Applicant's Environmental Report – Operating License Renewal Stage Hope Creek Generating Station

Unit 1
Docket No. 50-354
License No. NPF-57

PSEG Nuclear, LLC

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Acronyms and Abbreviations

AADT	Annual Average Daily Traffic
AEC	[U.S.] Atomic Energy Commission
AEI	Adverse Environmental Impact [analysis]
AIT	alternative intake technologies
AQCR	Air Quality Control Region
bgs	below ground surface
BNE	NJDEP Bureau of Nuclear Engineering
BOD	biochemical oxygen demand
BTA	best technology available
Btu	British thermal unit
BWR	boiling water reactor
°C	degrees Celsius
CAIR	Clean Air Interstate Rule
CDS	Comprehensive Demonstration Study
CEEEP	Center for Energy, Economic & Environmental Policy
CEQ	Council on Environmental Quality
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
cm	centimeter
CO	carbon monoxide
CPUE	catch per unit effort
CST	condensate storage tank
CVCS	Chemical and Volume Control System
CWA	Clean Water Act
CWS	Circulating Water System
DAW	Dry Active Waste
DNREC	Delaware Department of Natural Resources and Environmental Control
DRBC	Delaware River Basin Commission
DSM	demand side management
EPA	[U.S.] Environmental Protection Agency
ESA	Endangered Species Act
°F	degrees Fahrenheit
FES	Final Environmental Statement
FHB	Fuel Handling Building
fps	feet per second
ft	feet
ft^2	square feet
ft^3	cubic feet

Acronyms and Abbreviations (Continued)

ft^3/sec	cubic feet per second
gal	gallon
GEIS	Generic Environmental Impact Statement [for License Renewal of Nuclear Plants]
gpd	gallons per day
gpm	gallons per minute
GWh	gigawatt-hours
GWS	Gaseous Waste System
HCGS	Hope Creek Generating Station
HEPA	high efficiency particulate air
in	inch(es)
IPA	integrated plant assessment
IPE	individual plant examination
ISFSI	Independent Spent Fuel Storage Installation
ITS	Incidental Take Statement
km	kilometers
km^2	square kilometers
kV	kilovolt
kWh	kilowatt hour
lb	pound
LLC	Limited Liability Company
LLRSF	Low Level Radioactive [Waste] Storage Facility
LOS	level of service
LWMS	Liquid Waste Management System
m	meter
m^2	square meter
m^3	cubic meter
MACCS2	MECOR Accident Consequence Code System Version 2
MGD	million gallons per day
mi	mile
MOU	memorandum of understanding
msl	mean sea level
MUA	Municipal Utilities Authority
MWe	Megawatts - electric
MWt	megawatts - thermal
NA	not applicable, not available, or not analyzed
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code

Acronyms and Abbreviations (Continued)

NJBPU	New Jersey Board of Public Utilities
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen
NRC	[U.S.] Nuclear Regulatory Commission
NRLWDS	Non-Radioactive Liquid Waste Disposal System
OTEC	Ocean Thermal Energy Conversion
OWS	oil-water separator
pcb	polychlorinated biphenyls
pCi/l	pico-curies per liter
PHI	Pepco Holdings, Inc.
PJM	PJM Interconnection, LLC
$PM_{2.5}$	particulates with diameters less than 2.5 microns
PM_{10}	particulates with diameters less than 10 microns
ppt	parts per thousand
PRA	Probabilistic Risk Assessment
PRM	Potomac-Raritan-Magothy
PSA	Probabilistic Safety Assessment
PSEG	PSEG Nuclear, LLC, Public Service Electric and Gas (the operating company predecessor for PSEG Nuclear, LLC), Public Service Enterprise Group
PSE&G	Public Service Electric and Gas (the existing electricity transmission and distribution company)
psig	pounds per square inch gauge
PW	production well
PWR	pressurized water reactor
RCS	Reactor Coolant System
RGGI	Regional Greenhouse Gas Initiative
RGPP	Regional Groundwater Protection Program
RLWS	Radioactive Liquid Waste System
RM	river mile
ROI	region of interest
RPS	Renewable Portfolio Standards
Salem	Salem Nuclear Generating Station
SAMA	Severe Accident Mitigation Alternatives
SAR	Safety Analysis Report
sec	second

Acronyms and Abbreviations (Continued)

scfm	standard cubic feet per minute
SCR	selective catalytic reduction
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SMITTR	surveillance, monitoring, inspections, testing, trending, and recordkeeping
SO_2	sulfur dioxide
SO_X	oxides of sulfur
SWIS	Service Water Intake Structure
SWS	Service Water System
TLD	Thermoluminescent dosimeter
TSP	total suspended particulates
USCB	U.S. Census Bureau
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Conversion Factors

This table is derived from Thompson, A. and B. N. Taylor 2008. Guide for the Use of the International System of Units. NIST Special Publication 811, 2008 Edition. Gaithersburg, MD, US Department of Commerce, National Institute of Standards and Technology. Retrieved February 12, 2008, from http://physics.nist.gov/cuu/pdf/sp811.pdf.

To convert from	to	Multiply by
Area		
acre	hectare	4.047 E-01
square mile (mi^2)	kilometer (km^2)	2.589 E+00
Flow		
cubic foot per second (ft^3/sec)	cubic meter per second (m^3/sec)	2.831 E-02
Length		
foot (ft)	meter (m)	3.048 E-01
inch (in)	meter (m)	2.54 E-02
inch (in)	centimeter (cm)	2.54 E+00
mile (mi)	kilometer (km)	1.609 E+00
Mass		
pound	kilogram	4.535 E-01
ton (short ton)	metric ton	9.072 E-01
Temperature Interval		
°F (interval)	°C (interval)	5.55 E-01
Volume		
gallon (gal)	liter (l)	3.785 E+00
To convert from	**to**	**Use this formula**
degrees Fahrenheit (°F)	degrees Celsius (°C)	t°C = (t°F - 32°) / 1.8

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Chapter 1

Introduction

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1.1 Purpose Of and Need For Action

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants in accordance with the Atomic Energy Act of 1954, as amended, and NRC implementing regulations. PSEG Nuclear, LLC (PSEG) operates the Hope Creek Generating Station (HCGS) pursuant to NRC Operating License NPF-57. The license will expire on April 11, 2026.

PSEG Nuclear, LLC, is seeking license renewal of the HCGS operating license and has prepared this Environmental Report in conjunction with its application to NRC to renew the HCGS operating license, as provided by the following NRC regulations:

> Title 10, Energy, Code of Federal Regulations (CFR), Part 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants, Section 54.23, Contents of Application-Environmental Information (10 CFR 54.23) and

> Title 10, Energy, CFR, Part 51, Environmental Protection Requirements for Domestic Licensing and Related Regulatory Functions, Section 51.53, Postconstruction Environmental Reports, Subsection 51.53(c), Operating License Renewal Stage [10 CFR 51.53(c)].

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

> "...The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decision makers." (NRC 1996a)

The renewed operating license would allow HCGS to operate until April 11, 2046, an additional 20 years of operation beyond the current licensed operating period of 40 years.

1.2 Environmental Report Scope and Methodology

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

- Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS), as supplemented (NRC 1996b and 1999a);
- NRC supplemental information published in the Federal Register (NRC 1996a, 1996c, 1996d, and 1999b);
- Regulatory Analysis for Amendments to Regulations for the Environmental Review for Renewal of Nuclear Power Plant Operating Licenses (NRC 1996e);
- Public Comments on the Proposed 10 CFR Part 51 Rule for Renewal of Nuclear Power Plant Operating Licenses and Supporting Documents: Review of Concerns and NRC Staff Response (NRC 1996f); and
- Supplement 1 to Regulatory Guide 4.2, Preparation of Supplemental Environmental Report for Applications to Renew Nuclear Power Plant Operating Licenses (NRC 2000).

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

Table 1.2-1 Environmental Report Responses to License Renewal Environmental Regulatory Requirements

Regulatory Requirement	Responsive Environmental Report Section(s)	
10 CFR 51.53(c)(1)		Entire Document
10 CFR 51.53(c)(2), Sentences 1 and 2	3.0	Proposed Action
10 CFR 51.53(c)(2), Sentence 3	7.2.2	Environmental Impacts of Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(1)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(2)	6.3	Unavoidable Adverse Impacts
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(3)	7.0	Alternatives to the Proposed Action
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(3)	8.0	Comparison of Environmental Impacts of License Renewal with the Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(4)	6.5	Short-Term Use Versus Long-Term Productivity of the Environment
10 CFR 51.53(c)(2) and 10 CFR 51.45(b)(5)	6.4	Irreversible and Irretrievable Resource Commitments
10 CFR 51.53(c)(2) and 10 CFR 51.45(c)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
10 CFR 51.53(c)(2) and 10 CFR 51.45(c)	6.2	Mitigation
	7.2.2	Environmental Impacts of Alternatives
	8.0	Comparison of Environmental Impacts of License Renewal with the Alternatives
10 CFR 51.53(c)(2) and 10 CFR 51.45(d)	9.0	Status of Compliance
10 CFR 51.53(c)(2) and 10 CFR 51.45(e)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
10 CFR 51.53(c)(3)(ii)(A)	4.1	Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a Small River with Low Flow)
10 CFR 51.53(c)(3)(ii)(B)	4.2	Entrainment of Fish and Shellfish in Early Life Stages
10 CFR 51.53(c)(3)(ii)(B)	4.3	Impingement of Fish and Shellfish
10 CFR 51.53(c)(3)(ii)(B)	4.4	Heat Shock
10 CFR 51.53(c)(3)(ii)(C)	4.5	Ground-Water Use Conflicts (Plants Using >100 gpm of Ground Water)
10 CFR 51.53(c)(3)(ii)(C)	4.7	Ground-Water Use Conflicts (Plants Using Ranney Wells)
10 CFR 51.53(c)(3)(ii)(D)	4.8	Degradation of Ground-Water Quality
10 CFR 51.53(c)(3)(ii)(E)	4.9	Impacts of Refurbishment on Terrestrial Resources
	4.10	Threatened or Endangered Species
10 CFR 51.53(c)(3)(ii)(F)	4.11	Air Quality During Refurbishment (Non-Attainment or Maintenance Areas)

Table 1.2-1 Environmental Report Responses to License Renewal Environmental Regulatory Requirements (Continued)

Regulatory Requirement	Responsive Environmental Report Section(s)	
10 CFR 51.53(c)(3)(ii)(G)	4.12	Microbiological Organisms
10 CFR 51.53(c)(3)(ii)(H)	4.13	Electric Shock from Transmission-Line-Induced Currents
10 CFR 51.53(c)(3)(ii)(I)	4.14	Housing Impacts
10 CFR 51.53(c)(3)(ii)(I)	4.15	Public Water Supply
10 CFR 51.53(c)(3)(ii)(I)	4.16	Education Impacts from Refurbishment
10 CFR 51.53(c)(3)(ii)(I)	4.17	Offsite Land Use
10 CFR 51.53(c)(3)(ii)(J)	4.18	Transportation
10 CFR 51.53(c)(3)(ii)(K)	4.19	Historic and Archaeological Resources
10 CFR 51.53(c)(3)(ii)(L)	4.20	Severe Accident Mitigation Alternatives (SAMA)
10 CFR 51.53(c)(3)(iii)	4.0	Environmental Consequences of the Proposed Action and Mitigating Actions
10 CFR 51.53(c)(3)(iii)	6.2	Mitigation
10 CFR 51.53(c)(3)(iv)	5.0	Assessment of New and Significant Information
10 CFR 51, Appendix B, Table B-1, Footnote 6	2.6.2	Minority and Low-Income Populations

1.3 Hope Creek Generating Station Licensee and Ownership

HCGS is owned by PSEG Nuclear, LLC, which is a division of PSEG Power, LLC, the independent power production and energy marketing division of Public Service Enterprise Group, a corporation formed under the laws of the State of New Jersey in 1985 and headquartered in Newark, New Jersey.

In 2000, PSEG Nuclear, LLC obtained the nuclear generation assets from Public Service Electric and Gas (PSE&G), the operating predecessor to PSEG Nuclear, LLC, as required by the Electric Discount and Energy Competition Act and implementing New Jersey Board of Public Utilities orders. PSEG Nuclear, LLC holds the HCGS license and is applying to renew that license.

Reference documents identified in this Environmental Report as being authored by PSE&G (the operating predecessor company for PSEG Nuclear), Public Service Enterprise Group, or PSEG Nuclear, were developed during the different ownership periods of the generating station. Within this Environmental Report, these company designations may be interchangeably referred to as "PSEG."

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Chapter 2

Site and Environmental Interfaces

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2.1 Location and Features

HCGS is at the southern end of Artificial Island in Lower Alloways Creek Township, Salem County, New Jersey. The Delaware River is about 4 kilometers (km; 2.5 miles [mi]) wide at this location. HCGS is located at River Mile 51, 27 km (17 mi) south of the Delaware Memorial Bridge. Philadelphia is about 64 km (40 mi) northeast and the city of Salem, New Jersey, is 13 km (8 mi) northeast of the site (AEC 1973). The area adjacent to HCGS is in the Delaware River's Estuary Transition Zone, as defined by the U. S. Environmental Protection Agency's (EPA) Delaware Estuary Program Scientific and Technical Advisory Committee and the Delaware River Basin Commission Zone 5 (PSEG 2006a, Section 4). Figures 2.1-1 and 2.1-2 are the 80-km (50-mi) and 10-km (6-mi) vicinity maps, respectively.

Artificial Island is a 607 hectare (1,500 acre) island that was created, beginning early in the twentieth century, when the U.S. Army Corps of Engineers began disposing of hydraulic dredge spoils within a progressively enlarged diked area established around a natural bar that projected into the river. Habitats on the low and flat 607-hectare (1,500-acre) island, which has an average elevation of about 2.7 meters (m; 9 feet [ft]) above mean sea level (msl) and a maximum elevation of about 5.5 m (18 ft) above msl, can best be characterized as tidal marsh and grassland. (AEC 1973)

HCGS occupies about 62 hectares (153 acres) of approximately 300 hectares (740 acres)[1] owned by PSEG on Artificial Island. The Salem Nuclear Generating Station (Salem) is also located within the 300-hectare (740-acre) parcel owned by PSEG.[2] The remainder of Artificial Island is undeveloped. The northern portion of Artificial Island and a 1.6-km-wide (1-mi-wide) inland strip of land abutting the island are owned by the U.S. Government (AEC 1973). The State of New Jersey owns the remainder of Artificial Island as well as much nearby inland property. The northernmost tip of Artificial Island, which the U. S., Government owns, is within the State of Delaware boundary, which was established based on historical land grants related to the tide line at that time. Distance to the HCGS site boundary from the HCGS reactor building is 902 meters (2,960 ft). The nearest residence is approximately 5.5 km (3.4 mi) west of the HCGS site in Bay View Beach, Delaware. Other nearby residences are 5.6 km (3.5 mi) east-northeast and 5.6 km (3.5 mi) northwest of the HCGS site. The population center distance (defined in 10 CFR 100 ["Reactor Site Criteria"] as the distance from the reactor to the nearest boundary of a densely populated center with 25,000 residents or more) is 25 km (15.5 mi). The area within 24 km (15 mi) of the site is primarily utilized for agriculture. Heavy industry exists more than 24 km (15 mi) north of the site (PSEG 2009c).

There are no major highways or railroads within about 11 km (7 mi) of the HCGS site; the only land access is a road that PSEG constructed to connect its property with an existing secondary road about 5 km (3 mi) to the east. Barge traffic has access to the site by way of the Intracoastal Waterway channel maintained in the Delaware River. (AEC 1973)

Section 3.1 describes key features of HCGS, including the reactor and containment systems, cooling water system, waste management systems, and transmission system.

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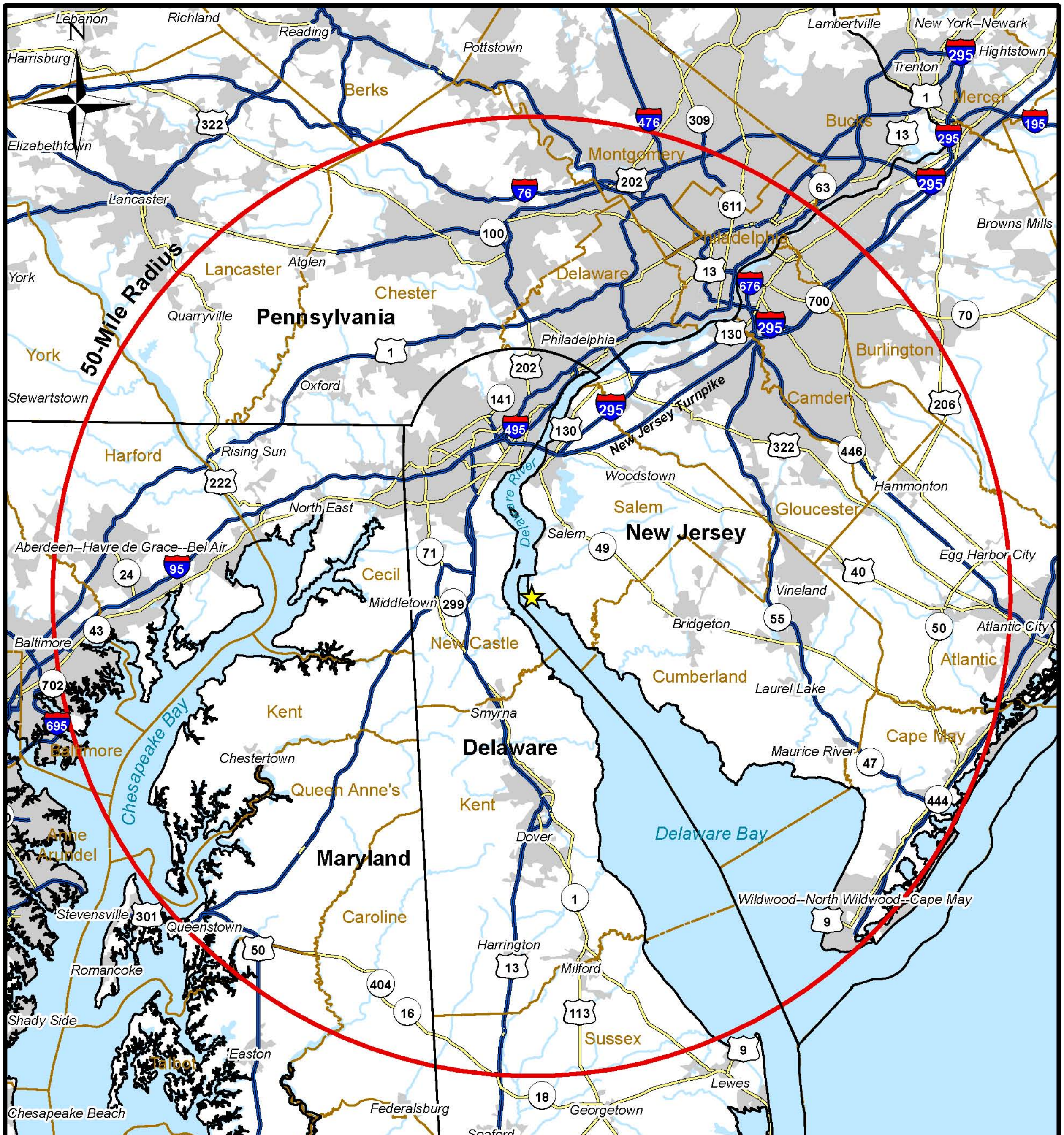
1 Throughout this report, the acreage of the PSEG-owned property on Artificial Island is reported as approximately 740 acres, which is consistent with the documentation for the original property conveyance. However, a recent survey indicates the PSEG-owned property size as 734 acres. The acreage change is likely the result of using improved technology that more accurately measures the boundaries of irregular surfaces in difficult physical environments, such as the riparian environment along the eastern boundary of the PSEG-owned property on Artificial Island. For the original conveyance, the meandering boundary line would have been approximated using straight lines.

2 This Environmental Report is specific to HCGS and includes all the information necessary for the NRC to prepare a Supplemental Environmental Impact Statement for HCGS. PSEG has prepared a second Environmental Report that is specific to Salem.

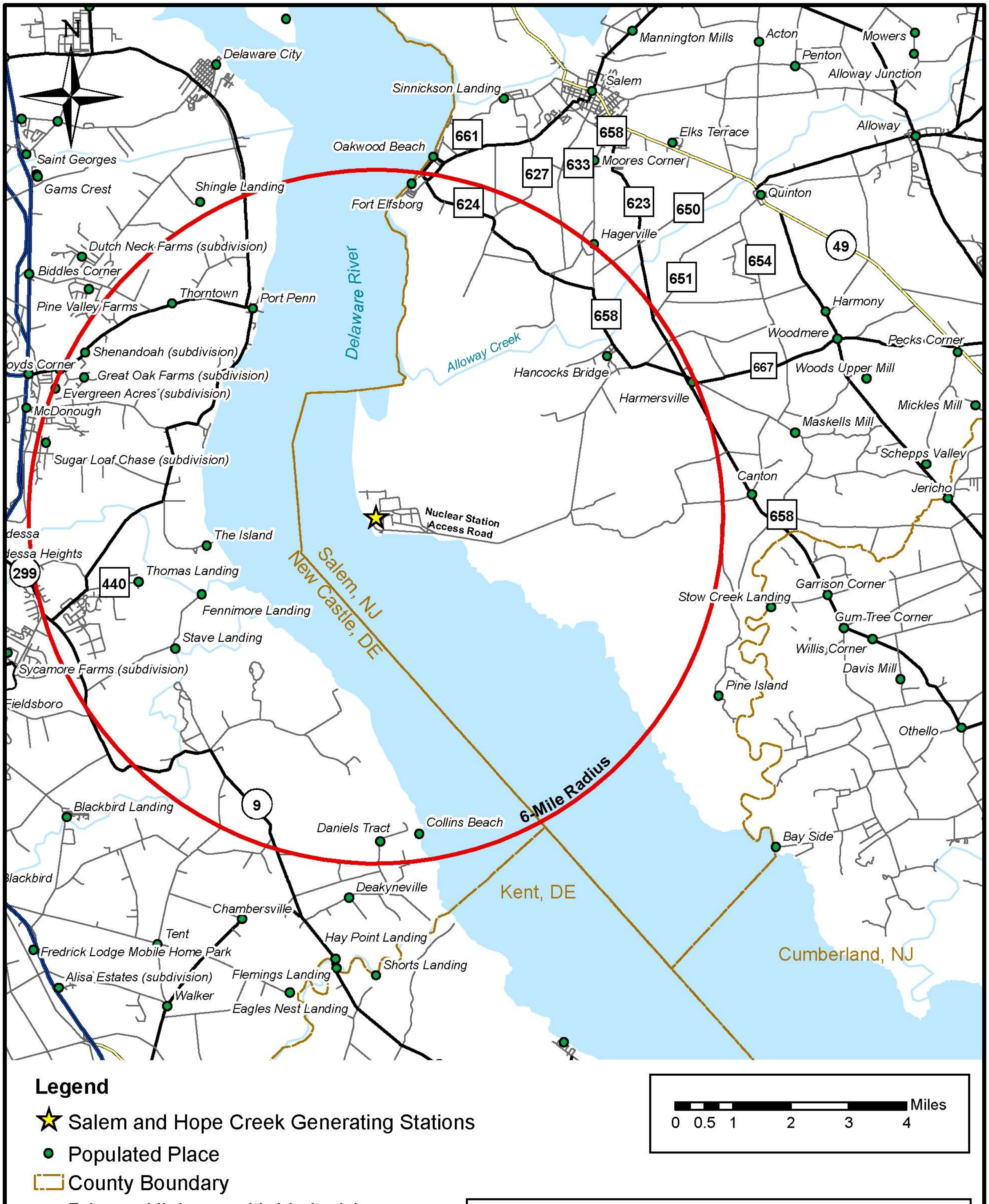


Legend

☆ Salem and Hope Creek Generating Stations
State Boundary
County Boundary
Primary Highway with Limited Access
Primary Highway
Urban Area
Water

Miles
0 5 10 20 30

Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 2.1-1 50-Mile Region



Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 2.1-2 6-Mile Vicinity

2.2 Aquatic Resources

The Delaware River rises on the western slope of the Catskill Mountains in south-central New York and flows south approximately 595 km (370 mi) to Liston Point, where it enters Delaware Bay (PSEG 1984). Delaware Bay extends another 80 km (50 mi) to the Atlantic Ocean. The Delaware River watershed encompasses parts of New York, Pennsylvania, Delaware, and New Jersey and drains an area of approximately 35,050 square kilometers (km^2) (13,533 square miles [mi^2]) (PSEG 2006a, Section 4). Major tributaries include the Lehigh River, which joins the Delaware at Easton, Pennsylvania, and the Schuylkill River, which joins the Delaware at Philadelphia. The Delaware River has a total volume of about 450 billion ft^3 (PSEG 2006a, Section 4).

Near Trenton, New Jersey, the Delaware River crosses the Fall Line, the narrow zone that separates the rocky Piedmont physiographic region from the sandy Coastal Plain. At the Fall Line, the river descends through rapids ("falls") and then flows into the Delaware Estuary, which is defined as the tidally influenced portion of the Delaware River between Trenton, New Jersey, and the mouth of Delaware Bay, a distance of approximately 214 km (133 mi) (PSEG 2006a; Section 4).

The Delaware Estuary ranges in width from 0.3 km to 43 km (0.2 mi to 27 mi), and has a surface area of more than 2,590 km^2 (1,000 mi^2) (PSEG 2006a, Section 4). The Estuary has a mean depth of 5.8 m (19 ft) with a maximum depth of nearly 45 m (148 ft) in Delaware Bay. The surface area of the main stem of the Estuary is about 1878 km^2 (725 mi^2), with tidal creeks adding about another 85 km^2 (33 mi^2). Approximately 798 km^2 (308 mi^2) of tidal marshes surround the Estuary, playing an important role in water and nutrient exchange and influencing its water chemistry and biological communities (PSEG 1984). HCGS is located adjacent to the Delaware Estuary. However, the documents referenced in this Environmental Report refer inconsistently to the water body adjacent to HCGS as either "the river" or "the estuary." Because the affected water body is an estuary, this Environmental Report refers to it as "the Estuary" or "the Delaware Estuary." An estuary is the tidally influenced interface between fresh water and salt water. As such, it supports a variety of habitats, and species common to both fresh water and marine environments.

