment is provided in Appendix F of this EIS, and the findings and determinations are summarized in this section. There are no critical habitats for aquatic species that occur near any of the planned building areas (FWS 2010-TN2204; NMFS 2010-TN2171).

Sea Turtles

The Federally threatened loggerhead sea turtle (*Caretta caretta*) and the Federally endangered Kemp's ridley turtle (*Lepidochelys kempii*) are known to occur in the Delaware River Estuary in the vicinity of the PSEG Site and may swim near the SGS cooling water intake area (PSEG 2014-TN3452). The Federally threatened Atlantic green sea turtle (*Chelonia mydas*) is also known to occur in the Delaware River Estuary near the PSEG Site (PSEG 2014-TN3452). The Federally endangered leatherback (*Dermochelys coriacea*) and hawksbill (*Eretmochelys imbricata*) sea turtles are rare within the Delaware River Estuary but may forage within this estuarine habitat. Sea turtles present in the Delaware River Estuary near the PSEG Site during building activities would likely avoid the in-water installation activities and swim away.

Shortnose Sturgeon

Federally endangered Shortnose Sturgeon (*Acipenser brevirostrum*) spawn in freshwater habitats in the Delaware River that are well upstream of the PSEG Site near Delaware River River Mile (RM) 52. Surveys of Shortnose Sturgeon movement in the Delaware River Estuary revealed an overwintering population of about 6,000 to 14,000 fish in the upper tidal portion of the Delaware River Estuary near Trenton at Delaware River RM 131.6 (Hastings et al. 1987-TN2260). Shortnose Sturgeon move upstream into the nontidal reach of the river in late March, presumably to spawn before traveling downstream to lower tidal waters near Philadelphia (O'Herron et al. 1993-TN2261). Therefore, building activities in the Delaware River Estuary near the PSEG Site are not likely to affect Shortnose Sturgeon eggs or larvae. Migrating juvenile and adult Shortnose Sturgeon may occur in Delaware River Estuary waters affected by building activities at the PSEG Site. One Shortnose Sturgeon was collected in a trawling sample from the Delaware River Estuary near the site in 2004 (PSEG 2005-TN2566), and two Shortnose Sturgeon were collected in 2008 and one in 2010 from bottom trawl sampling between Delaware River Estuary River Kilometer (RKM) 100 and RKM 120 to the north of the PSEG Site (PSEG 2009-TN2513; PSEG 2011-TN2571). The use of BMPs to minimize sedimentation, as described in Section 4.3.3.1, should prevent any adverse impacts to Shortnose Sturgeon because fish in the area of any building activities can use adjacent habitats and avoid areas of activity.

Atlantic Sturgeon

The Federally endangered Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) has life history characteristics similar to those of the Shortnose Sturgeon with the exception of a preference for

more marine habitats. Tagging studies in 2005 and 2006 indicated that Atlantic Sturgeon followed migration patterns similar to those of the Shortnose Sturgeon, with spawning potentially occurring from mid-to-late June in the upper tidal Delaware reaches between Philadelphia, Pennsylvania, and Trenton, New Jersey (Simpson and Fox 2007-TN2194). Atlantic Sturgeon juveniles were also observed around Artificial Island between 1991 and 1998 (ASSRT 2007-TN2082). A single Atlantic Sturgeon was collected in 2004 and 2009, respectively, in bottom trawl sampling in Delaware River Estuary waters between Delaware River Estuary RKM 100 and RKM 120 to the north of the PSEG Site (PSEG 2005-TN2566; PSEG 2010-TN2570). The use of BMPs to minimize sedimentation should prevent any adverse impacts to Atlantic Sturgeon as fish in the area of any building activities can use adjacent habitats and avoid areas of activity.

Essential Fish Habitats

The evaluation of EFHs for the Delaware River Estuary includes a determination for the presence of Habitat Areas of Particular Concern (HAPCs), as well as a site specific assessment of fish habitat. HAPCs are identified geographical areas that have elevated importance, provide important ecological functions, and are vulnerable to degradation. No HAPCs occur in the Delaware River Estuary (NOAA 2013-TN2177). Site-specific assessments of fish habitats associated with the Delaware River Estuary in the vicinity of the HCGS barge facility, barge storage and unloading facility, and intake and discharge structures are presented in Appendix F. Appendix F provides the known distributions and records of managed species and life stages and the potential ecological impacts of building activities on the species, their habitat, and their prey. Based on the PSEG plan for developing a new nuclear power plant at the PSEG Site, the review team believes that short-term impacts to EFHs associated with dredging, intake installation, and discharge installation would be minimal.

4.3.3.3 Aquatic Monitoring

The potential impacts to aquatic resources from building a new nuclear power plant and associated facilities would be monitored under the terms of authorizations from Federal and State agencies (PSEG 2014-TN3452). Site engineering controls, BMPs as described in Section 4.3.3.1, erosion control measures, and siltation control measures would be used to manage stormwater and keep accidental spills from affecting nearby surface waters (PSEG 2014-TN3452). In addition, seasonal restrictions on activities and monitoring levels of turbidity and sedimentation in key marsh creek systems on or near the site could be implemented to protect surface-water quality and aquatic resources. Building activities in the Delaware River Estuary may also require seasonal restrictions and/or monitoring to avoid impacts to spawning populations due to in-water work and turbidity plumes during dredging (PSEG 2014-TN3452).

4.3.3.4 Potential Mitigation Measures for Aquatic Impacts

Impacts on aquatic resources are expected to be temporary because fish and mobile invertebrates likely would avoid areas of building activity in the marsh creeks and Delaware River Estuary. PSEG plans to consult with local, State, and Federal agencies regarding any additional and practicable mitigation needs related to the development of the PSEG Site (PSEG 2014-TN3452).

4.3.3.5 Summary of Impacts to Aquatic Resources

The review team has reviewed the preconstruction and construction activities associated with a new nuclear power plant at the PSEG Site and the potential impacts of those activities on aquatic biota in the onsite ponds and small marsh creeks, the marsh creek systems, and the Delaware River Estuary. Preconstruction and construction activities would have the largest effect on onsite pond and some onsite marsh creek communities, and minor effects on aquatic communities in the offsite marsh creeks and Delaware River Estuary.

Filling in of onsite ponds and small marsh creeks would result in a loss of those habitats. However, the loss of habitat and species is expected to be minimal when compared to similar unaffected marsh creek habitats in the region.

Installation of the new barge unloading facility and water intake and discharge structures and improvements to the HCGS barge slip would result in temporary impacts at distinct locations within the Delaware River Estuary, but these would be largely controlled by the use of BMPs associated with the management of water quality. Based on this review, the review team concludes that the impacts resulting from the preconstruction and construction activities would be minimal.

Based on the information provided by PSEG and the above observations from the review team's independent evaluation, the review team concludes that impacts to onsite aquatic biota during preconstruction and construction would be SMALL, provided PSEG complies with BMPs required for Federal and State permitting. Based on the above analysis, and because the NRC-authorized construction activities represent only a portion of the analyzed activities, the review team concludes that the impacts of the NRC-authorized construction activities would be SMALL and no further mitigation measures would be warranted.

4.4 Socioeconomic Impacts

Preconstruction and construction activities (the review team will refer to these as building activities) at the PSEG Site could affect individual communities, the surrounding region, and minority and low-income populations. This section assesses the impacts of these building-related activities and the associated workforce on the region. The review team reviewed the PSEG ER (PSEG 2014-TN3452) and verified the data sources used in its preparation by examining cited references and independently confirming data in discussions with community members and public officials (NRC 2012-TN2499). To verify data in the ER, the review team requested clarifications and additional information from PSEG as needed. Unless otherwise specified in the sections below, the review team has drawn upon verified data from PSEG (PSEG 2012-TN2450; PSEG 2012-TN2370). Where the review team used different analytical methods or additional information for its own analysis, the sections include explanatory discussions and citations for the additional sources.

Although the review team considered the entire region within a 50-mi radius of the PSEG Site when assessing socioeconomic impacts, because of expected commuter patterns, the distribution of residential communities in the area, and the likely socioeconomic impacts, the review team identified a primary economic impact area composed of the four counties nearest

the site—Salem, Cumberland, and Gloucester Counties in New Jersey and New Castle County in Delaware—as the area with the greatest potential for economic impacts.

Section 4.4.1 presents a summary of the physical impacts of the project. Section 4.4.2 provides a description of the demographic impacts. Section 4.4.3 describes the economic impacts, including impacts on the local and state economy and tax revenues. Section 4.4.4 describes the impacts on infrastructure and community services. Section 4.4.5 summarizes the socioeconomic impacts of building activities at the PSEG Site.

4.4.1 Physical Impacts

Building activities can cause temporary and localized physical impacts such as noise, fugitive dust, air emissions, and visual aesthetic disturbances. The review team expects these impacts would be mitigated by compliance with all applicable Federal, State, and local environmental regulations and site-specific permit conditions. All of the mitigation activities discussed below are identified in the PSEG ER (PSEG 2014-TN3452). Vibration and shock impacts are not expected because of the strict control of blasting and other shock-producing activities. This section discusses potential impacts on people, buildings, and roads from building activities.

4.4.1.1 Workers and the Local Public

This section discusses potential impacts of air emissions, noise, and vibrations on workers, nearby residents, and transient visitors to the immediate area around the PSEG Site. The proposed PSEG Site is located adjacent to three existing nuclear power plants: the HCGS and SGS, Units 1 and 2, in Lower Alloways Creek Township, Salem County, New Jersey. The PSEG Site is located on the southern part of Artificial Island on the east bank of the Delaware River, about 15 mi south of the Delaware Memorial Bridge, 18 mi south of Wilmington, Delaware, 30 mi southwest of Philadelphia, Pennsylvania, and 7.5 mi southwest of Salem, New Jersey.

The nearest residences to the PSEG Site are located about 2.8 mi to the west in New Castle County, Delaware, and about 3.4 mi to the east-northeast in the Hancock's Bridge community of Salem County, New Jersey (PSEG 2014-TN3452). The closest recreational areas are the Augustine Beach Access Area and Augustine Wildlife Area, which are about 3.1 and 3.6 mi across the Delaware River from the PSEG Site. Because of these distances and the use of BMPs, residents of the area are not expected to experience impacts in the form of noise, vibrations, or fugitive dust associated with onsite building activities.

Because physical impacts attenuate rapidly with distance, onsite workers involved in building activities for a new plant would experience the most direct exposure to physical impacts, followed by operational workers at the adjacent HCGS and SGS. The welfare of construction and operations workers is regulated by the Federal Occupational Safety and Health Administration (OSHA). The use of heavy equipment for batch concrete production, excavation, drilling, and pile driving would generate noise, fugitive dust, emissions, and vibrations affecting both the building site and neighboring areas. OSHA requires all contractors, vendors, and other parties involved in building a new plant to follow BMPs to minimize and control dust, to use personal protective equipment and masks in areas of high dust, to properly maintain equipment to minimize harmful emissions, and to implement safety measures such as protective earplugs and other hearing protection to reduce noise impacts to workers (PSEG 2014-TN3452). Most of

the operational workforce at HCGS and SGS work indoors and would experience only intermittent exposure to the increased fugitive dust, emissions, and noise associated with building a new nuclear power plant at the PSEG Site. Consequently, the review team determined the physical impacts to onsite workers to be minimal.

Workers involved in building the proposed 4.8-mi-long causeway would be less likely to experience the effects of fugitive dust, emissions, noise, and vibrations because less equipment and fewer materials would be involved in these efforts and most of the work would occur away from the PSEG Site. In addition, contractors involved in these activities would use the BMPs discussed previously to minimize impacts on the workforce (PSEG 2014-TN3452). According to PSEG, the closest residence is a single home located to the west of the intersection of the causeway and Mason Point Road. The causeway would be built over marshland where no one resides, reducing any potential physical impacts (PSEG 2014-TN3452). The review team determined that physical impacts from emissions, noise, and fugitive dust during causeway construction would be minor and temporary.

The physical impacts to the workers and the local public from building activities at the PSEG Site and the offsite causeway would be minimal and would be considered an annoyance or nuisance, and no further mitigation beyond that identified by the applicant in its ER is warranted.

4.4.1.2 Noise

The main sources of noise during building at the PSEG Site would be from earthmoving activities, concrete mixers, cranes, portable generators, pile driving, and paving breakers. These activities would have a noise level of 80–88 dBA at 50 ft and 50–58 dBA at 1,500 ft. New Jersey provides regulatory limits for continuous noise sources. During the daytime, New Jersey has a 65 dBA limit at the property line of industrial facilities. New Jersey also has 65 dBA limits at residential property lines during the day and 50 dBA nighttime limits. Delaware has similar regulatory limits of 65 dBA at residential property lines and 55 dBA nighttime limits. The closest residences are 14,700 ft west and 15,900 ft east of the site (PSEG 2014-TN3452). Because of these distances and regulatory limits, the review team does not expect residents of the area to experience impacts in the form of noise during preconstruction or construction at the PSEG Site. Projected noise impacts from operation at the PSEG Site are discussed in further detail in Section 4.8.2.

4.4.1.3 Air Quality

Salem County is administratively in the Metropolitan Philadelphia Interstate Air Quality Control Region (40 CFR 81-TN255) and is in attainment with the National Ambient Air Quality Standards (NAAQS) (40 CFR 50-TN1089) for all criteria pollutants except 8-hour ozone. Thus, Salem County is in nonattainment for 8-hour ozone NAAQS. Temporary and minor effects on local ambient air quality would occur as a result of building activities. Dust particle emissions would be generated during land clearing, grading, and excavation activities. Air quality would also be affected by engine exhaust emissions and concrete batch plant operations. PSEG would create emission-specific strategies and measures to comply with the NAAQS (40 CFR 50) and the National Emission Standards for Hazardous Air Pollutants

(40 CFR 61-TN3289). PSEG indicates it would create a dust control program (PSEG 2014-TN3452). Also, PSEG would need to acquire a New Jersey State Construction Air Permit.

The review team understands that some emissions from building activities are unavoidable, but the physical impacts from building activities would be minimal and maintained within regulatory limits. Therefore, mitigation beyond that identified by the applicant in its ER is not warranted. Further discussion about air quality in this EIS is in Section 4.7.

4.4.1.4 Buildings

Building activities on the PSEG Site would not be likely to affect any offsite buildings, primarily because of the distance separating the site from other development. As noted previously, the nearest residence is located 2.8 mi from the site. The nearest industrial and commercial buildings are located farther away and would also not be affected by onsite building activities (PSEG 2014-TN3452).

The structures with the greatest potential to be affected by building activities associated with a new nuclear power plant at the PSEG Site would be the existing facilities at HCGS and SGS, which could experience vibration-related impacts associated with pile-driving activities. PSEG indicates that building activities would be planned, reviewed, and conducted in a manner that ensures no adverse effect on operations at HCGS and SGS (PSEG 2014-TN3452). In accordance with 10 CFR 50, Appendix A, HCGS and SGS have been built to safely withstand shock and vibration from activities associated with development at the PSEG Site. The review team expects that these measures would avoid impacts to existing structures on the PSEG Site. Buildings along the proposed causeway route include a PSEG environmental project office and one residence located at the causeway's northern terminus. This portion of the causeway would consist of the at-grade widening of the existing Money Island Road. Any pile driving, blasting, or other activities that create significant vibration would occur over marshland, not along the at-grade areas near the residence on Mason Point Road (PSEG 2014-TN3452). The review team expects that no structures would be removed to accomplish this widening, and the required work activities in this location would not generate significant vibrations.

In summary, the review team concludes that development activities associated with a new nuclear power plant on the PSEG Site and the associated causeway would not affect offsite buildings and that impacts to buildings on the PSEG Site would be minimized through design and construction practices. Thus, the impact of plant development on buildings would be minimal, and no mitigation beyond that identified by the applicant in its ER would be warranted.

4.4.1.5 Transportation

Roads

Building activities at the PSEG Site would affect existing roads and traffic volumes in two ways: the addition of the proposed causeway would alter traffic patterns in the area, and construction workers and other traffic related to a new nuclear power plant and the causeway would increase

traffic on the local roadway network. Section 2.5.2.3 describes the local transportation network around the PSEG Site, and Figure 2-23 depicts the road and highway system in the economic impact area.

The effects of the proposed causeway on local traffic patterns would be experienced primarily on the roads that connect the new route to major state highways (New Jersey State Routes 45 and 49) in the vicinity of Salem. In addition, vehicular traffic volumes in the area would increase due to construction workers and delivery trucks driving to and from the PSEG Site each day and the additional personal travel by in-migrating workers and their families. Given the size of the resulting increases in traffic volumes, it is likely that building activities at the PSEG Site would have noticeable physical impacts on some roads in the economic impact area, particularly those providing access to the proposed causeway, including Money Island Road, Amwellbury Road, Mason Point Road, Fort Elfsborg Road, Walnut Street, Hancocks Bridge Road, and Grieves Parkway. These impacts could warrant increased road repairs and maintenance and cause additional traffic congestion in some areas. The majority of road degradation would occur in Salem County and Lower Alloways Creek Township. Both have local ordinances that require the entity contributing to the degradation to provide resources to improve roadways (PSEG 2012-TN2370). Elsinboro Township would also experience some road degradation, but the township has similar land ordinances (Salem County 2013-TN2628). Consequently, due to the mitigating aspect from local ordinances, the review team considers the physical impacts to roads from building to be minimal, and mitigation beyond that identified by the applicant in its ER is not warranted. Section 4.4.4.1 discusses the socioeconomic impacts of the additional vehicular traffic on local roads and highways in the context of existing traffic volumes, road and intersection capacities, and level of service (LOS).

Water

As discussed in Section 2.5.2.3, there is an existing barge facility at the HCGS site. To support delivery of large components and equipment for building, PSEG indicated that the existing barge facility at HCGS would need to be modified and a parallel barge facility, built to regulatory requirements, would need to be constructed. The barge slips and the expected barge deliveries are expected to have a negligible impact on river traffic on the Delaware River.

Rail

There are no railroads within about 7 mi of the site (NRC 2011-TN3131). PSEG has not indicated that it would extend a rail line to the PSEG Site. The review team expects no impacts to rail lines in the area.

4.4.1.6 Aesthetics

Because of the distance to occupied areas, activities associated with building a new nuclear power plant at the PSEG Site would be visible primarily to workers on the site, including operational workers at HCGS and SGS. Aesthetic impacts to offsite areas would occur mainly from the introduction of large new elements, including cooling towers, reactor domes, and an elevated causeway, into the visual environment.

Because of the unobstructed view, boaters on the Delaware River and residents and recreationists near the river in New Castle County, Delaware, can clearly see the 512-ft HCGS cooling tower, the three reactor domes associated with HCGS and SGS, and smaller structures on the PSEG Site. Residents of nearby portions of Salem County (primarily the Hancocks Bridge community) and recreationists using the Abbotts Meadow Wildlife Management Area are mainly able to see the HCGS cooling tower, although the tops of the HCGS and SGS reactor domes are also visible from some locations. Figure 3-1 shows the current layout of the HCGS and SGS sites (PSEG 2014-TN3452).

The majority of building activities would not be visible off the site. However, building a new nuclear power plant at the PSEG Site and the proposed causeway would eventually add to the industrial character of the PSEG Site. The principal visual features added by a new nuclear power plant would be cooling towers (up to 590-ft tall), reactor buildings, and the elevated causeway. Under Federal Aviation Administration regulations, the cooling towers would be appropriately marked with lighting, making them visible during nighttime hours. The elevated causeway would be a dominant feature in the view from the Money Island Road viewing platform, as is likely to also be the case in the immediately adjacent Abbotts Meadow Wildlife Management Area, which receives recreational use for hunting and bird watching.

Even though a new nuclear power plant and causeway would be in keeping with the industrial character of the existing PSEG Site, the increased intensity of the visual presence of structures on the site plus the introduction of the elevated causeway as a dominant visual element in a sensitive recreational location would constitute a noticeable, but not destabilizing, impact. This impact would be due to the essential character of the new structures and would not be amenable to mitigation measures.

4.4.1.7 Summary of Physical Impacts

Based on the information provided by PSEG and the review team's independent evaluation and outreach, the review team concludes that the physical impacts of building-related activities on workers and the local public, from noise; on air quality; and on buildings would be SMALL, and no mitigation beyond that proposed by PSEG would be warranted. The physical impacts on the road network during building would be MODERATE. As discussed in Section 4.4.1.5, PSEG would provide resources to mitigate road degradation near the site. The addition of new cooling towers and new reactor domes at the PSEG site, and the proposed causeway that traverses the EEP area, would noticeably affect the aesthetic qualities from viewpoints in New Castle and Salem Counties. Thus, the review team concludes that a new nuclear power plant and causeway would have a MODERATE physical impact on aesthetic resources and that the impacts would not be amenable to mitigation.

Based on the above information, the review team determined the impacts of NRC-authorized construction activities on the physical aspects of the affected environment for MODERATE impact categories (roads and aesthetics) would also be MODERATE.

4.4.2 Demography

PSEG estimates that preconstruction activities associated with a new nuclear power plant, including site preparation work and building the proposed causeway, would begin in the second quarter of 2015 and last about 24 months (i.e., until the second quarter of 2017) (PSEG 2012-TN1489). In ER Section 4.4.1.1.1.2.1, PSEG estimates that no more than 10 percent of the peak construction workforce (no more than 410 workers) would be needed to construct the causeway (PSEG 2014-TN3452). The workforce to build roads in New Jersey is typically trade union labor. There are sufficient numbers of these workers available within a reasonable commuting distance to commute daily into and out of the area. The review team expects a negligible demographic impact from the workforce for the causeway.

The NRC-authorized construction activities on a new nuclear power plant would begin in the fourth quarter of 2016 and be completed in the third quarter of 2021 (PSEG 2014-TN3452). PSEG has not selected a reactor technology, but using the workforce requirements for two Advanced Passive 1000 (AP1000) reactors, PSEG estimates that 4,100 workers would be required during the period when construction activities were at their peak (PSEG 2012-TN2450). Table 4-3 presents the number of workers that would be required during each month of the construction period. For most socioeconomic resources, the review team analyzed only the impacts of the peak construction employment period as an upper bound to potential impacts, recognizing that impacts would likely be smaller during the rest of the building period.

Of the 4,100 workers required at peak employment to build a new nuclear power plant, PSEG estimates that 2,870 (70 percent) would be construction trade workers and the remaining 1,230 (30 percent) would be nontrade workers (PSEG 2014-TN3452). The largest trade workforce requirements would be for electricians and instrument fitters (12.0 percent), structural steel and iron workers (12.0 percent), and pipefitters (11.0 percent). PSEG estimates that most of the nontrade workers would be employed during the construction period to support building activities through vending and subcontracting, engineering and procurement, indirect support labor, and start-up activities.

According to an NRC study released in 1981 (Malhotra and Manninen 1981-TN1430), about 15 to 35 percent of the trade and nontrade workforce involved in building nuclear power plants come from outside the 50-mi region surrounding the plants. The study also found that trade workers generally drew from a large labor force within the region and had lower rates of relocation from outside. Nontrade workers and specific trades that were not well represented in the region were found to have higher rates of relocation from outside the region.

Because of the large labor force available within the 50-mi region of the PSEG Site, which includes much of the Philadelphia-Camden-Wilmington metropolitan area, and based on PSEG experience with HCGS and SGS construction, the review team believes that most of the workers required to build a new nuclear power plant would be drawn from the labor force within the region. These workers would maintain their current residences and commute to the work site.

Table 4-3. Estimated Construction Workforce Requirements by Construction Month

Construction Month	Shift 1	Shift 2	Shift 3	Total	Percent of Peak Workforce
1	125	73	10	208	5
3	311	182	26	519	13
6	592	345	49	986	24
9	872	509	73	1,454	35
12	1,059	618	88	1,765	43
15	1,246	727	104	2,077	51
18	1,432	836	119	2,387	58
21	1,619	945	135	2,699	66
24	1,806	1,054	151	3,011	73
27	1,931	1,126	161	3,218	78
30	2,024	1,181	169	3,374	82
33	2,117	1,235	176	3,528	86
36	2,211	1,290	184	3,685	90
39	2,335	1,362	195	3,892	95
42	2,460	1,435	205	4,100	100
45	2,460	1,435	205	4,100	100
48	2,460	1,435	205	4,100	100
51	2,460	1,435	205	4,100	100
54	2,398	1,399	200	3,997	97
57	2,242	1,308	187	3,737	91
60	2,055	1,199	171	3,425	84
63	1,775	1,035	148	2,958	72
66	872	509	73	1,454	35
68	343	200	29	572	14

Source: PSEG 2014-TN3452.

However, the number of boilermakers (103 workers) and iron workers (495 workers) required to build a new nuclear power plant is large compared to the number of such workers available in the regional labor force (596 and 2,289 workers, respectively) (DDOL 2013-TN2421; MDDLLR 2011-TN2422; NJLWD-TN2423). PSEG estimates that these specialty workers would be required from the second quarter of 2018 through the fourth quarter of 2021, a period of about 45 months (PSEG 2012-TN2450). Because boilermakers and iron workers are likely to be in demand by other construction projects in the region, the review team conservatively estimates that only 10 percent of the regional labor force in these two specialties would be available to support building a new nuclear power plant at the PSEG Site. Thus, the review team expects that the region would supply 60 boilermakers and 229 iron workers, and that the remaining 43 boilermakers (103 minus 60) and 266 iron workers (495 minus 229) would come from outside the 50-mi region. This would result in the in-migration of a total of 309 trade workers from outside the region.

The NRC study of migration of nuclear power plant workers (Malhotra and Manninen 1981-TN1430) found that nontrade workers were more likely than trade workers to migrate from outside the 50-mi region. However, because of the large labor force in the Philadelphia metropolitan area, many of the needed nontrade workers are likely to be available within the PSEG region. The review team concludes that it is not unreasonable to expect that 25 percent (the midpoint of the range identified by the NRC study) of the nontrade workers (or 308 workers) would migrate into the region to support building a new nuclear power plant at the PSEG Site. The nontrade workers also include the operations and maintenance staff and start-up personnel, who would be on the site during the operations period. Socioeconomic impacts from operations are discussed in Section 5.4 of this EIS.

In summary, the review team expects that at peak construction a total of 617 trade and nontrade workers would migrate into the 50-mi region surrounding the PSEG Site to support building a new nuclear power plant. This is similar to PSEG's estimate of 634 workers. This represents about 15 percent of the peak workforce, a figure that is at the low end of the range identified by the 1981 NRC study (Malhotra and Manninen 1981-TN1430). The review team believes that this relatively low proportion of in-migrating workers is not unreasonable because of the large existing and forecast labor force within the region. Workforce requirements for building activities at the PSEG Site are detailed in Table 4-4.

Not all in-migrating workers would bring families when they relocate to the area; however, to provide an upper bound for assessing impacts, the review team assumes that every worker would be accompanied by household members. The average household size is 2.55 people in Delaware and 2.68 people in New Jersey (USCB 2011-TN2424). To ensure that the upper bound of impacts is identified, the review team uses the higher household size figure for New Jersey to estimate that a total of 1,654 people (workers and their household members) would move into the region at peak employment while a new nuclear power plant is being built. This is similar to PSEG's estimate of 1,712 in-migrating persons.

In-migrating workers and their families are likely to choose to live in locations that allow convenient access to the PSEG Site. Therefore, the review team assumes that all of these workers would reside within the economic impact area. This assumption provides an upper bound on socioeconomic impacts by concentrating the additional population within the economic impact area. PSEG records indicate that, of current HCGS and SGS employees who live in the economic impact area, 12.1 percent reside in Cumberland County, 17.7 percent in Gloucester County, 49.6 percent in Salem County, and 20.6 in New Castle County (PSEG 2014-TN3452). The review team assumes that in-migrating workers involved in building a new plant at the PSEG Site would follow this distribution pattern. The resulting increase in population within the economic impact area is summarized in Table 4-5. The in-migration of workers and their families to support building a new plant would increase the population of the economic impact area by less than about two-tenths of one percent. The increase would be most pronounced in Salem County, which would experience about a 1.24 percent increase in population. These estimates are during peak construction and would be less during other times of the building phase and constitute minimal increases to the counties in the economic impact area.

Table 4-4. Projected Construction Labor Availability and Onsite Labor Requirement

	Workforce in 50-mi Region	Locally Available Labor[(a),(b)]	Construction Labor Requirement	Deficiency
Trade Labor				
Boilermakers	596[(c)]	60	103	43
Carpenters	41,795	274	274	0
Electricians/ Instrument Fitters	21,450	495	495	0
Iron Workers	2,289[(c)]	229	495	266
Insulators	2,700	51	51	0
Laborers	33,190	274	274	0
Cement Masons	5,000	51	51	0
Millwrights	1,215	85	85	0
Operating Engineers	11,780	222	222	0
Painters	11,535	51	51	0
Pipefitters	18,220	462	462	0
Sheet Metal Workers	6,755	85	85	0
Teamsters	51,805	85	85	0
Trade Supervision	19,690	137	137	0
Subtotal	225,135	2,561	2,870	309
Nontrade Labor				
Site Indirect Labor	N/A	205	273	68
Quality Control Inspectors	N/A	51	68	17
Vendors and Subcontractors	N/A	179	239	60
EPC Contractor Staff	N/A	128	171	43
Owner's Operations and Maintenance Staff	N/A	256	342	85
Start-Up Personnel	N/A	77	103	26
NRC Inspectors	N/A	26	34	9
Subtotal		922	1,230	308
Total Labor		3,466	4,100	617

(a) Assumes 100 percent of required trade labor is available in the region except for boilermakers and iron workers, which are limited relative to need, and it is further assumed that 10 percent of these two trades are available from within the 50-mi region.
(b) Assumes 75 percent of the required nontrade workforce would be available within the 50-mi region.
(c) From review team's analysis.

Source: Unless otherwise specified, data are from PSEG ER Table 4.4-3 (PSEG 2014-TN3452).

Table 4-5. Estimated Population Increase in the Economic Impact Area During the Peak Building Period

County	In-Migrating Workers	Population Increase	Projected 2020 Population	Percent Increase
New Castle	127	341	571,579	0.059
Cumberland	75	200	165,200	0.12
Gloucester	109	293	310,300	0.093
Salem	306	820	67,700	1.22
Total	**617**	**1,654**	**1,121,500**	**0.146**

Source: For projected 2020 population is Table 2-15 of this draft environmental impact statement.

Of the 3,483 workers that are from the region, some would have been unemployed prior to building activities. In March 2013, the national unemployment rate for the construction industry was 14.7 percent (BLS 2013-TN2482). Of the workforce that would not in-migrate, the review team assumes that 512 would have been previously unemployed. Assuming a similar distribution to the in-migrating workforce, 20.6 percent of the unemployed workers would already reside in New Castle County (105 workers), while 79.4 percent would already reside in the New Jersey counties of the economic impact area. About 62 workers would be hired in Cumberland County, 88 in Gloucester County, and 254 in Salem County. In the economic impact area, 1,129 jobs would have been filled between unemployed workers and in-migrating workers.

Of the 3,483 workers that are from the region, some would have been unemployed prior to building activities. In March 2013, the national unemployment rate for the construction industry was 14.7 percent (BLS 2013-TN2482). Of the workforce that would not in-migrate, the review team assumes that 512 would have been previously unemployed. Assuming a similar distribution to the in-migrating workforce, 20.6 percent of the unemployed workers would already reside in New Castle County (105 workers), while 79.4 percent would already reside in the New Jersey counties of the economic impact area. About 62 workers would be hired in Cumberland County, 88 in Gloucester County, and 254 in Salem County. In the economic impact area, 1,129 jobs would have been filled between unemployed workers and in-migrating workers.

The review team concludes that the increased levels of population would not noticeably affect the demographic character of the economic impact area or any of its counties and therefore that the impact would be SMALL.

4.4.3 Economic Impacts to the Community

This section evaluates the economic and tax impacts on the 50-mi region from building activities at the PSEG Site, focusing primarily on Salem, Cumberland, and Gloucester Counties in New Jersey, and New Castle County in Delaware. The evaluation assesses the impacts and demands from the workforce for building at the PSEG Site. As indicated in Section 4.4.2, the review team assumes 617 workers (about 15 percent of the peak construction workforce) would migrate into the economic impact area. Assuming a family size of 2.68, the review team assumes about 1,654 people would move into the economic impact area.

4.4.3.1 Economy

Direct employment for large industrial or infrastructure projects typically benefits the local economy. Each direct job stimulates spending on goods and services, resulting in the creation of indirect jobs. PSEG has not selected a reactor technology, but for the purposes of this analysis, the review team assumes two AP1000 reactors with an output of 2,200 megawatts (electrical) [MW(e)]. This is the same technology PSEG used to estimate workforce requirements (PSEG 2012-TN2450). In Section 3.2 of this EIS, the PPE is based on four reactor technologies. The AP1000 has the largest output in megawatts (electrical) and the largest workforce of the four technologies.

Studies of new power plant construction indicate that the estimated construction costs of a nuclear power plant average about $4,000 per kilowatt (e) in 2007 dollars (MIT 2009-TN2481). In 2013, the inflation adjusted amount would be $4,490.61 per kilowatt (e), using the Bureau of Labor Statistics Consumer Price Index Inflation Calculator. Using these assumptions, the review team assumes a planned capacity of 2,200 MW(e) would cost about $9.879 billion in 2013 dollars.

Given the highly specialized nature of nuclear power plant components, a large portion of the project's materials and equipment would be imported from outside the region. However, a new nuclear power plant would require substantial amounts of bulk materials and supplies (including concrete, steel piping, wiring, and electrical components), some of which could be procured locally. Because PSEG has not selected a reactor technology, it projected the expected purchases of materials based on purchases during operations from 2005–2008 at HCGS and SGS. These estimates are in Table 4-6. The review team's estimates in Table 4-6 are a reasonable estimate for the counties within the economic impact area based on the past history with HCGS and SGS, the review team's experience with other licensing reviews, and the characteristics of the economy in the economic impact area. However, the estimates for purchases outside of the economic impact area represent an upper bound because the table assumes all purchases of supplies and services would be made in the United States. These estimates may be adjusted once the reactor technology and construction plan are finalized by PSEG.

As shown in Table 4-6, building at the PSEG Site would provide a multiyear beneficial stimulus to the local economy. The purchases by PSEG during building would support employment in other sectors of the local economy at vendors and shops that provide materials and supplies for the building phase. The U.S. Department of Commerce Bureau of Economic Analysis (BEA), Economics and Statistics Division, provides Regional Input-Output Modeling System (RIMS II) regional multipliers for industry employment and earnings (BEA 2013-TN2594). The review team obtained multipliers from the BEA for the economic impact area. For every million dollars spent by PSEG on purchases of services, materials, and supplies, 10.7063 jobs would be supported in the economic impact area (BEA 2013-TN2594). The annual spending on services, materials, and supplies would support about 512 additional jobs in the economic impact area.

In addition to the purchases of materials, supplies, and services, direct employment for the building activities at the PSEG Site would benefit the local economy. The size of the

construction workforce needed for PSEG would range from a minimum of 208 workers to a maximum of 4,100. Assuming a 68-month construction cycle, the average number of workers would be 2,722 workers.

Table 4-6. Estimated Annual Purchases of Services and Materials During the Building Period

County/State[(a)]	Average 2005-2008 Annual Purchases for HCGS and SGS[(b)]	Percentage of Total	Projected Annual Expenditures during Building[(c)]	Added Employment per $1 million spent
New Castle	$6,773,114	0.85	$13,990,441	149.8
Cumberland	$2,285,912	0.29	$4,721,744	50.6
Gloucester	$8,351,326	1.05	$17,250,372	184.7
Salem	$5,779,051	0.72	$11,937,119	127.8
Economic Impact Area Total	*$23,189,403*	*2.91*	*$47,899,678*	512.8
Delaware[(d)]	$7,618,649	0.96	$15,736,965	168.5
New Jersey[(d)]	$503,363,601	63.15	$1,039,740,305	11,131.8
Pennsylvania[(d)]	$240,995,699	30.23	$497,797,100	5,329.6
Other States	$21,943,397	2.75	$45,325,950	485.3
Total	$797,110,749	100	$1,646,500,000	17,627.9

(a) Table 2.5-28 of the PSEG Environmental Report (ER) (PSEG 2014-TN3452) and Request for Additional Information Response Env-06, Question 2.5-8 (PSEG 2012-TN2370).
(b) Taken from total 2005–2008 amounts in Table 2.5-28 of the PSEG ER and divided by 4.
(c) To calculate, multiply total cost of construction ($9.879 billion) by percentage of total and then divide by 6 years for construction.
(d) These estimates are for the entire state, not just the counties within the 50-mi radius of the PSEG Site.

The types of construction workers that would be used on the project and the number of construction workers in the economic impact area are discussed in Section 4.4.2 of this EIS. The annual mean wage in May 2012 for a Construction and Extraction worker (U.S. Department of Labor, Bureau of Labor Statistics, Standard Occupational Classification code 470000) in the Philadelphia-Camden-Wilmington Metropolitan Statistical Area was $52,200 (BLS 2012-TN2483). Although the size of the building workforce and associated payroll spending would vary depending on the building schedule and mobilization each particular year, assuming an average of 2,722 workers per year, the review team estimates that PSEG would spend an average of $142 million annually, in 2012 dollars, on payroll during building. At peak construction, this number rises to $214 million.

As discussed in Section 4.4.2, most of these wages would be paid to construction workers residing in the economic impact area. A total of 617 workers are expected to move into the economic impact area at peak construction. These 617 workers would receive an estimated annual total of $32.21 million in compensation. PSEG would hire about 512 previously unemployed construction workers who would receive a total of $26.72 million in compensation. This total would be $58.93 million for the 1,129 newly hired workers in the economic impact area.

New workers have an additional indirect effect on the local economy because they stimulate the local economy by their spending on goods and services in other industries. This spending results in economic demand for a fraction of another indirect job. The review team obtained multipliers from the BEA for the economic impact area. The review team did not include workers who are currently employed that would be employed at the PSEG Site because their direct and indirect effects are already included in the economic impact area baseline.

In the economic impact area, BEA estimates that for every new construction job created, an additional 0.8224 jobs are created in the economic impact area (BEA 2013-TN2594). According to the analysis above, PSEG would hire 617 in-migrating workers and 512 unemployed workers during the peak building period, or 1,129 newly employed workers. These 1,129 direct jobs would result in 928 indirect jobs created (1,129 × 0.8224). For the purposes of this analysis, the review team expects these workers to already reside in the economic impact area. The impacts to each county are estimated in Table 4-7. BEA also estimates the indirect earnings multiplier in the economic impact area. This multiplier was applied to the wages of new workers to determine the effect of direct earnings on the local economy. For every dollar of wages earned by new workers during peak construction, BEA estimates an additional $0.6926 in income would be added in the economic impact area. The $58.93 million annual compensation at peak construction from the newly hired workers would lead to an estimated $40.91 million in annual indirect wages ($59.93 million × 0.6926) (BEA 2013-TN2594).

Given the size of the economies and workforces in the economic impact area, the review team estimates the impact of building at the PSEG Site would be minor, and positive, except in Salem County where there would be noticeable and beneficial impacts from hiring previously unemployed direct and indirect workers and from local spending on materials and supplies.

Table 4-7. Expected Distribution of Newly Created Workers in the Economic Impact Area at Peak Employment

County	Percent of Newly Hired Workers	In-migrating Plus Unemployed Workers	Indirect Workers Created	Total New Workers Hired
New Castle	20.6	232	191	423
Cumberland	12.1	137	113	250
Gloucester	17.7	200	164	364
Salem	49.6	560	460	1020

4.4.3.2 Taxes

The tax structure for the economic impact area and region is discussed in Section 2.5.2.2 of this EIS. Primary tax revenues associated with building activities at the PSEG Site would be from (a) State and local taxes on worker incomes, (b) State sales taxes on worker expenditures, (c) State sales taxes on the purchases of materials and supplies, (d) corporate taxes, and (e) local property taxes or payments in lieu of taxes based on the assessed value of a new nuclear power plant during building.

State and Local Income Taxes

Delaware and New Jersey would receive additional income tax revenue from the income tax on wages of new workers. Table 4-8 summarizes the estimated new income tax revenue that would be received by the two states during peak building. The exact amount of income tax revenue is determined on the basis of many factors such as rates, residency status, deductions, and other factors. These income tax revenues would be smaller in nonpeak building years.

Table 4-8. Estimated Increase in Income Tax Revenue Associated with Workforce

State	In-Migrating Workers	Previously Unemployed Workers	Estimated Annual Income at $52,200 per worker	Income Tax Revenue from Workers	Percent Increase in State Income Tax Revenue
Delaware	127	105	$12.11 million	$898,304[(a)]	0.089
New Jersey	490	407	$46.82 million	$2.94 million[(b)]	0.027
Total	**617**	**512**	**$58.93 million**	**$3.83 million**	**-**

(a) The 2012 Delaware Data Book (DEDO 2012-TN2390): Assumed 1,001+5.55% per worker.
(b) State of New Jersey Gross Income Tax Overview, (NJ Treasury 2010-TN2338): Assumed a tax rate of 6.279%, which is the average of 1.4% to 8.97% income tax rates.

The majority of the building workforce would already live in the region, would commute daily to and from the site, and would not have been unemployed elsewhere prior to building activities at the PSEG Site. For the purposes of this analysis, the review team assumes that all 1,129 workers (unemployed and in-migrating) would live in the economic impact area and would pay income taxes. Of these workers, 232 would pay income tax in Delaware and 897 would pay income tax in New Jersey. They would provide $0.89 million and $2.94 million additional income tax revenue to Delaware and New Jersey, respectively. This is about a nine one-hundredths of one percent increase in Delaware and less than a three one-hundredths of one percent increase in New Jersey compared to 2011 revenue. The indirect workers created from the building workforce would contribute further, yet minimal, revenue to the states. As discussed in Section 4.4.2, about 410 workers would be needed to build the causeway. These workers would already reside in the 50-mi region and pay income taxes to Delaware and New Jersey. Because the size of the causeway workforce is 10 percent of the peak building workforce, its impacts to state revenue would be minimal.

PSEG pays an energy receipts tax to the State of New Jersey based on revenues from electricity sales. However, because PSEG would not sell electricity from a new plant during building, the energy receipts tax would not change from the baseline tax payments to New Jersey. Consequently, the review team expects the impact from extra income taxes on State revenue would be minimal and beneficial.

State Sales Taxes on Worker Expenditures

Workers would spend some of their income on goods and services that may be taxed. New Jersey imposes a 7 percent sales tax; however, Delaware does not impose a sales tax. No localities in the economic impact area impose an additional sales tax. Because Delaware imposes no sales tax and New Jersey's 2011 revenue from sales taxes was more than

$11 billion, the review team expects a minimal, beneficial impact on State sales tax revenue from in-migrating, previously unemployed, and indirect worker expenditures.

State Sales Taxes* o*n Materials and Supplies

Section 4.4.3.1 discusses the review team's estimates of PSEG expenditures in the economic impact area, region, and beyond during building. These expenditures may be subject to sales taxes. New Jersey and Pennsylvania have sales taxes of 7 and 6 percent respectively. Delaware does not impose sales taxes. Some localities in New Jersey and Pennsylvania impose additional sales taxes (e.g., Philadelphia County imposes an extra 2 percent sales tax). However, none in the economic impact area impose extra sales taxes. The distribution of expenditures across the localities is not known.

During building, the review team estimates about $1 billion a year would be spent in New Jersey and $500 million in Pennsylvania. These expenditures would bring in almost $73 million and $30 million in sales tax revenue in New Jersey and Pennsylvania, respectively (Table 4-9). These estimates are also an upper bound because, as discussed in Section 4.4.3.1, the review team assumes all expenditures during building would be in Pennsylvania, New Jersey, and Delaware. These would account for a six-tenths of one percent and almost a two-tenths of one percent increase in New Jersey and Pennsylvania sales tax revenues, respectively. Therefore, the review team believes that there would be a minimal, positive impact on sales tax revenues during building.

Table 4-9. Estimated Sales Tax Revenue on Purchases During Building Period

State	Projected Annual Expenditures during Building[(a)]	Sales Tax Rate[(b)] (%)	Projected Annual Sales Tax Revenue	Increase in State Sales Tax Revenue (%)
New Jersey	$1,039,740,305	7	$72,781,821	0.622
Pennsylvania	$497,797,100	6	$29,867,826	0.198

(a) Taken from Table 4-6 of this draft environmental impact statement (draft EIS).
(b) Taken from Table 2-26 of this draft EIS.

Property Taxes

Property taxes that would be paid during the building phase by construction workers that are already living in the area are a part of the baseline and not relevant to this analysis. In-migrating workers would most likely move into existing houses rather than constructing new houses. Thus, the in-migrating workforce would result in a transfer of property taxes instead of an increase in local property tax revenues. Based on the above assessments, the review team determined there would be minor property tax impacts from construction workers.

In personal interviews with administrators in Salem County and Lower Alloways Creek Township, the review team discovered that there is no property tax assessed against construction projects in progress. PSEG would not pay property taxes to Salem County until the new plant is completed and commercial operations are started (NRC 2012-TN2499).

From the above assessments, the review team determined there would be minor construction phase property tax impacts in the economic impact area.

4.4.3.3 Summary of Economic Impacts to the Community

Based on the information provided by PSEG and the review team's independent evaluation and outreach, the review team concludes that the economic and tax impacts would be SMALL and beneficial for the region and the economic impact area, with the exception of MODERATE and beneficial economic impacts in Salem County. The increased benefits to Salem County would be from the hiring of unemployed direct and indirect workers and from PSEG spending on supplies and materials at local shops and vendors. Tax revenue to local jurisdictions would accrue through personal income, sales, and property taxes.

4.4.4 Infrastructure and Community Service Impacts

This section provides the estimated impacts on infrastructure and community services, including transportation, recreation, housing, public services, and education.

4.4.4.1 Traffic

Existing transportation routes would be affected by the transportation of equipment, materials, supplies, and the construction workforce to the PSEG Site. The PSEG Site can be accessed via roads and the Delaware River, and both modes would likely be used during building activities. Large components and equipment would be transported by barge via the Delaware River. PSEG plans to use the existing HCGS barge facility and construct a new barge facility parallel to the one near the PSEG Site (EIS Section 3.3.1). Building-related traffic would primarily use the proposed causeway to avoid disruptions to the HCGS and SGS workforce (PSEG 2014-TN3452). Personal vehicles and trucks on roadways would be the primary transportation mode for the construction workforce and would affect the LOS on local roadways, particularly during the peak building period. LOS is a measure of time delays at signalized and unsignalized intersections ranked from A to F based on delay times (Table 4-10). The lower value of each noted LOS range is for unsignalized intersections, and the higher value is for signalized intersections (PSEG 2013-TN2525).

The road system in the economic impact area is described in Section 2.5.2.3. Physical impacts on the local transportation network from building are discussed in Section 4.4.1.5. The size of the workforce would vary over an estimated 8-year building period from a minimum of 208 workers to a maximum of 4,100 workers at peak building. During shift changes at peak employment, 2,200 vehicles are expected to use local roads. PSEG expects, on average, 50 vehicles per day to deliver construction materials, equipment, and supplies to the site (PSEG 2014-TN3452).

PSEG conducted a traffic impact analysis (TIA) to determine traffic impacts around the PSEG Site (PSEG 2013-TN2525). The TIA analyzed deterioration of LOS on roads and intersections in Salem County using the following assumptions: (a) the maximum anticipated construction workforce; (b) build-out year of 2021; (c) use of key routes even though other, less-traveled routes are available; and (d) traffic load based upon a combination of peak construction, outage

workforce, maximum operations workforce at the PSEG Site, and baseline background traffic (which incorporates current HCGS and SGS employees) (PSEG 2013-TN2525). The analysis in the TIA is significantly more conservative than the analysis presented by PSEG in its ER (PSEG 2014-TN3452). The assumptions are detailed in Table 4-11 and the results in Table 4-12.

Table 4-10. Level of Service (LOS) Ranges

Type of Intersection	LOS	Delays (Seconds)
Signalized Intersections	A	≤10
	B	>10–20
	C	>20–35
	D	>35–55
	E	>55–80
	F	≥80
Unsignalized Intersections (Two-way-Stop–Controlled Intersections)	A	≤10
	B	>10–15
	C	>15–25
Unsignalized Intersections	D	>25–35
	E	>35–50
	F	≥50

Table 4-11. Traffic Impact Analysis Assumptions

Type of Commuter	Amount	Average Vehicle Occupancy	Vehicles Per Day
Construction Workforce[a]	4,100	1.3	3,153
Outage Workforce[b]	690	1	690
Operations Workforce[c]	600	1	600
Heavy Trucks[d]	355		355
Total[e]	**5,745**		**4,798**

(a) Assumes vehicles per day. Because there would be three shift changes, on average, there would be 2,200 vehicles on the road per shift change.
(b) Assumes a total of 850 outage workers, but 160 are considered nonoutage, non-PSEG personnel and are part of the background counts.
(c) Assumes maximum operations workforce. PSEG estimates actual operations workforce during building would be 342 workers.
(d) The traffic impact analysis assumes all trucks used for building would be traveling to the site during peak building. This includes trucks used for fill, concrete shipments, etc. that would actually be distributed more evenly throughout the building phase. The average number of trucks per day would be closer to 50 throughout the building phase.
(e) Salem Generating Station/Hope Creek Generating Station personnel are considered part of the background counts.

Sources: PSEG 2013-TN2525; PSEG 2014-TN3452.

Table 4-12. Impacts on Roadways around PSEG Site during Peak Building

Intersection	Intersection Level of Service (LOS): Future No Build[(a)]		Future With Causeway, No Mitigation Measures[(b)]		Future With Causeway, With Mitigation Measures[(a)]		Mitigation Measure[(c)]
	AM	PM	AM	PM	AM	PM	
Intersections with Traffic Signals							
Alloway Creek Neck Rd & Locust Island Rd (Salem-Hancocks Bridge Rd)	B	B	B	A	B	B	
Broadway (Route 49) & Front St	B	B	F	F	D	D	Extra Southbound Left Turn Bay
Broadway (Route 49) & Market St (Route 45)	B	C	C	D	C	E	None
Broadway (Route 49) & Yorke St/ Keasbey St	B	C	A	B	A	B	
Route 49 (Quinton Marlboro) & Quinton Alloway Rd	A	A	A	B	B	B	
Broadway (Route 49) & Yorke St (Route 658)	B	C	A	B	A	B	
Intersections with Stop Signs							
Grieves Parkway and Walnut Street					D	A	Traffic Signal
Northwest Approach	F	F	F	E			
Southeast Approach	F	F	F	C			
Grieves Parkway and Chestnut Street					B	D	Traffic Signal
Northwest Approach	C	E	D	E			
Southeast Approach	C	C	F	C			

Table 4-12 (continued)

Intersection	Intersection Level of Service (LOS)						Mitigation Measure(c)
	Future No Build(a)		Future With Causeway, No Mitigation Measures(b)		Future With Causeway, With Mitigation Measures(a)		
	AM	PM	AM	PM	AM	PM	
Grieves Parkway and Oak St					A	C	Traffic Signal Extra Eastbound Right Turn Bay Extra Northbound Left Turn Bay
Northwest Approach	B	C	B	F			
Southeast Approach	C	B	F	F			

Note: Values for letters A through F are defined in Table 4-10

Sources:
(a) Table 23 from the traffic impact analysis (TIA; PSEG 2013-TN2525).
(b) Table I-3 from the TIA.
(c) PSEG 2013-TN2525.

The TIA indicated that five intersections in Salem County would have traffic levels that deteriorated below New Jersey acceptable standards (LOS B or better) (PSEG 2013-TN2525). The intersections are

- Grieves Parkway and Chestnut Street (unsignalized),
- Grieves Parkway and Oak Street (unsignalized),
- Grieves Parkway and Walnut Street (unsignalized),
- Front Street and NJ Route 49 (signalized), and
- Market Street and NJ Route 49 (signalized).

The TIA indicated the most effective mitigation strategies for these intersections would be the following (PSEG 2013-TN2525).

- Changing the three Grieves Parkway intersections from two-way stop sign controls to traffic light controls
- Construction of turn bays at the Grieves Parkway–Oak Street intersection

- Adding another turn bay at the Front Street–NJ Route 49 intersection

The TIA indicated that, without mitigation measures, LOS would deteriorate. The suggested mitigation measures in the TIA may improve the LOS; however, some intersections would remain below the New Jersey acceptable standard. There is no room to expand one of the intersections, Broadway (Route 49) and Market St (Route 45), and no mitigation measures have been suggested. There is not room to expand the Broadway (Route 49) and Front Street intersection beyond the current suggested mitigation measure. The proposed causeway would separate all traffic to and from the new plant from traffic associated with the existing HCGS and SGS operations. The impacts from these two streams of traffic (from HCGS/SGS operations and PSEG building activities) would interact when they converge around Salem City (PSEG 2013-TN2525).

As discussed above, the TIA is based on a combination of peak construction employment, outage workforce, operations workforce, and baseline background traffic. The peak construction workforce is assumed to occur during construction months 42 through 51. Without mitigation, the review team expects the traffic impacts from building would be noticeable and not destabilizing, especially for the key intersections identified by the TIA. If the mitigation activities recommended in the TIA were undertaken, the review team expects the impact to traffic in the region would be minimal, with localized, temporary, noticeable, and adverse impacts around Salem.

4.4.4.2 Recreation

Recreational resources in the economic impact area may be affected by building activities at the PSEG Site. Impacts may include (1) increased user demand associated with the projected increase in population as a result of the in-migrating workforce and their families, (2) impaired recreational experience associated with the views of the building process and the potential cooling tower, and (3) access delays associated with increased traffic on local roadways. Increased user demand as a result of the in-migrating population may include increased competition for recreational vehicle spaces at campgrounds, which could be used for temporary housing for some of the workforce.

As discussed in Section 4.4.1, there would be some aesthetic impacts at recreational areas with an unobstructed view of the PSEG Site. These areas are typically across the Delaware River in Delaware. There would be additional aesthetic impacts from the PSEG EEP viewing platforms. The building activities at the PSEG Site would add to the industrial nature of the site. Also, people using recreational facilities in Salem County may experience traffic congestion on the roads during the morning and afternoon commutes of the building workforce.

However, because 85 percent of the workforce for building already lives within commuting distance of the site, the review team does not expect any stresses to be placed upon the capacity of recreational facilities near the PSEG Site. Also, after discussions with local officials, the review team does not expect any impacts on recreational trapping in the vicinity of the site (NRC 2012-TN2499).

The economic impact area and the region's parks and recreational facilities have sufficient capacity to accommodate in-migrating workers and their families, and the review team expects

no impact to trapping near the site. The review team expects the impacts to recreational activities in the vicinity to be minimal except for a noticeable but not destabilizing aesthetic impact from building activities at the site that cannot be reduced through mitigation and a localized, temporary, noticeable but not destabilizing impact for recreational traffic.

4.4.4.3 Housing

Section 2.5.2.5 discusses housing information for the economic impact area. According to Table 2-30, there are 30,578 vacant housing units available for purchase or rent in all counties of the economic impact area, and every county had a significant supply of vacant units. As discussed in Section 4.4.2, 617 workers and their families would move into the economic impact area from outside the 50-mi. region. The rest of the peak construction workforce is expected to come from the region and commute daily to the site, therefore having no impact on the housing stock.

The in-migrating workers and families may choose to buy available vacant housing or rent. Table 4-13 shows the estimated impact on housing availability for the in-migrating families.

Table 4-13. Estimated Housing Impacts in the Economic Impact Area

County	In-migrating families	Vacant Units	Percent Change in Vacancy Rates
New Castle	127	15,239	0.83
Cumberland	75	6,174	1.21
Gloucester	109	6,453	1.69
Salem	306	2,712	11.28
Total	**617**	**30,578**	**2.02**

Source: Table 2-30 of this draft environmental impact statement.

In addition to the housing stock for owner-occupied housing and rental units, there is also sufficient stock of temporary housing in the economic impact area, should workers decide to stay in hotels, motels, or campgrounds. Construction workers are more likely to take advantage of the temporary housing stock because they are expected to be at the PSEG Site for a relatively short time period. Salem County officials also indicate that many outage workers who come from outside the region rent out rooms in single-family homes in localities near the site (NRC 2012-TN2499).

Given the large supply of vacant housing relative to the in-migrating workforce during peak building employment and the availability of short-term accommodations, the review team expects sufficient housing to be available for workers relocating to the area and that there would be minimal impacts on the housing supply or prices in the local area. In addition, given the large supply of vacant housing, the short-term accommodations, and the temporary nature of the construction workforce in the area, the review team does not expect the in-migrating workers and families would stimulate new housing.

Building activities at the PSEG Site could affect housing values in the vicinity of the site. In a review of previous studies on the effect of seven nuclear power facilities, including four nuclear power plants, on property values in surrounding communities, Bezdek and Wendling (Bezdek and Wendling 2006-TN2748) concluded that assessed valuations and median housing prices have tended to increase at rates above national and State averages. Clark et al. (Clark et al. 1997-TN3000) similarly found that housing prices in the immediate vicinity of two nuclear power plants in California were not affected by any negative views of the facilities. These findings differ from studies that looked at undesirable facilities, largely related to hazardous waste sites and landfills, but also including several studies on power facilities (Farber 1998-TN2857) in which property values were negatively affected in the short-term, but these effects were moderated over time. Bezdek and Wendling attributed the increase in housing prices to benefits provided to the community in terms of employment and tax revenues, with surplus tax revenues encouraging other private development in the area. Given the findings from the studies discussed above, the review team expects that the impact on housing values from building at the PSEG Site would be minor.

Based on the information provided by PSEG, interviews with local officials, and its own independent review, the review team expects there would be minimal impacts in the economic impact area and the region on the price and availability of housing from building at the PSEG Site.

4.4.4.4 Public Services

This section discusses the impacts on existing water supply, wastewater treatment, police, fire, and healthcare services in the economic impact area.

Water Supply and Wastewater Treatment Services

About 85 percent of the project workforce would be local workers who currently reside in the region. The majority of these workers would commute from their homes to the project site and would not relocate. Therefore, the majority of workers are currently served by the water supply and wastewater treatment facilities within the communities in which they reside.

At peak employment, the review team expects 617 workers and their families to move into the economic impact area. This would constitute a total of 1,654 people moving into the economic impact area at peak construction. These relocating workers would increase the demand on the water supply and wastewater treatment services within the communities where they would reside.

The review team calculated the increase in demand for residential water based on the increase in people, using the New Jersey per capita demand for water of 100 gpd (Barnett 2010-TN2484). Table 4-14 shows the impact of the increased population on the excess capacity within each county of the economic impact area. As shown in Table 4-14, Salem County would have a 2.44 percent increase in water demand and the rest of the counties in the economic impact area would have less than a four-tenths of one percent increase.

Given the small increase in demand that would result from the in-migrating workers and their families compared to existing supply, the review team determined that impacts on water supply in the economic impact area would be minimal, and mitigation would not be warranted.

Table 4-14. Estimated Water Supply Impacts in the Economic Impact Area

County	Current Excess Capacity (Mgd)	Increase in Population	Estimated Increase in Water Demand (Mgd)[(a)]	Increase in Demand on Excess Capacity (%)
New Castle	≈1,000[(b)]	341	0.0341	0.003
Cumberland	3.995[(c)]	200	0.02	0.50
Gloucester	24.733[(c)]	293	0.0293	0.12
Salem	2.646[(c)]	820	0.082	3.1

(a) Increase in population multiplied by 100 gpd.
(b) New Castle County 2012 Comprehensive Plan Update (NCCDE 2012-TN2326).
(c) Table 2-31 of this draft environmental impact statement.

The review team calculated the increase in demand for wastewater based on the increase in people and using the New Jersey per capita demand for wastewater of 75 gpd (SJBC 2012-TN2485). Table 4-15 shows the impact of the increased population on the excess wastewater capacity within each county of the economic impact area. As shown in Table 4-15, Salem County would have a 3.0 percent increase in wastewater demand, and the rest of the counties in the economic impact area would have less than a four-tenths of one percent increase.

Table 4-15. Estimated Wastewater Supply Impacts in the Economic Impact Area

County	Current Excess Capacity (Mgd)[(a)]	Increase in Population	Estimated Increase in Wastewater Demand (Mgd)[(b)]	Percent Increase in Demand on Excess Capacity
New Castle	32.30	341	0.026	0.08
Cumberland	8.84	200	0.015	0.17
Gloucester	6.13	293	0.022	0.36
Salem	2.05	820	0.0615	3.0

(a) Table 2-32 of this draft environmental impact statement.
(b) Increase in population multiplied by 75 gpd.

Given the small increase in demand for wastewater treatment that would result from the in-migrating workers and their families compared to the existing supply, the review team determined that impacts on wastewater treatment in the economic impact area would be minimal, and mitigation would not be warranted.

PSEG indicates that a freshwater aquifer that currently supplies HCGS and SGS would also supply the construction site with potable and sanitary water, fire protection, and other miscellaneous construction uses such as concrete batch plant supply and dust suppression. PSEG indicates that it would need about 171,360 gpd on site (PSEG 2014-TN3452). The review team expects this impact of aquifer use on groundwater supply in the economic impact area would be negligible and would be subject to permit requirements. Further analysis of groundwater withdrawal during construction is in Section 4.2 of this EIS. PSEG also has a wastewater treatment facility on the site for the HCGS and SGS, but it was only sized for the demand at HCGS and SGS. PSEG would install a new sewage treatment facility or expand the

existing one to meet needs for the PSEG building and operations workforce. There would be no offsite treatment of wastewater from the new plant (PSEG 2014-TN3452). Therefore, there would be no impact on wastewater facilities from the PSEG Site.

The review team concluded from the information provided by PSEG, interviews with local planners and officials, and its own independent evaluation that building at the PSEG Site would have minimal impacts on the local water supply and on wastewater treatment facilities and no mitigation would be warranted.

Police, Fire, and Health Care Services

The building workforce at the PSEG Site would increase the demand on police, fire, and health care services within the communities where workers reside and at the PSEG Site.