The fresh-water flow into the Delaware Estuary averages 645 m^3 per second (cubic meter [m^3]/sec; 22,783 ft^3/sec), approximately half of which is contributed by the Delaware River at Trenton (PSEG 1984). The balance of the flow is contributed by the Schuylkill River and all other tributaries below Trenton. By contrast, tidal flow (or "flux") near the site (at River Km 80 [River Mile 50]) has been estimated to be 11,324 m^3/sec (400,000 ft^3/sec), which equates to 3.6 x 10^{11} m^3/year (1.3 x 1013 ft^3/year) (PSEG 1984). As a consequence, current speed and direction throughout the Estuary are determined primarily by tides. However, circulation patterns in the Delaware Estuary are influenced by river discharge. In general, as Delaware River discharge increases, there is a tendency for the Estuary to shift from well-mixed or partially mixed to a stratified or two-layered circulation pattern in which less-dense fresh (river) water overlies more-dense sea water, creating a salt wedge.

The Delaware River, Estuary, and Bay system is a continuum of environments: freshwater, tidal fresh water, tidal brackish water, and marine. Salinity in the Delaware River, Estuary, and Bay varies from fresh water at Trenton to typical ocean water concentrations of about 34 parts per thousand on the continental shelf off the mouth of the Bay. Variables such as freshwater discharge, tidal phase, basin morphology, and meteorological conditions affect salinity. In the vicinity of HCGS, salinity ranges seasonally from about 0.5 to 20 parts per thousand (PSEG 2007a).

Water circulation within the Delaware Estuary affects the occurrence, distribution, and abundance of organisms both directly (as a result of net water transport, turbulent mixing, and exchange of water among the system's components) and indirectly (as a result of its influence on biologically important water quality parameters such as salinity, temperature, dissolved oxygen, and turbidity). Tidal circulation, fresh-water discharge from the drainage basin and upstream impoundments, wind-induced flushing, and salinity-induced density gradients are major forces that influence the water circulation patterns in the system and result in its highly dynamic physical and chemical environment (PSEG 2007a).

The distribution and abundance of aquatic organisms in the Delaware River, Estuary, and Bay system is determined primarily by salinity, but is also influenced by other water quality parameters, especially temperature and dissolved oxygen. Salinity gradients move up and down the Estuary in response to changes in fresh-water inflow, which varies twice daily with tides and seasonally and annually with precipitation in the watershed. Water temperatures likewise vary seasonally, but changes are moderated by the large volume of ocean water entering the Bay with each tidal cycle, and river inflow. The buffering effect of the ocean water is most noticeable in the lower Bay and least noticeable in the upper Bay. The waters of the Delaware Estuary are generally well-oxygenated, with dissolved oxygen levels varying inversely with temperature. (PSEG 1984)

The major contributions to the food base of the Delaware Estuary are detritus from marsh plant production, material washed in from the tributaries, and phytoplankton production in the middle and lower bay. The area of the Estuary in the vicinity of Salem and HCGS supports very low levels of phytoplanktonic photosynthesis because high sediment loads and associated turbidity limit light penetration. Also, there are low concentrations of immature planktonic stages of commercially important shellfish, no commercially important species of zooplankton, and no threatened or endangered species of zooplankton. (PSEG 1999a, Appendix E)

The value of the Delaware River ecosystem, and its need to be protected, has been recognized for more than 40 years. In 1961, President John F. Kennedy, representing the United States, and the governors of New Jersey, New York, Pennsylvania, and Delaware signed the Delaware River Basin Compact which created the Delaware River Basin Commission. The Commission is responsible for administering a comprehensive multipurpose plan to provide effective flood control; conserve and develop ground and surface water supplies; develop recreational facilities; propagate fish and wildlife; promote related forestry, soil conservation, and watershed projects; protect and aid fisheries dependent upon the water resources; develop hydroelectric potential; improve navigation; control the movement of salt-water; control stream pollution; and regulate stream flow (DRBC 1961).

2.2.1 PSEG BIOLOGICAL MONITORING PROGRAM

HCGS is located adjacent to Salem. The aquatic resources in the Delaware Estuary at HCGS are the same as those at Salem. PSEG has conducted biological monitoring of the Delaware Estuary since 1968. In fulfillment of requirements of the 1994 and 2001 New Jersey Pollutant Discharge Elimination System (NJPDES) permits for Salem, PSEG developed and implemented an extensive biological monitoring program for the Delaware Estuary, which is described in the Salem license renewal Environmental Report, along with a summary of some recent results

(PSEG 2009a). The information and analyses of the aquatic community in the Delaware Estuary are also relevant to HCGS.

Trawl surveys have been conducted from the mouth of the Bay to the upper Estuary at Trenton (referred to as “bay wide” in some reports) using both bottom trawls and pelagic trawls. In addition, ichthyoplankton was collected for several years. Sampling began in 1968 for the then-planned Salem Nuclear Generating Station and has been conducted continuously since that time. PSEG has changed the program scope or gear deployment as the survey purposes changed in response to evolving regulatory requirements.

The PSEG bay-wide monitoring area was initially divided into eight sampling zones, and six additional freshwater zones were added later (Figure 2.2-1): Zones 1, 2, and 3 (lower Bay) are near the mouth of the Bay. Zones 4, 5, and 6 are located in the middle Bay. Zones 7 and 8 (upper Bay) are in the lower Delaware River. Zones 9 through 14 are in the fresh-water portion of the Estuary, extending to the falls at Trenton. These sampling zones, the EPA’s Delaware Estuary Program zones, the Delaware River Basin Commission (DRBC) zones, and the New Jersey Surface Water Quality Standards zones are independent of each other. As a point of reference when reviewing the various reports on the Delaware River, Estuary, and Bay system, the EPA’s Delaware Estuary Program locates HCGS in its Estuary Transition Zone, the New Jersey beach seine sampling program locates HCGS in Region 1, the DRBC water quality zone is 5, and the PSEG monitoring program locates HCGS in its Zone 7.

Primarily two data sources have been used to describe the fishery in the vicinity of HCGS. The NJPDES renewal application for Salem that PSEG submitted in 2006 (PSEG 2006a) includes the Comprehensive Demonstration Study (CDS; Section 4) and Adverse Environmental Impact (AEI) analysis (Section 5). These studies summarize data from a recent (2002-2004) three-year period of intensive sampling on distribution and abundance of fish in the vicinity of the Station. The CDS discussion is focused on Zone 7, an approximately ten-mile-long reach of the Estuary (Figure 2.2-1) that includes the Station. Each year PSEG produces an annual report of sampling results. The 2007 report is most frequently referenced here because it provides the most recent snapshot. However, annual reports have been produced since 1995, and taken together, the data indicate a typical fishery with some species common every year, and some species common to uncommon in different years. Fish were sampled using a variety of gear types (otter [bottom] trawl, pelagic frame trawl, plankton net, and beach seine) to ensure that a range of habitats and life stages were adequately characterized. The 1999 Salem NJPDES renewal application also contains extensive analyses and data compilations (PSEG 1999a).

Recent monitoring has focused on the following target species: blue crabs (*Callinectes sapidus*), blueback herring (*Alosa aestivalis*), alewife (*A. pseudoharengus*), American shad (*A. sapidissima*), bay anchovy (*Anchoa mitchilli*), white perch (*Morone americana*), striped bass (*M. saxatilis*), weakfish (*Cynoscion regalis*), spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulates*), Atlantic menhaden (*Brevoortia tyrannus*), Atlantic silverside (*Menidia menidia*), and bluefish (*Pomatomus saltatrix*).

2.2.1.1 Bottom Trawl Sampling

PSEG has conducted a daytime bottom trawl program since 1968. During each year of sampling, samples were collected beginning in the spring and ending in the fall. Sampling protocols have changed over the years. For example, until 1978 the tows were taken with a fixed-length towline. Since 1979, the trawls have been collected with a variable-length towline. In 1995, the direction of the trawl changed from towing with the current to towing into the current. Since 1995, daytime bottom trawls have been conducted monthly from April through November at randomly selected stations within the monitoring area, which extends from the mouth of the Delaware Bay (River Mile 0) to just north of the Delaware Memorial Bridge (River Mile 70).

Data collected from bottom trawl studies included the number of specimens per finfish species, individual lengths, and sex. All blue crabs were enumerated. Other data collected included tide, air and water temperature, salinity, dissolved oxygen, pH, secchi depth (visibility), and water depth.

Three species dominated bottom trawl collections from Zone 7 over the 2002-2004 period: Atlantic croaker, hogchoker (*Trinectes maculatus*), a non-target species, and white perch (PSEG 2006a, Section 4). These three species made up 81 to 88 percent, per annum, of all fish in bottom trawl samples and were present in relatively high numbers in all three years. In 2002, 69.7 percent of fish collected in Zone 7 bottom trawl samples were Atlantic croaker; with hogchoker and bay anchovy making up 13.1 and 5.7 percent, respectively, of fish collected. In 2003, hogchoker (35.7 percent), Atlantic croaker (30.7 percent), and white perch (17.0 percent) were first, second, and third in abundance in samples. In 2004, Atlantic croaker again dominated Zone 7 bottom trawl collections (47.2 percent of fish collected), with hogchoker (24.4 percent), white perch (2 percent), and weakfish (14.7 percent) also appearing frequently in samples.

Abundance of other fish species was more variable. Weakfish, for example, were uncommon in bottom trawl samples in 2002 and 2003, but were third in abundance in 2004, when 826 weakfish were collected (nearly 15 percent of the total). Striped bass, on the other hand, were uncommon in 2002 and 2004, but ranked fourth in the number of fish captured (123 total; 6.2 percent) in bottom trawls in 2003. Bay anchovy made up six percent of fish in bottom trawl collections in 2002, but were relatively uncommon in 2003 and 2004 (less than one percent in each year).

In the 2007 bay wide bottom trawl survey, 29,966 finfish from 55 species and 2,354 blue crabs were collected in 320 trawl samples. Approximately 78 percent (23,243 individuals) of the total finfish catch comprised the target species. Atlantic croaker (38 percent) and bay anchovy (24 percent) dominated the total catch. The remaining ten target finfish species collectively represented 15.5 percent of the total finfish catch. No Atlantic silverside was caught (PSEG 2007a).

Since 1995, the Atlantic croaker has generally been the dominant or co-dominant species in bottom trawl catches, representing more than 20 percent, of the catch during each year since 2001 (PSEG 2001, 2002, 2003, 2004a, 2005, 2006b, 2007a). Atlantic croaker comprised 71 percent of the catch in 2002, 47 percent in 2004 (PSEG 2006a), and 38 percent in 2007 (PSEG 2007a). Approximately eight percent of the total Atlantic croaker catch was from Zone 7 during the most recent sampling year (PSEG 2007a). No other finfish species routinely comprises more than ten percent of the annual bay wide bottom trawl samples, although occasional high abundances have been reported. Some examples include white perch in 2003 (20 percent; PSEG 2003), weakfish in 1997 (17 percent; PSEG 1997), and hogchoker in 2000 (28 percent; PSEG 2000). In 2007, the most abundant fish caught in the area of the estuary nearest HCGS was the hogchoker (32 percent of total catch); Atlantic croaker (30 percent) was second most abundant (PSEG 2007a).

In Zone 7, catch per unit effort (CPUE) was reported by species since 2002. During those years, CPUE for Atlantic croaker showed high variability, ranging from 100.28 (in 2002) to 18.94 (in 2003). Variability was also high for other finfish (PSEG 2002, 2003, 2004a, 2005, 2006b, 2007a).

2.2.1.2 Pelagic Trawl Sampling

Pelagic trawl sampling provides data on the relative abundance of juvenile organisms. PSEG conducted a pelagic trawl sampling program from 1979 through 1982, from 1988 through 1998, and then from 2002 through 2004. As was the case with the bottom trawls, sampling protocols changed during the course of the monitoring program.

From 2002 to 2004, pelagic trawls were conducted throughout the monitoring area at randomly selected stations in Zones 1 through 8, in the same manner as for bottom trawls. In addition, Zones 9 through 14 were established up-river in the Delaware Estuary. During the 2004 pelagic trawl effort, 191,672 finfish from 46 species and 277 blue crabs were collected (PSEG 2004a). In 2004, in Zone 7, the month with the highest mean density (341.8 organisms per 1000 m^3) was October.

More than 90 percent of fish collected annually in Zone 7 pelagic trawls in 2002, 2003, and 2004 were bay anchovy and Atlantic croaker (PSEG 2006a, Section 4). Approximately 99 percent of the total finfish catch during 2004 was of target species. Bay anchovy (88 percent) and Atlantic croaker (ten percent) dominated the total catch. Catches in 2002 and 2003 were consistent with the 2004 relative abundance (PSEG 2002, 2003). Weakfish and Atlantic menhaden appeared less consistently in pelagic trawl samples, but were relatively abundant in at least one year of the three. Weakfish, for example, were uncommon in pelagic trawl samples in 2002 and 2004, but were the species third most often collected in 2003 (433 fish; 5.3 percent of total). Atlantic menhaden were third in abundance in 2002 (346 fish; 4.4 percent of total), but were collected in very small numbers in 2003 and 2004, less than one percent of the total in each year.

The total abundance of target finfish species in the lower zones (1 through 6, downstream of HCGS) was similar for 2002, 2003, and 2004, with bay anchovy, Atlantic menhaden, and weakfish dominating the catches in all three years. In the fresh water sampling zones (7 through 14, near to and upstream of HCGS), the total abundance of target finfish species differed in 2003. White perch was dominant in 2002 and 2004. However in 2003, the clupeid group (unidentifiable clupeids, alewives, and American shad) was more dominant in the upper zones (PSEG 2003).

2.2.1.3 Ichthyoplankton Sampling

PSEG conducted ichthyoplankton sampling from 1968 through 1982, in 1996 and 1998, and from 2002 through 2004. The PSEG ichthyoplankton field program was designed to provide relative density, standing crop, spatial distribution, and length frequency data on early life stages of target species of finfish within the Delaware River, Estuary, and Bay system. Samples were collected with a 1.0-m diameter, 500-micron mesh conical plankton net.

PSEG conducted an ichthyoplankton sampling program in all trawl zones from 2002 through 2004 with sampling twice per month, at night, from April through July, for a total of eight sampling events per year. Three species dominated Zone 7 ichthyoplankton collections in 2002, 2003, and 2004: striped bass, bay anchovy, and *Morone* spp (PSEG 2006a, Section 4).

In each year, striped bass ranked first, bay anchovy second, and *Morone* spp. third in abundance. (*Morone* larvae were either striped bass or white perch; the early larval stages of the two species are difficult to tell apart.) Weakfish larvae were present in small numbers in 2002 and 2003 ichthyoplankton samples, but made up 10 percent of all ichthyoplankton collected in 2004. Small numbers of Atlantic croaker larvae were collected in 2002, but none were collected in 2003 and 2004. The scarcity of Atlantic croaker eggs and larvae in the area of the Station was not surprising, given the species' spawning habits. Atlantic croaker spawn in late fall and winter over the nearshore Continental Shelf, in depths up to 54 meters (Diaz and Onuf 1985; Creswell et al. 2007). Eggs are pelagic, and upon hatching, early-stage larvae are primarily planktonic. Post-larvae move or are carried by flood tides into estuaries. Actual mechanisms for larval transport into estuarine nursery grounds are unclear and may involve passive transport or directed movement (Diaz and Onuf 1985).

In 2004, the last year of ichthyoplankton sampling, 3,815,437 fish eggs and larvae from the 12 target species were collected from all zones. Bay anchovy (90 percent) dominated the total catch. Weakfish was the second most abundant species (7 percent), and white perch accounted for 1 percent of the total finfish catch (PSEG 2002, 2003, 2004a).

2.2.1.4 <u>Beach Seine Surveys</u>

The bay-wide beach seine surveys were initiated in 1995 to complement the NJDEP Bureau of Marine Fisheries Delaware River Seine Survey (initiated in 1980), providing sampling beyond the geographic boundaries of the NJDEP's monitoring area. The intent of the combined studies was to more fully characterize target species abundance and distribution patterns within the shallow water habitats of the Estuary. In 2002, the sampling gear and deployment procedures for the PSEG bay-wide beach seine survey were revised to provide data equivalent to the data collected in the NJDEP program as closely as possible. The PSEG bay wide beach seine survey targets the same 12 important finfish species identified in Section 2.2.1.1. Blue crab catches are also reported.

Beginning in 1995, PSEG collected samples at 32 selected locations between the mouth of the Bay and the Chesapeake & Delaware Canal (5 km [3 mi] north of HCGS) semi-monthly in November through July and monthly from August through October. In 2002, the program added 16 upriver stations. Additionally, the sampling frequency was changed to once per month in June and November and semi-monthly from July through October. As with the NJDEP Delaware River Seine Survey, samples are collected with a bagged 30.5-m by 1.8-m (100-ft by 6-ft) beach seine of 0.95-centimeter (cm) (3/8-in) bar mesh netting. Beach seine samples are collected during daylight at high slack tide.

Beach seine samples from Zone 7 over the 2002-2004 period were dominated by juvenile and adult representatives of small, schooling species and young gamefish (PSEG 2006a, Section 4). Atlantic silverside was the species collected most often, making up 35.8, 50.8, and 64.2 percent, respectively, of fish collected in 2002, 2003, and 2004. Bay anchovy was second in abundance every year, making up 23.6, 23.7, and 17.9 percent of fish collected. Substantial numbers of young weakfish, Atlantic croaker, and striped bass were also collected. Weakfish represented 4.0, 4.2, and 5.0 percent of seine collections in 2002, 2003, and 2004. Atlantic croaker and striped bass were also regularly collected, but in generally smaller numbers than weakfish.

In the most recent seine samples available from the PSEG bay wide beach seine survey, 13,187 specimens of 44 finfish species and 296 blue crab were collected (PSEG 2007a). Atlantic silverside was the most abundant species taken in the seine catch, composing

41 percent of the annual sample. Historically, Atlantic silverside has been predominant in the shore zone of the lower Delaware River and Bay (PSEG 1995, 1996, 1997, 1998, 1999a, 2000a, 2001, 2002, 2003, 2004a, 2005, 2006b, and 2007a), composing more than 50 percent of the annual seine catch in eight of the 13 years. Generally, bay anchovy ranked second in total catch, ranging from 47 percent in 1995 to 18 percent in 2004. In both 2006 and 2007, bay anchovy composed about 24 percent of the catch. Atlantic croaker and white perch each represented less than five percent of the annual catch (PSEG 2007a). Only four species were collected during all sampling periods, in all zones, and at all beach types: Atlantic silverside, bay anchovy, striped bass, and American shad. These species may be characterized as the ubiquitous core of the shore zone community (PSEG 2007a).

Relatively small catches of blueback herring and alewife have been consistently reported in the PSEG bay wide beach seine surveys since 1995 (with the exception of one anomalous year, 2001). These results, together with long-term data provided by the NJDEP Delaware River Seine Survey, which is conducted further upriver, indicate that the summer nursery grounds for alosids of interest (blueback herring and alewife) are restricted to freshwater and brackish portions of the river (PSEG 2005).

2.2.2 POTENTIAL IMPACT OF HCGS OPERATIONS ON AQUATIC RESOURCES

The following discussion is based on conclusions drawn from aquatic monitoring required by the Salem NJPDES permit. Because HCGS and Salem are adjacent and both use water from the Estuary, the conclusions regarding trends and long-term stability of populations of target fish species are relevant to both plants.

In 2006, in conjunction with the Salem NJPDES permit renewal, PSEG prepared a comprehensive evaluation of the long-term trends in population and community characteristics of the Delaware Estuary that included an assessment of impacts of Salem's CWS intake on fisheries and other aquatic life. With regard to potential impacts of cooling system operation, three benchmarks were evaluated: (1) whether adverse changes in the balance of the biotic community had occurred, (2) whether continuing declines in the abundance of aquatic species potentially attributable to Salem operations had occurred, and (3) whether the levels of mortality caused by plant operations were sufficient to jeopardize the long-term sustainability of fish stocks. Based on an examination of the three benchmarks, the report concluded that "…operation of Salem has had no adverse impacts on populations and communities inhabiting the Delaware Estuary" (PSEG 2006a, Section 5). These conclusions are consistent with the results of similar analyses performed in 1999 (PSEG 1999a, Appendix E) and earlier studies.

PSEG examined three indicators of community health to determine if station operations had adversely affected the balance of the aquatic community: species richness/species density, species abundance, and the presence (or absence) of nuisance aquatic species (PSEG 2006a, Section 5). The analysis showed that fish species richness in the vicinity of Salem had not changed since the startup of Salem, and fish species density had increased. (PSEG 2006a, Section 5). The analysis suggested that most species had either increased in abundance since 1998 or that mortality associated with Station operations over the 1999-2004 period was much too low to have reduced abundance. With respect to nuisance species, the only outbreak of consequence in the Delaware Estuary took place in 2000 when a harmful algal bloom caused a fish-kill in two creeks in Delaware more than 50 miles down-estuary and cross-estuary from the Station. Nuisance algal blooms are not anticipated near the station due to the high turbidity and low light penetration affect algal growth. (PSEG 1999a, Appendix E)

Trends in the relative abundance of the target species were analyzed using data from three long-term monitoring programs: the NJDEP Delaware River Seine Survey, the Delaware Department of Natural Resources and Environmental Control (DNREC) Juvenile Trawl Survey, and the PSEG bottom trawl sampling. Trends over time were evaluated to determine whether the relative abundance of each target species had increased, decreased, or remained stable since the 1980s. Alewife, American shad, Atlantic croaker, striped bass, weakfish, white perch, and blue crab showed either a statistically significant increase in abundance or no significant change in abundance (PSEG 2006a, Section 5). Spot was the only species for which a statistically significant decline was detected (PSEG 2006a, Section 5). This decline could not be attributed to anything occurring specifically within the Delaware River or Estuary because abundance of spot had declined throughout the region, including in the Chesapeake Bay. The Delaware Estuary is at the northern limit of the range of this species, and the numbers entering the Delaware Estuary are highly variable from year to year (PSEG 2006a, Section 5). The fact that most populations have increased during the period of Station operation suggests that there has been no continuing decline in abundance of aquatic populations.

The effect of Station operations on the long-term sustainability of fish stocks was assessed using widely accepted stock assessment models. The object of this assessment was to determine whether the future impact of Station operations could jeopardize the sustainability of any of these stocks. The analysis showed that incremental effects of Salem operation on five important fish species (weakfish, striped bass, white perch, spot, and American shad) were small compared to the effects of fishing. The analysis indicated that reducing or eliminating impingement and entrainment at Salem would not measurably increase the reproductive potential (spawning stock biomass per recruit) or spawning stock biomass of any of the five species.

HCGS withdraws approximately one-fourth of the water that Salem withdraws from the Estuary. It follows that if the operation of Salem is not measurably affecting the fishery, the operation of HCGS also is not affecting the fishery.

2.2.3 STATUS OF AQUATIC RESOURCES

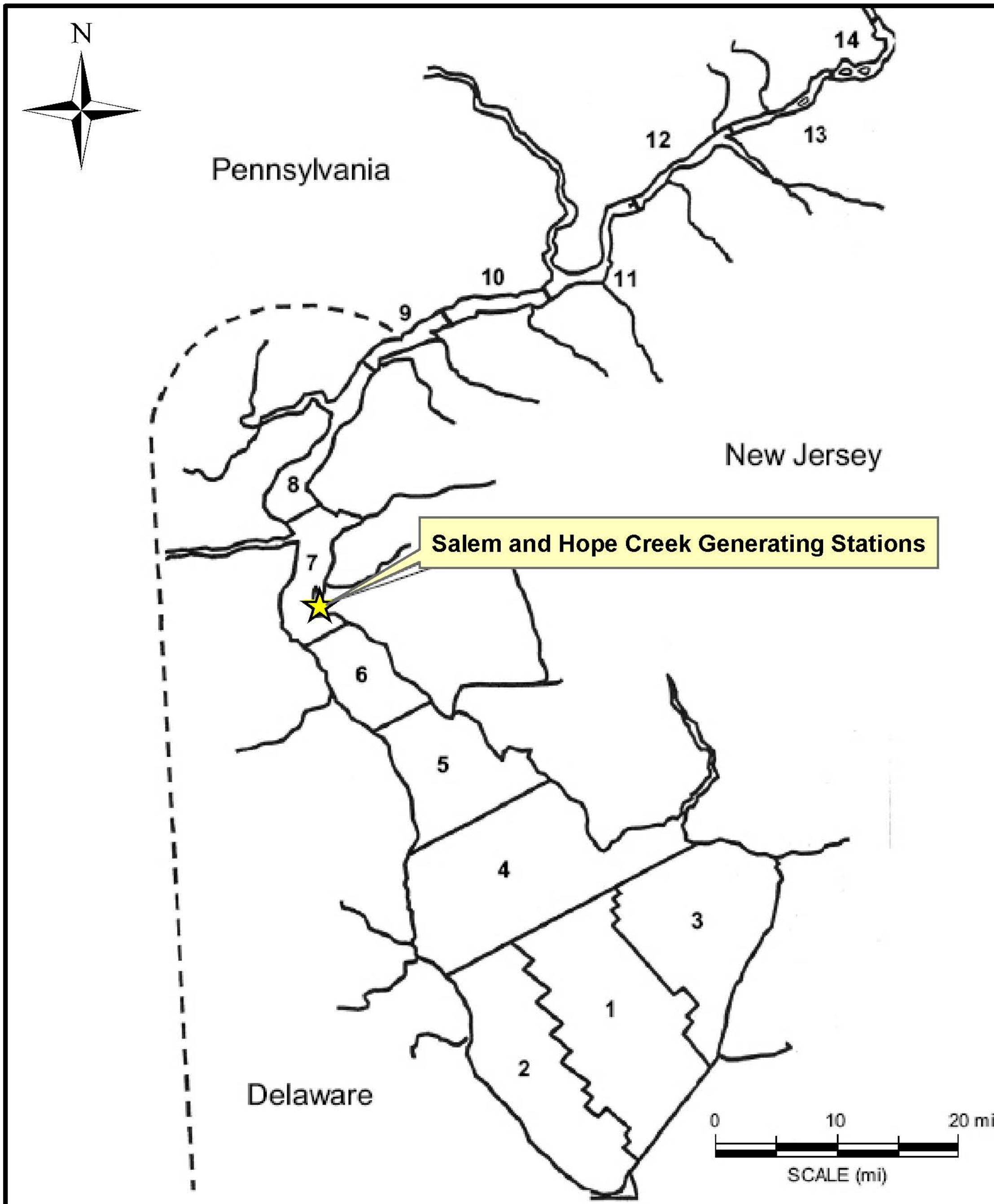
HCGS is located on the Delaware Estuary adjacent to Salem, and the aquatic resources analyzed as a requirement of Salem's NJPDES permit are the same resources that are present at HCGS. PSEG has periodically assessed population and community characteristics of the Delaware Estuary such as species composition and population abundance (see, e.g. PSEG 1999a, PSEG 2006a). Three benchmarks historically have been examined: (1) whether adverse changes in the balance of the biotic community have occurred; (2) whether continuing declines in the abundance of aquatic species that could potentially be attributable to nuclear power plant operations have occurred; and (3) whether the mortality attributable to plant operations is sufficient to jeopardize the sustainability of fish stocks. Evaluations of all three benchmarks identified no adverse impacts on populations or communities in the Delaware Estuary.

In 2006, data on the composition of the finfish community in the vicinity of the stations from 1970 through 2004 were analyzed using widely accepted techniques for measuring species richness (defined as the average number of species present in a community), and species density (defined as the average number of species per unit area or volume). Results indicate that finfish species richness has not changed since the startup of Salem, and that finfish species density has increased. During trawl surveys conducted from 1999 through 2004, 27 finfish species were collected that had not been collected during PSEG's earlier field surveys. Annual fluctuations in the abundance of individual fish species since 1998 were compared to the changes expected to occur as a result of documented changes in habitat quality, fisheries management practices, coast-wide environmental changes, increases in predator abundance, and to the changes expected to occur if Salem (or HCGS) was adversely affecting fish populations. Most species have increased in abundance since 1998. Rates of mortality due to station operations during this period that are too low to have caused measurable reductions in abundance. No estimates of mortality due to station operations are available for blue crab or Atlantic silverside. However, other data indicate that the apparent declines in abundance of these species are attributable to local environmental fluctuations (blue crab) or regional environmental changes (Atlantic silverside). (PSEG 2006a, Section 4)

Trends in the relative abundance of monitored species were analyzed for evidence of population decline. Data from three long-term monitoring programs were examined: the NJDEP Beach Seine Survey; the DNREC Juvenile Trawl Survey; and the PSEG Nearfield Bottom Trawl Survey. Statistically significant increases in abundance were found for alewife, American shad, Atlantic croaker, striped bass, weakfish, white perch, and blue crab. Spot had a statistically significant decline over the same time period. The Delaware Estuary is at the northern limit of the range of spot, and the number of individuals entering the Delaware Estuary are highly variable from year to year. A similar decline has been observed in the Chesapeake Bay.

The impact on the long-term sustainability of fish stocks was assessed using models that are commonly used in fisheries science and management. The objective of this assessment was to determine whether, compared to known effects of fishing on fish populations, the future impact of station operations could jeopardize the sustainability of any of these stocks. The stock jeopardy analyses show that, for all of the harvested species for which conditional mortality rates are available, the incremental effect of the stations is negligibly small compared to the effects of fishing. (PSEG 2006a, Section 5)

Analyses of the fish community indicate that a balanced indigenous community has been maintained in the Delaware River, Estuary, and Bay system (PSEG 2006a, Section 5). HCGS has operated for more than 20 years. During this time, the abundance of aquatic species has fluctuated in response to natural environmental factors and human use, but for most monitored species have generally increased or remained stable. Improvements in the aquatic community, principally attributable to advances in wastewater management and fisheries resource management, have been observed in the Delaware River system during this time.



Legend

★ Salem and Hope Creek Generating Stations

Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 2.2-1 PSEG Biological Sampling Zones

2.3 Ground-Water Resources

HCGS is adjacent to Salem in the New Jersey Coastal Plain, approximately 29 km (18 mi) south of the Fall Line (PSEG 2009c). The HCGS site is on the eastern shore of the Delaware River at approximately River Mile 51. The Delaware Estuary borders the PSEG-owned property on Artificial Island that contains the HCGS and Salem sites to the west and south, and extensive marshlands border it on the east and north (ARCADIS 2006). The Coastal Plain is underlain by an interbedded sequence of sands and silts that compose a series of aquifers, aquitards, and aquicludes of Quaternary, Tertiary, and Cretaceous ages (PSEG 2009c). The beds generally thicken seaward and dip gently to the southeast between two and 11 m per km (ten and 60 ft per mi) (ARCADIS 2006).

There are four primary water-bearing zones underlying the HCGS and Salem sites. Starting with the shallowest, they are the shallow water-bearing zone and three aquifers: 1) the Vincentown aquifer, 2) the Mount Laurel-Wenonah aquifer, and 3) the Potomac-Raritan-Magothy aquifer. The shallow water-bearing zone consists of dredge spoils, engineered fill, tidal marsh deposits and the discontinuous Quaternary riverbed sand and gravel deposits that make up Artificial Island. This zone occurs between three and 12 m (ten and 40 ft) below ground surface (bgs). In general, the dredge spoils, engineered fill, and tidal marsh deposits are characterized by high porosity and low permeability. Lenses of sand occur within the dredge spoils and may contain perched water within a few feet of ground surface. Ground water in the zone is generally brackish, and flow is toward the southwest at a gradient of 0.007 meter/meter (0.007 feet/foot) (PSEG 2007b). Recharge to the unit at the site is primarily through direct infiltration at an outcrop area (PSEG 2009b).

The Kirkwood Formation is approximately 12 m (40 ft) bgs in the vicinity of HCGS/Salem. At the site, the Kirkwood Formation consists of Miocene clays and acts as a confining unit, separating the shallow water-bearing zone from the underlying Vincentown aquifer. The Vincentown aquifer at the site occurs from approximately 17 to 41 m (55 to 135 ft) bgs and is a semi-confined-to-confined aquifer. Flow within this unit at the site is from north to south with a gradient of approximately 0.003 meter/meter (0.003 feet/foot). The Vincentown aquifer supplies potable water to domestic wells up-gradient of Artificial Island, in eastern Salem County, where ground water in this unit is moderately hard and has high iron content. Saltwater intrusion into the Vincentown aquifer occurs along the Delaware River in western Salem County making that water brackish and non-potable (PSEG 2007b). Recharge to the Vincentown aquifer occurs primarily from overlying units. Discharge under normal conditions is toward the southwest (PSEG 2009b).

The Hornerstown and Navesink confining units separate the Vincentown aquifer from the underlying Mount Laurel-Wenonah aquifer. The Hornerstown and Navesink confining units occur from approximately 41 to 52 m (135 to 170 ft) bgs (PSEG 2007b). The Mount Laurel-Wenonah aquifer consists of clayey sand with some gravel. In the vicinity of the site, the formation is approximately 30 m (100 ft) thick and occurs from 52 to 82 m (170 to 270 ft) bgs (PSEG 2009b). Recharge to the Mount Laurel-Wenonah aquifer at the site is through leakage of overlying aquifers (PSEG 2009b).

At the site, the Mount Laurel-Wenonah aquifer overlies the Marshalltown Formation. The Marshalltown Formation consists generally of 12 to 13 m (38 to 44 ft) of clayey silt with minor amounts of quartz and glauconite. The formation throughout the region generally consists of fine sand and sandy clay and is three to five m (10 to 15 ft) thick. The Marshalltown Formation acts as a leaky confining layer. Water quality is generally fair to poor for human consumption due to high iron content, turbidity, and an objectionable odor. (PSEG 2009b)

Underlying the Marshalltown Formation are the Englishtown Formation, which consists of fine sand; the Woodbury Clay; the Merchantville Formation clay; the Magothy Formation, a coarse to fine silt with little fine sand; and the Raritan and Potomac Formations consisting of interbedded sand, gravelly sand, and clay. The Magothy, Raritan, and Potomac Formations form the Potomac-Raritan-Magothy aquifer (ARCADIS 2006). Recharge to the aquifer is through precipitation at an outcrop area up-gradient of the site and leakage from under- and overlying aquicludes. (PSEG 2009b)

In 1986, New Jersey designated two Critical Water-Supply Management Areas in the New Jersey Coastal Plain in response to long-term declines in ground-water levels where ground water is the primary water supply (USGS 2007). Critical Water-Supply Management Area 1 includes portions of Middlesex, Monmouth, and Ocean counties along the Atlantic Ocean shore. Critical Water-Supply Management Area 2, the nearer Critical Water-Supply Management Area, is northeast of the site in portions of Ocean, Burlington, Camden, Atlantic, Gloucester, and Cumberland counties, and a small portion of eastern Salem County (USGS 2007). In Critical Water-Supply Management Area 2, ground-water withdrawals were reduced and new allocations are limited from the Potomac-Raritan-Magothy Aquifer (USGS 2007). The HCGS and Salem sites are southwest of the management area along the Delaware River, not in a Critical Water-Supply Management Area, and are not subject to the ground-water withdrawal restrictions.

There are no off-site public water supply wells or private wells within 1.6 km (1 mi) of the HCGS and Salem sites. The nearest off-site potable supply well is located more than 5.6 km (3.5 mi) west of the site, across the Delaware River, in Delaware (ARCADIS 2006). For a discussion of HCGS ground-water usage, refer to Section 3.1.4.

Ground-Water Tritium

Tritium has not been detected in ground water beneath the HCGS in any concentrations that exceed the EPA Drinking Water Standard or that suggest an adverse trend (PSEG 2008a). In 2003, PSEG identified tritium in ground water from onsite sampling wells near the Salem Unit 1 Fuel Handling Building (FHB). The source of tritium was the Salem Unit 1 Spent Fuel Pool, the tritium release to the environment has been stopped, and tritium concentrations above the New Jersey Ground Water Quality Criterion have not migrated to the property boundary. Neither strontium nor plant-related gamma emitters were detected in any ground-water well. In September 2005, a ground-water recovery system (GRS) began operating to reverse the ground-water flow gradient so that ground water in the recovery system's radius of influence is pulled toward the recovery system and away from the site boundary. The ground-water remediation project is being performed in accordance with the Remedial Action Work Plan approved by NJDEP. (PSEG 2008a) The effectiveness of the ground-water extraction system is discussed more fully in the Salem license renewal Environmental Report, Section 2.3 (PSEG 2009a). HCGS is hydraulically upgradient of Salem, and routine monitoring of ground-water wells has not identified any impacts on ground water at HCGS as a result of tritium released at Salem.

2.4 Critical and Important Terrestrial Habitats

HCGS occupies about 62 hectares (153 acres) at the southern portion of Artificial Island on the east bank of the Delaware River in Salem County, New Jersey. The 607-hectare (1,500-acre) Artificial Island was created and has been maintained since the early 1900s through the 1950s by deposition of hydraulic dredge spoils. It is connected to the New Jersey mainland by a strip of tideland also formed by fill from dredging operations in the River. PSEG owns approximately 300 hectares (740 acres) on Artificial Island. HCGS was constructed on a portion of this property between 1974 and 1986. HCGS is immediately adjacent to the approximately 89-hectare (220-acre) Salem nuclear facility, which is also owned by PSEG (see Figure 3.1-1), thus ecological surveys for each facility provide information relevant to both. The remainder of the island consists of marshes, impounded areas, and open pools.

Artificial Island, actually an artificial peninsula, projects from the New Jersey shore into the Delaware River. The average elevation of the site is 2.7 m (nine ft) above sea level. Construction of HCGS resulted in the permanent loss of 62 hectares (153 acres) of land previously occupied by dense stands of giant reed (*Phragmites australis*). Giant reed, a strongly invasive plant (NJ Category 1; Ling 2003) common to disturbed soils and tolerant of varying levels of soil moisture and salinity, is considered a pest due to its ability to out-compete native marsh plants such as the cordgrasses (*Spartina* spp.), often producing a thick monoculture stand of little value to wildlife or fish. Notwithstanding, Artificial Island provides critical foraging habitat for bald eagles, which were de-listed from the federal list of endangered and threatened wildlife in 2007 (USFWS 2007), but remain federally protected under the Bald and Golden Eagle Protection Act and remain on the New Jersey list of endangered species (NJDEP 2006).

As a dredge spoil island with poor quality soils, Artificial Island has few trees and is dominated primarily by giant reed. Other plants in the marshes surrounding the PSEG property include big cordgrass (*Spartina cynosuroides*), salt marsh cordgrass (*S. alterniflora*), saltmeadow cordgrass (*S. patens*), and saltmarsh bulrush (*Scirpus robustus*).

The wildlife species on Artificial Island and in the surrounding areas are those typically found in similar habitats within the Delaware River Estuary. Avian species observed on the Salem site during construction included marsh hawk (now northern harrier, *Circus cyaneus*), red-winged blackbird (*Agelaius phoeniceus*), common grackle (*Quiscalus quiscala*), yellowthroat (*Geothlypis trichas*), and song sparrow (*Melospiza melodia*) (AEC 1973). Ospreys (*Pandion haliaetus*) nested within the local marshes. Forty-four avian species were observed within six km (four mi) of Salem during pre-construction surveys, which included some upland/farmland areas (AEC 1973). Approximately half of these species were water birds (wading birds, waterfowl, seabirds, shorebirds, etc.), likely associated with nearby open water and tidal habitats. A study done for the HCGS construction project has indicated the occurrence of at least 178 avian species within 16 km (ten mi) of HCGS; 25 percent were considered year-round resident species (PSEG 1983). Other observations made at the Alloways Creek Estuary Enhancement Program restoration site, located just north of Artificial Island, included many species of water birds, common marsh birds such as red-winged blackbirds and marsh wrens (*Cistrothorus palustris*), and migrant songbirds such as palm warblers (*Dendroica palmarum*) and swamp sparrow (*Melospiza georgiana*) (PSEG 2004b). Overall avian community composition and relative abundance are largely a function of migration.

Common mammals observed during wildlife surveys associated with Salem construction included white-tail deer (*Odocoileus virginiana*), eastern cottontail (*Silvilagus floridanus*), house mouse (*Mus musculus*), and Norway rat (*Rattus norvegicus*) (AEC 1973). Other mammals thought to be common in the surrounding areas were raccoon (*Procyon lotor*), opossum (*Didelphis virginianus*), and muskrat (*Ondatra zibethica*). An additional 39 mammal species are expected to occur within 16 km (ten mi) of HCGS (NRC 1984). The only herpetological species found at Salem during the construction period was the diamondback terrapin (*Malaclemys terrapin*). An additional eight turtle species, four snakes, and one skink species were observed within ten km (six mi) of Salem during early surveys (AEC 1971).

Other surveys of the area surrounding both facilities suggest that up to 26 species of reptiles, including five species of sea turtles, may occur on or near the site (PSEG 1983). Of the three most common sea turtles in vicinity of the station, the loggerhead (*Caretta caretta*) and Atlantic green turtle (*Chelonia midas*) are classified as federally threatened, and the Kemp's ridley sea turtle (*Lepidochelys kempi*) is classified as federally endangered. Both the hawksbill (*Eretmochelys imbricata*) and leatherback sea turtle (*Dermochelys coriacea*) are classified as federally endangered, but are not typically observed near the plant site.

Section 3.1.6 describes the transmission lines built to deliver electricity generated at the HCGS and Salem sites to the transmission grid. The approximately 171 km (106 mi) of corridors associated with HCGS and Salem exit through three corridors routed to two primary substations (Figure 3.1-3). Two corridors, containing three lines, run roughly parallel to each other (1.6 to 3.2 km [one to two mi] apart) and extend east-northeast toward the New Freedom Substation. The more northern corridor contains the Salem-New Freedom (North) line and the HCGS-New Freedom line, and the more southern corridor contains the Salem-New Freedom (South) line.

The third corridor exits the site toward the north for a distance and then turns west and crosses the Delaware River into Delaware. It contains the Salem-Keeney line. This line, although now connected to HCGS, was constructed to connect Salem to the transmission grid. Therefore, no line evaluated in this Environmental Report extends into Delaware, and protected species found in Delaware are not evaluated here.

Only the HCGS-New Freedom transmission line, which is located in the more northern of the two transmission corridors extending east-northeast from the HCGS and Salem sites, was originally built to connect HCGS to the electricity transmission grid. Accordingly, it is the only transmission line for which impacts are assessed in this Environmental Report.

All three corridors cross land identified as critical bald eagle foraging habitat (NJDEP 2006). In addition, both of the corridors extending east-northeast from the HCGS and Salem sites traverse approximately two miles of marsh habitat east of the PSEG property and then traverse a combination of forested and agricultural lands, and for approximately one-quarter of their total distance nearest the New Freedom substation, both corridors cross the New Jersey Pinelands National Reserve, which has been designated a biosphere reserve. A biosphere reserve is a representative ecological area with three mutually reinforcing functions: conservation, sustainable development, and logistic support for scientific research and education. Biospheres are recognized by the United Nations Educational, Scientific and Cultural Organization (UNESCO) under its Programme on Man and the Biosphere. (UNESCO 2009)

The New Jersey Pinelands Commission implements the Pinelands Comprehensive Management Plan, the purpose of which is to preserve, protect, and enhance the natural and cultural resources of the Pinelands National Reserve, and to encourage compatible economic and other human activities. Electric transmission line corridor maintenance in the New Jersey Pinelands is regulated by the New Jersey Pinelands Commission (New Jersey Pinelands Commission 2009).

In the Pinelands National Reserve, the two corridors extending east-northeast from the HCGS and Salem sites also cross the Great Egg Harbor River, a National Scenic and Recreational River.

Each transmission corridor is 107 m (350 ft) wide and the corridors in New Jersey are currently maintained by PSE&G. PSE&G performs ground inspections annually and aerial inspections once every five years, and maintains vegetation (primarily the removal of fast-growing trees, trimming, and herbicides or mechanical cutting if herbicides are prohibited) as needed to ensure continued and safe distribution of electricity throughout the system (PJM 2005).

2.5 Threatened or Endangered Species

Table 2.5-1 lists protected animal and plant species recorded in counties in which HCGS and its associated transmission line are located. The species are those that are state- or federally listed as endangered or threatened, and those that are candidates or proposed for federal listing. The HCGS-New Freedom corridor, which as noted in Section 3.1.6 is the only transmission corridor for which impacts are assessed in this Environmental Report, crosses portions of Salem, Gloucester, and Camden counties in New Jersey (Figure 3.1-3). The species shown in Table 2.5-1 as occurring in these counties were taken from county records maintained by the U.S. Fish and Wildlife Service (USFWS undated) and the New Jersey Department of Environmental Protection (NJDEP 2008a), except shortnose sturgeon and five species of sea turtles, which are not included on county lists, but are listed by the USFWS in 50 CFR 17.11 and are known to occur in the Delaware River (see below).

As shown in Table 2.5-1, numerous special-status animal and plant species have been recorded in Salem, Gloucester, and Camden counties. Most of these species have not been observed on the HCGS site. Some endangered or threatened bird species could move through the site during seasonal migrations. Federally listed species recorded in Salem, Gloucester, and Camden counties, and state-listed species that have been observed on the HCGS site or along the transmission line, are discussed below.

The bog turtle (*Clemmys muhlenbergii*) and American burying beetle (*Nicrophorus americanus*) are the only terrestrial animals in Table 2.5-1 that are federally listed as endangered or threatened. The bog turtle, which is federally listed as threatened, inhabits calcareous (limestone) fens, sphagnum bogs, and wet, grassy pastures that are characterized by soft, muddy substrates (bottoms) and perennial ground-water seepage (NJDEP 2008b). These habitats are not found on the HCGS site but could occur along the transmission corridor. The federally and state-listed endangered American burying beetle, although recorded in Camden and Gloucester counties, is now believed to have been extirpated from New Jersey (NJDEP 2008a, USFWS undated).

The Pine Barrens tree frog (*Hyla andersoni*), which is state-listed as endangered, has not been found within any transmission corridor associated with HCGS, but is known from other transmission corridors in the Pine Barrens (NJDEP 2008a, DNREC 2008).

Four federally listed plant species have been recorded in Salem, Gloucester, and Camden counties: chaffseed, sensitive joint vetch, swamp pink, and Knieskern's beaked-rush. Chaffseed (*Schwalbea americana*), which is federally listed as endangered, and sensitive joint vetch (*Aeschynomene virginica*), which is federally listed as threatened, are known only from historic records and no current populations are known to exist in these counties (USFWS undated). Swamp pink (*Helonias bullata*), which is federally listed as threatened, is restricted to forested wetlands that are perennially water-saturated (NatureServe 2008). Transmission corridors in Salem County cross habitats known to support swamp pink (NJDEP 2008c), and PSEG is aware of one occurrence of the species along a transmission corridor in Salem County.

Knieskern's beaked-rush (*Rhynchospora knieskernii*), which is federally listed as threatened, is restricted to early successional habitats in pitch pine lowland forests, typically in areas with fluctuating water regimes. The species is usually found in bare or sparsely vegetated areas within pine barrens where open conditions are maintained through natural disturbances such as fire or flood scouring, or through human-caused disturbances such as roadside, railroad, or transmission line right-of-way maintenance, or in inactive sand or clay pits (NatureServe 2008). Within New Jersey, Knieskern's beaked-rush is known to occur in Camden County but is not known to occur in Salem or Gloucester counties (NJDEP 2008c, USFWS undated).

Bald eagles (*Haliaeetus leucocephalus*) and peregrine falcons (*Falco peregrinus*) are occasionally seen in the vicinity of HCGS (NRC 1984) but are not known to nest at the site or within the transmission corridors (NJDEP 2008d, NJDEP 2008e); however, elevated structures and open fields near these areas could support nesting. Bald eagles were removed from the federal list of endangered and threatened wildlife in 2007 (USFWS 2007), but the species remains federally protected under the Bald and Golden Eagle Protection Act and is on the New Jersey list of endangered species (NJDEP 2006). New Jersey reported 64 eagle pairs in 2007; 37 of those were in Salem, Cumberland or Gloucester counties (NJDEP 2007a). The nearest bald eagle nest is approximately eight km (five mi) from the HCGS site (NJDEP 2008d).

Peregrine falcons were removed from the federal list of endangered and threatened wildlife in 1999 (USFWS 1999), but the species remains on the New Jersey list of endangered species (Table 2.5-1). Peregrine falcons continue to do well throughout New Jersey (NJDEP 2008e).

Ospreys (*Pandion haliaetus*), which are state-listed as threatened, nest on transmission towers near the HCGS site and in areas along the Delaware Estuary (NJDEP 2008f). PSEG has erected nesting platforms for ospreys at off-site locations, and birds are currently using the platforms (TNC 2008).

The Cooper’s hawk (*Accipiter cooperii*), bobolink (*Dolichonyx oryzivorus*), and grasshopper sparrow (*Ammodramus savannarum*) have been observed within ten km (six mi) of HCGS (AEC 1973). None of these birds is federally listed. The Cooper’s hawk and bobolink are state-listed as threatened. NJDEP classifies the breeding population of grasshopper sparrows as threatened, and the migratory or winter population of grasshopper sparrows as stable in number (NJDEP 2008b).

Five federally listed species of sea turtle may occur in Delaware Bay: the threatened loggerhead sea turtle (*Caretta caretta*), threatened Atlantic green turtle (*Chelonia mydas*), endangered Kemp’s ridley sea turtle (*Lepidochelys kempi)*, endangered hawksbill turtle (*Eretmochelys imbricata*), and endangered leatherback turtle (*Dermochelys coriacea*). The NJDEP classifies these turtle species as endangered, except the Atlantic green turtle, which is state-listed as threatened. Young sea turtles move from the open waters of the Atlantic Ocean into near-shore coastal areas where they forage and mature into adults. The young turtles make occasional forays into the shallow waters of mid-Atlantic estuaries in late summer to feed and rest. While no nesting occurs along Delaware Bay beaches, all five sea turtle species can move into the Bay and may travel up the Estuary as far as Artificial Island (Delaware Estuary Program 1996). Most of the sea turtles found in Delaware Bay are sub-adults that were hatched on beaches in the Caribbean, Florida, and the Carolinas and have migrated north to nursery grounds in the mid-Atlantic region. The vast majority of the sea turtles observed in Delaware Bay are loggerheads, with smaller numbers of Kemp’s ridley and Atlantic green turtles occasionally observed.

One federally listed fish, the shortnose sturgeon (*Acipenser brevirostrum*), occurs in Delaware Bay. In the Delaware River system, adult shortnose sturgeons spend most of their lives in the upper tidal freshwater portion of the river (the most heavily used portion of the river is that between River Mile 118 and River Mile 137). However, shortnose sturgeon often move further upstream to spawn (O’Herron, Able, and Hastings 1993). After spawning, some adults move downstream into low-salinity reaches of the river (including Delaware Bay), primarily in spring and summer (O'Herron, Able, and Hastings 1993; NMFS 1998a). This is in sharp contrast to sturgeon in southeastern rivers, which spend most of the year in the lower Estuary and move upstream in spring into the middle and upper reaches of natal rivers to spawn. Based on surveys conducted in the 1980s, the Delaware River shortnose sturgeon population is one of the largest along the eastern seaboard, with population estimates ranging from 6,408 to 14,080 individuals (NMFS 1998a).

Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus) occurs in the Delaware River. In 2006, the National Marine Fisheries Service (NMFS) initiated a status review for Atlantic sturgeon to determine if listing as threatened or endangered under the Endangered Species Act (ESA) is warranted. The Status Review Report was published on February 23, 2007 (NMFS 2007). NMFS is currently considering the information presented in the Status Review Report to determine if any listing action pursuant to the ESA is warranted at this time. If it is determined that listing is warranted, a final rule listing the species could be published. As a candidate species, Atlantic sturgeon receive no substantive or procedural protection under the ESA; however, NMFS recommends that project proponents consider implementing conservation actions to limit the potential for adverse effects on Atlantic sturgeon from any proposed project. The Atlantic sturgeon is a member of the Acipenseridae family as is the short-nosed sturgeon and sturgeon are among one of the oldest fish species in the world. Its range extends from New Brunswick, Canada to the eastern coast of Florida. Atlantic sturgeon have not been recorded in the 2002 through 2004 PSEG biological monitoring program in the bottom trawl, pelagic trawl, ichthyoplankton and macrozooplankton sampling, impingement sampling, nor as eggs, larvae, juveniles or adults in the entrainment sampling (described in Section 2.2.1). A single Atlantic sturgeon was reported on the 2003 beach seine sampling. These data indicate that a robust population of Atlantic sturgeon that would be of particular concern is not present in the vicinity of the Station.