About 85 percent of the project workforce would be local workers who currently reside in the region. The majority of these workers would commute from their homes to the project site and would not relocate. Therefore, the existing police, fire, and healthcare services in the 50-mi region already serve the majority of the proposed project's construction workers within the communities in which they reside.

At peak employment, the review team expects 617 workers and their families to move into the economic impact area for a total of 1,654 people (workers plus their families). These in-migrating workers and their families would increase the demand on the police, fire, and healthcare services within the communities where they would reside.

No county in the economic impact area, except Salem County, has a projected population increase at peak employment of more than 1 percent. Salem County's projected increase is 1.22 percent. In discussion with local officials of the localities closest to the site (Lower Alloways Creek Township, Elsinboro Township, and Salem County), the review team found that such minimal increases in population should not have any noticeable effect on the performance of police, fire, and health care services at peak employment in the economic impact area (NRC 2012-TN2499).

Locally, Elsinboro Township receives police services from a contract with Lower Alloways Creek Township and its fire protection and emergency medical services are provided by volunteer forces. Lower Alloways Creek Township has its own police force and volunteer fire and emergency medical services forces. Salem City has its own police force and fire/emergency medical services as well. Salem County also has a sheriff's office and is patrolled by state police. All hospitals in the area are under capacity (NRC 2012-TN2499). Because of their proximity to the site, these three jurisdictions in Salem County would receive the greatest impacts from construction worker injuries or accidents on the roads leading to the site and at the site. These personnel may encounter traffic congestion on local roadways when responding to calls when the building workforce is commuting to the site, especially during peak employment periods. However, the area around the PSEG Site is sparsely populated, so there would not be a high demand for these personnel near the site. In addition, measures to mitigate traffic delays

have been recommended and are discussed in Section 4.4.4.1 of this EIS; these could reduce the impacts on emergency responders as well as on members of the general public using local roadways.

Based on discussions with local officials and its own independent analysis, the review team expects a minimal impact on police, fire, and healthcare services from building activities at the PSEG Site, and no mitigation would be warranted.

4.4.4.5 Education

The building workforce at the PSEG Site would increase the demand for educational services within the communities where workers reside. About 85 percent of the project workforce would be local workers who currently reside in the region. The majority of these workers would commute from their homes to the project site and would not relocate. Therefore, the majority of workers are currently served by the educational services within the communities where they reside.

As shown in Table 4-16, during peak building there would be an estimated increase of 283 students in the economic impact area. The review team determined this to be a small increase compared to the existing rolls in the economic impact area (more than 160,000 students, as shown in Table 2-34). No county in the economic impact area would experience a noticeable increase in the number of students per teacher. The greatest increase in student-to-teacher ratios would be in Salem County, where the increase would be slightly greater than one-tenth of a student per teacher. Some schools may receive higher numbers of children during peak employment because of amenities and the school choice programs available in New Jersey and Delaware.

Table 4-16. Estimated Number of School-Aged Children Associated with In-Migrating Workforce Associated with Building at the PSEG Site

County	Estimated Increase in Population	Percent of Population Between 5 and 18 Years Old[a]	Estimated Increase in School-Age Children	Student/Teacher Ratio Existing Conditions[b],[c]	Student/Teacher Ratio During Peak Building[c]
New Castle	341	16.5%	56	15.24	15.25
Cumberland	200	17.1%	34	12.02	12.03
Gloucester	293	18.0%	52	12.93	12.94
Salem	820	17.2%	141	11.24	11.37
Total	**1,654**	**17.1%**	**283**	**13.58**	**13.60**

(a) U.S. Census Bureau (USCB 2009-TN2344).
(b) Table 2-34 of this draft environmental impact statement.
(c) Public school estimates only.

Because of these estimates, the public choice programs, and discussions with local officials, the review team foresees minimal impacts on local school districts and schools in the economic impact area, and no mitigation would be warranted.

4.4.4.6 Summary of Community Service and Infrastructure Impacts

Based on the information provided by PSEG and the review team's independent evaluation and outreach, the review team concludes that the building-related impacts to all infrastructure and community services would be SMALL for the region and the economic impact area, with the exception of recreation-related traffic and aesthetics near the PSEG Site. The review team expects MODERATE, temporary adverse impacts on traffic on local recreation routes near the PSEG Site. These impacts could be reduced by further planning and mitigation measures similar to those discussed in the TIA. The review team expects MODERATE adverse impacts to local recreational resources due to impacts on "view sheds" and noticeable traffic impacts. For aesthetic impacts to recreational activities, the review team determined that additional mitigation beyond what has already been proposed by PSEG would not reduce the expected impact below MODERATE.

Based on the above information, the review team determined the impacts of NRC-authorized construction activities on infrastructure and community services for MODERATE impact categories (traffic and recreation-related aesthetics) are integrally related to the period of maximum construction workforce and therefore would also be MODERATE.

4.4.5 Summary of Socioeconomic Impacts

The review team has assessed the activities related to building a new nuclear power plant at the PSEG Site and the potential socioeconomic impacts in the region and economic impact area. The above discussion includes scenarios with and without mitigation. However, given that the applicant identified specific mitigation actions for each category, which are consistent with industry standards or required by local ordinances and which would reduce negative impacts, the review team finds it reasonable to assume for this summary that those mitigating actions would be successfully implemented. Therefore, for clarity, the summary discussion below refers strictly to the expected level of impacts following the implementation of applicant-identified mitigation.

Physical impacts on workers and the general public would include those on noise levels, air quality, existing buildings, transportation resources, and aesthetics. The review team concludes most physical impacts from building at the PSEG Site would be SMALL, with the exception of MODERATE impacts to local roadways and aesthetics. Physical impacts to local roadways would be manageable with mitigation required by local ordinances. Aesthetic impacts could not be mitigated.

On the basis of information supplied by PSEG and the review team interviews conducted with public officials, the review team concludes that impacts on the demographics of the region and economic impact area from building at the PSEG Site would be SMALL. Economic impacts throughout the region and economic impact area would be SMALL and beneficial, with the exception of MODERATE and beneficial economic impacts to Salem County. Tax impacts would be SMALL and beneficial throughout the region and economic impact area.

Infrastructure and community services impacts span issues associated with traffic, recreation, housing, public services, and education. Impacts from building at the PSEG Site on housing,

public services, and education would be SMALL. Traffic impacts are expected to be localized, short-term, MODERATE, and adverse. These impacts could be reduced by further planning and mitigation measures similar to those discussed in the TIA. Recreational impacts would be MODERATE and adverse due to impacts to roadways around recreational resources and on view sheds from the increased industrial character of the PSEG Site.

4.5 Environmental Justice Impacts

The review team evaluated whether minority or low-income populations would experience disproportionately high and adverse human health or environmental effects from building a new nuclear power plant at the PSEG Site. To perform this assessment, the review team (1) identified [through U.S. Census Bureau and American Community Survey demographic data, the PSEG ER (PSEG 2014-TN3452), and site visit assessments] minority and low-income populations of interest; (2) identified all potentially significant pathways for human health, environmental, physical, and socioeconomic effects on those identified populations of interest; and (3) determined whether the characteristics of the pathway or special circumstances of the minority or low-income populations would result in a disproportionately high and adverse impact.

To perform this assessment, the review team followed the method described in Section 2.6.1. In the context of building activities at the PSEG Site, the review team considered the questions outlined in Section 2.6.1. For all three health-related questions, the review team determined that the level of environmental emissions projected is well below the protection levels established by the NRC and EPA regulations and would not impose a disproportionate and adverse effect on minority or low-income populations.

4.5.1 Health Impacts

Section 4.8 assesses the nonradiological health effects for construction workers and the local population from fugitive dust, noise, occupational injuries, and transport of materials and personnel. In Section 4.8, the review team concludes that nonradiological health impacts would be SMALL. The review team’s investigation and outreach did not identify any unique characteristics or practices among minority or low-income populations that might result in disproportionately high and adverse nonradiological health effects.

Section 4.9 assesses the radiological doses to construction workers and the local population and concludes that the doses would be within the NRC and EPA dose standards. Section 4.9 concludes that radiological health impacts on the construction workforce at the PSEG Site would be SMALL. In addition, there would be no radioactive material on the construction site except for very small sources such as those commonly used by radiographers; therefore, there would be no radiation exposure to members of the public from building at the PSEG Site. Based on this information, the review team concludes that there would be no disproportionately high and adverse impact on low-income or minority populations.

4.5.2 Physical and Environmental Impacts

For the physical and environmental considerations described in Section 2.6.1, the review team determined through literature searches and consultations that (1) the impacts on the natural or

physical environment would not significantly or adversely affect a particular group, (2) no minority or low-income population would experience an adverse impact that would appreciably exceed or be likely to appreciably exceed those of the general population, and (3) the environmental effects would not occur in groups affected by cumulative or multiple adverse exposure from environmental hazards.

The review team determined that the physical and environmental impacts from onsite building activities at the PSEG Site would attenuate rapidly with distance, intervening foliage, and terrain. There are four primary exposure media in the environment: soil, water, air, and noise. The following sections discuss each of these pathways in greater detail.

4.5.2.1 Soil

Building activities on the PSEG Site represent the largest source of soil-related environmental impacts. The site is well-defined, and access is restricted. Soil-disturbing activities are localized on the site, sufficiently distant from surrounding populations, and have little ability to migrate, resulting in no noticeable offsite impacts. Soil migration would be minimized by adherence to regulations, permits, and the use of BMPs.

4.5.2.2 Water

Water-related environmental impacts from erosion-related degradation of surface water and the introduction of anthropogenic substances into surface and groundwater would occur, but the impacts would be mitigated through adherence to permit requirements and BMPs. Increased water turbidity during dredging activities could affect near-shore water quality, but the effect would be minimized through adherence to permit requirements and BMPs. Consumptive use of surface water for building activities would also occur but would have only a minimal effect because the water supply is from the Delaware River. The water-related impacts of building activities associated with the proposed action would be of limited magnitude, localized, and temporary.

4.5.2.3 Air

Air emissions are expected from increased vehicle traffic, construction equipment, and fugitive dust from building activities. Emissions from vehicles and construction equipment would be unavoidable but would be temporary and minor in nature and subject to management under State and Federal air regulations and permits. Furthermore, because of the distance between the site and the closest minority or low-income population, the review team did not identify any disproportionately high and adverse impacts from air-related pathways.

4.5.2.4 Noise

Noise would result from clearing; moving earth; preparing foundations; pile driving; concrete mixing and pouring; erecting steel structures; and various stages of facility equipment fabrication, assembly, and installation. PSEG would, however, use standard noise control measures for construction equipment, limit the types of building activities during nighttime and weekend hours, notify all potentially affected neighbors of planned activities, and establish a

construction-noise monitoring program. The review team determined that noise impacts on the public would be temporary and would not be significant; therefore, the review team determined there would be no disproportionately high and adverse impact on any minority or low-income population from noise.

4.5.2.5 Summary of Physical and Environmental Impacts

The review team's investigation and outreach did not identify any unique characteristics or practices among minority or low-income populations that might result in physical or environmental impacts on them that were different from those on the general population.

As discussed in Section 2.6, most of the census block groups classified as minority or low-income are located across the Delaware River in New Castle County. The closest block groups to the site are about 8 mi north of the PSEG Site in the City of Salem. The census block groups would not be affected by any physical or environmental impacts because of the distance from the site.

On the basis of information provided by PSEG and the review team's independent review, the review team found no pathways from soil, water, air, and noise that would lead to disproportionately high and adverse impacts on minority or low-income populations.

4.5.3 Socioeconomic Impacts

Socioeconomic impacts (discussed in Section 4.4) were reviewed to evaluate whether there would be any building activities that could have a disproportionately high and adverse impact on minority or low-income populations. Except for effects on traffic and recreational resources, all adverse socioeconomic impacts associated with building activities at the PSEG Site are expected to be SMALL for the general public. The review team found that there could be adverse MODERATE impacts on traffic and recreational resources in Salem County; however, these impacts are not expected to disproportionately affect the nearby low-income and minority populations.

4.5.4 Subsistence and Special Conditions

The NRC method for environmental justice assessments includes assessment of populations with unique characteristics such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements or high-density concentrations of minority populations.

4.5.4.1 Subsistence

Access to the PSEG Site is restricted; such restricted access reduces any impact on plant-gathering, hunting, and fishing activities at the site. PSEG and the review team independently interviewed community leaders in Salem County and New Castle County and found that no such practices were identified in the vicinity of the PSEG Site nor any documented subsistence fishing in the Delaware River. As discussed, in Section 2.6.3, hunting, plant-gathering, and fishing are all done for recreational purposes.

From the information provided by PSEG, interviews with local officials, and the review team's independent evaluation, the review team concludes that there would be no building-related disproportionately high and adverse impacts on subsistence activities on minority or low-income populations.

4.5.4.2 High-Density Communities

As discussed in Section 2.6.3, there are no high-density communities in Elsinboro and Lower Alloways Creek Townships. There are two public housing projects in Penns Grove and three in Salem City. From its own independent evaluation and interaction with local officials, the review team does not predict any impacts to the communities in Penns Grove from building activities at the PSEG Site. However, the three Salem City communities would notice an adverse effect from construction traffic similar to the rest of the area around Salem City. The review team, after discussions with local officials from Salem, does not believe the impact would disproportionately affect those communities because no pathways exist. The impacts would be temporary in nature and PSEG has provided suggested mitigation strategies to limit any impacts.

4.5.5 Migrant Labor

As discussed in Section 2.6.4, the main migrant populations closest to the site are the HCGS and SGS outage workforces. There are farm workers in the economic impact area as well, but they are located closer to or in Gloucester and Cumberland Counties and not near the PSEG Site. Therefore, from the information provided by PSEG, interviews with local officials, and the review team's independent evaluation, the review team concludes that there would be no disproportionately high and adverse impacts on minority or low-income migrant laborers.

4.5.6 Summary of Environmental Justice Impacts

The review team evaluated the impacts of building activities at the PSEG Site on environmental justice populations. The review team did not identify any potential environmental pathways by which the identified minority or low-income populations in the 50-mi region and economic impact area would likely experience disproportionately high and adverse human health, environmental, physical, or socioeconomic effects as a result of building activities.

Based on the preceding analysis, and because the NRC-authorized construction activities represent only a part of the analyzed activities, the review team concludes that there would be no disproportionately high and adverse impacts on minority and low-income populations resulting from building activities at the PSEG Site.

4.6 Historic and Cultural Resources

NEPA (42 USC 4321-TN661) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to interested parties. The National Historic Preservation Act of 1966, as amended (NHPA) (16 USC 470-TN993), also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of Historic Places (NRHP). Such resources are referred to as "historic properties" in

NHPA. As outlined in 36 CFR 800.8, "Coordination with the National Environmental Policy Act of 1969" (36 CFR 800-TN513), the NRC is coordinating compliance with Section 106 of NHPA in fulfilling its responsibilities under NEPA.

Building a new nuclear power plant could affect either known or undiscovered historic and cultural resources. In accordance with the provisions of NHPA and NEPA, the NRC and the USACE, cooperating Federal agencies, are required to make a reasonable and good faith effort to identify historic properties and cultural resources in the areas of potential effect (APEs) and permit areas and, if present, determine whether any significant impacts are likely. Identification is to occur in consultation with the appropriate state historic preservation officer, Native American tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them.

Because the NRC and the USACE each have separate regulatory authority, no one agency is responsible for all aspects of the project. The NRC is responsible for effects resulting from the construction and operation of a new nuclear power plant. Other aspects of the project, such as development of the causeway and dredging for a barge facility, are the responsibility of the USACE. Cultural resources that could be affected by building a new nuclear power plant could include archaeological sites, historic resources in the vicinity of the plant, and traditional cultural properties of significance to Native Americans.

The NRC is responsible for considering potential effects on historic and cultural resources on Artificial Island and any potential visual impacts resulting from the construction and operation of a new nuclear power plant. Artificial Island is a man-made island and therefore has no potential for intact archaeological remains; however, construction of a new nuclear power plant could visually impact historic properties. For a description of the efforts undertaken to identify historic and cultural resources in the vicinity of the PSEG Site, see Section 2.7. Six historic properties listed in the NRHP in New Jersey and 18 historic properties in Delaware are visible in the 4.9-mi APE from the project area. Two additional properties with the potential for listing were noted in New Jersey, and one property with the potential for listing was found in Delaware (AKRF 2012-TN2876). Analyses conducted on behalf of PSEG examined the visual effect of the construction of a new nuclear power plant (MACTEC 2009-TN2543; AKRF 2012-TN2876). Because the location of the PSEG Site is adjacent to the existing SGS and HCGS units, introduction of a new plant would be consistent with the existing landscape. Therefore, the NRC determined that the visual impacts from a new nuclear power plant would not have an adverse effect on historic properties. The Delaware State Historic Preservation Office (SHPO) concurred that no adverse effects to historic resources under its jurisdiction would result from the project (DDHCA 2013-TN2639) (see Appendix C). The New Jersey SHPO concurred that no adverse effects would result from the visual effects of the project (NJDEP 2013-TN2870).

The USACE is responsible for considering the effects on historic and cultural resources of dredging for a barge facility, water intakes for a new nuclear power plant, and construction of a causeway and the Money Island access road. A Phase I assessment of submerged resources off of Artificial Island identified three possible resources (PCI 2009-TN2544). A Phase II survey was performed to clarify the nature of the submerged resources, and they were determined by the contractors conducting the survey to be ineligible for NRHP listing (PCI 2013-TN2749). The New Jersey SHPO concurred with the findings of the Phase II study that no historic properties

would be affected by the required dredging (NJDEP 2013-TN2742). The USACE has yet to make its eligibility and effects determinations concerning the submerged resources.

An archaeological survey completed for the proposed causeway from the PSEG Site to Money Island Road identified six archaeological sites (28SA179, 28SA180, 28SA181, 28SA182, 28SA183, and 28SA186). All six sites were recommended as potentially eligible for NRHP listing by the contractors performing the survey (PSEG 2009-TN2550). The New Jersey SHPO indicated that additional information on these resources was necessary and recommended that a Phase II survey was needed. PSEG conducted the Phase II survey, and its contractor recommended that the sites were not eligible for NRHP listing. It was the contractor's opinion that the sites do not possess sufficient integrity or significance to be considered individually eligible for NRHP or State listing or to be considered eligible as contributing resources to either the Elsinboro-Lower Alloways Creek Rural Agricultural District or the John Mason House (AKRF 2013-TN2653). The New Jersey SHPO did not concur with the assessment and has requested that additional research be conducted (NJDEP 2013-TN2742). The USACE has yet to make its eligibility and effects determinations concerning the six sites within the permit area for the proposed causeway.

Several Native American tribes were contacted to determine whether any resources of concern to them were in the project area. No Native American tribes have responded to the NRC, so there is currently no indication that construction of a new nuclear power plant or causeway would result in adverse effects to resources of concern to the tribes. Consultation with the tribes will continue throughout the NEPA process [42 USC 4321 et seq. (42 USC 4321-TN661)]. No traditional cultural properties have been identified in the project area. For a description of the consultation efforts under Section 106 for the project, see Section 2.7.3. The USACE consultation effort is ongoing.

As discussed above, impacts to historic and archaeological resources due to building activities are not expected to occur, but monitoring during building would be expected to minimize the effects on inadvertently discovered resources. The applicant has a procedure for inadvertent discovery of archaeological sites during construction (PSEG 2012-TN2557). For the purposes of the NRC review team's NEPA analysis, based on (1) no known significant resources on Artificial Island, (2) the review team's cultural resource analysis, (3) PSEG's procedure for inadvertent discovery of archaeological resources, and (4) consultation with the New Jersey and Delaware SHPOs, the review team concludes the potential impacts on historic and cultural resources are expected to be SMALL. Consultations between the USACE and the New Jersey SHPO on the USACE permit area for the ESP are ongoing. The New Jersey SHPO has concurred with the findings from PSEG's contractor concerning no effects on submerged resources; however, the USACE has yet to issue its finding.

4.7 Meteorological and Air-Quality Impacts

Section 2.9 discusses the meteorological characteristics and air quality at and around the PSEG Site. The primary impacts on local meteorology and air quality of constructing a new nuclear power plant at the PSEG Site would be from dust generated by land clearing and building activities, emissions from equipment and machinery, concrete batch plant operations, and

emissions from vehicles used to transport workers and deliver materials to and from the site. Air quality impacts directly associated with these activities are described in Section 4.7.1; air quality impacts associated with transportation of construction workers are addressed in Section 4.7.2.

4.7.1 Construction and Preconstruction Activities

Preconstruction and construction activities at the PSEG Site would result in temporary impacts to local air quality. Equipment and vehicle emissions from these activities would contain carbon monoxide, oxides of nitrogen, volatile organic compounds (VOCs), and oxides of sulfur to a lesser extent. Fugitive dust particle emissions (such as PM_{10} and $PM_{2.5}$; that is, particulate matter with a mean aerodynamic diameter of less than or equal to 10 and 2.5 microns, respectively) would be generated during earthmoving, concrete batch plant operation, and movement of vehicular traffic and over recently disturbed or cleared areas and during windy periods. The site grade would be made uniform to ensure access to all areas of the construction site. The crosshatched areas depicted on the site utilization plan (Figure 2-2) illustrate the areas to be cleared, grubbed, and graded. No vegetation would be disposed of by burning. Painting, coating, and similar operations would also generate emissions of VOCs. Additionally, construction of the proposed causeway and roadway improvements may generate fugitive dust and equipment emissions.

As discussed in Section 2.9.2, with the exception of the 8-hour ozone NAAQS, air quality in Salem County is in attainment with or better than national standards for criteria pollutants. Salem County is in nonattainment of the 8-hour ozone NAAQS; therefore, in accordance with Section 176(c) of the Clean Air Act (42 USC 7401-TN1141), the General Conformity Rule [40 CFR 93 Subpart-B (40 CFR 93-TN2495)] applies. The NRC and the USACE must analyze the proposed permit action for conformity applicability pursuant to 40 CFR 93.150(a). As discussed in Section 1.1, the ESP application and review processes make it possible to evaluate and resolve safety and environmental issues related to siting before the applicant makes a large commitment of resources, but it does not authorize construction and operation of a nuclear power plant. The Federal action of issuing an ESP with no Limited Work Authorization for the PSEG Site does not directly or indirectly cause any emissions, and therefore, an applicability analysis and potential conformity determination will not be performed at this time. Compliance with 40 CFR 93, Subpart B, will be demonstrated when a CP, an OL, or a COL is submitted to the NRC.

Authorizations for construction and preconstruction activities are listed in Table 1.3-1 of the ER (PSEG 2014-TN3452). The State of New Jersey regulates air quality through the New Jersey Administrative Code (NJAC), Title 7, *Environmental Protection*, Chapter 27, "Air Pollution Control" (NJAC 7:27-TN3290). The applicant must follow New Jersey reporting requirements for air emissions that would be generated during construction and preconstruction activities. Additionally, the applicant plans to implement a fugitive dust control program and plans for proper maintenance of construction equipment (PSEG 2014-TN3452). A dust control program would identify specific mitigation measures to control fugitive dust. Section 4.4.1.3 of the ER (PSEG 2014-TN3452) lists mitigation measures specifically related to dust control that may be used, including

- stabilizing construction roads and spoil piles,
- limiting speeds on unpaved construction roads,
- periodically watering unpaved construction roads,
- performing housekeeping (e.g., removing dirt spilled onto paved roads),
- covering haul trucks when loaded or unloaded,
- minimizing material handling (e.g., drop heights, double-handling),
- phased grading to minimize the area of disturbed soils, and
- revegetating road medians and slopes.

Construction and preconstruction activities, such as operation of on-road construction vehicles, commuter vehicles, nonroad construction equipment, and marine engines, would also result in greenhouse gas (GHG) emissions, principally carbon dioxide (CO_2). Assuming a 7-year period for construction and preconstruction activities and typical construction practices, the review team estimates that the total construction/preconstruction equipment GHG emissions footprint for building a new nuclear power plant at the PSEG Site would be on the order of 78,000 MT CO_2 equivalent (CO_2e)[5] (an emission rate of about 11,100 MT CO_2e annually, averaged over the period of construction/preconstruction). This amounts to about 0.008 percent of the total estimated GHG emissions in New Jersey (143,400,000 MT of gross[6] CO_2e) in 2010 (NJDEP 2008-TN2776). This also equates to about 0.0002 percent of the total U.S. annual emission rate of 6.7 billion MT CO_2e in 2011 (EPA 2013-TN2815). Appendix K of this EIS provides the details of the review team estimate for a reference 1,000-MW(e) nuclear power reactor.

Based on its assessment of the relatively small construction equipment GHG footprint compared to total New Jersey and U.S. annual GHG emissions, the review team concludes that the atmospheric impacts of GHGs from construction and preconstruction activities would not be noticeable and additional mitigation would not be warranted.

In general, emissions from construction and preconstruction activities for building a nuclear power plant, including GHG emissions, would vary based on the level and duration of a specific activity, but the overall impact is expected to be temporary and limited in magnitude. PSEG asserted in ER Section 4.4.1.3 (PSEG 2014-TN3452) that emission-specific strategies and measures would be developed and implemented to ensure compliance with the applicable regulatory limits defined by the National Primary and Secondary Ambient Air Quality Standards (40 CFR 50-TN1089). Additionally, a dust control program would be implemented. Considering the information provided by PSEG and its stated intent to develop and implement strategies to reduce emissions to ensure compliance with Federal, State, and local regulations, the review team concludes that the impacts on air quality from PSEG Site construction and preconstruction activities would not be noticeable because appropriate mitigation measures would be adopted.

[5] A measure to compare the emissions from various greenhouse gases (GHGs) on the basis of their global warming potential, defined as the ratio of heat trapped by one unit mass of the GHG to that of one unit mass of CO_2 over a specific time period.
[6] Excluding GHG emissions removed due to forestry and other land uses.

4.7.2 Traffic (Emissions)

During building activities, about 3,150 commuter vehicles and 50 additional trucks and other vehicles would pass through Elsinboro and Lower Alloways Creek Townships and Salem City daily. This traffic would include the passenger cars and light duty trucks of the preconstruction and construction workforce and truck traffic for delivery of construction materials and heavy equipment used to support development (e.g., excavators, bulldozers, heavy haul trucks, cranes). Potential effects of this daily traffic are considered as indirect impacts associated with onsite building activities. Workers may carpool or shuttle to the site, thereby minimizing the number of workers using the causeway and other roadways. Additionally, the existing HCGS barge slip and the proposed parallel barge facility would be used to deliver larger components (constructed at offsite facilities) and construction materials to the site. Because the workforce would be divided into three shifts, the increased traffic would be distributed over the day, with only periodic and short-term increases at shift changes. As a result, increases in emission levels are expected to be minimal and temporary, even when combined with the workforce for the existing HCGS and SGS, and would have a minimal impact on air quality from criteria pollutants.

The workforce associated with PSEG Site building activities would primarily use the proposed causeway to avoid disruption to the HCGS and SGS operations workforce (PSEG 2014-TN3452). The TIA (PSEG 2013-TN2525) indicates that traffic from Salem City to the proposed causeway would be greatest during shift changes. The receiving roadways are likely to experience a significant increase in traffic during shift changes that could lead to periods of congestion and decreased air quality. However, the overall impact caused by increased traffic volume and congestion would be localized and temporary. In the ER, PSEG identifies mitigation measures that would be developed before building activities begin. These traffic mitigation measures would reduce the impact of increased traffic on air quality. Potential mitigation measures involve changes to intersections to reduce congestion. After building activities are complete, the measures implemented would remain in place and continue to reduce congestion.

Workforce transportation would also result in GHG emissions, principally CO_2. Assuming a 7-year period for construction and preconstruction activities and a typical workforce, the review team estimates that the total workforce GHG emission footprint for building a new nuclear power plant at the PSEG Site would be on the order of 86,000 MT CO_2e (an emission rate of about 12,300 MT CO_2e annually, averaged over the period of construction/preconstruction). This amounts to about 0.009 percent of the total estimated GHG emissions in New Jersey (143,400,000 MT of gross CO_2e) in 2010 (NJDEP 2008-TN2776). This also equates to about 0.0002 percent of the total U.S. annual emission rate of 6.7 billion MT CO_2e in 2011 (EPA 2013-TN2815). Appendix K of this EIS provides the details of the review team estimate for a reference 1,000-MW(e) nuclear power reactor.

Based on its assessment of the relatively small construction and preconstruction workforce GHG footprint compared to the New Jersey and U.S. annual GHG emissions, the review team concludes that the atmospheric impacts of GHGs from workforce transportation would not be noticeable, and additional mitigation would not be warranted. Based on the limited increase in local vehicle traffic and the applicant's stated intent to develop mitigation measures listed in the PSEG ER (PSEG 2014-TN3452), the review team concludes that the impact on the local air quality related to construction and preconstruction activities, including

the effect of GHG emissions, would be temporary and would not be noticeable if the applicant's proposed mitigation measures are adopted.

4.7.3 Summary

The review team evaluated potential impacts on air quality associated with criteria pollutants and GHG emissions during PSEG Site development activities. The review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts on air quality from emissions of criteria pollutants and GHGs during PSEG Site development would be SMALL and that no further mitigation would be warranted. Because the NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the air quality impacts of the NRC-authorized construction activities would also be SMALL, and no further mitigation beyond those mitigation measures that the applicant has committed to implement would be warranted.

4.8 Nonradiological Health Impacts

Nonradiological health impacts on the public and workers from preconstruction and construction activities include exposure to dust and vehicle exhaust, occupational injuries, noise, and risk from the transport of materials and personnel to and from the site. PSEG discussed these impacts qualitatively in Sections 4.4.1 and 4.6 of the ER (PSEG 2014-TN3452).

The area around the PSEG Site is predominantly rural, and the two counties located within a 6-mi radius are New Castle, Delaware, and Salem, New Jersey (PSEG 2014-TN3452). Most of the land surrounding the site is owned by the Federal government and the State of New Jersey, with the three major land uses (agriculture, open water and wetlands) accounting for 94 percent of land use within this 6-mile vicinity. There are about 42,000 people residing within 10 mi of the PSEG Site, with the majority within 5 to 10 miles of the PSEG Site (PSEG 2014-TN3452). There is no resident population within 2 miles of the PSEG Site, and an estimated 75 individuals reside within 2 to 3 miles. Of the roughly 1,300 people employed at the existing facilities (SGS and HCGS) on the PSEG property, the majority (82.6 percent) live in four counties in two states. These counties are Salem County (41.0 percent), Gloucester County (14.6 percent), and Cumberland County (10.0 percent) in New Jersey and New Castle County (17.0 percent) in Delaware (PSEG 2014-TN3452). People who would be vulnerable to nonradiological health impacts from preconstruction and construction activities include construction workers and personnel working at the PSEG Site; people working or living in the vicinity or adjacent to the site; and transient populations in the vicinity (e.g., temporary employees, recreational visitors, tourists).

The nonradiological impacts on health are described in the following sections: Section 4.8.1, impacts on public and occupational health; Section 4.8.2, impacts of noise; and Section 4.8.3, impacts of transporting construction materials and personnel to and from the PSEG Site. A summary of nonradiological health impacts is provided in Section 4.8.4.

4.8.1 Public and Occupational Health

This section includes a discussion of the impacts of site preparation and construction on public health and worker health.

4.8.1.1 Public Health

The physical impacts on the public from building a new nuclear power plant at the PSEG Site would include air pollution from dust and vehicle exhaust during site preparation. The PSEG ER (PSEG 2014-TN3452) indicated that physical impacts to the public from construction and preconstruction on the PSEG Site are unlikely because the nearest residences to the center point of the new plant are located 2.8 mi west in Delaware and 3.4 mi east-northeast near Hancocks Bridge, New Jersey. PSEG stated that operational controls would be imposed to mitigate dust emissions to meet State requirements. Further, engine exhaust would be minimized by maintaining equipment in good mechanical order, and the operation of vehicles and other combustion-engine equipment would comply with applicable standards, regulations, and requirements (PSEG 2014-TN3452). As there are no residences in the immediate proximity of the new plant location, noise, dust, emissions, and vibration from onsite construction activities would be unlikely to have direct physical impacts on the public (PSEG 2014-TN3452).

The PSEG Site is located in Salem County, administratively within the Metropolitan Philadelphia Interstate Air Quality Control Region (40 CFR 81-TN255), and Salem County is in attainment with NAAQS for all criteria pollutants except 8-hour ozone. Thus, Salem County is in nonattainment for 8-hour ozone NAAQS. Salem County is adjacent to New Castle County, Delaware, which is a nonattainment area for $PM_{2.5}$. Temporary and minor effects on local ambient air quality would occur as a result of building activities. Dust particle emissions would be generated during land-clearing, grading, and excavation activities. Air quality would also be affected by engine exhaust emissions and concrete batch plant operations. PSEG would create emission-specific strategies and measures to comply with National Primary and Secondary Ambient Air Quality Standards (40 CFR 50-TN1089) and National Emission Standards for Hazardous Air Pollutants (40 CFR 61-TN3289). Furthermore, PSEG indicates it would create a dust control program (PSEG 2014-TN3452).

An increase in daily traffic (up to 3,150 construction worker vehicles and 50 trucks) is expected during peak construction along roads passing through Elsinboro and Lower Alloways Creek Townships and Salem City (PSEG 2014-TN3452). This traffic would include passenger cars and light duty trucks of the construction workforce as well as truck traffic for delivery of construction materials and heavy equipment used to support facility construction (e.g., excavators, bulldozers, heavy haul trucks, cranes). Construction-related traffic could expose people living or working along these roads to additional emissions and noise. Because the construction workforce would be divided into three shifts, the increased traffic would be distributed over the day with only periodic and short-term increases at shift changes, which would result in increases in emissions and noise levels. Additionally, the existing HCGS barge slip and the proposed parallel barge facility would be used to deliver larger components (constructed at offsite facilities) and construction materials to the PSEG Site. Because barge traffic would be intermittent, it would not represent a significant impact. Impacts to fishermen and boaters on the Delaware River from noise, dust, or water transport during onsite building activities would be minimal.

4.8.1.2 Public Health Impacts from Offsite Building Activities

PSEG has identified the proposed causeway as the major offsite building activity with potential impacts to public health. The proposed causeway would extend to the northeast from the

PSEG Site for 4.8 mi and pass over tidal marshland areas. The only nearby residences are located at the extreme northern end of the proposed causeway. A single residence is located just to the west of the intersection of the proposed causeway and Mason Point Road. Building the causeway and any improvements of connecting roadways may expose residents of this and other nearby buildings to temporary and intermittent increases in noise, dust, and air pollution emissions associated with these activities. PSEG states that construction practices and controls would be used to minimize fugitive dust, and all construction equipment would meet appropriate emissions standards (PSEG 2014-TN3452). Most building activities would be during the day, thereby reducing nighttime noise levels. Traffic associated with building the causeway would potentially have physical impacts similar to those described for building a new nuclear power plant on the PSEG Site. However, because the proposed causeway building period would be limited and the peak workforce would be less than 10 percent of the peak construction workforce for a new nuclear power plant, potential impacts from causeway building traffic to public health would be minimal.

Most of the proposed causeway would be built on support structures to elevate the roadway above the marsh to minimize impacts to the wetlands. Activities would include pile driving, form construction, and steel and concrete work. Emissions, noise, and vibrations would be the primary potential physical impacts from construction activities (Table 4-17). However, impacts to public health would be unlikely as there are no homes near the proposed elevated portions of the causeway (PSEG 2014-TN3452). Impacts to the public near the northern at-grade portions of the proposed causeway from emissions, noise, and vibration would be minimal and temporary.

Table 4-17. Typical Noise and Emissions from Construction Equipment and Light Vehicles Used in Major Construction Projects

Equipment Type	Noise Level (dBA)			Emissions (grams/horsepower-hour)					
	At 50 ft	At 500 ft	At 1,000 ft	VOC	CO	NO_x	$PM_{2.5 \& 10}$[(a)]	SO_2	CO_2
Earthmoving									
Loaders	88	68	58	0.38	1.55	5.00	0.69	0.74	536.2
Dozers	88	68	58	0.36	1.38	4.76	0.65	0.74	536.3
Tractors	80	60	50	1.85	8.21	7.22	2.70	0.95	691.1
Graders	85	65	55	0.35	1.36	4.73	0.65	0.74	536.3
Trucks	86	66	56	0.44	2.07	5.49	0.81	0.74	536.0
Shovels	84	64	54	0.34	1.30	4.60	0.63	0.74	536.3
Materials Handling									
Concrete pumps/ Mixers	81	61	51	0.61	2.32	7.28	0.95	0.73	529.7
Derricks and Mobile Cranes	83	63	53	0.44	1.30	5.72	0.67	0.73	530.2
Stationary									
Portable Generators	84	64	54	1.23	3.76	5.97	1.44	0.81	587.3

Table 4-17. (continued)

Equipment Type	Noise Level (dBA)			Emissions (grams/horsepower-hour)					
	At 50 ft	At 500 ft	At 1,000 ft	VOC	CO	NO_x	$PM_{2.5\ \&\ 10}$ (a)	SO_2	CO_2
Impact									
Paving Breakers	80	60	50	NA	NA	NA	NA	NA	NA
				Emissions (grams/mi)					
Light Duty Vehicles(b)				HC	CO	NO_x		CO_2	
	NA	NA	NA	2.8–3.5	20.9–27.7	1.39–1.81		416–522	

(a) $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of 2.5 μm or less; PM_{10} = particulate matter with a mean aerodynamic diameter of 10 μm or less.
(b) Includes cars and light trucks. Lower values for cars.

Source: PSEG 2014-TN3452.
Reference for noise: CEC 2009-TN2733.
References for emissions: DHS 2008-TN2858; EPA 2000-TN2729.

4.8.1.3 Construction Worker Health

In general, human health risks for construction workers and other personnel working on the site would be expected to be dominated by occupational injuries (e.g., falls, electrocution, asphyxiation) to workers engaged in activities such as construction, maintenance, and excavation. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. According to the U.S. Bureau of Labor Statistics (BLS 2011-TN2425), the fatal work injury rate has continued a gradual drop from 5.8 to 3.3 per 100,000 workers from 1992 through 2009. PSEG expects that the construction workforce for a new nuclear power plant would peak at 4,100 during the projected 68-mo construction period, with construction commencing in 2016 and a 2021 commercial operation date (PSEG 2014-TN3452). To meet this 68-mo schedule, the workforce would be divided into three shifts, with about 60 percent working on the first shift (days), 35 percent on the second shift (evenings), and 5 percent on the third shift (overnight).

While statistical rates show some variation, they can be used to estimate health impacts on the construction workers. The peak labor force involved in building a new nuclear power plant was multiplied by 2009 fatal injury rates (PSEG 2014-TN3452). (If the current trend of declining deaths continues, these numbers should be bounding.) Using the BLS fatal injury rate for the overall workforce and for the construction sector (BLS 2011-TN2425), one would not expect a fatality (0.13–0.39 expected fatal injuries) during the years of construction of a new plant at the PSEG Site. The BLS also tracks different kinds of nonfatal work injuries (BLS 2010-TN2731; BLS 2010-TN2427; BLS 2010-TN2428). Applying the 2009 rates to the same workforce over the years of work produced the projected occupational illnesses and injuries in Table 4-18. The total number of reportable injuries and occupational illnesses could range from 148 to 160 over the length of construction for the new plant. Projected nonfatal accidents and occupational illnesses severe enough to cause days away from work would be much smaller, ranging from 45 to 86, with New Jersey utility construction again near the lower end of the estimate. When interpreting these results, it is especially important to recall that they are gross (total) injury estimates. If the workers

were not employed building a new plant at the PSEG Site, they would be doing other work or would be unemployed. As noted previously, the injury rate for utility construction activities in New Jersey is near the lower end of the estimate. Thus, the estimates developed above are conservative estimates of the net impact of new plant construction activities on workplace injuries.

Table 4-18. Projected Total Nonfatal Occupational Illnesses and Injuries to Construction Force Using 2009 Rates for Various Groups

	Total Reportable Occupational Illnesses and Injuries				Occupational Illnesses and Injuries with Days Away from Work			
	All Private Industry	All Construction	New Jersey Construction	New Jersey Utility Construction	All Private Industry	All Construction	New Jersey Construction	New Jersey Utility Construction
Rate per 100 full-time workers per year	3.6[(a)]	4.3[(b)]	4.4[(c)]	3.9[(c)]	1.1[(a)]	1.6[(b)]	2.1[(c)]	1.4[(c)]
Illnesses and injuries	148	176	180	160	45	66	86	57

Sources:
(a) BLS 2010-TN2731.
(b) BLS 2010-TN2427.
(c) BLS 2010-TN2428.

In addition to the BLS data, site-specific injury data associated with staff contracted to support refueling outages at the existing HCGS and SGS were provided by PSEG (PSEG 2012-TN2403). The work activities associated with a refueling outage (e.g., electrical work, welding, scaffold erection, heavy load rigging) are representative of many of the activities associated with construction of a new nuclear power plant. The rotating refueling outage schedule for the three existing nuclear units at SGS and HCGS is such that one of the units is in an outage every 6 mo. The routine schedule of outages for the three existing units makes the SGS and HCGS sites unique in that they experience a consistent recruitment of nominally 1,000 contracted labor support staff from the region. This recurrent outage support staff represents a reasonable surrogate for long-term nuclear power plant construction staff. Each outage at SGS and HCGS requires about 1,000 contracted staff, depending on the scope of work for a given outage, a majority of which are provided by a primary support staff contractor for PSEG. Injury incident data for the PSEG primary support staff contractor were collected between January 2009 and August 2012. During this time frame there were 57 total reported injuries over the course of more than 1.12 million person-hours worked. These injuries were experienced over a number of craft types (e.g., carpenters, electricians, insulators, laborers) and were predominantly minor in nature (e.g., abrasions, sprains, insect bites, eye irritation). The low incidence of PSEG site-specific workplace injuries during outage construction activities suggests future construction activities would have minimal impacts on worker health.

Other nonradiological impacts on workers who would clear land or build the facility would include noise, fugitive dust, and gaseous emissions resulting from site preparation and development activities. Table 4-17 provides typical noise and emission levels associated with

construction equipment. Mitigation measures discussed for the public would also help limit exposure to construction workers. Onsite impacts on workers also would be mitigated through training and use of personal protective equipment to minimize the risk of potentially harmful exposure. The NRC staff assumes that PSEG would adhere to all applicable NRC, Occupational Safety and Health Administration, and State safety standards and procedures during preconstruction and construction activities.

4.8.1.4 Summary of Public and Construction Worker Health Impacts

Based on the mitigation measures identified in the PSEG ER (PSEG 2014-TN3452), the permits and authorizations required by State and local agencies, and the review team's independent review, the review team concludes that the nonradiological health impacts to the public and workers from preconstruction and construction activities would be SMALL and that additional mitigation beyond the actions stated above would not be warranted.

4.8.2 Noise Impacts

Preconstruction and construction activities for a nuclear power plant are similar to those for other large industrial projects and involve many noise-generating activities. Regulations governing noise from construction-type activities are generally limited to protecting workers' hearing. Federal regulations governing construction noise are found in 29 CFR 1910 (29 CFR 1910-TN654) and 40 CFR 204 (40 CFR 204-TN653). The regulations in 29 CFR 1910 deal with noise exposure in the construction environment, and the regulations in 40 CFR 204 generally govern the noise levels of compressors. New Jersey also has established protective noise levels. NJAC 7:29 includes regulatory limits on continuous noise levels at the residential property line from industrial, commercial, public service, or community service facilities. For continuous noise sources, the protective level is 65 dBA during the day and 50 dBA during the night at the residential property line (NJAC 7:29-TN2732). The similar Delaware limits (7 Del Admin. C. § 1149-TN3001) provide for a protective level of 65 dBA during the day and 55 dBA during the night for residential receptors.

PSEG states that activities associated with construction of a new nuclear power plant at the PSEG Site would involve equipment producing peak noise levels of 102 dBA at 50 ft (PSEG 2014-TN3452). As illustrated in Table 4-17, noise strongly attenuates with distance. Noise levels for construction equipment typically found during building activities at a nuclear power plant are reduced by 30 dBA over a distance of 1,450 ft. A 10-dBA decrease in noise level is generally perceived as cutting the loudness in half. For context, Tipler and Mosca (Tipler and Mosca 2008-TN1467) list the sound intensity of a quiet office as 50 dBA, normal conversation as 60 dBA, busy traffic as 70 dBA, and a noisy office with machines or an average factory as 80 dBA. Construction noise (at 10 ft) is listed as 110 dBA, and the pain threshold is 120 dBA.

Based on the peak construction noise levels of 102 dBA at 50 ft and the natural attenuation of noise levels over distance, the bounding condition construction noise level would fall below the New Jersey daytime standard (65 dBA) between 3,000 and 4,000 ft from the source (PSEG 2014-TN3452). The closest residences and recreation areas are more than 2 mi from the PSEG Site. Further, noise mitigation could be accomplished by maintaining equipment,

verifying that noise control equipment on vehicles and equipment is in proper working order, and restricting noise- and vibration-generating activities to daylight hours. Occupational exposure would be monitored, and construction personnel would be provided with hearing protection when appropriate.

According to NUREG–1437 (NRC 1996-TN288), noise levels below 60 to 65 dBA are considered to be of small significance. More recently, the impacts of noise were considered in NUREG–0586, Supplement 1 (NRC 2002-TN665). The criterion for assessing the level of significance was not expressed in terms of sound levels but based on the effect of noise on human activities. The criterion in NUREG–0586, Supplement 1, is stated as follows.

> "Noise impacts are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected."

Considering the temporary nature of construction activities and the location and characteristics of the PSEG Site, the review team concludes that noise impacts from preconstruction and construction activities would be SMALL and that no further mitigation beyond the actions identified above would be warranted.

4.8.3 Impacts of Transporting Construction Materials and Construction Personnel to the PSEG Site

This EIS assesses the impact of transporting workers and materials to and from the PSEG Site from three perspectives: socioeconomic impacts, air quality impacts resulting from the dust and particulate matter emitted by vehicle traffic, and potential health impacts caused by additional traffic-related accidents. The socioeconomic impacts are addressed in Section 4.4, and the air quality impacts are addressed in Section 4.7. The human health impacts are addressed in this section and in Section 4.9. The assumptions that were made to determine reasonable estimates of nonradiological impacts from transportation during construction are discussed below.

To develop representative commuter traffic impacts, traffic accident, injury, and fatality rates for New Jersey, data were obtained from the New Jersey Department of Transportation (NJDOT 2012-TN2430) and the U.S. Department of Transportation, National Highway Traffic Safety Administration (NHTSA 2012-TN2429), for the years 2006 to 2010. The New Jersey traffic statistics indicate there are 3.63 accidents, 0.88 injuries, and 0.77 fatalities per 100 million vehicle miles (NJDOT 2012-TN2430). The estimated impacts of transporting construction workers to and from the PSEG Site are shown in Table 4-19. The total annual traffic fatalities during construction are estimated to be less than 0.21. There may be 0.24 injuries from traffic accidents associated with transport of the construction workforce. The addition of vehicles associated with personnel performing construction activities at a new nuclear power plant at the PSEG Site is expected to result in a minimal increase relative to the current traffic accident

injury risk in the area surrounding the PSEG Site. The implementation of mitigation measures identified in Section 4.4 would reduce the potential for traffic accidents in the area surrounding the PSEG Site.

Table 4-19. Nonradiological Impacts of Transporting Construction Workers to and from the PSEG Site

Type of Worker	Accidents per Year	Injuries per Year	Fatalities per Year
Construction	0.99	0.24	0.21

Traffic associated with the construction workforce traveling to and from the PSEG Site would also generate noise. The construction workforce would work in shifts, with the largest shift working during the day. Smaller shifts would work in the evening and night. Because of this, the increase in noise relative to background conditions would likely be most noticeable during shift changes in the morning and late afternoon. Posted speed limits, traffic control, and administrative measures such as staggered shift hours would be used to reduce traffic noise during weekday business hours. Potential noise impacts to the community would be intermittent and limited primarily to shift changes. Therefore, human health impacts from noise would be minimal.

Large components and equipment would be transported by barge and delivered to a barge unloading facility constructed at the PSEG Site. Construction of this unloading facility would not result in impacts to the public as its location is in an access-restricted area of the PSEG Site (PSEG 2014-TN3452). Also, a concrete batch plant would be located on the PSEG Site during construction, thus further reducing the number of trucks need for transport of materials during construction activities associated with a new nuclear power plant.

The use of barges for transporting large components and equipment to the PSEG Site and the onsite concrete batch plant would reduce the number of trucks needed for construction activities. Based on these factors, the information provided by PSEG, and the review team's independent evaluation, the review team concludes that impacts of transporting building materials and personnel to a new nuclear power plant at the PSEG Site during preconstruction and construction activities would have minimal nonradiological health impacts. The NRC staff also concludes that no further mitigation measures beyond those proposed by PSEG would be warranted.

4.8.4 Summary of Nonradiological Health Impacts

The review team evaluated the mitigation measures identified in the PSEG ER (PSEG 2014-TN3452) and the permits and authorizations required by State and local agencies to build a new nuclear power plant at the PSEG Site. The review team also evaluated impacts on public health and on construction workers from fugitive dust, occupational injuries, noise, and the transport of materials and personnel to the PSEG Site. No significant impacts related to the nonradiological health of staff or personnel were identified during the course of this review.

On the basis of information provided in the PSEG ER and the review team's independent evaluation, the review team concludes that nonradiological health impacts from noise, air quality, and occupational injuries from preconstruction- and construction-related activities for a new nuclear power plant would be minimal. Use of the proposed causeway for construction traffic, implementation of proposed improvements to roads, and installation of traffic signals and improved traffic patterns would reduce transportation impacts associated with building-related activities. On the basis of the above analysis, the review team concludes that the impacts on nonradiological health would be SMALL, and no further mitigation would be warranted.

4.9 Radiation Health Impacts

Potential sources of radiation exposure for construction workers during the site preparation and construction phases of building a new nuclear power plant at the PSEG Site would include direct radiation; liquid radioactive waste discharges; and gaseous radioactive effluents from the first new nuclear unit (if a multiunit design, such as the AP1000, is selected), SGS Units 1 and 2, and HCGS Unit 1. For the purposes of this discussion, construction and site preparation workers are assumed to be members of the public. Therefore, the dose estimates are compared to the dose limits for the public, pursuant to 10 CFR 20 (10 CFR 20-TN283), Subpart D.

4.9.1 Direct Radiation Exposures

In the ER (PSEG 2014-TN3452), PSEG identified three sources of direct radiation exposure from the site: (1) casks loaded into the onsite independent spent fuel storage installation (ISFSI), (2) SGS Units 1 and 2 and HCGS Unit 1, and (3) the first AP1000 unit (if an AP1000 design is chosen). The first AP1000 unit would be placed in service during construction of the second AP1000 unit, so direct radiation from the first unit must be considered.

PSEG used fence line thermoluminescent dosimeters (TLDs) and environmental TLDs to measure direct radiation levels at locations in and around the protected area. Direct radiation dose measurements from SGS and HCGS were taken at the north TLD station (1S1) with an average monthly reading of 4.77 mrem resulting in an equivalent annual dose of 57.2 mrem (PSEG 2014-TN3452). This is comparable to the preoperational dose of 55 mrem per year. Assuming continuous occupancy would result in an annual direct radiation dose from SGS and HCGS of approximately 2.2 mrem. Based on a 2,400-hour work year for a construction worker, PSEG calculated this direct radiation pathway would provide for an annual construction worker dose of about 0.6 mrem (PSEG 2014-TN3452).

Direct radiation exposure from the ISFSI was calculated by PSEG using the Monte Carlo N-Particle computer code, considering a conservative scenario with the ISFSI fully loaded with 200 HI-STORM 100S Version B (Model 100S-218) storage casks (PSEG 2014-TN3452). Doses were determined at distances of 10 and 25 m north of the ISFSI pad (PSEG 2014-TN3452). Direct radiation doses from the ISFSI are monitored and minimized by administrative controls such as cask loading procedures that maximize shielding and physical barriers such as a fence to establish a standoff distance that minimizes construction worker dose to remain within regulatory limits. Administrative controls for loading the ISFSI limit doses from exceeding

100 mrem per year at the ISFSI fence, 10 m north of the ISFSI pad. Based on this dose limit, doses for construction workers were adjusted for the 25 m location (PSEG 2014-TN3452). As provided in ER Table 4.5-8, the annual worker dose from the ISFSI was estimated to be 10.3 mrem (PSEG 2014-TN3452).

If a dual-unit AP1000 is selected for the PSEG Site, one unit would be placed in service while construction workers were working on the second unit. PSEG calculated the direct radiation doses for construction workers at the second AP1000 using the distance of 800 ft from the first AP1000 *containment* centerline (the expected minimum distance between containment building centerlines). The shield building wall and compartment shield walls for the reactor vessel and steam generators would reduce the radiation levels outside of the shield building to less than 0.25 mrem per hour according to the AP1000 Design Certification Document (DCD) (Westinghouse 2011-TN261). The AP1000 DCD also provides a nominal distance of 72.5 ft between the outside surface of the shield building wall and the building's centerline (Westinghouse 2011-TN261). PSEG applied an inverse square distance model to the AP1000 DCD dose rate to determine the dose rate at 800 ft from the first containment building centerline along with an adjustment for the estimated 2,400-hour work year for a construction worker. The resulting annual construction worker dose was estimated by PSEG to be about 4.9 mrem (PSEG 2014-TN3452).

In addition, at certain times during construction, PSEG would receive, possess, and use specific radioactive byproduct, source, and special nuclear material in support of construction and preparations for operation. These sources of low-level radiation are required to be controlled by the applicant's radiation protection program, with physical protections if necessary, and have very specific uses under controlled conditions. Therefore, these sources are expected to result in a negligible contribution to construction worker doses.

4.9.2 Radiation Exposures from Gaseous Effluents

Gaseous radioactive effluents from SGS Units 1 and 2 are released at a plant vent receiving discharges from the waste gas holdup system, condenser evacuation system, containment purge and pressure/vacuum relief vents, and auxiliary building ventilation. Gaseous radioactive effluents from HCGS are released at the north plant vent and the south plant vent. A small amount of gaseous radioactive effluents is also released from the filtration, recirculation, and ventilation system vent during testing periods.

Gaseous radioactive releases are reported to the NRC annually. The gaseous activity emitted from HCGS and SGS Units 1 and 2 are shown in Tables 1A and 1C of the *PSEG Nuclear LLC 2008 Annual Radioactive Effluent Release Report for the Salem and Hope Creek Generating Stations* (PSEG 2009-TN2730). This year was selected by PSEG as being an acceptable basis for estimating the normal effluent releases during construction due to, in part, the operating record of the HCGS and SGS units that year (PSEG 2014-TN3452). Using the 2008 gaseous effluent data and the methods in the PSEG *Offsite Dose Calculation Manual* (PSEG 2010-TN2741), the estimated dose from the 2008 gaseous effluents (submersion in cloud, inhalation, and deposition) from SGS and HCGS was determined by PSEG to be less than 0.01 mrem (PSEG 2014-TN3452).

For the case of two AP1000 units, the first AP1000 unit would be placed in service during construction of the second AP1000 unit, so gaseous effluents must be considered. The estimated air doses are based on a postulated DCD atmospheric dispersion factor (χ/Q). The doses were altered for site-specific conditions by multiplying them by the ratio of the site-specific dispersion factor to the DCD dispersion factor. By applying a χ/Q of 1.6×10^{-5} s/m^3 (Westinghouse 2011-TN261), and the hours in a work year (2,400 hours), PSEG calculated the annual construction worker dose for gaseous effluents from the first AP1000 to be about 2.67 mrem (PSEG 2014-TN3452).

4.9.3 Radiation Exposures from Liquid Effluents

Liquid radioactive effluents discharged to the Delaware River were evaluated for their contribution to TEDE to construction workers. The principal exposure pathways are fish ingestion, boating, swimming, and shoreline use on and near the Delaware River. There are no dose contributions from drinking water because the brackish water of the Delaware River near the PSEG Site is not potable. As done for the gaseous effluents, PSEG obtained doses from liquid effluents from the *PSEG Nuclear LLC 2008 Annual Radioactive Effluent Release Report for the Salem and Hope Creek Generating Stations* (PSEG 2009-TN2730). Using the 2008 liquid effluent data (PSEG 2009-TN2730) and the methods in the *Offsite Dose Calculation Manual* (PSEG 2010-TN2741), the estimated annual construction worker whole body dose from liquid effluents of HCGS and SGS was estimated to be less than 0.01 mrem (PSEG 2014-TN3452). For the case of two AP1000 units, PSEG applied the same dose from this pathway as members of the public from liquid effluents from the first AP1000 unit. By assuming construction workers would have the same recreational and consumption patterns, PSEG estimated an annual dose of about 0.19 mrem (PSEG 2014-TN3452).

4.9.4 Total Dose to Site Preparation Workers

PSEG estimated maximum annual TEDE to a construction worker to be about 18.7 mrem based on a 2,400-hour work year (PSEG 2014-TN3452). This is the sum of seven sources: (1) SGS and HCGS direct sources, (2) ISFSI direct sources, (3) AP1000 direct sources, (4) SGS and HCGS gaseous effluents, (5) AP1000 gaseous effluents, (6) SGS and HCGS liquid effluents, and (7) AP1000 liquid effluents (PSEG 2014-TN3452). This estimate is well within the dose limit to an individual member of the public (100 mrem in a year) found in 10 CFR 20.1301 (10 CFR 20-TN283). The maximum estimated annual collective dose to site preparation workers, based on an annual individual dose of about 18.7 mrem and an estimated maximum workforce of 4,100, would be about 77 person-rem (PSEG 2014-TN3452).

4.9.5 Summary of Radiological Health Impacts

The NRC staff concludes that the estimates of doses to construction workers during site preparation and construction activities are well within the NRC annual exposure limits (i.e., 100 mrem) designed to protect the public health. Based on information provided by PSEG and the NRC staff's independent evaluation, the NRC staff concludes that the radiological health impacts to construction workers engaged in building activities related to a new nuclear power plant at the PSEG Site would be SMALL, and no further mitigation would be warranted.

4.10 Nonradioactive Waste Impacts

This section describes the environmental impacts that could result from the generation, handling, and disposal of nonradioactive waste during building activities for a new nuclear power plant at the PSEG Site. The types of nonradioactive waste that would be generated, handled, and disposed of during building activities would include construction debris, municipal waste, excavation spoils, and sanitary waste. The potential impacts resulting from these types of wastes are assessed in the following sections.

4.10.1 Impacts to Land

Building activities related to a new nuclear power plant would generate wastes such as construction debris and spoils (i.e., earthen debris, including soil and rock). These materials would be sorted at the PSEG Site, with the majority reclaimed as recyclable or reusable material and the remainder disposed of in appropriate landfills. Furthermore, PSEG currently implements a successful waste minimization plan for SGS and HCGS and proposes to apply this plan to building activities for a new nuclear power plant at the PSEG Site (PSEG 2012-TN2458).

PSEG would not allow open burning on the site of refuse, garbage, or any other waste material. The solid waste would be taken to the nearest suitable landfill for disposal (PSEG 2014-TN3452). Hazardous and nonhazardous solid wastes would be managed according to county and State handling and transportation regulations. Consistent with current PSEG practice, solid wastes would be reused or recycled to the extent possible. Wastes appropriate for recycling or reclamation (e.g., used oil, antifreeze, scrap metal, universal wastes) would be managed using approved, licensed contractors. Nonradioactive solid waste destined for offsite landfill disposal would be handled according to county, State, and Federal regulations and disposed of at approved, licensed offsite commercial waste disposal sites. County and State permits and regulations for the handling and disposal of solids would be obtained and implemented. The review team expects that solid waste impacts would be minimal and that additional mitigation would not be warranted.

Based on the waste management and minimization program already in place for HCGS and SGS and PSEG plans to manage solid and liquid wastes for a new nuclear power plant in a similar manner and in accordance with all applicable Federal, State, and local requirements and standards, the review team expects that impacts to land from nonradioactive wastes generated during building would be minimal and that no further mitigation would be warranted.

4.10.2 Impacts to Water

Surface-water runoff from site development activities for a new nuclear power plant at the PSEG Site would be controlled and managed according to existing water and wastewater treatment procedures at SGS and HCGS (PSEG 2014-TN3452). PSEG currently maintains engineering and procedural controls that prevent or minimize the release of harmful levels of wastewater constituents to the Delaware River watershed consistent with Federal, State and local requirements, including those of the Delaware River Basin Commission (DRBC) related to

surface-water regulations (72 FR 46931-TN2736). There would be an increase in the generation of sanitary wastewater, but discharges from a new nuclear power plant are expected to be minor and would not warrant mitigation given the small volume of these constituents, the capacity of the existing wastewater treatment system, the large volume of the receiving water body (the Delaware River), and the regular tidal mixing that occurs within the Delaware River adjacent to and downstream of the PSEG Site.

Chemical treatment of the safety-related cooling water system of a new nuclear power plant at the PSEG Site with biocides, dispersants, molluskicides, and scale inhibitors would be required on a periodic basis. These chemicals are subject to review and approval for use by NJDEP, and wastewater discharges to surface water would comply with the NJPDES permit. The total residual chemical concentrations in the discharges to the Delaware River watershed are subject to limits established by NJDEP that are deemed protective of the water quality of the Delaware River (PSEG 2014-TN3452).

Stormwater discharges associated with building activities for a new nuclear power plant would require an NJPDES permit (PSEG 2014-TN3452). PSEG states that in addition to the application for the NJPDES permit, it would implement an SWPPP designed to prevent the discharge of harmful quantities of pollutants with stormwater discharge. The SWPPP would follow EPA guidance (EPA 1992-TN3300) and the current version of New Jersey Stormwater Best Management Practices (NJDEP 2009-TN3221). This SWPPP would incorporate drainage from all areas and facilities associated with building a new nuclear power plant at the PSEG Site and would be consistent with the existing SWPPPs at HCGS and SGS (PSEG 2014-TN3452).