Winter flounder (NMFS 1998b), windowpane flounder (NMFS 1998c), and butterfish (NMFS 1999a) essential fish habitat (as defined by the Magnuson-Stevens Fishery Conservation and Management Act [P.L. 94-25]) has been identified in the Delaware Bay in the area of HCGS. Winter flounder essential fish habitat ranges from Passamaquoddy Bay in Maine to Chincoteague Bay in Maryland (NMFS 1998b). Windowpane flounder essential fish habitat ranges from Passamaquoddy Bay in Maine to Chesapeake Bay in Maryland (NMFS 1998c). Butterfish essential fish habitat ranges from Newfoundland to Cape Hatteras in North Carolina (NMFS 1999a).

Table 2.5-1 Threatened or Endangered Species Recorded in Salem County and Counties Crossed by Transmission Lines

Scientific Name	Common Name	Status		County[c]
		Federal[a]	State[a,b]	
Mammals				
Lynx rufus	Bobcat	-	E	Salem
Birds				
Accipiter cooperii	Cooper's hawk	-	T/T	Gloucester, Salem
Ammodramus henslowii	Henslow's sparrow	-	E	Gloucester
A. savannarum	Grasshopper sparrow	-	T/S	Salem
Bartramia longicauda	Upland sandpiper	-	E	Gloucester, Salem
Buteo lineatus	Red-shouldered hawk	-	E/T	Gloucester
Circus cyaneus	Northern harrier	-	E/U	Salem
Cistothorus platensis	Sedge wren	-	E	Salem
Dolichonyx oryzivorus	Bobolink	-	T/T	Salem
Falco peregrinus	Peregrine falcon	-	E	Camden, Gloucester, Salem
Haliaeetus leucocephalus	Bald eagle	-	E	Gloucester, Salem
Melanerpes erythrocephalus	Red-headed woodpecker	-	T/T	Camden, Gloucester, Salem
Pandion haliaetus	Osprey	-	T/T	Gloucester, Salem
Passerculus sandwichensis	Savannah sparrow	-	T/T	Salem
Podilymbus podiceps	Pied-billed grebe	-	E/S	Salem
Pooecetes gramineus	Vesper sparrow	-	E	Gloucester, Salem
Strix varia	Barred owl	-	T/T	Gloucester, Salem
Reptiles and Amphibians				
Ambystoma tigrinum tigrinum	Eastern tiger salamander	-	E	Gloucester, Salem
Clemmys insculpta	Wood turtle	-	E	Gloucester
C. muhlenbergii	Bog turtle	T	E	Camden, Gloucester, Salem
Crotalus horridus horridus	Timber rattlesnake	-	E	Camden
Hyla andersoni	Pine barrens treefrog	-	E	Camden, Gloucester, Salem
Pituophis melanoleucus	Northern pine snake	-	T	Camden, Gloucester, Salem
Caretta caretta	Loggerhead sea turtle	T	E	Delaware River[d]
Lepidochelys kempi	Kemp's ridley	E	E	Delaware River[d]
Dermochelys coriacea	Leatherback turtle	E	E	Delaware River[d]
Eretmochelys imbricata	Hawksbill turtle	E	E	Delaware River[d]
Chelonia mydas	Atlantic green turtle	T	T	Delaware River[d]
Fish				
Acipenser brevirostrum	Shortnose sturgeon	E	E	Delaware River[d]
A. oxyrinchus oxyrinchus	Atlantic sturgeon	C	-	Delaware River[d]
Insects				
Nicrophorus americanus	American burying beetle	E	E	Camden, Gloucester

Table 2.5-1 Threatened or Endangered Species Recorded in Salem County and Counties Crossed by Transmission Lines (Continued)

Scientific Name	Common Name	Status		County[c]
		Federal[a]	State[a,b]	
Plants				
Aeschynomene virginica	Sensitive joint vetch	T	E	Camden, Gloucester, Salem
Aplectrum hyemale	Putty root	-	E	Gloucester
Aristida lanosa	Wooly three-awn grass	-	E	Camden, Salem
Asimina triloba	Pawpaw	-	E	Gloucester
Aster radula	Low rough aster	-	E	Camden, Gloucester, Salem
Bouteloua curtipendula	Side oats grama grass	-	E	Gloucester
Cacalia atriplicifolia	Pale Indian plantain	-	E	Camden, Gloucester
Calystegia spithamaea	Erect bindweed	-	E	Camden, Salem
Cardamine longii	Long's bittercress	-	E	Gloucester
Carex aquatilis	Water sedge	-	E	Camden
C. bushii	Bush's sedge	-	E	Camden
C.cumulata	Clustered sedge	-	E	Camden
C. limosa	Mud sedge	-	E	Gloucester
C. polymorpha	Variable sedge	-	E	Gloucester
Castanea pumila	Chinquapin	-	E	Gloucester, Salem
Cercis canadensis	Redbud	-	E	Camden
Chenopodium rubrum	Red goosefoot	-	E	Camden
Commelina erecta	Slender dayflower	-	E	Camden
Cyperus lancastriensis	Lancaster flat sedge	-	E	Camden, Gloucester
C. polystachyos	Coast flat sedge	-	E	Salem
C. pseudovegetus	Marsh flat sedge	-	E	Salem
C. retrofractus	Rough flat sedge	-	E	Camden, Gloucester
Dalibarda repens	Robin-run-away	-	E	Gloucester
Diodia virginiana	Larger buttonweed	-	E	Camden
Draba reptans	Carolina Whitlow-grass	-	E	Camden, Gloucester
Eleocharis melanocarpa	Black-fruit spike-rush	-	E	Salem
E. equisetoides	Knotted spike-rush	-	E	Gloucester
E. tortilis	Twisted spike-rush	-	E	Gloucester
Elephantopus carolinianus	Carolina elephant-foot	-	E	Gloucester, Salem
Eriophorum gracile	Slender cotton-grass	-	E	Gloucester
E. tenellum	Rough cotton-grass	-	E	Camden, Gloucester
Eupatorium capillifolium	Dog fennel thoroughwort	-	E	Camden
E. resinosum	Pine barren boneset	-	E	Camden, Gloucester,
Euphorbia purpurea	Darlington's glade spurge	-	E	Salem

Table 2.5-1 Threatened or Endangered Species Recorded in Salem County and Counties Crossed by Transmission Lines (Continued)

Scientific Name	Common Name	Status		County[c]
		Federal[a]	State[a,b]	
Glyceria grandis	American manna grass	-	E	Camden
Gnaphalium helleri	Small everlasting	-	E	Camden
Gymnopogon brevifolius	Short-leaf skeleton grass	-	E	Gloucester
Helonias bullata	Swamp-pink	T	E	Camden, Gloucester, Salem
Hemicarpha micrantha	Small-flower halfchaff sedge	-	E	Camden
Hottonia inflata	Featherfoil	-	E	Salem
Hydrastis canadensis	Golden seal	-	E	Camden
Hydrocotyle ranunculoides	Floating marsh-pennywort	-	E	Salem
Hypericum adpressum	Barton's St. John's-wort	-	E	Salem
Juncus caesariensis	New Jersey rush	-	E	Camden
J. torreyi	Torrey's rush	-	E	Camden
Kuhnia eupatorioides	False boneset	-	E	Camden
Lemna perpusilla	Minute duckweed	-	E	Camden, Salem
Limosella subulata	Awl-leaf mudwort	-	E	Camden
Linum intercursum	Sandplain flax	-	E	Camden, Salem
Luzula acuminate	Hairy wood-rush	-	E	Gloucester, Salem
Melanthium virginicum	Virginia bunchflower	-	E	Camden, Gloucester, Salem
Micranthemum micranthemoides	Nuttall's mudwort	-	E	Camden, Gloucester
Muhlenbergia capillaris	Long-awn smoke grass	-	E	Gloucester
Myriophyllum tenellum	Slender water-milfoil	-	E	Camden
M. pinnatum	Cut-leaf water-milfoil	_	E	Salem
Nelumbo lutea	American lotus	-	E	Camden, Salem
Nuphar microphyllum	Small yellow pond-lily	-	E	Camden
Onosmodium virginianum	Virginia false-gromwell	-	E	Camden, Gloucester, Salem
Ophioglossum vulgatum pycnostichum	Southern adder's tongue	-	E	Salem
Panicum aciculare	Bristling panic grass	-	E	Gloucester
Penstemon laevigatus	Smooth beardtongue	-	E	Gloucester
Plantago pusilla	Dwarf plantain	-	E	Camden
Platanthera flava flava	Southern rein orchid	-	E	Camden
Pluchea foetida	Stinking fleabane	-	E	Camden
Polemonium reptans	Greek-valerian	-	E	Salem
Polygala incarnata	Pink milkwort	-	E	Camden, Gloucester

Table 2.5-1 Threatened or Endangered Species Recorded in Salem County and Counties Crossed by Transmission Lines (Continued)

Scientific Name	Common Name	Status		County[c]
		Federal[a]	State[a,b]	
Prunus angustifolia	Chickasaw plum	-	E	Camden, Gloucester, Salem
Pycnanthemum clinopodioides	Basil mountain mint	-	E	Camden
P. torrei	Torrey's mountain mint	-	E	Gloucester
Quercus imbricaria	Shingle oak	-	E	Gloucester
Q .lyrata	Overcup oak	-	E	Salem
Rhododendron atlanticum	Dwarf azalea	-	E	Salem
Rhynchospora globularis	Coarse grass-like beaked-rush	-	E	Camden, Gloucester, Salem
R. knieskernii	Knieskern's beaked-rush	T	E	Camden
Sagittaria teres	Slender arrowhead	-	E	Camden
Scheuchzeria palustris	Arrow-grass	-	E	Camden, Gloucester
Schwalbea americana	Chaffseed	E	E	Camden
Scirpus longii	Long's woolgrass	-	E	Camden
S. maritimus	Saltmarsh bulrush	-	E	Camden
Scutellaria leonardii	Small skullcap	-	E	Salem
Spiranthes laciniata	Lace-lip ladies' tresses	-	E	Gloucester
Stellaria pubera	Star chickweed	-	E	Camden
Triadenum walteri	Walter's St. John's wort	-	E	Camden
Utricularia biflora	Two-flower bladderwort	-	E	Gloucester, Salem
Valerianella radiata	Beaked cornsalad	-	E	Gloucester
Verbena simplex	Narrow-leaf vervain	-	E	Camden, Gloucester
Vernonia glauca	Broad-leaf ironweed	-	E	Gloucester, Salem
Vulpia elliotea	Squirrel-tail six-weeks grass	-	E	Camden, Gloucester, Salem
Wolffiella floridana	Sword bogmat	-	E	Salem
Xyris fimbriarta	Fringed yellow-eyed grass	-	E	Camden

[a] E = Endangered; T = Threatened; C = Candidate; - = Not listed.
[b] State status for birds separated by a slash (/) indicates a dual status. First status refers to the state breeding population, and the second status refers to the migratory or winter population. S = Stable species (a species whose population is not undergoing any long-term increase or decrease within its natural cycle); U = Undetermined (a species about which there is not enough information available to determine the status) (NJDEP 2008a).
[c] Source of county occurrence: USFWS (undated); NJDEP (2008a).
[d] Sea turtles and sturgeon are not included in county lists maintained by USFWS (undated) and NJDEP (2008a), but are listed by the USFWS at 50 CFR 17.11and are known to occur in the Delaware River (see text).

2.6 Demography

2.6.1 REGIONAL DEMOGRAPHY

The Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) presents a population characterization method that is based on two factors: "sparseness" and "proximity" (NRC 1996b). "Sparseness" measures population density and city size within 32 km (20 mi) of a site and categorizes the demographic information as follows:

Demographic Categories Based on Sparseness

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

Source: NRC 1996b

"Proximity" measures population density and city size within 80 km (50 mi) and categorizes the demographic information as follows:

Demographic Categories Based on Proximity

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

Source: NRC 1996b

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

GEIS Sparseness and Proximity Matrix

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

Low Population Area	Medium Population Area	High Population Area
1.1, 1.2, 2.1	1.3, 1.4, 2.2, 2.3, 2.4, 3.1, 3.2, 3.3, 4.1, 4.2	3.4, 4.3, 4.4

Source: NRC 1996b

PSEG used 2000 census data from the U.S. Census Bureau (USCB) and geographic information system software (ArcGIS®) to determine most demographic characteristics in the HCGS vicinity. Approximately 501,820 people live within 32 km (20 mi) of HCGS, at a population density of 450 persons per square mile. The GEIS sparseness matrix identifies this density as in the least sparse category; Category 4 (greater than or equal to 120 persons per square mile within 20 miles).

PSEG determined that 5,201,842 people live within 80 km (50 mi) of HCGS, at a population density of 771 persons per square mile. Based on the GEIS proximity matrix, the population density is classified as Category 4 (greater than or equal to 190 persons per square mile within 50 miles). Therefore, according to the GEIS sparseness and proximity matrix, the HCGS regional population ranks of sparseness Category 4 and proximity Category 4 result in the conclusion that HCGS is in a high population area.

All or parts of 21 counties and a number of Metropolitan Statistical Areas (MSAs) are located within 80 km (50 mi) of HCGS (Figure 2.1-1). The MSAs nearest HCGS are (1) Wilmington, Delaware, (2) Dover, Delaware, (3) Philadelphia, Pennsylvania, (4) Camden, New Jersey, (5) Baltimore-Towson, Maryland, (6) Atlantic City, New Jersey, and (7) Vineland-Millville-Bridgeton, New Jersey (USCB 2003). The nearest major city is Wilmington, Delaware (32 km [20 mi] north), with a 2000 population of 72,664 (USCB 2000a). The municipality nearest HCGS is the city of Salem (13 km [eight mi] northeast) with a 2000 population of 5,857 (USCB 2000a).

From 1990 to 2007, the population of the Wilmington, Delaware MSA increased from approximately 579,000 to approximately 694,000; an increase of 20 percent. In the same time period, the population of the Dover Delaware MSA increased from approximately 111,000 to approximately 152,000; an increase of 37 percent. The population of the Philadelphia, Pennsylvania MSA increased from approximately 3,700,000 to approximately 3,900,000; an increase of five percent. The population of the Camden, New Jersey MSA increased from approximately 1,100,000 to approximately 1,200,000; an increase of nine percent. The population of the Baltimore-Towson, Maryland MSA increased from approximately 2,400,000 to approximately 2,700,000; an increase of 12 percent. The population of the Atlantic City, New

Jersey MSA increased from approximately 220,000 to approximately 271,000; an increase of 23 percent. The population of the Vineland-Millville-Bridgeton, New Jersey MSA increased from approximately 138,000 to 156,000; an increase of 13 percent. (Table 2.6-1)

Because approximately 81 percent of HCGS employees reside in Cumberland, Gloucester, or Salem counties, New Jersey, or New Castle County, Delaware (Table 2.6-2), and because most property taxes from the plant are paid to municipalities in Salem County, they are the counties with the greatest potential to be socioeconomically affected by license renewal at HCGS, and are collectively referred to as the socioeconomic region of interest in this report. Table 2.6-3 shows population counts and annual growth rates for the four counties in which most HCGS employees reside. The table also provides these statistics for the states of New Jersey and Delaware for comparison.

From 1990 to 2000, the growth rates of Salem and Cumberland counties were less than that of New Jersey, and Gloucester County's was slightly higher. Salem County's population decreased between 1990 and 2000, although its population increased from 2000 to 2006. Between 1990 and 2000, the growth rate of New Castle County, Delaware, was less than that of Delaware overall. Gloucester County has experienced the highest percentage of growth of any county of interest (Table 2.6-3).

Because the city of Salem and Lower Alloways Creek Township, New Jersey, receive property taxes from HCGS, population in these municipalities is also reviewed. The population in the city of Salem has steadily declined from 1970 to 2000. Lower Alloways Creek township population increased from 1970 to 2000; however, it is a smaller municipality than Salem. From 1990 to 2000, the population of the city of Salem decreased from 6,883 to 5,857; a decrease of 14.9 percent, although since 2006 the population has increased slightly. The population of Lower Alloways Creek Township has increased by approximately one percent in the same time period (Table 2.6-4).

2.6.2 MINORITY AND LOW-INCOME POPULATIONS

The NRC performed environmental justice analyses for previous license renewal applications and concluded that an 80-km (50-mi) radius (Figure 2.1-1) could reasonably be expected to contain potential environmental impact sites and that the state was appropriate as the geographic area for comparative analysis. PSEG has adopted these parameters for quantifying the minority and low-income populations that may be affected by HCGS operations.

PSEG used 2000 census data from the USCB with geographic information system software (ArcGIS®) to determine the minority characteristics by block group. If any part of a block group was located within 80 km (50 mi) of HCGS, then PSEG included that entire block group in the analysis. The 80-km (50-mi) radius includes 4,585 block groups (Table 2.6-5).

2.6.2.1 Minority Populations

The NRC's Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues defines a "minority" population as: American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black Races; and Hispanic Ethnicity (NRC 2001). Additionally, NRC's guidance requires that (1) all other single minorities are to be treated as one population and analyzed, (2) multi-racial populations are to be analyzed, and (3) the aggregate of all minority populations is to be treated as one population and analyzed. The guidance indicates that a minority population exists if either of the following two conditions exists:

- The minority population in the census block group or environmental impact site exceeds 50 percent.
- The minority population percentage of the environmental impact area is significantly greater (typically at least 20 percentage points) than the minority population percentage in the geographic area chosen for comparative analysis.

For each of the 4,585 block groups within the 80-km (50-mi) radius, PSEG calculated the percent of the block group's population represented by each minority. If any block group minority percentage exceeded 50 percent, then the block group was identified as containing a minority population. PSEG selected Delaware, Maryland, New Jersey, and Pennsylvania, depending on which state the block groups fell within, as the geographic area for comparative analysis for block groups located within the 80-km (50-mi) radius, and calculated the percentages of each minority category within each state (Table 2.6-5). If any block group percentage exceeded the corresponding state percentage by more than 20 percent, then a minority population was determined to exist.

Table 2.6-5 presents the number of block groups in each county in the 80-km (50-mi) radius that exceed the threshold for minority populations. Figures 2.6-1 through 2.6-6 display the minority block groups within the 80-km (50-mi) radius.

For all categories but the Aggregate of Minorities in Maryland, the "more than 20 percent greater than the state average" was the limiting criterion. For the Aggregate category in Maryland, 50 percent was the limiting criterion. Within the 80-km (50-mi) radius, one-thousand three-hundred twenty census block groups have significant Black races populations. Sixty-seven census block groups within the 80-km (50-mi) radius have significant Asian populations. One-hundred eighty-five census block groups within the 80-km (50-mi) radius have significant All Other Single Minority populations. One census block group within the 80-km (50-mi) radius is Multi-Racial. One-thousand five-hundred eighty-two census block groups within the 80-km (50-mi) radius have significant Aggregate Minority populations. Two-hundred seventy-three census block groups within the 80-km (50-mi) radius have significant Hispanic Ethnicity populations. None of the census block groups within the 80-km (50-mi) radius has significant American Indian or Alaskan Native, or Native Hawaiian or Other Pacific Islander populations.

2.6.2.2 Low-Income Populations

NRC guidance defines low-income population based on statistical poverty thresholds (NRC 2001) if either of the following two conditions is met:

- The low-income population in the census block group or the environmental impact site exceeds 50 percent.
- The percentage of households below the poverty level in an environmental impact area is significantly greater (typically at least 20 percentage points) than the low-income population percentage in the geographic area chosen for comparative analysis.

PSEG divided the number of USCB low-income households in each census block group by the total households for that block group to obtain the percentage of low-income households per block group. Table 2.6-5 and Figure 2.6-7 illustrate the low-income block groups in the 80-km (50-mi) radius, based on NRC's criteria. Six-hundred sixty-seven census block groups within the 80-km (50-mi) radius have significant low-income households.

Table 2.6-1 Population and Growth Rates for Surrounding Metropolitan Statistical Areas

MSA	Year	Population	Annual Percent Growth
Wilmington, DE	1990[a]	578,587	NA
	2000[a]	650,501	1.2
	2007[b]	693,929	0.9
Dover, DE	1990[a]	110,993	NA
	2000[a]	126,697	1.4
	2007[b]	152,255	2.0
Baltimore-Towson, MD	1990[a]	2,382,172	NA
	2000[a]	2,552,994	0.7
	2007[b]	2,668,056	0.6
Philadelphia, PA	1990[a]	3,728,909	NA
	2000[a]	3,849,647	0.3
	2007[b]	3,887,694	0.1
Camden, NJ	1990[a]	1,127,927	NA
	2000[a]	1,186,999	0.5
	2007[b]	1,246,339	0.7
Atlantic City, NJ	1990[a]	224,327	NA
	2000[a]	252,552	1.2
	2007[b]	270,644	1.0
Vineland-Millville-Bridgton, NJ	1990[a]	138,053	NA
	2000[a]	146,438	0.6
	2007[b]	155,544	0.9

NA = Not applicable
[a] USCB 2003
[b] USCB 2008a

Table 2.6-2 Residential Distribution of HCGS Employees

County and State of Residence	Number of Employees	Percent of Total
Adams, OH	1	0.1
Atlantic, NJ	3	0.3
Bergen, NJ	1	0.1
Berks, PA	2	0.2
Burlington, NJ	24	2.8
Camden, NJ	40	4.6
Cape May, NJ	3	0.3
Cecil, MD	12	1.4
Chester, PA	31	3.6
Cumberland, NJ	76	8.7
Dane, WI	1	0.1
Darlington, SC	1	0.1
Delaware, PA	25	2.9
Fairfax, VA	1	0.1
Gloucester, NJ	137	15.8
Harford, MD	1	0.1
Howard, MD	1	0.1
Hunterdon, NJ	1	0.1
Kent, DE	1	0.1
Lake, IN	1	0.1
Lancaster, PA	2	0.2
Lehigh, PA	1	0.1
Luzerne, PA	1	0.1
Montgomery, PA	7	0.8
New Castle, DE	144	16.6
New London, CT	1	0.1
Ocean, NJ	1	0.1
Onondaga, NY	1	0.1
Saint Lucie, FL	1	0.1
Salem, NJ	346	39.8
Wayne, OH	1	0.1
Total	**869**	**100**

Shading indicates a county within the socioeconomic region of interest.

Table 2.6-3 Decennial Populations and Growth Rates

	Cumberland		Gloucester		Salem		New Jersey		New Castle		Delaware	
	Population	Annual Percent Growth	Population	Annual Percent Growth	Population	Annual Percent Growth	Population	Annual Percent Growth	Population	Annual Percent Growth	Population	Annual Percent Growth
1970[a]	121,374	NA	172,681	NA	60,346	NA	7,168,164	NA	385,856	NA	548,104	NA
1980[a]	132,866	0.9	199,917	1.5	64,676	0.7	7,364,823	-0.5	398,115	0.3	594,338	0.8
1990[a]	138,053	0.4	230,082	1.4	65,294	0.1	7,730,188	0.5	441,946	1.0	666,168	1.1
2000[b]	146,438	0.6	254,673	1.0	64,258	-0.2	8,414,350	0.9	500,265	1.2	783,600	1.6
2006[c]	154,823	0.9	282,031	1.7	66,595	0.6	8,724,560	0.6	525,587	0.8	853,476	1.4

[a] USCB 1995
[b] USCB 2000b
[c] USCB 2006
NA = Not Applicable

Table 2.6-4 Population and Growth Rates for the City of Salem and Lower Alloways Creek Township

	City of Salem [a,b]		Lower Alloways Creek Twp [a,b]	
	Population	Decennial Percent Growth	Population	Decennial Percent Growth
1970	7648	NA	1400	NA
1980	6959	-9.0	1547	10.5
1990	6883	-1.1	1858	20.1
2000	5857	-14.9	1851	-0.4
2007	5678	-3.1	1883	1.7

[a] USCB 1982
[b] USCB 2008b
NA = Not Applicable

Table 2.6-5 Environmental Justice Summary [a,b]

State Name	County Name	Number of Block Groups	Black	American Indian or Alaskan Native	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Multi-Racial	Aggregate	Hispanic	Low-Income Households
Delaware	Kent	68	7	0	0	0	0	0	9	0	1
Delaware	New Castle	349	66	0	0	0	6	0	72	15	21
Delaware	Sussex	23	1	0	0	0	1	0	2	1	0
Maryland	Baltimore	68	4	0	0	0	0	0	6	0	1
Maryland	Caroline	18	1	0	0	0	0	0	1	0	0
Maryland	Cecil	55	0	0	0	0	0	0	0	0	1
Maryland	Harford	138	3	0	0	0	0	0	6	0	2
Maryland	Kent	19	0	0	0	0	0	0	0	0	0
Maryland	Queen Anne's	16	0	0	0	0	0	0	0	0	0
Maryland	Talbot	2	0	0	0	0	0	0	0	0	0
New Jersey	Atlantic	53	2	0	0	0	0	0	3	2	0
New Jersey	Burlington	133	3	0	0	0	0	0	4	0	0
New Jersey	Camden	407	91	0	0	0	30	0	107	38	47
New Jersey	Cape May	59	3	0	0	0	0	0	3	0	1
New Jersey	Cumberland	101	11	0	0	0	9	0	23	14	9
New Jersey	Gloucester	196	16	0	0	0	0	0	11	0	4
New Jersey	Salem	49	7	0	0	0	0	0	5	0	2
Pennsylvania	Berks	2	0	0	0	0	0	0	0	0	0
Pennsylvania	Chester	243	15	0	0	0	1	0	17	11	6
Pennsylvania	Delaware	462	82	0	8	0	0	0	95	0	13
Pennsylvania	Lancaster	44	0	0	0	0	0	0	0	0	0
Pennsylvania	Montgomery	311	33	0	0	0	0	0	41	2	3
Pennsylvania	Philadelphia	1762	975	0	59	0	138	1	1177	190	556
Pennsylvania	York	7	0	0	0	0	0	0	0	0	0
	TOTALS:	4585	1320	0	67	0	185	1	1582	273	667

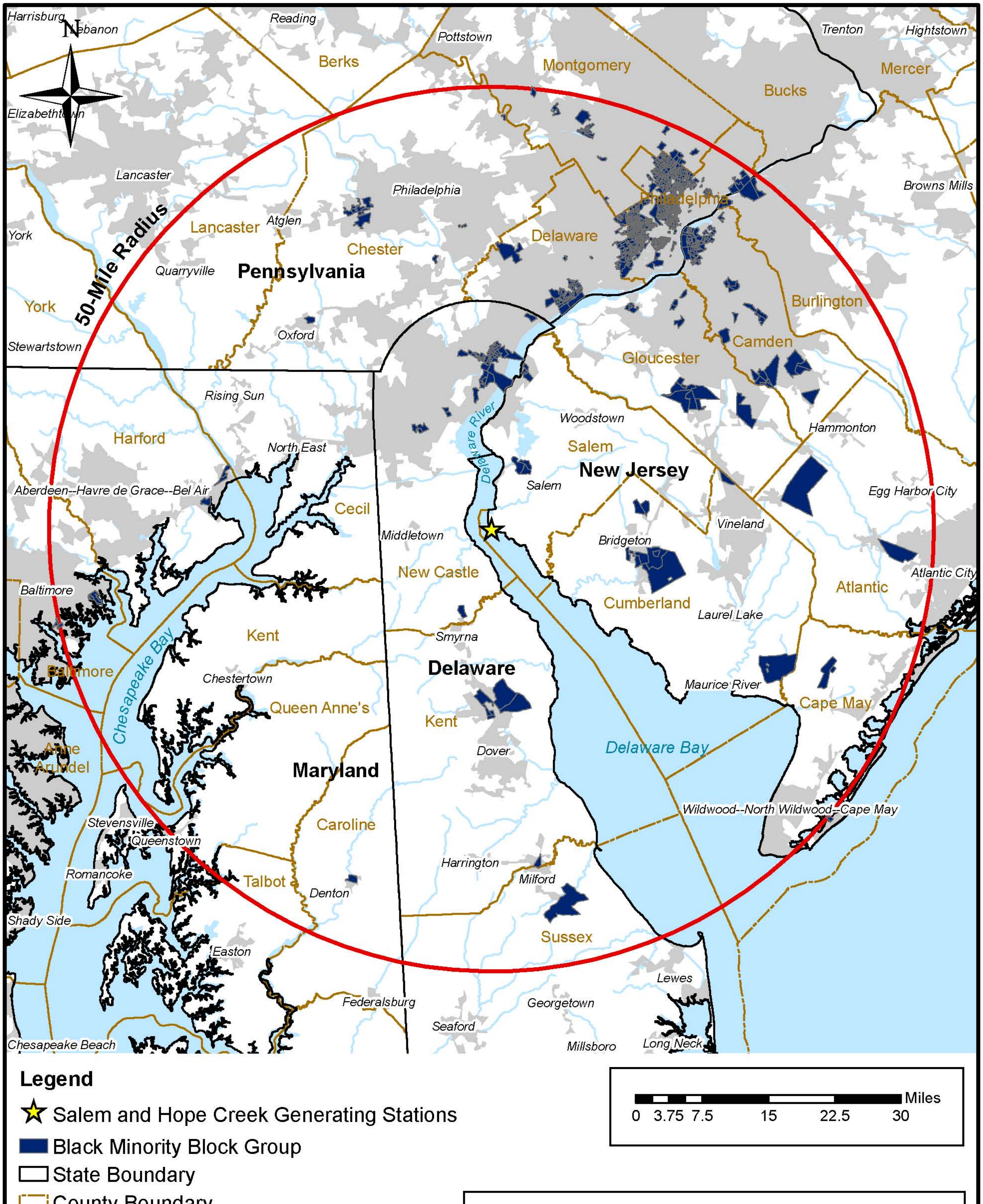
Table 2.6-5 Environmental Justice Summary (Continued)

	Black	American Indian or Alaskan Native	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Multi-Racial	Aggregate	Hispanic	Low-Income Households
Delaware Percentages	19.23	0.35	2.07	0.04	2.02	1.66	25.37	4.76	8.75
Maryland Percentages	27.89	0.29	3.98	0.04	1.80	1.96	35.97	4.30	8.32
New Jersey Percentages	13.57	0.23	5.71	0.04	5.36	2.54	27.45	13.28	8.29
Pennsylvania Percentages	9.97	0.15	1.79	0.03	1.53	1.16	14.63	3.21	10.99

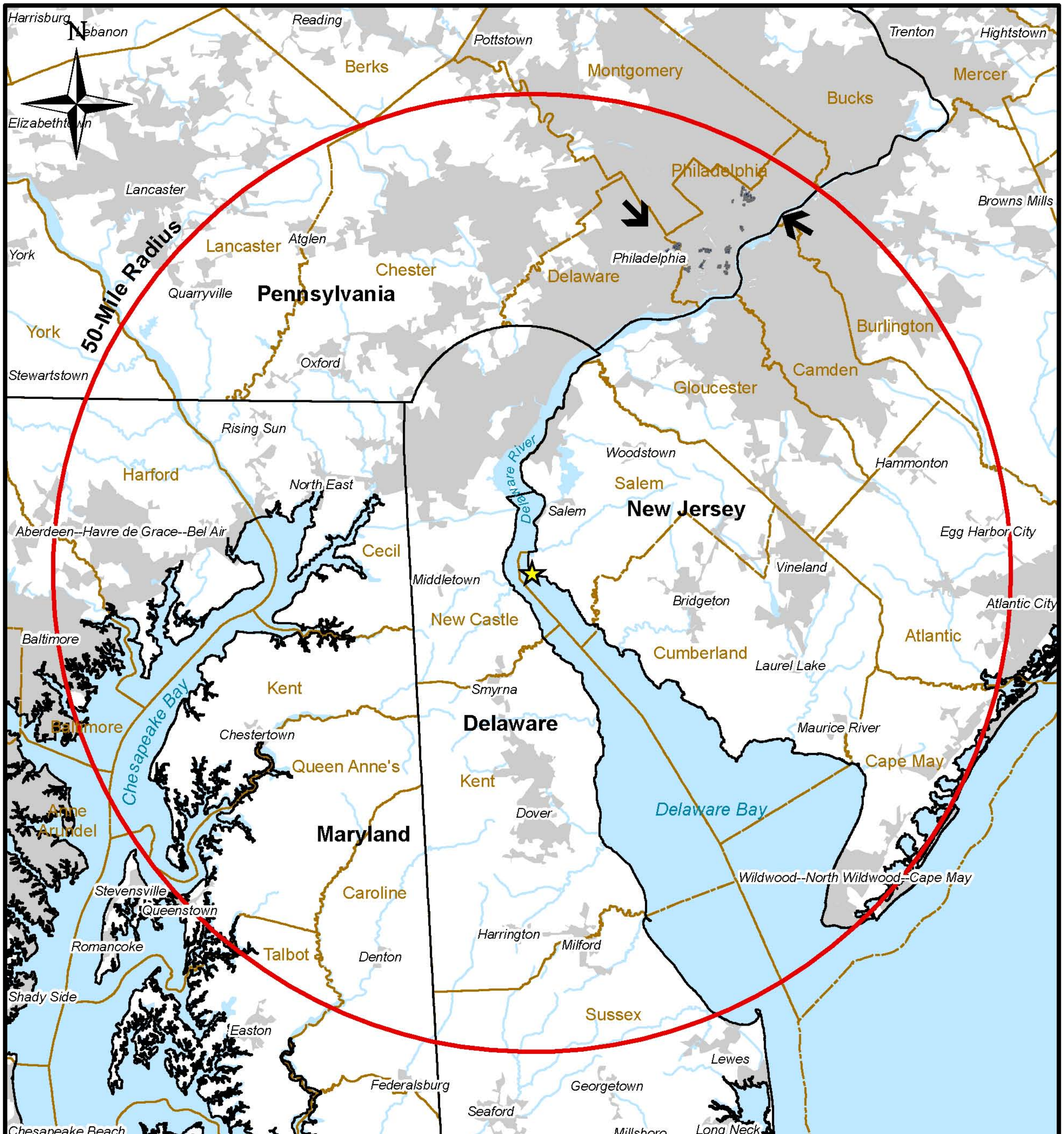
Highlighted counties are completely contained within the 50-mile radius.

[a] USCB 2000a

[b] Table entries denote number of census block groups, except on lines indicated as “percentages.”



Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 2.6-1 Black Minority Populations

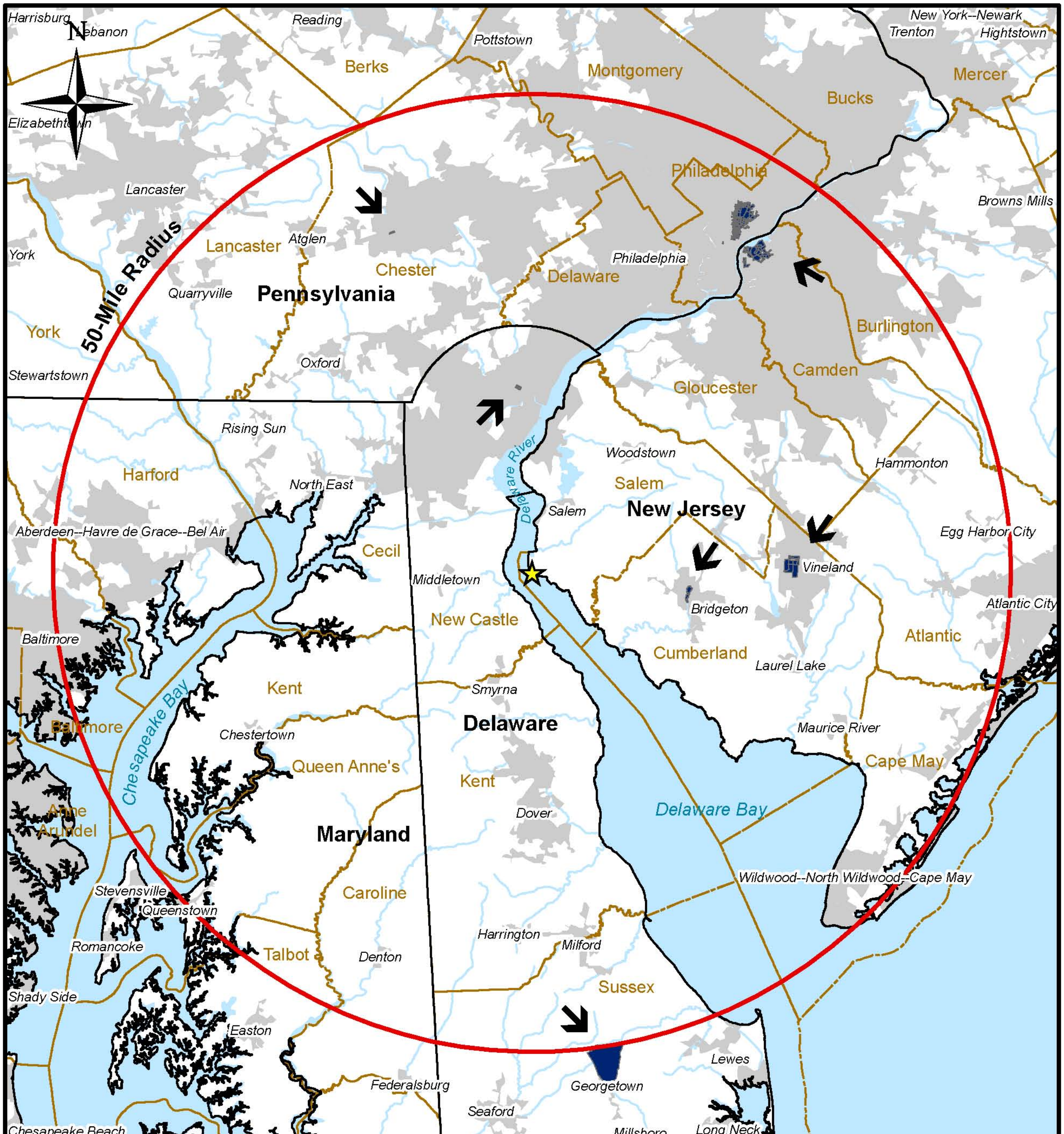


Legend

- ☆ Salem and Hope Creek Generating Stations
- Asian Minority Block Group
- State Boundary
- County Boundary
- Urban Area
- Water

Miles: 0, 3.75, 7.5, 15, 22.5, 30

Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 2.6-2 Asian Minority Populations

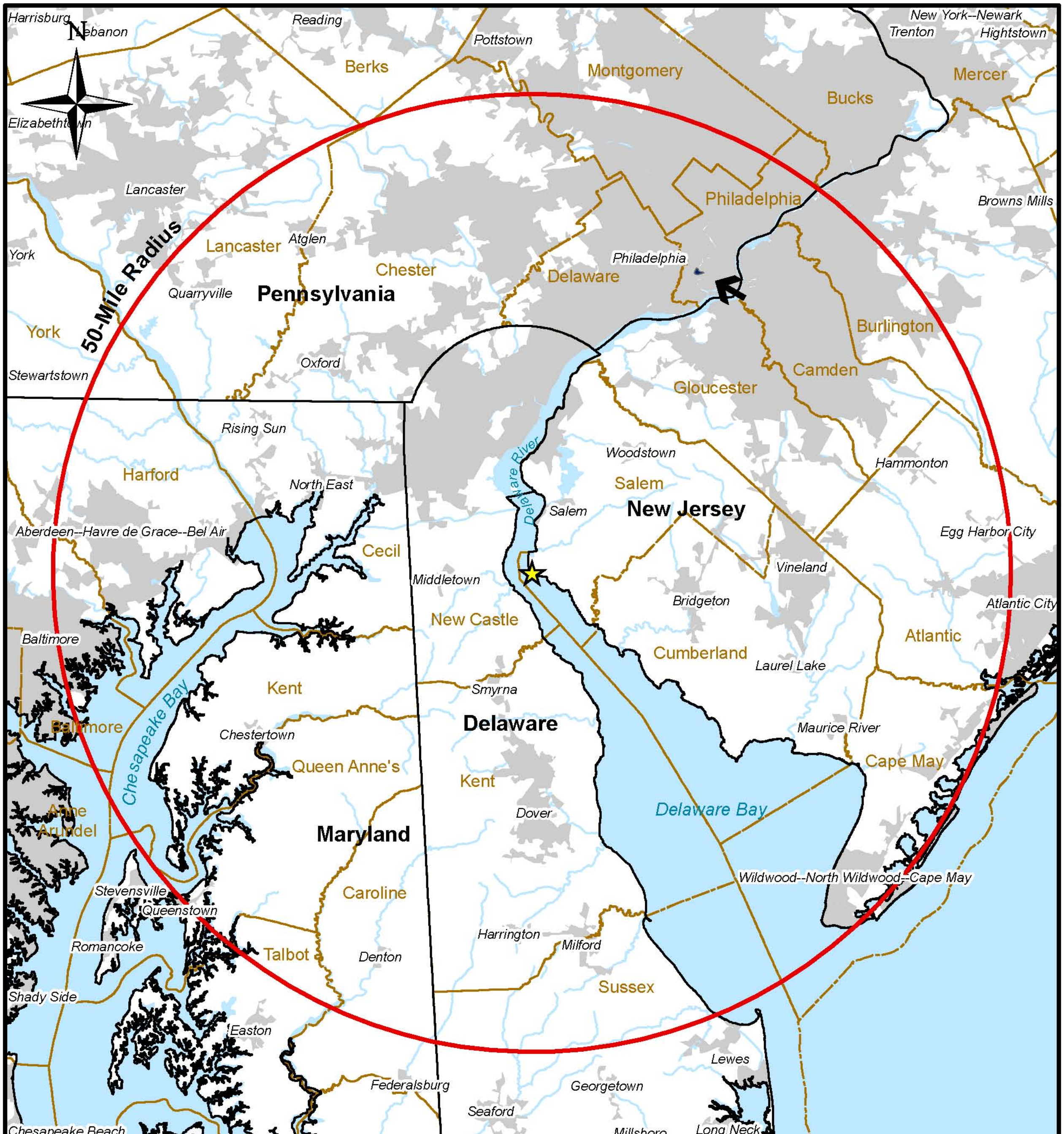


Legend

- ☆ Salem and Hope Creek Generating Stations
- Other Minority Block Group
- State Boundary
- County Boundary
- Urban Area
- Water

Miles: 0, 3.75, 7.5, 15, 22.5, 30

Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 2.6-3 Other Minority Populations

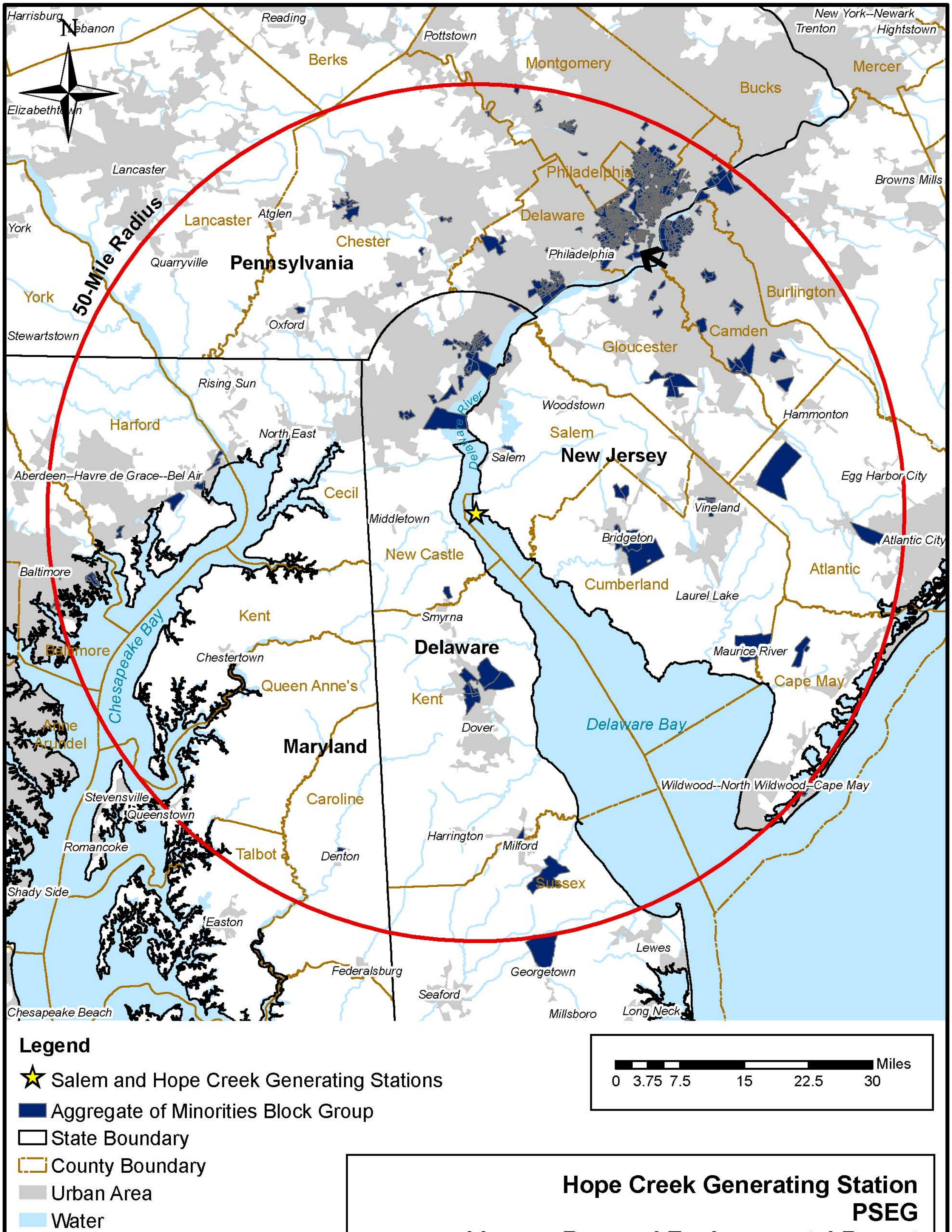


Legend

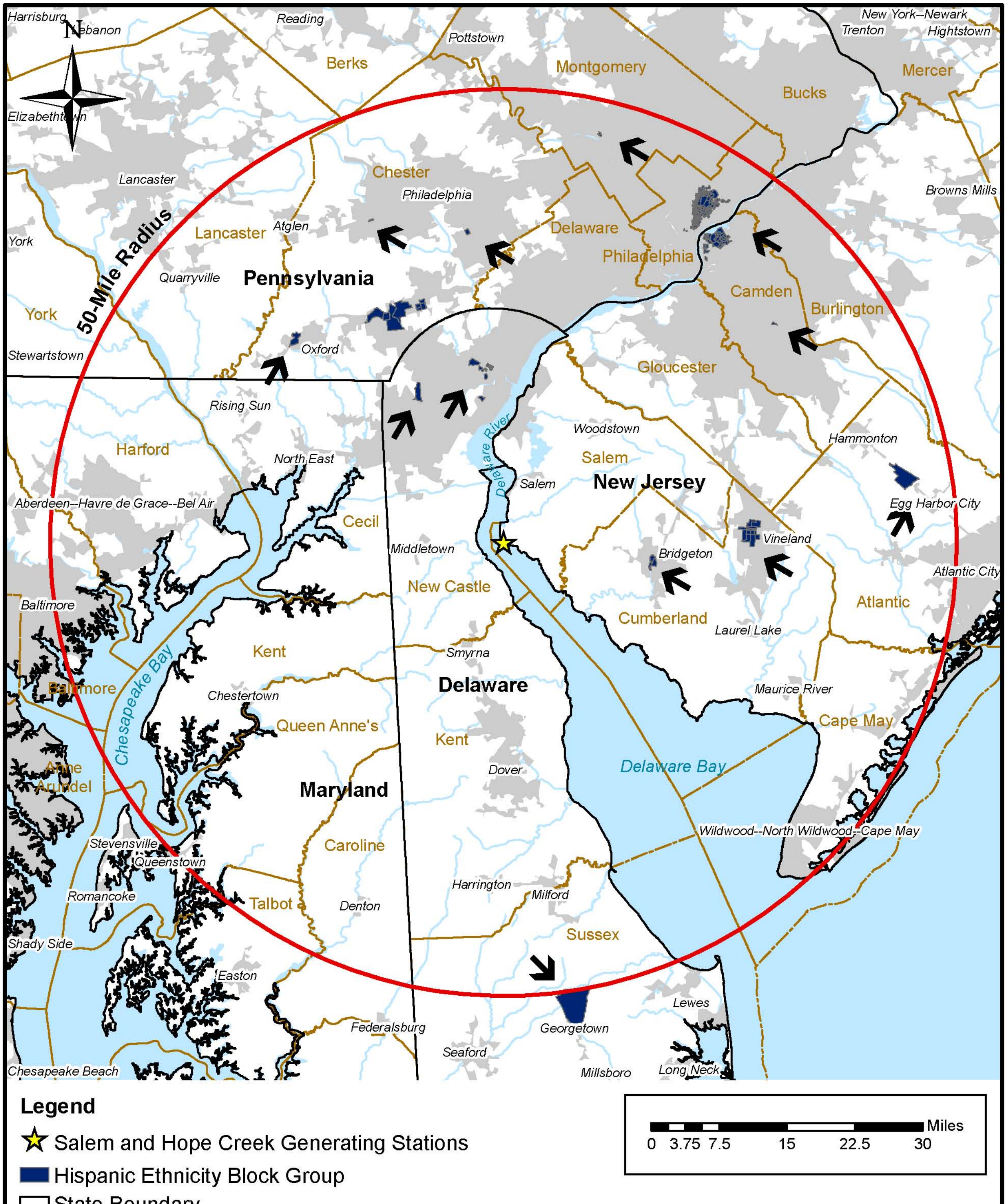
- Salem and Hope Creek Generating Stations
- Multi-Racial Minority Block Group
- State Boundary
- County Boundary
- Urban Area
- Water

Miles: 0, 3.75, 7.5, 15, 22.5, 30

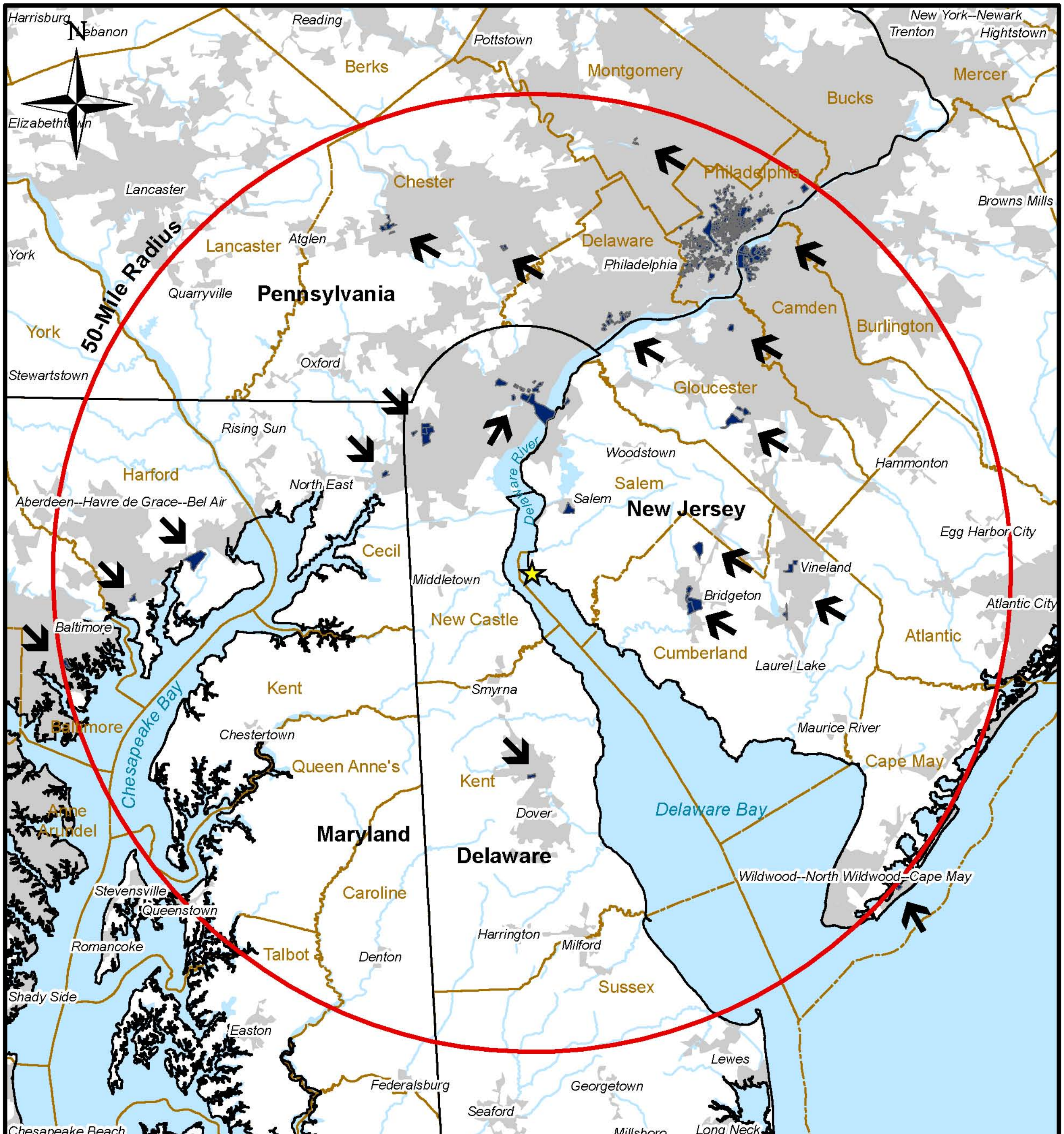
Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 2.6-4 Multi-Racial Minority Populations



Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 2.6-5 Aggregate of Minorities Populations



Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 2.6-6 Hispanic Ethnicity Minority Populations



Legend

- Salem and Hope Creek Generating Stations
- Low-Income Household Block Group
- State Boundary
- County Boundary
- Urban Area
- Water

Miles
0 3.75 7.5 15 22.5 30

Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 2.6-7 Low-Income Households

2.7 Taxes

New Jersey is one of a few states that initiate the budget process at a local, rather than county, level. In addition, local governments in New Jersey use the calendar year as opposed to a July-June fiscal year. Property taxes collected in Lower Alloways Creek Township are not retained by the township but are provided to Salem County, which provides most services to residents of Lower Alloways Creek Township.