Based on the existing regulated practices for managing liquid discharges for HCGS and SGS by PSEG, including sanitary wastewater, and the plans for managing stormwater, the review team expects that impacts to water from nonradioactive effluents when building a new nuclear power plant at the PSEG Site would be minimal, and additional mitigation would not be warranted.

4.10.3 Impacts to Air

As discussed in Sections 4.4.1.1 and 4.7.1, PSEG would need to manage fugitive dust generated during preconstruction and construction activities. PSEG would use air quality protection procedures to minimize the generation of fugitive dust and the release of emissions from equipment and vehicles and comply with local permits from the NJDEP Division of Air Quality and the Delaware Department of Natural Resources and Environmental Control (Division of Air and Waste Management) for control of fugitive dust.

The construction environmental controls would include managing the use of unpaved roads (speed limits, use of dust suppression, and minimization of dirt tracking onto paved roads); covering haul trucks; phasing grading activities to minimize the exposed amount of disturbed soils; stabilizing roads and excavated areas with coarse material covers or vegetation; and performing proper maintenance of vehicles, generators, and other equipment.

Based on the regulated practices for managing air emissions from construction equipment and temporary stationary sources, BMPs for controlling fugitive dust, and vehicle inspection and traffic management plans, the review team expects that impacts to air from nonradioactive

emissions while building a new nuclear power plant at the PSEG Site would be minimal. As discussed in Section 4.7, additional mitigation may be warranted, depending on the outcome of conformity applicability analyses being performed by the NRC and the USACE pursuant to the Clean Air Act Section 176 (42 USC 7401-TN1141) and 40 CFR 93, Subpart B (40 CFR 93-TN2495).

4.10.4 Summary of Impacts

Solid, liquid, and gaseous wastes generated when building a new nuclear power plant at the PSEG Site would be managed by following the practices currently used by PSEG during the operation of HCGS and SGS and would be in compliance with county, State, and Federal regulations. County and State permits and regulations for handling and disposal of solid and liquid waste would ensure compliance with the CWA (33 USC 1251-TN662), NJDEP limits and requirements, and DRBC water-quality standards. Solid waste would be recycled or disposed of in existing, permitted landfills. Sanitary wastes would be treated on the site and discharged locally after being treated to the levels stipulated in the NJPDES permit. An SWPPP would specify the mitigation measures to be put in place to manage stormwater runoff. To avoid any noticeable offsite air quality impacts, the use of BMPs to control dust and minimize vehicle emissions would be expected.

Based on information provided by PSEG and the review team's independent evaluation, the review team concludes that nonradioactive waste impacts on land, water, and air from building activities associated with a new nuclear power plant at the PSEG Site would be SMALL and that additional mitigation would not be warranted.

4.11 Measures and Controls to Limit Adverse Impacts During Construction Activities

In its evaluation of environmental impacts during building activities for a new nuclear power plant at the PSEG Site, the review team considered PSEG's stated intention to comply with the following measures and controls that would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts (e.g., solid waste management, erosion and sediment control, air emissions control, noise control, stormwater management, discharge prevention and response, hazardous material management);

- compliance with applicable requirements of permits or licenses required for construction of a new nuclear power plant at the PSEG Site (e.g., Department of the Army Section 404 Permit, NPDES permit);

- compliance with existing PSEG processes and/or procedures applicable for environmental compliance activities during construction and preconstruction at the PSEG Site (e.g., solid waste management, hazardous waste management, and discharge prevention and response);

- incorporation of environmental requirements into construction contracts; and
- identification of environmental resources and potential impacts during the ESP process and the development of revisions to the PSEG ER.

Examples of PSEG's stated measures to minimize impacts and protect the environment include the following:

- using BMPs for construction and preconstruction activities;
- implementing plans to manage stormwater and to prevent and appropriately address accidental spills;
- managing and/or restoring wetlands and marsh creek channels; and
- adhering to Federal, State, and local permitting requirements.

The review team considered these measures and controls in its evaluation of the impacts of building a new nuclear power plant at the PSEG Site. Table 4-20, which is based on Table 4.6-1 in the ER (PSEG 2014-TN3452) and other information provided by the applicant, summarizes the measures and controls to limit adverse impacts when building a new nuclear power plant. Some measures apply to more than one impact category.

Table 4-20. Measures and Controls to Limit Adverse Impacts when Building a New Nuclear Power Plant at the PSEG Site

Resource Area	Specific Measures and Controls
Land-Use Impacts	
—The Site and Vicinity	• Use of stormwater management plans to control erosion and runoff • Return of lands to former use upon completion of construction • Offset loss of wetland use and function by mitigation • Allow wetland areas to return to former use upon completion of construction • Limit ground disturbances to the smallest amount of area necessary to construct and maintain the plant • Perform ground-disturbing activities in accordance with regulatory and permit requirements; use adequate best management practices (BMPs) erosion control measures to minimize impacts • Minimize potential spills of chemicals and petroleum materials through training, spill prevention plans, and rigorous compliance with applicable regulations and procedures • Restrict soil stockpiling and reuse to designated areas

Table 4-20 (continued)

Resource Area	Specific Measures and Controls
—Causeway and Pipeline Corridors	• Use BMPs and stormwater management plans to control erosion and runoff, minimize clearing, minimize effects on human populations, wetlands, water bodies, archaeological and historic sites, vegetation, and wildlife • Site the new corridors to avoid impact on critical or sensitive habitats/species and to minimize work in wetlands and floodplains • Limit ground-disturbing activities such as vegetation removal to defined corridors • Minimize potential spills of hazardous wastes/materials through training and rigorous compliance with applicable regulations
Water-Related Impacts	
—Hydrological Alterations	• Minimize sizes of cleared areas and use BMPs and design features to control erosion and to minimize and stabilize affected areas, including areas where shoreline modifications and dredging occur • Reconnect isolated marsh creek channels and restore marsh creek channels as part of wetland mitigation program implementation • Use stormwater management plan to control erosion and runoff; grading design to manage runoff for controlled discharge to Delaware River • Construct causeway as an elevated structure • Limit extent of dewatering to only that necessary to proceed with construction • Develop and implement a formal stormwater pollution prevention plan (SWPPP) and erosion-control plan to define specific stormwater control measures during construction activities • Reconnect isolated marsh creek channels by development of supplemental connecting channels
—Water Use and Quality	• Use BMPs and stormwater management plans to control erosion and runoff • Design and implement site grading to manage runoff for controlled discharge to Delaware River • Follow New Jersey Pollution Discharge Elimination System (NJPDES) permit requirements to minimize discharge impacts to receiving waters • Use cofferdams and/or silt curtains to limit mixing and transport of suspended sediments • Dispose of dredged materials in approved upland areas • Implement spill prevention control plans; limit construction to shallow aquifers to avoid adverse effects on deeper aquifers used for potable water; use secondary containments to prevent and control spills • Obtain potable water from a local municipality, and send wastewater to be treated by a local municipality so as not to affect onsite groundwater resources

Table 4-20 (continued)

Resource Area	Specific Measures and Controls
Ecological Impacts	
—Terrestrial Ecosystems	• Obtain a Department of the Army permit and comply with requirements to avoid, minimize, restore, and/or compensate impacts on wetlands, including development of a mitigation action plan • Maintain ongoing efforts to avoid and minimize impacts to wetlands as part of design and permitting process • Phase the building activities to minimize the duration of soil exposure and implement soil stabilization measures as quickly as possible after disturbance to minimize erosion and sedimentation • Conduct consultations with State and Federal agencies to minimize potential unavoidable impacts to listed species as part of offsite proposed causeway development • Limit clearing to the smallest amount of area necessary to construct the plant and the causeway • Use established (SWPPP) procedures for minimizing erosion or sediment deposition on terrestrial habitat • Confine vehicles to roadways and authorized stream crossings
—Aquatic Ecosystems	• Obtain and comply with Department of the Army permit and State 401 water-quality certification requirements to avoid and minimize impacts on aquatic resources from dredging and in-water installation activities • Comply with applicable NJPDES permit requirements for stormwater discharge • Use BMPs to minimize erosion and sedimentation based on New Jersey SWPPP requirements • Use cofferdams and/or silt curtains to limit mixing and transport of suspended sediments • Maintain ongoing efforts to avoid and minimize impacts to aquatic ecosystems as part of design and permitting process
Socioeconomic Impacts	
—Physical Impacts	• Manage major high noise construction activities to limit and minimize noise impacts to residences in the vicinity • Use BMPs for controlling fugitive dust and proper maintenance of construction equipment for controlling emissions • Train and appropriately protect employees and construction workers to reduce the risk of potential exposure to noise, dust, and exhaust emissions • To the extent possible, recycle construction wastes with remaining waste disposed in approved landfills • Stabilize cleared areas, minimize disturbance and visual intrusion, and remove construction debris in timely manner • Install traffic controls and additional turning capacity to mitigate traffic delays; construction workforce will work in three shifts to spread additional construction traffic volume over a 24-hr period • Provide onsite services for emergency first aid, and conduct regular health and safety monitoring • Establish procedures and perform audits to ensure that all waste is disposed of according to applicable regulations such as the Resource Conservation and Recovery Act (42 USC 6901-TN1281)

1 **Table 4-20 (continued)**

Resource Area	Specific Measures and Controls
—Socioeconomic Impacts	• Install traffic controls and additional turning capacity to mitigate traffic delays in and around Salem City • Implement three shifts for construction workforce to spread additional construction traffic volume over a 24-hr period • Stagger shifts, encourage carpooling, and time deliveries to avoid shift change or commute times • Erect signs alerting drivers of construction and potential for increased construction traffic • Use procedures and employee training program to reduce potential for traffic accidents
Environmental Justice	• No mitigating measures or controls required beyond those identified above
Historic Properties and Cultural Resources	• Conduct Phase II survey and consult with the New Jersey State Historic Preservation Office (SHPO) to define mitigation requirements, as appropriate, for construction of the causeway • Consult with New Jersey SHPO if a cultural resource is discovered during construction activities • Follow established procedures to halt work if a potential unanticipated historic, cultural, or paleontological resource is discovered
Air Quality	• Use dust control measures (e.g., surface watering, stabilizing disturbed areas and spoils areas, covering trucks) • Maintain operational effectiveness of pollution control devices installed on construction vehicles and emissions-generating equipment
Nonradiological Health	• Adhere to all Occupational Safety and Health Administration and State safety standards, practices, and procedures during building activities; provide regular training for site workers and visitors • Implement site-wide safety and medical program, including safety policies, safe work practices, and general and topic-specific training
Radiation Exposure to Construction Workers	• Ensure compliance with all Federal and State regulatory requirements pertaining to the radiation protection program (e.g., 10 CFR 20-TN283)
Nonradioactive Waste	• Handle waste generated during building in accordance with local, State, and Federal requirements • Use existing landfills • Implement a waste-minimization plan, including beneficial reuse and recycling of building debris • Implement both an SWPPP as required by the NJPDES permit and an SPCCP to reduce impacts from site runoff and spills • Implement operational controls (BMPs) to minimize fugitive dust emissions; implement traffic plans to reduce emissions from vehicles; regularly maintain emissions-generating equipment and operate in accordance with State air quality regulations

Source: Adapted from Table 4.6-1 in the PSEG Environmental Report (PSEG 2014-TN3452).

4.12 Summary of Preconstruction and Construction Impacts

The impact category levels determined by the review team in the previous sections are summarized in Table 4-21. The impact category levels for the NRC-authorized construction discussed in this chapter are denoted in the table as SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. Impact levels for the combined construction and preconstruction activities are similarly noted. Some impacts, such as the addition of tax revenue from a new nuclear power plant at the PSEG Site to the local economies, are likely to be beneficial and are noted as such in the "Impact Level" columns.

Table 4-21. Summary of Impacts from Building a New Nuclear Power Plant at the PSEG Site

Resource Area	Comments	Impact Category Levels for the NRC-Authorized Construction	Impact Category Levels for Construction and Preconstruction
Land-Use Impacts			
Site and Vicinity	Much of the land disturbance associated with building a new nuclear power plant on the PSEG Site (205 ac of a total of 431 ac) would be temporary, and the land would return to its existing use (primarily degraded wetlands, old field habitat, and developed areas) once building activities were completed. However, most of the permanent land disturbance (108 ac of a total of 225 ac) would occur on wetlands, most of which (52 ac) are in the parcel that PSEG would acquire from the USACE. Land-use impacts on this 85-ac parcel would be somewhat larger than those on the existing PSEG property because it supports the USACE dredging operations as part of the Artificial Island Confined Disposal Facility (CDF). The USACE would need to replace some or all of this disposal capacity by using an existing CDF or developing a new CDF at another location. Combined, the change in land use of 108 ac from wetlands to developed and industrial uses and the USACE loss of dredge spoil disposal capacity at the Artificial Island CDF would alter noticeably, but not destabilize, existing land uses on the PSEG Site.	MODERATE	MODERATE
Offsite (the Proposed Causeway)	Some of the land disturbance associated with building the causeway (23.5 ac of a total of 69.0 ac) would be temporary, and the land would return to its existing use (primarily degraded wetlands) once the causeway were completed. However, most of the land disturbance (45.5 ac of a total of 69.0 ac) would be permanent and would have a noticeable impact because it would occur on undeveloped wetlands protected under Deeds of Conservation Restriction (DCRs) within the Alloway Creek Watershed Wetland Restoration site, the Abbott's Meadow Wildlife Management Area (WMA), and the Mad Horse Creek WMA. Releasing these lands from the existing DCRs would	N/A	MODERATE

Table 4-21 (continued)

Resource Area	Comments	Impact Category Levels for the NRC-Authorized Construction	Impact Category Levels for Construction and Preconstruction
	require the New Jersey Department of Environmental Protection (NJDEP) to take various procedural actions and, for the WMAs, would require that PSEG provide compensatory land elsewhere. The change in land use of 45.5 ac from wetlands to developed lands in these protected areas would alter noticeably, but not destabilize, existing land uses along the causeway route.		
Water-Related Impacts			
—Water Use			
Surface Water	The brackish nature of the Delaware River near the PSEG Site makes the use of surface water undesirable during building, so water from the Delaware River and tidal creeks and marshes would not be used. Small amounts of water from stormwater retention ponds may be used for dust suppression during building of a new nuclear power plant. Because the amount of water used from these retention ponds would be relatively small, the effects on surface-water resources would be minor.	SMALL	SMALL
Groundwater	Water for building a new nuclear power plant at the PSEG Site would be obtained from wells used for the existing Hope Creek Generating Station (HCGS) and Salem Generating Station (SGS). Potential effects of groundwater withdrawal during preconstruction and construction could result from two activities: (1) dewatering to facilitate power block construction and (2) preconstruction and construction support (including concrete batch plant supply and dust suppression). Based on the maximum permitted withdrawal for the existing wells, the sufficiency of the excess capacity at the existing wells, and the historic modeling efforts conducted in support of water allocation permits, groundwater-use impacts to support preconstruction and construction activities would be minor.	SMALL	SMALL

Table 4-21 (continued)

Resource Area	Comments	Impact Category Levels for the NRC-Authorized Construction	Impact Category Levels for Construction and Preconstruction
—Water Quality			
Surface Water	The preconstruction and construction activities that could affect surface water on and near the PSEG Site include clearing vegetation, disturbing the land surface, inadvertent release of contaminants associated with building materials and equipment, building activities in the tidal marsh and tidal stream areas during building of the proposed causeway, and dredging activities in the Delaware River. Because of alteration of the land surface, alteration of surface cover, and changes to drainage patterns, both the quantity and quality of the surface runoff from the site could change and result in impacts to the quality of the surface-water resources near the site. However, because engineering controls (such as site grading, silt fences, and detention basins) would be used during building activities and because permits would require the use of BMPs, building-related impacts would be controlled, localized, temporary, and minor.	SMALL	SMALL
Groundwater	The preconstruction and construction activities that could affect groundwater at or near the PSEG Site include dewatering for power block construction, potential pollutant releases, and discharge of groundwater to adjacent surface water bodies. However, none of the lower potable water aquifers, including the Potomac-Raritan-Magothy that supplies HCGS and SGS potable water, are expected to be affected, so dewatering impacts would be minor. Also, the use of BMPs and NJDEP remediation requirements would prevent chemical impacts to groundwater quality.	SMALL	SMALL

Table 4-21 (continued)

Resource Area	Comments	Impact Category Levels for the NRC-Authorized Construction	Impact Category Levels for Construction and Preconstruction
Ecological Impacts			
—Terrestrial and Wetland Resources			
	Loss or disturbance of wetland habitat associated with building a new nuclear power plant on the PSEG Site would have a noticeable effect. However, the impacts would not be expected to destabilize important attributes of wetland resources. Proposed compensatory actions could offset some of the impacts.	MODERATE	MODERATE
—Aquatic Resources			
	Potential impacts on aquatic resources as a result of building activities would be temporary, localized, and minor but would involve some physical alteration of habitat (e.g., infilling, cofferdam placement, dredging, pile driving) including temporary or permanent removal of associated benthic organisms, sedimentation, changes in hydrological regimes, and changes in water quality.	SMALL	SMALL
Socioeconomic Impacts			
Physical Impacts	The physical impacts of building-related activities on workers and the local public, buildings, and roads would be minor. However, vehicular traffic for construction worker commuting and building-related deliveries may have MODERATE impacts on local roadways, and the addition of two new cooling towers and two new reactor domes at the PSEG Site, and an elevated causeway to the PSEG Site, would noticeably affect the aesthetic qualities from sensitive viewpoints in New Castle County, Delaware, and Salem County, New Jersey. These impacts would not be amenable to mitigation.	SMALL to MODERATE	SMALL to MODERATE

Table 4-21 (continued)

Resource Area	Comments	Impact Category Levels for the NRC-Authorized Construction	Impact Category Levels for Construction and Preconstruction
Demography	The in-migration of workers and their families to support building a new nuclear power plant would increase the population of the economic impact area by about one-sixth of one percent. The increase would be most pronounced in Salem County, New Jersey, which would experience about a 1.24 percent increase in population. These levels of population increase would be minor for the economic impact area or any of its counties.	SMALL	SMALL
Taxes and Economic Impacts	The economic and tax impacts would be SMALL and beneficial for the region and the economic impact area, with the exception of MODERATE and beneficial economic impacts in Salem County. The increased benefits to Salem County are from the hiring of unemployed direct and indirect workers and from PSEG's spending on supplies and materials at local shops and vendors. Tax revenue to local jurisdictions would accrue through personal income, sales, and property taxes.	SMALL (beneficial to the region) to MODERATE (beneficial for Salem County)	SMALL (beneficial to the region) to MODERATE (beneficial for Salem County)
Infrastructure and Community Services	The building-related impacts to all infrastructure and community services would be SMALL for the region and the economic impact area, with the exception of traffic and recreational impacts near the PSEG Site. MODERATE, temporary, adverse impacts on traffic would be experienced on local roadways near the site. MODERATE adverse impacts to local recreational resources would be expected due to impacts on view sheds and noticeable traffic impacts.	SMALL (for all categories except traffic and recreation) to MODERATE (for traffic and recreation)	SMALL (for all categories except traffic and recreation) to MODERATE (for traffic and recreation)
Environmental Justice Impacts	No potential environmental pathways were identified by which the minority or low-income populations in the 50-mi region and economic impact area would likely experience disproportionately high and adverse human health, environmental, physical, or socioeconomic effects as a result of building activities.	none	none

Table 4-21 (continued)

Resource Area	Comments	Impact Category Levels for the NRC-Authorized Construction	Impact Category Levels for Construction and Preconstruction
Historic and Cultural Resource Impacts	The USACE consultation with the New Jersey State Historic Preservation Office (SHPO) and Native American tribes continues. The NRC has completed consultation with the Delaware and New Jersey SHPOs. No archaeological sites are present on Artificial Island, and no visual effects to historic properties are anticipated from building activities at the PSEG Site. No traditional cultural properties have been identified in the vicinity of the PSEG Site.	SMALL	SMALL
Air Quality Impacts	PSEG would develop and implement emission-specific strategies and measures to ensure compliance with the applicable regulatory limits defined by the National Primary and Secondary Ambient Air Quality Standards (40 CFR 50-TN1089) and the National Emission Standards for Hazardous Air Pollutants (40 CFR 63-TN1403). Also, PSEG would implement a dust control program to minimize fugitive dust emissions. Potential impacts to air quality associated with criteria pollutants and greenhouse gas emissions during preconstruction and construction activities would be minimal.	SMALL	SMALL
Nonradiological Health Impacts	Potential nonradiological health impacts from construction and preconstruction activities would include impacts on public health and on construction workers from fugitive dust, occupational injuries, noise, and the transport of materials and personnel to the PSEG Site. Nonradiological health impacts to the public and workers from noise, air quality, and transportation activities resulting from preconstruction- and construction-related activities for a new nuclear power plant would be minimal. Use of the proposed causeway for construction traffic and implementation of proposed improvements to roads and traffic patterns would reduce potential impacts.	SMALL	SMALL

Table 4-21 (continued)

Resource Area	Comments	Impact Category Levels for the NRC-Authorized Construction	Impact Category Levels for Construction and Preconstruction
Radiological Health Impacts	Doses to site preparation workers would be within the NRC exposure limits designed to protect the public health (i.e., 100 mrem), even if workers exceeded the 2,080 hr/yr occupancy factor. Thus, the impacts of radiological exposures to site preparation workers would be small.	SMALL	SMALL
Nonradiological Waste Impacts	Solid, liquid, and gaseous wastes generated when building a new nuclear power plant at the PSEG Site would be managed following the existing practices currently used at HCGS and SGS and would be in compliance with county, State, and Federal regulations. County and State permits and regulations for handling and disposal of solid and liquid waste would ensure compliance with the Clean Water Act (33 USC 1251-TN662), NJDEP, and Delaware River Basin Commission water-quality standards. Solid waste would be recycled or disposed of in existing, permitted landfills. Sanitary wastes would be treated on the site and discharged locally after being treated to the levels stipulated in the New Jersey Pollutant Discharge Elimination System permit. A stormwater pollution prevention plan would specify the mitigation measures to be put in place to manage stormwater runoff. Overall, the impacts of nonradiological wastes generated during preconstruction and construction would be minor.	SMALL	SMALL

5.0 OPERATIONAL IMPACTS AT THE PROPOSED SITE

This chapter examines environmental issues associated with operating a new nuclear power plant at the PSEG Power, LLC and PSEG Nuclear, LLC (PSEG) Site as described by the applicant, PSEG. As part of its application for an Early Site Permit (ESP), PSEG submitted an Environmental Report (ER) that discusses the environmental impacts of station operation for an initial 40-year period assuming the future issuance of a combined license (COL) (PSEG 2014-TN3452). In its evaluation of operational impacts, the staffs of the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Army Corps of Engineers (USACE) (hereafter known as the “review team”) relied on operational details supplied by PSEG in its ER and its responses to NRC Requests for Additional Information (RAIs).

This chapter is divided into 13 sections. Sections 5.1 through 5.12 discuss the potential operational impacts on land use, water, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological health effects, radiological health effects, nonradioactive waste, postulated accidents, and applicable measures and controls that would limit the adverse impacts of station operation during an assumed 40-year operating period. Section 5.13 provides a summary of operational impacts.

In accordance with Title 10 of the *Code of Federal Regulations* (CFR) Part 51 (10 CFR 51-TN250), impacts have been analyzed, and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned by the review team to each impact category. In the area of socioeconomics related to taxes, the impacts may be considered beneficial and are stated as such. The review team’s determination of significance levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various state and county governments, such as infrastructure upgrades, would be implemented. Failure to implement these upgrades might result in a change in significance level. Possible mitigation of adverse impacts is also presented, where appropriate. A summary of these impacts is presented in Section 5.13.

5.1 Land-Use Impacts

Sections 5.1.1 and 5.1.2 contain information regarding land-use impacts associated with operating a new nuclear power plant at the PSEG Site. Section 5.1.1 discusses land-use impacts at the site and in the vicinity of the site. Section 5.1.2 discusses land-use impacts at offsite areas, especially the proposed causeway alignment.

5.1.1 The Site and Vicinity

Onsite land-use impacts from operating a new nuclear power plant are expected to be minimal. Of the 430 ac disturbed in building a new plant (excluding the proposed causeway), only 225 ac (27.5 percent of the 819-ac PSEG Site) would be occupied by permanent structures and supporting facilities during operations. Of this 225-ac area, 70 ac would be permanently

disturbed for the power block (PSEG 2014-TN3452). Section 4.1 discusses the land-use impacts of this permanent land disturbance.

Onsite land-use impacts associated with operating a new nuclear power plant would result primarily from the deposition of solids from cooling tower operation (impacts of the heat dissipation system, including deposition, are discussed in Section 5.3). PSEG has stated the cooling towers would be located north of the power block as shown on Figure 2-2. There is the potential for fogging, icing, salt drift, and noise to occur from cooling tower operations (NRC 2013-TN2654). However, a review of the cooling tower operations presented in the PSEG ESP application indicates that land uses would not be noticeably affected (PSEG 2014-TN3452). Adjacent land uses north, west, and east of the proposed cooling tower location are the Artificial Island Confined Disposal Facility (CDF), the Delaware River, and coastal marsh, respectively. There are no residences, farmland, or other developed land uses within 2.8 mi of the PSEG Site, so only minor salt deposition impacts to land uses on the site or in the vicinity are expected (see Section 5.3).

As discussed in Section 4.1.1, operating a new nuclear power plant on the PSEG Site would be consistent with existing land uses at Hope Creek Generating Station (HCGS) and Salem Generating Station (SGS) and with current land use zoning (Industrial) in Lower Alloways Creek Township (LACT 1999-TN2416). Further, the New Jersey Department of Environmental Protection (NJDEP) Division of Land Use Regulation has determined the PSEG ESP application is consistent with New Jersey Rules on Coastal Zone Management (see Section 2.2.1). PSEG has submitted a petition to the State of New Jersey to expand the existing “Heavy Industry–Transportation–Utility Node” on Artificial Island to include the location of a new nuclear power plant (PSEG 2012-TN2282) (see Section 2.2.1).

There are no prime farmlands or farmlands of unique or statewide importance on the PSEG Site, and operating a new nuclear power plant on the site would not affect any such farmlands in the vicinity. Likewise, there are no lands under Deeds of Conservation Restriction (DCR) or Wildlife Management Areas (WMA) on the PSEG Site, and operating a new plant on the site would not affect any of the lands under DCRs or lands in WMAs in the vicinity of the site.

Any indirect offsite land-use changes in the 6-mi vicinity of the PSEG Site incidental to plant operations, such as conversion of land to housing for operations and outage workers, are expected to be minor. The analysis of housing impacts in Section 5.4.4 finds sufficient vacant permanent housing is available to accommodate the projected demand from workers who would operate a new plant. Thus, no substantial offsite land-use impacts in the vicinity are expected due to project employment during operations.

Overall, the land-use impacts of operating a new nuclear power plant on the PSEG Site would be minor and would neither destabilize nor noticeably alter any important attributes of existing land uses on the site or in the vicinity. Therefore, based on the information provided by PSEG and the review team’s independent review, the review team concludes the land-use impacts of operating a new nuclear power plant on the PSEG Site would be SMALL.

5.1.2 Offsite Areas

Offsite land-use impacts from operating a new nuclear power plant are expected to be minimal and primarily associated with the proposed causeway. Of the 69.0 ac disturbed in building the causeway, about 45.5 ac would be permanently affected or occupied by permanent structures (PSEG 2014-TN3452). Section 4.1 discusses the land-use impacts of this permanent land disturbance.

Two land-use related issues associated with the long-term presence of the causeway would result from shading caused by the 50-ft-wide causeway structure and its piers and other support structures and automobile traffic on the causeway. The impacts of shading on surface water and aquatic resources are discussed in Sections 4.2 and 4.3, and the impacts of automobile traffic on water quality, ecological resources, and socioeconomic resources are discussed in Sections 4.3 through 4.5.

Over the operating life of a new plant, periodic maintenance would be required to ensure the causeway is in safe operational condition, including storm drainage features. PSEG has stated that maintenance activities would include repair and maintenance of the roadway surface and catch basins/drainage, lane striping, and periodic management, mowing, and cutting of adjacent vegetation (PSEG 2014-TN3452). The land-use impacts of these maintenance activities are expected to be minimal.

As discussed in Section 4.1.2, the section of the proposed causeway from the PSEG property north to Lower Alloways Creek is zoned for Industrial Use by Lower Alloways Creek Township (LACT 1999-TN2416). However, the section of the causeway from Lower Alloways Creek north to Money Island Road is zoned for Conservation by Elsinboro Township, while the section along Money Island Road is zoned Rural Residential (Elsinboro 2007-TN2417). Thus, the causeway would be consistent with current zoning in Lower Alloways Creek Township, but inconsistent with part of the current zoning (i.e., Conservation) in Elsinboro Township. PSEG could request a zoning variance from Elsinboro Township to operate the proposed causeway in the area zoned for Conservation.

As discussed in Sections 2.2.1 and 4.1.1, the NJDEP Division of Land Use Regulation has determined the PSEG ESP application, including the proposed causeway, is consistent with New Jersey's Rules on Coastal Zone Management. Most of the proposed causeway route (21.0 ac of impact) is protected under DCRs held by the State of New Jersey (PSEG 2012-TN2282). If these DCRs are released for the causeway to be built (see Section 4.1.2), the causeway would not have any adverse impacts on offsite land uses protected under a DCR, including those in the Alloway Creek Watershed Wetland Restoration (ACW) Site and Abbotts Meadow and Mad Horse Creek WMAs.

Overall, the land-use impacts of the proposed causeway during operations at a new nuclear power plant would be minor and would neither destabilize nor noticeably alter any important attributes of existing offsite land uses. Therefore, based on the information provided by PSEG and the review team's independent review, the review team concludes that the offsite land-use impacts of operating a new nuclear power plant would be SMALL.

5.2 Water-Related Impacts

This section discusses water-related impacts to the surrounding environment from operation of a new nuclear power plant at the PSEG Site. The primary water-related impacts would be associated with the cooling water system for a new plant. Details of the operational modes and cooling water systems associated with operation of a new nuclear power plant can be found in Section 3.2.2. Secondary water-related impacts would be associated with groundwater withdrawals for operating a new plant.

Managing water resources requires understanding and balancing the tradeoffs among various, often conflicting, objectives. In the vicinity of the PSEG Site, these objectives include navigation, recreation, visual aesthetics, and a variety of beneficial consumptive water uses. The responsibility for regulating water use and water quality is delegated to NJDEP and the Delaware River Basin Commission (DRBC).

Water-use and water-quality impacts involved with operating a nuclear power plant are similar to the impacts associated with any large thermoelectric power generation facility, and PSEG must obtain the same water-related permits and certifications as these other facilities. Permits and certifications needed would include these.

- Clean Water Act (CWA) Section 401 Certification. This water quality certification would be issued by NJDEP and would ensure that operation of a new nuclear power plant would not conflict with State water-quality management programs. This certification must be obtained before the NRC could issue a COL to PSEG.

- CWA Section 402(p) National Pollutant Discharge Elimination System (NPDES) Discharge Permit. This permit would be issued by NJDEP and would regulate limits of pollutants in liquid discharges to surface water (point source stormwater and wastewater) and construction dewatering. A stormwater pollution prevention plan (SWPPP) would be required.

- CWA Section 404 Permit. This permit would be issued by the USACE and would be required for the discharge of any dredged and/or fill material during operations into waters of the United States.

- CWA Section 316(a). This section regulates the cooling water discharges to protect the health of the aquatic environment. The scope would be covered under the NPDES permit with NJDEP.

- CWA Section 316(b). This section regulates cooling water intake structures to minimize environmental impacts associated with their location, design, construction, and capacity. The scope would be covered under the NPDES permit with NJDEP.

- Section 10 of the Rivers and Harbors Act of 1899 Permit. This permit prohibits obstruction or alteration of navigable waters of the United States and would be issued by the USACE for dredging activities that may be needed during operations.

- Federal Coastal Zone Management Act of 1972 Certification. This concurrence of consistency with the State coastal program's policies would be issued by NJDEP. It applies to any activity that is on land, in water or in any natural resource, or any activity that affects land use, water use, or any natural resource in the coastal zone, if the activity requires a federal license or permit.

- Delaware River Basin Compact, Section 3.8, Resolution No. 71-4. PSEG would comply with the DRBC agreements on surface water withdrawal from the Delaware River (for cooling) and groundwater withdrawals from the aquifer.

- New Jersey Water Supply Management Act. Permits under this act would be issued by NJDEP to regulate dewatering, well drilling, and groundwater use.

PSEG would also comply with other applicable regional, state, and local regulations as described in its ER (PSEG 2014-TN3452).

Section 5.2.1 discusses the hydrologic alterations in surface water and groundwater related to operation of a new nuclear power plant at the PSEG Site. Water-use impacts from operations are discussed in Sections 5.2.2.1 and 5.2.2.2 for surface water and groundwater, respectively. Water-quality impacts from operations are discussed in Sections 5.2.3.1 and 5.2.3.2 for surface water and groundwater, respectively. Water monitoring during plant operation is discussed in Section 5.2.4. The combined impacts of operating a new nuclear power plant at the PSEG Site along with the existing HCGS and SGS, as well as other activities in the surrounding environment, are discussed in Chapter 7 (Cumulative Impacts).

5.2.1 Hydrological Alterations

This section discusses the hydrological alterations and the resulting effects from operation of a new nuclear power plant at the PSEG Site. As stated in Section 4.2.1, site hydrological alterations during construction and preconstruction would include a change to the local landscape and drainage patterns, which could cause increased runoff or erosion. Hydrological alterations to the Delaware River from operations would include increased water withdrawal, discharge of cooling water blowdown and wastewater, and maintenance dredging of the intake canal.

During construction and preconstruction, the power block for a new plant would be placed on an elevated area, with drainage directed away from the facilities. Modifications to the land surface made during preconstruction and construction activities would alter the local hydrology, and these alterations would remain during plant operations. A new nuclear power plant would be located north of the existing HCGS plant at the PSEG Site. Stormwater runoff from the PSEG Site would drain primarily to the Delaware River. A detailed design of retention and holding areas has not been determined, but an SWPPP would be in place to manage stormwater runoff and prevent erosion. An SWPPP would be required to meet New Jersey Pollutant Discharge Elimination System (NJPDES) stormwater discharge requirements (PSEG 2014-TN3452). Because of the relatively small area that could generate increased runoff compared to the drainage area of the Delaware River near the PSEG Site, the increased runoff is not expected to noticeably affect the hydrologic conditions in the Delaware River near the PSEG Site.

Because best management practices (BMPs) would be used as required by NJPDES under SWPPP, and because the additional runoff-generating area is small compared to the drainage area of the Delaware River near the PSEG Site, the surface water quality of the river would be minimally affected by the land surface modifications at the PSEG Site.

Land surface modification would also alter groundwater infiltration areas because of the increased amount of impervious surface at the PSEG Site, regrading of the site, and the filling of some onsite water bodies. These alterations could impact groundwater flow in the alluvium and Vincentown aquifers in the vicinity of the site, but the effects are expected to be localized to the site. Also, the alluvium and Vincentown aquifers are not used locally as sources of potable water, and low permeability units separate them from the deeper aquifers that supply potable water. Therefore, it is likely that water supply and quality in the Wenonah–Mount Laurel aquifer and the Potomac–Raritan–Magothy (PRM) aquifer system would be unaffected by the hydrological alterations resulting from land surface modifications at the PSEG Site.

As described in Chapter 3, a new nuclear power plant at the PSEG Site would withdraw water from the Delaware River for the circulating water, service water, and ultimate heat sink (UHS) systems. The primary hydrologic alteration from this water use would be the reduction of flow in the Delaware River, which could affect both the availability of water for other uses and the salinity of the upstream reach of the river. In addition, the intake canal would require periodic dredging. The impacts from consumptive water use by a new nuclear power plant are evaluated in terms of the estimated reduction in Delaware River flow in absolute and relative terms for normal and maximum operational uses and for long-term average flows and low flows in the river. These impacts are discussed in Sections 5.2.2 and 5.2.3.

Plant blowdown and wastewater would be discharged to the Delaware River, with potential effects on the thermal characteristics of the river and on water quality. The impacts of plant discharges to the Delaware River are evaluated in Section 5.2.3.

As described in Chapter 3, a new nuclear power plant would withdraw water from the PRM aquifer system for those plant systems requiring freshwater. The effect of this groundwater use would be a reduction in the hydraulic head in the confined aquifer around the pumping wells. With a sufficient reduction in head, the pumping could cause saltwater intrusion in the aquifer. These impacts are evaluated in terms of the magnitude and extent of the anticipated reduction in hydraulic head in Sections 5.2.2 and 5.2.3.

In summary, the hydrological alterations applicable to operations would be primarily from the intake of Delaware River water, the discharge of blowdown water and associated waste streams to the river, altered drainage patterns from landscape changes, withdrawal of groundwater from the PRM aquifer system, and periodic dredging of the intake canal.

5.2.2 Water-Use Impacts

This section describes the potential impacts on surface water and groundwater uses and users resulting from operation of a new nuclear power plant at the PSEG Site. Information presented in PSEG's ER (PSEG 2014-TN3452), other information obtained by the review team, and independent analyses performed by the review team were used to assess the impacts.

5.2.2.1 Surface-Water-Use Impacts

A major concern of the DRBC is preventing salt water intrusion in the upstream regions of the Delaware River during a drought. As stated in Section 2.3.2.1, instream flow objectives are in place for the Delaware River to maintain the salt line at Delaware River Mile (RM) 98, downstream of public water supply intakes on the river. Salt line in the tidal Delaware River is defined as the location where the 7-day average chloride concentration equals 250 ppm (DRBC 2008-TN2277). Several programs are in place to ensure sufficient freshwater is available to prevent upstream salt intrusion from occurring. These programs involve reservoirs that can be used to release water to the river during a drought. PSEG has an allocation of 6,695 ac-ft of storage in the Merrill Creek reservoir to offset the consumptive uses of its existing power plants in the region (HCGS, SGS, and Mercer Generating Stations 1 and 2) during a drought (PSEG 2014-TN3452). As stated in Section 2.3.1.1, the total storage in the Merrill Creek reservoir is 46,000 ac-ft. The DRBC requires releases from the Merrill Creek reservoir when the DRBC drought management plan causes the flow objective at Trenton to fall below 3000 cfs and the equivalent flow at Trenton falls below 3,000 cfs for two consecutive days (MCOG 2003-TN3312). A minimum release of 3 cfs from Merrill Creek reservoir is required at all times. In the past, releases from the Merrill Creek reservoir have occurred on four occasions (PSEG 2012-TN3313):

1. 41 days between September 13, 1991, and November 22, 1991, with a total release of 2,001,752,000 gallons (6,143 ac-ft) of water;

2. 11 days between September 16, 1995, and November 1, 1995, with a total release of 502,988,000 gallons (1,544 ac-ft) of water;

3. 16 days between December 15, 1998, and February 3, 1999, with a total release of 666,363,000 gallons (2,045 ac-ft) of water; and

4. 37 days between October 29, 2001, and January 25, 2002, with a total release of 1,658,472,000 gallons (5,090 ac-ft) of water.

After these periods of release, the reservoir was filled by pumping water over periods of 26, 11, 27, and 46 days, respectively. The filling periods occurred one to several months after stopping the previous releases (PSEG 2012-TN3313).

The average consumptive water use from the Delaware River for operation of a new nuclear power plant at the PSEG Site would be 26,420 gpm (58.9 cfs) (PSEG 2014-TN3452). Water withdrawn from the Delaware River is brackish with up to 18 ppt salinity and, therefore, is not fit for potable use. The DRBC applies an equivalent impact factor of 0.18 to account for the difference between the river water near the PSEG Site and freshwater. This makes the water consumption of a new nuclear power plant at the PSEG Site equivalent to a freshwater consumption of 4,756 gpm (10.6 cfs). This equivalent freshwater consumptive use is 0.1 percent of the mean annual flow at Trenton, New Jersey, during the historic low water period of 1961–1967 (7,888 cfs), and 0.7 percent of the minimum monthly flow (1,548 cfs, recorded in July 1965). The total consumptive losses associated with a new nuclear power plant at the PSEG Site would be less than 0.01 percent of the tidal flows at the PSEG Site (PSEG 2014-TN3452).

PSEG has not selected a reactor technology for a new nuclear power plant at the PSEG Site. One reactor technology used in the ESP plant parameter envelope (PPE) approach, the Advanced Passive 1000 (AP1000), may require surface water withdrawals from the Delaware River that would cause the currently permitted PSEG allocation of 6,695 ac-ft in the Merrill Creek reservoir to fall short by 465 ac-ft or 6.9 percent (PSEG 2014-TN3452). When PSEG selects a reactor technology, PSEG would (1) revise the consumptive water use allocations of other plants it owns and supports through its storage allocation in Merrill Creek reservoir or (2) acquire additional storage from the existing rights of other Merrill Creek co-owners to support NJDEP permitting and DRBC docketing of a new nuclear power plant (PSEG 2014-TN3452). The Merrill Creek reservoir storage capacity of 46,000 ac-ft far exceeds that needed to meet the additional 465 ac-ft allocation required for the AP1000. In addition, the DRBC allows for temporary acquisition of releases from other owners of Merrill Creek reservoir storage (MCOG 2003-TN3312). For these reasons, the review team determined that additional surface water use for operations of a new nuclear power plant could be met without a noticeable impact to the instream flow targets in the Delaware River. Because the consumptive water use would be a small percentage of the river flow, even under drought conditions, and it is reasonably foreseeable that there would be sufficient water in the Merrill Creek Reservoir to offset a new plant's consumptive use, the review team has determined that the impact of consumptive use of surface water by a new nuclear power plant at the PSEG Site would be SMALL.

5.2.2.2 Groundwater-Use Impacts

Groundwater would be used at a new nuclear power plant for the potable and sanitary water system (PSWS), the fire protection system (FPS), the demineralized water distribution system (DWDS), and other minor uses. The average withdrawal rate for operations would be 210 gpm, primarily for the PSWS and DWDS, with a maximum withdrawal rate of 953 gpm, two-thirds of which is accounted for by the FPS (PSEG 2014-TN3452). Maximum rates would be temporary as they would occur only during abnormal conditions. Two additional wells would be installed in the PRM aquifers to supply groundwater for a new plant (PSEG 2014-TN3452).

By lowering hydraulic heads in the PRM aquifers, groundwater pumping to support operation of a new nuclear power plant at the PSEG Site could impact other groundwater users. The nearest public supply wells that withdraw from the PRM aquifer system are located approximately 3 mi across the Delaware River in Delaware and over 5 mi to the northeast in Salem, New Jersey. The nearest private residences are located approximately 3 mi east of the site. To evaluate the potential impact on these groundwater users, the review team estimated the reduction (drawdown) in groundwater head that could result from the operational pumping of 210 gpm from the middle PRM aquifer.

To estimate the drawdown at offsite locations, the review team completed an independent evaluation using an analytical solution for radial flow to a well in a confined aquifer (the Theis solution, e.g., Freeze and Cherry 1979-TN3275). The review team expects the analytical solution to be bounding for locations offsite (e.g., the closest groundwater users) because leakage from the overlying/underlying aquitard units would tend to reduce the drawdown. Hydraulic parameters of the middle PRM aquifer were taken from a modeling study at the site that was conducted to evaluate potential aquifer responses to changes in groundwater withdrawal rates for HCGS/SGS operation (Dames and Moore 1988-TN3311).

Dames and Moore (Dames and Moore 1988-TN3311) selected parameter values to match groundwater heads and chloride concentrations measured in site wells in 1987. The transmissivity value used in the analytical solution represents a central value from the Dames and Moore model (1,485 ft/d, or 11,110 gpd/ft) and is within the range of values presented in ER Table 2.3-9 (PSEG 2014-TN3452). The storage coefficient value used in the analytical solution matches the value used by the Dames and Moore model (0.00009). Use of a larger storage coefficient value, such as the value presented in ER Table 2.3-9 (PSEG 2014-TN3452), would decrease the estimated drawdown.

The analytical solution was evaluated for use at the PSEG Site by comparing it to model results presented in Dames and Moore (Dames and Moore 1988-TN3311): 20 years of pumping at 1987 rates (493 gpm from the middle PRM aquifer). The analytical solution provided a reasonable approximation, as shown on the left side of Figure 5-1. The analytical solution overestimated drawdown near the pumping well because all pumping was concentrated at a single well instead of distributing it among three wells as is the actual case. The analytical solution slightly underestimated the drawdown at 4,500 ft.

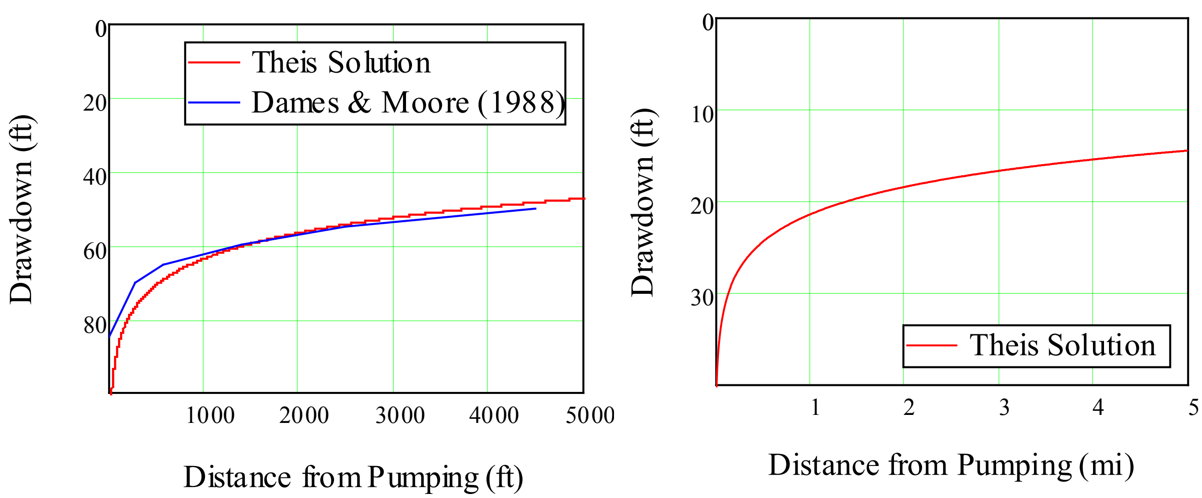

Figure 5-1. Theis analytical solution (left) compared with model results from Figure 44 of Dames and Moore (Dames and Moore 1988-TN3311) (20 years of pumping 493 gpm from the middle PRM aquifer). ***Estimated drawdown (right) from 40 years of continuously pumping 210 gpm from the middle PRM aquifer.***

The analytical solution was applied to estimate drawdown after 40 years of continuous pumping at 210 gpm. The resulting drawdown is shown on the right side of Figure 5-1 as a function of the distance from the pumping well. The drawdown is 16.6 ft at a distance of 3 mi and 14.4 ft at a distance of 5 mi. According to the U.S. Geological Survey (dePaul et al. 2009-TN2948), existing groundwater heads in the middle PRM aquifer are estimated to be at an elevation of about -20 ft and are located 3–5 mi northeast of the site. An additional 14–17 ft of drawdown would pose no risk of dewatering an offsite well screened in the middle PRM aquifer. Because of leakage from the overlying and underlying aquitard units, actual drawdown is expected to be less than predicted by the analytical solution. As a result, the review team concludes that the impact on nearby groundwater users from the operational use of groundwater by a new nuclear power plant at the PSEG Site would be SMALL, and no further mitigation would be warranted.

5.2.3 Water-Quality Impacts

This section discusses impacts to the quality of water resources from the operation of a new nuclear power plant at the PSEG Site. Surface water impacts would include those from discharges of thermal, chemical, and radiological wastes as well as physical changes in the Delaware River resulting from effluents discharged by a new plant. Groundwater impacts would include those from inadvertent chemical spills that may affect shallow (brackish) groundwater and pumping-induced salinity increases to deep aquifers.

5.2.3.1 Surface-Water-Quality Impacts

Stormwater Runoff

During operation of a new nuclear power plant, stormwater runoff from the newly developed areas of the PSEG Site could increase. However, as stated in Section 5.2.1, an SWPPP would be in place to manage stormwater runoff and prevent erosion. The SWPPP would be required to meet NJPDES stormwater discharge requirements. PSEG would use BMPs as required by NJPDES under the SWPPP to minimize degradation of runoff water quality. Because of the relatively small area that could generate increased runoff compared to the drainage area of the Delaware River and the use of BMPS, the increased runoff and its quality are not expected to noticeably affect Delaware River water quality near the PSEG Site. Therefore, the review team concluded that the surface water quality of the river would be minimally affected by stormwater runoff during operations.

Thermal Discharge

During operation of a new nuclear power plant at the PSEG Site, blowdown from the cooling water system cooling towers would be discharged to the Delaware River using a discharge pipeline. Thermal discharges are allowed and regulated as part of the NJPDES permit (PSEG 2014-TN3452). DRBC's Administrative Manual Part III, which sets water quality requirements, applies to all public and private waste discharges to waters to the Delaware River Basin (DRBC 2011-TN2371). Water quality standards for the Delaware River Basin are listed in Article 3 of the Delaware River Basin Water Code, and water quality standards for interstate tidal streams are listed in Section 3.30 of Article 3 (DRBC 2011-TN2371). Zone 5 of the interstate tidal streams is the part of the Delaware River between Delaware RMs 78.8 and 48.2; the discharge from a new nuclear power plant at the PSEG Site would occur in this zone. Stream water quality objectives for Zone 5 are listed in Water Code Article 3 Section 3.30.5. The temperature-related standards for Zone 5 require that the ambient water temperature in the river outside the designated heat dissipation area (HDA) may not increase by more than 4°F (2.2°C) from September through May, and by 1.5°F (0.8°C) from June through August, with a year-round maximum water temperature of 86°F (30°C). The DRBC defines an HDA for thermal discharges; these are determined on a case-by-case basis and are an area within which thermal limits set by the DRBC may be exceeded (DRBC 2011-TN2371). The HDA for SGS has been in effect since 1977. The HDA for SGS was modified by DRBC in 1995 and 2001, with the 2001 requirements stated in the 2001 NJPDES permit (NRC 2011-TN3131).

SGS has seasonal HDAs. From June through August, the SGS HDA extends 25,300 ft upstream and 21,100 ft downstream from the SGS discharge, with its lateral extent into the river

reaching no closer than 1320 ft from the eastern edge of the Delaware River shipping channel (NRC 2011-TN3131). From September through May, the SGS HDA extends 3,300 ft upstream and 6000 ft downstream from the discharge, with its lateral extent into the river reaching no closer than 3,200 ft from the eastern edge of the Delaware River shipping channel (NRC 2011-TN3131). PSEG also has held a thermal variance for SGS under Section 316(a) since the 1994 NJPDES permit. In 2006, PSEG applied for the NJPDES permit renewal with a request for renewal of the 316(a) variance, which was granted by NJDEP in 2006. The 30-day average SGS circulating water flow for its once-through cooling system is approximately 3,024 million gallons per day or 4,679 cfs.

The HCGS HDA is a rectangle extending 2,500 ft upstream, 2500 ft downstream, and 1,500 ft into the river from the HCGS blowdown discharge (PSEG 2014-TN3452). The HCGS blowdown discharge is located approximately 4,000 ft upstream of the SGS discharge. A new nuclear power plant at the PSEG Site would have a blowdown discharge to the Delaware River similar to that of the HCGS discharge, which is an average of 50,516 gpm or 113 cfs. The blowdown discharge pipe for a new nuclear power plant would be located approximately 100 ft offshore in the river and approximately 2,500 ft north of the HCGS discharge (PSEG 2014-TN3452). The discharge pipe outlet for a new plant would be located approximately 3.0 ft above the river bottom, and the average discharge and velocity would be approximately 51,946 gpm or 116 cfs and 9.2 fps, respectively (PSEG 2014-TN3452).

To determine the effects of discharge from a new nuclear power plant on the Delaware River, PSEG used the Cornell Mixing Zone Expert System (CORMIX) to perform a conservative analysis (PSEG 2014-TN3452). PSEG used the CORMIX model that was developed to support the recent HCGS extended power uprate application as the starting point (PSEG 2012-TN2244). During the thermal plume analysis to support the HCGS power uprate application, PSEG determined that June was the critical month for meeting regulatory criteria for temperature in the Delaware River. For a new nuclear power plant, PSEG evaluated five discharge thermal plume scenarios: (1) during ebb tide after slack water; (2) during ebb tide, running tide; (3) during low water, running tide; (4) during flood tide after slack water; and (5) during flood tide, running tide. No heat loss to the atmosphere was assumed, which maximizes water temperature in the plume. The discharge from a new plant was set to 116 cfs. The discharge excess temperature was set to 17.3°F, which is the 10 percent exceedance excess temperature for the HCGS discharge. PSEG assumed discharge from a new plant would be similar in thermal characteristics to discharge from HCGS (PSEG 2014-TN3452). Similarly, PSEG selected the excess salinity of the discharge from a new plant as 0.81 kg/m^3, which is more than the 10 percent exceedance excess salinity (0.61 kg/m^3) but less than the 5 percent exceedance excess salinity (0.88 kg/m^3) of the HCGS discharge. PSEG used the ambient discharge velocities and water levels in the Delaware River using a June 2008 Acoustic Doppler Current Profiler measurement at Reedy Point station (PSEG 2012-TN2244). The review team evaluated the CORMIX simulation input parameters selected by PSEG for the thermal effects assessment and determined the following combination would result in a thermal plume that would be larger and would have higher water temperature than typical average conditions:

- 10 percent exceedance excess temperature of the discharge,
- greater than 10 percent exceedance excess salinity of the discharge, and
- no heat exchange with the atmosphere.

Therefore, the review team concluded that the thermal effects determined by PSEG for a new nuclear power plant are conservative.

In the two CORMIX scenarios run during slack tide (scenarios 1 and 4), the plume extends directly into the Delaware River away from the discharge point because the tidal velocities are small. For scenarios 1 and 4, the CORMIX results showed that the distances along the plume centerline where the excess temperatures would fall to 1.5°F were 492 ft and 656 ft from the discharge, respectively (PSEG 2014-TN3452). The lateral extent of the plume transverse to ambient flow was 427 ft for scenario 1 and 466 ft for scenario 4 (PSEG 2014-TN3452). In the other three CORMIX scenarios, the plume is quickly turned in the direction of the advancing tide. The farthest downstream extent of the plume during ebb tide before the temperature excess falls to 1.5°F was 443 ft for CORMIX scenario 2, and the farthest upstream extent of the plume during flood tide before the temperature excess falls to 1.5°F was 295 ft for CORMIX scenario 5. The lateral extent of the plume transverse to ambient flow was 450 from the point of discharge (PSEG 2014-TN3452).

Based on the CORMIX simulations, the thermal plume of the discharge from a new nuclear power plant would have a maximum extent of about 700 ft into the river from the discharge location, about 300 ft upstream from the discharge, and about 500 ft downstream from the discharge. This plume extent is smaller than the HCGS HDA and would partially overlap the HCGS HDA during slack and ebb tides. Because the new plant discharge would be comparable to the discharge from HCGS and the distance between the two discharge locations (about 2,500 ft) is much larger than the maximum extent of the new plant's thermal plume, the review team determined that the actual overlap of the thermal plumes from the new plant and HCGS will be minor.

The extent of the thermal plume from the new plant is much smaller than the SGS HDA and would be completely contained within the existing SGS HDA. Because the extent of the thermal plume from a new plant would be small relative to the approved HDA for SGS, and because the extent of its largest excess temperatures would be localized near the discharge outlet far from the areas of large excess temperatures at SGS, the review team determined the impacts of thermal discharges from a new nuclear power plant would be minor.

Figure 5-2 illustrates the relationship among the CORMIX-predicted thermal plume from the new plant's discharge during flood tide, the HCGS HDA, and the approximate thermal plume from the SGS discharge based on surface temperature measurements at the end of flood tide on May 29, 1998. PSEG reported that during flood tides, the excess temperature near the discharge location of a new nuclear power plant from both SGS units operating at full capacity is about 3.6°F (PSEG 2014-TN3452). HCGS HDA extends 2,500 ft north of the HCGS discharge point, approximately where a new nuclear power plant's discharge point would be located. Therefore, it is possible that the water temperature in the Delaware River could rise above 86°F in a small area just outside HCGS HDA. This area is just outside the location where the excess temperature from discharge from a new plant would reach 1.5°F when the ambient Delaware River temperature is at or above 79.4°F. The excess temperatures from operations of the SGS, HCGS, and a new plant would be 3.6°F, 1.5°F, and 1.5°F, respectively (PSEG 2014-TN3452).

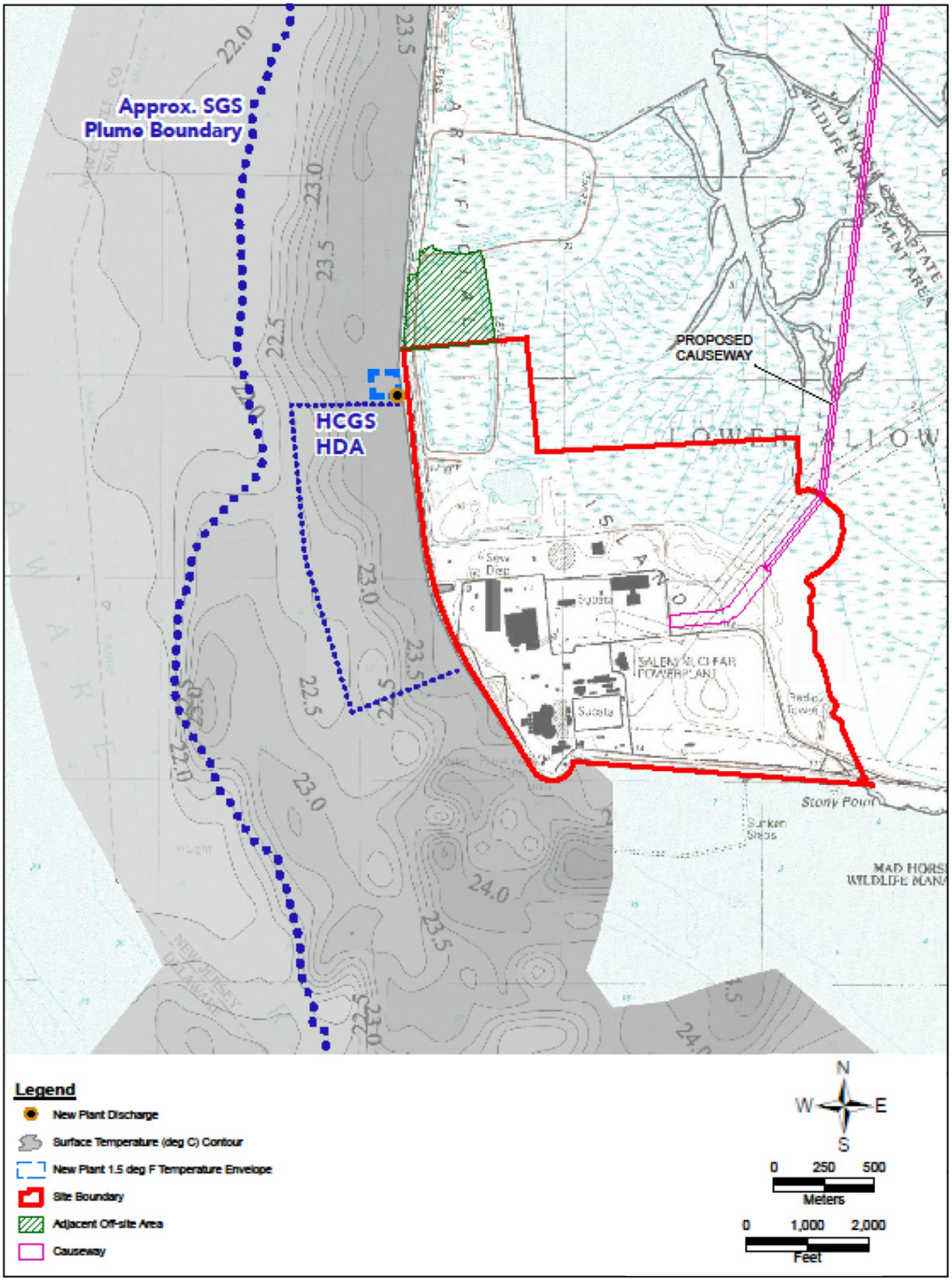

Figure 5-2. Predicted PSEG Thermal Plume in Relation to the Approximate Locations of the HCGS HDA and the SGS Plume Boundary Under Flood Tide Conditions. ***(Source: Modified from PSEG 2014-TN3452)***

Based on analysis of statistics of water temperature data measured at the U.S. Geological Survey (USGS) station Delaware River at Reedy Island Jetty, Delaware, the review team determined that median water temperature exceeds 79.4°F from July 14 through August 20. Therefore, the review team concluded that in the area just outside HCGS HDA and just outside the area where the excess temperature from the discharge for a new nuclear power plant would reach 1.5°F, water temperature in the Delaware River could frequently (more than half of the days) exceed 86°F when all units of SGS, HCGS, and a new plant are operating. However, as shown by the PSEG CORMIX modeling, the thermal plume quickly mixes and dissipates in the river such that the plume areas are small. Also, while reviewing the NJPDEP application for a new discharge to the Delaware River, DRBC and NJDEP would have the opportunity to designate an HDA for a new nuclear power plant and require discharge rules that would protect the aquatic environment. Therefore, the review team determined the combined discharges from SGS, HCGS, and a new nuclear power plant would not noticeably affect the Delaware River.