PSEG pays property taxes to Lower Alloways Creek Township for HCGS. Over the last five years, the taxes paid to Lower Alloways Creek Township for HCGS ranged from a low of $457,029 in 2006 to a high of $485,624 in 2005 (Table 2.7-1). PSEG also pays taxes to the City of Salem for the Energy and Environmental Resource Center, which is located in the City of Salem and is shared by Salem and HCGS. Table 2.7-1 summarizes PSEG's property tax payments to Lower Alloways Creek and the City of Salem from 2003 to 2007.

From 2003 through 2007, Lower Alloways Creek Township collected between $2,099,185 (in 2003) and $2,325,378 (in 2005) annually in total commercial property tax revenues (Table 2.7-1). From 2003 to 2007, HCGS's property tax payments represented 20.8 to 22.1 percent of Lower Alloways Creek Township's total property tax revenues. PSEG's property tax payment to Lower Alloways Creek Township is large enough to relieve the Lower Alloways Creek residents of the burden of local municipal property taxes on residences, local school taxes, and open space municipal taxes (a local option). The Lower Alloways Creek residents only pay Salem County taxes and county open space taxes. The PSEG property tax payments represent 1.03 to 1.34 percent of Salem County's total property tax revenues during the same time period (Table 2.7-1).

From 2003 through 2007, the City of Salem collected between $5,092,527 and $7,389,319 annually in total property tax revenues (see Table 2.7-1). The City of Salem's property tax revenues are allocated to county services, schools, open space, and municipal services. From 2003 to 2007, PSEG's property tax payments for the Energy and Environmental Resource Center represented 2.6 to 3.2 percent of the City of Salem's total property tax revenues. The City of Salem's property tax revenues are allocated to county services, schools, open space, and municipal services.

Table 2.7-1 Tax Information for HCGS and the Energy and Environmental Resource Center, 2003 - 2007

PSEG's Property Taxes for HCGS					
	2003	**2004**	**2005**	**2006**	**2007**
Amount PSEG Paid in Property Tax	$464,677	$474,512	$485,624	$457,029	$480,476
Lower Alloways Creek Total Property Tax Revenue[a]	$2,099,185	$2,251,474	$2,325,378	$2,195,746	$2,310,262
Percent of Lower Alloways Creek Total Property Tax Revenues	22.1	21.1	20.9	20.8	20.8
Salem County Total Property Tax Revenue[a]	$34,697,781	$36,320,365	$40,562,971	$43,382,037	$46,667,551
Percent of Salem County Total Property Tax Revenues	1.34	1.31	1.20	1.05	1.03
PSEG's Property Taxes for the Energy and Environmental Resource Center in Salem New Jersey[b]					
	2003	**2004**	**2005**	**2006**	**2007**
Amount PSEG Paid in Property Tax	$131,477	$156,974	$163,695	$169,381	$236,408
City of Salem Total Property Tax Revenues[a]	$5,092,527	$6,049,675	$6,294,613	$6,485,947	$7,389,319
Percent of City of Salem Total Property Tax Revenues	2.6	2.6	2.6	2.6	3.2

[a] Source: State of New Jersey 2008

[b] Property taxes for the Energy and Environmental Resource Center is provided for information only. The Resource Center would not be affected by any license renewal decision.

2.8 Land Use Planning

This section focuses on Salem County because the property taxes paid by PSEG for HCGS and the Energy and Environmental Resource Center are paid to the municipalities in Salem County. Land use in the City of Salem and in Lower Alloways Creek Township is analyzed because PSEG pays property taxes to these municipalities, which host the Energy and Environmental Resource Center and HCGS, respectively. Regional and local planning officials have shared goals of encouraging expansion and development in areas where public facilities, such as water and sewer systems, have been planned, and discouraging incompatible land use mixes in agricultural or open spaces (Rukenstein and Associates 2004).

2.8.1 SALEM COUNTY

Salem County occupies roughly 875 km^2 (338 mi^2) of land area (USCB 2008b) in the southwestern corner of New Jersey and is bordered by Gloucester County to the north, Cumberland County to the east and south, and the Delaware River to the west. Salem County's Smart Growth Plan, submitted for final adoption in January 2004 (Rukenstein and Associates 2004), focuses on directing future growth toward the western side of the county, where infrastructure and major roadways already exist, and containing growth in the eastern and central portions to protect the traditional agrarian economy of the area. The Smart Growth Plan sets forth a strategic plan for a western economic growth and development corridor. Only ten percent of Salem County is developed for residential, commercial, or industrial use. Over half the county's land comprises tidal and fresh water wetlands, lakes, ponds, and forests, and the remainder (over one-third of the total area) is farmland. Salem County would like to provide sustainable economic development while protecting its rural character. Salem County has no measures to limit growth (Rukenstein and Associates 2004).

2.8.2 CITY OF SALEM

The City of Salem is the county seat of Salem County and had a population of approximately 5,700 in 2007. As noted in Section 2.6, in general, the City of Salem's population has been declining for decades. In 1999, "Salem Main Street" was formed to stimulate business opportunities, historic preservation, and community growth. Salem Main Street created the Main Street Revitalization Master Plan, which acts as a "road map" for future land use for the City of Salem. The Master Plan focuses on creating a cohesive town core and coordinating with Salem County to reduce competition between the city and the county. (Salem Main Street 2003)

2.8.3 LOWER ALLOWAYS CREEK TOWNSHIP

Lower Alloways Creek Township occupies approximately 122 km^2 (47 mi^2) in the southwest corner of Salem County (Lower Alloways Creek Township 1992) and had a population of approximately 1,900 in 2007. Lower Alloways Creek's land use plan focuses on preserving farmland and open spaces and directing growth toward areas of the community most capable of providing necessary services (Lower Alloways Creek Township 1992).

The 2005 Master Plan Reexamination Report for Lower Alloways Creek Township states that there has been little change in the Township's land use patterns since the last Master Plan review in 1999 (Alaimo Group 2005). The Master Plan describes the following land use (Lower Alloways Creek Township 1992):

- Residential – seven percent
- Commercial – <one percent
- Industrial – three percent (the industrial district is entirely composed of the nuclear generating facilities on Artificial Island)
- Public/Quasi-public – 37.5 percent
- Agriculture – 52 percent

The Master Plan designates the area immediately adjacent to Artificial Island as appropriate for additional industrial development.

2.9 Social Services and Public Facilities

2.9.1 PUBLIC WATER SUPPLY

Because HCGS is in Salem County and most of the HCGS employees reside in Salem, Cumberland, or Gloucester counties (in New Jersey), or New Castle County (in Delaware), the discussion of public water supply systems will be limited to these counties.

2.9.1.1 Salem County

Salem County is served by 15 public water systems. In addition to the large public systems, there are some small private systems that serve individual communities such as mobile home parks. Public water systems serve approximately 41,700 persons (EPA 2008a). Water systems serving the largest populations are Penns Grove Water Supply (approximately14,400 persons served in Salem and Gloucester counties) and the Pennsville Water Department (approximately 13,500 persons served) (EPA 2008a). The sources for these systems are primarily ground water. Table 2.9-1 lists the largest municipal water suppliers (serving more than 5,000 people) in Salem, Gloucester, and Cumberland counties, and indicates their daily peak demands, total capacities, and excess capacities.

The Penns Grove Water Supply is at 80 percent of capacity. In order to provide additional storage capacity, Carneys Point Township, which receives water from Penns Grove Water Supply, has secured federal and state grants for the Penns Grove Water Supply to construct an additional 500,000-gallon storage tank. The Penns Grove Water Supply Company has requested additional permitted capacity from NJDEP to meet the projected demand. (Rukenstein and Associates 2004)

2.9.1.2 Cumberland County

Cumberland County is served by 15 public water systems. In addition to the large public systems, there are some small private systems that serve individual communities such as mobile home parks. Public water systems serve approximately 83,300 persons. Water systems serving the largest populations are Vineland Water & Sewer Utility (approximately 33,000 persons served), the Millville Water Department (approximately 27,500 persons), and the Bridgeton Water Department (approximately 23,000 persons). The sources for these systems are primarily ground water. (EPA 2008a)

2.9.1.3 Gloucester County

Gloucester County has 32 public water systems. In addition to the large public systems, there are some small private systems that serve individual communities such as mobile home parks and campgrounds. Public water systems serve approximately 220,000 persons. Water systems serving the largest populations are Washington Municipal Utilities Authority (MUA) (approximately 48,000 persons served), the Monroe MUA (approximately 26,000 persons served), the Deptford MUA (approximately 26,000 persons), and the West Deptford Water Department (approximately 20,000 persons). The sources for these systems are primarily ground water, with the exception of the Deptford MUA, which uses purchased surface water. (EPA 2008a)

2.9.1.4 New Castle County, Delaware

Seventy-five percent of drinking water in New Castle County comes from surface water sources and 25 percent is from ground water (New Castle County 2007). New Castle County is served by three privately owned water utilities and four city-owned water utilities. Public and private water systems serve approximately 334,000 persons (EPA 2008a). The sources for these systems are ground and surface water. Table 2.9-2 lists the daily demand, total capacity, and excess capacity for those water systems for which information was available.

2.9.2 TRANSPORTATION

Salem County is traversed by two major highways, one interstate highway (I-295) and the New Jersey Turnpike. Road access to HCGS is via Alloways Creek Neck Road, a small two-lane road, to Nuclear Station Access Road. The combined HCGS and Salem workforces use the Nuclear Station Access Road entrance. Approximately 11 km (seven mi) east of HCGS, Alloways Creek Neck Road intersects County Route 658, which has a north-south orientation (Figure 2.9-1). Employees traveling to HCGS from locations to the north, northeast, or northwest, could use a variety of interstate, state, and secondary roads to access State Route 49, which intersects County Route 658 at the western edge of the City of Salem. These employees could then reach HCGS by traveling south on County Route 658 to Alloways Creek Neck Road. Employees traveling to HCGS from Greenwich could use County Route 623, which intersects Alloways Creek Neck Road about one mile east of the intersection of Alloways Creek Neck Road and County Route 658. From County Route 623, these employees could reach HCGS by traveling west on Alloways Creek Neck Road. Employees from farther south than Greenwich or from the southeast could reach HCGS by using a variety of state highways and secondary roads to access State Route 49. From State Route 49, these employees could reach HCGS by traveling northwest to County Route 667, then west to County Route 623, and from there, south to Alloways Creek Neck Road.

Table 2.9-3 provides annual average daily traffic counts (AADTs) for roads in the vicinity of HCGS for which traffic counts were available. Figure 2.9-1 shows the locations at which such AADTs are collected and the major roadways in the area. New Jersey does not collect data for highway Levels of Service.

Table 2.9-1 Major Water Suppliers (serving 5,000 or more people) in Salem, Cumberland, and Gloucester Counties, New Jersey

Water System Name	County	Population Served[a]	Primary Water Source	Peak Daily Demand plus additional Committed Peak (MGD)	Total Capacity (MGD)	Excess Capacity (MGD)
Bridgeton Water Department	Cumberland	22,770	Ground water	3.083	5.616	2.533
Millville Water Department	Cumberland	27,500	Ground water	7.232	7.82	0.588
Vineland Water & Sewer Utility	Cumberland	33,000	Ground water	14.91	16.392	1.482
Clayton Water Department	Gloucester	7,155	Ground water	1.42	1.944	0.524
Deptford MUA	Gloucester	26,000	Purchased surface water	4.628	8.6	3.972
Glassboro Water Department	Gloucester	19,238	Ground water	3.829	6.036	2.207
Greenwich Water Department	Gloucester	4,900	Ground water	1.427	1.972	0.545
Mantua MUA	Gloucester	11,713	Ground water	2.172	2.376	0.204
Monroe MUA	Gloucester	26,145	Ground water	4.789	6.54	1.751
NJ American Water Company	Gloucester	5,967	Ground water	1.518	2.146	0.628
Paulsboro Water Department	Gloucester	6,200	Ground water	1.248	1.8	0.552
Penns Grove Water Supply Company	Gloucester/Salem	14,406	Ground water	2.377	3.055	0.678
Pitman Water Department	Gloucester	9,445	Ground water	0.85	1.67	0.82
South Jersey Water Supply	Gloucester	9,181	Ground water	2.635	3.398	0.763
Washington MUA	Gloucester	48,000	Ground water	7.992	11.7	3.708
West Deptford Water Department	Gloucester	20,000	Ground water	3.265	6.884	3.619
Westville Water Department	Gloucester	6,000	Ground water	0.696	1.728	1.032
Woodbury Water Department	Gloucester	11,000	Purchased surface water	1.857	5.76	3.903
Pennsville Water Department	Salem	13,500	Ground water	1.445	3.376	1.931
Salem Water Department	Salem	6,199	Surface water	1.655	4.274	2.619
Total Excess Capacity						**34.1**

Source: EPA 2008a; NJDEP 2007b

[a] Population served may include more or less persons than previously specified within the geopolitical boundaries

MUA = Municipal Utility Authority

Table 2.9-2 Major Water Suppliers (serving 5,000 or more people) in New Castle County, Delaware

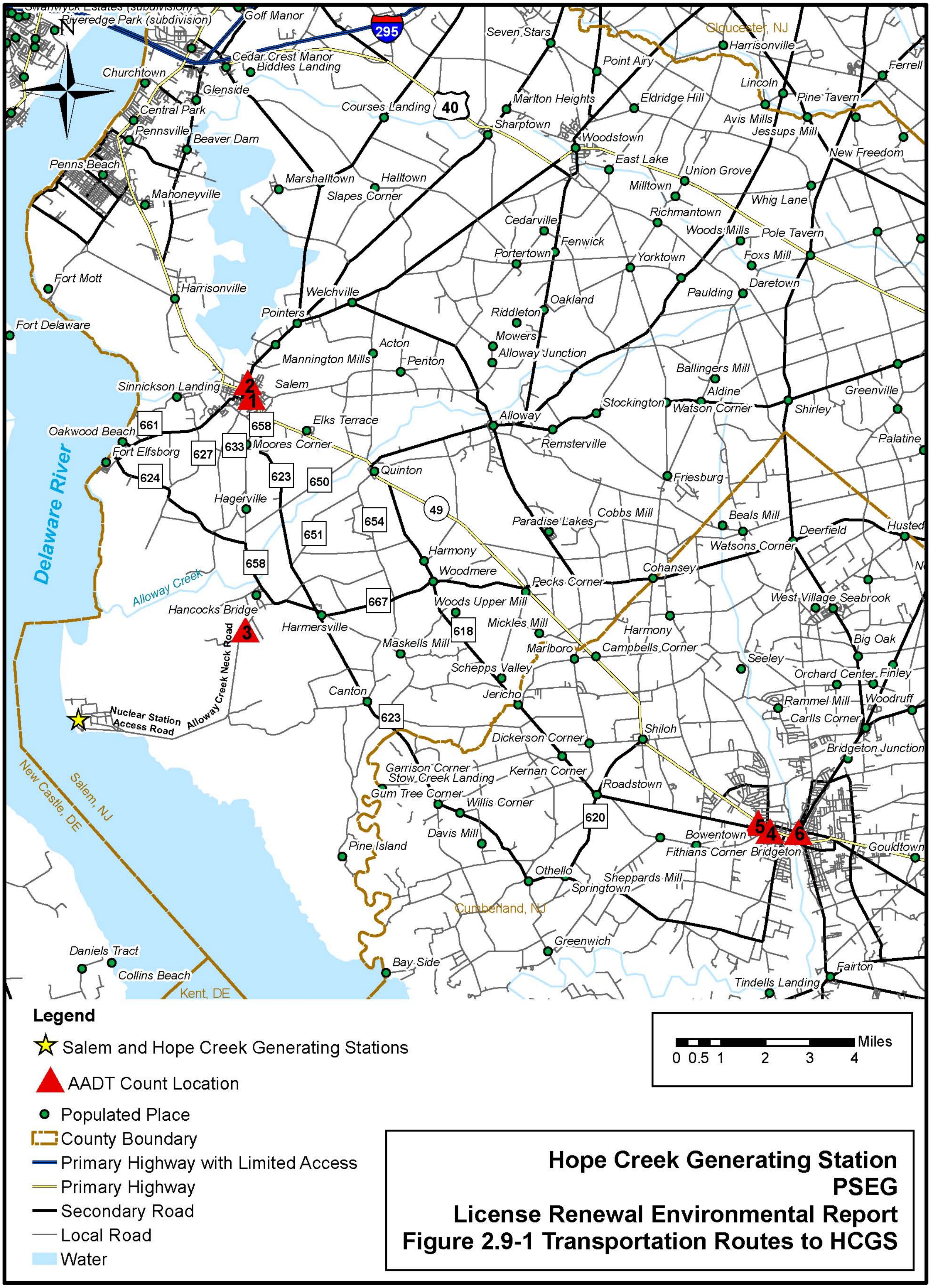
Water System Name	Population Served[a]	Primary Water Source Type	Average Daily Production (MGD)	Maximum Capacity (MGD)
Artesian Water Company, Inc.	6,483	Purchased surface water	NA	NA
City of Wilmington Water	140,000	Surface water	29	61
Tidewater Utilities, Inc.	30,000	Ground water	NA	NA
United Water Delaware	105,270	Surface water	NA	NA
New Castle Water Department	6,000	Ground water	0.5	1.3
Middletown Water Department	9,900	Ground water	NA	NA
Newark Water Department	36,130	Surface water	4	6
Total Production/ Capacity			33.5	68.3
Total Excess Capacity				**34.8**

Source: EPA 2008a; TetraTech 2008
MGD = million gallons per day
NA = Not Available
[a] Population served may include more or less persons than previously specified within the geopolitical boundaries

Table 2.9-3 Annual Average Daily Traffic Counts on Roads in the Vicinity of HCGS

	Roadway and Location	Annual Average Daily Traffic (AADT)
1[a]	NJ 49, between NJ 45 and York Street	12,920
2	NJ 45, between CR 657 and Howell Street	11,246
3	Alloways Creek Neck Road, between Grosscup Road and Pancoast Road	3,175
4	NJ 49, between CR 607 and Lawrence Street	12,340
5	NJ 49, between CR 607 and Commerce Street	8,490
6	NJ 49, between Laurel Street and NJ 77	20,590

Source: NJDOT 2007
[a] Numbers refer to locations on Figure 2.9-1.



Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 2.9-1 Transportation Routes to HCGS

2.10 Meteorology and Air Quality

HCGS is located in Salem County, New Jersey. New Jersey, while small in total land area (20,295 km^2 [7,836 mi^2]), has five distinct climatic zones: Northern, Central, Pine Barrens, Southwest, and Coastal. The diversity of climatic conditions is attributed to the regional geology, close proximity to the Atlantic Ocean, and the prevailing atmospheric flow pattern impacting the state. The Northern Zone is dominated by mountainous climate that is unlike other zones in the state. This area receives the most precipitation and thunderstorms. The Central Zone is comprised of heavily urbanized areas, which affect local temperatures. The boundary of freezing and non-freezing precipitation is located near the northern portion of this zone. The climate of the Pine Barrens Zone is affected by the dense forests and sandy soils, which allow for drier conditions and a wider range of maximum and minimum daily temperatures. The Coastal Zone is heavily influenced by continental and oceanic conditions. The climatic conditions of this zone are affected by ocean breezes, which buffer extreme seasonal temperature fluctuations compared to the inland portions of the state. Coastal storms also influence this zone, resulting in higher winds and larger cumulative effects from precipitation. The Southwest Zone is close to the Delaware Bay, and its climate is influenced to some degree by maritime weather conditions. High humidity and moderate temperatures produced by prevailing winds from the south or east and early spring conditions provide the longest growing season in New Jersey. (NCDC 2008a)

Salem County is in the Southwest climate zone, and the local climate can be described as humid continental and humid sub-tropical (PSEG 2009c). Based on data from the National Oceanic and Atmospheric Administration's weather station in Salem County, New Jersey (Woodstown Pittsgrove Station), winter temperatures average 1.78 degrees Celsius (°C; 35.2 degrees Fahrenheit [°F]) and summer temperatures average 23.78°C (74.8°F). Average annual precipitation is 112 cm (44 in), with the most precipitation in July and August. The average seasonal snowfall is 39 cm (15 in), with the largest percentage falling during the month of January (NCDC 2008b).

Under the Clean Air Act, the U.S. Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS), which specify maximum concentrations for carbon monoxide (CO), particulate matter with aerodynamic diameters of 10 microns or less (PM_{10}), particulate matter with aerodynamic diameters of 2.5 microns or less ($PM_{2.5}$), ozone, sulfur dioxide (SO_2), lead, and nitrogen dioxide (NO_2). Areas of the United States having air quality as good as or better than the NAAQS are designated by the EPA as "attainment areas." Areas having air quality that is worse than the NAAQS are designated by EPA as "non-attainment areas." Those areas that were previously designated non-attainment and subsequently re-designated as attainment due to meeting the NAAQS are termed "maintenance areas." States with maintenance areas are required to develop an air quality maintenance plan as an element of the State Implementation Plan.

Salem County, New Jersey, is part of the Metropolitan Philadelphia Interstate Air Quality Control Region (AQCR) (40 CFR 81.15). Salem County is in attainment for CO, SO_2, and NO_2. However, several neighboring counties are designated non-attainment or maintenance areas (NJDEP 2008g).

Salem County is designated as non-attainment for 8-hour ozone (40 CFR 81.331). On March 12, 2008, the EPA significantly strengthened its national air quality standards for ground-level ozone. As the regulations require, NJDEP has provided recommendations to EPA regarding areas to be designated as attainment, non-attainment, or unclassifiable. (NJDEP 2009) The EPA will issue final designations by 2010 or 2011 (EPA 2008b). Salem County's non-attainment designation would not be expected to change following the issuance of new EPA standards.

Salem County is in attainment for $PM_{2.5}$; however, New Castle County, Delaware, which is across the Delaware River from HCGS, is non-attainment for $PM_{2.5}$ (40 CFR 81.331). In October 2006, the EPA issued a final rule that revised the 24-hour $PM_{2.5}$ standard and revoked the annual PM_{10} standard (EPA 2006a). Non-attainment designations for PM_{10} are not affected by the new rule, but additional non-attainment areas could be designated under the new $PM_{2.5}$ standard (EPA 2008c). Salem County is in attainment for PM_{10}. On December 18, 2007, the NJDEP submitted recommendations to the EPA that identified many areas surrounding Salem County as not in attainment with the 2006 24-hour $PM_{2.5}$ NAAQS. Under the final rule, Salem County, including the HCGS site, is in attainment (NJDEP 2008g).

The Clean Air Act, as amended, established 156 Mandatory Class I Federal Areas where visibility is an important issue. The Brigantine Wilderness (a portion of the Edwin B. Forsythe National Wildlife Refuge) is approximately 93 km (58 mi) southeast of HCGS, and is the only Class I area located within 161 km (100 mi) of HCGS (40 CFR 81.420).

2.11 Historic and Archaeological Resources

2.11.1 REGIONAL HISTORY IN BRIEF

Aboriginal people migrated to New Jersey approximately 15,000 years ago. Three major cultural traditions dominated the prehistory of New Jersey and the Middle Atlantic Coastal Plain: the Paleo-Indian Tradition (15,000 to 10,000 years ago); the Archaic Tradition (10,000 to 3,000 years ago); and the Woodland Tradition (3,000 years ago to European contact). Artifacts from the Paleo-Indians are the earliest documented evidence of early populations inhabiting the area now known as New Jersey. When the first European explorers and settlers came to the area, they found the Late Woodland period people (BBNEP 2001).