Nonradioactive Liquid Effluent Discharge

Nonradioactive liquid effluents from a new nuclear power plant would be discharged to the Delaware River with the cooling water system blowdown. However, releases to the tidal marsh areas north of the PSEG Site are not anticipated. The effluents to be released include stormwater drainage and treated power block discharges such as oily wastes, acid/caustic wastes, operational wastes, blowdown, and sanitary wastes (PSEG 2014-TN3452). Potable and sanitary discharges are regulated under the Clean Water Act through the NJPDES permit and the requirements of DRBC. Chemical treatment in the cooling water system would include biocides and other chemicals (corrosion inhibitors) to maintain water quality. All effluents would be controlled in accordance with appropriate permits (PSEG 2014-TN3452). The concentrations of pollutants in the liquid discharge would be set by NJDEP in the NJPDES permit for a new plant. Once discharged to the Delaware River, liquid wastes would quickly mix in the ambient flow and become diluted. The review team determined that discharge of nonradioactive liquid effluents to the Delaware River would not cause a noticeable impact on the water quality of the river. Therefore, water quality impacts from nonradioactive waste discharge from a new nuclear power plant would be minor, and no additional mitigation is needed beyond that specified in appropriate permits.

Physical Effects of Discharge

Discharge from a new nuclear power plant would have a relatively high velocity of 9.2 fps (PSEG 2014-TN3452). To minimize potential scour, the river bottom near the outlet of the discharge pipe would be armored with riprap or other engineered features. Therefore, the review team concluded that physical effects of wastewater discharge during operation of a new plant would be minimal.

Also, infrequent dredging of the intake channel and the barge canal area may be needed during operation of a new nuclear power plant at the PSEG Site. These activities would be infrequent, and any sediment disturbed would quickly settle upon cessation of the activities. Any effects to water quality during these periods would be temporary and would be managed using BMPs. Therefore, the review team concluded that physical effects of dredging during operation of a new plant would be minimal.

Surface-Water-Quality Impacts Summary

The review team determined that the impacts of operations activities on the quality of surface water in the area would be limited because: (1) the volume of stormwater runoff from the site would be small compared to the volume of the Delaware River, and BMPs would be used; (2) the thermal plume for the proposed plant would be completely contained within the existing SGS HDA; (3) DRBC and NJDEP would designate an HDA for the proposed plant and require discharge rules that would protect the aquatic environment; (4) nonradioactive liquid effluent concentrations would meet NJDEP permit requirements; (5) the river bottom near the outlet of the discharge pipe would be armored with riprap or other engineered features; and (6) dredging of the intake would be infrequent and any disturbed sediment would quickly settle. Therefore, the review team determined that impacts on water quality in the Delaware River from operations of a new plant at the PSEG Site would be SMALL.

5.2.3.2 Groundwater-Quality Impacts

PSEG does not plan routine discharges to groundwater from a new nuclear power plant at the PSEG Site (PSEG 2014-TN3452). Potential impacts to groundwater could come from non-routine chemical spills that may migrate to shallow water (brackish) zones. BMPs would be used during operations to minimize potential impacts of chemical spills on groundwater quality. If a spill occurs, NJDEP requires reporting and remediation to minimize or prevent groundwater impacts. The site grade would contain engineered fill with a low permeability to further limit the risk of groundwater contamination from accidental releases to the land surface (PSEG 2014-TN3452). An additional factor limiting the impact of any spills to shallow groundwater is the lack of use of these aquifers because of their brackish water.

By reducing groundwater head in the region surrounding the PSEG Site, operational use of water from the PRM aquifers has the potential to induce saltwater intrusion. Regional estimates of aquifer salinity are based on limited data (Schaefer 1983-TN3007) and modeling (Pope and Gordon 1999-TN3006). Recent estimates place the 250 mg/L line of equal chloride concentration close to Artificial Island in the middle PRM aquifer (dePaul et al. 2009-TN2948). Chloride data from the HCGS and SGS production wells presented in Section 2.3.3.2 indicate that the concentration has been fairly stable for the past 10 years. Data presented in Dames and Moore (Dames and Moore 1988-TN3311) show that chloride concentration in 1987 was 15 mg/L in wells HC-1 and HC-2 and 45 mg/L in PW-5. These concentrations are slightly higher than the median values between March 2003 and September 2013: 8 mg/L in HC-1, 5 mg/L in HC-2, and 22 mg/L in PW-5. The higher concentrations in 1987 may have resulted from higher pumping rates; combined pumping from the middle PRM aquifer was 493 gpm in 1987 and averaged 369 gpm between 2002 and 2009. However, regional pumping was also greater in the early 1980s, as this was before the establishment of Water Supply Critical Area 2 and may have influenced chloride concentrations in the HCGS/SGS production wells. Combined pumping for HCGS/SGS and a new nuclear power plant is expected to average 579 gpm from the middle PRM aquifer (369 gpm plus 210 gpm), less than 100 gpm (17 percent) more than the 1987 withdrawals.

Dames and Moore (Dames and Moore 1988-TN3311) used modeling to evaluate the potential for saltwater intrusion from expansion of HCGS/SGS groundwater pumping from the middle PRM aquifer. They considered scenarios with 598 gpm and 736 gpm of pumping from the

middle PRM aquifer. The higher pumping rates produced increases in chloride concentrations of 17 and 24 mg/L, respectively, in well PW-5 and an increase of 2–5 mg/L in wells HC-1 and HC-2. The magnitude of these increases is similar to the differences between chloride concentration in 1987 and median chloride concentrations during 2003–2013.

The available data and the modeling results suggest that operational pumping for a new nuclear power plant would increase chloride concentrations in the middle PRM aquifer, but these increases would be manageable. Additional factors that would limit the impacts are the lack of significant nearby groundwater use and the availability of the upper PRM aquifer as an alternative water source. The presence of aquitards (Marshalltown, Woodbury, and Merchantville Formations) between the PRM aquifers and the overlying saltwater-impacted aquifers also limits the potential for saline intrusion from the Vincentown and Wenonah–Mount Laurel aquifers. In addition, results from Pope and Gordon (Pope and Gordon 1999-TN3006) showed that changes in aquifer salinity have been more responsive to historic sea levels than to the regional groundwater withdrawals in the 20th century. Therefore, the review team concludes that the groundwater quality impacts from the operational use of groundwater by a new nuclear power plant at the PSEG Site would be SMALL, and no further mitigation would be warranted.

5.2.4 Water Monitoring

Discharge monitoring of all waste streams is required to demonstrate compliance with NJPDES limits. PSEG anticipates that surface water monitoring requirements for a new nuclear power plant's NJPDES permit would be similar to those for the HCGS and SGS. These monitoring requirements would include continuous temperature monitoring at cooling water intake structures and at the discharge point. Because a new nuclear power plant at the PSEG Site would be a new facility under Phase I requirements of 40 CFR 125.84, monitoring to demonstrate compliance with 40 CFR 125.87 would be required under the NJPDES permit and would include monitoring of intake velocity (40 CFR 125-TN254).

Section 6.3 of PSEG's ER (PSEG 2014-TN3452) describes the hydrological monitoring program that would be used to control potential adverse impacts of new plant operations on surface water and groundwater and identifies alternatives or engineering measures that could be implemented to reduce these impacts. Section 6.6 of the ER describes the chemical monitoring program for surface water and groundwater quality. The objective of chemical monitoring is to identify changes in water quality that may result from new plant operations.

PSEG maintains a Radiological Groundwater Protection Program (RGPP) and tritium remediation monitoring wells. The wells installed for the RGPP at HCGS and SGS and for tritium remediation monitoring at SGS are generally located in the shallow water-bearing strata or the Vincentown aquifer, consistent with the wells installed in conjunction with the ESP Application. A monitoring plan would be developed for the final selected plant design to monitor potential impacts of plant operations on the groundwater.

5.3 Ecological Impacts

This section describes the potential impacts to ecological resources from operating a new nuclear power plant at the PSEG Site. The impacts are discussed separately for terrestrial ecosystems (see Section 5.3.1) and aquatic ecosystems (see Section 5.3.2).

5.3.1 Terrestrial and Wetland Impacts Related to Operations

The main concerns regarding potential impacts on terrestrial ecological resources from the operation of a new nuclear power plant at the PSEG Site are associated with cooling system operations. Cooling system operations can result in the deposition of dissolved solids; increased local fogging, precipitation, or icing; a greater risk of bird and bat collision mortality; shoreline alteration of the source water body; and noise. The addition of a new nuclear power plant at the PSEG Site would also result in increased traffic along the proposed causeway from additional employees at the site (NRC 2013-TN2654; NRC 1999-TN289).

5.3.1.1 Terrestrial and Wetland Resources—Site and Vicinity

Cooling System Impacts on Vegetation

Cooling system operations for a new nuclear power plant at the PSEG Site pose the most significant risks to vegetation. The proposed cooling systems, as described in Chapter 3, would use a recirculating (closed cycle) cooling water system that includes natural draft cooling towers (NDCTs), mechanical draft cooling towers (MDCTs), or fan-assisted cooling towers during normal operations. The circulating water system (CWS) cooling towers would be the tallest structures on site at a potential height of 590 ft and would dissipate heat at a rate of 1.508×10^{10} Btu/hr with evaporation losses as high as 25,264 gpm and a drift loss as high as 12 gpm. The service water system (SWS) would provide cooling functions for systems not serviced by the CWS during operation and during cool down, refueling, and plant startup modes. The shorter SWS cooling towers would dissipate heat at a maximum rate of 2,284 gpm and a maximum drift loss of 4 gpm. Because the impacts from the SWS cooling towers would be less than the CWS cooling towers, discussion of potential impacts as a result of cooling system operations will be limited to the CWS cooling towers (PSEG 2014-TN3452).

Heat from operating a new nuclear power plant would be transferred to the atmosphere in the form of water vapor and drift from cooling towers. Vapor plumes and drift can affect crops, ornamental vegetation, and native plants, and water losses can affect shoreline habitat. Total dissolved solids (TDS) found in the vapor and drift have the potential to be deposited onto foliage or soil and cause visible damage (e.g., necrotic tissue and other deformities) and/or chronic effects (e.g., reduced growth and increased susceptibility to disease). NUREG–1555, Section 5.3.3.2 (NRC 1999-TN614) indicates that plants are generally not damaged by salt deposition rates of 1 to 2 kg/ha per month. Salt deposition rates greater than 10 kg/ha per month during the growing season have the potential to cause leaf damage in some vegetation species.

The linear mechanical draft cooling tower (LMDCT) has greater potential for salt drift than other proposed cooling tower structures. Therefore, discussion of salt deposition as a result of

cooling tower drift will be limited to the deposition rate of the LMDCT. The results of Seasonal and Annual Cooling Tower Impact (SACTI) Prediction Code modeling conducted by PSEG and confirmed by the staff's independent analysis for the proposed site shows that the maximum salt deposition rate during any season is 1.31 kg/ha per month (1.17 lb/ac per month) during the winter. The maximum expected salt deposition rate in any direction is 0.89 kg/ha per month (0.80 lb/ac per month) (Table 5-1) (PSEG 2014-TN3452). These salt deposition rates fall within the rate described by NUREG–1555 as generally not damaging to plants (NRC 1996-TN288; NRC 1999-TN289).

Analyses performed by PSEG have shown that cooling tower drift over terrestrial habitats is primarily to the east (within coastal wetlands) (Figure 5-3) and southeast on the PSEG Site. Most of the plant communities within the salt drift zone that would be exposed to drift from the PSEG cooling towers are salt marsh or brackish marsh ecosystems dominated by species (*Phragmites australis* and *Spartina alterniflora*) with medium to high salinity tolerance. Surveys conducted previously at the PSEG Site did not record any impacts from salt deposition due to drift from the existing HCGS NDCT for any specific plant species. Damage to native vegetation has not occurred at HCGS, which uses brackish water for cooling and represents a comparatively high probability of impact from operation of NDCTs (NRC 1996-TN288; NRC 1999-TN289; PSEG 2014-TN3452).

Previous evaluations of increased fogging, icing, humidity, and/or precipitation caused by cooling tower plume have been conducted for nuclear power plants with cooling towers (natural draft and mechanical draft). No significant impacts were reported as a result of these evaluations (NRC 1996-TN288; NRC 1999-TN289). In addition, based on an analysis conducted for the PSEG Site, the duration of any fogging and other cooling tower induced precipitation events would be expected to be short (PSEG 2014-TN3452).

Based on these results, combined with the nature of the local plant communities, the potential effects of cooling tower operations on surrounding plant communities on the PSEG Site and in the vicinity would be expected to be minimal.

Table 5-1. Maximum Predicted Salt Deposition Rate

Parameter	Linear mechanical draft cooling tower (LMDCT)	Natural draft cooling tower (NDCT)
Maximum predicted deposition rate	0.89 kg/ha per month (0.80 lb/ac per month)	0.023 kg/ha per month (0.021 lb/ac per month)
Distance to maximum deposition	700 m (2,297 ft)	1,300 m (4,265 ft)
Direction to maximum deposition	East	North

Source: PSEG 2014-TN3452.

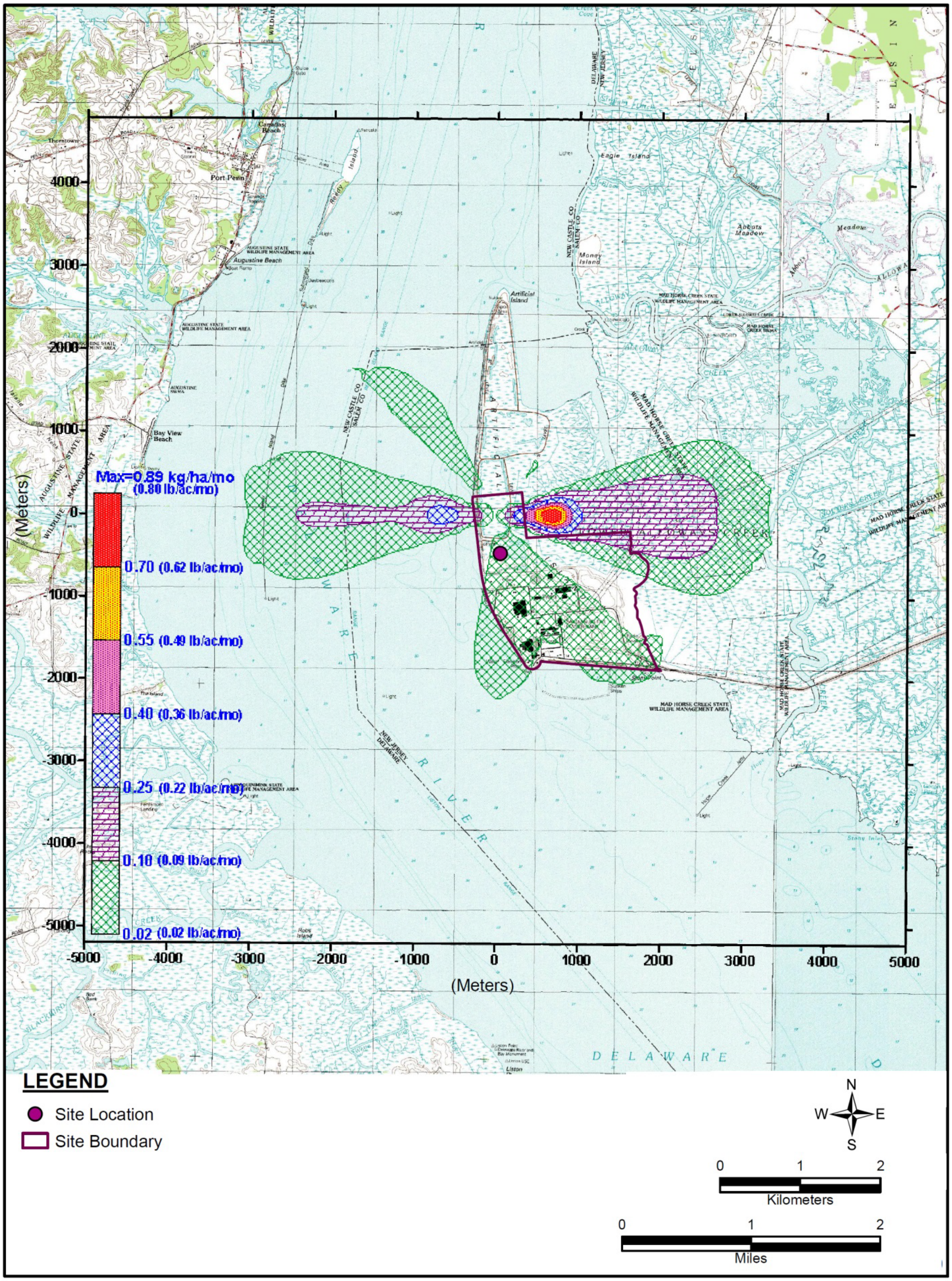

Figure 5-3. LMDCT Salt Deposition Rates. ***(Source: Modified from PSEG 2014-TN3452)***

Noise Impacts

Noise from nuclear power plants has the potential to disrupt behavior patterns of wildlife species in the vicinity (NRC 2013-TN2654). Principal noise sources at a nuclear power plant include natural draft and mechanical draft cooling towers, transformers, and loudspeakers. The bounding level for noise emissions from operation of a new nuclear power plant at the PSEG Site is associated with fan-assisted NDCTs, as presented in the Site Safety Analysis Report (PSEG 2014-TN3453). The estimated "A" weighted noise emission for this type of cooling tower is 60 decibels (acoustic) (dBA) at 1,000 feet. Noise measurements recorded on the site demonstrate that existing noise levels attenuate to a maximum of 51.6 dBA (a value typical of ambient low noise environments) near the site boundary (PSEG 2014-TN3452).

Noise from onsite sources associated with the PSEG Site attenuates with distance. For example, a source with a noise level of 50 dBA at 1,000 ft has a noise level of 44 dBA at 2,000 ft from the source, and a source with a noise level of 60 dBA at 1,000 ft has a dBA of 54 at 2,000 ft. A 2009 baseline ambient noise survey indicates noise from sources at the existing HCGS and SGS facilities attenuates to levels that generally represent background noise values in natural environments (see Table 5-2). This noise level is similar to that measured near the PSEG Site boundary. Noise sources within the adjacent marsh environment include wind, rustling of reeds and grasses (*Phragmites*), and animal noises (frog calls, bird songs, etc.). There are no known Federally listed threatened or endangered terrestrial species within the vicinity of the PSEG Site that potentially could be impacted by the noise of plant operations (see Section 2.4.1). In addition, the expected noise level is well below threshold levels that would generally exhibit a response in wildlife populations, as further discussed in Section 4.3.1.1. Thus, impacts of noise from operation of a new nuclear power plant are expected to be minimal.

Table 5-2. Ambient Noise Levels at HCGS and SGS in February 2009

Monitoring Location	Location Specific Attributes	Noise Levels (dBA)	
		Day Leq[(a)]	Night Leq[(a)]
1	Open area 500 ft south of SGS switchyard near Delaware River shoreline	58.9	57.4
2	Open area near meteorological tower	51.6	51.6
3	Open area adjacent to high-use onsite road	54.3	65.6
4	Open area under 500 kV transmission Line	53.2	53.6
5	Open area near HCGS cooling tower, small arms firing range, and low-use onsite road	60.9	61.5
6	Open area near Delaware River shoreline	43.4	51.6
7	Open area near material services building, HCGS intake pump house and Delaware River shoreline	52.0	51.6

(a) Leq is the equivalent continuous sound level measured over the run time.

Source: PSEG 2014-TN3452.

Impacts of Avian and Bat Collisions with Power Plant Structures

Avian mortality resulting from bird collisions with NDCTs at nuclear plants is a potential concern. Existing literature suggests that structures at a height approximately 300 ft or taller tend to exhibit higher tendencies for bird collisions and mortality rates (Kerlinger 2000-TN3188). Because an NDCT could potentially be 600 ft tall, it has the potential to cause increased bird mortality rates. The NRC concluded that relatively shorter mechanical-draft towers tend to cause negligible mortality rates (NRC 2013-TN2654).

As described in Section 2.4.1.1, the PSEG Site is within the Atlantic flyway and has the potential for a higher number of avian collisions. PSEG completed a report on avian collisions at HCGS to NJDEP in 1987. The report was based on studies on bird collisions because of the 512 ft NDCT at the site. There were 30 mortalities at the HCGS site during the yearlong study lasting from February 1985 to January 1986, and no Federally or State-listed endangered or threatened species were among the mortalities documented. At the end of the study period, PSEG concluded that the HCGS cooling towers appeared to be an insignificant source of bird collisions and mortality (PSEG 1987-TN2893).

NRC studies found that bird mortalities do occur at nuclear power plants, but such mortalities decreased when proper illumination was installed on the towers. Additionally, the NRC concluded that avian collisions with nuclear power plant structures occur at rates that are unlikely to pose a significant source of mortality to migratory bird populations (NRC 2013-TN2654). As a result, bird collisions with additional structures at the PSEG Site are expected to have a negligible effect on resident and migratory bird populations.

Literature regarding bat collisions with cooling tower structures is limited. However, several studies have been completed regarding bat collisions with other human-made structures. Mortalities because of collisions with television and communication towers were recorded involving eastern red (*Lasiurus borealis*), hoary (*Lasiurus cinereus*), and silver-haired bats (*Lasionycteris Peters*). These incidents have been recorded in Kansas, Florida, Missouri, North Dakota, and Tennessee. Similarly, bats have been known to collide with tall buildings in New York City and Chicago (Erickson et al. 2002-TN771).

Bat mortalities because of collisions with wind turbines are well documented. Over 360 bats were collected from wind turbines in Minnesota, and the highest mortality rate of 32 bat mortalities per three wind turbines was recorded at a wind generating facility in Tennessee. Only 6 of the 39 species of bats that are known to occur in the United States were affected. Most of the mortalities occurred in late summer to early fall and involved mostly migratory tree bat species. These migratory species included mostly hoary bats, eastern red bats, and silver-haired bats. Other species found in smaller numbers included big brown bat (*Eptesicus fuscus*), little brown bat (*Myotis lucifugus*), and tri-colored bat (*Perimyotis subflavus*). The study suggests that bat species do not use echolocation during migration, which can result in higher collision rates with human-made structures. Fewer collisions occurred with resident bat populations that forage near these structures. Additionally, evidence suggest that bat collisions with human-made structures are not a significant source of population declines (Erickson et al. 2002-TN771).

Impacts of Artificial Light

Artificial light can impact wildlife by both disorientation and attraction. Night migrating bird species can be impacted when meteorological conditions, such as inclement weather, bring them into close proximity with artificial lighting. Birds may become disoriented and collide with each other or structures, become exhausted, or be taken by predators (Longcore 2004-TN3189). Artificial lighting may impact terrestrial mammal nocturnal predator–prey relationships (Beier 2006-TN2380). Light pollution also may have significant negative impacts on the selection of flight routes by bats (Stone et al. 2009-TN3190). When exposed to artificial light, green frogs were found to exhibit fewer advertisement calls and moved more frequently than they did under ambient light conditions; this could result in potential impacts on recruitment rates, leading to effects on population dynamics (Baker and Richardson 2006-TN2379).

Down shielding of lights to prevent light from being directed into the night sky can help reduce the effect on migratory birds. This means lights can be shielded so that the pattern of illumination is below the horizontal plane of the light fixture. However, this will not prevent potential impacts to other species, such as frogs (Longcore 2004-TN3189).

The impacts of additional lighting could be lessened by using low sodium lighting. Down shielding, as described above, could be employed to further mitigate certain impacts. Operating experience with HCGS has not shown that bird collisions with units have been a noticeable issue (PSEG 1987-TN2893). It is not expected that the incremental effect of lighting added for a new nuclear power plant would increase impacts to noticeable levels, particularly if down shielding and other best management practices (BMPs) were employed. With the use of appropriate BMPs, impacts to terrestrial wildlife from the additional lighting at the PSEG Site are expected to be minimal. Further discussion on potential impacts of artificial lighting on terrestrial resources can be found in Section 4.3.1.1.

Impacts of Increased Vehicle Traffic

Increased vehicle traffic as a result of operating a new nuclear power plant at the PSEG Site has the potential to increase wildlife mortality caused by vehicle collisions. PSEG estimates that the onsite workforce could increase by 600 employees during normal operations and by 1,000 employees during refueling operations (PSEG 2014-TN3452). The increase in workforce population would increase the amount of vehicle traffic on the site and in the vicinity. Local wildlife populations could decline if road-kill rates exceed the rates of reproduction and immigration. However, road-kills occur frequently and wildlife populations are not significantly affected (Forman and Alexander 1998-TN2250). No individual Federally or State-listed threatened or endangered species were identified that would be adversely affected by vehicle traffic. Therefore, the effect of increased traffic on terrestrial wildlife populations on the site and in the vicinity would be minimal.

The proposed causeway would be constructed on piers, preserving wildlife travel corridors (PSEG 2014-TN3452). By allowing wildlife travel below the causeway, this elevated design would also help minimize the possibility for wildlife–vehicle collisions and wildlife mortality over conventional roadways built on embankments. The elevated design would also minimize potential impacts to plant communities (PSEG 2014-TN3452). Permanent impacts to wetland

plant communities along the causeway would be limited to placement of piers and direct shading. Shading could potentially result in some alteration of plant community makeup under the causeway and a reduction in primary productivity. However, because the effect will be to a small area relative to the overall plant community, impacts are expected to be minimal.

Impacts to Shoreline Habitat

Based on the PSEG Site Utilization Plan (Figure 2-2), the western shoreline of the PSEG Site would be modified with the development of shoreline plant features that include the water intake structure, heavy haul road, and barge facility. In total, 9.5 acres of near-shore water and riparian shoreline would be impacted below the coastal wetland boundary, also known as the New Jersey upper wetland boundary. Based on the Site Utilization Plan, the shoreline would be constructed as a stabilized shoreline (using riprap or other appropriate treatment) (PSEG 2014-TN3452). This would be the condition of the shoreline during the operational phase of a new nuclear power plant at the PSEG Site.

The existing disturbed nature of the shoreline likely provides marginal habitat for most terrestrial species. The main use of these areas is likely by some riparian zone/edge birds, as well as waterfowl and other birds on the open water. Open water habitat would remain during the operational phase, but the riparian zone would provide little habitat after the installation of the riprap bank. However, there are large areas of similar shoreline habitat of higher quality in the vicinity of the site. Therefore, it is expected that the shoreline modifications in place during the operational stage would have a negligible impact on terrestrial wildlife populations.

5.3.1.2 Important Terrestrial and Wetland Species and Habitats—Operational Impacts

This section discusses the potential impacts of operating a new nuclear power plant at the PSEG Site on recreationally valuable species and Federally and State-listed species, as well as important habitats (including wetlands) as defined by the NRC (NRC 1999-TN614). To meet responsibilities under Section 7 of the Endangered Species Act of 1973, as amended (16 USC 1531-TN1010), the review team is preparing a biological assessment that evaluates potential impacts of preconstruction, construction, and operations on Federally listed or proposed threatened or endangered aquatic and terrestrial and wetland species (see Appendix F). There are no areas designated as critical habitat on the PSEG Site, in the 6-mi vicinity, or along the proposed causeway.

Recreationally and commercially valuable species include those that are routinely hunted, such as white-tailed deer (*Odocoileus virginianus*) and a number of avian species. There are also two valuable furbearer species in the area (i.e., river otter and muskrat).

Most of the species identified on the site and in the vicinity are common to the region (see Section 2.4.1). Those rare or listed species that could potentially occur on the site more likely frequent higher quality habitat in the region.

PSEG Site and Vicinity

Terrestrial and Wetland Species of Recreational or Commercial Value

Recreationally valuable species that would be affected by the operation of a new nuclear power plant on the PSEG Site include numerous avian species and mammal species. As discussed in Section 4.3.1.2, most habitats available for recreationally valuable species on the PSEG Site and in the vicinity are common to the region. As described in Section 5.3.1.1, avian species have the potential to be affected by plant structures. There is no evidence linking any species present on the site to critical structure or function at the ecosystem level or that any species would serve as a biological indicator.

Federally or State-Listed Threatened or Endangered Species

The Federally and State-listed species that have the potential to occur on the PSEG Site and in the vicinity are described in Section 2.4.1.3 (Table 2-8). The only Federally listed species with a record of occurrence are the bog turtle (*Gyptemys muhlenbergii*) and swamp pink (*Helonias bullata*). Both of these species are discussed below. The Federally proposed endangered northern long-eared bat has the potential to occur in the vicinity of the site and is described below as well.

Reptiles and Amphibians

The bog turtle is Federally listed as threatened and is listed by both New Jersey and Delaware as endangered. This species was recorded historically on Artificial Island and in the vicinity during a study conducted between 1972 and 1978. However, there were no records for this species in the latest surveys conducted by PSEG in 2009 and 2010 (PSEG 2014-TN3452). Although the most recent distribution for bog turtles includes Salem County, the PSEG Site does not currently contain suitable habitat for this species. In addition, the U.S. Fish and Wildlife Service (FWS) previously indicated that this species is not known to occur on or in the vicinity of the HCGS and SGS sites (NRC 2011-TN3131). Bog turtles require large contiguous areas of land for dispersal, and intense land-uses such as those found on the PSEG Site are not favorable to this species. Furthermore, monocultures of invasive species, such as *Phragmites*, are not conducive to bog turtle presence. In a worst-case scenario, salt drift could affect potential bog turtle habitat in the vicinity. However, the chances of this happening are thought to be minimal because no damage to native vegetation has been recorded for HCGS (NRC 1996-TN288; NRC 1999-TN289). Therefore, it is not expected that the operation of a new nuclear power plant on the PSEG Site would impact this species.

The eastern tiger salamander (*Ambystoma tigrinum tigrinum*) is listed as endangered by both New Jersey. This species was recorded historically during the Artificial Island study (1972 to 1978). There were no records for this species in the latest surveys conducted by PSEG in 2009 and 2010 (PSEG 2014-TN3452). The altered habitat present on the PSEG Site would not appear to be conducive to supporting tiger salamander populations. In addition, surveys of this species conducted in 1995 revealed that the tiger salamander occurred at only a limited number of sites in Atlantic and Cumberland counties. Therefore, the operations phase of the PSEG project would not be expected to impact this species.

Birds

There were eight birds of prey identified as important species. These include the Cooper's hawk (*Accipiter cooperii*), northern goshawk, red-shouldered hawk (*Buteo lineatus*), northern harrier (*Circus cyaneus*), bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), American kestrel (*Falco sparverius*), and peregrine falcon (*Falco peregrinus*).

The Cooper's hawk is listed as special concern in New Jersey (Table 2-8). Cooper's hawks prefer large tracts of forested land where they nest in large, mature trees. One was observed in a small tree on the site in the fall of 2009. Preferred habitat for this species is not present on the site, and Cooper's hawks are more likely residents of forested habitat in the vicinity of the PSEG Site. Use of habitat at the PSEG Site by this species is most likely of a transient nature. Therefore, operations-related impacts to Cooper's hawks are expected to be minimal.

Northern goshawks, listed as endangered for the breeding population and special concern for the non-breeding population in New Jersey (Table 2-8), have been reported in the project vicinity during recent (2008 to 2009) Audubon Society Annual Christmas Bird Counts for Salem County (PSEG 2014-TN3452; Audubon 2013-TN2414). The PSEG Site contains no potential breeding habitat for goshawks and probably would provide only marginal non-breeding season habitat for this species during the operations stage of the project. Given the abundance of non-breeding season habitat in the site vicinity and the actual rarity of this species in the area, any impacts to the northern goshawk would be expected to be minimal.

The red-shouldered hawk, a New Jersey listed endangered species (Table 2-8), has been identified in recent years near the PSEG Site during the Audubon Society Annual Christmas Bird Counts for Salem County as discussed in Section 2.4.1. However, no red-shouldered hawks were observed on the site during the 2009 to 2010 PSEG field survey. There is no breeding habitat for this species on the PSEG Site, and this species probably only uses the site transiently. Preferred habitat for this species is available in the site vicinity. Therefore, operations-related impacts to red-shouldered hawks are expected to be minimal.

The northern harrier, listed as endangered in New Jersey and Delaware (Table 2-8), was commonly observed foraging in the coastal wetlands on the site and in proximity to the site. Nests were not observed on the site during the 2009 to 2010 field surveys; however, nesting habitat in the coastal marsh is present on the site and in the vicinity. Onsite habitat would have already been reduced by the time of operations, with abundant higher quality habitat remaining in the vicinity. The northern harrier has remained a common species in the area with ongoing operations at the nearby HCGS and SGS facilities.

Therefore, it would not be expected that this species would be impacted significantly with the addition of a new nuclear power plant on the PSEG Site. Therefore, impacts to the northern harrier during the operations stage are expected to be minimal.

Owing to its successful recovery, the bald eagle is no longer a Federally listed species by the FWS. The bald eagle was identified as important because of its status as a Federally protected species (16 USC 703-TN3331; 16 USC 668-TN1447) and as a State-listed endangered species for both New Jersey and Delaware (Table 2-8). Although bald eagles were occasionally

observed during the 2009 to 2010 onsite field survey, there are no known bald eagle nests or suitable roosting habitat at the PSEG Site. This is primarily due to the absence of large trees or suitable structures that could support nesting activities. Therefore, operations-related impacts to the bald eagle are expected to be minimal (PSEG 2014-TN3452).

Ospreys, a threatened species in New Jersey and a species of special concern in Delaware (Table 2-8), were occasionally observed both on the site and in the vicinity of the PSEG Site during the 2009 to 2010 field survey. Active osprey nests were observed on transmission towers along the current access road, on the transmission towers that run from the proposed site north towards Money Island Road, and on human-made nesting platforms constructed by PSEG along Alloway Creek. Potential nesting habitat in the form of additional transmission towers may be more plentiful after the construction phase of a new nuclear power plant. The osprey has remained a common species in the area with ongoing operations at the nearby HCGS and SGS facilities. Therefore, it would not be expected that this species would be significantly impacted with the addition of a new nuclear power plant. Consequently, impacts to the osprey during the operations stage are expected to be minimal.

American kestrels, listed as threatened in New Jersey (Table 2-8), have been reported in the PSEG Site vicinity by the USGS North American Breeding Bird Survey (BBS) and during recent (2005–2010) Audubon Society Annual Christmas Bird Counts for Salem County (PSEG 2014-TN3452; Audubon 2013-TN2414). This species was also recorded during past work conducted in the Alloway Creek Watershed (PSEG 2004-TN2897). The species was not recorded on the site during the 2009 to 2010 PSEG survey. This species prefers open country. A relatively small amount of potential American kestrel habitat would be permanently disturbed by building activities on the PSEG Site and causeway, and mitigation of those areas temporarily disturbed may actually improve habitat for this species during the operations phase. Large areas of higher quality and more suitable habitat are also present in the site vicinity. Consequently, impacts on kestrels during the operations phase are expected to be minimal.

Peregrine falcons, listed as endangered for the breeding population and special concern for the non-breeding population in New Jersey (Table 2-8), have been reported in the PSEG Site vicinity during recent (2005 to 2006) Audubon Society Annual Christmas Bird Counts for Salem County (PSEG 2014-TN3452; Audubon 2013-TN2414). There are no records for nesting peregrine falcons in Salem County. Any expected use of the PSEG Site by peregrines would be for foraging, which would most likely occur in the winter. This species favors open areas for hunting, frequently hunting over marshes, beaches, and open water. There would be some loss of potential foraging habitat (i.e., wetlands) for this species because of onsite and causeway development. However, large areas of higher quality suitable habitat exist in the site vicinity, and it is more likely that peregrines would use this higher quality adjacent habitat. Therefore, impacts on peregrine falcons during the operations phase are expected to be minimal.

A number of wading birds have been documented on and adjacent to the PSEG Site during past surveys. Several of these species have listed status in New Jersey and/or Delaware (Table 2-8). The list includes the following state-designated species of concern: great blue heron (*Ardea herodias*), little blue heron (*Egretta caerulea*), snowy egret (*Egretta thula*), and glossy ibis (*Plegadis falcinellus*). State-listed endangered and threatened species include black-crowned night-heron (*Nycticorax nycticorax*) and cattle egret (*Bubulcus ibis*). An

additional State-listed species, the pied-billed grebe (*Podilymbus podiceps*), has been observed in low numbers during Audubon Society Annual Christmas Bird Counts for Salem County. Common terns (*Sterna hirundo*), state-designated species of concern, also have been recorded at the site and in the vicinity. Spotted sandpipers (*Actitis macularius*), New Jersey state-designated species of concern, may also frequent such areas. There are no known heron/egret rookeries or tern colonies on the PSEG Site. The PSEG Site does contain potential foraging habitat that would be impacted permanently by construction. However, large areas of similar habitat exist in the vicinity of the site. In addition, these species have continued to frequent the area with ongoing operations at the nearby HCGS and SGS facilities (PSEG 2014-TN3452). Therefore, impacts to these species during the operations phase are expected to be minimal.

A number of New Jersey and/or Delaware State-listed bird species that typically frequent old fields and other open habitats have been recorded on or in the vicinity of the PSEG Site. These include state-designated species of concern, including brown thrasher (*Toxostoma rufum*), eastern meadowlark (*Sturnella magna*), and yellow-breasted chat (*Icteria virens*). Additionally, State-listed endangered and threatened species, such as horned lark (*Eremophila alpestris*), bobolink (*Dolichonyx oryzivorus*), grasshopper sparrow (*Ammodramus savannarum*), and savannah sparrow (*Passerculus sandwichensis*) are known to occur in these habitats (Table 2-8). The construction phase would permanently impact potential habitat for these species, and mitigation to restore habitat temporarily impacted could actually improve habitat for these species during the operations phase. In addition, these species would most likely use the large areas of higher quality habitat in the vicinity. Therefore, impacts to these species during the operations phase are expected to be minimal.

The red-headed woodpecker (*Melanerpes erythrocephalus*) breeding and non-breeding populations are listed by New Jersey as threatened (Table 2-8). No red-headed woodpeckers were observed during the 2009 to 2010 field survey, nor have they been reported in the USGS BBS or the Audubon Society Annual Christmas Bird Counts for Salem County. In addition, as noted in Section 2.4.1, the site and vicinity lack suitable habitat for this species (i.e., open woods, deciduous forests, forest edges, river bottoms, orchards, grasslands with scattered trees and clearings, and dead or dying trees). Therefore, it is not expected that this species would be present during the operations phase. Consequently, it is not expected that there would be any operations-related impacts to red-headed woodpeckers as a result of a new nuclear power plant at the PSEG Site.

The northern parula (*Parula americana*) and hooded warbler (*Wilsonia citrina*), New Jersey state-designated species of concern, are two warbler species recorded during USGS BBS surveys in the vicinity of the site. These species would not be impacted by the project because the site contains very little viable habitat to support them. Only transient use of the site would be expected for these species.

<u>Plants</u>

The sensitive joint vetch (*Aeschynomene virginica*) is Federally listed as threatened. The historic range of this species includes New Jersey counties of Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Middlesex, Monmouth, Morris, Ocean, and Salem, and Delaware counties of Kent, New Castle, and Sussex (FWS 2014-TN3319). Sensitive joint vetch is an

obligate wetland species that occurs in palustrine forested wetlands with canopy closures of 20 to 100 percent. There were no records of occurrences during studies conducted between 1972 and 1978 and surveys conducted from 2009 to 2010 (PSEG 2014-TN3452). Sensitive joint vetch is not expected to occur on the PSEG Site because of the lack of available habitat. Thus, operational impacts associated with a new nuclear power plant on the PSEG Site are not expected to affect this species.

Swamp pink (*Helonias bullata*) and whorled pogonia (*Isotria medeoloides*) are Federally listed as threatened. Swamp pink is an obligate wetlands species that occurs in palustrine forested wetlands with canopy closures of 20 to 100 percent. Although it is believed to occur in the vicinity of the PSEG Site, suitable habitat does not exist on the site. Small whorled pogonia grows in upland, mid-successional, wooded habitats, usually with mixed deciduous/coniferous forest with canopy trees ranging from 40 to 75 years old. Like the swamp pink, suitable habitat is not available on the PSEG Site. Thus, operational impacts associated with a new nuclear power plant on the PSEG Site are not expected to affect these species.

Other Important Species

The northern long-eared bat (*Myotis septentrionalis*) is known to occur in the northern and central portions of Salem County, New Jersey, and has the potential to be impacted by operations of a new nuclear power plant at the PSEG Site. The primary risk to northern long-eared bats is from collisions with power plant structures. As mentioned in Section 5.3.1.1, bat collisions are known to occur with human-made structures. However, collisions are attributed to bat migrations near these structures. There are no known bat populations on the PSEG Site, and hibernacula, maternity roosts, and foraging habitat are not available on the site. Northern long-eared bat mortality as a result of collisions with plant structures would not be expected. Therefore, the review team has determined that operating a new nuclear power plant on the PSEG Site would not affect the northern long-eared bat.

Green tree frogs (*Hyla cinerea*) were observed on the site in small isolated impounded areas within the PSEG desilt basin during the 2009 to 2010 survey (PSEG 2014-TN3452). A survey conducted in June and July 2012 also detected this species in the same general onsite location as well as in numerous offsite locations in the vicinity (AMEC 2012-TN3187). This was a new species record for New Jersey, although its range does extend throughout the Delmarva Peninsula to the south and west. The range of this species appears to be expanding and it is not listed on the New Jersey special concern, threatened, or endangered species lists. As discussed in Section 4.3.1, building a new nuclear power plant on the PSEG Site will alter or eliminate habitat for this species. However, the green tree frog was recorded in numerous offsite locations during the 2012 survey, some in the vicinity of the existing HCGS and SGS facilities. Therefore, the impacts of operations on this species would be expected to be minimal.

Summary of Operational Impacts on Important Terrestrial and Wetland Species at the PSEG Site and Vicinity

The impact on important terrestrial species resulting from the operation of a new nuclear power plant on the PSEG Site is projected to be minimal with no additional mitigation needed. Habitat available to important species that currently exist on the PSEG Site where operational activities

would occur is more common elsewhere in the vicinity. Avian collisions with the new nuclear power plant structures would be minimal and would not be a significant threat to overall bird populations in the area. Noise impacts would be localized and would attenuate with distance. Artificial lighting would not be expected to significantly disrupt important species behaviors beyond the PSEG Site. Therefore, the review team concludes that operational impacts to important terrestrial and wetland species would be negligible.

Important Terrestrial and Wetland Habitats—PSEG Site and Vicinity

Wetlands

Jurisdictional wetlands [i.e., those that are regulated by the USACE under Section 404 of the Clean Water Act (33 USC 1251-TN662)] are often more narrowly defined than wetlands identified as part of the NJDEP land use and land cover (LULC) classification system and are subject to USACE permitting requirements. Therefore, jurisdictional wetlands are evaluated separately from the LULC analysis presented in Section 5.3.1.1.

Wetland impacts during the operation of a new nuclear power plant at the PSEG Site would be limited to the operation of cooling towers. Cooling tower impacts on vegetation are discussed in Section 5.3.1.1. Cooling towers are expected to have the greatest influence on those wetland communities located to the east and southeast of the PSEG Site and include salt marsh or brackish marsh ecosystems dominated by species (*Phragmites australis* and *Spartina alterniflora*) with medium to high salinity tolerance. Previous surveys of salt drift from the existing HCGS cooling tower did not show any damage as the result of salt deposition, soil salinization, fogging, or icing. Analysis conducted for the PSEG Site did not indicate a high rate of fogging or other cooling tower induced precipitation (PSEG 2014-TN3452). Therefore, the impacts on wetlands from the operation of a new nuclear power plant on the PSEG Site are expected to be minimal.

Mad Horse Creek WMA and Abbotts Meadow WMA

As discussed in Section 4.3.1.2, Mad Horse Creek WMA and Abbotts Meadow WMA would be affected by the addition of a new nuclear power plant on the PSEG Site. The operational impacts to these important areas are associated with the proposed causeway. The proposed causeway would be elevated above the surface through these areas, and the flow of water through wetlands and open water is not expected to be affected (PSEG 2014-TN3452). However, damage as a result of shading may occur. Less than 1 ac is expected to be affected, which is less than 1 percent of the total available WMA. Therefore, the impacts of operating a new nuclear power plant at the PSEG Site on important terrestrial and wetland habitats on these WMAs are expected to be minimal.

Summary of Impacts to Important Habitats at the PSEG Site

Impacts to important habitats as a result of operations of a new nuclear power plant on the PSEG Site are expected to be minimal. The main impacts to wetlands would be from cooling tower operations. However, no perceptible impacts are expected based on the nature of the vegetation and previous studies that have been conducted on salt deposition resulting from

cooling towers in similar environments. Less than 1 percent of the WMAs would be impacted because of shading created by the proposed causeway. Although noticeable, the shading would have only a localized impact on species dependent on this resource. Therefore, the review team concludes that operational impacts on important habitats would be negligible.

5.3.1.3 Terrestrial and Wetland Monitoring During Operations

PSEG does not plan to conduct terrestrial and wetland monitoring during the operations phase of a new nuclear power plant (PSEG 2014-TN3452).

5.3.1.4 Potential Mitigation Measures for Terrestrial and Wetland Impacts

PSEG does not plan any specific mitigation measures and controls for ecosystems during the operations phase because any such impacts are expected to be negligible (PSEG 2014-TN3452).

5.3.1.5 Summary of Impacts to Terrestrial and Wetland Ecosystems

The potential impacts on vegetation, birds, and other wildlife due to operation of a new nuclear power plant at the PSEG Site with natural draft, mechanical draft, or fan-assisted proposed cooling towers are likely to be minimal. Owing to the nature of the vegetation in the vicinity of the PSEG Site (salt marsh or brackish marsh ecosystems with medium to high salinity tolerance), impacts from salt drift during operations is expected to be minimal. In addition, surveys conducted previously at the PSEG Site did not record any impacts from salt deposition because of drift from the existing HCGS NDCT for any specific plant species. Past research has shown that bird collisions with cooling towers do not appear to impact bird population levels. In addition, several years of data collected at the existing HCGS NDCT have shown few instances of bird collisions. Therefore, the review team concludes that operational impacts to terrestrial and wetland resources would be SMALL.

5.3.2 Aquatic Impacts Related to Operation

This section discusses the potential impacts of operating a new nuclear power plant at the PSEG Site on the aquatic resources of the Delaware River Estuary and nearby streams and ponds. A list of permits and certifications required to operate a new plant at the PSEG Site is included in Section 5.2.

5.3.2.1 Aquatic Resources–Site and Vicinity

Delaware River Estuary

All cooling water for the operation of a new nuclear power plant at the PSEG Site would be withdrawn from the Delaware River Estuary, and impacts associated with operation of the water intake system would be limited to aquatic resources within the Delaware River Estuary. For aquatic resources, the primary concerns are related to the amount of water withdrawn and the amount of water consumed through evaporation and the potential for organisms to be impinged on the intake screens or entrained into the cooling water system. Impingement occurs when aquatic organisms are drawn into the cooling water intake and are trapped against the intake

screens by the force of the water passing through the cooling water intake structure (66 FR 65256-TN243). Impingement can result in starvation, exhaustion, asphyxiation, descaling of fish, and other physical injuries (66 FR 65256-TN243). Entrainment occurs when aquatic organisms drawn into the intake structure are small enough to pass through the intake screens and the cooling system. Entrained organisms are usually passively drifting forms (plankton) or small, weakly swimming early life stages of fish and shellfish (66 FR 65256-TN243). As entrained organisms pass through the cooling system for a new plant at the PSEG Site, they would be subjected to mechanical, thermal, pressure, and chemical stresses.

A number of factors, such as the type of cooling system, the design and location of the intake structure, and the amount of water withdrawn from the source water body greatly influence the degree to which impingement and entrainment affect aquatic biota. Impingement and entrainment impacts are regulated by EPA or its designees (in this case, the NJDEP) under Section 316(b) of the CWA (33 USC 1251-TN662). Section 316(b) "requires that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact." A new nuclear power plant at the PSEG Site would employ closed-cycle cooling (PSEG 2014-TN3452). Depending on the quality of the makeup water, closed-cycle, recirculating cooling-water systems can reduce water use by 96 to 98 percent of the amount that the facility would use if it employed a once-through cooling system (66 FR 65256-TN243). This significant reduction in the water withdrawal rate results in a corresponding reduction in impingement and entrainment losses.

The intake design through-screen velocity is another factor that greatly influences the rate of impingement of fish and shellfish at a facility. In general, the higher the through-screen velocity, the greater the number of fish impinged. The EPA has established a national standard for the maximum design through-screen velocity of no more than 0.5 fps (66 FR 65256-TN243). The EPA determined that species and life stages evaluated in various studies could endure a velocity of 1.0 fps; they then applied a safety factor of two to drive the threshold of 0.5 fps. PSEG has stated that the proposed intake structure would be located flush with the east shoreline of the Delaware River Estuary and would be designed to have a through-screen velocity of less than 0.5 fps (PSEG 2014-TN3452). The resulting low through-screen velocity would reduce the probability of impingement because most fish can swim against such low flows to avoid the intake screens. The fish protection system, including the traveling screens and fish return, would be designed and operated to comply with the NJPDES permit that would be issued for the cooling system (PSEG 2014-TN3452).

Another factor affecting impingement and entrainment losses is the percentage of the flow of the source water body past the site that is withdrawn by the station. To minimize impacts, the EPA determined that for estuaries or tidal rivers, intake flow must be less than or equal to one percent of the tidal excursion (one tidal cycle of flood and ebb) volume (66 FR 65256-TN243). Makeup water for the cooling system would be drawn from the Delaware River Estuary at an average rate of 78,196 gpm (174 cfs), with consumptive use at a rate of 26,420 gpm (59 cfs) (PSEG 2014-TN3452). Tidal flows near the PSEG Site average 400,000 to 472,000 cfs, and the freshwater flow from the Delaware River and its tributaries averages 20,240 cfs. Therefore the makeup water use rate is less than 0.05 percent of the average flow of the Delaware River Estuary near the PSEG Site (PSEG 2014-TN3452).

Impingement

Because of its location on the Delaware River Estuary, a new nuclear power plant at the PSEG Site would impinge a variety of freshwater and marine fish and shellfish.

Data from the impingement studies for SGS (once-through cooling) indicate that between 50 and 67 finfish species are impinged each year, compared to just under 50 species of finfish impinged at HCGS (closed-cycle cooling) between 1986 and 1987. However, the number of sampling events differed dramatically between the two plants with only 46–48 sampling events at HCGS over the same years (1986–87) as the more than 530 sampling events per year at SGS (VJSA 1988-TN2564; ECS 1989-TN2572). The species composition in the screen samples also varied between SGS and HCGS during the 1986–87 sampling and varied at SGS between the sampling dates in the 1980s and sampling dates since 2003. Table 5-3 compares important, most abundant, and total finfish species, as well as blue crab (*Callinectes sapidus*), impinged at SGS and HCGS between 1986 and 1987 and at SGS between 2003 and 2010.

Table 5-3. Impingement Rate for Important Most Abundant and Total Finfish Species and Blue Crab Impinged at SGS and HCGS

Common Name	Scientific Name	Impingement Rate (# of individuals/$10^6 m^3$)		
		SGS (1986–87)[(a)]	HCGS (1986–87)[(a)]	SGS (2003–10)[(b)]
American Eel	*Anguilla rostrata*	7.6	13.4	4.1
Blueback Herring	*Alosa aestivalis*	49.1	5.0[(d)]	37.2
Alewife	*Alosa pseudoharengus*	7.6	1.1[(d)]	8.14
Bay Anchovy	*Anchoa mitchilli*	601.9	521.5	115.4[(d)]
Atlantic Menhaden	*Brevoortia tyrannus*	31.0	3.7[(d)]	28.9
Atlantic Silverside	*Menidia menidia*	18.6	15.1	46.7[(c)]
White Perch	*Morone americana*	359.3	27.9[(e)]	1066.4[(c)]
Striped Bass	*Morone saxatilis*	5.3	0.7[(d)]	78.8[(e)]
Weakfish	*Cynoscion regalis*	585.4	143.0[(c)]	486.4
Spot	*Leiostomus xanthurus*	13.8	2.1[(d)]	16.6
Atlantic Croaker	*Micropogonias undulatus*	109.8	965.4[(d)]	636.7[(d)]
Summer Flounder	*Paralichthys dentatus*	13.0	4.7[(c)]	4.1[(c)]
Oyster Toadfish	*Opsanus tau*	16.2	38.3[(c)]	1.8[(d)]
Northern Pipefish	*Syngnathus fuscus*	2.1	40.6[(e)]	4.1
Naked Goby	*Gobiosoma bosc*	2.3	303.2[(e)]	3.3
Hogchoker	*Trinectes maculatus*	636.4	112.2[(d)]	152.3[(c)]
Spotted Hake	*Urophycis regia*	58.6	7.0[(d)]	83.5
Gizzard Shad	*Dorosoma cepedianum*	14.3	1.7[(d)]	63.0[(c)]
American Shad	*Alosa sapidissima*	5.5	0.2	12.3[(c)]
Black Drum	*Pogonias cromis*	2.8	0.8	3.0
Black Sea Bass	*Centropristis striata*	3.0	2.0	0.4

Table 5-3 (continued)

Common Name	Scientific Name	Impingement Rate (# of individuals/$10^6 m^3$)		
		SGS (1986–87)[(a)]	HCGS (1986–87)[(a)]	SGS (2003–10)[(b)]
Butterfish	*Peprilus triacanthus*	0.7	ND	0.6
Channel Catfish	*Ictalurus punctatus*	0.9	1.0	8.2[(d)]
Conger Eel	*Conger oceanicus*	0.1	0.4	0.1
Northern Kingfish	*Menticirrhus saxatilis*	0.2	ND	12.2[(e)]
Northern Searobin	*Prionotus carolinus*	3.8	1.8	6.0
Scup	*Stenotomus chrysops*	ND	ND	1.4
Silver Hake	*Merluccius bilinearis*	0.4	0.1	0.1
Windowpane Flounder	*Scophthalmus aquosus*	4.7	2.4	5.2
Winter Flounder	*Pseudopleuronectes americanus*	0.3	0.4	1.1
Total finfish density rate[(f)]		**2,643.6**	**2,095.4**	**3,152.5**
Blue crab	*Callinectes sapidus*	1,542.5	2,450.1	690.4[(c)]
Total finfish and blue crab density rate[(f)]		**4,186.1**	**4,545.5**	**3,842.9**

Note: ND = not detected.
(a) Sources: VJSA 1988-TN2564; ECS 1989-TN2572.
(b) Sources: PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571.
(c) Differs from 1986–87 SGS impingement rate by more than a factor of 2.
(d) Differs from 1986–87 SGS impingement rate by more than a factor of 5.
(e) Differs from 1986–87 SGS impingement rate by more than a factor of 10.
(f) Includes all finfish impinged, not just those listed in table.

Within the 1986–1987 sampling years, species composition differed between SGS and HCGS. Many of the abundant or important species impinged at SGS were either not as abundant at HCGS at similar densities or were noticeably more abundant at HCGS than at SGS. Species that shared similar densities included blue crab, American Eel (*Anguilla rostrata*), Bay Anchovy (*Anchoa mitchilli*), and Atlantic Silverside (*Menidia menidia*). Total density of impinged fish at both SGS and HCGS between 1986 and 1987 was comparable and was calculated using the number of a given species collected per million cubic meters of intake water volume sampled.

Differences in impinged species composition between SGS and HCGS may be attributable to the different physical locations of the intake structures of the two existing sites (i.e., southwest for the SGS cooling water intake structure versus west for the HCGS service water intake structure) and differences in intake screening technology and screen approach velocities (PSEG 2014-TN3452).

The comparison of the SGS 1986–87 impingement data with SGS 2003–10 impingement data shows shifts in specific species abundance. Calculating mean density impinged per volume of

water corrects for the difference in number of sampling events as more frequent samples were collected between 2003 and 2010. Interestingly, the total abundance of blue crab, Bay Anchovy, Summer Flounder (*Paralichthys dentatus*), Oyster Toadfish (*Opsanus tau*), and Hogchoker (*Trinectes maculatus*) diminished by a factor of 2 or more since the 1986–87 sampling events. However, increases in Atlantic Silverside, White Perch (*Morone americana*), Striped Bass (*Morone saxatilis*), Atlantic Croaker (*Micropogonias undulatus*), American Shad (*Alosa sapidissima*), Channel Catfish (*Ictalurus punctatus*), Northern Kingfish (*Menticirrhus saxatilis*), and Gizzard Shad (*Dorosoma cepedianum*) are evident since the 1986–87 sampling. Of note, impingement data for SGS from 2008–10 (PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571), were also examined and compared with the 2003–07 SGS impingement data (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569) to assess any recent deviation from the previous 2003–07 trend (data not shown in table). Gizzard Shad, Northern Kingfish, Black Drum (*Pogonias cromis*), and Atlantic Menhaden (*Brevoortia tyrannus*) all increased by a factor of 2 in the more recent sampling. However, Blueback Herring (*Alosa aestivalis*), Atlantic Croaker, Butterfish (*Peprilus triacanthus*), Channel Catfish, Scup (*Stenotomus chrysops*), and Spotted Hake (*Urophycis regia*) were all reduced by a factor of 2 in the more recent sampling. These deviations in annual averages may represent changes to environmental conditions at the larger regional scale and do not appear to reflect any longer term trends in abundance.

Impingement mortality was not reported during the HCGS impingement sampling in 1986 or 1987 (VJSA 1988-TN2564; ECS 1989-TN2572). However, sampling at SGS between 1986 and 1987 and between 2003 and 2010 reported between 97 percent and 100 percent live, undamaged blue crab and live condition for greater than 50 percent of the finfish impinged with the exception of White Perch and Atlantic Croaker juveniles between 1986 and 1987 (VJSA 1988-TN2564; ECS 1989-TN2572; PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Historical impingement rates for the aquatic community from SGS (2003–10) and HCGS (1986–87) were used to estimate potential impingement losses associated with the operation of a new nuclear power plant at the PSEG Site (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571, VJSA 1988-TN2564; ECS 1989-TN2572). HCGS is more similar to a new plant at the PSEG Site because it has a closed-cycle cooling system design, which differs from the once-through cooling system of SGS. SGS withdraws larger volumes of water from the Delaware River Estuary with a faster through-screen velocity (0.9 fps), and therefore, SGS would be expected to impinge more fish than the closed-cycle cooling systems of HCGS and a new power plant.

PSEG examined the most recent HCGS impingement data from 1986 and 1987 with same year impingement data for SGS and derived a correction factor by dividing the HCGS data by the SGS data to allow comparison between the two plants and normalize the differences in intake volume and velocity (VJSA 1988-TN2564; ECS 1989-TN2572). Examination of 1986–87 density impingement rates for finfish show a total impingement density average of 2,095.4 organisms per million m^3 total water volume for HCGS and 2,643.6 organisms per million m^3 total water volume for SGS. When combining both finfish and blue crab impingement rates, HCGS has a

total impingement density average of 4,545.5 organisms per million m^3 total water volume and 4,189.1 organisms per million m^3 total water volume for SGS. The more recent impingement rates for SGS between 2003 and 2010 report a finfish impingement rate of 3,152.5 organisms per million m^3 total water volume and a combined blue crab and finfish impingement rate of 3,842.9 organisms per million m^3 total water volume. Therefore, a correction factor may not be needed to assess total organism impingement, and PSEG used a conservative approach for assessing potential impingement rates for a new nuclear power plant in its ER. However, for comparative purposes, PSEG presented in its ER both the conservative assumption and the correction factor for estimating potential impingement rates (PSEG 2014-TN3452).

Sampled total finfish density was moderately lower at HCGS relative to SGS using data sets from either 1986 to 1987 or 2003 to 2010, possibly because of the lower approach velocities to the HCGS screens. The only commercially important invertebrate vulnerable to substantial impingement by the intake structure of a new nuclear power plant at the PSEG Site is the blue crab. Blue crab densities for impingement samples at SGS were 690.4 per million m^3 total water volume between 2003 and 2010 and 1,542.5 per million m^3 total water volume in 1986 to 1987. At HCGS, blue crabs were impinged at a mean rate of 2,450.1 per million m^3 total water volume in 1986–87 (see Table 5-3). It is possible that the rate of impingement at a new nuclear power plant at the PSEG Site for blue crab may be less than in 1986–87 because there was a significant drop in impingement abundance of blue crab at SGS between the sampling dates in the 1980s and the average of 8 years of more recent sampling.

The applicant estimated impingement rates of finfish at a new nuclear power plant at the PSEG Site by multiplying the more recent SGS impingement densities by a correction factor representing the ratio of the total finfish impingement density at HCGS (1986–87) to that of SGS for the same period. Recent examination of these data sets and impingement rates derives the correction factor to be 0.79 (2,095.4/2,643.6). It is reasonable to use the historical HCGS impingement rate correction factor for the estimate of impingement rate at a new plant at the PSEG Site because the intake design velocity for a new plant (less than 0.5 fps) is more comparable to HCGS than to SGS (roughly 0.9 fps). Thus, the estimated total impingement rate of finfish due to operation of a new plant is 2,490.5 per million m^3 total water volume compared to the more recent impingement rate of 3,152.5 per million m^3 total water volume for SGS. White Perch, Atlantic Croaker, and Weakfish (*Cynoscion regalis*) are expected to comprise the majority of the impingement total. The proposed maximum rate of water withdrawal for a new nuclear power plant at the PSEG Site is equivalent to 3.7 percent of the intake flow at SGS (PSEG 2014-TN3452). Assuming a constant withdrawal of 78,196 gpm for a new plant, and using the 79 percent correction factor for finfish impingement, a new plant would result in impingement of an estimated 386,526 fish annually. Using the conservative assumption with no correction factor, and a maximum rate of water withdrawal for a new plant of 3.7 percent of the intake flow of SGS, approximately 489,148 fish would be impinged annually at a new plant at the PSEG Site (PSEG 2014-TN3452).

The intake structure for a new nuclear power plant at the PSEG Site would contain traveling screens to collect debris and fish. Impinged organic debris and aquatic organisms would be washed from the traveling screens and returned to the Delaware River Estuary. Mixed organic and manmade debris (e.g., wood, plastic) collected from the trash racks would be disposed offsite.