When the European immigrants arrived in the mid-1600s and early 1700s, they settled first along the coastal bays and inlets of the Hudson, Hackensack, Passaic, and Raritan river valleys in northern New Jersey, and the Delaware River Valley and inner Coastal Plain south of Trenton. The area between the Delaware River and the Atlantic Ocean in the southern part of the outer Coastal Plain was still "unsettled" in 1765. This vast area, eventually called the "Pine Barrens," was used by the earliest European settlers largely for harvesting lumber and hunting, and later it supplied resources for colonial industries. From the 17th through the 20th centuries, European settlers engaged in a number of vocations and avocations in the New Jersey Pine Barrens, such as hunting, fishing, lumber harvesting, shipbuilding, bog iron manufacture, charcoal manufacture, cranberry and blueberry cultivation, salt hay and eelgrass harvesting, sphagnum moss harvesting, mineral (silica) extraction, salt harvesting, and tourism. A number of these industries no longer exist for various reasons, including resource depletion (BBNEP 2001).

2.11.2 PRE-OPERATIONAL AND OPERATIONAL HISTORIC AND ARCHAEOLOGICAL ANALYSIS

HCGS is on the southern portion of Artificial Island. Beginning in the early 1900s, Artificial Island was created by disposing of hydraulic dredge spoil within a progressively larger diked area on a natural peninsula that projected into the river. The completed island is approximately 607 hectares (1,500 acres) with an average elevation of three m (nine ft) above msl (AEC 1973). The Final Environmental Statement for the operation of HCGS identified 57 properties listed on the National Register of Historic Places within a 16-km (ten-mi) radius of the station (NRC 1984). Due to the disturbed and artificial nature of the PSEG property, no archaeological resources have ever been identified.

2.11.3 CURRENT HISTORIC AND ARCHAEOLOGICAL ANALYSIS

As of 2008, 21 properties in Salem County, New Jersey, and 387 properties in New Castle County, Delaware, have been listed on the National Register of Historic Places. Of these 408 properties, six locations in Salem County, New Jersey (NPS 2008a), and 17 locations in New Castle County, Delaware (NPS 2008b), fall within a ten-km (six-mi) radius of the HCGS (Table 2.11-1).

Table 2.11-1 Sites Listed on the National Register of Historic Places within a 10-km (6-mi) Radius of HCGS

Resource Name	Address	City	Distance (km [mi]) from Station
Salem County, New Jersey			
Alloways Creek Friends Meetinghouse	Buttonwood Avenue, 150 ft. West of Main Street	Hancock's Bridge	8 (5)
Hancock House	3 Front Street	Hancock's Bridge	8 (5)
Holmes, Benjamin, House	West of HCGS on Fort Elfsborg-Hancock's Bridge Road	Salem	10 (6)
Nicholson, Abel and Mary, House	Junction of Hancocks Branch and Fort Elfsborg Road, Elsinsboro Township	Salem	8 (5)
Nicholson, Sarah and Samuel, House	Two miles South of HCGS on Amwellbury Road	Salem	10 (6)
Ware, Joseph, House	134 Poplar Street	Hancock's Bridge	6 (4)
New Castle County, Delaware			
Ashton Historic District	North of Port Penn on Thornton Road	Port Penn	8 (5)
Augustine Beach Hotel	South of Port Penn on DE 9	Port Penn	6 (4)
Cleaver House	Off Biddle's Corner Road	Port Penn	10 (6)
Dilworth House	Off DE 9	Port Penn	8 (5)
Gordon, J.M., House	Route 44	Odessa	8 (5)
Green Meadow	Thomas Landing Road (DE 440), Appoquinimink Hundred	Odessa	6 (4)
Grose, Robert, House	1000 Port Penn Road	Port Penn	8 (5)
Hart House	East of Taylors Bridge on DE 453	Taylor's Bridge	5 (3)
Hazel Glen	West of Port Penn on DE 420	Port Penn	8 (5)
Higgins, S., Farm	Route 423	Odessa	8 (5)
Johnson Home Farm	Co. Road 453 East of Junction with DE 9, Blackbird Hundred	Taylor's Bridge	6 (4)
Liston House	East of Taylors Bridge on DE 453	Taylor's Bridge	6 (4)
Misty Vale	Route 423	Odessa	10 (6)
Port Penn Historic District	DE 9	Port Penn	6 (4)
Reedy Island Range Rear Light	Junction of DE 9 and Road 453	Taylor's Bridge	8 (5)
Thomas, David W., House	326 Thomas Landing Road, Appoquinimink Hundred	Odessa	8 (5)
Vandegrift, J., House	Route 44	Odessa	8 (5)

2.12 Known or Reasonably Foreseeable Projects in Site Vicinity

As indicated on Figure 2.1-2, there is no urban area within the 10-km (6-mi) radius of HCGS, nor is there any industrial development. The immediate vicinity consists of extensive tidal marshlands and low-lying meadowlands.

2.12.1 WATER USERS IN THE DELAWARE RIVER BASIN IN THE VICINITY OF HCGS

In its "Envirofacts Data Warehouse" online database access tool, the EPA provides information about environmental activities that may affect air, land, and water. A search of the Envirofacts "water" database for facilities that hold permits to discharge to waters of the United States in the vicinity of HCGS identified heavy industries, electric generation, and manufacturing, among others. These industries represent the types of existing dischargers to the river in the vicinity of HCGS. They also represent the types of industrial facilities that could be permitted near HCGS in the future. Additional information concerning these facilities may be accessed through the EPA's "Envirofacts Warehouse" (http://oaspub.epa.gov/enviro/).

2.12.2 ELECTRIC CAPACITY IN THE IMMEDIATE VICINITY OF HCGS

2.12.2.1 Salem Nuclear Generating Station

The Salem Nuclear Generating Station and HCGS are co-located on Artificial Island. Salem is a two-unit plant utilizing pressurized water reactors (PWRs) designed by Westinghouse Electric. Each unit has a current licensed thermal power at 100 percent power of 3,459 MWt (PSEG 2009c). An air-cooled combustion turbine peaking unit rated at approximately 40 MWe (referred to as "Salem Unit 3") is also present.

Salem has a once-through circulating water system (CWS) for condenser cooling that withdraws water from and discharges water to the Delaware Estuary. The intake structure for the CWS is on the south shore of Artificial Island and the Salem Service Water System (SWS) has an independent intake structure located upstream of the CWS intake. Discharge for both systems is through a submerged pipe that extends 152 m (500 ft) into the estuary approximately halfway between the SWS and CWS intakes. Each unit's CWS pumps approximately 3.97 million liters (1.05 million gallons) per minute from the river.

PSEG has a current NJPDES (No. NJ0005622) permit for Salem that limits intake flow from the Delaware Estuary to a 30-day average of 11.5 billion liters (3.0 billion gallons) per day of circulating water (NJDEP 2004).

PSEG is authorized by the Delaware River Basin Commission (DRBC) to withdraw surface water from the Delaware Estuary through the Salem CWS and SWS intakes for consumptive and non-consumptive use as cooling water not to exceed 367,000 million liters (97,000 million gallons) in a single 30-day period. (DRBC 2001)

PSEG has a single ground-water allocation permit from NJDEP for the diversion by both Salem and HCGS of up to 164 billion liters (43.2 billion gallons) of ground water per month (NJDEP 2004).

As a result of operations, both HCGS and Salem release liquid and gaseous radiological effluents into the environment. The releases are controlled and monitored to ensure that regulatory limits on the radioactivity discharged to the environment are not exceeded. Doses from these releases represent a fraction of the allowable doses specified in the facility operating license and NRC regulations. Results presented in the Radiological Environmental Monitoring Report, which evaluates the combined contributions from both HCGS and Salem, indicate that there has been no significant impact on the radiological characteristics of the environs of the area (PSEG 2007b).

2.12.2.2 Potential New Generating Unit(s)

PSEG currently plans to submit an Early Site Permit (ESP) application to the NRC during the second quarter of 2010 to address the possibility that new nuclear generating capacity could be located on Artificial Island (PSEG 2008c). The decision to pursue an ESP does not represent a commitment by PSEG to build a new nuclear power plant. If the decision were made later to build new nuclear generation, then PSEG would develop and submit a Combined License Application (COLA).

2.12.2.3 Mid-Atlantic Power Pathway

PJM has identified a 500-kV transmission line to be constructed from Possum Point in Virginia to Salem as necessary to increase grid stability, and to get additional power into the mid-Atlantic states (PJM 2009).

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Chapter 3

The Proposed Action

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3.1 General Plant Information

NRC

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

PSEG proposes that the NRC extend the term of the operating license for HCGS for 20 years beyond its current term of 40 years. License renewal would give PSEG and the State of New Jersey the option of relying on HCGS to meet future electricity needs. Section 3.1 discusses the station in general. Sections 3.2 through 3.4 address potential changes that could occur as a result of license renewal.

General information regarding HCGS is available in several documents. In 1984, the NRC issued the Final Environmental Statement (FES) related to operation of HCGS (NRC 1984). The Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS; NRC 1996b) describes HCGS features. Finally, in accordance with NRC requirements, PSEG routinely revises the Updated Final Safety Analysis Report (UFSAR) for HCGS to reflect current plant design and operating features (PSEG 2009b). PSEG has referred to each of these and additional documents while preparing the Environmental Report for license renewal.

Figure 3.1-1 illustrates the PSEG property boundary and the spatial relationship of HCGS and Salem on the south end of Artificial Island. The major structures and facilities located on and adjacent to the HCGS site are shown in Figure 3.1-2. Major buildings include the following:

- Unit 1 reactor building which houses the nuclear steam supply system including the reactor, reactor coolant pumps, and related equipment;
- The turbine/administration building;
- The cooling tower;
- The adjacent Salem Nuclear Generating Station (Salem); and
- Other structures and facilities of interest such as the service water intake structure, discharge structure, switchyard, the Independent Spent Fuel Storage Installation (ISFSI), the low-level radioactive waste interim storage building, and the nuclear department administration building.

3.1.1 REACTOR AND CONTAINMENT SYSTEMS

HCGS is a one-unit plant utilizing a boiling water reactor (BWR) designed by General Electric. Bechtel was the original plant builder and architect-engineer. The license for fuel loading and low-power testing was issued on April 11, 1986. Following fuel loading and a period of testing the NRC issued the Facility Operating License, NPF-57, authorizing full commercial operation, which began December 20, 1986. The original licensed core power for HCGS was 3,293 MWt (PSEG 2009b). HCGS underwent a 1.4 percent (46 MWt) measurement uncertainty recapture uprate in 2001 and a 15 percent (501 MWt) extended power uprate in 2008 (NRC 2008a, NRC 2008b). HCGS's current licensed thermal power is 3,840 MWt (PSEG 2009b). At 100 percent reactor power, the electrical output is estimated to be approximately 1,265 MWe (NRC 2008b).

The nuclear steam supply system includes a boiling water reactor (BWR), reactor coolant system (RCS), and associated auxiliary fluid systems. The RCS consists of the two reactor recirculation pump loops external to the reactor vessel. Each external loop contains one recirculation pump and two motor-operated gate valves for pump maintenance. Each loop also contains a flow measuring system. (PSEG 2009b)

Auxiliary systems charge the RCS, add makeup water, purify reactor coolant water, provide chemicals for corrosion inhibition, cool system components, remove residual heat when the reactor is shut down, cool the spent fuel storage pool, sample reactor coolant water, provide for emergency safety injection, and vent and drain the RCS. (PSEG 2009b)

The reactor building houses the reactor, the primary containment, and fuel handling and storage areas. The primary containment is a steel shell, shaped like a light bulb, enclosed in reinforced concrete, and interconnected to a torus-type steel suppression chamber. The reactor building is capable of containing any radioactive materials that might be released due to a loss-of-coolant accident. (PSEG 2009b)

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

3.1.2 FUEL ENRICHMENT AND BURN-UP

HCGS is licensed for low-enriched uranium-dioxide fuel with enrichments to a nominal 5.0 percent by weight uranium-235 and an allowable fuel burn-up of 60,000 megawatt-days per metric ton uranium (NRC 2008b). The uranium-dioxide fuel is in the form of high-density ceramic pellets. Fuel rods used in the reactors consist of Zircaloy-based tubing with fuel pellets stacked inside and sealed with a welded end plug (PSEG 2009b).

The HCGS spent fuel pool facility provides storage space for the spent fuel assemblies. The pool is designed to store up to 3,976 fuel assemblies (PSEG 2009b).

The NRC issued a general license to PSEG authorizing an Independent Spent Fuel Storage Installation (ISFSI) at the HCGS site. The general license allows PSEG, as a reactor licensee under 10 CFR 50, to store spent fuel from both HCGS and Salem at the ISFSI, provided that such storage occurs in pre-approved casks in accordance with the requirements of 10 CFR 72, subpart K (General License for Storage of Spent Fuel at Power Reactor Sites). Currently, only HCGS spent fuel is being stored at the ISFSI. Spent fuel transfers to the ISFSI from each Salem unit are expected to begin approximately one year before complete offload capability is lost (NRC 2004).

3.1.3 COOLING AND AUXILIARY WATER SYSTEMS

HCGS has a closed cycle circulating water system for condenser cooling that consists of a natural draft cooling tower and associated withdrawal, circulation, and discharge facilities. HCGS withdraws brackish water with the Service Water System (SWS) from the Delaware

Estuary through an intake structure. Service Water provides cooling to Reactor Auxiliaries Cooling System, Safety Auxiliaries Cooling System, and other heat exchangers, and is discharged to the cooling tower basin to serve as condenser cooling water makeup to replace the water lost through evaporation and cooling tower blowdown. Cooling tower blowdown and other station effluents are discharged into the Delaware Estuary through an underwater conduit located 458 m (1,500 ft) upriver of the SWS intake (PSEG 1983). Onsite ground-water wells provide fresh water for domestic/potable, industrial, and fire protection needs. The following subsections describe the water systems at HCGS.

3.1.3.1 Surface Water

PSEG has a current NJPDES permit from the New Jersey Department of Environmental Protection for HCGS (No. NJ0025411; NJDEP 2003). The NJPDES permit authorizes the use of surface water and the discharge of effluents within the terms and conditions specified in the permit. The SWS withdraws an average of 253 million liters per day (66.8 million gallons per day [MGD]) from the Delaware Estuary. Approximately 25 million liters per day (6.7 MGD) are immediately returned as screen and strainer backwash, 49 million liters per day (13 MGD) are evaporated in the cooling tower process, and the remainder is returned to the Delaware Estuary in accordance with the NJPDES permit.

PSEG is authorized by the DRBC for consumptive use by HCGS of brackish water from the Delaware Estuary (DRBC 1984a, DRBC 1984b). This authorization includes provisions allowing for compensatory releases from storage or reduction in withdrawal from PSEG facilities on the Delaware River in specified low-flow conditions at Trenton. The Merrill Creek reservoir in Washington, New Jersey, stores water that can be used to make up for evaporative water loss from certain electric generating facilities on the Delaware River. PSEG is a member of the Merrill Creek Owners Group.

Service Water System

The SWS withdraws brackish water from the Delaware Estuary through an intake structure. After use in the SWS, the water is used as make-up for the cooling water system (CWS). The intake structure, which has eight intake bays, is parallel to the Delaware Estuary shoreline (Figure 3.1-1). Only four of the bays are equipped with service water pumps and associated equipment. The four empty bays were originally intended to supply service water to a second reactor, which was never constructed. The intake system has trash racks, Ristroph traveling screens, and a fish-return system. (NJDEP 2002)

The trash racks extend 4 m (13 ft) in front of the intake; river currents sweep the face of the intake structure, and the trash racks, which are set on 7.6-cm (3-in) centers, prevent heavy debris from entering the intake and damaging the traveling screens. Mechanical rakes remove collected debris, which is aggregated in trash containers for off-site disposal. The intake velocity at the trash racks is about 0.03 m/sec (0.1 ft/sec). (NJDEP 2002)

Behind the trash racks is a skimmer wall that prevents the entrance of oil slicks or surface ice. Intake water flows under the skimmer wall at a maximum velocity of approximately 0.11 m/sec (0.35 ft/sec), into four bays, each 3.4 m high by 2.9 m wide (11 ft high by 9.5 ft wide). The water then flows through a traveling screen, at a maximum velocity of approximately 0.12 m/sec (0.39 ft/sec). The traveling screens have a bucket on the lower lip designed to prevent re-impingement of fish on the screen and provide the mechanism to return the fish to the river. The buckets allow organisms to remain in the water while being lifted to fish return troughs.

Organisms are washed into the fish-return trough with a low-pressure screen spray. As the screen moves further along the sprocket, high-pressure spray washes debris into the debris trough. The fish and debris troughs return water, fish, and debris to the Delaware Estuary south of the SWS intake structure. (NJDEP 2002)

After passing through the traveling screens, the estuary water enters the service water pumps. During normal operation, two or three station service water pumps, depending on the temperature of the Delaware Estuary, are required. The four service water pumps are each rated at 62,459 liters per minute (16,500 gallons per minute [gpm]) (NJDEP 2002). Sodium hypochlorite is continuously added at the suction of the service water pumps as a biocide to prevent fouling (NJDEP 2002).

Circulating Water System

Once the water exits the service water system it is sent to the cooling tower basin for use as make-up water for the CWS. The circulating water system (CWS) consists of one natural draft cooling tower with make-up, blowdown, and basin bypass systems; the four circulating water pumps; a two-pass surface condenser; and a closed loop circulating water piping arrangement. The cooling tower basin contains approximately 34 million liters (9 million gallons) of water. The CWS provides approximately 2.317 million liters per minute (612,000 gpm) from the cooling tower basin by means of four pumps (NJDEP 2002). The CWS pumps supply cooling water to the main condenser to condense steam from the turbine, and return this condenser cooling water back to the cooling tower for removal of heat and recirculation. In normal operation, all four circulating water pumps continuously operate. At least two pumps must operate to sustain electric power production (PSEG 1983).

The main condenser is a double-pass, three-shell, horizontal, de-aerating type surface condenser. Each shell has two tube bundles, two inlet-outlet boxes, and two reversing-end water boxes. From the condenser, the water returns to the cooling tower to complete the cooling cycle (PSEG 1983).

A single counterflow, hyperbolic, natural draft cooling tower dissipates the heat from the circulating water system. Continuous blowdown controls the build-up of solids in the cooling tower basin (NJDEP 2002). Effluent heat and temperature are limited and monitored, but the low effluent temperature and high flow rate of the Delaware Estuary preclude heat shock and cold shock. Monthly average evaporative losses in the cooling tower consume between 36,340 liters per minute (9,600 gpm; January) and 49,210 liters per minute (13,000 gpm; July). Sodium hydroxide is added to the circulating water system to minimize scaling. Sodium hypochlorite is used to prevent biofouling in the cooling tower, and cooling tower blowdown is dechlorinated with ammonium bisulfate prior to discharge (NJDEP 2002).

3.1.3.2 Ground Water

PSEG has authorization from the NJDEP (NJDEP 2004) and DRBC (DRBC 2000) for consumptive use of up to 163 million liters (43.2 million gallons) of ground water per month at the HCGS and Salem sites combined. The discussion of ground water in this section includes use at both the HCGS and Salem sites for the following reasons.

- NJDEP issued a single permit for both sites combined. Although each site uses separate wells and there are individual pumping limits for each well, the permit limits are for both sites combined. The current permit allows a combined maximum diversion rate for HCGS and Salem of 11,000 liters per minute (2,900 gpm) and limits actual water diverted to 163 million liters (43.2 million gallons) per month or 1.1 billion liters (300 million gallons) per year (NJDEP 2004). The ground-water pumping limit per well, based on the January 1, 2005, permit (NJDEP 2004), is indicated in Table 3.1-1. This limit is consistent with the docket authorization issued by DRBC for ground-water withdrawal. (DRBC 2000)

- The ground-water withdrawal systems for HCGS and Salem are interconnected in order to transfer water between the stations, if needed.

Ground water is the only source of fresh water at the HCGS and Salem sites. Both sites use fresh water for potable, industrial process make-up, fire protection, and sanitary purposes (PSEG 2009c, PSEG 2009b).

HCGS derives ground water from two production wells (HC-1 and HC-2), installed to a depth of 249 m (816 ft) in the Upper Raritan Formation of the Potomac-Raritan-Magothy Aquifer (DRBC 2000). The wells supply two 1.3 million-liter (350,000-gallon) storage tanks. Of the total volume, approximately 2.5 million liters (656,000 gallons) of water are reserved for fire protection; the remainder is for potable, sanitary, and industrial purposes, including demineralized makeup water (PSEG 2009c). The Demineralized Water Makeup system uses ion-exchange resin to provide the ultrapure water required.

Ground water at Salem is primarily withdrawn from two production wells, PW-5 and PW-6, which are installed to depths of 256 m (840 ft) and 347 m (1,140 ft), respectively, in the Upper and Middle Raritan Formations of the Potomac-Raritan-Magothy Aquifer (DRBC 2000). Salem also has the capability of using two shallower wells, PW-2 and PW-3, currently classified as stand-by wells by NJDEP (NJDEP 2004). These wells are installed to depths of 87 m (286 ft) and 89 m (293 ft), respectively, in the Mt Laurel-Wenonah Aquifer (DRBC 2000). The wells supply two 1.3 million-liter (350,000-gallon) storage tanks (for a total of four storage tanks, two for each station). Of the total volume, 2.27 million liters (600,000 gallons) of water are reserved for fire protection; the remainder is for potable, sanitary, and industrial purposes, including makeup water to those plant systems requiring demineralized water (PSEG 2009c). The demineralized water makeup system uses reverse osmosis to provide the ultrapure water required.

Ground-Water Usage

PSEG has authorization from the NJDEP (NJDEP 2004) and DRBC (DRBC 2000) for consumptive use of up to 163 million liters (43.2 million gallons) of ground water per month at the HCGS and Salem sites combined.

Between 2002 and 2008 the Salem wells pumped an average of 821 liters per minute (217 gpm) with a production low for the period of 640 liters per minute (169 gpm) during 2002 and a high of 1,007 liters per minute (266 gpm) during 2008. During the same period, the HCGS wells pumped an average of 609 liters per minute (161 gpm) with a production low for the period of 518 liters per minute (137 gpm) during 2002 and a high of 749 liters per minute (198 gpm) during 2004. (Table 3.1-1; TetraTech 2009)

Ground-water elevations were measured during a ground-water study in 1987 by Dames & Moore (Dames & Moore 1988) in the River Sand and Gravel Aquifer, the Vincentown Aquifer, the Mt. Laurel-Wenonah Aquifer, and the Upper and Middle Raritan Formations of the Potomac-

Raritan-Magothy (PRM) Aquifer. The ground-water elevation ranges measured for these aquifers are indicated in Table 3.1-2. Ground-water elevation ranges were more recently monitored in the HCGS/Salem wells, as indicated in Table 3.1-3. Of the four primary HCGS/Salem wells, three (PW-5, HC-1, and HC-2) are installed in the Upper Raritan Formation. The fourth (PW-6) is installed in the Middle Raritan Formation.

The ground-water elevation ranges (Table 3.1-3) measured in PW-6 (in the Middle Raritan Formation) in 2002, 2003, 2005, 2006, 2007, and 2008 are higher than the elevation recorded in 1987; the ranges of elevations recorded from PW-6 in 2000, 2001 and 2004 bracket the elevation recorded in 1987. For the last three years, elevations in PW-6 have been fairly constant at about-45 to -48 feet.

The data for wells PW-5, HC-1, and HC-2 in the Upper Raritan Formation are more difficult to interpret. In eight of nine years from 2000 to 2008, the ranges of elevations monitored in these three wells in the Upper Raritan Formation bracketed the 1987 data. That is, in eight of nine years, elevations measured in the Upper Raritan Formation were both higher and lower than those measured in 1987. In 2005, the range was lower than was measured in 1987. Elevation ranges in individual wells and between wells are highly variable. Taken as a whole, the ranges exhibit a consistent pattern of high variability. One explanation of the difference in ground-water elevations observed among and within the wells is that the ground-water elevations in the wells were measured before the water level had stabilized during the monitoring events.

Because the PRM is an important aquifer extending from as far north as Mercer and Middlesex Counties, New Jersey southward into and beyond Delaware, it is subject to numerous pumping influences (NJGS 1965). The groundwater demand placed on the PRM has resulted in a decrease in the elevation of the piezometric surface that has been historically observed in the counties of Camden, Middlesex, and Monmouth (USGS 1983). The development of these piezometric surface reductions was observed in wells completed in the middle and lower aquifers during the period between 1973 and 1978. The declines may have been a result of an increase in the amount of extraction from the lower aquifer, which began in approximately 1973. Coincident cones of depression in the upper and middle/lower PRM suggest that significant communication occurs between these aquifers (USGS 1983). Furthermore PRM aquifer withdrawals in Camden County have been previously shown to influence water levels at significant lateral distances resulting in water level reductions in Salem and Gloucester counties (USGS 1983).

Groundwater withdrawals in central and southern New Jersey increased from 1904 to a peak in the mid/late 1970s they then dropped off precipitously in the mid 1980s (USGS 1983, USGS 2001a). A slower rate of declining withdrawals continued until 1995 (USGS 2001a). Water levels in lower PRM observation wells in New Jersey and Delaware generally increased during the period from the mid-1980s to the late 1990s as documented by the USGS (2001b). Decreased consumptive use and greater controls on water withdrawals by the state of New Jersey (in favor of surface water withdrawals [NJDEP 1985] as referenced by USGS [2001a]) allowed water levels in the PRM to recover in central New Jersey from the over pumping of the 1970s.

Station pumping wells completed in the PRM have exhibited relatively stable to slightly decreasing water levels during the period 2000-2008. A study by the USGS (2001b) clearly shows that the pumping centers north of the Chesapeake and Delaware Canal influence water levels in the lower PRM in the Artificial Island vicinity. The interconnected nature of the lower and middle units of the PRM in conjunction with this study (USGS 2001b) suggest that water levels in the middle PRM are influenced by/related to water levels in the lower PRM. A more recent USGS study (USGS 2009) indicates that Delaware withdrawals from the middle and lower PRM had increased as of 2003. This appears to have resulted in reduced regional water levels in this area of the lower PRM. These effects continued to influence water levels at Artificial Island in both the lower and middle units of the PRM. Water level monitoring at the station is consistent with the regional water level changes resulting from the increased withdrawals in Delaware (USGS 2009).