Details about the screen design, screen wash, and fish return system are not available, but PSEG has stated in its ER that the screen design would be compliant with EPA 316(b) Phase I requirements specified in 40 CFR 125.84 (40 CFR 125-TN254), similar to screens at HCGS, and would include low-pressure screen washes to safely remove impinged organisms and water-filled fish buckets to improve the survival of screen-washed fish and shellfish until they are transported back to the Delaware River Estuary by the fish return system (PSEG 2014-TN3452).

In terms of numbers, the estimated impingement of most fish species is a small percentage of the commercial and recreational harvests of these species in Delaware and New Jersey as described in Section 2.4.2. Blue crab, Weakfish, White Perch, and Atlantic Croaker potentially would have the highest impingement rates at a new nuclear power plant at the PSEG Site. However, it is expected that a large portion of these impinged organisms would survive because of the comparable impingement mortality recorded for SGS with a higher through-screen velocity than would be used for a new plant. Based on the planned low through-screen intake velocity and the use of closed-cycle cooling, the review team concludes that impacts from impingement of aquatic organisms at a new nuclear power plant at the PSEG Site would be minor.

Entrainment

Small, passively drifting, or weakly swimming aquatic organisms that are drawn into the intake and pass through the openings in the traveling screens would be killed by passage through the closed-cycle cooling system. Some entrained organisms are present year-round, such as phytoplankton and many types of zooplankton. These diverse plant and animal species (often referred to as holoplankton) are abundant throughout the Delaware River Estuary and have short generation times, so they can rapidly replace the losses due to entrainment, heat shock, and other stresses. Other entrained organisms, such as the larval stages of fish, crabs, and other bottom-dwelling crustaceans, are present only seasonally near the proposed intake of a new nuclear power plant at the PSEG Site. However, many of these seasonally planktonic organisms (collectively referred to as meroplankton) have longer life spans and generation times, so losses from cooling system effects are not as readily replaced.

The history of entrainment sampling at SGS and analyses of entrainment losses are described in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants—Supplement 45: Regarding Hope Creek Generating Station and Salem Nuclear Generating Station, Units 1 and 2, Final Report* (NRC 2011-TN3131). Most recently, entrainment of fish eggs, larvae, juveniles, and adults in the SGS cooling water system was studied between 2003 and 2010 (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). Over the 8-year period, between 25 and 38 species were identified each year among the entrained fish (eggs, larvae, small juveniles, and adults). Of these, 92 percent of the entrainment samples were composed of two species: Bay Anchovy (75.3 percent) and Naked Goby (*Gobiosoma bosc*) (16.7 percent). Additional species that comprised over 98 percent of all entrained species included Atlantic Croaker (3.5 percent), Striped Bass (1.4 percent), Weakfish (0.8 percent), Atlantic Menhaden (0.4 percent), and Atlantic Silverside (0.4 percent). Bay Anchovy was the most abundantly entrained species for the egg (99.7 percent) and adult (57 percent) life stages, while Naked Goby was the most abundantly entrained larval species

(49 percent), and Atlantic Croaker was the most abundantly entrained juvenile species (56 percent) (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). Seasonal vulnerability to entrainment is species-specific. For example, eggs, larvae, and juveniles of Bay Anchovy were most numerous in entrainment samples in summer months (June and July), whereas Atlantic Croaker juveniles were most abundant in the fall (October and November) (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). In general, the densities of entrained individuals for most fish species were greatest in the spring and/or summer, corresponding to the spawning periods for these species. Total densities of all fish life stages in the entrainment samples ranged from 54.0/100 m^3 (2003) to 264.2/100 m^3 (2007) and averaged 125.0/100 m^3 (PSEG 2014-TN3452).

PSEG applied estimated annual entrainment rates from SGS directly to calculate entrainment rates for a new nuclear power plant at the PSEG Site. The entrainment rates at SGS were applied to a new plant without a correction factor because entrained organisms are planktonic. Entrainment rates are a function of water withdrawal rates and are not influenced by through-screen velocities. Entrainment of holoplankton and meroplankton would be much smaller for a new plant than for SGS because of the smaller volume of water withdrawn by the closed-cycle system at a new plant. Based on the small volume of water withdrawn for the closed-cycle cooling water system at a new plant at the PSEG Site, the annual entrainment of organisms during operation of the intake system is expected to be minor and average less than 125 organisms per 100 m^3. The species most likely to be entrained is the Bay Anchovy, a highly abundant species in the area with females spawning every 4 to 5 days over the spawning season (Zastrow et al. 1991-TN2670).

Cooling-Water Discharge Impacts

Blowdown from the cooling towers, SWS, and other aqueous waste streams at a new nuclear power plant at the PSEG Site would be combined and discharged to the Delaware River Estuary at an average flow rate of 50,516 gpm (113 cfs) and a velocity of 9.2 fps, as described in Section 5.2.3.1. The submerged 48-in. diameter discharge pipe would be located 8,000 ft north of the SGS discharge pipe and 4,000 ft north of the HCGS discharge pipe. The outlet of the discharge pipe would be 100 ft from the shoreline, 12 ft below mean lower low water and 3 ft above the river bottom (PSEG 2014-TN3452). Relative to the Delaware River Estuary, the discharged water would have an elevated temperature and increased concentration of both natural chemical constituents and chemical contaminants. Because of the tidal nature of the Delaware River Estuary in this area, the direction of the thermal discharge plume would vary with the tidal cycle.

Thermal Impacts

Potential thermal impacts on aquatic organisms could include heat stress, cold shock, and the creation of favorable conditions for invasive species.

As described in Section 5.2.3.1, the portion of the Delaware River Estuary where discharge would occur is located in Zone 5 between Delaware RM 78.8 and RM 48.2. The DRBC

temperature-related standards for Zone 5 require that the discharge-induced water temperature increases above the ambient water temperature in the river outside the permitted HDA may not increase by more than 4°F (2.2°C) from September through May and by 1.5°F (0.8°C) from June through August, with a year-round maximum water temperature of 86°F (30°C) (18 CFR 410-TN3235; DRBC 2011-TN2371) (Figure 5-2). Recent trawling of the Delaware River Estuary zone in the vicinity of SGS and HCGS between 2003 and 2010 has not identified significant shifts in species abundances near the SGS and HCGS discharge areas compared to adjacent zones (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). The volume of the thermal discharge from a new nuclear power plant at the PSEG Site (50,516 gpm) is only 2.4 percent of that from SGS (about 2,100,000 gpm circulated through the once-through cooling system) (PSEG 2014-TN3452). As discussed in Section 5.2.3.1, the thermal plume of the discharge from a new plant would have a maximum extent of about 700 ft into the river from the discharge location, about 300 ft upstream from the discharge, and about 500 ft downstream from the discharge. This plume would be contained completely within the existing SGS HDA and would not be expected to impede fish migration. During flood tide conditions, when the median water temperature exceeds 79.4°F, the review team estimated that a portion of the thermal plume would exceed 86°F due to the cumulative effects from SGS, HCGS, and a new plant (3.6°F, 1.5°F, 1.5°F, respectively; see Figure 5-2). However, the combination of high velocity discharge, turbulence in the discharge outlet area, and rapid mixing of the discharge effluent would limit the size of the thermal plume.

A factor related to thermal discharges that may affect aquatic biota is cold shock. Cold shock occurs when aquatic organisms that have been acclimated to warm water are exposed to a sudden temperature decrease. This sometimes occurs when single-unit power plants shut down suddenly in winter or when an unseasonable cold weather event occurs. Cold shock is less likely to occur at a multiple-unit plant because the temperature decrease from shutting down one unit is moderated by the heated discharge from the units that continue to operate. Based on the foregoing, any thermal impacts on the fish populations due to cold shock would be expected to be minor.

Chemical Impacts

As described in Section 3.2.1.2, the cycles of concentration increase the concentration of TDS and minerals in the blowdown. In addition, the blowdown would contain chemical additives such as biocides and pH-adjusting chemicals to ensure proper functioning of the cooling towers. Predicted concentrations of dissolved chemical constituents in the discharges from the cooling water and other systems are expected to be compliant and controlled by the terms of the NJPDES permit that would be issued for a new plant at the PSEG Site (PSEG 2014-TN3452).

Physical Impacts

Because of the increased temperature and chemical content of the discharged water compared to ambient conditions, the plume is expected to be negatively buoyant (PSEG 2014-TN3452). Due to the discharge’s high velocity of 9.21 fps, there would be rapid mixing with tidal currents upstream and downstream, with some potential for scouring occurring at the point of discharge. To minimize the scouring potential, PSEG would place riprap or other engineered features near

the end of the discharge pipe and reduce the possible interactions of the discharge plume with bottom habitats and bottom-dwelling aquatic organisms (PSEG 2014-TN3452).

Use of the HCGS barge slip and the new barge storage and unloading facility are expected to be infrequent during operation. However, propeller wash may cause localized scouring and sedimentation within the barge slip. Because this area would be previously disturbed during site preparation and used during transport of building materials, it is unlikely that the temporary habitat disruption would have adverse effects on the aquatic communities in the area (PSEG 2014-TN3452). Adjacent, undisturbed habitat is available, and mobile aquatic organisms would likely avoid the barge slip area.

Dredging may be required to maintain use of the HCGS barge slip and the intake channel as well as barge storage and unloading facility during operation. Any effects to water quality, such as siltation, during these infrequent periods would be temporary and would be managed through the use of Federal and State permitting requirements for use of BMPs, and dredged material disposal would be in approved upland disposal areas (PSEG 2014-TN3452). Mobile organisms in the area would avoid activities involved in dredging and could use adjacent, undisturbed habitat during the temporary disruption.

Based on the foregoing, the review team concludes that the thermal, chemical, and physical impacts of discharge from a new nuclear power plant at the PSEG Site on habitat and aquatic biota in the Delaware River Estuary would be minor.

Stormwater Management

As described in 5.2.3.1, PSEG would develop an SWPPP to minimize stormwater drainage effects to nearby surface waters. The SWPPP would be required to meet NJPDES stormwater discharge requirements.

5.3.2.2 Aquatic Resources–Offsite Areas

Maintenance of the proposed causeway could result in soil disturbance (erosion, suspended sediments, sedimentation) and the addition of road chemicals to offsite water bodies. The resulting water quality degradation could in turn affect aquatic biota.

Causeway maintenance activities could temporarily degrade surface water quality and aquatic habitats. PSEG expects to minimize the impacts of such activities by using temporary work mats and other impact-reducing measures. The presence of the causeway would introduce permanent shading patterns for the marsh creeks crossed by the causeway, which would reduce sunlight required for primary productivity. While primary productivity may be reduced for these areas, abundant adjacent marsh creek resources would be expected to remain unaffected. Compliance with Federal and State permits is expected to prevent degradation of water quality and aquatic resources through use of required BMPs to minimize impacts (PSEG 2014-TN3452).

5.3.2.3 Important Aquatic Species and Habitats

This section describes the potential impacts to important aquatic species and habitats from operation and maintenance of a new nuclear power plant at the PSEG Site. Important species include Federally threatened, endangered, or candidate species; those species listed by the states of New Jersey and Delaware as threatened, endangered, or of special concern; commercially or recreationally important fish and shellfish; or species that affect the well-being of the above species or are critical to the structure and function of a valuable ecological system. Important aquatic species and aquatic habitats in the vicinity of the PSEG Site are described in Section 2.4.2.3.

Important Recreational or Commercial Aquatic Species

In the Delaware River Estuary in the vicinity of the PSEG Site, 21 species of finfish have been identified as being commercially or recreationally important in New Jersey or Delaware (see Section 2.4.2.3). In addition to these fish species, three species of invertebrates, which occur in the region, are commercially harvested in New Jersey and Delaware, including the blue crab, eastern oyster (*Crassostrea virginica*), and northern quahog clam (*Mercenaria mercenaria*) (PSEG 2014-TN3452). A fourth invertebrate species, the horseshoe crab (*Limulus polyphemus*), is harvested in Delaware. Since 2008 there has been a moratorium in place on the harvest of horseshoe crabs in New Jersey (ASMFC 2014-TN3511).

Previous impingement and entrainment studies at SGS and HCGS commonly collected the following commercially or recreationally important species: Weakfish, Atlantic Croaker, White Perch, Striped Bass, and blue crab. Although these species were observed in these studies, trawling and seining studies in the Delaware River Estuary show that these populations experience annual changes in relative density throughout the watershed, yet remain abundant (see Section 2.4.2; PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571).

Trawl surveys in the PSEG sampling zone near SGS, HCGS, and the PSEG Site show reduced numbers of commercially and recreationally important species when compared to other regions in the estuary because most of these species prefer marine habitats (PSEG 2004-TN2565; PSEG 2005-TN2566; PSEG 2006-TN2567; PSEG 2007-TN2568; PSEG 2008-TN2569; PSEG 2009-TN2513; PSEG 2010-TN2570; PSEG 2011-TN2571). Therefore, cooling water intake and discharge operation at a new plant is not expected to have noticeable effects on commercially and recreationally important species that occur in the Delaware River Estuary.

Because a new nuclear power plant at the PSEG Site would have a closed-cycle cooling system, the amounts of water withdrawn and discharged would be a small fraction of the Delaware River Estuary flow. In addition, traveling intake screens with a low through-mesh velocity of less than 0.5 fps would permit the survival of a portion of the impinged aquatic organisms that are returned to the river (Section 5.3.2.1). The effects of operation of a new plant's cooling system on important aquatic species in the Delaware River are expected to be minor.

Non-native and Nuisance Species

Invasive species that may occur in the Delaware River Estuary include the Asian shore crab (*Hemigrapsus sanguineus*), Chinese mitten crab (*Eriocheir sinensis*), the Northern Snakehead (*Channa argus*), and the Flathead Catfish (*Pylodictis olivaris*). While each of these species has been documented in the vicinity of the PSEG Site, there are no reports that would indicate they have increased in abundance and would pose a risk to operation of a new nuclear power plant, nor would operation of a new plant be expected to increase occurrences of these species.

Aquatic Threatened or Endangered Species

As part of NRC responsibilities under ESA Section 7, the review team is preparing a biological assessment documenting potential impacts on Federally listed threatened or endangered aquatic species as a result of operating a new nuclear power plant at the PSEG Site. The loggerhead sea turtle (*Caretta caretta*), Atlantic green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), hawksbill sea turtle (*Eretmochelys imbricata*), leatherback sea turtle (*Dermochelys coriacea*), Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*), and Shortnose Sturgeon (*A. brevirostrum*) are Federally listed threatened or endangered species known to occur in the vicinity of the PSEG Site (NMFS 2010-TN2171; NMFS 2013-TN2804). A biological assessment is provided in Appendix F, and the findings and determinations are summarized in this section. The review team has determined that no critical habitat occurs near any of the planned building areas. The sea turtles and sturgeon do not nest or reproduce in the vicinity of the PSEG Site intake or discharge. Therefore, the impact of intake or discharge operations on newly hatched turtles or eggs and fry of sturgeon would be insignificant. Because the flow requirements under 316(b) require through-screen velocities of 0.5 fps or less, any juvenile, subadult, and adult healthy sea turtles or sturgeon that enter the intake area during operation would be able to swim away. However, injured or moribund species may become entrapped on the intake trash bars or traveling screens. There have been no documented protected species found on the intake trash bars or traveling screens for HCGS, which uses intake and discharge technologies (closed-cycle cooling) similar to what is being proposed for a new nuclear power plant at the PSEG Site. For the once-through cooling intakes at SGS, live and dead loggerhead, Atlantic green, and Kemp's ridley sea turtles, as well as Shortnose and Atlantic Sturgeon, have been collected from the intake bays or trash racks and documented extensively as part of the operation parameters for SGS (see Section 2.4.2.3). Discharge of effluent from a new nuclear power plant would not significantly affect Federally or State-listed species due to rapid mixing under tidal influence in the immediate Delaware River Estuary discharge area. Dredging or maintenance activities for the HCGS barge slip, intake channel, barge storage and unloading facility, and causeway are expected to create temporary, localized disturbances that could be minimized and/or avoided using BMPs required to minimize impacts to water quality under Federal and State permits. This may also be accomplished through permit conditions in the State and Federal permits, and as such would not adversely affect any listed species. Therefore, operation of a new nuclear power plant at the PSEG Site may affect, but is not likely to adversely affect, juvenile, subadult, and adult sea turtles or sturgeon.

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act defines adverse effects to essential fish habitat (EFH) as including "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…" A new nuclear power plant at the PSEG Site would affect EFH primarily through operation of the cooling water system. Water withdrawn for cooling is no longer available as fish habitat, and fish and their food can be lost due to impingement and entrainment. Blowdown water returned to the Delaware River Estuary as heated effluent would change the natural thermal and water current regimes in fish habitat. Consequently, the proposed action has the potential to alter at least some aspects of EFH. Appendix F contains a detailed discussion of potential impacts on EFH.

5.3.2.4 Aquatic Monitoring During Operation

The NJPDES permit for a new nuclear power plant at the PSEG Site would have monitoring requirements related to thermal and chemical constituents of waste streams. Discharge monitoring of regulated chemical constituents would be part of on-going operations of a new plant to ensure compliance with NJPDES permit limits. Monitoring of intake effects (entrainment and impingement) is required as a condition of the NJPDES permit and would be similar to the 2 years of initial monitoring required for HCGS, which also employs a closed-cycle cooling system. The NJPDES permit is required for the entire duration of site operation and must be renewed every 5 years, with provisions for updating monitoring programs and parameters, as necessary (PSEG 2014-TN3452).

5.3.2.5 Summary of Operational Impacts to Aquatic Resources

Operation of a new nuclear power plant at the PSEG Site would increase the entrainment and impingement of aquatic organisms and the discharge of heat and chemical contaminants to the Delaware River Estuary that are already occurring as a result of the operation of SGS and HCGS. However, because a new plant would use a closed-cycle cooling system and a fish screening system designed to increase the survival of impinged fish, these impacts are expected to have no more than minor impacts to the aquatic resources in the area. Other impacts from operational activities, such as maintenance dredging and causeway maintenance, are expected to be minor. Based on this review, the review team has determined the impacts resulting from operational and maintenance activities would be SMALL.

5.4 Socioeconomic Impacts

Operation of a new nuclear power plant on the PSEG Site could affect individual communities, the surrounding region, and minority and low-income populations. This section assesses the impacts of operations-related activities and the associated workforce on the region. The review team reviewed the PSEG ER (PSEG 2014-TN3452) and verified the data sources used in its application by examining cited references and independently confirming data in discussions with community members and public officials (NRC 2012-TN2499). To verify data in the ER, the review team requested clarifications and additional information from PSEG as needed. Unless otherwise specified in the sections below, the review team has drawn upon verified data from

PSEG (PSEG 2012-TN2450; PSEG 2012-TN2370). Where the review team used different analytical methods or additional information for its own analysis, the EIS includes explanatory discussions and citations for the additional sources.

Although the review team considered the entire region within a 50-mi radius of the PSEG Site when assessing socioeconomic impacts, because of expected commuter patterns, the distribution of residential communities in the area, and the likely socioeconomic impacts, the review team identified a primary economic impact area composed of the four counties nearest the site—Salem, Cumberland, and Gloucester Counties in New Jersey and New Castle County in Delaware—as the area with the greatest potential for economic impacts.

Section 5.4.1 presents a summary of the physical impacts of the project. Section 5.4.2 provides a description of the demographic impacts. Section 5.4.3 describes the economic impacts, including impacts on the local and state economy and tax revenues. Section 5.4.4 describes the impacts on infrastructure and community services. Section 5.4.5 summarizes the socioeconomic impacts of operations activities at the PSEG Site.

5.4.1 Physical Impacts

Operations at the PSEG Site would cause physical impacts to nearby communities, including noise, odors, exhausts, thermal emissions, and visual intrusions. The review team expects some of these impacts would be mitigated by compliance with all applicable Federal, State, and local environmental regulations and site-specific permit conditions. This section addresses potential physical impacts that may affect people, buildings, and roads.

5.4.1.1 Workers and the Local Public

This section discusses potential effects of air emissions and noise on workers, nearby residents, and nearby users of recreational facilities. The PSEG Site is located adjacent to the existing HCGS and SGS, Units 1 and 2, in Lower Alloways Creek Township, Salem County, New Jersey. The site is located on the southern part of Artificial Island on the east bank of the Delaware River, about 15 mi south of the Delaware Memorial Bridge, 18 mi south of Wilmington, Delaware, 30 mi southwest of Philadelphia, Pennsylvania, and 7.5 mi southwest of Salem, New Jersey.

The nearest residences to the PSEG Site are located about 2.8 mi to the west in New Castle County, Delaware, and about 3.4 mi to the east–northeast in the Hancock’s Bridge community of Salem County, New Jersey (PSEG 2014-TN3452). The closest recreational areas are the Augustine Beach Access Area and Augustine Wildlife Area, which are approximately 3.1 and 3.6 mi, respectively, across the Delaware River from the PSEG Site. Because of distance and intervening foliage, residents and visitors to recreational areas would experience minimal impacts.

All activities related to operation at the PSEG Site would occur within the site boundary and would be performed in compliance with Occupational Safety and Health Administration (OSHA) standards, BMPs, and other applicable regulatory and permit requirements.

Because of the close proximity of workers to the sources of operations-related physical impacts, onsite workers involved in operational activities at the PSEG Site would experience the most direct exposure to physical impacts, followed by operational workers at the adjacent HCGS and

SGS. Excessive noise is expected inside some buildings, so workers would wear personal protective equipment. Auxiliary boilers, cooling towers, emergency diesel generators, and/or combustion engines would be required to meet workplace and environmental standards before startup. The PSEG Site would comply with OSHA standards for onsite exposure to noise, vapors, dusts, and other air contaminants for workers. Operations workers also would receive safety training. Emergency first aid care would be available, and regular health and safety monitoring would be conducted (PSEG 2014-TN3452). Consequently, the review team determined the physical impacts to onsite workers would also be minimal.

5.4.1.2 Noise

The main sources of noise during operations at the PSEG Site would be from the switchyard, transformers, and cooling towers. Fan assisted natural-draft cooling towers are the bounding noise element with 60 dBA at 1,000 ft. At 10,000 ft, the noise level would be 41 dBA. New Jersey provides regulatory limits for continuous noise sources. During the day, New Jersey has a 65 dBA limit at the property line of industrial facilities. New Jersey also has 65 dBA limits at residential property lines during the day and 50 dBA nighttime limits. Delaware has similar regulatory limits of 65 dBA limits at residential property lines and 55 dBA nighttime limits. The closest residences are 14,700 ft west and 15,900 ft east of the site. The closest recreational areas are even farther than the residential areas (PSEG 2014-TN3452). Because of these distances and regulatory limits, the review team does not expect residents of the area to experience impacts in the form of noise during operations. Projected noise impacts from operation at the PSEG Site are discussed in further detail in Section 5.8.2.

5.4.1.3 Air Quality

The main sources for emissions with plant operation are cooling towers, auxiliary boilers for plant heating and startup, engine driven emergency equipment, and diesel generators and/or combustion turbines. Cooling tower emissions are discussed separately in Section 5.7. The bounding PPE assumptions are for six backup diesel generators. Emissions sources discussed above would be small, would be used infrequently (except the cooling tower), and would require permits from NJDEP. Therefore, the review team concludes that physical impacts on air quality would be minimal. Projected air emissions and impacts on air quality from operation at the PSEG Site are discussed in further detail in Section 5.7.

5.4.1.4 Buildings

Activities associated with operations at the PSEG Site would not affect offsite buildings because of distance and intervening terrain. Onsite buildings are designed to withstand any impact from operational activities. Consequently, the review team determines the operations impacts on onsite and offsite buildings would be minimal.

5.4.1.5 Transportation

This EIS assesses the impact of workers commuting to and from the PSEG Site from three perspectives: socioeconomic impacts from congestion and reductions in levels of service (LOS), air quality impacts resulting from the emissions from vehicles, and the potential health

impacts caused by traffic-related accidents. Only the physical impacts are addressed here. Section 2.5.2.3 describes the local transportation network around the PSEG Site, and Figure 2-23 depicts the road and highway system in the economic impact area. Section 4.4.1.3 discusses the building impacts on roads in the economic impact area. Section 5.4.4.1 addresses traffic impacts. Air quality impacts from vehicle emissions are addressed in Section 5.7, and human health impacts are addressed in Section 5.8.

Roads

Use of area roadways by commuting workers could contribute to physical deterioration of roadway surfaces. However, some or all the mitigation measures incorporated during the building phase would remain in place during operations (see Section 4.4.1.3). Given the much smaller volume of traffic on the roads during operations compared to building, the review team determines that the overall impacts on road quality would be less than the impacts on road quality from building activities. Therefore, the operations-related impacts on road quality would be minimal.

Water

As discussed in Section 2.5.2.3, there is an existing barge facility at the HCGS site. To support delivery of large components and equipment for building, PSEG indicated that the existing barge facility at HCGS would need to be modified, and a parallel barge facility would need to be constructed. Both would be built to regulatory requirements. The barge slips and the expected barge deliveries are expected to have a negligible impact on river traffic on the Delaware River.

Rail

There are no railroads within about 7 mi of the PSEG Site (NRC 2011-TN3131). PSEG has not indicated it would extend a rail line to the site. The review team expects no impacts to rail lines in the area.

5.4.1.6 Aesthetics

Similar to the discussion in Section 4.4.1.4, the completed PSEG Site would be visible primarily to onsite workers. Aesthetic impacts to offsite areas would occur mainly from the introduction of large new elements into the visual environment, including cooling towers, reactor domes, and an elevated causeway.

A new nuclear power plant at the PSEG Site would further contribute to the industrial character of the existing PSEG property, which also includes HCGS and SGS. The principal visual features added by a new plant would be cooling towers (up to 590 ft tall) and their associated plumes, reactor buildings, and the elevated causeway. Under Federal Aviation Administration regulations, the cooling towers would be appropriately marked with lighting, making them visible during nighttime hours. Figures 5-4 and 5-5 depict how the developed PSEG Site would appear from several sensitive locations during daylight. PSEG modified these photographs by adding duplicated images of the existing HCGS facilities to simulate the appearance of potential new facilities at the PSEG Site (PSEG 2012-TN1489).

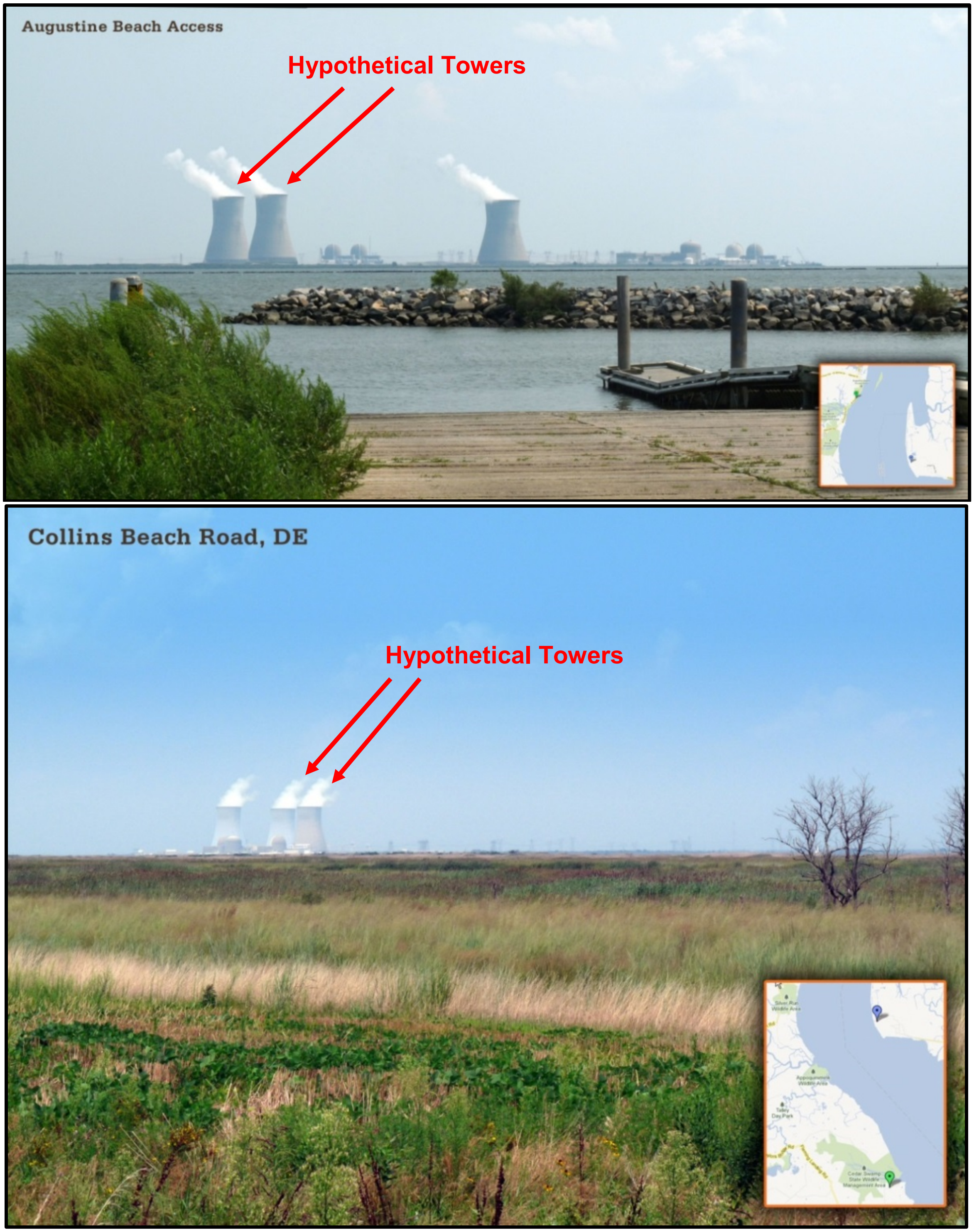

Figure 5-4. Simulations of the appearance of new nuclear power plant facilities at the PSEG Site from Augustine Beach access and Collins Beach Road, New Castle County, Delaware. ***(The arrows indicate which towers belong to the proposed project and were added to the photograph for analytical purposes.) (Source: PSEG 2012-TN1489)***

Figure 5-5. Simulations of the appearance of new nuclear power plant facilities at the PSEG Site and the proposed causeway from the Hancocks Bridge community and the Money Island Estuary Platform in Salem County, New Jersey. ***(Source: PSEG 2012-TN1489)***

Figure 5-4 reflects how a new nuclear power plant would appear from two recreational areas in New Castle County, Delaware. Views from nearby residential areas along the Delaware shore would be similar. Delaware County officials indicated that residents of Delaware would notice the new construction but would become accustomed to the view shed once the project is finished (NRC 2012-TN2499). Figure 5-5 depicts how the new nuclear power plant might appear from the Hancocks Bridge community and from the viewing platform along Money Island Road, both in Salem County, New Jersey.

The additional structures on the PSEG Site would be clearly visible from both of these locations. The elevated causeway would be a dominant feature in the view from the Money Island Road viewing platform and likely in the immediately adjacent Abbotts Meadow Wildlife Management Area, which receives recreational use for hunting and bird watching.

The height of the plumes from the natural draft cooling towers would depend on weather conditions and winds. The median plume height for the cooling tower would be 1,574 ft above ground level and would be higher during the winter months (PSEG 2014-TN3452). The plume would look similar to that of the HCGS cooling tower.

Although a new plant and causeway would be in keeping with the industrial character of the existing PSEG property, the increased intensity of the visual presence of structures on the PSEG Site as well as the introduction of the elevated causeway as a dominant visual element in a sensitive recreational location would constitute a noticeable, but not destabilizing, impact. This impact would be due to the essential character of the new structures and would not be amenable to mitigation measures.

5.4.1.7 Summary of Physical Impacts

Based on the information provided by PSEG and the review team's independent evaluation and outreach, the review team concludes that the physical impacts of operations-related activities on workers and the local public, buildings, and transportation would be SMALL, and no mitigation beyond that proposed by PSEG would be warranted. However, the addition of new cooling towers and new reactor domes at the PSEG Site, and the proposed causeway that traverses the Estuary Enhancement Program (EEP) area, would noticeably affect the aesthetic qualities from viewpoints in New Castle and Salem Counties. Thus, the review team concludes that a new nuclear power plant and causeway would have a MODERATE physical impact on aesthetic resources and that the impacts would not be amenable to mitigation.

5.4.2 Demography

PSEG anticipates it would need 600 employees for operations related activities at the PSEG Site. Based on the current residential distribution of the HCGS and SGS operations workforces, PSEG estimated 82.6 percent of the operations workforce for a new plant would live in the economic impact area. In its ER, PSEG found SMALL impacts using this assumption and an assumed 100 percent in-migration of operations workers (PSEG 2014-TN3452).

According to a 1981 NRC study (Malhotra and Manninen 1981-TN1430), 40 to 60 percent of "nonconstruction" workforce in-migrated into the area surrounding the construction of a nuclear power plant. Given the large labor pool within a 50-mi radius, the long history of nuclear power operations in the economic impact area, and the existence of a Nuclear Energy Technology Program at Salem County Community College, the review team expects that many of the skills needed for the operations workforce can be found locally and that about 40 percent of the operations workforce (240 workers) would be in-migrants into the region. These workers would find homes according to the same residential distribution characteristics as the current SGS and HCGS operations workers. In other words, 82.6 percent of the in-migrants (198 workers) would reside in the economic impact area, and the remaining 42 workers would be sparsely distributed throughout the rest of the 50-mi region and beyond.

As discussed in Section 4.4, the review team assumes in-migrating workers would bring their families. Assuming a household size of 2.68, the review team predicts a population increase of 643 people into the region and 530 into the economic impact area. PSEG records indicate that,

of current HCGS and SGS employees who live in the economic impact area, 12.1 percent reside in Cumberland County, 17.7 percent in Gloucester County, 49.6 percent in Salem County, and 20.6 in New Castle County (PSEG 2014-TN3452). The resulting increase in population within the economic impact area is summarized in Table 5-4. The in-migration of operations workers and their families would increase the population of the economic impact area by about five-hundredths of one percent. The increase would be most pronounced in Salem County, which would experience a population increase of about four-tenths of one percent. The review team considers such increases to be minimal for the counties in the economic impact area.

Table 5-4. Estimated Population Increase in the Economic Impact Area During Operations

County	Workers	Population Increase	Projected 2020 Population[(a)]	Percent Increase
New Castle	41	110	578,300	0.02
Cumberland	24	64	165,200	0.04
Gloucester	35	94	310,300	0.03
Salem	98	262	67,700	0.04
Total	**198**	**530**	**1,121,500**	**0.05**

(a) Source: Table 2-15.

Some of the workers that would be employed at the PSEG Site would have been previously unemployed. In 2010, the unemployment rate for Utilities Industry workers in Salem County was 6.21 percent (Section 2.5.2.1). Therefore, of the workforce that already lives in the region (360 workers), the review team assumes 22 of them would have been unemployed when hired by PSEG. Assuming the same distribution as the in-migrating workforce, 20.5 percent of the unemployed workers would already reside in New Castle County (5 workers), while 79.5 percent (17 workers) would already reside in the New Jersey counties of the economic impact area. In the economic impact area, 220 jobs would have been filled between unemployed workers (22) and in-migrating workers (198). Some of these workers would already be at the site as part of the 342 operations and maintenance staff and 103 startup personnel during the building phase. The impacts of these workers are discussed in Section 4.4.2.

In addition to the full-time operations workforce at the PSEG Site, 1,000 workers would be required every 18–24 months for outages. These workers would have a similar residential distribution as the HCGS Fall 2010, SGS Unit 1 Fall 2011, and SGS Unit 2 Spring 2011 outages (PSEG 2012-TN2370). About 70 percent of the outage workers (700 workers) would in-migrate into the economic impact area for less than a month at a time and then leave at the end of the outage. Because outages last less than a month, outage workers typically do not bring their families. The maximum size of the in-migrating workforce during operations (240 operations workers and 700 outage workers) is about one and a half times the in-migrating peak employment building workforce (617). Because the in-migrating building phase workforce constituted less than one-fifth of one percent of the baseline population, the review team

expects the demographic impact of in-migrating outage and operations workers to be similar to the demographic impacts during building, which were determined to be minimal.

The review team concludes that these levels of increase would not noticeably affect the demographic character of the economic impact area or any of its counties and, therefore, the impact would be SMALL.

A small number of operations workers and their families would in-migrate to counties outside of the economic impact area. Their impact on any one jurisdiction would not be noticeable. The current and projected populations of the regional area are so large and the in-migrating population is so small that the in-migrating workers would represent less than 1 percent of the total population in any of the counties where these employees reside. Therefore, the review team concludes that the demographic impacts of operation on the remainder of the 50-mi region also would be SMALL.

5.4.3 Economic Impacts to the Community

This section evaluates the economic and tax impacts on the 50-mi region from operating a new nuclear power plant at the PSEG Site, focusing primarily on Salem, Cumberland, and Gloucester Counties in New Jersey and New Castle County, Delaware. The evaluation assesses the impacts and demands from the workforce for operating a new plant. As indicated in section 5.4.2, the review team assumes that 198 workers would migrate into the economic impact area. Assuming a family size of 2.68, the review team assumes approximately 530 people would move into the economic impact area.

5.4.3.1 Economy

Operation of a new nuclear power plant at the PSEG Site would have a positive impact on the local and regional economy through direct employment of the operations workforce, purchases of materials and supplies for operation, and maintenance of the plant and any capital expenditures that occur within the region.

PSEG would employ 600 full time operations workers and 1,000 temporary (about one month) outage workers every 18–24 months. In 2004, the average income for employees at SGS and HCGS was $77,800 (NEI 2006-TN2491). Based on that number and according to the Bureau of Labor Statistics CPI Inflation Calculator, the 2013 average wage would be $95,869. For an annual workforce of 600, $57.5 million would be paid in annual wages to the region in 2013 dollars. In the economic impact area, where 82.6 percent of the operations workers would reside, $47 million would be paid in annual wages. A total of $18.9 million would be paid annually to the 198 in-migrating workers into the economic impact area and $2.1 million to the 22 formerly unemployed workers.

PSEG would also pay the wages of the 1,000 outage workers that would come every 18 to 24 months. Compared with workers required for construction, outage workers tend to be highly specialized and come from many different areas, companies, and vendors. To estimate the wage expenditures, the review team uses the annual per capita income in New Jersey, which is $53,181, or $4,431 a month. Assuming 1,000 workers for exactly one month are needed for

outages, PSEG would spend $4.431 million every 18–24 months to outage workers. Approximately 30 percent of those outage workers would be from the economic impact area, so PSEG would spend about $1.32 million to local workers every 18–24 months.

PSEG would also purchase materials and supplies for operation and maintenance of the plant, and any capital expenditures that would occur in the region would also have direct and indirect effects on the local and regional economy. Table 5-5 shows the estimates for purchases by PSEG for operating activities at the new plant. PSEG has not selected a reactor technology, but the review team's calculations are based on average purchases at HCGS and SGS from 2005 to 2008. Because the new plant's output would be a maximum of 2,200 MW(e), the review team assumes that it would have approximately 60 percent of the average annual purchases that occur at HCGS and SGS, which have a total of 3,655 MW(e). As shown in Table 5-5, operations at the PSEG Site would provide an annual increase in economic activity over the current baseline. The purchases by PSEG during operations would support employment in other sectors of the local economy at vendors and shops that provide materials and supplies for operations. The U.S. Department of Commerce Bureau of Economic Analysis (BEA), Economics and Statistics Division, provides Regional Input-Output Modeling System (RIMS II) regional multipliers for industry employment and earnings. The review team obtained multipliers from the BEA for the economic impact area. For every million dollars spent by PSEG on purchases of services, materials, and supplies, 3.8474 jobs are supported in the economic impact area (BEA 2013-TN2594). The annual spending on services, materials, and supplies would support approximately 60 additional jobs in the economic impact area.

Table 5-5. Estimated Annual Purchases of Services and Materials During Operations

County/ State[(a)]	Average 2005–2008 Annual Purchases for HCGS and SGS[(b)]	Purchases in 2013 dollars[(c)]	Annual Purchases for New Plant[(d)]	Added Employment per $1 Million Spent
New Castle	$6,773,114	$7,603,852	$4,562,311	17.6
Cumberland	$2,285,912	$2,566,284	$1,539,770	5.9
Gloucester	$8,351,326	$9,375,636	$5,625,382	21.6
Salem	$5,779,051	$6,487,865	$3,892,719	15.0
Economic Impact Area Total	*$23,189,403*	*$ 26,033,637*	*$15,620,182*	60.1
Delaware[(e)]	$7,618,649	$8,553,094	$5,131,856	19.7
New Jersey[(e)]	$503,363,601	$565,102,369	$339,061,421	1304.5
Pennsylvania[(e)]	$240,995,699	$270,554,406	$162,332,644	624.6
Other States	$21,943,397	$24,634,807	$14,780,884	56.9
Total	$797,110,749	$894,878,313	$536,926,988	2065.8

(a) Table 2.5-28 of ER (PSEG 2014-TN3452) and RAI Response Env-06, Question 2.5-8 (PSEG 2012-TN2370).
(b) Taken from total 2005–2008 amounts in Table 2.5-28 of ER and divided by 4.
(c) BLS inflation calculator. Assuming 12.3% cumulative inflation rate from 2007 to 2013.
(d) SGS/HCGS have output of 3,655 MWe. New plant would have maximum of 2,200 MWe. To calculate, take 2013 purchases for HCGS/SGS and multiply by 0.6.
(e) These are estimates for each state as a whole, not just for the counties that fall within the 50-mi radius.

New workers (i.e., in-migrating workers and those previously unemployed) would have an additional indirect effect on the local economy because they would stimulate the local economy by their spending on goods and services in other industries. This spending results in economic demand for a fraction of another indirect job. The review team obtained multipliers from the BEA for the economic impact area. The review team did not include currently employed workers who would be employed at the PSEG Site because their direct and indirect effects are already included in the economic impact area baseline.

In the economic impact area, BEA estimates that for every new utility industry worker, an additional 1.3032 workers in all industries is created (BEA 2013-TN2594). According to the analysis above, PSEG would hire 198 in-migrating workers and 22 unemployed workers. These 220 direct jobs would result in 286 indirect jobs created (220 × 1.3032). For the purposes of this analysis, the review team expects these indirect workers to already reside in the economic impact area. The impacts to each county are estimated in Table 5-6. BEA also estimates the indirect earnings multiplier in the economic impact area. This multiplier was applied to the wages of new workers to determine the effect of direct earnings on the local economy. For every dollar of wages earned by new workers during operations, BEA estimates an additional $0.5276 in income would be added in the economic impact area. The $21 million annual compensation from the newly hired workers would lead to an estimated $11.08 million in annual indirect wages ($21 million × 0.5276) (BEA 2013-TN2594).

Given the size of the economies and workforces in the economic impact area, the review team estimates the impact of operations at the PSEG Site would be minor, and positive.

Table 5-6. Expected Distribution of Newly Created Workers in the Economic Impact Area During Operations

County	Percent of Newly Hired Workers	In-migrating Plus Unemployed Workers	Indirect Workers Created	Total New Workers Hired
New Castle	20.6	45	59	104
Cumberland	12.1	27	34	61
Gloucester	17.7	39	51	90
Salem	49.6	109	142	251

5.4.3.2 Taxes

The tax structure for the economic impact area and region is discussed in Section 2.5.2.2. Primary tax revenues associated with operating activities at the PSEG Site would be from (a) State and local taxes on worker incomes, (b) State sales taxes on worker expenditures, (c) State sales taxes on the purchases of materials and supplies, (d) corporate taxes, and (e) local property taxes or payments in lieu of taxes based on the assessed value of the new PSEG plant during operation.

State and Local Income Taxes

Delaware and New Jersey would receive additional income tax revenue from the income tax on wages of new workers. Table 5-7 summarizes the estimated new income tax revenue that would be received by the two states during operations. The exact amount of income tax revenue would be determined on the basis of many factors such as rates, residency status, deductions, and other factors.

Table 5-7. Estimated Increase in Income Tax Revenue Associated with Workforce

State	In-migrating Workers	Previously Unemployed Workers	Estimated Annual Income at $95,869 per worker	Income Tax Revenue from Workers	Percent Increase in State Income Tax Revenue
Delaware	41	5	$4,409,974	$244,753[(a)]	0.02
New Jersey	157	17	$16,681,206	$1,047,413[(b)]	0.01
Total	**198**	**22**	**$21,091,180**	**$1,292,166**	**-**

(a) DEDO 2012-TN2390; assumed 1,001 workers + 5.55 percent per worker.
(b) NJ Treasury 2010-TN2338; assumed a tax rate of 6.279 percent, or an average of income tax rates of 1.4 to 8.97 percent.

The majority of the operations workforce would already live in the region, would commute daily from the site, and would not be unemployed prior to operations. For the purposes of this analysis, the review team assumes that all the workers (unemployed and in-migrating) would live in the economic impact area. Approximately 220 workers would be newly employed and would then pay income taxes. Forty-six workers would pay income tax in Delaware, and 174 would pay in New Jersey. They would provide $0.24 million and $1.05 million in additional income tax revenue to Delaware and New Jersey, respectively. This is an increase of approximately two-hundredths of one percent in Delaware and one-hundredth of one percent in New Jersey, compared to 2011 revenue. The indirect workers would also pay income taxes, but because the amount of indirect jobs created is similar to the newly employed workforce (286 versus 220 workers), their tax payments would be minimal compared with the tax base in New Jersey and Delaware.

The addition of a new plant at the PSEG Site would have a noticeable and beneficial impact on New Jersey's corporate income tax revenue.

No localities within the economic impact area impose extra income taxes on workers. The review team believes the impact from extra income taxes on state revenue would be minimal and beneficial.

State Sales Taxes on Worker Expenditures

Workers would spend some of their income on goods and services that may be taxed. New Jersey imposes a 7 percent sales tax; however, Delaware does not impose a sales tax. No localities in the economic impact area impose an additional sales tax. Because Delaware imposes no sales tax and New Jersey's 2011 revenue from sales taxes was over $11 billion,

the review team expects a minimal, beneficial impact on state sales tax revenue from in-migrating and previously unemployed worker expenditures.

State Sales Taxes on Materials and Supplies

Section 5.4.3.1 discusses the review team's estimates of PSEG expenditures in the economic impact area, region, and beyond during operations. These expenditures may be subject to sales taxes. New Jersey and Pennsylvania have sales taxes of 7 and 6 percent, respectively. Delaware does not impose sales taxes. Some localities in New Jersey and Pennsylvania impose additional sales taxes (e.g., Philadelphia County imposes an extra 2 percent sales tax). However, none in the economic impact area impose extra sales taxes.

During operations, the review team estimates over $339 million a year would be spent in New Jersey and over $162 million would be spent in Pennsylvania. These expenditures would bring in approximately $23.7 million and $9.7 million in sales tax revenue in New Jersey and Pennsylvania, respectively (Table 5-8). These would account for sales tax revenue increases of two-tenths of one percent and almost six-hundredths of one percent in New Jersey and Pennsylvania, respectively. Therefore, the review team believes that there would be a minimal and beneficial impact on sales tax revenues during operations.

Table 5-8. Estimated Sales Tax Revenue on Purchases During Operations

State	Projected Annual Expenditures during Building[(a)]	Sales Tax Rate[(b)]	Projected Annual Sales Tax Revenue	Percent Increase in State Sales Tax Revenue
New Jersey	$339,061,421	7 percent	$23,734,299	0.20
Pennsylvania	$162,332,644	6 percent	$9,733,958	0.06

(a) Source: Table 5-5.
(b) Source: Table 2-26.

Corporate Income Taxes

PSEG would also pay to New Jersey a corporate energy receipts tax of 9 percent of its annual revenue each year during operations. In 2011, New Jersey received $2.2 billion in corporate income tax revenue, and PSEG paid a total of $146 million for all of its business operations (PSEG 2011-TN3327). Assuming an AP1000 design [the largest MW(e) in the ER's PPE] and a 95 percent capacity factor, PSEG would pay the energy receipts tax on about 18,469 million kWh of electricity sold in the state of New Jersey. At an average retail rate of 14.68 cents per kWh (DOE 2012-TN2524), PSEG would have estimated annual revenues of about $2.7 billion and would pay an energy receipts tax of about $244 million to the State of New Jersey; this would be equal to about 11 percent of the state's 2011 corporate income tax receipts.

Assuming an Advanced Boiling Water Reactor (ABWR) design [the smallest MW(e) in the ER's PPE] and a 95 percent capacity factor, PSEG would pay the energy receipts tax on about 10,914 million kWh of electricity sold in the state of New Jersey. At an average retail rate of 14.68 cents per kWh, PSEG would have estimated annual revenues of about $1.6 billion and

would pay an energy receipts tax of about $144 million to the State of New Jersey; this would be equal to about 6.5 percent of the state's 2011 corporate income tax receipts.

Property Taxes

The review team assumes the 198 in-migrating operations workers would have to either purchase an existing home or build a new home in the economic impact area. For existing homes, the property tax effect would be zero, as the residence would already be on the tax rolls for the county and township. For new homes, the review team believes only a limited number of in-migrating workers would prefer to build rather than buy an existing structure. Given the magnitude of the property tax base in each of the four counties in the economic impact area, the contribution of new real property to each area would result in a minor but beneficial impact.

All of the real property and improvements related to a new nuclear power plant at the PSEG Site would be located in Salem County, New Jersey, primarily in the Lower Alloways Creek Township. However, the review team determined through interviews with the chief financial officer for Lower Alloways Creek Township that the township does not have a property tax or a school tax but instead relies on the distribution of the energy receipts tax from the state government. The review team also determined that Salem County imposes a $1.207 per hundred dollars of assessed value property tax on all improvements and that PSEG pays the same rate (NRC 2012-TN2499). For an AP1000 design, the expected property tax revenue to Salem County would be about $120 million in the first year of operation, declining thereafter over the 40-year life of the plant[7]. Over the 40 years of service, the AP1000 design would generate a total of about $2.5 billion in property taxes to Salem County. For the ABWR design, the property tax revenue would be about $71 million in the first year of operation, with a 40-year total of about $1.4 billion in property taxes. Salem County's 2013 budget shows an expected total revenue of $84 million (Salem County 2013-TN2576). Therefore, the proposed project would add be between about 140 percent (AP1000) and 82 percent (ABWR) to the current Salem County budget in the first year. Consequently, the review team determined that Salem County would experience a major and beneficial impact from the anticipated new property tax revenues, and the economic impact area would experience a minimal and beneficial impact.

5.4.3.3 Summary of Economic Impacts to the Community

Based on the information provided by PSEG and the review team's independent evaluation and outreach, the review team concludes that the economic impacts would be SMALL and beneficial for the region and the economic impact area. The review team predicts SMALL and beneficial impacts to sales and excise tax and income tax receipts in the economic impact area and region. The review team also predicts MODERATE and beneficial impacts to the State of New Jersey from PSEG corporate tax payments and LARGE and beneficial impacts to Salem County from property tax payments.

[7]Depreciation assumed at straight line (the most commonly used rate for utilities) for 40 years (assuming a units-of-production approach to service life) and no salvage value (Burns et al. 1982-TN2650).

5.4.4 Infrastructure and Community Service Impacts

This section provides the estimated impacts on infrastructure and community services, including transportation, recreation, housing, public services, and education.

5.4.4.1 Traffic

Existing transportation routes would be affected by an increase in commuter traffic to and from the PSEG Site associated with the operations and outages workforce at the PSEG Site. The workforce for the new plant would primarily use the proposed causeway to avoid disruptions to the HCGS and SGS workforces (PSEG 2014-TN3452). The proposed causeway would separate all traffic to and from the new plant from traffic associated with the existing HCGS and SGS operations. The impacts from these two streams of traffic would interact when they converge around Salem City (PSEG 2013-TN2525).

PSEG conducted a traffic impact analysis (TIA) to determine traffic impacts around the PSEG Site. The TIA analyzed deterioration of LOS on roads and intersections in Salem County. The TIA used the following assumptions: (a) the maximum anticipated construction workforce, (b) build-out year of 2021, (c) assumed selection of key routes although other, less-traveled routes are available, and (d) traffic load is based upon a combination of peak construction, outage workforce, maximum operations workforce present during building at the PSEG, and baseline background traffic (which incorporates current HCGS and SGS employees) at once (PSEG 2013-TN2525). The analysis in the TIA assumes a worst case traffic scenario compared to the analysis presented by PSEG in its ER. Further discussion of the analysis and its assumptions are in Section 4.4.4.1.

The TIA suggests certain mitigation measures to alleviate traffic impacts during building, which are discussed in Section 4.4.4.1. According to Table 4-12, some intersections would have unacceptable LOS values in the future no-build scenario. Even with conservative assumptions in the TIA, these intersections show improvement with the implementation of suggested mitigation measures. Because the operations workforce and the outage workforce is significantly smaller than the assumptions used in the TIA (approximately 1,200–1,300 vehicles per day compared to nearly 5,000 as discussed in Table 4-11), the review team expects impacts from traffic in the economic impact area to be minimal and localized. The greatest impacts would be during shift changes with an outage in process.

5.4.4.2 Recreation

Recreational resources in the economic impact area may be affected by operations activities at the PSEG Site. Impacts may include (1) increased user demand associated with the projected increase in population as a result of the in-migrating workforce and their families, (2) an impaired recreational experience associated with the views of the site and the potential cooling tower, and (3) access delays associated with increased traffic from extra traffic on local roadways. Increased user demand as a result of the in-migrating population may include increased competition for recreational vehicle spaces at campgrounds and at hotels/motels, which could be used for temporary housing for some of the workforce during outages or for recreational purposes by the new operations workforce.

As discussed in section 5.4.1, there would be some aesthetic impacts at recreational areas with an unobstructed view of the PSEG Site. These areas are typically across the Delaware River in Delaware. There would be additional aesthetic impacts from PSEG's EEP viewing platforms. Operations at the PSEG Site would add to the already industrial nature of the site. Also, people using recreational facilities in Salem County may experience traffic congestion on the roads during morning and afternoon commutes of the operations and outage workforce.

However, because 60 percent of the operations workforce already lives within commuting distance of the PSEG Site, the review team does not expect the in-migrating portion of the operations workforce would place any stresses upon the capacity of recreational facilities near the site. The economic impact area and region's parks and recreational facilities have sufficient capacity to accommodate in-migrating workers and their families and the review team expects no impact to trapping near the site (NRC 2012-TN2499).

The review team expects the impacts to recreational activities in the vicinity to be minimal, except for a noticeable but not destabilizing aesthetic impact from operations at the site that would not be amenable to mitigation.

5.4.4.3 Housing

Section 2.5.2.5 discusses housing information for the economic impact area. According to Table 2-30, there are 30,578 vacant units in the economic impact area. As discussed in section 5.4.2, 198 workers and their families would move into the economic impact area. The rest of the operations workforce is expected to come from the region and commute daily to the site, therefore having no impact on the housing stock.

The in-migrating workers and families may choose to buy available vacant housing or rent. Table 5-9 shows the estimated impact on housing availability for the in-migrating families. As shown in the table, there are minimal impacts on housing supply.

Table 5-9. Estimated Housing Impacts in the Economic Impact Area

County	In-migrating families	Vacant Units[(a)]	Percent Change in Vacancy Rates
New Castle	41	15,239	0.27
Cumberland	24	6,174	0.39
Gloucester	35	6,453	0.54
Salem	98	2,712	3.61
Total	**198**	**30,578**	**0.65**

(a) Source: Table 2-30.

Operations workers are more likely to take advantage of the permanent housing stock or build new homes. Outage workers are more likely to take advantage of the temporary housing stock as they are expected to be at the PSEG Site for a relatively short period of time. In addition to the housing stock for owner occupied housing and rental units, there is also sufficient stock of temporary housing in the economic impact area if workers decide to stay in hotels, motels, or

campgrounds. Salem County officials also indicate that many outage workers who come from outside the region rent rooms in single-family homes in localities near the site (NRC 2012-TN2499).

Given the large supply of vacant housing relative to the in-migrating operations workforce during operations and the availability of short-term accommodations for outage workers, the review team expects sufficient housing to be available for workers relocating to the area and minimal impacts on the housing supply or prices in the local area.

Operations at the PSEG Site could affect housing values in the vicinity. In a review of previous studies on the effect of seven nuclear power facilities, including four nuclear power plants, on property values in surrounding communities, Bezdek and Wendling (Bezdek and Wendling 2006-TN2748) concluded that assessed valuations and median housing prices have tended to increase at rates above national and State averages. Clark et al. (Clark et al. 1997-TN3000) similarly found that housing prices in the immediate vicinity of two nuclear power plants in California were not affected by any negative views of the facilities. These findings differ from studies that looked at undesirable facilities, largely related to hazardous waste sites and landfills, but also including several studies on power facilities (Farber 1998-TN2857) in which property values were negatively affected in the short-term, but these effects were moderated over time. Bezdek and Wendling (Bezdek and Wendling 2006-TN2748) attributed the increase in housing prices to benefits provided to the community in terms of employment and tax revenues, with surplus tax revenues encouraging other private development in the area. Given the findings from the studies discussed above, the review team determines that the impact on housing value from operations at the PSEG Site would be minor.

Based on the information provided by PSEG, interviews with local officials, and its own independent review, the review team expects there would be minimal impacts in the economic impact area and the region on the price and availability of housing from operations at the PSEG Site.

5.4.4.4 Public Services

This section discusses the impacts on existing water supply, wastewater treatment, police, fire, and healthcare services in the economic impact area.

Water Supply and Wastewater Treatment Services

Approximately 60 percent of the project operations workforce would be local workers who currently reside in the region. The majority of these workers would commute from their homes to the project site and would not relocate. Therefore, the majority of workers are currently served by the water supply and wastewater treatment facilities within the communities where they reside.

During operations, the review team expects 198 workers (530 people, including families) to move into the economic impact area. These relocating workers would increase the demand on the water supply and wastewater treatment services within the communities where they reside.

The review team calculated the increase in demand for residential water based on the increase in people and using the New Jersey per capita demand of 100 gallons per day (gpd) (Barnett 2010-TN2484). Table 5-10 shows the impact of the increased population on the excess capacity within each county of the economic impact area. As shown in Table 5-10, each county has less than a one percent increase in demand on current excess capacity.

Table 5-10. Estimated Water Supply Impacts in the Economic Impact Area

County	Current Excess Capacity (Mgd)	Increase in Population	Estimated Increase in Water Demand (Mgd)[(a)]	Percent Increase in Demand on Excess Capacity
New Castle	≈1,000[(b)]	110	0.011	0.001
Cumberland	3.995[(c)]	64	0.006	0.150
Gloucester	24.733[(c)]	94	0.009	0.000
Salem	2.646[(c)]	262	0.026	0.982

(a) Increase in population multiplied by 100 gpd.
(b) New Castle County 2012 Comprehensive Plan Update, NCCDE 2012-TN2326.
(c) Source: Table 2-31.

Given the small increase in demand that would result from the in-migrating workers and their families compared to existing supply, the review team has determined that impacts on water supply in the economic impact area would be minimal, and mitigation would not be warranted.

The review team calculated the increase in demand for residential wastewater treatment based on the increase in population and by using the New Jersey per capita demand for wastewater treatment of 75 gpd (SJBC 2012-TN2485). Table 5-11 shows the impact of the increased population on the excess capacity within each county's wastewater treatment facilities within the economic impact area. As shown in Table 5-11, no county in the economic impact area would have greater than a one percent increase in demand on excess capacity.

Given the small increase in demand that would result from the in-migrating workers and their families compared with existing supply, the review team has determined that impacts on wastewater treatment in the economic impact area would be minimal, and mitigation would not be warranted.

Table 5-11. Estimated Wastewater Supply Impacts in the Economic Impact Area

County	Current Excess Capacity (Mgd)[(a)]	Increase in Population	Estimated Increase in Wastewater Demand (Mgd)[(b)]	Percent Increase in Demand on Excess Capacity
New Castle	32.30	110	0.008	0.025
Cumberland	8.84	64	0.005	0.054
Gloucester	6.13	94	0.007	0.115
Salem	2.05	262	0.020	0.959

(a) Source: Table 2-32.
(b) Increase in population multiplied by 75 gpd.

PS7EG indicates that a freshwater aquifer that currently supplies HCGS and SGS would also supply the new plant with potable and sanitary water, fire protection, and other miscellaneous uses. PSEG indicates that it would need between 302,400 and 1.37 million gpd on the site (PSEG 2014-TN3452). The review team believes this impact would be negligible and would be subject to permit requirements. Further analysis of groundwater withdrawal during operation is in Section 5.2. PSEG also has an onsite wastewater treatment facility for HCGS and SGS, but it was sized only to meet the demand of HCGS and SGS. PSEG would install a new sewage treatment facility or expand the existing one to meet needs for the construction and operations workforce at a new nuclear power plant, so there would be no offsite treatment of wastewater from the new plant (PSEG 2014-TN3452). Therefore, there would be no impact on public wastewater facilities from the PSEG Site.

The review team has concluded from the information provided by PSEG, interviews with local planners and officials, and its own independent evaluation that operations at the PSEG Site would have minimal impacts on the local water supply and on wastewater treatment facilities, and no mitigation would be warranted.

Police, Fire, and Health Care Services

The operations workforce at the PSEG Site would increase the demand on police, fire, and health care services within the communities where workers reside and at the PSEG Site.

Approximately 60 percent of the project workforce would be local workers who currently reside in the region. The majority of these workers would commute from their homes to the project site and would not relocate. Therefore, the majority of workers are currently served by the police, fire, and health care services within the communities where they reside.

During operations, the review team expects 198 workers and their families to move into the economic impact area. This constitutes a total of 530 people moving into the economic impact area during operations. These relocating workers would increase the demand on the police, fire, and health care services within the communities where they reside.

No county in the economic impact area would have a population increase greater than one-half of one percent. In discussion with local officials of the localities closest to the site, Lower Alloways Creek Township, Elsinboro Township, and Salem County, the review team found no need to increase police, fire, or health care services because of in-migrating operations workers. The review team, after discussing with local officials, found that with the minimal increases in population, there should be only a negligible effect on the performance of police, fire, and health care services in the economic impact area.

Locally, Elsinboro Township receives police services from a contract with Lower Alloways Creek Township, and its fire and emergency medical services (EMS) are volunteer-based. Lower Alloways Creek Township and Salem City have their own police force and volunteer fire/EMS forces. Salem County also has a sheriff's office and is patrolled by state police. All hospitals in the area are under capacity (NRC 2012-TN2499). Because of their proximity to the site, these three jurisdictions in Salem County would receive the most impacts from operations and outage worker injuries or accidents on the roads leading to the site and at the site. After discussions

with local officials and its own independent analysis, the review team expects a minimal impact on these services from operations at the PSEG Site, and no mitigation would be warranted.

5.4.4.5 Education

The operations workforce at the PSEG Site would increase the demand for educational services within the communities where workers reside. Approximately 60 percent of the project workforce would be local workers who currently reside in the region. The majority of these workers would commute from their homes to the project site and would not relocate. Therefore, the majority of workers are currently served by the educational services within the communities they reside.

As shown in Table 5-12, during operations there would be an estimated increase of 34 students into the economic impact area. This is a small increase compared to the existing rolls in the economic impact area (over 160,000 students, as shown in Table 2-34). No county in the economic impact area would have a noticeable increase in the number of students per teacher. The only increase in student-to-teacher ratios would be in Salem County, where the review team estimated an increase of one-hundredth of one student per teacher. Some schools may receive higher numbers of children during operations because of amenities and the school choice programs available in New Jersey and Delaware. Because of these estimates, the public choice programs, and discussions with local officials, the review team foresees minimal impacts on local school districts.

Based on the review team's independent analysis and discussions with local officials, the review finds that the impacts to schools in the economic impact area would be minimal, and no mitigation would be warranted.

Table 5-12. Estimated Number of School-aged Children Associated with In-migrating Workforce Associated with Operations at the PSEG Site

County	Estimated Increase in Population	Percent of Population Ages 5–18 Yr[a]	Estimated Increase in School-Age Children	Student/Teacher Ratio Existing Conditions[b],[c]	Student/Teacher Ratio During Operations[c]
New Castle	41	16.5%	7	15.24	15.24
Cumberland	24	17.1%	4	12.02	12.02
Gloucester	35	18.0%	6	12.93	12.93
Salem	98	17.2%	17	11.24	11.25
Total	**198**	**17.1%**	**34**	**13.58**	**13.58**

(a) U.S. Census Bureau 2008, USCB 2008-TN2344.
(b) Source: Table 2-34.
(c) Public school estimates only.

5.4.4.6 Summary of Community Service and Infrastructure Impacts

Based on the information provided by PSEG and the review team's independent evaluation and outreach, the review team concludes that impacts to all infrastructure and community services

would be SMALL for the region and the economic impact area, with the exception of recreational impacts near the PSEG Site. The review team expects MODERATE adverse impacts to local recreational resources because of impacts on view sheds from the increased industrial character of the PSEG Site.

5.4.5 Summary of Socioeconomics

The review team has assessed the activities related to operating a new nuclear power plant at the PSEG Site and the potential socioeconomic impacts in the region and economic impact area. Physical impacts on workers and the general public include those on noise levels, air quality, existing buildings, roads, and aesthetics. The review team concludes most physical impacts from operations at the PSEG Site would be SMALL, with the exception of a MODERATE impact to aesthetics that could not be reduced through mitigation.

On the basis of information supplied by PSEG and the review team interviews conducted with public officials, the review team concludes that impacts from operations at the PSEG Site on the demographics of the region and economic impact area would be SMALL. Economic impacts throughout the region and economic impact area would be SMALL and beneficial. Tax impacts would be SMALL and beneficial throughout the region and economic impact area, with the exceptions of MODERATE and beneficial corporate income payments to New Jersey and LARGE and beneficial property tax payments to Salem County.

Infrastructure and community services impacts span issues associated with traffic, recreation, housing, public services, and education. Impacts from operations at the PSEG Site on traffic, housing, public services, and education would be SMALL. Recreational impacts would be MODERATE and adverse because of impacts on view sheds from the increased industrial character of the PSEG Site, which would not be amenable to mitigation.

5.5 Environmental Justice

The review team evaluated whether minority or low-income populations would experience disproportionately high and adverse human health or environmental effects from the operation of a new nuclear power plant at the PSEG Site. To perform this assessment, the review team (1) identified (through U.S. Census Bureau and American Community Survey demographic data, PSEG's ER, and on-the-ground assessments) minority and low-income populations of interest; (2) identified all potentially significant pathways for human health, environmental, physical, and socioeconomic effects on those identified populations of interest; and (3) determined whether or not the characteristics of the pathway or special circumstances of the minority or low-income populations would result in a disproportionately high and adverse impact.

To perform this assessment, the review team followed the methodology described in Section 2.6.1. In the context of operations activities at the PSEG Site, the review team considered the questions outlined in Section 2.6.1. For all three health-related questions, the review team determined that the level of environmental emissions projected is well below the protection levels established by NRC and EPA regulations and would not impose a disproportionate and adverse effect on minority or low-income populations.

5.5.1 Health Impacts

Section 5.8 assesses the nonradiological health effects for operations workers and the local population from fugitive dust, noise, occupational injuries, and transport of materials and personnel. In Section 5.8, the review team concludes that nonradiological health impacts would be SMALL. The review team's investigation and outreach did not identify any unique characteristics or practices among minority or low-income populations that might result in disproportionately high and adverse nonradiological health effects.

Section 5.9 of this EIS assesses the radiological doses to construction workers and the local population and concludes that the doses would be within NRC and EPA dose standards. Section 5.9 concludes that radiological health impacts on the operations workforce at the PSEG Site would be SMALL.

During operations at a new plant, PSEG would be required to maintain a Radiological Environmental Monitoring Program (REMP). The REMP program assesses the impact of the plant on the environment, and samples of environmental media are collected and analyzed for radioactivity. A plant effect would be indicated if the radioactive material detected in a sample was significantly larger than the background level. The results of the 2009 REMP sampling and previous REMP reports at HCGS and SGS indicate that operations at the PSEG Site would not result in any offsite impacts. The New Jersey Department of Environmental Protection's Bureau of Nuclear Engineering performs an independent Environmental Surveillance and Monitoring Program (ESMP) in the environment around HCGS and SGS. The ESMP monitors pathways for entry of radioactivity into the environment to identify potential exposures to the population from routine and accidental releases of radioactive effluent and to provide a summary and interpretation of this information to members of the public and government agencies. The 2008 report indicated that, overall, there were no received measurable exposures of radiation above normal background to residents living in the area around HCGS and SGS (NRC 2011-TN3131). Per regulatory requirements, the review team expects similar results for a new plant at the PSEG Site. Based on this information, the review team concludes that there would be no disproportionately high and adverse impact on low-income or minority populations.

5.5.2 Physical and Environmental Impacts

For the physical and environmental considerations described in Section 2.6.1, the review team determined through literature searches and consultations that (1) the impacts on the natural or physical environment would not significantly or adversely affect a particular group; (2) no minority or low-income population would experience an adverse impact that would appreciably exceed or be likely to appreciably exceed those of the general population; and (3) the environmental effects would not occur in groups affected by cumulative or multiple adverse exposure from environmental hazards.

The review team determined that the physical and environmental impacts from operations at the PSEG Site would attenuate rapidly with distance, intervening foliage, and terrain. There are four primary exposure media in the environment: soil, water, air, and noise. The following subsections discuss each of these pathways in greater detail.

5.5.2.1 Soil

The review team did not identify any pathway by which operations-related impacts on soils at the PSEG Site would impose a disproportionately high and adverse impact on any population of interest. The review team considers the risk of soil salinization from cooling towers to be low. Therefore, the review team determines there is no soil-related pathway by which minority or low-income populations of interest could receive a disproportionately high and adverse impact.

5.5.2.2 Water

Operations at the PSEG Site could affect the water quality in the Delaware River and water use of the Delaware River. Water quality impacts result from increased stormwater runoff from the impervious surfaces of the PSEG Site and thermal and chemical constituents in the cooling water discharges. As discussed in Sections 5.2 and 5.3.2, operations at the PSEG Site would generate a small thermal plume from cooling water discharge into the Delaware River. Solutes in the effluent discharged would be diluted by the large water volume of the Delaware River. In addition, discharges would be required to comply with limits imposed by permits. Consequently, the increase in temperature and concentration of these chemicals and the thermal plume impacts in the Delaware River would be negligible. Therefore, the review team determines there is no water-related pathway by which minority or low-income populations of interest could receive a disproportionately high and adverse impact.

5.5.2.3 Air

Air emissions sources associated with operations at the PSEG Site would include standby diesel generators, auxiliary diesel generators, boilers, diesel-driven pumps, and other ancillary equipment. These emissions sources would be small, occur infrequently, and be permitted for use by a Clean Air Act (CAA) Permit. Modifications to the SGS and HCGS Title V Operating Permit under the CAA from the NJDEP would be required for a new nuclear power plant at the PSEG Site, addressing emissions and compliance with state and federal regulations (PSEG 2014-TN3452). Cooling towers would emit small amounts of particulate matter as drift. However, emissions from these sources would be expected to have only a minimal impact on ambient air quality in offsite communities. Therefore, the review team determines there is no air-related pathway by which minority or low-income populations of interest could receive a disproportionately high and adverse impact.

5.5.2.4 Noise

Primary noise sources associated with operations at the PSEG Site would be cooling towers and transformers. As noted in Section 5.8.2, noise from the transformers and cooling towers would be buffered by the distance of the plant from residences such that ambient sound level should not increase appreciably. Noise levels are anticipated to be less than 65 dBA at the nearest noise-sensitive receptor. Therefore, the review team determines there is no noise-related pathway by which minority or low-income populations of interest could receive a disproportionately high and adverse impact.

5.5.2.5 Summary of Physical and Environmental Impacts

The review team's investigation and outreach did not identify any unique characteristics or practices among minority or low-income populations that might result in physical or environmental impacts that would be different from those on the general population.

As discussed in Section 2.6, most of the census block groups classified as minority or low-income are located across the Delaware River in New Castle County. The closest block groups to the PSEG Site are about 8 mi north of the site in the City of Salem. The census block groups would not be affected by any physical or environmental impacts because of the distance from the site.

Based on information provided by PSEG and the review team's independent review, the review team found no pathways from soil, water, air, and noise that would lead to disproportionately high and adverse impacts on minority or low-income populations.

5.5.3 Socioeconomic Impacts

Socioeconomic impacts (discussed in Section 5.4) were reviewed to evaluate whether there would be any operational activities that could have a disproportionately high and adverse impact on minority or low-income populations. Except for adverse effects on recreational resources, all adverse socioeconomic impacts associated with operations at the PSEG Site are expected to be SMALL for the general public. The review team found that there could be adverse MODERATE impacts on recreational resources; however, these impacts are not expected to disproportionately affect the nearby low-income and minority populations.

5.5.4 Subsistence and Special Conditions

NRC's environmental justice methodology includes an assessment of populations with unique characteristics, such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements or high-density concentrations of minority populations.

5.5.4.1 Subsistence

Access to the PSEG Site is restricted, so there are no plant-gathering, hunting, or fishing activities at the site. PSEG and the review team independently interviewed community leaders in Salem County and New Castle County and found that no such practices were identified in the vicinity of the PSEG Site. There is no documented subsistence fishing in the Delaware River, and all hunting, plant-gathering, and fishing near the PSEG Site is done for recreational purposes (Section 2.6.3).

From the information provided by PSEG, interviews with local officials, and the review team's independent evaluation, the review team concludes that there would be no operations-related disproportionately high and adverse impacts on subsistence activities on minority or low-income populations.

5.5.4.2 High-Density Communities

As discussed in Section 2.6.3, there are no high-density communities in Elsinboro and Lower Alloways Creek Townships. There are two public housing projects in Penns Grove and three in Salem City. From its own independent evaluation and interaction with local officials, the review team does not predict any impacts to the communities in Penns Grove because of its distance from the site and because no pathways exist for adverse impacts.

5.5.5 Migrant Labor

As discussed in Section 2.6.3, the main migrant populations closest to the site are the HCGS and SGS outage workforces. Farm workers in the economic impact area are located closer to or in Gloucester and Cumberland counties and not near the PSEG Site. Therefore, from the information provided by PSEG, interviews with local officials, and the review team's independent evaluation, the review team concludes that there would be no disproportionately high and adverse impacts on migrant laborers.

5.5.6 Summary of Environmental Justice Impacts

The review team evaluated the proposed operations activities at the PSEG Site on environmental justice populations. The review team did not identify any potential environmental pathways by which the identified minority or low-income populations in the 50-mi region and economic impact area would likely experience disproportionately high and adverse human health, environmental, physical, or socioeconomic effects as a result of operations activities.

5.6 Historic and Cultural Resources

Operation of a new nuclear power plant at the PSEG Site has the potential to affect historic and cultural resources. Impact levels from operation are dependent on the resources present. Section 2.7 describes the historic and cultural resources found in the vicinity of the project area. Section 4.6 describes the effects from building activities on historic and cultural resources in the vicinity of the PSEG Site. Both the NRC and the USACE are responsible for considering the effects of the project on historic and cultural resources. The NRC is responsible for any effects to historic and cultural resources that could occur on Artificial Island and that would result from the visual intrusion of a new nuclear power plant. The USACE is responsible for effects from any required dredging and the construction of a new causeway linking Artificial Island to Money Island. No impacts to historic and cultural resources are expected from any dredging activities; however, the USACE has yet to make its effects determination on this aspect of the project (NJDEP 2013-TN2742). Consultation is ongoing for the Money Island (i.e., causeway) and dredging area aspects of the project. In most cases, any impacts to historic and cultural resources would occur during building when most ground disturbing activities, which pose the main threat to these resources, would take place. Operation of a new nuclear power plant would not be expected to further affect these resources.

Operation of a new nuclear power plant at the PSEG Site could visually affect architectural resources in the vicinity of the site that are listed in or eligible for listing in the National Register of Historic Places (NRHP). As discussed in Section 2.7, there are 28 architectural resources of

concern in line of sight within 4.9 mi of the project area (MACTEC 2009-TN2543; AKRF 2012-TN2876). It is not anticipated that operation of a new nuclear power plant would affect these resources because development of the PSEG Site would be consistent with the current setting, which includes the existing SGS and HCGS facilities. The Delaware State Historic Preservation Office (SHPO) concurred that no historic properties in Delaware would be visually affected by the project (DDHCA 2013-TN2639). The New Jersey SHPO concurred that no historic properties in New Jersey would be visually affected by the project (NJDEP 2013-TN2870).

No traditional cultural properties of significance to Native American tribes have been identified in the vicinity of the project area. See Section 2.7.3 for additional information on consultation with Native American tribes.

As discussed above, impacts to historic and archaeological resources because of operational activities are not expected to occur, but monitoring during operations would be expected to minimize the effects on inadvertently discovered resources. No visual impacts are expected because a new nuclear power plant would be consistent with the current setting. This is supported by the fact that both the Delaware SHPO and the New Jersey SHPO concur that the project's visual impacts would not adversely affect any historic properties listed in or eligible for listing in the NRHP (DDHCA 2013-TN2639; NJDEP 2013-TN2870). In the event that significant historic and cultural resources were encountered during operations, PSEG maintains procedure EN-AA-602-0006 for considering cultural resources during operations (PSEG 2012-TN2557). For the purposes of the review team's analysis of the National Environmental Policy Act of 1969, as amended, based on (1) no known significant resources on Artificial Island, (2) the review team's cultural resource analysis, (3) PSEG's procedure for inadvertent discovery of archaeological resources, and (4) consultation with the New Jersey and Delaware SHPOs, the review team concludes the potential operational impacts on historic and cultural resources are expected to be SMALL.

5.7 Meteorology and Air Quality Impacts

The primary impacts of operating a new nuclear power plant at the PSEG Site on local meteorology and air quality would be from releases to the environment of heat and moisture from the primary cooling system, operation of auxiliary equipment (e.g., generators and auxiliary boilers), and mobile emissions (e.g., worker vehicles). Section 5.7.1 discusses potential air quality impacts from nonradioactive effluent releases from the PSEG Site. The potential impacts of releases from operating the cooling system are discussed in Section 5.7.2. Section 5.7.3 discusses the potential air quality impacts associated with transmission lines during plant operation.

5.7.1 Air Quality Impacts

Section 2.9 describes the meteorological characteristics and air quality of the PSEG Site. Based on PSEG's plant parameter envelope (PPE), sources of air emissions would include stationary combustion sources (four emergency diesel generators, two regular diesel generators, and auxiliary boilers), cooling towers (one or two natural draft, mechanical draft, or fan-assisted natural draft wet cooling towers and smaller mechanical draft cooling towers for SWS cooling)

(PSEG 2014-TN3452), and mobile sources (worker vehicles, onsite heavy equipment and support vehicles, and delivery of materials and disposal of wastes). Stationary combustion sources would operate only for limited periods, often for periodic maintenance testing.

5.7.1.1 Criteria Pollutants

The principal air emission sources associated with a new nuclear power plant at the PSEG Site would be cooling towers, auxiliary boilers for heating and start-up, engine driven emergency equipment, and emergency power supply system diesel generators and/or combustion turbines. Based on the PPE bounding assumptions (Appendix I), the new plant would have six backup generators (four emergency diesel generators and two normal diesel generators) as part of the emergency power supply system. The anticipated annual auxiliary boiler and diesel generator air emissions, which include nitrogen oxides (NO_x), carbon monoxide (CO), sulfur oxides (SO_x), hydrocarbons in the form of volatile organic compounds (VOCs), and particulate matter, are provided in Table 5-13. Operation of a new nuclear power plant would increase gaseous and particulate emissions to the air by a small amount, primarily from equipment associated with auxiliary systems and the cooling towers. The primary sources of emissions from auxiliary systems would be the auxiliary boilers, standby power units such as diesel generators or gas turbines, and engine driven emergency equipment. The auxiliary boilers would be used for heating buildings associated with the new plant, primarily during the winter months, and for process steam during site start-ups. The diesel generators/gas turbines and engine driven emergency equipment would be used intermittently and for brief durations (PSEG 2014-TN3452).

Low-sulfur fuels would be used for all equipment, minimizing gaseous and particulate emissions during the periods when the equipment operates. The cooling towers would be the primary source of particulate emissions (PSEG 2014-TN3452).

Table 5-13 presents PSEG's estimated annual non-radiological emissions associated with operating a new nuclear power plant at the PSEG Site. As discussed in Section 2.9.2, Salem County is in a nonattainment area for the 8-hour ozone (O_3) National Ambient Air Quality Standards (NAAQS) (40 CFR 81.331, 40 CFR 81-TN255) and adjacent to a nonattainment area for particulate matter with a mean aerodynamic diameter of 2.5 µm or less ($PM_{2.5}$) (New Castle County, Delaware) (40 CFR 81.308, 40 CFR 81-TN255), so the General Conformity Rule (40 CFR 93, Subpart B, 40 CFR 93-TN2495) applies. The primary precursors to O_3 are NO_x and VOCs. New Jersey is located inside the Northeast Ozone Transport Region. For ozone and its precursors in states within the Northeast Ozone Transport Region, such as New Jersey, the applicable 40 CFR 93.153(b)(1) *de minimis* rates (40 CFR 93, Subpart B, 40 CFR 93-TN2495) are 100 tons per year (tpy) for NO_x and 50 tpy for VOCs. The estimated annual NO_x emissions in Table 5-13 are 52.5 tpy, well below the 100 tpy *de minimis* rate. The estimated annual VOC emissions are 202 tpy, significantly larger than the 40 CFR 93.153(b)(1) *de minimis* rate (40 CFR 93, Subpart B, 40 CFR 93-TN2495). The VOC emission rate is higher than that of similar large nuclear power plant. However, PSEG plans to use the auxiliary boilers continuously for 4 months per year (mid-November to mid-March) to provide heat to the new plant (PSEG 2014-TN3452), rather than solely using the auxiliary boilers for plant startup. If, at the combined construction permit and operating license (COL) stage, the estimated VOC emission rate remains above the *de minimis* rate, NRC staff will need to demonstrate conformity with the

applicable state implementation plan (SIP) according to 40 CFR 93.150 to comply with the General Conformity Rule (40 CFR 93, Subpart B, 40 CFR 93-TN2495). Because the ESP does not authorize the activities that would lead to these emissions, the General Conformity Rule is not addressed at this time.

Table 5-13. Annual Estimated Emissions from Cooling Towers, Auxiliary Boilers, and Emergency Power Supply System Diesel Generators at the PSEG Site

Emission Effluent	Cooling Towers (lb/yr)[(a)]	Auxiliary Boilers (lb/yr)[(b)]	Diesel Generators (lb/yr)[(c)]	Total Emissions	
				(lb/yr)	(ton/yr)
Nitrogen Oxides	NA[(d)]	76,088	28,968	105,056	52.5
Carbon Monoxide	NA	6,996	4,600	11,596	5.8
Sulfur Oxides	NA	460,000	5,010	465,010	232.5
Volatile Organic Compounds[(e)]	NA	400,800	3,070	403,870	201.9
Particulate Matter (PM_{10})	122,000	138,000	1,620	261,620	130.8

(a) Based on 8,760 hr of operation at 13.9 lb/hr (14.63 gm/s).
(b) Based on 120 days of operation; PPE values are based on 30 d/yr operation; to obtain emissions for 120 days, the value in PPE is multiplied by 4.
(c) Based on 4 hr of operation per month.
(d) NA = Not applicable.
(e) As total hydrocarbon.

Source: PSEG 2014-TN3452.

Air emission sources associated with a new nuclear power plant would be managed in accordance with Federal, State, and local air quality control laws and regulations. A new plant at the PSEG Site would comply with all regulatory requirements of the CAA, including requirements of the NJDEP Division of Air Quality and Delaware Department of Natural Resources and Environmental Control (DNREC) Division of Air Quality, thereby minimizing any impacts on state and regional air quality. Modifications to the SGS and HCGS Title V Operating Permit under the CAA from the NJDEP would be required for a new nuclear power plant at the PSEG Site, addressing emissions and compliance with state and federal regulations (PSEG 2014-TN3452).

The U.S. Environmental Protection Agency (EPA) revised the 8-hour ozone NAAQS on March 27, 2008 (73 FR 16436-TN3337). The primary 8-hour ozone standard was lowered from 0.080 ppm to 0.075 ppm. The secondary standard was also strengthened to make it identical to the revised primary standard. New Jersey submitted recommendations for designating nonattainment areas for the 2008 revised ozone standard to EPA on April 1, 2009. On January 6, 2010, EPA proposed to strengthen the 8-hour ozone NAAQS set in March 2008. EPA is proposing to strengthen the 8-hour “primary” ozone standard, designed to protect public health, to a level within the range of 0.060 to 0.070 ppm. Salem County is not in the Philadelphia-Wilmington (PA-NJ-DE) nonattainment area for $PM_{2.5}$ NAAQS (40 CFR 81.331, 40 CFR 81-TN255).

New or modified sources of air pollution must undergo a New Source Review before construction and obtain a Title V operating permit if they emit or have the potential to emit (PTE) more than the threshold values in N.J.A.C. Title 7, Chapter 27 for criteria air pollutants. Stationary equipment such as diesel generators and auxiliary boilers would be required to comply with the requirements of the “National Emission Standards for Hazardous Air Pollutants” given in 40 CFR 63 (40 CFR 63-TN1403). These regulations specify emission limits and, for nonemergency diesels, performance tests, limitations on fuel sulfur content, and operating limitations. In addition, depending on when the engines are built and installed, there may be additional requirements under the “Standards of Performance for Stationary Compression Ignition Internal Combustion Engines” (40 CFR 60, Subpart IIII, 40 CFR 60-TN1020). These Federal requirements would be administered by the State and included in the Title V operating permit. Given the small size and infrequent operation of combustion equipment, impacts on offsite air quality are expected to be minimal.

Additional operations-related traffic would also result in vehicular air emissions. Of particular concern is NO_x because it contributes to ozone formation, and Salem County is in an 8-hour ozone nonattainment area. Nominal localized increases in emissions would occur due to the increased numbers of cars, trucks, and delivery vehicles that would travel to and from the ESP Site. Most of the increased traffic would be associated with employees driving to and from work. Once the workers are at the site, the volume of traffic and its associated emissions is expected to decrease. The workforce would also be staggered in shifts, which would further reduce the amount of traffic during peak traffic times (PSEG 2014-TN3452). Therefore, impacts to local and regional air quality from operations-related traffic would be minimal.

Fugitive dust is expected to be generated during operation. However, dust suppression methods could minimize impacts from fugitive dust. These include watering exposed areas, reseeding, or stabilizing areas after construction activities (PSEG 2014-TN3452).

The closest mandatory Class I Federal area where visibility is an important value is the Brigantine Wilderness Area at the Edwin B. Forsythe National Wildlife Refuge north of Brigantine, New Jersey (40 CFR 81.420, 40 CFR 81-TN255), approximately 60 miles east of the PSEG Site. Considering the distance to the Class I area, which is not downwind of prevailing winds at the site, and the minor air emissions from the PSEG Site, there is little likelihood that activities at the PSEG Site could adversely affect air quality and air quality-related values (e.g., visibility or acid deposition) in this Class I area.

Based on the information provided by PSEG and the review team’s independent evaluation, the review team concludes that the air quality impacts of criteria pollutants would not be noticeable, and additional mitigation would not be warranted, given PSEG’s commitment to manage and mitigate emissions in accordance with applicable regulations.

5.7.1.2 Greenhouse Gases

Operating a nuclear power plant involves the emission of some GHGs, primarily carbon dioxide (CO_2). The review team has estimated that the total GHG footprint for operating a new nuclear power plant at the PSEG Site for 40 years is on the order of 634,000 metric tons (MT) of CO_2 equivalent (CO_2e) (an emission rate of about 15,850 MT CO_2e annually, averaged over the

period of operation). This amounts to about 0.011 percent of the total projected GHG emissions estimate in New Jersey of 143,400,000 MT of gross CO_2e in 2010 (NJDEP 2008-TN2776). This also equates to about 0.0002 percent of the total United States annual emission rate of 6.7 billion MT CO_2e in 2011 (EPA 2013-TN2815). The value of 634,000 MT CO_2e includes the emissions from a nuclear power plant operating (362,000 MT CO_2e) and the associated emissions from the operations workforce (272,000 MT CO_2e). These estimates are based on GHG footprint estimates in Appendix K.

The EPA promulgated the Prevention of Significant Deterioration (PSD) requirements and the Title V GHG Tailoring Rule on June 3, 2010 (75 FR 31514-TN1404). This rule states that, among other items, new and existing sources not already subject to a Title V permit, or that have a PTE at least 100,000 tpy (or 75,000 tpy for modifications at existing facilities) CO_2e, will become subject to the PSD and Title V requirements effective July 1, 2011. The rule also states that sources with a PTE below 50,000 tpy CO_2e will not be subject to PSD or Title V permitting before April 30, 2016. EPA may decide not to require permits for sources with GHG emissions less than 50,000 tpy. Based on the review team's estimate of 15,850 MT CO_2e emitted annually from operation of a new nuclear power plant at the PSEG Site, PSEG would fit into the category of smaller sources that are subject to permitting after April 30, 2016, or may be exempt from permitting (EPA 2014-TN2497).

Based on its assessment of the plant operations' GHG footprint when compared with annual GHG emissions for New Jersey and the United States, the review team concludes that the atmospheric impacts of GHGs from plant operations would not be noticeable, and additional mitigation would not be warranted.

5.7.2 Cooling System Impacts

The proposed cooling systems for the CWS at the PSEG Site would include three different closed-loop, evaporative (wet) designs: mechanical draft; natural draft; and fan-assisted natural draft (PSEG 2014-TN3452). For this impact analysis, the first two designs are evaluated, and the impacts of the last design are considered to be bounded by the impacts of the first two designs. The mechanical draft design consists of two LMDCTs, each with a tower length, width, and height of 817 ft, 100 ft, and 46 ft, respectively. Each LMDCT has 34 cells with a cell diameter of 31.6 ft. The natural draft design consists of two NDCTs, each with a tower height and diameter of 590 ft and 242 ft, respectively. In addition, the new nuclear power plant would use four smaller essential SWS/UHS cooling towers; the heat dissipated by these towers would be by an order of magnitude less than that dissipated by cooling towers for the CWS. Accordingly, impacts from the SWS/UHS cooling towers are not considered further in the analysis because they have a considerably smaller impact than the CWS cooling towers.

The proposed cooling towers would remove excess heat by evaporating water. Upon exiting the tower, water vapor would mix with the surrounding air, and this process would generally lead to condensation and formation of a visible plume, which would have aesthetic impacts. Other meteorological and atmospheric impacts include ground-level fogging/icing, plume shadowing, drift deposition from dissolved salts and chemicals found in the cooling water, and ground-level temperature and humidity increases. In addition, plumes from the cooling towers could interact cumulatively with emissions from other sources and the existing HCGS cooling tower.

The Electric Power Research Institute's SACTI prediction computer code was used to estimate potential seasonal and annual impacts associated with operating the proposed cooling towers (EPRI 1987-TN3335). Site-specific, tower-specific, and circulating water-specific engineering data were used as input to the SACTI model. Three years (2006–08) of onsite meteorological data combined with cloud data (such as cloud cover and ceiling heights) from nearby New Castle County Airport in Wilmington, Delaware, and mixing height data from the Dulles International Airport in Sterling, Virginia, which is the closest representative upper-air station, were used in the analysis (PSEG 2014-TN3452; PSEG 2014-TN3334). The source of cooling water for these towers is brackish water from the Delaware River. The TDS value of 12,900 mg/L (or 12,900 ppm) is conservatively assumed for the analysis, although the highest measured mean TDS value in the river is 6,280 mg/L (or 6,280 ppm). As cooling water continues to evaporate from the towers or be lost via drift, the concentration of minerals in the water increases, which can lead to scaling and corrosive conditions. To control TDS levels, the portion of the circulating water should be blown down. Because of the use of brackish water, a lower cycle of concentration (1.5), defined as the ratio of TDS concentration in the circulating water compared to the raw makeup water, is assumed. Both the mechanical and natural draft designs would be equipped with high efficiency drift eliminators, which significantly reduce particulate matter (PM) emissions (especially larger PM) and, thereby, salt deposition around the site. Detailed model input data to SACTI for LMDCTs and NDCTs are presented in ER Tables 5.3-5 and 5.3-6 (PSEG 2014-TN3452). The SACTI modeling results for visible plumes, ground-level fogging/icing, plume shadowing, and salt deposition are presented, which are made by the applicant and confirmed by the staff's independent analysis.

Both ground-level temperature and humidity would increase in the vicinity of the warm and humid cooling tower plumes. However, any increases in ground-level temperature and humidity would be localized and short-lived as the plume, reaching a considerable height, disperses and mixes with the far larger volume of surrounding air, and thus ground-level temperature and humidity increases are not considered further.

Visible Plumes. Results from the SACTI analysis, as reported by PSEG (PSEG 2014-TN3452; PSEG 2014-TN3334), indicate that the largest frequency of visible plume occurrence is on the site. For comparison, the nearest plant boundary is 1,100 ft from the center of the tower area. On an annual basis, SACTI predicts that the plume lengths from the LMDCTs would be less than 1,969 ft for about half of the time and that the most frequent occurrences would be 9.5 percent of the time (or 831 hours per year) at 328 ft southeast of the LMDCTs. The highest probability of a visible plume near the nearest plant boundary would be about 5.7 percent of the time (or 499 hours per year) at 984 ft north of the LMDCTs. By season, the most frequent occurrence is predicted during the winter: 14.0 percent of the time (or 302 hours per year) at 328 ft southeast of the LMDCT and 11.9 percent of the time (or 257 hours per year) at 984 ft southeast of the LMDCTs. The visible plume frequency would be reduced with increasing distance from the towers. The visible plume would extend to a distance of 1,640 ft with an average of 278 hours per year and to a distance of 3,281 ft with an average of 179 hours per year. In general, the visible plumes from the NDCTs could be seen more frequently than those from the LMDCT at downwind locations. On an annual basis, SACTI predicts that the plume lengths from the NDCTs would be less than 3,281 ft about half of the time and that the most frequent occurrences would be about 9.5 percent of the time (or 831 hours per year) up to 984 ft

southeast of the NDCTs. Of these occurrences, the most frequent occurrence is predicted during the winter, 14.0 percent of the time (or 302 hours per year) at up to 1,640 ft southeast of the NDCTs. The visible plume would extend to a distance of 1,640 ft with an average of 499 hours per year and to a distance of 3,281 ft with an average of 282 hours per year.

Considering the physical tower heights, the visible plume could reach a height of at least 112 ft and 820 ft above ground level for the LMDCTs and NDCTs, respectively (PSEG 2014-TN3452; PSEG 2014-TN3334). On an annual basis, the median plume height for the LMDCTs would be about 702 ft, while that for the NDCTs would be about 1,574 ft. Due to the greater release height of the plumes, the NDCT plumes would achieve a greater height above ground level than the LMDCT plumes.

The visible plume frequencies discussed above include nighttime hours when plumes may not be perceived. Thus, cooling tower plumes would be seen less frequently than the aforementioned values, considering daytime hours only. The frequency of occurrence of long cooling tower plumes from either LMDCTs or NDCTs in a given direction is predicted to be low. Given the limited elevations and extent of the visible plumes from both designs, any associated impacts would be minor and would not warrant mitigation.

Ground Fogging and Icing. Ground-level fogging occurs when a visible plume from a cooling tower contacts the ground. In general, fogging is predicted to occur more frequently in non-summer months. A large majority of fogging is predicted to occur within the PSEG Site boundary. On an annual basis, fogging could extend up to 3,609 ft east-southeast of the LMDCTs, and maximum fogging duration would be 7 hours at 1,312 ft northwest of the LMDCTs (PSEG 2014-TN3452; PSEG 2014-TN3334). On a seasonal basis, maximum fogging durations and distances from the LMDCTs are 2.7 hours at 656 ft northwest in winter, 5.5 hours at 656 ft west-southwest in spring, and 3.0 hours between 1,312 and 1,640 ft northwest in fall. No fogging is predicted to occur during the summer. As discussed in Section 2.9.1, the prevailing wind direction is from the northwest, but fogging occurs more frequently to the west, which suggests that meteorological conditions conducive to fogging are associated with winds from the east and southeast (i.e., the Atlantic Ocean and Delaware Bay). As a consequence, fogging events would be infrequent, and most fogging events would be limited to the PSEG Site, which would not significantly affect roadway conditions in the vicinity of the site or commercial shipping traffic on the Delaware River. Icing may occur when the cooling tower plume comes in contact with the ground (i.e., fogging occurs) at below-freezing temperatures. The SACTI model predicts that no icing events are anticipated at any location in any season, which suggests that fogging events would not occur during freezing conditions.

Based on studies of actual NDCTs, the SACTI model assumes that the occurrence of fogging (and icing) is an insignificant event because of the greater plume height of the NDCTs and therefore does not estimate their occurrence.

Meteorological conditions favoring natural fogs also favor cooling tower fogging. Natural heavy fogging in the PSEG Site area occurs about 26 days per year on average (PSEG 2014-TN3452). Any plume-induced event would thus be infrequent and likely to occur concurrently with a natural fog. Considering that fogging events occur infrequently and most frequently on

the site, and that no icing impacts are predicted, potential impacts of LMDCT-induced fogging/icing are anticipated to be negligible and would not warrant mitigation.

Plume Shadowing. Plume shadowing from cooling tower plumes is predicted by the SACTI model by calculating the average number of hours the visible plume would shadow the ground. Most of the plume shadowing would occur within 656 ft of the towers for 2,830 hours per year for LMDCTs and 1,658 hours per year for NDCTs (PSEG 2014-TN3452; PSEG 2014-TN3334). Plume shadowing frequency decreases rapidly with increasing distances. Plume shadowing frequency decreases to 1,098 hours per year at 1,312 ft and 345 hours per year at 3,281 ft for the LMDCTs. Similarly, it decreases to 1,117 hours per year at 1,312 ft and 412 hours per year at 3,281 ft for the NDCTs. Beyond 9,843 ft, the average plume shadowing frequency would be less than 145 hours per year, about 3.3 percent of the 4,380 daylight hours, which would be insignificant in terms of effects on agricultural production. Given the limited agricultural activities around the PSEG Site, the impacts of plume shadowing are expected to be minor and would not require mitigation.

Salt Deposition. The NDCT would use high efficiency drift eliminators to minimize the loss of cooling water from the tower via drift, but some droplets still would escape from the tower along with the moving airstream and would be deposited on the ground. For LMDCTs, the SACTI model predicted maximum deposition rates of 0.89 kilograms per hectare per month (kg/ha per month) annually at 2,297 ft east of the towers (PSEG 2014-TN3452; PSEG 2014-TN3334). The maximum seasonal impact would occur during the winter, with 1.31 kg/ha per month at 2,297 ft east of the towers, while the minimum seasonal impact would occur during the summer, with 0.56 kg/ha per month between 1,969 and 2,297 ft east of the towers. These maximum impacts are below the maximum levels considered acceptable in NUREG–1555 (NRC 1999-TN614) (i.e., deposition of salt drift at rates of 1 to 2 kg/ha per month, which generally is not damaging to plants). The predicted deposition rates are well below the level for which deposition rates could cause leaf damage in many species (i.e., approaching or exceeding 10 kg/ha per month in any month during the growing season). In contrast, potential impacts from the NDCTs would be much lower, and maximum concentrations would occur farther than those from LMDCTs because of the taller plume release height, which is the sum of physical tower height and buoyant plume rise caused by a greater volume of hot and humid effluents. For the NDCTs, the annual maximum deposition rate of 0.023 kg/ha per month is predicted to occur between 4,265 and 7,546 ft north of the towers, with a maximum seasonal deposition of 0.034 kg/ha per month in winter and a minimum seasonal deposition of 0.024 kg/ha per month in summer. The predicted deposition rates from the NDCTs are well below the levels of concern. Based on 2001 land use/land cover data from the USGS, one percent of the land within 3 mi of the PSEG Site is designated as medium- and high-intensity developed land, while surface waters and wetlands comprise about 90 percent of the land (PSEG 2014-TN3452). Most of the plant communities within the salt drift zone that would be exposed to drift from the cooling towers consist of salt marsh or brackish marsh ecosystems dominated by medium- to high-salinity tolerant species. Thus, the impacts of salt deposition from the cooling towers on nearby vegetation are expected to be minor, and no further mitigation would be warranted.

Interaction with Other Pollutant Sources. The existing HCGS NDCT is located more than 0.6 mi south-southeast of the planned location of the cooling towers for a new nuclear power plant at the PSEG Site. The plumes from the HCGS tower and the PSEG Site towers would usually

travel in parallel, rather than in intersecting directions. The potential cumulative interaction of existing and new cooling tower plumes is expected to be insignificant given the large separation distance and the fact that the plumes would travel along nonintersecting paths most of the time.

Existing combustion sources such as diesel generators and boilers currently operate infrequently at HCGS and SGS (typically not during normal plant operations). Combustion sources that would be associated with a new nuclear power plant at the PSEG Site would operate similarly for only limited periods. With the exception of particulates, these combustion sources emit criteria air pollutants [such as NO_x, sulfur dioxide (SO_2), and CO] that are different from those produced by cooling towers (i.e., small amounts of PM as drift). Interaction among pollutants emitted from these sources and the cooling tower plumes would be intermittent and would not have a significant impact on air quality. Based on the above considerations and the assumption that cooling towers associated with the PSEG Site would be similar to existing cooling towers used at other nuclear sites, the review team concludes that the cooling tower impacts on air quality would be minimal, and additional mitigation of air quality impacts would not be warranted.

Conclusion. As discussed above, the SACTI model predicts that potential impacts of plumes from the cooling towers at the PSEG Site would be limited primarily to the immediate onsite area and just beyond the site boundary. The cooling towers proposed for the PSEG Site would be equipped with high efficiency drift eliminators, which are intended to significantly reduce PM emissions (especially larger PM) and salt deposition. The area around the PSEG Site is relatively sparsely populated and less sensitive to the potential impacts from cooling tower operations (e.g., plume shadowing or salt deposition, considering limited agricultural activities). On the basis of the analysis presented by the applicant in its ER and the staff's independent evaluation of that analysis, the staff concludes that atmospheric impacts of cooling tower operation at the PSEG Site would be SMALL and that no further mitigation would be warranted.

5.7.3 Transmission Line Impacts

Impacts of existing transmission lines on air quality are addressed in the GEIS, Revision 1 (NRC 2013-TN2654). Small amounts of ozone and even smaller amounts of NO_x are produced by transmission lines. The production of these gases was found to be insignificant for 745-kV transmission lines (the largest lines in operation) and for a prototype 1,200-kV transmission line. In addition, it was determined that potential mitigation measures, such as burying transmission lines, would be very costly and would not be warranted.

There are currently two 500-kV transmission lines leading to HCGS, two 500-kV transmission lines leading to SGS, and 500-kV tie lines between the two switchyards. PJM Interconnection, LLC (PJM) identified the potential need for an additional 500-kV transmission line to resolve grid stability issues. The existing transmission line sizes and the potential new offsite 500-kV transmission line are well within the range of transmission lines evaluated in NUREG-1437, Revision 1 (NRC 2013-TN2654). The review team therefore concludes that air quality impacts from the transmission lines would not be noticeable and mitigation would not be warranted.

5.7.4 Summary

The review team evaluated potential impacts on air quality associated with criteria pollutants and GHG emissions from operating a new nuclear power plant at the PSEG Site. The review team also evaluated potential impacts of cooling system emissions. In each case, the review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of operating a new nuclear power plant on air quality from criteria pollutant emissions, GHG emissions, cooling system, and transmission lines would be SMALL and that no further mitigation would be warranted.

5.8 Nonradiological Health Impacts

This section addresses the nonradiological human health impacts of operating a new nuclear power plant at the PSEG Site. Health impacts on the public from operation of the cooling system, noise generated by operations, EMFs, and transporting operations are discussed. Health impacts from the same sources for workers at a new nuclear power plant are also evaluated. Health impacts from radiological sources during operations are discussed in Section 5.9.

5.8.1 Etiological Agents

Operation of a new nuclear power plant at the PSEG Site would result in a thermal discharge to the Delaware River (PSEG 2014-TN3452). Such discharges have the potential to increase the growth of etiological agents, both in the CWS and the river. Etiological agents include enteric pathogens (such as *Salmonella* spp.), *Pseudomonas aeruginosa*, thermophilic fungi, bacteria (such as *Legionella* spp.), and free-living amoeba (such as *Naegleria fowleri* and *Acanthamoeba* spp.). These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels. Available data assembled by the U.S. Centers for Disease Control and Prevention (CDC) for the years 2000 to 2010 were reviewed for outbreaks of legionellosis, salmonellosis, or shigellosis within the vicinity of the PSEG Site and in New Jersey and Delaware (CDC 2002-TN2444; CDC 2002-TN2438; CDC 2003-TN2437; CDC 2004-TN2435; CDC 2004-TN2436; CDC 2005-TN2442; CDC 2006-TN2445; CDC 2006-TN2441; CDC 2007-TN2440; CDC 2008-TN2439; CDC 2008-TN557; CDC 2013-TN2377; CDC 2010-TN2447; CDC 2011-TN2446; CDC 2011-TN2448, CDC 2011-TN558; CDC 2012-TN2378). Outbreaks that occurred in Delaware and New Jersey were within the range of national trends in terms of cases per populations of 100,000 and in terms of total cases per year; the outbreaks were associated with pools, spas, or lakes. Additionally, the Salem County Department of Health and the New Jersey and Delaware state health agencies have not recorded any major waterborne disease outbreaks in the Delaware River in proximity of the PSEG Site (PSEG 2014-TN3452).

The CDC Council of State Territorial Epidemiologists *Naegleria* Work Group, after reviewing the data from different sources, identified 121 fatal cases of primary amoebic meningoencephalitis (PAM, caused by *Naegleria fowleri*) in the United States from 1937 to 2007; most cases occurred in southern states during the months of July and September (CDC 2013-TN2375; Neil and Berkelman 2008-TN2735). No outbreaks of Legionnaires' disease, PAM, or any other

waterborne diseases associated with HCGS or SGS operations have been reported in the past. The standard practices for operating cooling towers include adding biocides to the water to limit growth of microorganisms inside the towers and providing appropriate protective equipment for workers who enter the cooling towers for maintenance operations. PSEG would use biocides to reduce the levels of microbial populations in the cooling tower, condenser equipment, and facilities at a new nuclear power plant. Chlorination controls microbial growth in the piping and condenser to prevent biofouling and microbiological deposits. PSEG policies and procedures regarding industrial hygiene procedures for protection of workers from thermophilic microorganisms in a new nuclear power plant would follow the existing PSEG maintenance procedures for SGS and HCGS (PSEG 2014-TN3452). Sodium hypochlorite solution also is used to control biofouling, and all blowdown waters are treated to comply with NJPDES permit requirements before discharge to the Delaware River (PSEG 2014-TN3452).

The existing Delaware River water temperature conditions in the vicinity of the PSEG Site and the proposed discharge location are affected by the presence of discharges from the existing SGS and to a lesser extent HCGS (PSEG 2014-TN3452). Water temperature monitoring data and thermal plume analysis indicate that the SGS HDA envelopes the HCGS HDA and extends northward along the shoreline well beyond the location of the proposed PSEG Site discharge, which would extend only about 100 ft into the Delaware River (PSEG 2014-TN3452). It is assumed that a new nuclear power plant at the PSEG Site would use two cooling towers (with a mechanical draft, natural draft, or fan-assisted natural draft wet cooling tower) and would have a closed-loop cooling system to reduce the temperature of water discharged to the Delaware River. The thermal plume modeling of this discharge indicates the PSEG Site thermal plume would be contained within 600 ft of the shoreline. Consequently, the plume from a new nuclear power plant would be contained within the SGS thermal plume, and the combined excess temperatures from a new nuclear power plant, HCGS, and SGS would be less than the maximum temperature in the existing SGS thermal plume (PSEG 2014-TN3452). NJDEP has issued a discharge permit for SGS and determined that the SGS thermal plume does not impact the balanced indigenous community (PSEG 2014-TN3452). Furthermore, existing DRBC regulatory standards for thermal discharges to the Delaware River state that temperature increases above ambient outside the permitted heat dissipation area may not exceed 2.2°C (4°F) from September to May or 0.8°C (1.5°F) from June through August. Overall temperatures may not exceed 30°C (86°F) (72 FR 46931-TN2736). The temperature of the river water would be below the optimal temperatures for thermophilic bacteria to grow and reproduce.

Study of the PSEG Site indicated the following:

- a historical low incidence of diseases from etiological agents in Delaware and New Jersey associated with exposure to the Delaware River in proximity to the PSEG Site,
- a relatively small volume of water discharged from the closed-cycle cooling system of a new nuclear power plant,
- rapid mixing that occurs within the Delaware River, and
- small size of the heat dissipation area.

For these reasons, the review team concludes the impacts on human health from the microorganisms, including thermophiles, in the Delaware River and the cooling towers of a new nuclear power plant at the PSEG Site would be minimal and that mitigation would not be warranted.

5.8.2 Noise

In NUREG–1437 (NRC 1996-TN288), NRC staff discusses the environmental impacts of noise at existing nuclear power plants. Common sources of noise from site operation include cooling towers, transformers, and switchyards, with intermittent contributions from loud speakers and auxiliary equipment such as diesel generators. These noise sources are discussed in this section.

The existing HCGS and SGS units use water from the Delaware River to remove waste heat. HCGS has a closed-loop cooling system with a natural draft cooling tower (NDCT), and SGS has a once-through cooling water system with condenser cooling. A new nuclear power plant at the PSEG Site would have a cooling water system with mechanical draft, natural draft, or fan-assisted natural draft cooling towers with a closed-loop cooling system. Cooling water would be pumped from the Delaware River by an intake pipeline, and blowdown from the cooling towers would be returned to the river through a discharge pipeline after the blowdown was mixed with other site operation wastewater and passed through a wastewater treatment facility (PSEG 2014-TN3452).

The main source of continuous noise is anticipated to be the two cooling towers associated with a new nuclear power plant. Two fan-assisted NDCTs are used as the bounding condition for this assessment because NDCTs are taller than MDCTs (590 ft versus approximately 46 ft, respectively) (PSEG 2014-TN3452). The fan-assisted NDCT is a continuous noise source during site operation with an estimated noise emission of 60 dBA at 1,000 ft. The nearest PSEG Site boundary is west of the cooling towers, 1,100 ft from the center of the proposed cooling tower area; the next closest site boundary is 1,165 ft to the east. PSEG also has identified HVAC systems, vents, transformers and electrical equipment, transmission lines, water pumps, material-handling equipment, motors, and public address systems as additional noise sources from operations at the PSEG Site. Noise attributed to operations-related truck and vehicular traffic would be intermittent, primarily during shift changes.

Applicable protective noise levels for the PSEG Site are contained in the New Jersey Administrative Code (NJAC) 7:29, which includes regulatory limits on continuous noise levels at the residential property line from industrial, commercial, public service, or community service facilities. For continuous noise sources, the protective level is 65 dBA during the day and 50 dBA during the night at the residential property line (NJAC 7:29-TN2732). The similar Delaware limits (Part VII, Title 7, Chapter 71 of the Delaware Code) provide for a protective level of 65 dBA during the day and 55 dBA during the night for residential receptors.

According to NUREG–1437 (NRC 1996-TN288), noise levels below 60 to 65 dBA as the day-night average noise level (DNL or Ldn) are considered to be of small significance. More recently, impacts of noise were considered in NUREG–0586, Supplement 1 (NRC 2002-TN665). The criterion for assessing the level of significance was not expressed in terms of

sound levels but instead was based on the effect of noise on human activities and on threatened and endangered species. The criterion in NUREG–0586, Supplement 1, is stated as follows.

> The noise impacts are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected. (NRC 2002-TN665)

PSEG conducted a baseline noise survey in 2009 for the PSEG Site and determined that noise from sources at HCGS and SGS attenuate to levels that meet New Jersey and Delaware State standards of 65 dBA for daytime at the boundary of the PSEG property (PSEG 2014-TN3452). Based on the natural attenuation of noise levels over distance, noise levels for the fan-assisted NDCTs for the PSEG Site are estimated at a distance of 10,000 ft. A fan-assisted NDCT with a noise emission level of 60 dBA at 1,000 ft has a noise level of 41 dBA at 10,000 ft. PSEG states that the closest residences are 14,700 ft west and 15,900 ft east of the PSEG Site boundaries (PSEG 2014-TN3452). Thus, noise from onsite sources would attenuate to levels that would meet the New Jersey nighttime noise level standards (50 dBA) at the property boundary of the nearest residence.

The review team concludes the impact of noise from operating a new nuclear power plant at the PSEG Site would be minimal (depending on the reactor and cooling tower design as well as equipment choices) and that mitigation would not be warranted.

5.8.3 Acute Effects of Electromagnetic Fields

Electric shock resulting from either direct access to energized conductors or induced charges in metallic structures is an example of an acute effect from EMF associated with transmission lines (NRC 1999-TN289). Such acute effects are controlled and minimized by conformance with National Electrical Safety Code (NESC) criteria and the Organization of PJM States, Inc. (OPSI), which organizes the statutory regulatory agencies in the 13 states and Washington, D.C., where PJM operates transmission systems. The PSEG ER (PSEG 2014-TN3452) states that if PJM determines that new transmission lines are needed for additional capacity from the PSEG Site or to support the regional grid, the new lines would meet or exceed design requirements set forth by NESC and meet the Lower Delaware Valley 500 kV Transmission Design Criteria. Also, lines would meet USACE requirements for clearance over flood levels (PSEG 2014-TN3452). PSEG and PJM both have committed to design new transmission lines to meet present NESC criteria, and NRC staff assumes that if new transmission lines are needed, such lines would be constructed to meet NESC criteria. For these reasons, the review team concludes the impact to the public from acute effects of EMFs would be minimal, and additional mitigation would not be warranted.

5.8.4 Chronic Effects of Electromagnetic Fields

Power transmission lines in the United States operate at 60 Hz. The EMFs resulting from 60-Hz power transmission lines fall under the category of nonionizing radiation and are considered to

be extremely low frequency (ELF) EMFs. Research on the potential for chronic effects from 60-Hz EMFs from energized transmission lines was reviewed by the NRC and is addressed in NUREG–1437 (NRC 1996-TN288). At the time of that review, research results were not conclusive. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy (DOE). An NIEHS report (NIEHS 1999-TN78) contains the following statement.

> 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 a 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.

The staff reviewed available scientific literature on chronic effects to human health from ELF–EMFs published since the NIEHS report and found that several other organizations reached the same conclusions (HPA 2006-TN1273; WHO 2007-TN1272). Additional work under the auspices of the World Health Organization (WHO) updated the assessments of a number of scientific groups that reflected the potential for transmission line EMFs to cause adverse health impacts in humans. The monograph summarized the potential for ELF-EMFs to cause diseases such as cancers in children and adults; depression; suicide; reproductive dysfunction; developmental disorders; immunological modifications; and neurological disease. The results of the review by WHO (WHO 2007-TN1272) found the extent of scientific evidence linking these diseases to EMF exposure is not conclusive.

These conclusions by four national and international groups are in agreement. The current scientific evidence regarding the chronic effect of ELF-EMFs does not conclusively link ELF–EMFs to adverse health impacts. The staff will continue to follow developments in this area.

5.8.5 Occupational Health

In general, occupational health risks for the PSEG Site are expected to be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) to workers engaged in activities such as maintenance, testing, and site modifications. In 2009, annual incidence rates (the number of injuries and illnesses per 100 full-time workers) for electrical power generation, transmission, and distribution workers for New Jersey and the United States are 1.4 and 3.0, respectively (BLS 2010-TN2427; BLS 2010-TN2428). Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. In 2009, the incidence rate of nonfatal injuries and illnesses for the nuclear electric power generation industry was 0.6 total recordable cases per 100 full-time-equivalent employees, with 0.1 cases per 100 full-time-equivalent employees involving days away from work, job transfer, or restriction (BLS 2010-TN2427). Based on the assumption of a total operations workforce of 600 (PSEG 2014-TN3452), these rates suggest that operation of a new nuclear power plant at

the PSEG Site would be associated with approximately four occupational injuries and illnesses per year. However, these are gross estimates and do not take into account risks workers would face if they were employed somewhere other than a new nuclear power plant at the PSEG Site.

In addition, PSEG monitors current operations at HCGS and SGS for OSHA recordable and non-recordable injury rates per PSEG Nuclear procedure SA-AA-123, Injury and Illness Reporting and Recordkeeping (PSEG 2012-TN2403). This procedure ensures accurate and consistent injury recording to maintain compliance with OSHA regulations and PSEG policy. As of June 2012, the HCGS OSHA recordable rate is 0.61, which represents a rolling average of injuries per 200,000 person-hours worked. The OSHA recordable rate for SGS as of the end of June 2012 is 0.11 per 200,000 person-hours worked. The 2011 HCGS OSHA recordable rate was 0.34, while the SGS OSHA recordable rate for 2011 was 0.40. These OSHA recordable rates are applicable to PSEG employees only.

Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards (29 CFR 1910-TN654), practices, and procedures. Appropriate State and local statutes also must be considered when the occupational hazards and health risks associated with a new nuclear power plant's operation are being assessed. The staff assumes adherence to NRC, OSHA, and State safety standards, practices, and procedures during operation of a new plant at the PSEG Site. Additional occupational health impacts may result from exposure to hazards such as noise, toxic or oxygen-replacing gases, etiological agents in the condenser bays, and caustic agents. PSEG reports it maintains a health and safety program to protect workers from industrial safety risks at the operating units and would implement the program for a new plant at the PSEG Site (PSEG 2014-TN3452; PSEG 2012-TN2403). Health impacts on workers from nonradiological emissions, noise, and EMFs would be monitored and controlled in accordance with the applicable OSHA regulations and would be minimal.

5.8.6 Impacts of Transporting Operations Personnel to the PSEG Site

The general approach used to estimate nonradiological impacts from transport of operations and refueling personnel to and from the PSEG Site was the same as that used to calculate impacts from transport of the construction workforce. The parameter assumptions needed to calculate nonradiological impacts for transportation of operational workforce are discussed below.

- The average number of workers needed for operation of a new nuclear power plant at the PSEG Site was given as 600 in the ER (PSEG 2014-TN3452), which also stated that a peak refueling staff of 1,000 temporary workers was required every 24 months.
- It is assumed workers travel 50 mi roundtrip to the PSEG Site for 250 days per year. It is assumed that no sharing of personnel with HCGS and SGS operations staff would occur.
- To develop representative commuter traffic impacts, rates of New Jersey traffic accidents, injuries, and fatalities were obtained from the New Jersey Department of Transportation (NJDOT 2012) and the U.S. Department of Transportation, National Highway Traffic Safety Administration (USDOT 2012) for the years 2006 to 2010.

The estimated impacts of transporting operations and outage workers to and from a new nuclear power plant at the PSEG Site are shown in Table 5-14. The total number of traffic fatalities during operations, including both operations and outage personnel, are estimated to average less than 0.15 annually. The estimated average number of injuries would 0.18 annually from traffic accidents among both the permanent operations and outage workforces. The addition of operational personnel at the PSEG Site is expected to result in a minimal, if not imperceptible, increase relative to the current traffic injury risk in the area surrounding the PSEG Site.

Table 5-14. Nonradiological Impacts of Transporting Operations Personnel to and from the PSEG Site

Type of Workers	Accidents per Year (average)	Injuries per Year (average)	Fatalities per Year (average)
Permanent	0.27	0.07	0.06
Permanent and Refueling	0.73	0.18	0.15

5.8.7 Summary of Nonradiological Health Impacts

The review team evaluated health impacts on the public and workers from operation of a new nuclear power plant at the PSEG Site, including cooling systems, noise generated by unit operations, acute and chronic impacts of EMFs from transmission lines, and transportation of operations and outage workers to and from the site. Health risks to workers are expected to be dominated by occupational injuries at rates below the average U.S. industrial rates. Health impacts on the public and workers from operations at a new nuclear power plant, including exposure to etiologic microorganisms, noise generated by plant operations, and acute impacts of EMFs, would be minimal. Based on the information provided by PSEG and the review team's independent review, the review team concludes the potential nonradiological health impacts resulting from the operation of a new nuclear power plant at the PSEG Site would be SMALL. Current scientific evidence regarding the chronic impacts of EMFs on public health is inconclusive, and the staff will continue to follow developments in this area.

5.9 Radiological Impacts of Normal Operations

This section addresses the radiological impacts of normal operations of a new nuclear power plant on the PSEG Site, including a discussion of the estimated radiation dose to a member of the public and to the biota inhabiting the area around the PSEG Site. Estimated doses to workers are also discussed. The determination of radiological impacts was based on the PPE approach, where bounding direct radiation and liquid and gaseous radiological effluents were used in the evaluation.

5.9.1 Exposure Pathways

The public and biota would be exposed to increased ambient background radiation from normal operations of a new plant at the PSEG Site via liquid effluent, gaseous effluent, and direct

radiation pathways. PSEG estimated the potential exposures to the public and biota by evaluating exposure pathways typical of those surrounding a new nuclear power plant at the PSEG Site. PSEG considered pathways that could cause the highest calculated radiological dose based on the use of the environment by the residents located around the site (PSEG 2014-TN3452; PSEG 2014-TN3453). For example, factors such as the location of homes in the area, consumption of milk from dairy cows and goats in the area, consumption of meat, and consumption of vegetables grown in area gardens were considered.

For the liquid effluent release pathway, PSEG considered the following exposure pathways in evaluating the dose to the maximally exposed individual (MEI): (1) ingestion of aquatic organisms as food (i.e., fish and invertebrates); (2) ingestion of meats, vegetables, and milk; (3) radiation exposure from swimming and boating activities on the Delaware River. The drinking water exposure pathway was not considered, because the Delaware River is composed of brackish water and is not a potable source of water. Liquid effluents were assumed to be released through a site outfall into the Delaware River. The analysis for population dose considered the same exposure pathways as those used for the individual dose assessment.

For the gaseous release pathway, PSEG considered the following exposure pathways in evaluating the dose to the MEI and to the population: (1) immersion in airborne activity in the plume; (2) direct radiation exposure from deposited activity on the ground; (3) inhalation of airborne activity in the plume; (4) ingestion of meat and milk, including goat milk; and (5) ingestion of garden fruit and vegetables (see Figure 5-6).

For population doses from the gaseous effluents, PSEG used the same exposure pathways as used for the individual dose assessment, including the assumed cow and goat milk ingestion pathway. All agricultural products grown within 50 mi of the PSEG Site were assumed to be consumed by the population within 50 mi of the site (Figure 5-6).

PSEG states that sources of direct radiation from SGS and HCGS (including an operational ISFSI) are shielded and do not contribute significantly to the external radiation levels at the site boundary or the population. If an ISFSI is needed for a plant at the PSEG Site, the impacts would likely be similar, namely not contributing significantly to radiation levels at the site boundary or to offsite radiation levels. As discussed in Section 2.11, doses from SGS and HCGS due to direct radiation are measured using thermoluminescent dosimeters (TLDs) located around the site, and the measured values are comparable to the preoperational background radiation data. PSEG states that direct dose contribution from the PSEG Site would be bounded by the ABWR design and that the direct dose from the other advanced reactor designs being considered would be less than the ABWR design (PSEG 2014-TN3452; PSEG 2014-TN3453).

Exposure pathways considered by PSEG in the ER in evaluating dose to biota are shown in Figure 5-7 and included

- ingestion of aquatic foods,
- ingestion of water,
- external exposure from water immersion or surface effect,
- inhalation of airborne radionuclides,

- external exposure to immersion in gaseous effluent plumes, and
- surface exposure from deposition of iodine and particulates from gaseous effluents.

The NRC staff reviewed the exposure pathways for the public and nonhuman biota identified by PSEG and found them to be appropriate, based on documentation review and interviews with PSEG staff during the Environmental Site Audit in May 2012**.**

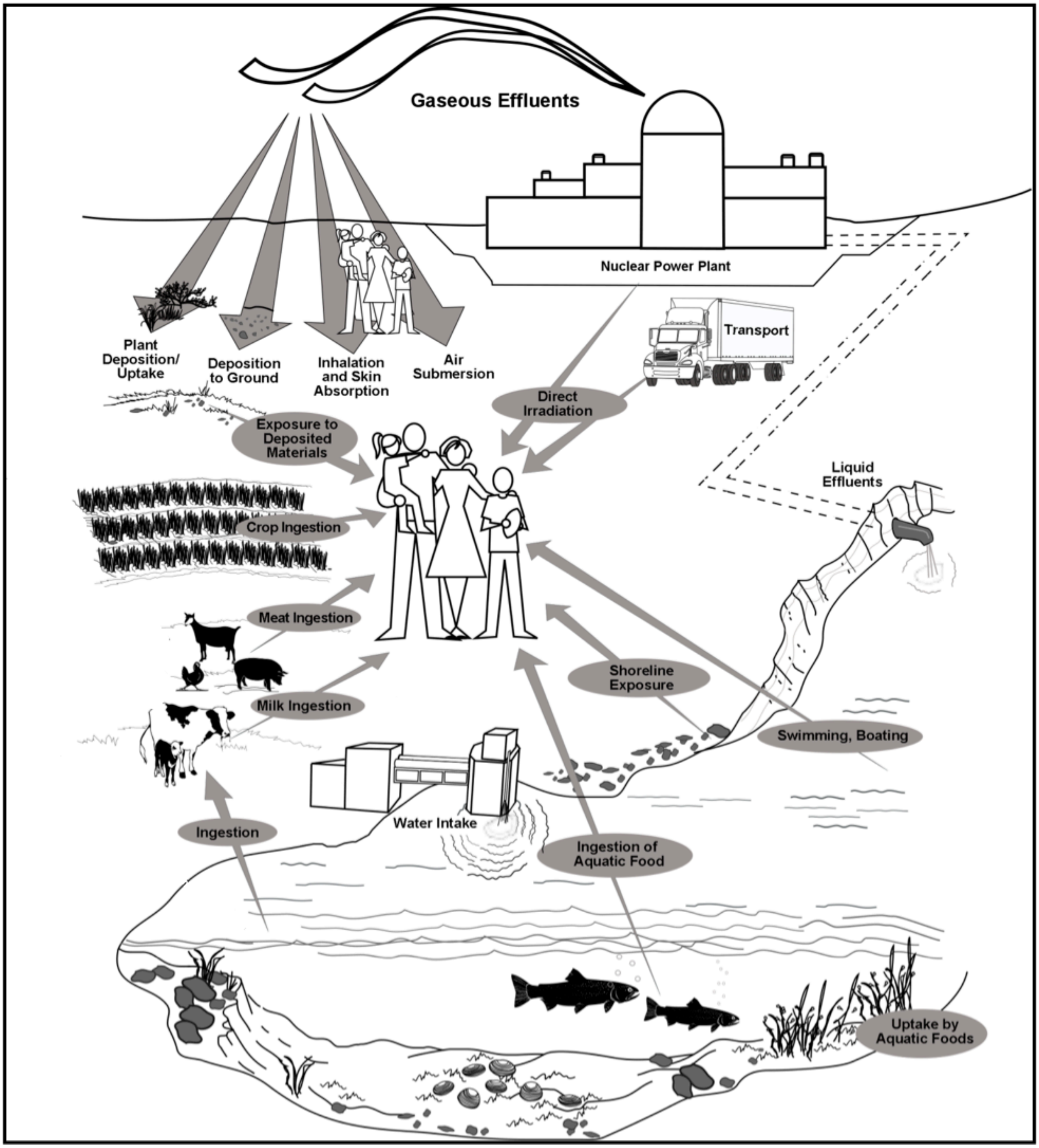

Figure 5-6. Exposure Pathways to Humans.
(Source: Modified from Soldat et al. 1974-TN710)

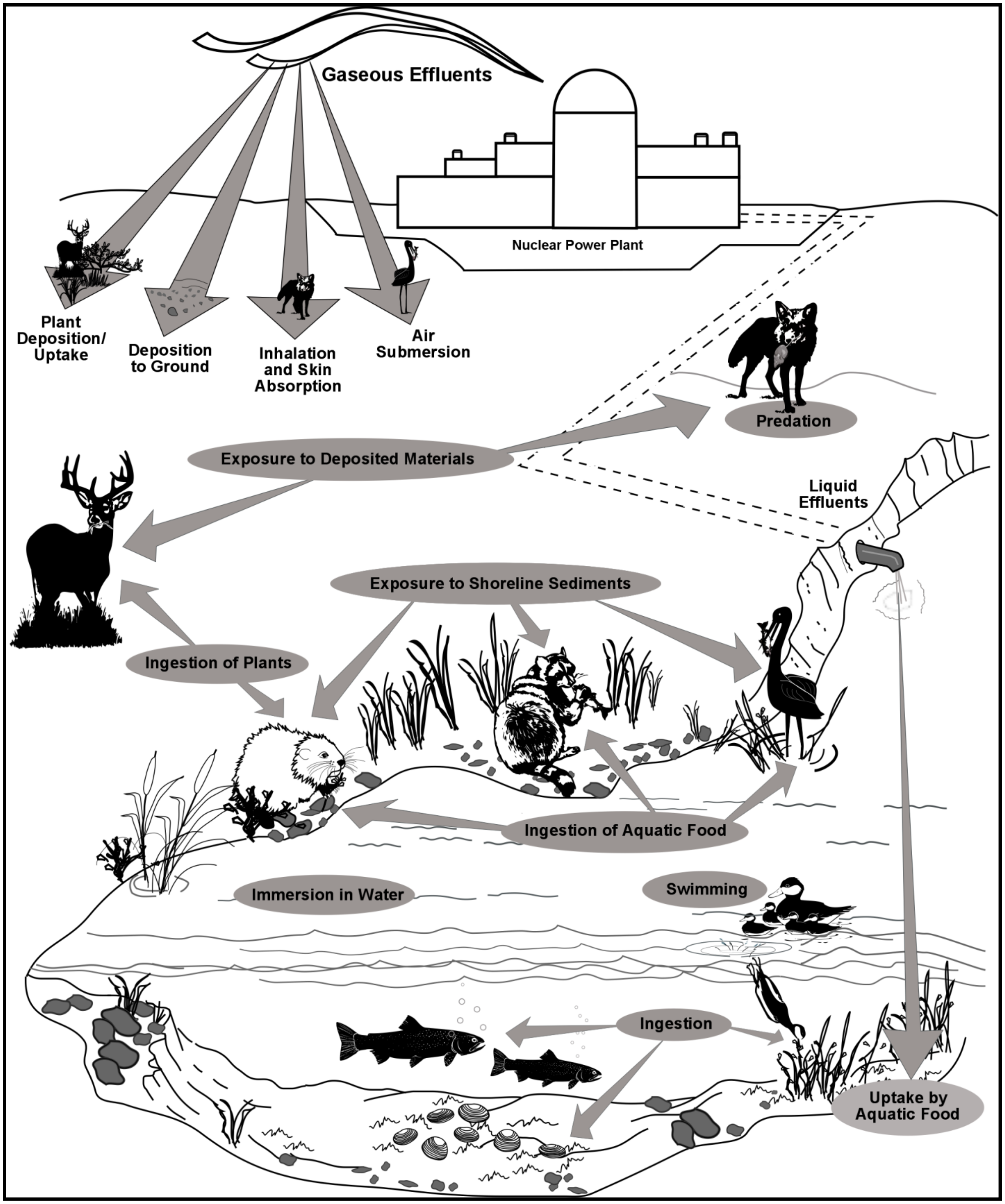

Figure 5-7. Exposure Pathways to Biota Other than Humans.
(Source: Soldat et al. 1974-TN710)

5.9.2 Radiation Doses to Members of the Public

PSEG calculated the dose to the MEI and the population living within a 50-mi radius of the PSEG Site from both the liquid and gaseous effluent release pathways (PSEG 2014-TN3452). As discussed in the previous sections, direct radiation exposure to MEI from sources of radiation at a new nuclear power plant would be bounded by the ABWR design.

5.9.2.1 Liquid Effluent Pathway

Liquid pathway doses to the MEI were calculated using the LADTAP II computer program (Strenge et al. 1986-TN82). The following activities were considered in the dose calculations: (1) consumption of meat; (2) consumption of fish, shellfish, or other aquatic organisms from water sources affected by liquid effluents; and (3) direct radiation from swimming in, boating on, and shoreline use of water bodies affected by liquid effluents. PSEG stated that the brackish water from the Delaware River is not a potable source of water and is not used for irrigation in the vicinity of the PSEG Site.

The liquid effluent releases used in the estimates of dose are found in Table 5.4-2 of the ER (PSEG 2014-TN3452). Other parameters used as inputs to the LADTAP II program—including the effluent discharge rate, dilution factor for discharge, transit time to receptor, and liquid pathway consumption and usage factors (i.e., shoreline usage and fish consumption)—are found in ER Tables 5.4-3, 11.2-3, and 11.2-4 (PSEG 2014-TN3452). PSEG calculated liquid pathway doses to the MEI; these dose estimates are shown in ER Table 5.4-4 (PSEG 2014-TN3452). The MEI is an adult for whom the majority of the dose comes from fish ingestion, and the maximally exposed organ is the gastrointestinal lining of lower intestine (GI-LLI). ER Table 5.4-11 provides the annual whole body and thyroid doses to the population for the various liquid pathways calculated by PSEG (PSEG 2014-TN3452).

Table 5-15. Doses to the MEI for Liquid Effluent Releases from PSEG

Pathway	Total Body (mrem/yr)	Thyroid (mrem/yr)	GI-LLI (mrem/yr)
Fish	1.02×10^{-2}	1.98×10^{-2}	6.55×10^{-2}
Invertebrate	5.17×10^{-3}	2.14×10^{-2}	1.11×10^{-1}
Shoreline (includes water recreation)	2.84×10^{-4}	2.84×10^{-4}	2.86×10^{-4}
Total	1.57×10^{-2}	4.15×10^{-2}	1.77×10^{-1}
Age group receiving maximum dose	Adult	Adult	Adult

Source: PSEG 2014-TN3452.

The NRC staff recognizes the LADTAP II computer program as an appropriate method for calculating the dose to the MEI for liquid effluent releases. The staff performed an independent evaluation of liquid pathway doses by using input parameters from the ER, and results were similar to those in the ESP. The NRC staff judged all input parameters used in PSEG's calculations to be appropriate. Results of the staff's independent evaluation are presented in Appendix G.

5.9.2.2 Gaseous Effluent Pathway

PSEG calculated the gaseous pathway doses to the MEI using the GASPAR II computer program (Strenge et al. 1987-TN83) at the following locations: nearest meat animal, nearest milk-producing animals (cow/goat), nearest residence, nearest vegetable garden, and nearest site boundary. The GASPAR II computer program was also used to calculate annual population doses. The following activities were considered in the dose calculations: (1) direct radiation from submersion in the gaseous effluent cloud and exposure to particulates deposited on the ground; (2) inhalation of gases and particulates; (3) ingestion of milk and meat from animals eating grass affected by gases and particulates deposited on the ground; and (4) ingestion of foods (e.g., vegetables) affected by gases and particulates deposited on the ground.

The gaseous effluent releases used in the estimate of dose to the MEI and population are found in ER Table 5.4-1 (PSEG 2014-TN3452). Other parameters used as inputs to the GASPAR II program, including population data, milk production rates, vegetable production rates, meat production rates, atmospheric dispersion factors, ground deposition factors, receptor locations, and consumption factors, are found in ER Tables 5.4-5, 5.4-6, and 5.4-7 (PSEG 2014-TN3452) or were obtained by the staff during the Environmental Site Audit.

Gaseous pathway doses to MEI calculated by PSEG are found in SSAR Table 11.3-7 (PSEG 2014-TN3453). ER Table 5.4-12 shows the annual whole body and thyroid doses to the population from various gaseous pathways calculated by PSEG (PSEG 2014-TN3452).

The NRC staff recognizes the GASPAR II computer program as an appropriate tool for calculating dose to the MEI and population from gaseous effluent releases. The NRC staff performed an independent evaluation of gaseous pathway doses and found similar results (see Table 5-16). All input parameters used in the PSEG calculations were judged by the staff to be appropriate. Results of the NRC staff's independent evaluation are found in Appendix G.

Table 5-16. Doses to the MEI from the Gaseous Effluent Pathway for a New Nuclear Power Plant[(a)]

Pathway	Age Group	Total Body Dose	Maximum Organ Dose		Skin Dose	Thyroid Dose
		(mrem/yr)	(mrem/yr)	Organ	(mrem/yr)	(mrem/yr)
Nearest Site Boundary (0.24 mi ENE)						
Plume	All	3.97	1.22×10^{1}	skin	1.22×10^{1}	3.97
Ground	All	6.55×10^{-1}	7.69×10^{-1}	skin	7.69×10^{-1}	6.55×10^{-1}
Inhalation	Adult	9.03×10^{-2}	2.61	thyroid	7.97×10^{-2}	2.61
	Teen	9.31×10^{-2}	3.40	thyroid	8.04×10^{-2}	3.40
	Child	8.44×10^{-2}	4.18	thyroid	7.10×10^{-2}	4.18
	Infant	4.97×10^{-2}	3.79	thyroid	4.09×10^{-2}	3.79
Nearest Resident (2.8 mi NW)						
Plume	All	9.52×10^{-2}	2.92×10^{-1}	skin	2.92×10^{-1}	9.52×10^{-2}
Ground	All	1.53×10^{-2}	1.80×10^{-2}	skin	1.80×10^{-2}	1.53×10^{-2}

Table 5-16 (continued)

Pathway	Age Group	Total Body Dose (mrem/yr)	Maximum Organ Dose (mrem/yr)	Organ	Skin Dose (mrem/yr)	Thyroid Dose (mrem/yr)
Inhalation	Adult	2.14×10^{-3}	5.78×10^{-2}	thyroid	1.91×10^{-3}	5.78×10^{-2}
	Teen	2.20×10^{-3}	7.51×10^{-2}	thyroid	1.93×10^{-3}	7.51×10^{-2}
	Child	2.00×10^{-3}	9.23×10^{-2}	thyroid	1.70×10^{-3}	9.23×10^{-2}
	Infant	1.18×10^{-3}	8.36×10^{-2}	thyroid	9.80×10^{-4}	8.36×10^{-2}
Vegetables (4.9 mi NW)(b)						
	Adult	1.55×10^{-2}	1.77×10^{-1}	thyroid	1.35×10^{-2}	1.77×10^{-1}
	Teen	2.32×10^{-2}	2.25×10^{-1}	thyroid	2.11×10^{-2}	2.25×10^{-1}
	Child	5.21×10^{-2}	4.29×10^{-1}	thyroid	4.94×10^{-2}	4.29×10^{-1}
Meat (4.9 mi NW)(b)						
	Adult	4.90×10^{-3}	2.26×10^{-2}	bone	4.66×10^{-3}	1.17×10^{-2}
	Teen	4.03×10^{-3}	1.90×10^{-2}	bone	3.88×10^{-3}	9.04×10^{-3}
	Child	7.36×10^{-3}	3.57×10^{-2}	bone	7.20×10^{-3}	1.50×10^{-2}
Goat milk (4.9 mi NW)(c)						
	Adult	9.93×10^{-3}	2.53×10^{-1}	thyroid	5.92×10^{-3}	2.53×10^{-1}
	Teen	1.45×10^{-2}	4.02×10^{-1}	thyroid	1.03×10^{-2}	4.02×10^{-1}
	Child	2.83×10^{-2}	8.05×10^{-1}	thyroid	2.42×10^{-2}	8.05×10^{-1}
	Infant	5.44×10^{-2}	1.94	thyroid	4.92×10^{-2}	1.94

(a) Ground-level releases were assumed. Doses are based on 3 yr of meteorological data (see EIS Section 2.9.3).
(b) No infant doses were calculated for the vegetable and meat pathway because the doses that infants receive by consumption are only from milk, drinking water, and inhalation (NRC 1977-TN90).
(c) Goats as milk producing animals have a more conservative exposure pathway than milk cows (PSEG 2014-TN3452).

Source: PSEG 2014-TN3453.

5.9.3 Impacts to Members of the Public

This section describes the NRC staff's evaluation of the estimated impacts from radiological releases and direct radiation of a new nuclear power plant at the PSEG Site. The evaluation addresses dose from operations to the MEI located near the PSEG Site and the population dose (collective dose to the population within 50 mi) around the site.

5.9.3.1 Maximally Exposed Individual

PSEG states the total body and organ dose estimates to the MEI from liquid and gaseous effluents for a new nuclear power plant would be within the design objectives of Appendix I (10 CFR 50, Appendix I, 10 CFR 50-TN249). Total body and maximum organ annual doses at the nearest location from liquid effluents were well within the respective 3 mrem and 10 mrem Appendix I design objectives. Annual doses at the exclusion area boundary from gaseous effluents were well within the Appendix I design objectives of 10 mrad air dose from gamma radiation, 20 mrad air dose from beta radiation, 5 mrem to the total body, and 15 mrem to the

skin. In addition, the dose to the thyroid was within the 15 mrem Appendix I design objective. A comparison of dose estimates to MEI for a new nuclear power plant to the Appendix I design objectives is found in Table 5-17. The NRC staff completed an independent evaluation of compliance with Appendix I dose design objectives and found similar results, as shown in Appendix G. Gaseous and liquid effluents from the PSEG Site would be below the Appendix I dose design objectives (PSEG 2014-TN3452).

PSEG compared the combined dose estimates from direct radiation and gaseous and liquid effluents from the existing units (SGS Unit 1, SGS Unit 2, and HCGS Unit 1) and a new plant at the PSEG Site against the 40 CFR 190 (40 CFR 190-TN739). Table 5-18 shows that PSEG's assessment of the total doses to the MEI would be well below the standards of 40 CFR 190 (40 CFR 190-TN739). The NRC staff completed an independent evaluation of compliance with the standards of 40 CFR 190 (40 CFR 190-TN739) and found similar results, as shown in Appendix G.

Table 5-17. Comparison of MEI Dose Estimates from Liquid and Gaseous Effluents of the PSEG Site to Design Objectives

Type of Dose	Annual Dose	Limit
Liquid Effluent		
Total Body (mrem)	0.02	3
Maximum Organ—GI-LLI[a] (mrem)	0.18	10
Gaseous Effluent		
Gamma Air (mrad)	6.10	10
Beta Air (mrad)	11.0	20
Total Body (mrem)	4.62	5
Skin (mrem)	12.2	15
Iodine and Particulates (Gaseous Effluents)		
Maximum Organ—Thyroid (mrem)	7.22	15

(a) GI-LLI = gastrointestinal lining of lower intestine.

Sources: PSEG 2014-TN3452 and 10 CFR 50-TN249.

5.9.3.2 Population Dose

PSEG estimates the annual collective total body dose within a 50 mi radius of the PSEG Site to be 65.9 person-rem, based on the liquid and gaseous pathway collective doses provided in ER Tables 5.4-11 and 5.4-12, respectively (PSEG 2014-TN3452). Collective dose was estimated using a combination of the GASPAR II and LADTAP II computer codes, accounting for gaseous and liquid effluent pathways, respectively. The annual collective dose to the populations projected to live within 50 mi of PSEG in the year 2081 was not considered because, as stated in Section 5.9.1, direct dose contributions from the PSEG Site would be bounded by the ABWR design. The NRC staff's independent estimate of the collective dose is discussed in Appendix G.

Table 5-18. Comparison of Doses for the PSEG Site to 40 CFR 190

	Type of Dose	Liquid	Gaseous	Direct[(g)]	Total	Limit
Dual New Units	Total Body (mrem/yr)	3.14×10^{-2}[(a)]	4.00×10^{-1}[(d)]	2.5	2.93	–
	Thyroid (mrem/yr)	8.30×10^{-2}[(b)]	4.26[(e)]	2.5	6.84	–
	Other Organ (mrem/yr)	3.54×10^{-1}[(c)]	1.10[(f)]	2.5	3.95	–
Existing Units	Total Body (mrem/yr)	6.69×10^{-5}	5.29×10^{-3}		5.36×10^{-3}	–
	Thyroid (mrem/yr)	NA	NA		2.04×10^{-2}	–
	Other Organ (mrem/yr)	NA	NA		2.04×10^{-2}	–
Site Total	Total Body (mrem/yr)	3.15×10^{-2}	4.05×10^{-1}		2.94	25
	Thyroid (mrem/yr)	NA	NA		6.86	75
	Other Organ (mrem/yr)	NA	NA		3.97	25

Note: NA = Not Available. The Radioactive Effluent Release Report (RERR) provides total liquid and gaseous dose from SGS and HCGS but does not provide a breakdown into the separate liquid and gaseous dose component for organ and thyroid dose.

(a) Liquid MEI for total body dose is an adult. Value is obtained from ER Table 5.4-4 and multiplied by two to account for dual units (PSEG 2014-TN3452).

(b) Liquid MEI for the thyroid dose is an adult. Value is obtained from ER Table 5.4-4 and multiplied by two to account for dual units (PSEG 2014-TN3452).

(c) Liquid MEI for the limiting organ GI-LLI dose is an adult. Value is obtained from ER Table 5.4-4 and multiplied by two to account for dual units (PSEG 2014-TN3452).

(d) Gaseous MEI for this case is a child. Value is the sum of child total body dose from meat, milk, vegetable, and inhalation exposure plus the ground plan and plume exposure (PSEG 2014-TN3452).

(e) Gaseous MEI for this case is an infant. Value is the sum of infant thyroid dose from milk and inhalation exposure plus the ground plan and plume exposure (PSEG 2014-TN3452).

(f) Gaseous MEI for this case is a child, and the limiting organ is the bone. Value is the sum of child bone dose from meat, milk, vegetable, and inhalation exposure plus the ground plan and plume exposure (PSEG 2014-TN3452).

(g) A single unit ABWR is the bounding direct radiation dose at the PSEG Site (PSEG 2014-TN3452).

Sources: PSEG 2014-TN3452 and 40 CFR 190-TN739.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is greater for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. Simply stated, any increase in dose, no matter how small, results in an incremental increase in health risk. A recent report by the National Research Council (2006), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by NRC staff as a conservative model for estimating health risk from radiation exposure, recognizing the model probably overestimates those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. In a recent publication of the International Commission on Radiological Protection (ICRP) (ICRP 2007-TN422), a health detriment of 570 was associated with fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem or 0.00057 effects per person-rem.

Both the National Council on Radiation Protection & Measurements (NCRP) and ICRP suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (i.e., less than 1/0.00057, which is less than 1,754 person-rem), the assessment should note the most likely number of excess health effects is zero (NCRP 1995-TN728; ICRP 2007-TN422). As noted above, the estimated annual collective total body dose to the population living within 50 mi of the PSEG Site is 65.9 person-rem, which is less than the 1,754 person-rem value that both ICRP and NCRP suggest would most likely result in zero excess health effects (NCRP 1995-TN728; ICRP 2007-TN422).

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published a report in 1990 titled *Cancer in Populations Living Near Nuclear Facilities* (Jablon et al. 1990-TN1257). The NCI report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the United States in 1981; it found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (Jablon et al. 1990-TN1257).

5.9.3.3 Summary of Radiological Impacts to Members of the Public

The NRC staff evaluated the health impacts from routine gaseous and liquid radiological effluent releases from a new nuclear plant at the PSEG Site. Based on the information provided by PSEG and NRC staff's own independent evaluation, the NRC staff concludes there would be no observable health impacts to the public from normal operation of a new nuclear power plant; the health impacts would be SMALL; and additional mitigation would not be warranted.

5.9.4 Occupational Doses to Workers

PSEG concluded the maximum annual occupational dose from a new plant at the PSEG Site is expected to be less than that from SGS and HCGS because the proposed PSEG Site designs and application of technology would result in reduced occupational radiation exposure. For 2007, the collective total effective dose equivalent (TEDE) to workers was 118 person-rem at SGS and 191 person-rem at HCGS (PSEG 2014-TN3452). If two new AP1000 units were constructed at the PSEG Site, some dose would be received by construction workers at the second unit from operation of the first unit. In the AP1000 Design Control Document (DCD) (Westinghouse 2011-TN261), Westinghouse estimated an annual collective dose of 63.2 man-rem/yr for the following activities: reactor operations and surveillance (21.8%); routine inspection and maintenance (19.2%); inservice inspection (22.7%); special maintenance (23.7%); waste processing (8.2%); and refueling (4.4%). Considering this estimate, it is expected that any dose received by construction workers at the second new unit from the operation of the first new unit would be SMALL.

5.9.5 Impacts to Biota Other than Humans

PSEG estimated doses to biota in the site environs using surrogate species. Surrogate species used in the ER are well defined and provide an acceptable method for evaluating doses to the biota (PSEG 2014-TN3452). Surrogate species analysis was performed for aquatic species such as fish, invertebrates, and algae, and for terrestrial species such as muskrats, raccoons, and birds, such as herons and ducks. Exposure pathways considered in

evaluating doses to biota other than humans were discussed in Section 5.9.1 and are shown in Figure 5-7. The NRC staff has reviewed PSEG's analysis and completed an independent evaluation that found similar results, as shown in Appendix G.

5.9.5.1 Liquid Effluent Pathway

PSEG used the LADTAP II computer code to calculate doses to the biota from the liquid effluent pathway. In estimating the concentration of radioactive effluents in the Delaware River, PSEG included no credit for dilution or transit time from the outflow. Liquid pathway doses were higher for biota compared to humans because of considerations for bioaccumulation of radionuclides, ingestion of aquatic plants, ingestion of invertebrates, increased time spent in water and shoreline compared to humans, and the assumption of no dilution beyond the outflow. The liquid effluent releases used in estimating biota dose are found in ER Table 5.4-13 (PSEG 2014-TN3452).

5.9.5.2 Gaseous Effluent Pathway

Gaseous effluents would contribute to the total body dose of the terrestrial surrogate species (i.e., muskrat, raccoon, heron, and duck). The exposure pathways include inhalation of airborne radionuclides, external exposure due to immersion in gaseous effluent plumes, and surface exposure from deposition of iodine and particulates from gaseous effluents. PSEG used the calculations methods of MEI from gaseous effluent releases described in Section 5.9.2 to calculate dose to terrestrial surrogate species, with a modification increasing the ground deposition factors by a factor of two to account for the closer proximity of terrestrial animals to the ground compared to the MEI. The gaseous effluent releases used in estimating dose are found in ER Table 5.4-1, and the gaseous doses also are presented in ER Table 5.4-13 (PSEG 2014-TN3452). Total body dose estimates to the surrogate species from the gaseous pathway are shown in Table 5-19 (PSEG 2014-TN3452).

Table 5-19. Biota Other Than Human Doses from Liquid and Gaseous Effluents (per new unit)

Biota	Liquid Effluents Dose (mrad/yr)	Gaseous Effluents Dose (mrad/yr)	Total Body Biota Dose All Pathways (mrad/yr)
Fish	1.66	-	1.66
Invertebrate	5.88	-	5.88
Algae	8.22	-	8.22
Muskrat	1.89	5.37	7.27
Raccoon	0.83	5.37	6.20
Heron	2.02	5.37	7.40
Duck	2.15	5.37	7.52

Source: PSEG 2014-TN3452.

5.9.5.3 Impact of Estimated Nonhuman Biota Doses

The International Atomic Energy Agency (IAEA) and NCRP reported a chronic absorbed dose rate of no greater than 1,000 mrad/d would ensure protection of aquatic organism population (IAEA 1992-TN712; NCRP 1991-TN729). IAEA also concluded that a chronic absorbed dose rate of 100 mrad/d or less does not appear to cause observable changes in terrestrial animal populations (IAEA 1992-TN712).

Table 5-20 compares estimated absorbed dose rates to surrogate biota species produced by releases from the PSEG Site (PSEG 2014-TN3452) to the IAEA/NCRP biota dose guidelines (IAEA 1992-TN712; NCRP 1991-TN729). The absorbed dose rates from all surrogate species were much less than the guidelines. The absorbed dose rate estimated for the PSEG Site is conservative because no consideration was given to dilution or decay of liquid effluents during transit. Actual absorbed dose rates to biota are likely to be much less.

Table 5-20. Comparison of Biota Dose Rate from a New Nuclear Power Plant at the PSEG Site to IAEA Guidelines for Biota Protection

Biota	Absorbed Dose Rate (mrad/d)	
	Estimate for PSEG Site[(a),(b)]	Protection Guidelines[(b),(c)]
Fish	0.0045	1,000
Invertebrate	0.0161	1,000
Algae	0.0225	1,000
Muskrat	0.0199	100
Raccoon	0.0170	100
Heron	0.0203	100
Duck	0.0206	100

(a) Estimate of the total absorbed dose rate based on the annual dose to biota other than human from liquid and gaseous effluents of ER Table 5.4-13 (PSEG 2014-TN3452).
(b) Divide mrad/d by 100 to obtain mGy/d.
(c) IAEA and NCRP guidelines for protection of biota populations (IAEA 1992-TN712; NCRP 1991-TN729).

On the basis of the information provided by PSEG and the NRC staff's independent evaluation, the NRC staff concludes that the radiological impact on nonhuman biota from a new nuclear power plant at the PSEG Site would be SMALL, and additional mitigation is not warranted.

5.9.6 Radiological Monitoring

A REMP has been in place for the PSEG Site since operations began in 1977, with preoperational sample collection activities from 1973 to 1976 (PSEG 2014-TN3452). The REMP includes monitoring of the airborne exposure pathway, direct exposure pathway, water exposure pathway, aquatic exposure pathway from the Delaware River, and ingestion exposure

pathway in a 5-mi radius of the station, with indicator locations near the site perimeter and control locations at distances greater than 10 mi. An annual survey is conducted for the area surrounding the site to verify the accuracy of assumptions used in the analyses, including the occurrence of milk production. The preoperational REMP sampled various media in the environment to determine a baseline from which to observe the magnitude and fluctuation of radioactivity in the environment once the new power plant began operation.

The preoperational program included collection and analysis of air particulates, precipitation, crops, soil, well water, surface water, fish, and silt, as well as measurement of ambient gamma radiation. After operation of SGS Unit 1 began in 1977, the monitoring program continued to assess the radiological impacts on workers, the public, and the environment. Radiological releases are summarized in the *Annual Radiological Environmental Operating Report* and the *PSEG Nuclear LLC Annual Radioactive Effluent Release Report for the Salem and Hope Creek Generating Stations*. The limits for all radiological releases are specified in the respective HCGS and SGS offsite dose calculation manuals (ODCMs). Administrative controls and physical barriers are currently in place or will be implemented to monitor and minimize dose to construction workers from the independent spent fuel storage installation (ISFSI).

As discussed in Section 2.11, operations personnel at SGS in 2002 identified a release of radioactive liquids from the Unit 1 Spent Fuel Pool to the environment. In the HCGS and SGS annual Radioactive Effluent Release Reports (RERR), PSEG describes how it developed a Remedial Action Work Plan and installed a Groundwater Recovery System to remove the groundwater containing tritium (PSEG 2013-TN2739). The system is designed to prevent migration of the tritium plume toward the plant boundary and to reduce the concentrations of tritium in the groundwater. An RGPP was established in 2006 with monitoring wells installed and developed for both SGS and HCGS that allow for groundwater samples to be collected and analyzed at a minimum frequency of semi-annually to a lower limit of detection of 200 pCi/L. RGPP data are published in the annual RERR (PSEG 2013-TN2739).

No additional monitoring program has been established for the PSEG Site. To the greatest extent practical, the REMP would use the procedures and sampling locations used by the existing REMP, ODCMs, and recent monitoring reports from HCGS and SGS. However, if any new monitoring locations and other monitoring requirements are established for a new plant, they would be provided in the combined construction permit and operating license application (PSEG 2014-TN3452). The NRC staff have reviewed these documents and determined the current operational monitoring program is adequate to establish the radiological baseline for comparison with the expected impacts on the environment related to building and operating a new nuclear power plant at the PSEG Site.

5.10 Nonradiological Waste Impacts

This section describes potential impacts on the environment that could result from the generation, handling, and disposal of nonradioactive waste and mixed waste during operation of a new nuclear power plant at the PSEG Site. As discussed in Section 3.4.4, the types of nonradioactive waste that would be generated, handled, and disposed of during operational activities include solid wastes, liquid effluents, and air emissions. Solid wastes include

municipal waste, dredge spoils, sewage treatment sludge, and industrial wastes. Liquid waste includes NPDES-permitted discharges (such as effluents that contain chemicals or biocides), wastewater effluents, site stormwater runoff, and other liquid wastes (such as used oils, paints, and solvents that require offsite disposal). Air emissions would primarily be generated by vehicles, diesel generators, and combustion generators. In addition, small quantities of hazardous waste and mixed waste (waste that has both hazardous and radioactive characteristics) may be generated during plant operations. The assessment of potential impacts resulting from these types of wastes is presented in the following subsections.

5.10.1 Impacts to Land

The operation of a new nuclear power plant at the PSEG Site would generate solid and liquid wastes similar to those already generated by the current operations of HCGS and SGS. Although the total volume of solid and liquid wastes would increase with the addition of a new nuclear power plant at the PSEG Site, no new solid or liquid waste types are expected to result from operating the new plant (PSEG 2014-TN3452). PSEG has indicated it would continue to use recycling and waste minimization practices in place at SGS and HCGS for nonradioactive solid waste generated from the operation of a new nuclear power plant. Solid wastes—such as used oils, antifreeze, scrap metal, lead-acid batteries, and paper—that could be recycled or reused would be managed through the approved and licensed contractor. Solid waste that could not be recycled or reused would be transported to licensed offsite commercial disposal sites (PSEG 2014-TN3452). Spoils from maintenance and dredging could be used as fill material. Debris collected on trash screens at the water intake structure would be disposed of offsite in accordance with State regulations. Sanitary wastes generated from the operation of a new nuclear power plant would be treated on the site and discharged to the Delaware River in accordance with NJDEP and DRBC permits and requirements. Residuals are disposed of offsite in compliance with applicable laws, regulations, and permit conditions imposed by Federal, State, and local agencies.

Effective practices for recycling and minimizing waste are already in place at SGS and HCGS, and PSEG plans to manage solid and liquid wastes from a new nuclear power plant in a similar manner in accordance with applicable Federal, State, and local requirements and standards. For these reasons, the review team expects that impacts on land from nonradioactive wastes generated during operation of a new nuclear power plant at the PSEG Site would be minimal and that no further mitigation is warranted.

5.10.2 Impacts to Water

Effluents containing chemicals or biocides from the operation of a new nuclear power plant at the PSEG Site would be discharged mainly to the Delaware River. Discharge sources would include cooling tower blowdown, wastewater from auxiliary systems, and stormwater runoff. Sections 5.2.3.1 and 5.2.3.2 discuss impacts on the quality of the surface water and groundwater, respectively, from operation of a new plant. Nonradioactive liquid effluents discharged to the Delaware River would be subject to limitations contained in the site's NJDEP and DRBC water quality permits (PSEG 2014-TN3452). Because there are regulated practices for managing liquid discharges containing chemicals or biocides and other wastewater, and because there are plans for managing stormwater, the review team concludes that impacts on

water from nonradioactive effluents during the operation of a new nuclear power plant at the PSEG Site would be minimal, and no further mitigation is warranted.

5.10.3 Impacts to Air

Operations of a new nuclear power plant at the PSEG Site would result in gaseous emissions from the intermittent operation of emergency diesel generators, auxiliary boilers, and engine driven emergency equipment. In addition, increased vehicular traffic associated with the personnel needed to operate a new plant would increase vehicle emissions in the area. Impacts on air quality are discussed in detail in Section 5.7.1. Increases in air emissions from operation of a new plant would be in accordance with permits issued by NJDEP Division of Air Quality that would ensure compliance with Federal, State, and local air quality control laws and regulations. Because there are regulated practices for managing air emissions from stationary sources, the review team concludes impacts on air from nonradioactive emissions during the operation of a new nuclear power plant at the PSEG Site would be minor, and no further mitigation is warranted.

5.10.4 Mixed Waste Impacts

Mixed waste contains both low-level radioactive waste and hazardous waste. The generation, storage, treatment, and disposal of mixed waste is regulated by the Atomic Energy Act of 1964, the Solid Waste Disposal Act of 1965 as amended by the Resource Conservation and Recovery Act (RCRA) in 1976, and the Hazardous and Solid Waste Amendments (which amended RCRA in 1984). Neither HCGS nor SGS currently has processes that result in the generation of mixed waste (PSEG 2014-TN3452). In the past, most mixed wastes generated at HCGS and SGS resulted from the contamination of oils (hydraulic and lubricating) used in plant systems. All oils currently used in plant systems are non-hazardous and do not result in mixed waste if they become radiologically contaminated. Processes for a new nuclear power plant at the PSEG Site are similarly designed to prevent the generation of mixed waste (PSEG 2014-TN3452). PSEG has contingency plans and spill prevention procedures for treatment, storage, and disposal in the unlikely event of mixed waste generation. Because effective practices for minimizing mixed waste are already in place at SGS and HCGS, the review team concludes impacts from the generation of mixed waste during operation of a new nuclear power plant at the PSEG Site would be minimal, and no further mitigation is warranted.

5.10.5 Summary of Waste Impacts

Solid, liquid, gaseous, and mixed wastes generated during operation of a new nuclear power plant at the PSEG Site would be handled according to county, State, and Federal regulations. NPDES permits for permitted releases of cooling and auxiliary system effluents would ensure compliance with CWA as well as NJDEP and DRBC water quality requirements. Wastewater discharge would be required to comply with NPDES limitations. Air emissions from new plant operations would be compliant with air quality standards as permitted by NJDEP Division of Air Quality. Processes for a new plant at the PSEG Site are designed to prevent the generation of mixed wastes.

The review team concludes the potential impacts from nonradioactive waste resulting from operation of a new nuclear power plant at the PSEG Site would be SMALL, and further mitigation is not warranted, on the basis of the following:

- information provided by PSEG;
- effective practices for recycling, minimizing, managing, and disposing of wastes already in use at SGS and HCGS;
- the review team's expectation that regulatory approvals would be obtained to regulate the additional waste that would be generated during operation of a new nuclear power plant; and
- the review team's independent evaluation.

Cumulative impacts on water and air from nonradioactive emissions and effluents are discussed in Sections 7.2.2.1 and 7.6, respectively. For the purposes of Chapter 9, the staff concludes that (1) there would be no substantive differences between the impacts from nonradioactive waste at the PSEG Site and those at the four alternative sites, and (2) no substantive cumulative impacts warrant further discussion beyond those discussed for the alternative sites in Section 9.3.

5.11 Environmental Impacts of Postulated Accidents

The NRC staff considered the radiological consequences on the environment of potential accidents at a new nuclear power plant at the PSEG Site. Consequence estimates are based on the following four different reactor designs: ABWR, AP1000 with a dual unit, the U.S. Evolutionary Power Reactor (U.S. EPR), and the U.S. Advanced Pressurized Water Reactor (US-APWR).

The term "accident," as used in this section, refers to any off-normal event not addressed in Section 5.9 that results in release of radioactive materials into the environment. The focus of this review is on events that could lead to releases substantially in excess of permissible limits for normal operations. Normal release limits are specified in 10 CFR 20, Appendix B, Table 2 (10 CFR 20-TN283).

Many safety features combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation of the sites, which comprise the first line of defense, are intended to prevent the release of radioactive materials from the site. The design objectives and the measures for keeping levels of radioactive materials in effluents to unrestricted areas as low as reasonably achievable (ALARA) are specified in 10 CFR 50-TN249, Appendix I. There are additional measures designed to mitigate the consequences of failures in the first line of defense. These include NRC reactor site criteria in 10 CFR 100 (10 CFR 100-TN282), which require the site to have certain characteristics that reduce the risk to the public and the potential impacts of an accident, and emergency preparedness plans and protective action measures for the site and environs, as set forth in 10 CFR 50.47, 10 CFR 50 (10 CFR 50-TN249), Appendix E, and NUREG–0654/FEMA-REP-1

(NRC 1980-TN512). All of these safety features, measures, and plans make up the defense-in-depth philosophy to protect the health and safety of the public and the environment.

On March 11, 2011, and for an extended period thereafter, several nuclear power plants in Japan experienced the loss of important equipment necessary to maintain reactor cooling after the combined effects of severe natural phenomena: an earthquake followed by the tsunami it caused. In response to these events, the Commission established a task force to review the current regulatory framework in place in the United States and to make recommendations for improvements. The task force reported the results of its review (NRC 2011-TN684) on July 12 and July 19, 2011. As part of the short-term review, the task force concluded that, while improvements are expected to be made as a result of the lessons learned, the continued operation of nuclear power plants and licensing activities for new plants do not pose an imminent risk to public health and safety. In addition, a number of areas were recommended to the Commission for long-term consideration. Collectively, these recommendations are intended to clarify and strengthen the regulatory framework for protection against severe natural phenomena, for mitigation of effects of such events, for coping with emergencies, and for improving NRC program effectiveness.

On March 12, 2012, the NRC issued three orders and a request for information (RFI) to holders of U.S. commercial nuclear reactor licenses and construction permits to enhance safety at U.S. reactors based on specific lessons learned from the event at Japan's Fukushima Dai-ichi nuclear power plant as given in the task force report.

The first and third orders apply to every U.S. commercial nuclear power plant, including recently licensed new reactors. The first order requires a three-phase approach for mitigating beyond-design-basis external events. Licensees are required to use installed equipment and resources to maintain or restore core, containment, and spent fuel pool cooling during the initial phase. During the transition phase, licensees are required to provide sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from offsite. During the final phase, licensees are required to obtain sufficient offsite resources to sustain those functions indefinitely (77 FR 16091-TN2476). The second order requires reliable hardened vent systems at boiling water reactor facilities with "Mark I" and "Mark II" containment structures (77 FR 16098-TN2477). The third order requires reliable spent fuel pool level instrumentation (77 FR 16082-TN1424). The RFI addressed five topics: (1) seismic reevaluations, (2) flooding reevaluations, (3) seismic hazard walkdowns, (4) flooding hazard walkdowns, and (5) a request for licensees to assess their current communications system and equipment under conditions of onsite and offsite damage and prolonged station blackout as well as perform a staffing study to determine the number and qualifications of staff required to fill all necessary positions in response to a multiunit event (NRC 2012-TN2198; NRC 2012-TN2903). The RFI requested reactor licensees to reevaluate seismic and flooding hazards using present day methods to determine if the plant's design basis needs to be changed.

The NRC staff issued RAIs to PSEG requesting information to address the first RFI topic (NRC 2012-TN2904). All of the containment designs differ from those identified in the second order; therefore, the actions addressed in this order are not applicable to the PSEG Site. The NRC's evaluation of PSEG's responses is addressed in the NRC's Final

Safety Evaluation Report, and any changes to the ESP application that are deemed necessary will be incorporated into the applicant's SSAR.

The severe accident evaluation presented later in this section draws from the analyses developed in the staff's safety review, which includes consideration of severe accidents initiated by external events and those that involve fission product releases. The staff evaluation discusses the environmental impacts of severe accidents in terms of risk, which considers the likelihood of both a severe accident and its consequences. For several reasons discussed below, the staff has determined that the Fukushima accident and the NRC's implementation of the task force recommendations do not change the staff's conclusions on the environmental impacts of design basis accidents or severe accidents.

Each new reactor application evaluates the natural phenomena that are pertinent to the site for the proposed reactor design by applying present-day regulatory guidance and methodologies. This includes the determination of the characteristics of the flood and seismic hazards. With respect to flooding, the NRC issued a letter to PSEG documenting the need for PSEG to provide the necessary flood hazard analysis in the SSAR consistent with present-day guidance and methodologies (NRC 2014-TN3589). PSEG will need to demonstrate and the NRC staff will confirm that the hazards from flooding are acceptable at the PSEG Site. After the final flooding hazards analysis results are submitted by PSEG to the NRC for review, the NRC staff will evaluate its impact to determine if the required safety criteria have been accounted for with an acceptable safety margin. The ESP cannot be issued to PSEG until this portion of the safety review has been satisfactorily completed.

With respect to the consideration of severe accidents initiated by seismic events, PSEG submitted its response (PSEG 2012-TN2905; PSEG 2012-TN2906; PSEG 2012-TN2907; PSEG 2013-TN2908; PSEG 2013-TN2910) to the staff's seismic hazard RAI (stemming from the first RFI topic) (NRC 2012-TN2904). In this RAI, the applicant was requested to evaluate the impacts of the newly released Central and Eastern United States Seismic Source Characterization model, as documented in NUREG–2115, on the PSEG Site specific seismic hazard calculation. This model considers the latest seismic source information for the Central and Eastern United States. The NRC staff reviewed the applicant's response, and related revisions to its SSAR demonstrated that the applicant's analyses of vibratory ground motion adequately characterize the PSEG Site. If submitting a COL application for the PSEG Site, the applicant will use these analyses in its accident analyses and design margin determination.

In addition to the above seismic and flooding considerations, the safety features of the reactor designs being considered further support the conclusion that the Fukushima accident does not warrant a change in the environmental risks of severe accidents considered in this PSEG ESP EIS analysis. In particular, the potential design-related vulnerabilities raised by the event at Fukushima, such as the impact of the beyond-design-basis extended loss of alternating current (AC) to the essential and nonessential switchgear buses, would not materially affect the current bounding analysis of severe accidents for the PSEG Site because the planned reactors have been designed with additional capabilities as well as mitigating strategies to withstand such a loss of power and prevent and mitigate severe accidents. As previously noted in the task force report for one of the designs considered in the ESP application, the AP1000 passive safety systems would remove the decay heat from the reactor core on the loss of alternating and/or

direct current electric power and operate to maintain adequate core cooling for a period of 72 hours without further operator action, unlike the facilities at the Fukushima site. This core cooling by the passive safety systems can be sustained for an extended period beyond 72 hours where the only operator action is to re-fill the internal pool that provides the source of water for the passive safety systems. Additional details are provided in the NRC staff's Safety Evaluation Report for the AP1000 design certification, NUREG–1793 Supplement 2 (NRC 2011-TN2479).

Other reactor designs considered by PSEG in its ER rely upon active safety systems and additional coping capabilities, along with mitigating strategies for a beyond-design-basis event such as an extended loss of AC power. The NRC also issued orders to the construction permit and design certification licensees (77 FR 16091-TN2476; 77 FR 16082-TN1424). The US-APWR and U.S. EPR reactor designs that are currently under review would satisfy these orders before their certification. If the ABWR certified design is proposed for a particular site, addressing the NRC Fukushima related orders or rule would be undertaken as part of the site-specific combined or operating licensing application review process. The mitigation strategies for beyond-design-basis external events proposed for any new reactor application would be evaluated by the NRC staff against the functional requirements of NRC Order EA-12-049 as described in Interim Staff Guidance JLD-ISG-2012-01 (NRC 2012-TN3163). In accordance with the Interim Staff Guidance, future COL applicants would be responsible for describing their proposed overall implementation of these mitigation strategies, such as the industry's "FLEX" and station blackout mitigating strategies, or they must provide design or engineered alternatives. As such, at the time of a COL application, PSEG would need to document how the selected reactor design and proposed mitigation strategies meet the requirements of the orders.

In sum, none of the information the staff has identified about the Fukushima accident or the steps taken by the NRC to date to implement the task force recommendations suggests that the seismic and flooding hazards or the available mitigation capability (i.e., passive safety systems) assumed in the PSEG ESP EIS analysis of severe accidents would be affected. For these reasons, the NRC's analysis of the environmental impacts of design basis and severe accidents presented herein remains valid.

This section discusses (1) the types of radioactive materials; (2) the paths to the environment; (3) the relationship between radiation dose and health effects; and (4) the environmental impacts of reactor accidents, including both design-basis accidents (DBAs) and severe accidents. The environmental impacts of accidents during transportation of spent fuel are discussed in Chapter 6.

The potential for dispersion of radioactive materials in the environment depends on the mechanical forces that physically transport the materials and on the physical and chemical forms of the material. Radioactive material exists in a variety of physical and chemical forms. The majority of the radioactive material in the fuel is in the form of nonvolatile solids. However, there is a significant amount of radioactive material in the form of volatile solids or gases. The gaseous radioactive materials include the chemically inert noble gases (e.g., krypton and xenon), which have a high potential for release. Radioactive forms of iodine, which are created in substantial quantities in the fuel by fission, are volatile. Other radioactive materials formed

during the operation of a nuclear power plant have lower volatilities and, therefore, have lower tendencies to escape from the fuel than the noble gases and iodines.

Radiation dose to individuals is determined by their proximity to radioactive material, the duration of their exposure, and the extent to which they are shielded from the radiation. Pathways that lead to radiation exposure include (1) external radiation from radioactive material in the air, on the ground, and in the water; (2) inhalation of radioactive material; and (3) ingestion of food or water containing material initially deposited on the ground and in water.

Radiation protection experts assume that any amount of radiation exposure may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A report by the National Research Council, the BEIR VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses (National Research Council 2006-TN296). This approach is accepted by the NRC as a conservative model for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks.

Physiological effects are clinically detectable if individuals receive radiation exposure resulting in a dose greater than about 25 rad over a short period of time (hours). Doses of about 250 to 500 rad received over a relatively short period (hours to a few days) can be expected to cause some fatalities.

5.11.1 Design-Basis Accidents

PSEG evaluated the potential consequences of postulated accidents to demonstrate that an ABWR unit, two AP1000 units, a U.S. EPR unit, or a US-APWR unit could be constructed and operated at the PSEG Site without undue risk to the health and safety of the public (PSEG 2014-TN3452). These evaluations used a set of surrogate DBAs representative for each of the reactor designs being considered for the PSEG Site and site-specific meteorological data. The set of accidents covers events that range from relatively high probability of occurrence with relatively low consequences to relatively low probability with high consequences.

The bases for analyses of postulated accidents for these four designs are well established because these reactors are being reviewed or have been reviewed in the NRC advanced reactor design certification process. Potential consequences of DBAs are evaluated following procedures outlined in regulatory guides and standard review plans. The potential consequences of accidental releases depend on the specific radionuclides released, the amount of each radionuclide released, and the meteorological conditions.

As stated in the ER (PSEG 2014-TN3452), PSEG applied information from the ABWR DCD (GE 1997-TN2767), where the source terms are calculated based on Regulatory Guide (RG) 1.3, *Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors*, Revision 2 (NRC 1974-TN85); RG 1.25, *Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors*,

Revision 0 (NRC 1972-TN87); and TID-14844, *Calculation of Distance Factors for Power and Test Reactor Sites* (DiNunno et al. 1962-TN21). The ABWR source terms are calculated for a power level of 4386 MW(t), which is 102 percent of 4,300 MW(t) [an uprated version of the standard ABWR, which is rated at 4,005 MW(t)].

PSEG states that the source terms for the AP1000 (PSEG 2014-TN3452; PSEG 2012-TN2460) are based on NUREG–1465, *Accident Source Terms for Light-Water Nuclear Power Plants* (NRC 1995-TN2766), and RG 1.183 (NRC 2000-TN517). The AP1000 source terms are calculated for a power level of 3,468 MW(t), which is 102 percent of the rated core power of 3,400 MW(t).

PSEG also states that the source terms for the U.S. EPR (PSEG 2014-TN3452; PSEG 2012-TN2460) are calculated in accordance with NUREG–0800 (NRC 2007-TN3036) and RG 1.183 (NRC 2000-TN517). The U.S. EPR source terms are calculated for a reactor power of 4,612 MW(t) [4,590 MW(t) rated power plus 22 MW(t) heat balance measurement uncertainty].

PSEG (PSEG 2014-TN3452) applied information from the US-APWR DCD (MHI 2008-TN3169), which is based on the source terms methods for evaluating potential accidents from guidance in NUREG–0800 (NRC 2007-TN3036) and RG 1.183 (NRC 2000-TN517). The US-APWR source terms are calculated for a reactor power of 4,555 MW(t) [102 percent of the rated power of 4,466 MW(t)].

For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. Meteorological conditions are represented in these consequence analyses by an atmospheric dispersion factor, which is also referred to as χ/Q. Acceptable methods of calculating χ/Q for DBAs from meteorological data are set forth in Regulatory Guide 1.145 (NRC 1983-TN279). Consistent with NUREG–1555 (NRC 2000-TN1160), the 50th percentile χ/Q values are used that reflect probable accident conditions.

Table 5-21 lists χ/Q values pertinent to the environmental review of DBAs for the PSEG Site (PSEG 2014-TN3452). The first column lists the time periods and boundaries for which χ/Q and dose estimates are needed. For the exclusion area boundary, the postulated DBA dose and its atmospheric dispersion factor are calculated for a short-term, i.e., 2 hr; for the low population zone, they are calculated for the course of the accident, i.e., 30 days composed of 5 time periods. The second column lists the χ/Q values presented in Tables 5.11-1-1, 7.1-38, 7.1-40, 7.1-46, and 7.1.55 of the PSEG ER (PSEG 2014-TN3452). PSEG calculated the χ/Q values listed in those tables using onsite meteorology described in SSAR Section 2.3 (PSEG 2014-TN3453).

Table 5-21. Atmospheric Dispersion Factors for PSEG Site DBA Calculations

Time Period and Boundary	χ/Q (s/m^3)
0 to 2 hr, or worst 2-hr period, EAB	1.41×10^{-4}
0 to 2 hr, LPZ	4.72×10^{-6}
2 to 8 hr, LPZ	2.30×10^{-6}
8 to 24 hr, LPZ	1.61×10^{-6}
24 to 96 h (1 to 4 d), LPZ	7.51×10^{-7}
96 to 720 h (4 to 30 d), LPZ	3.05×10^{-7}

Note: EAB = exclusion area boundary; LPZ = low population zone.

Source: PSEG 2014-TN3452.

The NRC staff reviewed Section 2.9.3 meteorological data used by PSEG and the PSEG atmospheric dispersion factors. Based on these reviews, the NRC staff concludes the atmospheric dispersion factors for the PSEG Site are acceptable for use in evaluating potential environmental consequences of postulated DBAs at the ESP Site.

Tables 5-22, 5-23, 5-24, and 5-25 list the set of DBAs considered by PSEG for the four different reactor technologies and present estimates of the environmental consequences of each accident in terms of total effective dose equivalent (TEDE). TEDE is estimated by the sum of the committed effective dose equivalent from inhalation and the deep dose equivalent from external exposure. Table 5-22 is for the US-APWR design, and these values are from Table 7.1-39 of the PSEG ER (PSEG 2014-TN3452). Table 5-23 is for U.S. EPR, and these values are from Table 7.1-56 of the PSEG ER (PSEG 2014-TN3452). Table 5-24 is for AP1000 (one unit), and these values are from Tables 7.1-47 through 7.1-54 of the PSEG ER (PSEG 2014-TN3452). Finally, Table 5-25 is for the ABWR, and these values are from Tables 7.1-41 through 7.1-45 of the PSEG ER (PSEG 2014-TN3452).

Table 5-22. Design Basis Accident Doses for US-APWR

Accident	Standard Review Plan Section[(b)]	TEDE in rem[(a)]		
		EAB	LPZ	Review Criterion
Main steam line break	15.1.5			
Pre-existing iodine spike		5.36×10^{-2}	1.32×10^{-3}	25[(c)]
Accident-initiated iodine spike		9.02×10^{-2}	3.36×10^{-3}	2.5[(d)]
Steam generator rupture	15.6.3			
Pre-existing iodine spike		1.02×10^{0}	1.80×10^{-2}	25[(c)]
Accident-initiated iodine spike		2.71×10^{-1}	5.16×10^{-3}	2.5[(d)]
Loss-of-coolant accident (LOCA)	15.6.5	3.67×10^{0}	1.56×10^{-1}	25[(c)]
Rod ejection	15.4.8	1.44×10^{0}	5.40×10^{-2}	6.25[(d)]

Table 5-22. (continued)

Accident	Standard Review Plan Section[b]	TEDE in rem[a]		
		EAB	LPZ	Review Criterion
Reactor coolant pump rotor seizure (locked rotor)	15.3.3	1.38×10^{-1}	8.40×10^{-3}	2.5[d]
Failure of small lines carrying primary coolant outside containment	15.6.2	4.23×10^{-1}	7.20×10^{-3}	2.5[d]
Fuel handling	15.7.4	9.31×10^{-1}	1.68×10^{-2}	6.25[d]

(a) To convert rem to Sv, divide by 100.
(b) Source: NUREG–0800 (NRC 2007-TN3036).
(c) 10 CFR 50.34(a)(1) (10 CFR 50-TN249) and 10 CFR 100.21 (10 CFR 100-TN282) criteria.
(d) Standard Review Plan criterion.

Source: PSEG 2014-TN3452.

Table 5-23. Design Basis Accident Doses for U.S. EPR

Accident	Standard Review Plan Section[b]	TEDE in rem[a]		
		EAB	LPZ	Review Criterion
Main steam line break	15.1.5			
Pre-existing iodine spike		2.82×10^{-2}	1.70×10^{-3}	25[c]
Accident-initiated iodine spike		4.23×10^{-2}	3.40×10^{-3}	2.5[d]
Fuel rod clad failure		7.47×10^{-1}	4.42×10^{-2}	25[d]
Fuel overheat		8.18×10^{-1}	4.76×10^{-2}	25[d]
Steam generator rupture	15.6.3			
Pre-existing iodine spike		1.55×10^{-1}	5.10×10^{-3}	25[c]
Accident-initiated iodine spike		9.87×10^{-2}	8.50×10^{-3}	2.5[d]
Loss-of-coolant accident (LOCA)	15.6.5	1.72×10^{-0}	1.89×10^{-1}	25[c]
Rod ejection	15.4.8	8.04×10^{-1}	5.95×10^{-2}	6.25[d]
Reactor coolant pump rotor seizure (locked rotor)	15.3.3	3.24×10^{-1}	1.53×10^{-2}	2.5[d]
Failure of small lines carrying primary coolant outside containment	15.6.2	2.54×10^{-1}	5.10×10^{-3}	2.5[d]
Fuel handling	15.7.4	7.90×10^{-1}	1.70×10^{-2}	6.25[d]

(a) To convert rem to Sv, divide by 100.
(b) Source: NUREG–0800 (NRC 2007-TN3036).
(c) 10 CFR 50.34(a)(1) (10 CFR 50-TN249) and 10 CFR 100.21 (10 CFR 100-TN282) criteria.
(d) Standard Review Plan criterion.

Source: PSEG 2014-TN3452.

Table 5-24. Design Basis Accident Doses for AP1000 Reactor

Accident	Standard Review Plan Section[b]	TEDE in rem[a]		
		EAB	LPZ	Review Criterion
Main steam line break	15.1.5			
Pre-existing iodine spike		1.76×10^{-1}	3.81×10^{-3}	25[c]
Accident-initiated iodine spike		1.94×10^{-1}	9.67×10^{-3}	2.5[d]
Steam generator rupture	15.6.3			
Pre-existing iodine spike		3.87×10^{-1}	6.16×10^{-3}	25[c]
Accident-initiated iodine spike		1.94×10^{-1}	3.99×10^{-3}	2.5[d]
Loss-of-coolant accident (LOCA)	15.6.5	6.71×10^{-0}	2.31×10^{-1}	25[c]
Rod ejection	15.4.8	6.34×10^{-1}	2.72×10^{-2}	6.25[d]
Reactor coolant pump rotor seizure (locked rotor)–No feedwater	15.3.3	1.41×10^{-1}	1.95×10^{-3}	2.5[d]
Feedwater available	15.3.3	1.06×10^{-1}	3.97×10^{-3}	2.5[d]
Failure of small lines carrying primary coolant outside containment	15.6.2	3.70×10^{-1}	5.10×10^{-3}	2.5[d]
Fuel handling	15.7.4	9.15×10^{-1}	1.72×10^{-2}	6.25[d]

(a) To convert rem to Sv, divide by 100.
(b) Source: NUREG–0800 (NRC 2007-TN3036).
(c) 10 CFR 50.34(a)(1) (10 CFR 50-TN249) and 10 CFR 100.21 (10 CFR 100-TN282) criteria.
(d) Standard Review Plan criterion.

Source: PSEG 2014-TN3452.

Table 5-25. Design Basis Accident Doses for ABWR

Accident Considered	Standard Review Plan Section[c]	TEDE in rem[a],[b]		
		EAB	LPZ	Review criteria
Failure of Small Lines Carrying Primary Coolant Outside Containment[d]	15.6.2	2.45×10^{-2}		2.5
LOCA	15.6.5	1.1	0.33	25
Fuel Handling Accident[d]	15.7.4	0.39		6.25
Main Steamline Break—Case 1[d],[e]	15.6.4	1.44×10^{-2}		2.5
Main Steamline Break—Case 2[d],[e]	15.6.4	0.292		25

(a) To convert rem to Sv, divide by 100.
(b) TEDE dose in rems converted from ER Table 7.1-41 (PSEG 2014-TN3452) using weighting factors from 10 CFR 20.1003 (10 CFR 20-TN283).
(c) Source: NUREG–0800 (NRC 2007-TN3036).
(d) The dose is calculated for the maximum 2-hr EAB meteorology only, based on the design control document (DCD).
(e) The level of activity is consistent with an off-gas release rate of 3.7 GBq/s for Case 1 and 14.8 GBq/s for Case 2, referenced to a 30-min decay. The iodine concentrations are also different for each case.

Source: PSEG 2014-TN3452.

Dose conversion factors from Federal Guidance Report 11 (Eckerman et al. 1988-TN68) were used to calculate the committed effective dose equivalent. Similarly, dose conversion factors from Federal Guidance Report 12 (Eckerman and Ryman 1993-TN8) were used to calculate the deep dose equivalent.

The Commission has determined that the ABWR meets the TEDE dose criteria of 10 CFR 50.34 (10 CFR 52-TN251, Appendix A; 10 CFR 50-TN249). Equivalent TEDE values have been estimated for ABWR from doses reported by the applicant in ER by multiplying the thyroid dose by a factor of 0.03 (the organ weighting factor for the thyroid) and adding the product to the whole body dose. The doses are also converted to rems from the original reported values in Sv.

The NRC staff reviewed the PSEG selection of DBAs for each reactor design by comparing the accidents listed in the application with DBAs considered in the latest respective design control document (DCD) version released. Although some enhancements are in progress with these design certification documents, no significant changes of information pertaining to DBAs are anticipated that would alter the conclusions presented in this section. The US-APWR DCD is Rev. 1 (MHI 2008-TN3169); the AP1000 DCD is Rev. 17 (Westinghouse 2008-TN496); the U.S. EPR DCD is Rev. 0 (AREVA 2007-TN1921); and the ABWR is Rev. 4 (GE 1997-TN2767). The AP1000 final design certification was based on DCD Revision 19 (Westinghouse 2011-TN261), and the DBAs in PSEG's ER for the AP1000 (i.e., DCD Rev. 17) are the same. DBAs in the ER are the same as those considered in the design certification; therefore, the NRC staff concludes that the set of DBAs is appropriate. In addition, the NRC staff reviewed the calculation of the site-specific consequences of DBAs and found the results of the calculations to be acceptable.

There are no environmental criteria related to the potential consequences of DBAs. Consequently, the review criteria used in the NRC staff's safety review of DBA doses are included in Tables 5-22, 5-23, 5-24 and 5-25 to illustrate the magnitude of the calculated environmental consequences (TEDE doses). In all cases, the calculated TEDE values are considerably smaller than the TEDE doses used as safety review criteria. Considering the magnitude of the doses presented in Tables 5-22, 5-23, 5-24 and 5-25, the NRC staff concludes the potential environmental impacts of design basis accidents for the selected reactor designs at the PSEG Site are SMALL.

NRC staff reviewed PSEG DBA analysis and PSEG Site-specific data in PSEG ER for the four different reactor technologies under consideration and found them to be appropriate and acceptable. The site-specific analysis results demonstrate that all US-APWR, AP1000, U.S. EPR, and ABWR accident doses meet the site acceptance criteria of 10 CFR 50.34 (10 CFR 50-TN249).

The results indicate the environmental risks associated with DBAs for any of the four reactor technologies considered would be SMALL. On this basis, the NRC staff concludes that the environmental consequences of DBAs at the PSEG Site would be of SMALL significance for any of the four reactor technologies considered.

5.11.2 Severe Accidents

In its ER (PSEG 2014-TN3452), PSEG considers the potential consequences of severe accidents for four different reactor technologies at the PSEG Site: ABWR [4,300 MW(t)], AP1000 (two units), U.S. EPR, and US-APWR. Three pathways are considered: (1) the atmospheric pathway, in which radioactive material is released to the air; (2) the surface-water pathway, in which airborne radioactive material falls out on open bodies of water; and (3) the groundwater pathway, in which groundwater is contaminated by a basemat melt-through with subsequent contamination of surface water by the groundwater.

Because the PPE does not include source terms for severe accidents, PSEG bases its evaluation of the potential environmental consequences for the atmospheric and surface water ingestion pathways on the results of the MELCOR Accident Consequence Code System (MACCS2) computer code version 1.13.1 (Chanin and Young 1998-TN66) using source term information from the four reactor technologies and site-specific meteorological, population, and land-use data.

The MACCS computer code (Chanin et al. 1990-TN2056; Jow et al. 1990-TN526) was developed to evaluate the potential offsite consequences of severe accidents for the sites covered by NUREG–1150 (NRC 1990-TN525). MACCS2 is the version of MACCS employed in these calculations (Chanin and Young 1998-TN66). The MACCS and MACCS2 codes evaluate the consequences of atmospheric releases of material following a severe accident. The pathways modeled include exposure to the passing plume, exposure to material deposited on the ground and skin, inhalation of material in the passing plume and resuspended from the ground, and ingestion of contaminated food and surface water. The primary enhancements in MACCS2 are that MACCS2 has (1) a flexible emergency-response model, (2) an expanded library of radionuclides, and (3) a semidynamic food-chain model (Chanin and Young 1998-TN66).

In response to an NRC request for additional information, PSEG provided the NRC with copies of the input and output files for the MACC2 computer runs (PSEG 2012-TN2462). NRC staff reviewed the input and output files, ran independent confirmatory calculations with the MACCS2 code, and concurred with the PSEG results.

Environmental consequences of some potential surface-water pathways (e.g., swimming and fishing) are not evaluated by MACCS2. PSEG relied on generic analyses in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, NUREG–1437 (NRC 2013-TN2656) for these pathways. Similarly, the MACCS2 code does not address the potential environmental consequences of the groundwater pathway.

Three types of severe accident consequences were assessed: (1) human health, (2) economic costs, and (3) land area affected by contamination. Human health effects are expressed in terms of the number of cancers that might be expected if a severe accident were to occur. These effects are directly related to the cumulative radiation dose received by the general population. MACCS2 estimates both early fatalities and latent cancer fatalities. Early fatalities are related to high doses or dose rates and can be expected to occur within a year of exposure

(Jow et al. 1990-TN526). Latent cancer fatalities are related to exposure of a large number of people to low doses and dose rates and can be expected to occur after a latent period of several (2 to 15) years.

Population health-risk estimates are based on the population distribution within a 50-mi radius of the site. Economic costs of a severe accident include costs associated with short-term relocation of people; decontamination of property and equipment; interdiction of food supplies, land, and equipment use; and condemnation of property. The affected land area is a measure of the areal extent of the residual contamination following a severe accident. Farmland decontamination is an estimate of the area that has an average whole body dose rate for the 4-year period following the release that would be greater than 0.005 Sv/yr (0.5 rem/yr) if not reduced by decontamination and that would have a dose rate following decontamination of less than 0.005 Sv/yr (0.5 rem/yr). Decontaminated land is not necessarily suitable for farming.

Risk is the product of the frequency and consequences of an accident. For example, the probability of a severe accident (also called core damage frequency) without loss of containment for a US-APWR (Release Category RC6) is estimated to be 1.1×10^{-6} per reactor-year (Ryr) for internal events. The cumulative population dose associated with a severe accident without loss of containment at the PSEG Site is calculated to be 16.9 person-Sv (1,690 person-rem). The population dose risk for this release class is the product of 1.1×10^{-6} Ryr^{-1} and 16.9 person-Sv (1,690 person-rem), which equals 1.86×10^{-5} person-Sv Ryr^{-1} (1.86×10^{-3} person-rem Ryr^{-1}). These values are shown in Table 5-26.

Core damage frequency estimates are made using well developed methods that have been updated based on investigation of the accident at Three Mile Island, Unit 2, and research following the accident. Core damage frequency estimation methods used to generate the estimates presented in this EIS are described in NUREG–1150, *Severe Accident Risk: An Assessment for Five U.S. Nuclear Power Plants* (NRC 1990-TN525). These methods explicitly consider both pre-accident and post-accident human errors. The core damage frequencies listed in this EIS are those estimated for the US-APWR, AP1000, U.S. EPR and ABWR reactor designs as part of the design certification process. The following sections discuss estimated risks associated with the air, surface water, and groundwater pathways. The risks presented in the following tables are risks per year of reactor operation.

5.11.2.1 Air Pathway

The MACCS2 code directly estimates consequences associated with releases to the air pathway. The results of the MACCS2 runs (PSEG 2014-TN3452) for the four reactor technologies are presented in Tables 5-26, 5-27, 5-28, and 5-29. For the AP1000 (Table 5-27), values for one unit have been calculated. Table 5-28 shows the environmental risks for U.S. EPR. The estimated risks for US-APWR (Table 5-26) are the largest of the four reactor technologies considered, and the estimated risks for ABWR (Table 5-29) are the lowest. US-APWR has the largest values for all the categories of the tables: core damage frequency, population dose, early fatalities and latent cancer fatalities, cost, farm land decontamination, and population dose from water ingestion. Therefore, US-APWR results are bounding for the four reactor technologies considered.

Table 5-26. Environmental Risks from a US-APWR Severe Accident at the PSEG Site

Release Category (Accident Class)	Description	Environmental Risk[a]						
		Core Damage Frequency (Ryr^{-1})[(a)]	Population Dose (person-Sv Ryr^{-1})[(b)]	Fatalities (Ryr^{-1}) Early[(c)]	Fatalities (Ryr^{-1}) Latent Cancer[(d)]	Cost[(e)] (\$ Ryr^{-1})	Farm Land Decontamination[(f)] (ha Ryr^{-1})	Population Dose from Water Ingestion (person Sv Ryr^{-1})[(b)]
RC1	Containment bypass which includes both core damage after steam generator tube rupture (SGTR) and thermal-induced SGTR after core damage	7.5×10^{-9}	9.98×10^{-4}	2.57×10^{-12}	4.62×10^{-5}	$662	9.08×10^{-4}	9.98×10^{-6}
RC2	Containment isolation failure	2.1×10^{-9}	2.23×10^{-4}	1.93×10^{-15}	1.10×10^{-5}	$100	2.09×10^{-4}	7.12×10^{-7}
RC3	Containment overpressure failure before core damage due to loss of heat removal	2.0×10^{-8}	5.18×10^{-3}	1.24×10^{-9}	4.48×10^{-4}	$2,560	2.08×10^{-3}	6.46×10^{-5}
RC4	Early containment failure due to dynamic loads, including hydrogen combustion before or just after reactor vessel failure, in-vessel and ex-vessel steam explosion, rocket-mode reactor vessel failure, and direct containment heating	1.1×10^{-8}	8.67×10^{-4}	1.06×10^{-13}	4.53×10^{-5}	$413	7.93×10^{-4}	3.69×10^{-6}
RC5	Late containment failure, including containment overpressure failure after core damage, hydrogen combustion long after reactor vessel failure, and basemat melt through	6.5×10^{-8}	4.25×10^{-3}	0.0×10^{-0}	1.85×10^{-4}	$1,290	3.35×10^{-3}	8.39×10^{-6}
RC6	Intact containment in which fission products are released at design leak rate	1.1×10^{-6}	1.86×10^{-5}	0.0×10^{-0}	8.37×10^{-7}	$0.2	3.81×10^{-7}	1.25×10^{-8}
	Total	$\mathbf{1.2 \times 10^{-6}}$	$\mathbf{1.15 \times 10^{-2}}$	$\mathbf{1.24 \times 10^{-9}}$	$\mathbf{7.36 \times 10^{-4}}$	**$5,030**	$\mathbf{7.34 \times 10^{-3}}$	$\mathbf{8.74 \times 10^{-5}}$

(a) All values in the table are based on data supplied by PSEG 2014-TN3452.
(b) To convert person-Sv to person-rem, multiply by 100.
(c) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990-TN526).
(d) Latent cancer fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2–15) years.
(e) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990-TN526).
(f) Land risk is area where the average whole body dose rate for the 4-yr period following the accident exceeds 0.005 Sv/yr but can be reduced to less than 0.005 Sv/yr by decontamination.

Table 5-27. Environmental Risks from AP1000 Reactor Severe Accident at the PSEG Site

Release Category (Accident Class)	Description[b]	Environmental Risk[a]						
		Core Damage Frequency (Ryr^{-1})[(a)]	Population Dose (person-Sv Ryr^{-1})[(b)]	Fatalities (Ryr^{-1})		Cost[(e)] (\$ Ryr^{-1})	Farm Land Decontamination[(f)] (ha Ryr^{-1})	Population Dose from Water Ingestion (person Sv Ryr^{-1})[(b)]
				Early[(c)]	Latent Cancer[(d)]			
IC	Intact containment	2.21×10^{-7}	2.32×10^{-5}	0	1.04×10^{-6}	\$0.261	2.39×10^{-6}	2.32×10^{-8}
CFE	Early containment failure	7.47×10^{-9}	2.99×10^{-4}	1.11×10^{-14}	1.42×10^{-5}	\$171	3.25×10^{-4}	1.58×10^{-6}
CFI	Intermediate containment failure	1.89×10^{-10}	1.01×10^{-5}	0	3.95×10^{-7}	\$6.1	1.50×10^{-5}	2.68×10^{-8}
CFL	Late containment failure	3.45×10^{-13}	2.04×10^{-8}	0	7.62×10^{-10}	\$212	3.83×10^{-8}	5.97×10^{-12}
CI	Containment isolation failure	1.33×10^{-9}	5.40×10^{-5}	0	3.13×10^{-6}	\$26.5	5.49×10^{-5}	2.62×10^{-7}
BP	Containment bypass	1.05×10^{-8}	1.40×10^{-3}	8.36×10^{-13}	6.90×10^{-5}	\$826	1.26×10^{-3}	1.05×10^{-5}
	Total (1 unit)	**2.40×10^{-7}**	**1.79×10^{-3}**	**8.47×10^{-13}**	**8.78×10^{-5}**	**\$1,030**	**1.66×10^{-3}**	**1.24×10^{-5}**

(a) All values in the table are based on data supplied by PSEG 2014-TN3452.
(b) To convert person-Sv to person-rem, multiply by 100.
(c) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990-TN526).
(d) Latent cancer fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2 to 15) years.
(e) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990-TN526).
(f) Land risk is area where the average whole body dose rate for the 4-yr period following the accident exceeds 0.005 Sv/yr but can be reduced to less than 0.005 Sv/yr by decontamination.

Table 5-28. Environmental Risks from a U.S. EPR Severe Accident at the PSEG Site

Release Category (Accident Class)[b]	Description	Environmental Risk[a]						
		Core Damage Frequency (Ryr^{-1})[a]	Population Dose (person-Sv Ryr^{-1})[c]	Fatalities (Ryr^{-1})		Cost[f] (\$ Ryr^{-1})	Farm Land Decontamination[g] (ha Ryr^{-1})	Population Dose from Water Ingestion (person Sv Ryr^{-1})[c]
				Early[d]	Latent Cancer[e]			
RC101	No containment failure	3.4×10^{-7}	2.02×10^{-4}	0	9.71×10^{-6}	\$3.77	2.83×10^{-5}	1.11×10^{-7}
RC201	Containment isolation failure before breach	5.0×10^{-10}	1.88×10^{-5}	5.48×10^{-14}	8.37×10^{-7}	\$17.3	1.41×10^{-5}	2.73×10^{-7}
RC206	Containment failure due to failure to isolate 2-in. or smaller lines	1.6×10^{-8}	4.37×10^{-4}	0	2.41×10^{-5}	\$244	5.59×10^{-4}	1.08×10^{-6}
RC303	Containment fails before breach, no MCCI, flooded, sprays	2.3×10^{-9}	7.45×10^{-5}	0	3.66×10^{-6}	\$43.5	7.96×10^{-5}	2.71×10^{-7}
RC304	Containment fails before breach, no MCCI, flooded, no sprays	1.8×10^{-8}	9.99×10^{-4}	0	5.15×10^{-5}	\$530	8.26×10^{-4}	5.02×10^{-6}
RC404	Containment fails after breach before melt transfer	1.4×10^{-8}	3.90×10^{-4}	0	1.76×10^{-5}	\$214	4.07×10^{-4}	1.28×10^{-6}
RC504	Containment fails after quench	1.2×10^{-7}	7.77×10^{-5}	0	3.49×10^{-6}	\$2.2	1.77×10^{-6}	4.21×10^{-8}
RC701	Steam Generator Tube Rupture, FP scrubbing	1.0×10^{-8}	2.26×10^{-4}	0	1.18×10^{-5}	\$122	2.89×10^{-4}	5.01×10^{-7}
RC702	Steam Generator Tube Rupture, no FP scrubbing	5.4×10^{-9}	8.55×10^{-4}	1.39×10^{-11}	7.59×10^{-5}	\$337	3.79×10^{-4}	5.23×10^{-6}
RC802	Interfacing LOCA, no FP scrubbing	2.6×10^{-10}	1.48×10^{-4}	3.99×10^{-11}	1.67×10^{-5}	\$31.4	1.24×10^{-5}	1.38×10^{-6}
	Total	$\mathbf{5.3 \times 10^{-7}}$	$\mathbf{3.48 \times 10^{-3}}$	$\mathbf{5.39 \times 10^{-11}}$	$\mathbf{2.18 \times 10^{-4}}$	**\$1,570**	$\mathbf{2.64 \times 10^{-3}}$	$\mathbf{1.54 \times 10^{-5}}$

Notes: MCCI = molten corium-to-concrete interaction; FP = fission products; LOCA = loss of coolant accident.
(a) All values in the table are based on data supplied by PSEG 2014-TN3452 and PSEG 2012-TN2462.
(b) Release categories contributing less than 1 percent of the risk in all risks categories are not shown. Totals include all release categories.
(c) To convert person-Sv to person-rem, multiply by 100.
(d) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990-TN526).
(e) Latent cancer fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2 to 15) years.
(f) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990-TN526).
(g) Land risk is area where the average whole body dose rate for the 4-yr period following the accident exceeds 0.005 Sv/yr but can be reduced to less than 0.005 Sv/yr by decontamination.

Table 5-29. Environmental Risks from an ABWR Severe Accident at the PSEG Site

Release Category (Accident Class)[b]	Description	Environmental Risk[a]						
		Core Damage Frequency (Ryr^{-1})[a]	Population Dose (person-Sv Ryr^{-1})[c]	Fatalities (Ryr^{-1})		Cost[f] ($ Ryr^{-1})	Farm Land Decontamination[g] (ha Ryr^{-1})	Population Dose from Water Ingestion (person Sv Ryr^{-1})[b]
				Early[d]	Latent Cancer[e]			
NCL	No loss of containment	1.34×10^{-7}	2.16×10^{-5}	0	9.63×10^{-7}	$0.343	1.04×10^{-6}	1.37×10^{-8}
Case 1	Transients followed by failure of high pressure coolant makeup	2.08×10^{-8}	1.78×10^{-6}	0	7.4×10^{-8}	$0.0152	0	1.37×10^{-11}
Case 6	Transient, LOCA and ATWS	1.0×10^{-10}	3.66×10^{-6}	0	1.63×10^{-7}	$1.89	3.95×10^{-6}	1.38×10^{-8}
Case 7	Small/medium LOCA	3.91×10^{-10}	2.10×10^{-5}	0	9.34×10^{-7}	$13.7	2.13×10^{-5}	1.55×10^{-7}
Case 8	LOCA followed by high pressure coolant makeup	4.05×10^{-10}	3.14×10^{-5}	1.56×10^{-14}	1.42×10^{-6}	$22.7	2.80×10^{-5}	3.37×10^{-7}
Case 9	ATWS followed by boron injection failure	1.7×10^{-10}	1.64×10^{-5}	9.98×10^{-14}	7.48×10^{-7}	$14.5	1.37×10^{-5}	2.81×10^{-7}
	Total	**1.56×10^{-7}**	**9.83×10^{-5}**	**1.15×10^{-13}**	**4.41×10^{-6}**	**$53.7**	**6.95×10^{-5}**	**8.04×10^{-7}**

Notes: ATWS = anticipated transient without scram. LOCA = loss of coolant accident.
(a) All values in the table are based on data supplied by PSEG 2014-TN3452 and PSEG 2012-TN2462).
(b) Release categories 2 through 5 are not shown as they contribute to less than 1 percent of the risk. Totals include all release categories.
(c) To convert person-Sv to person-rem, multiply by 100.
(d) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990-TN526).
(e) Latent cancer fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2 to 15) years.
(f) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990-TN526).
(g) Land risk is area where the average whole body dose rate for the 4-yr period following the accident exceeds 0.005 Sv/yr but can be reduced to less than 0.005 Sv/yr by decontamination.

The core damage frequencies given in the prior tables include internally initiated accident sequences. Internally initiated accident sequences include sequences that are initiated by human error, equipment failures, loss of offsite power, etc. It should be noted that the core damage frequencies cited by PSEG for U.S. EPR and US-APWR are those from the Design Certification/Control Document and Environmental Report submitted as part of the application for certification of the U.S. EPR (AREVA 2007-TN1921) and the US-APWR (MHI 2008-TN3169) reactor designs. The NRC staff has not finished its evaluation of the core damage frequencies. Consequently, core damage frequencies are subject to change as the design certification review continues. Nevertheless, core damage frequencies in these tables are the values available at the time PSEG ER was prepared.

Tables 5-26, 5-27, 5-28, and 5-29 show the probabilistically weighted consequences (i.e., risks) of severe accidents are small for all risk categories considered for a US-APWR, an AP1000, a U.S. EPR, and an ABWR located on the PSEG Site. For perspective, Tables 5-30 and 5-31 compare the health risks from severe accidents for a US-APWR, one AP1000, a U.S. EPR, and an ABWR at the PSEG Site with the risks for current-generation reactors at various sites.

In Table 5-30, the health risks estimated for a US-APWR, an AP1000, a U.S. EPR, and an ABWR at the PSEG Site are compared with health-risk estimates for the five reactors considered in NUREG–1150 (NRC 1990-TN525). Although risks associated with both internally and externally initiated events were considered for the Peach Bottom and Surry reactors in NUREG–1150, only risks associated with internally initiated events are presented in Table 5-30. The resulting health risks for a new reactor or reactors at the PSEG Site are generally lower than the risks associated with current-generation reactors presented in NUREG–1150.

The last two columns of Table 5-30 provide average individual fatality risk estimates. To put these estimates into context for the environmental analysis, the staff compares these estimates to the safety goals. The Commission has set safety goals for average individual early fatality and latent cancer fatality risks from reactor accidents in the Safety Goal Policy Statement (51 FR 30028-TN594). These goals are presented here solely to provide a point of reference for the environmental analysis and do not serve the purpose of a safety analysis. The Policy Statement expressed the Commission's policy regarding the acceptance level of radiological risk from nuclear power plant operation as follows.

- Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health.

- Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

Table 5-30. Comparison of Environmental Risks for a New Nuclear Power Plant at the PSEG Site with Risks for Current-Generation Reactors at Five Sites Evaluated in NUREG–1150

	Core Damage Frequency (Ryr^{-1})	50-mi Population Dose Risk (person-Sv Ryr^{-1})(a)	Fatalities Ryr^{-1}		Average Individual Fatality Risk Ryr^{-1}	
			Early	Latent Cancer	Early	Latent Cancer
Grand Gulf(b)	4.0×10^{-6}	5×10^{-1}	8×10^{-9}	9×10^{-4}	3×10^{-11}	3×10^{-10}
Peach Bottom(b)	4.5×10^{-6}	$7 \times 10^{+0}$	2×10^{-8}	5×10^{-3}	5×10^{-11}	4×10^{-10}
Sequoyah(b)	5.7×10^{-5}	$1 \times 10^{+1}$	3×10^{-5}	1×10^{-2}	1×10^{-8}	1×10^{-8}
Surry(b)	4.0×10^{-5}	$5 \times 10^{+0}$	2×10^{-6}	5×10^{-3}	2×10^{-8}	2×10^{-9}
Zion(b)	3.4×10^{-4}	$5 \times 10^{+1}$	4×10^{-5}	2×10^{-2}	9×10^{-9}	1×10^{-8}
US-APWR(c) at PSEG Site	1.2×10^{-6}	1.15×10^{-2}	1.24×10^{-9}	7.36×10^{-4}	5.3×10^{-10}	1.8×10^{-10}
One AP1000(c) at PSEG Site	2.4×10^{-7}	1.79×10^{-3}	8.47×10^{-13}	8.78×10^{-5}	2.6×10^{-11}	2.3×10^{-11}
U.S. EPR(c) at PSEG Site	5.3×10^{-7}	3.48×10^{-3}	5.39×10^{-11}	2.18×10^{-4}	1.5×10^{-11}	3.1×10^{-11}
ABWR(c) at PSEG Site	1.6×10^{-7}	9.83×10^{-5}	1.15×10^{-13}	4.41×10^{-6}	5.7×10^{-13}	1.5×10^{-12}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Risks were calculated using the MACCS code and are presented in NUREG–1150 (NRC 1990-TN525).
(c) Calculated with MACCS2 code using PSEG Site-specific input for internal at power initiating events.

Source: PSEG 2014-TN3452 and PSEG 2013-TN2909.

The following quantitative health objectives are used in determining achievement of the safety goals.

- The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of 1 percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.

- The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of 1 percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.

These quantitative health objectives are translated into two numerical objectives as follows.

- The individual risk of a prompt fatality from all “other accidents to which members of the U.S. population are generally exposed,” is about 4.0×10^{-4} per year, including a

1.3×10^{-4} per year risk associated with transportation accidents (NSC 2010-TN3240); one-tenth of 1 percent of these figures imply that the individual risk of prompt fatality from a reactor accident should be less than 4×10^{-7} per Ryr.

- "The sum of cancer fatality risks resulting from all other causes" for an individual is taken to be the cancer fatality rate in the U.S., which is about 1 in 500 or 2×10^{-3} per year (Reed 2007-TN523); one-tenth of 1 percent of this implies that the risk of cancer to the population in the area near a nuclear power plant because of its operation should be limited to 2×10^{-6} per Ryr.

MACCS2 calculates average individual early fatality and latent cancer fatality risks. The average individual early fatality risk is calculated using the population distribution within 1 mi of the site boundary. The average individual latent cancer fatality risk is calculated using the population distribution within 10 mi of the site. For sites considered in NUREG–1150 (NRC 1990-TN525), these risks were well below the Commission's safety goals (51 FR 30028-TN594). In general, risks calculated for the US-APWR, one AP1000, a U.S. EPR, and an ABWR at the PSEG Site are lower than the risks associated with the current-generation reactors considered in NUREG–1150. While the US-APWR design at the PSEG Site may have a higher average individual early fatality risk that two of the reactors assessed in NUREG–1150, all risk values are well below the Commission's safety goals.

The NRC staff compared the core damage frequency and population dose risk estimate for a US-APWR, an AP1000, a U.S. EPR and an ABWR at the PSEG Site with statistics summarizing the results of contemporary severe accident analyses performed for over 70 reactors at over 40 sites. The results of these analyses are included in the final site-specific Supplements 1 through 49 to the Generic Environmental Impact Statement (GEIS) for License Renewal, NUREG–1437 (NRC 2013-TN2656) and in ERs included with license renewal applications for those sites for which supplements have not been published. All of the analyses were completed after publication of NUREG–1150 (NRC 1990-TN525); the analyses for most of the reactors used MACCS2, which was released in 1997.

Table 5-31 shows that core damage frequency estimated for US-APWR, AP1000, U.S. EPR, and ABWR is significantly lower than those of current-generation reactors. Similarly, the population doses estimated for any of the four reactor technologies considered at the PSEG Site are well below the mean and median values for current-generation reactors that have undergone or are undergoing license renewal and are lower than the current reactor minimum except for US-APWR. The reason the US-APWR population dose risk is larger than the current reactor minimum (with a value of 5.5×10^{-3} person-Sv/R-yr for Arkansas Nuclear One) is due to the larger population within a 50-mi range of the PSEG Site. Population projections for the year 2081 have been considered for the PSEG Site (PSEG 2014-TN3452). The year 2081 has been selected considering the 40-year operating life plus the potential 20-year license extension. The start-up date has been considered in the year 2020. The population projection for the year 2081 is the most conservative estimate as it corresponds to the highest population value at the end of the site operation, assuming the population always increases with time.

Table 5-31. Comparison of Environmental Risks from Severe Accidents for a US-APWR, an AP1000, a U.S. EPR, and an ABWR at the PSEG Site with Risks for Current Plants from Operating License Renewal Reviews

	Core Damage Frequency (yr^{-1})	50-mi Population Dose Risk (person-Sv Ryr^{-1})[(a)]
Current Reactor Maximum[(b)]	2.4×10^{-4}	6.9×10^{-1}
Current Reactor Mean[(b)]	3.1×10^{-5}	1.5×10^{-1}
Current Reactor Median[(b)]	2.5×10^{-5}	1.3×10^{-1}
Current Reactor Minimum[(b)]	1.9×10^{-6}	5.5×10^{-3}
US-APWR[(c)] at PSEG Site	1.2×10^{-6}	1.15×10^{-2}
AP1000[(c)] at PSEG Site	2.4×10^{-7}	1.79×10^{-3}
U.S. EPR[(c)] at PSEG Site	5.31×10^{-7}	3.48×10^{-5}
ABWR[c] at PSEG Site	1.56×10^{-7}	9.83×10^{-5}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Based on MACCS and MACCS2 calculations for over 70 current plants at over 40 sites.
(c) Calculated with MACCS2 code using PSEG Site-specific input.

Source: PSEG 2014-TN3452.

Finally, the population dose risk from a severe accident for a new US-APWR (this is the reactor with the largest population dose risk of the four reactors considered) at the PSEG Site (1.15×10^{-2} person-Sv/Ryr) may be compared with the dose risk for normal operation of a US-APWR at the PSEG Site. The population dose risk from normal operation of a US-APWR is 0.6 person-Sv/yr (PSEG 2014-TN3452). Thus, the population dose risk associated with a severe accident is less than the dose risk associated with normal operations.

5.11.2.2 Surface-Water Pathways

Surface-water pathways are an extension of the air pathway. These pathways cover the effects of radioactive material deposited on open bodies of water. The surface water pathways of interest include exposure to external radiation from submersion in water and activities near the water, ingestion of water, and ingestion of fish and other aquatic creatures. Of these pathways, the MACCS2 code evaluates only the ingestion of contaminated water. The risks associated with this surface water pathway calculated for the PSEG Site are included in the last column of Tables 5-26, 5-27, 5-28, and 5-29. For each accident class, the population dose risk from ingestion of water is a small fraction of the dose risk from the air pathway.

Surface water pathways involving swimming, fishing, and boating are not modeled by MACCS2. Typical population exposure risk for the aquatic food pathway for sites located on small rivers was considered in NUREG–1437 (NRC 2013-TN2656). For these sites, the population dose from the food pathway was below the population dose from the air pathway. Analysis of water-related exposure pathways at the Fermi reactor, NUREG–0769

(NRC 1981-TN675) suggests population exposures from swimming are significantly lower than exposures from the aquatic ingestion pathway.

Should a severe accident occur at the PSEG Site, it is likely that Federal, State and local official would restrict access to the river/bay near the site and in contaminated areas around the site. These actions would further reduce surface-water pathway exposures.

Surface water bodies within the 50-mi region of PSEG Site include the Chesapeake Bay, Delaware Bay, Delaware River, Susquehanna River, Smyrna River, Schuylkill River, Cooper River, and the several reservoirs listed on Table 2.3-3 of the PSEG ER (PSEG 2014-TN3452). The tributary streams in the vicinity of the PSEG Site are listed in Table 2.3-4 of the PSEG ER (PSEG 2014-TN3452). The NRC evaluated doses from the aquatic food pathway (fishing) for the current nuclear fleet discharging to various bodies of water in NUREG–1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NRC 2013-TN2656). The NRC evaluation concluded that with interdiction, the risk associated with the aquatic food pathway is small relative to the atmospheric pathway for most sites and essentially the same as the atmospheric pathway for the few sites with large annual aquatic food harvests. The new site atmospheric pathway doses are lower than those of the current U.S. nuclear fleet; therefore, the doses from surface water sources are consistently lower for a new reactor at the PSEG Site as well.

5.11.2.3 Groundwater Pathway

The groundwater pathway involves a reactor core melt, reactor vessel failure, and penetration of the floor (basemat) below the reactor vessel. Ultimately, core debris reaches the groundwater where soluble radionuclides are transported with the groundwater. MACCS2 does not evaluate the environmental risks associated with severe accident releases of radioactive material to groundwater. However, this pathway has been addressed by NUREG–1437 in the context of renewal of licenses for current-generation reactors (NRC 2013-TN2656). In NUREG–1437, the staff assumes a 1×10^{-4} Ryr^{-1} probability of occurrence of a severe accident with a basemat melt-through leading to potential groundwater contamination. The staff concluded that groundwater contribution to risk is generally a small fraction of the risk attributable to the atmospheric pathway.

The NRC staff has re-evaluated its assumption of a 1×10^{-4} Ryr^{-1} probability of a basemat melt-through. The NRC staff considers the 1×10^{-4} probability as too large for new sites. The probability of core melt with basemat melt-through should be no larger than the total core damage frequency estimate for the reactor. Table 5-30 gives a total core damage frequency estimate of 1.2×10^{-6} for US-APWR, the largest core damage frequency of the four reactor technologies considered. NUREG–1150 (NRC 1990-TN525) indicates that the conditional probability of a basemat melt-through ranges from 0.05 to 0.25 for current-generation reactors. New designs include features to reduce the probability of basemat melt-through in the event of a core melt accident. On this basis, the staff believes a basemat melt-through probability of less than 1.7×10^{-7} Ryr^{-1} (MHI 2008-TN3317) is reasonable and still conservative.

The groundwater pathway is also more tortuous and affords more time for implementing protective and remedial actions and, therefore, results in a lower risk to the public. The same

consideration applies to the other three reactor types considered at the PSEG Site. As a result, the staff concludes the risks associated with releases to groundwater are sufficiently small that they would not have a significant effect on overall risk of a severe accident for a new reactor at the PSEG Site.

5.11.2.4 Externally Initiated Events

The analyses described above are specifically for internally initiated events. PSEG's ER and SSAR do not address potential probability-weighted consequences (i.e., risk) from externally initiated events. The consideration of externally initiated events is not necessary for the NRC staff to reach a finding concerning the risks of the reactor designs considered by PSEG as related to the risks for current generation reactors from severe accidents. However, externally initiated events can have notable contributions to the total averted costs dependent on the reactor design. As outlined by 10 CFR 52.79(a)(46), Regulatory Guide 1.206 (NRC 2007-TN3035), and Section 19.0 Revision 2 of NUREG–0800 (NRC 2007-TN3036), these events are required to be included in the Level 1 and Level 2 of the probabilistic risk assessment and, as such, would be considered in the offsite consequences analysis and the severe accident mitigation alternatives (SAMA) assessment. Therefore, the NRC staff expects PSEG would include externally initiated events in a SAMA assessment for a combined license application.

5.11.2.5 Summary of Severe Accident Impacts

The NRC staff has reviewed the analysis in the PSEG ER (PSEG 2014-TN3452) and conducted its own confirmatory analysis using the MACCS2 code. The results of the PSEG analysis and the NRC analysis indicate that the environmental risks associated with severe accidents if a US-APWR, two AP1000 reactors, a U.S. EPR or an ABWR were to be located at the PSEG Site would be small compared to risks associated with operation of the current-generation reactors at the PSEG Site and other sites. These risks are well below NRC safety goals. On these bases, the staff concludes the probability weighted consequences of severe accidents at the PSEG Site would be of SMALL significance for one US-APWR reactor, one U.S. EPR reactor, one ABWR reactor, or two AP1000 reactors.

It is worth noting that a significant effort has been made to re-quantify realistic severe accident source terms under the State-of-the-Art Reactor Consequence Analysis (SOARCA) project (NRC 2012-TN3089; NRC 2012-TN3092). The results of the SOARCA project indicate that source term timing progresses more slowly, and release much smaller amounts of radioactive material than calculated in earlier studies. As a result, public health consequences from severe nuclear power plant accidents modeled in SOARCA are smaller than previously calculated.

At the COL stage, the NRC staff would need to verify that the environmental impacts of severe accidents from the selected reactor technology at the PSEG Site remain bounded by the environmental impacts from the designs and their respective DCD revisions considered in this EIS. For the COL submission, NRC anticipates that applicant analyses will be comprehensive in scope and will address all applicable internal and external events and all plant operating modes.

5.11.3 Severe Accident Mitigation Alternatives

This section is not required for an ESP permit.

5.11.4 Summary of Postulated Accident Impacts

The NRC staff evaluated the environmental impacts from both DBAs and internally initiated severe accidents for four different reactor technologies (ABWR, AP1000 dual-unit, U.S. EPR and US-APWR) at the PSEG Site. Based on the information provided by PSEG and the NRC staff independent review, the NRC staff concludes the potential environmental impacts from the operation of the four reactor designs evaluated in this EIS at the PSEG Site would be SMALL. However, the environmental impacts of SAMAs or involving other reactor designs cannot be resolved in this ESP review and they can be resolved at the COL stage.

5.12 Measures and Controls to Limit Adverse Impacts During Operation

In its evaluation of environmental impacts during operation of a new nuclear power plant at the PSEG Site, the review team considered PSEG's stated intent to comply with the following measures and controls that would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts (e.g., solid waste management, erosion and sediment control, air emissions, noise control, stormwater management, discharge prevention and response, and hazardous material management);
- compliance with applicable requirements of permits or licenses required for construction of a new nuclear power plant at the PSEG Site (e.g., Department of the Army Section 404 Permit, NPDES permit);
- compliance with existing PSEG processes and/or procedures applicable for environmental compliance activities during construction and preconstruction at the PSEG Site (e.g., solid waste management, hazardous waste management, and discharge prevention and response);
- incorporation of environmental requirements into construction contracts; and
- management and minimization of solid, radiological, chemical, and hazardous wastes.

Examples of PSEG measures to minimize impacts and protect the environment include

- using BMPs for construction and preconstruction activities,
- implementing plans to manage stormwater and to prevent and appropriately address accidental spills,

- managing and/or restoring wetlands and marsh creek channels, and
- adhering to Federal, State, and local permitting requirements.

The review team considered these measures and controls in its evaluation of the potential environmental impacts of plant operation. Table 5-32 summarizes the measures and controls to limit adverse impacts during operation of a new nuclear power plant at the PSEG Site based on Table 5.10-1 in the PSEG ER (PSEG 2014-TN3452) and other information provided by the applicant. Some measures apply to more than one impact category.

Table 5-32. Measures and Controls to Limit Adverse Impacts During Operation of a New Nuclear Power Plant at the PSEG Site

Resource Area	Specific Measures and Controls
Land-Use Impacts	
— The Site and Vicinity	• Limit continued disturbance of vegetation to the area within the site designated for construction of a new nuclear power plant
— Causeway Right-of-Way and Offsite Areas	• Maintenance activities will follow established procedures and will conform with regulations to minimize soil or water impacts
Water-Related Impacts	
— Hydrologic Alterations and Plant Water Supply	• Stormwater BMPs and permit requirements to limit erosion and sedimentation due to runoff • Prepare and maintain an SWPPP and comply with NJPDES permit to minimize releases • Engineered discharge outfall minimizes scour • Discharge structure to be designed to promote rapid mixing to minimize thermal and chemical impacts
— Water-Use Impacts	• During drought periods, water consumption offset, as required by DRBC, by release of water from the PSEG existing allocation upstream reservoir water storage • Effluent discharges limited; compliance with CWA regulations (40 CFR 423-TN253), compliance with NJPDES regulations, and blowdown treated to minimize discharge of residual chemicals
— Water Quality Impacts	• Chemical and thermal impacts limited by NJPDES permit requirements • Prepare and maintain an SPCCP to minimize the impacts of any spills • BMPs for dredging and stormwater controls to limit sediment impacts on surface water quality • BMPs and spill controls (including hazmat first response team and secondary containment designs) and counter-measures used to limit and contain chemical spills; remedial measures are regulated by NJDEP • Limit planned effluent discharges and monitor such discharges in compliance with CWA regulations (Federal Water Pollution Control Act) and NJPDES permit specifications

Table 5-32 (continued)

Resource Area	Specific Measures and Controls
Cooling System Impacts	
—Intake system	
Hydrodynamic Descriptions and Physical Impacts	• Design of new intake to comply with regulations on new facility intake structures • To limit impact of noise associated with operations of water makeup pumps, protective hearing equipment used, as appropriate, by employees working near the pumps and cooling towers • Stabilize shoreline with erosion controls, as needed • Water intake design to avoid buildup of sediment deposits and debris
Aquatic Ecosystems	• Design of new intake to comply with regulations on new facility intake structures • Utilization of closed-cycle cooling and cooling towers using the best technology available • Design of intake structures to ensure minimum water velocity through screens designed to prevent fish from being drawn into the intake structure; use a return system to deposit impinged fish and other aquatic biota downstream of the intake in the Delaware River • Use BMPs to minimize sediment loading during any maintenance dredging activities
—Discharge system	
Thermal Discharges and Other Physical Impacts	• Bottom scour to be mitigated by engineered discharge pipe • Discharges controlled in accordance with NJPDES permit
Aquatic Ecosystems	• To the extent practicable, equipment employed and positioned to reduce scouring and turbidity effects • Reduction of thermal plume effects on aquatic organisms through use of cooling towers and closed-loop cooling cycle • Blowdown treated to minimize discharge of residual chemicals according to NJPDES permit specifications
—Cooling towers	
Heat Dissipation to the Atmosphere	• Drift eliminators to be used in cooling towers to minimize the amount of water lost for the towers via drift • Blowdown treated to minimize total dissolved content of circulating water according to NJPDES permit specifications
Terrestrial Ecosystems	• Cooling towers designed to minimize noise levels and drift
Impacts to Members of the Public	• Noise attenuates to site boundary and offsite residences • As applicable, workers trained in compliance with Noise Control Act (NCA), 42 USC 4901 et seq. and OSHA • To limit impact of noise associated with operations of water makeup pumps, protective hearing equipment used, as appropriate, by employees working near the pumps and cooling towers • Water periodically monitored and tested for thermophilic microorganisms according to CDC Surveillance for Waterborne-Disease Outbreaks–United States • Workers trained on safe work procedures including, as appropriate, the use of air respirators

Table 5-32 (continued)

Resource Area	Specific Measures and Controls
Ecological Impacts	
— Terrestrial Ecosystems	• Minimize potential impacts through compliance with permitting requirements • Vegetation management primarily through mechanical clearing, with herbicide application in accordance with integrated pest management plans; herbicides are applied by trained employees licensed to apply herbicides • Employees trained on how to perform work in a manner that reduces adverse environmental impacts • To the extent feasible, avoid any additional disturbances on critical or sensitive terrestrial habitats/species • As practical, machinery use, noise suppression/mufflers, and vehicles are maintained to reduce emissions • Readily available spill response materials and personnel trained to respond to, clean up, and report spills • Employees trained in hazardous materials/waste procedures to minimize the risk of spills
— Aquatic Ecosystems	• Closed-cycle cooling, size and design of intake screens to ensure low approach water velocity across screens of less than 0.5 fps to minimize impingement and entrainment. • Discharges to the Delaware River Estuary are expected to meet NJPDES permitting requirements. Chemical discharges would be monitored, and concentrations are expected to be below criteria that are protective of aquatic life. • Aquatic resources on the site and in offsite corridors are protected during maintenance activities with BMPs that comply with Federal and State permits to prevent degradation to water quality.
Socioeconomic Impacts	
— Physical Impacts of a New Nuclear Power Plant	• Measures to mitigate impacts to level of service (LOS) for local roads from construction traffic would be left in place • Coordination with NJDEP on final modeling of air emissions and ways to reduce $PM_{2.5}$ emissions to meet regulatory limits • Zoning and land-use restriction may be used to help manage development • Train and appropriately protect employees to reduce the risk or potential exposure to noise • Monitor release of waste emissions and effluents • Train workers on procedures and regulations involving waste emissions and effluents

Table 5-32 (continued)

Resource Area	Specific Measures and Controls
— Socioeconomic Impacts of a New Nuclear Power Plant	• Measures to mitigate impacts to LOS for local roads from construction traffic would be left in place to offset traffic impacts from the operational workforce • Increased property and worker-related taxes can help offset some of the problems potentially related to increased population such as community facilities and infrastructure, police, fire protection, and schools • Local land zoning and ordinances can help mitigate potential socioeconomic growth problems • Provide appropriate job-training to workers • Provide onsite services for emergency first aid, and conduct regular health and safety monitoring
Environmental Justice	• No mitigating measures or controls required beyond those listed above
Historic and Cultural Resources	• Follow established procedures to halt work and consult with the State Historic Preservation Office if a potential unanticipated historic, cultural, or paleontological resource is discovered
Air Quality	• Obtain air permits and operate systems within permit limits, and monitor emissions as required
Nonradiological Health Impacts	• Implement site-wide Safety and Medical Program, including safety policies and safe work practices, as well as general and topic-specific training
Radiological Impacts of Normal Operation	
— Radiation Doses to Members of the Public	• Calculated doses for all exposure pathways less than guidelines established in 10 CFR 50, Appendix I, and regulatory limits set in 40 CFR 190 • Effluent discharges must comply with requirements specified in 10 CFR 20 • Comply with requirements and design to maintain dose ALARA • Implement an annual offsite Radiological Environmental Monitoring Program to evaluate potential exposures and doses to members of the public
— Impacts to Biota Other than Humans	• Calculated doses for biota other than humans within NCRP and IAEA guidelines • Implement an annual offsite Radiological Environmental Monitoring Program to evaluate potential exposures and doses to biota other than humans and the environment • Use of exposure guidelines, such as 40 CFR 190, that apply to members of the public in unrestricted areas, is considered very conservative when evaluating calculated doses to biota other than humans. The International Commission on Radiological Protection states that "… if man is adequately protected, then other living things are also likely to be sufficiently protected," and uses human protection to infer environmental protection from the effects of ionizing radiation

Table 5-32 (continued)

Resource Area	Specific Measures and Controls
— Occupational Radiation Doses	• Establish a monitoring program for workforce exposure • Based on the available PPE data, the maximum annual occupational dose at the PSEG Site is expected to be less than that from SGS (TEDE to workers 118 person-rem) and HCGS (TEDE to workers 191 person-rem). Impacts to workers from occupational radiation doses are SMALL and do not warrant additional mitigation • Comply with requirements and design to maintain dose ALARA
Accidents	
— Design Basis Accidents	• The calculated dose consequences of design basis accidents for a US-APWR, an AP1000, a U.S. EPR, or an ABWR at the PSEG Site were found to be within regulatory limits
— Severe Accidents	• The calculated probability-weighted consequences of severe accidents for the US-APWR, AP1000, U.S. EPR or ABWR designs at the PSEG Site were found to be lower than the probability-weighted consequences for current operating reactors and the Commission's safety goals
Nonradiological Waste Impacts	
— Nonradioactive Waste System Impacts	• Emissions to the atmosphere and discharges to surfaces waters in accordance with Federal, State, and local regulations • Solid wastes recycled to the extent possible with remaining wastes disposed of in approved landfills • Hazardous waste carefully monitored • Sanitary wastes from a new sewage treatment plant managed on the site and disposed of offsite in compliance with applicable laws, regulations, and permit conditions • Non-hazardous, non-radioactive waste generated and disposed of according to applicable local, State, and Federal regulations, including the Solid Waste Disposal Act, as amended, 42 USC 6901 et seq. • Discharges from the sediment retention pond monitored in accordance with SWPPP • Minor air emissions sources operated in accordance with applicable Federal, State, and local regulations
— Pollution Prevention and Waste Minimization	• Comply with current Waste Minimization Plan developed for existing SGS and HCGS to address hazardous waste management, treatment (decay in storage), work planning, waste tracking, and awareness training

Source: Adapted from Table 5.10-1 in the PSEG Environmental Report (PSEG 2014-TN3452).

5.13 Summary of Operational Impacts

The review team's evaluation of the environmental impacts of operations at a new nuclear power plant at the PSEG Site is summarized in Table 5-33. Impact category levels are denoted in the table as SMALL, MODERATE, or LARGE as a measure of their expected adverse impacts. Some impacts, such as the addition of tax revenue for the local economies, are likely to be beneficial and are noted as such in the Impact Level column.

Table 5-33. Summary of Operational Impacts for a New Nuclear Power Plant at the PSEG Site

Resource Area	Comments	Impact Category Level
Land-Use Impacts		
The Site and Vicinity	Land-use impacts of salt deposition from cooling tower operations would be minor and confined to the site. Operating a new nuclear power plant would be consistent with existing land uses at HCGS and SGS, local zoning and state land use planning, and New Jersey Rules on Coastal Zone Management. Operations would not affect prime farmlands or farmlands of unique or statewide importance, lands under DCRs, or WMAs.	SMALL
Offsite (the Proposed Causeway)	Land-use impacts of causeway maintenance would be minor and confined to the causeway. Use of the causeway during operations at a new nuclear power plant would be consistent with existing land uses at HCGS and SGS, local zoning (except for a small section in Elsinboro Township) and state land use planning, and New Jersey Rules on Coastal Zone Management. Use of the causeway would not affect prime farmlands or farmlands of unique or statewide importance, lands under DCRs, or WMAs.	SMALL
Water-Related Impacts		
—Water Use		
Surface Water	During operations, surface water withdrawals from the Delaware River could exceed PSEG's current storage allocation of water in the Merrill Creek reservoir. However, PSEG could (1) revise the consumptive use allocations of other plants it owns and supports through its allocation in Merrill Creek reservoir or (2) temporarily or permanently acquire additional storage from the existing rights of other Merrill Creek co-owners. Thus, additional surface water use for a new nuclear power plant could be met without a noticeable impact to the instream flow targets in the Delaware River.	SMALL
Groundwater	Groundwater would be used during operations for sanitary and potable water systems and for demineralized makeup water. The average withdrawal rate would be 210 gpm, with a maximum rate of 953 gpm. The expected combined withdrawal rate from a new nuclear power plant and the existing SGS and HCGS units is 589 gpm, well below the withdrawal rate used in groundwater modeling (875 gpm) that indicated only minimal saline intrusion and other impacts on aquifer quality. Thus, groundwater use for a new nuclear power plant would not cause salinity changes in the PRM aquifer system or impact offsite groundwater users.	SMALL

Table 5-33 (continued)

Resource Area	Comments	Impact Category Level
—Water Quality		
Surface Water	Based on CORMIX simulations, the largest discharge thermal plume from a new nuclear power plant would extend about 700 ft from the shoreline into the river, about 300 ft upstream, and about 500 ft downstream. This thermal discharge plume from a new nuclear power plant would be completely contained within the existing SGS HDA. Also, the combined excess temperature of the discharges from SGS, HCGS, and a new nuclear power plant would be less than the maximum SGS excess temperature. Thus, the impacts of thermal discharges from a new nuclear power plant would be minor. In the area just outside the existing HCGS HDA and just outside the area where the excess temperature of discharge from a new nuclear power plant would reach 1.5°F, water temperature in the Delaware River could frequently (more than half of the days) exceed 86°F when all units of SGS, HCGS, and the PSEG Site are operating. However, as indicated by CORMIX modeling, the thermal plume quickly mixes and dissipates in the river such that the plume areas are small. Also, DRBC and NJDEP would have the opportunity to designate an HDA for a new nuclear power plant at the PSEG Site and require discharge rules to protect the aquatic environment. Therefore, the combined discharges from SGS, HCGS, and a new nuclear power plant would not noticeably affect the Delaware River. Nonradioactive liquid effluents from a new nuclear power plant would be discharged to the Delaware River with the cooling water system blowdown. Potable and sanitary discharges are regulated under CWA through the NJPDES permit and the requirements of DRBC. Once discharged to the Delaware River, liquid wastes would quickly mix in the ambient flow and become diluted. Thus, discharge of nonradioactive liquid effluents to the Delaware River would not cause a noticeable impact on the water quality of the river.	SMALL

Table 5-33 (continued)

Resource Area	Comments	Impact Category Level
Groundwater	PSEG does not plan routine discharges to groundwater for a new nuclear power plant, but impacts could result from chemical or radiological spills that could migrate to shallow water (brackish) zones or saline intrusion to deep aquifers due to groundwater withdrawals. However, based on the natural system, site management practices, and regulatory oversight, the impacts of inadvertent chemical and radiological releases would be minor. Also, groundwater flow calculations would be revised once the final plant design is determined for a new nuclear power plant, including the type and design of any soil retention barrier that may or may not remain in place around the power block. Details would be evaluated in the combined license application stage of the application process.	SMALL
Ecological Impacts		
—Terrestrial Resources and Wetlands	Impacts to terrestrial and wetland wildlife and plant species, including important terrestrial and wetland species and habitat, would be minor. The bog turtle is a Federally listed threatened species with potential to be in the vicinity of the PSEG Site. The bog turtle also is State-listed as endangered by both New Jersey and Delaware. Additionally, one Federally-proposed endangered species, northern long-eared bat, also is known to occur in the vicinity of the PSEG Site. Additional State-listed species for New Jersey and/or Delaware in the vicinity of the PSEG Site include one salamander species and 20 bird species.	SMALL
—Aquatic Resources	Because the proposed intake structure for a new nuclear power plant would be located flush with the east shoreline of the Delaware River Estuary and would use a closed-cycle cooling system, a low through-screen intake velocity (less than 0.5 fps), and a fish screening system designed to increase the survival of impinged fish, entrainment and impingement impacts on aquatic resources are expected to have no more than minor impacts on the aquatic resources in the area. Thermal and chemical impacts on aquatic resources from the plant discharge would be controlled and minimized by compliance with the NJPDES permit that would be issued for the project. Other impacts from operational activities, such as maintenance dredging and causeway maintenance, also are expected to be minor.	SMALL

Table 5-33 (continued)

Resource Area	Comments	Impact Category Level
Socioeconomic Impacts		
Physical Impacts	The physical impacts of operations-related activities on workers and the local public, buildings, and transportation would be SMALL. However, the addition of new cooling towers and new reactor domes at the PSEG Site, as well as the proposed causeway that traverses the Estuary Enhancement Program (EEP) area, would noticeably affect the aesthetic qualities from viewpoints in New Castle and Salem Counties and would, therefore, have a MODERATE physical impact on aesthetic resources.	SMALL to MODERATE
Demography	The current and projected populations of the region are so large and the in-migrating population is so small that the in-migrating workers would represent less than 1 percent of the total population in any of the counties where these employees reside. Therefore, there would be no demographic impacts of operation on the remainder of the 50 mi region.	SMALL
—Social and Economic Impacts to Community		
Economy	Economic impacts throughout the region and economic impact area would be SMALL and beneficial.	SMALL (beneficial)
Taxes	Tax impacts would be SMALL and beneficial throughout the region and economic impact area, with the exceptions of MODERATE and beneficial corporate income payments to New Jersey and LARGE and beneficial property tax payments to Salem County.	SMALL (beneficial for the region), MODERATE (beneficial for the State of New Jersey), and LARGE (beneficial for Salem County)

Table 5-33 (continued)

Resource Area	Comments	Impact Category Level
—Infrastructure and Community Services		
Transportation	The impacts from traffic in the economic impact area would be minimal and localized for operations, including during outages when operations-related traffic would be greatest.	SMALL
Recreation	The impacts to recreational activities in the vicinity would be minimal, except for a noticeable, but not destabilizing, reduction in recreational enjoyment due to the aesthetic impact from structures on the site and the new causeway traversing the EEP.	MODERATE
Housing	There would be minimal impacts in the economic impact area and the region on the price and availability of housing from operations at the PSEG Site.	SMALL
Public Services	There would be minimal impact on the local water supply and on wastewater treatment facilities, as well as on police, fire, and health care services.	SMALL
Education	The impacts to schools in the economic impact area would be minimal.	SMALL
Environmental Justice	No potential environmental pathways were identified by which the minority or low-income populations in the 50-mi region and economic impact area would likely experience disproportionately high and adverse human health, environmental, physical, or socioeconomic effects as a result of operations activities.	none
Historic and Cultural Resources	There are 27 significant architectural resources within line of sight of the PSEG Site. However, operation of a new nuclear power plant would have only a minor impact on these resources because development of the site would be consistent with the visual character of the existing SGS and HCGS facilities. Consultation with the Native American tribes and the New Jersey and Delaware SHPOs is ongoing. Additionally, in the event that significant historic and cultural resources were encountered during operations, PSEG maintains procedure EN-AA-602-0006 for considering cultural resources during normal operations.	SMALL

Table 5-33 (continued)

Resource Area	Comments	Impact Category Level
Air Quality	The PSEG Site lies within an ozone nonattainment area (Salem County, New Jersey) and adjacent to a nonattainment area for $PM_{2.5}$, particulate matter with a mean aerodynamic diameter of less than or equal to 2.5 microns (New Castle County, Delaware). The impacts of operations at a new nuclear power plant in terms of emissions of criteria pollutants, greenhouse gas emissions, and cooling system emissions would be minor. Operations at a new nuclear power plant would increase gaseous and particulate emissions by a small amount, primarily from equipment associated with auxiliary systems and the cooling towers. The primary sources of emissions from auxiliary systems would be the auxiliary boilers, standby power units such as diesel generators or gas turbines, and engine driven emergency equipment. The cooling towers would be the primary source of particulate emissions. A new nuclear power plant at the PSEG Site would comply with all regulatory requirements of CAA, including requirements of the NJDEP Division of Air Quality and DNREC Division of Air Quality, thereby minimizing any impacts on state and regional air quality. Modifications to the SGS and HCGS Air Operating Permit under Title V of CAA from the NJDEP would be required for a new nuclear power plant, addressing emissions and compliance with State and Federal regulations.	SMALL
Nonradiological Health Impacts	Health impacts on the public and workers from operation of a new nuclear power plant, including exposure to etiologic microorganisms through cooling systems, noise generated by power plant operations, and transportation of operations and outage workers to and from the site, would be minimal. Health risks to workers would be dominated by occupational injuries and would likely occur at rates below the average U.S. industrial rates.	SMALL

Table 5-33 (continued)

Resource Area	Comments	Impact Category Level
Radiological Impacts		
Members of the Public	The staff evaluated the health impacts to members of the public from routine gaseous and liquid radiological effluent releases from a new nuclear power plant at the PSEG Site. Doses to members of the public would be below NRC and EPA standards, and there would be no observable health impacts (10 CFR 20-TN283; 10 CFR 50-TN249; 40 CFR 190-TN739).	SMALL
Plant Workers	The maximum annual occupational dose to onsite workers from a new nuclear power plant at the PSEG Site would be less than that from SGS and HCGS because the site design and application of technology would result in reduced occupational radiation exposure. Occupational doses to plant workers at the site would be below NRC standards and program to maintain doses ALARA would be implemented.	SMALL
Biota Other than Humans	Doses to biota other than humans would be well below NCRP and IAEA guidelines.[a]	SMALL
Nonradioactive Waste	Current PSEG practices and procedures would help minimize waste generation at a new nuclear power plant at the site. Solid, liquid, gaseous, and mixed wastes generated during the operation of a new nuclear power plant would be handled according to county, State, and Federal regulations.	SMALL

Table 5-33 (continued)

Resource Area	Comments	Impact Category Level
Postulated Accidents		
Design-Basis Accidents	Staff reviewed the PSEG design-basis accident (DBA) analysis and PSEG Site-specific data for the four different reactor technologies under consideration and found them to be appropriate and acceptable. The site-specific analysis results demonstrate that all US-APWR, AP1000, U.S. EPR, and ABWR accident doses meet the site acceptance criteria of 10 CFR 50.34 (10 CFR 50-TN249). All ABWR accident doses meet also the site acceptance criteria of 10 CFR 100 (10 CFR 100-TN282). The environmental consequences of DBAs at the PSEG Site would be of minor significance for any of the four reactor technologies considered.	SMALL
Severe Accidents	Staff reviewed the PSEG severe accident analysis and PSEG Site-specific data and conducted its own confirmatory analysis using the MACCS2 code. The environmental risks associated with severe accidents if a US-APWR, two AP1000 reactors, a U.S. EPR, or an ABWR were to be located at the PSEG Site would be small compared to risks associated with operation of the current-generation reactors at the PSEG Site and other sites. Probability-weighted consequences of severe accidents would be lower than the Commission’s safety goals and probability-weighted consequences for currently operating reactors.	SMALL

(a) The International Commission on Radiological Protection (ICRP) states that if humans are adequately protected, then other living things are also likely to be sufficiently protected (ICRP 1977-TN713; ICRP 1990-TN74).

NRC FORM 335 (12-2010) NRCMD 3.7 U.S. NUCLEAR REGULATORY COMMISSION **BIBLIOGRAPHIC DATA SHEET** *(See instructions on the reverse)*	1. REPORT NUMBER (Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.) NUREG-2168, Volumes 1, 2, and 3 DRAFT
2. TITLE AND SUBTITLE Environmental Impact Statement for an Early Site Permit (ESP) at the PSEG Site, Draft Report for Comment	3. DATE REPORT PUBLISHED MONTH: August YEAR: 2014 4. FIN OR GRANT NUMBER
5. AUTHOR(S) See Appendix A.	6. TYPE OF REPORT Technical 7. PERIOD COVERED (Inclusive Dates)

8. PERFORMING ORGANIZATION - NAME AND ADDRESS (If NRC, provide Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)

Division of New Reactor Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

9. SPONSORING ORGANIZATION - NAME AND ADDRESS (If NRC, type "Same as above", if contractor, provide NRC Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address.)

Same as above.

10. SUPPLEMENTARY NOTES

Docket No. 52-043

11. ABSTRACT (200 words or less)

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by PSEG Power, LLC, and PSEG Nuclear, LLC (PSEG), for an early site permit (ESP). The proposed action requested in the PSEG application is the NRC issuance of an ESP for the PSEG Site located adjacent to the existing Hope Creek and Salem Generating Stations.

This draft supplemental environmental impact statement includes the preliminary analysis that evaluates the environmental impacts of the proposed action and alternatives to the proposed action.

After considering the environmental aspects of the proposed NRC action, the NRC staff's preliminary recommendation to the Commission is that the ESP be issued as requested. This recommendation is based on (1) the application submitted by PSEG, including Revision 3 of the Environmental Report (ER), and the PSEG responses to requests for additional information from the NRC and USACE staffs; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the public scoping process; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)	13. AVAILABILITY STATEMENT: unlimited
PSEG ESP PSEG Site Draft Environmental Impact Statement, DEIS National Environmental Policy Act, NEP A NUREG-2168	14. SECURITY CLASSIFICATION *(This Page)* unclassified *(This Report)* unclassified 15. NUMBER OF PAGES 16. PRICE

Printed
on recycled
paper

Federal Recycling Program

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

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NUREG-2168, Vol. 1 Draft

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August 2014