The information described above suggests that the observed decrease in water levels in observation wells at Artificial Island are part of a larger regional trend rather than a result of station-related withdrawals. This is supported by data documenting increased water withdrawals (both location and quantity) in Lower New Castle County, Delaware and water level maps prepared by the USGS as part of a long-term groundwater monitoring program.

Artificial Island is not included in either the Southeastern Pennsylvania Ground Water Protected Area, or a New Jersey Critical Area, and the Delaware River Basin Commission (DRBC) monitors these regional ground water sources (DRBC 2008). PSEG withdraws less than half of the allocation authorized by DRBC and NJDEP.

Ground-Water Monitoring for Tritium and Other Radionuclides

In March of 2006, PSEG implemented a program to proactively review the environmental status of its nuclear power generating stations, specifically to identify the potential for releases of tritium, strontium, or station-related gamma-emitting radionuclides from all systems, structures, and components at the stations that are not designed for such a release. The PSEG program was designed as part of an industry-wide initiative, consistent with the guidance provided by the Nuclear Energy Institute (NEI 2007).

To more thoroughly quantify the potential for unmonitored releases of tritium, strontium, or station-related radionuclides to the environment from various systems, engineers performed an internal review of systems, structures, and components to determine which have the greatest potential for impacting shallow ground-water quality, should a release of radionuclides occur. Based on the results of those reviews, a ground-water monitoring well network was designed and installed to include wells located: (1) in the vicinity and downgradient of station systems that "screened in" as a result of the analysis; (2) at downgradient locations around the perimeter of the Station; and, (3) at upgradient locations, to verify that any radionuclides that may be found in ground water are not migrating offsite above applicable New Jersey Ground Water Quality Criteria. Thirteen wells were identified at Salem, five existing wells and eight newly installed wells (Figure 3.1-4). Thirteen new wells were installed at HCGS (Figure 3.1-5). Following installation, each well was developed and sampled by trained technicians using low-flow ground-water sampling techniques, and the samples were analyzed by a laboratory qualified to perform the requested analyses. No plant-related gamma emitter or strontium was detected in those ground-water samples.

Monitoring has been conducted at least semi-annually since installation of the Radiological Groundwater Protection Program (RGPP) wells. No plant-related gamma emitters have been detected in the 26 RGPP wells. No analytical results for tritium have exceeded the EPA Drinking Water Standard or triggered voluntary communication or reporting under the criteria contained in Nuclear Energy Institute (NEI) guidance (NEI 2007). Some variability in the tritium concentrations has been observed but there is no identifiable trend. Results of the monitoring program, including trending data, program modifications, reporting protocols, and other information are included as an appendix to the annual Radiological Environmental Operating Report. (PSEG 2007b, PSEG 2008a).

3.1.4 RADIOACTIVEWASTE MANAGEMENT SYSTEMS

3.1.4.1 Liquid Radioactive Waste Systems

The Liquid Waste Management System (LWMS) is designed to collect, store, process, and dispose of or recycle all radioactive or potentially radioactive liquid waste generated by plant operation or maintenance. The LWMS consists of five process subsystems, each for collecting, storing, processing, monitoring, and disposing of specific types of liquid wastes in accordance with their conductivity, chemical composition, and radioactivity (PSEG 2009b). These subsystems are:

- Equipment drain (high-purity waste)
- Floor drain (low-purity waste)
- Regenerant waste (high-conductivity waste)
- Chemical waste (decontamination solution waste and chemistry lab drains)
- Detergent drain waste (laundry waste and personnel decontamination drains)

Sufficient treatment capability is available to process certain liquid waste to meet demineralized water quality requirements. Liquid wastes that cannot be processed to meet the quality requirement for use as demineralized water are released into the cooling tower blowdown line for discharge to the Delaware Estuary at a permitted outfall. The releases are controlled and monitored to ensure that regulatory limits on the radioactivity discharged to the environment are not exceeded (PSEG 2009b).

Potentially radioactive liquid wastes are collected in tanks in the Auxiliary Building. System components are segregated in shielded enclosures with controlled access to minimize exposure to plant personnel. During liquid waste processing, radioactive contaminants are removed from the wastewater, either by demineralization or filtration. This ensures that the water returned to the condensate storage tank (CST) is restored to demineralized-water quality, and any other water is discharged to the environment via the cooling tower blowdown line through a permitted outfall. If the liquid is recycled to the plant, it meets the purity requirements for CST makeup. If the liquid is discharged to the environment, the activity concentration is consistent with the radiation exposure standards in 10 CFR 20. The radioactivity removed from the liquid wastes is concentrated in the filter media and ion exchange resins, which are managed as solid radioactive wastes.

3.1.4.2 Gaseous Radioactive Waste Systems

The Gaseous Waste Management Systems (GWMS) include all systems that process potential sources of airborne releases of radioactive materials during normal operation and anticipated operational occurrences. Included are the Off-gas System and various ventilation systems. These reduce radioactive gaseous releases from the plant by filtration or delay, which allows decay of radioisotopes prior to release (PSEG 2009b).

The function of the Off-gas System is to collect and delay the release of non-condensable radioactive gases removed from the main condenser. Off-gases consist of activation gases, fission product gases, radiolytic hydrogen and oxygen, and condenser air in-leakage. The Off-gas System uses a catalytic recombiner and a cooler condenser for control of hydrogen concentration and volume reduction, respectively. The remaining non-condensable gas (principally air with traces of krypton and xenon) is delayed in a series of eight, 61-cm-(24-in)-diameter, 17-m-(55-ft)-long holdup pipes. At a flow rate of 75 standard cubic feet per minute (scfm), these pipes provide a minimum of ten minutes of delay for off-gas prior to entering the ambient charcoal treatment section. Selective adsorption of fission-product noble gases (xenon and krypton) on charcoal is used to provide time for delay before release (PSEG 2009b). The off-gas stream then passes through a high efficiency particulate air (HEPA) filter where radioactive particulate matter and any charcoal particles are retained. The off-gas stream is directed to the north plant vent where it is combined with air from the Solid Radioactive Waste System exhaust and chemical lab exhaust before being released (PSEG 2009b).

Plant ventilation systems process airborne radioactive releases from other plant sources, such as equipment leakage, maintenance activities, the mechanical vacuum pump, and the Steam Seal System. (PSEG 2009b)

3.1.4.3 Solid Radioactive Waste Systems

The Solid Radioactive Waste System collects, processes, packages, and provides temporary storage for radioactive solid waste until offsite shipment, volume reduction, and disposal at a licensed disposal facility. New Jersey is a member of the Atlantic Interstate Low Level Radioactive Waste Management Compact and, thus, is not affected by the closing of the Barnwell Low Level Radioactive Waste facility (Barnwell) to non-compact members, effective July 1, 2008.

Spent resins from the demineralizers and filter cartridges are packaged and stored onsite until shipment offsite for disposal in a licensed low-level radioactive waste disposal facility. All radioactive resin waste and cartridge waste are shipped to Barnwell. Packaging is done within the Auxiliary Building to control releases to the environment. Radioactivity levels of the contents are monitored to maintain doses within regulatory limits. (PSEG 2009b)

Dry Active Waste (DAW) consisting of compactable trash is placed in Sea-van containers and shipped to a licensed off-site vendor for volume reduction. Contaminated metals are also processed by an offsite vendor. The volume-reduced DAW is repackaged at the vendor and shipped for disposal at a licensed low-level waste disposal facility (PSEG 2009b). Class A non-resin waste is typically shipped to the EnergySolutions Class A disposal facility in Clive, Utah. All other radioactive waste normally is shipped to Barnwell.

The PSEG Low Level Radwaste Storage Facility (LLRSF) is on the HCGS site. The LLRSF can support normal radioactive material handling activities for HCGS and Salem (excluding wet waste processing). Examples of these activities are pre-staging waste packages awaiting shipment, using handling equipment and shielding capabilities to prepare and load radioactive materials for shipment, performing radiography, storing and working on contaminated equipment and supplies, as well as other activities that require appropriate radiation protection controls. The NRC has approved a Process Control Program for the LLRSF. The Process Control Program outlines the in-plant measures and controls to assure the suitability of solid radioactive waste for transportation and/or disposal at a licensed low-level radioactive waste disposal facility. All packaging meets U.S. Department of Transportation and NRC standards as well as the waste acceptance criteria of any offsite burial facility to which it is destined. (PSEG 2009b)

The LLRSF is intended to serve as an interim storage facility for HCGS and Salem low-level radioactive waste until the waste can be shipped to a radioactive waste disposal facility. It is sized to store the volume of waste that typically would be generated from both HCGS and Salem over a five-year period, and has a maximum capacity of 1,918.5 m^3 (67,750 ft^3). The LLRSF was designed in accordance with the guidelines provided in Generic Letter 81-38 (Storage of Low Level Radioactive Wastes at Power Reactor Sites [NRC 1981]). (PSEG 2009b)

PSEG expects Barnwell and the LLRSF will provide adequate low-level radioactive waste management capacity through the HCGS license renewal term.

HCGS currently does not have processes that result in the generation of mixed waste (i.e., waste having both a hazardous waste component that is subject to the requirements of the Resource Conservation and Recovery Act, and a radioactive component that is subject to the requirements of the Atomic Energy Act). In the past, most mixed waste generated at HCGS resulted from the contamination of oils (hydraulic and lubricating) used in plant systems. All oils currently used in plant systems are non-hazardous and would not result in mixed waste if they became radiologically contaminated. There are currently no mixed wastes stored at HCGS.

3.1.5 NON-RADIOACTIVE WASTE MANAGEMENT SYSTEMS

A common sewage treatment system located at HCGS and operated by HCGS staff treats domestic wastewater from both HCGS and Salem. Wastewater and activated sludge are introduced into the single-channel oxidation ditch where extended aeration, a modification of the activated sludge process, oxidizes the organic constituents of the wastewater. This process lowers Biochemical Oxygen Demand (BOD), reduces suspended solids, nitrifies, and partially denitrifies the wastewater. Rotor aerators mix air into the contents of the basin and keep the contents moving through the oxidation ditch. Following aeration, mechanical settling in the biological clarifiers separates suspended solids from the liquid flow. The settled solids (i.e., sludge) are either returned to the oxidation ditch or removed to a sludge-holding tank, based upon process requirements. Sludge directed to the sludge-holding tank is aerated and dewatered before being trucked offsite to a licensed disposal facility, or to an NRC-licensed facility if the residuals contain low levels of radioactivity. The sewage treatment system waste stream is a facility internal outfall monitored in accordance with the current Hope Creek NJPDES Permit. The sewage treatment system effluent discharges through the Hope Creek cooling tower blowdown outfall to the Delaware Estuary. Residual cooling tower blowdown de-chlorination chemical, ammonium bisulfite, de-chlorinates the sewage treatment effluent. (NJDEP 2002, Tab DSN 462B – Sewage Treatment System [Explanation of Summary Notes]).

A common chemical waste treatment system, known as the Non-Radioactive Liquid Waste Disposal System (NRLWDS), is located at Salem and operated by Salem staff. The NRLWDS collects and treats secondary plant wastewater from HCGS and Salem which may contain chemicals, especially acidic and caustic wastewater, prior to discharge. The NRLWDS processes and treats the non-radioactive low-volume wastes from various Station processes, such as demineralizer regenerations, steam generator blowdown, chemical handling operations, and reverse osmosis reject waste. The NRLWDS discharge commingles with the non-contact cooling water prior to discharge to the environment. Treatment processes include thorough mixing in an equalization-mixing basin to provide homogeneity and some self-neutralization of acid and caustic wastes, solids removal by settling, chlorination, and pH adjustment to induce precipitation of any remaining metals prior to commingling with cooling water for ultimate discharge to the Delaware Estuary. (PSEG 2007b)

At HCGS, the low-volume and oily waste system collects and treats potentially oily wastewater from area, building, and equipment drains throughout the site. Collected waste streams are processed through an API-type oil water separator for removal of solid and floatable materials. Treated effluent is then discharged through the internal monitoring point which is combined with cooling tower blowdown before discharge to the Delaware Estuary.

PSEG currently is a conditionally exempt small-quantity hazardous waste generator, generating less than 100 kilograms/month (220 pounds/month). Because of episodic generation of hazardous wastes, during outages for example, PSEG maintains the program required of a small-quantity generator and monitors the amount of hazardous waste generated each month to determine the correct status. Hazardous waste is disposed of through a licensed broker. Universal waste, such as paint waste, lead-acid batteries, used lamps, and mercury-containing switches, is segregated and disposed of through a licensed broker.

Normal station waste (e.g., paper, plastic, glass, river vegetation) is segregated and, as much as possible, processed for recycling. Approximately 55 percent of the normal station waste is transferred to recycling vendors, and the remaining 45 percent is disposed in the local landfill.

3.1.6 TRANSMISSION SYSTEM

The transmission lines of interest in this Environmental Report are indicated in Table 3.1-4 and shown in Figure 3.1-3.

The FES (NRC 1984) for HCGS identifies three 500-kV transmission lines needed to deliver electricity generated by HCGS to the transmission system. One 0.8-km (0.5-mi) onsite tie line was built to connect HCGS with Salem. Two lines previously connected to Salem (Salem-New Freedom North and Salem-Keeney) were re-routed to the HCGS switchyard.

After construction of HCGS, a new substation (known as Red Lion) was built along the Salem-Keeney transmission line. Hence, the Salem-Keeney transmission line is now comprised of two segments: one from HCGS to Red Lion and the other from Red Lion to Keeney.

Because the Salem-New Freedom North line was re-routed to HCGS, it was necessary to build a new transmission line to connect Salem to the New Freedom substation. This line is referred to as the HCGS-New Freedom transmission line. Another transmission line that preexisted HCGS, called the Salem-New Freedom South line, also connects Salem to the New Freedom substation. The Salem-New Freedom North, Salem-New Freedom South, and Salem-Keeney lines were not constructed to connect HCGS to the grid. The only new transmission lines constructed as a result of the HCGS are the HCGS-New Freedom line, the tie line, and short reconnections for Salem-New Freedom North and Salem-Keeney. The HCGS-Salem tie line and the short reconnections do not pass beyond the site boundary and, therefore, are not evaluated in this Environmental Report. Nevertheless, for completeness, all lines are described below.

- *HCGS-New Freedom* – This 500-kV line, which is operated by PSE&G, extends northeast from Salem for 69 km (43 mi) in a 107-m-(350-ft)-wide corridor to the New Freedom switching station north of Williamstown, New Jersey. This line shares the corridor with the 500-kV Salem-New Freedom North line. During 2008, a new substation (Orchard) was installed along this line, dividing it into two segments.

- *Salem-New Freedom North* – This 500-kV line, which is operated by PSE&G, runs northeast from HCGS for 63 km (39 mi) in a 107-m-(350-ft)-wide corridor to the New Freedom Switching Station north of Williamstown, New Jersey. This line shares the corridor with the 500-kV HCGS-New Freedom line.

- *Salem-Red Lion segment of Salem-Keeney* – This 500-kV line extends north from HCGS for 21 km (13 mi) and then crosses over the New Jersey-Delaware state line. It then continues west over the Delaware River about six km (four mi) to the Red Lion substation. In New Jersey the line is operated by PSE&G, and in Delaware it is operated by PHI. Two thirds of the 27-km (17-mi) corridor is 61 m (200 ft) wide, and the remainder is 107 m (350 ft) wide.

- *Red Lion-Keeney segment of Salem-Keeney* – This 500-kV line, which is operated by PHI, extends from the Red Lion substation 13 km (eight mi) northwest to the Keeney switch station. Two thirds of the corridor is 70 m (200 ft) wide, and the remainder is 107 m (350 ft) wide.

- *Salem-New Freedom South* - This 500-kV line operated by PSE&G extends northeast from Salem for 68 km (42 mi) in a 107-m-(350-ft)-wide corridor from Salem to the New Freedom substation north of Williamstown, New Jersey.

- *HCGS-Salem* – This 500-kV tie line connects the HCGS and Salem switchyards. It consists of two towers and spans about 610 m (2,000 ft). This line does not pass beyond the site boundary, and is not discussed further or included in Table 3.1-4.

The HCGS-New Freedom line is the only offsite transmission line constructed at the time HCGS was constructed; therefore, it is the only line analyzed in this Environmental Report. In total, the transmission line is 69 km (43 mi) long occupying about 738.5 hectares (1,825 acres) of transmission corridor. This corridor passes through the marshes and wetlands north and east of HCGS then crosses land that is primarily agricultural or forested. Corridors that pass through pastures generally continue to be used as pastures. This line also passes through or near residential and urban areas with low population densities. It crosses several roadways including state highway 55, U.S. highway 40, and the Atlantic City Expressway.

PSE&G owns and operates the HCGS-New Freedom transmission line, which connects to the PJM interconnection. PJM is a regional transmission organization that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia. This transmission line would remain under PSE&G ownership and would stay in service if the HCGS operating license was not renewed and the unit was decommissioned.

The transmission line of interest was designed and constructed in accordance with the National Electrical Safety Code and other industry guidance that were current when the line was built. Ongoing surveillance and maintenance of the transmission facilities ensure continued conformance to design standards. These maintenance practices are described in Section 4.13.

Table 3.1-1 Salem and HCGS Annual Ground-Water Pumpage (MG), 2002-2008

		2002	2003	2004	2005	2006	2007	2008
Salem								
Water Supply Well	**Pump Limit**	**Pumpage**	**Pumpage**	**Pumpage**	**Pumpage**	**Pumpage**	**Pumpage**	**Pumpage**
PW-2	300 gpm	0.0	0.0	0.0	0.1	0.0	0.0	0.0
PW-3	600 gpm	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PW-5	800 gpm	87.2	98.5	107.9	133.8	108	104	127.3
PW-6	600 gpm	1.7	1.6	4.2	3.7	1	8	13.2
Total Salem Ground-water Pumpage per Year		89 MG (169 gpm)	100 MG (190 gpm)	112 MG (213 gpm)	138 MG (263 gpm)	109 MG (207 gpm)	112 MG (213 gpm)	140 MG (266 gpm)
HCGS								
Water Supply Well	**Pump Limit**	**Pumpage**	**Pumpage**	**Pumpage**	**Pumpage**	**Pumpage**	**Pumpage**	**Pumpage**
HC-1	750 gpm	36.5	38.5	49.7	36.7	39.7	49.6	40.8
HC-2	750 gpm	35.5	34.9	53.9	44.8	41.7	47.56	42.7
Total HCGS Ground-Water Pumpage per Year		72 MG (137 gpm)	73 MG (139 gpm)	104 MG (198 gpm)	81 MG (154 gpm)	81 MG (154 gpm)	97 MG (184 gpm)	83 MG (158 gpm)
Salem and HCGS Combined								
		Pumpage	**Pumpage**	**Pumpage**	**Pumpage**	**Pumpage**	**Pumpage**	**Pumpage**
Total Salem and HCGS Ground-Water Pumpage per Year		161 MG (306 gpm)	173 MG (329 gpm)	216 MG (411 gpm)	219 MG (417 gpm)	190 MG (361 gpm)	209 MG (398 gpm)	223 MG (424 gpm)

Source: TetraTech 2009
MG = million gallons
gpm = gallons per minute

Table 3.1-2 Ground-Water Elevations, 1987

Aquifer	Ground-Water Elevation (ft bgs)
River Sand and Gravel Aquifer	+3 to +7
Vincentown Aquifer	0 to +4
Mt. Laurel-Wenonah Aquifer	-2 to -8
Upper Raritan Formation	-57 to -62
Middle Raritan Formation	-49

Source: Dames & Moore 1988

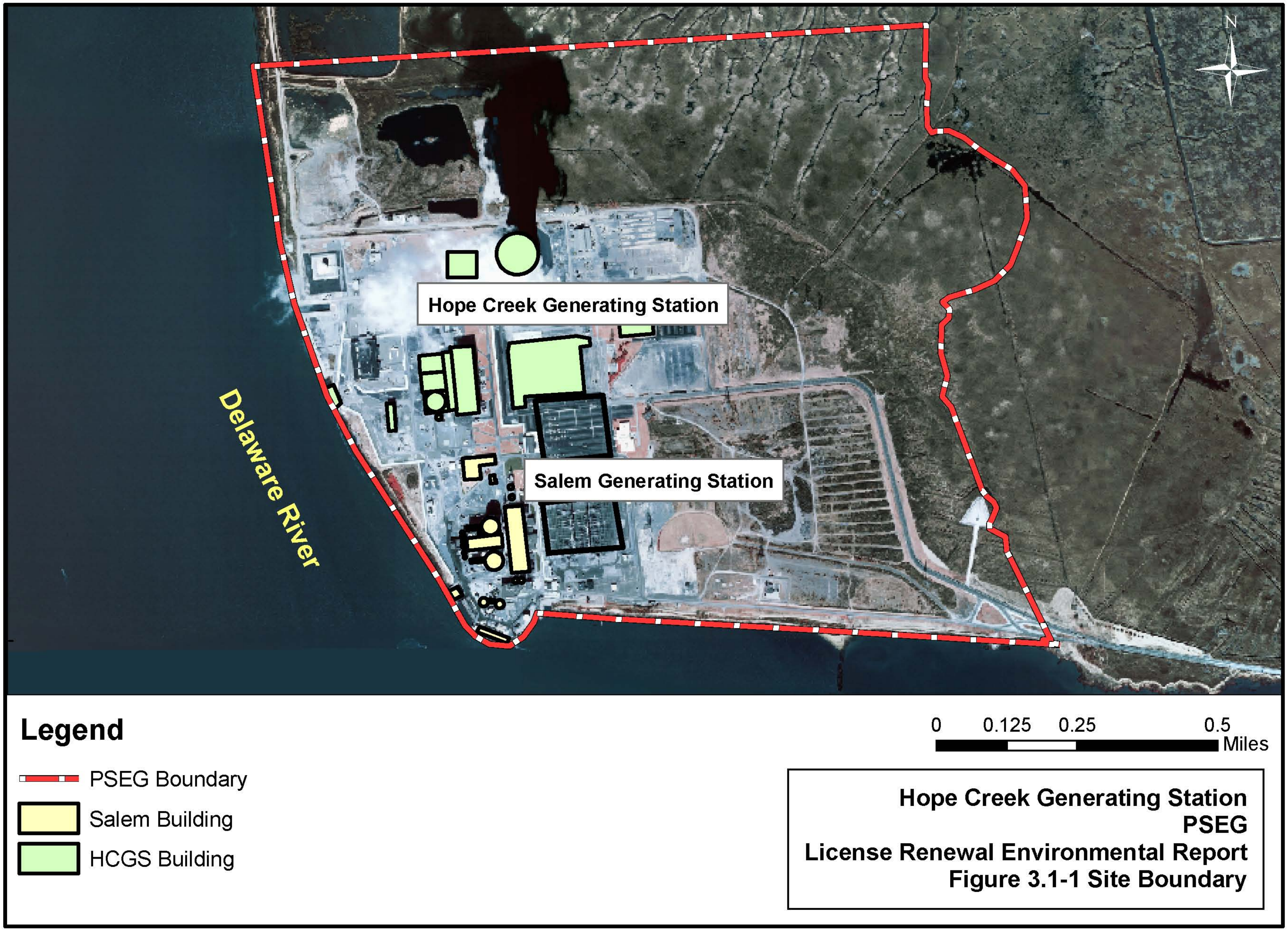
Table 3.1-3 Ground-Water Elevation Data Range (in feet) for Salem and HCGS Ground-Water Wells, 2000 – 2008. (The aquifer range includes data from all production wells monitored in that aquifer.)

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Mount Laurel/Wenonah	**3.08 to -3.12**	**3.68 to -1.12**	**4.08 to 0.16**	**3.28 to 0.86**	**3.48 to -7.82**	**13.78 to 0.68**	**3.58 to 1.08**	**3.56 to 0.96**	**3.88 to 1.58**
Salem Wells									
PW-2	2.36 to -1.64	2.26 to -0.14	2.96 to 0.16	2.66 to 0.86	2.96 to -0.14	10.06 to 1.36	2.66 to 1.56	3.56 to 0.96	2.76 to 1.66
PW-3	3.08 to -3.12	3.68 to -1.12	4.08 to 0.28	3.28 to 0.88	3.48 to -7.82	13.78 to 0.68	3.58 to 1.08	2.98 to 0.98	3.88 to 1.58
Middle Raritan	**-35.85 to -64.75**	**-42.45 to -54.15**	**-42.45 to -45.15**	**-40.45 to -45.65**	**-41.55 to -52.65**	**-35.75 to -45.45**	**-44.75 to -46.25**	**-45.35 to -48.35**	**-45.35 to -51.35**
Salem Well (PW-6)	-35.85 to -64.75	-42.45 to -54.15	-42.45 to -45.15	-40.45 to -45.65	-41.55 to -52.65	-35.75 to -45.45	-44.75 to -46.25	-45.35 to -48.35	**-45.35 to -51.35**
Upper Raritan	**-28.93 to -68.35**	**-41.53 to -72.13**	**-54.33 to -74.94**	**-55.73 to -74.35**	**-57.94 to -84.35**	**-60.94 to -86.35**	**-53.94 to -81.35**	**-55.94 to -83.35**	**-53.93 to -88.35**
Salem Well									
PW-5	-28.93 to -67.73	-41.53 to -72.13	-54.33 to -66.23	-55.73 to -70.73	-58.23 to -78.13	-64.33 to -80.73	-59.33 to -75.33	-63.03 to -79.63	-54.63 to -74.33
Hope Creek Wells									
HC-1	-59.94 to -67.94	-58.94 to -65.94	-57.94 to -74.94	-60.94 to -71.94	-57.94 to -83.94	-60.94 to -74.94	-53.94 to -73.94	-55.94 to -65.94	-53.94 to -71.94
HC-2	-61.35 to -68.35	-60.35 to -70.35	-58.35 to -74.35	-61.35 to -74.35	-69.35 to -84.35	-73.35 to -86.35	-69.35 to -81.35	-70.35 to -83.35	-63.35 to -88.35

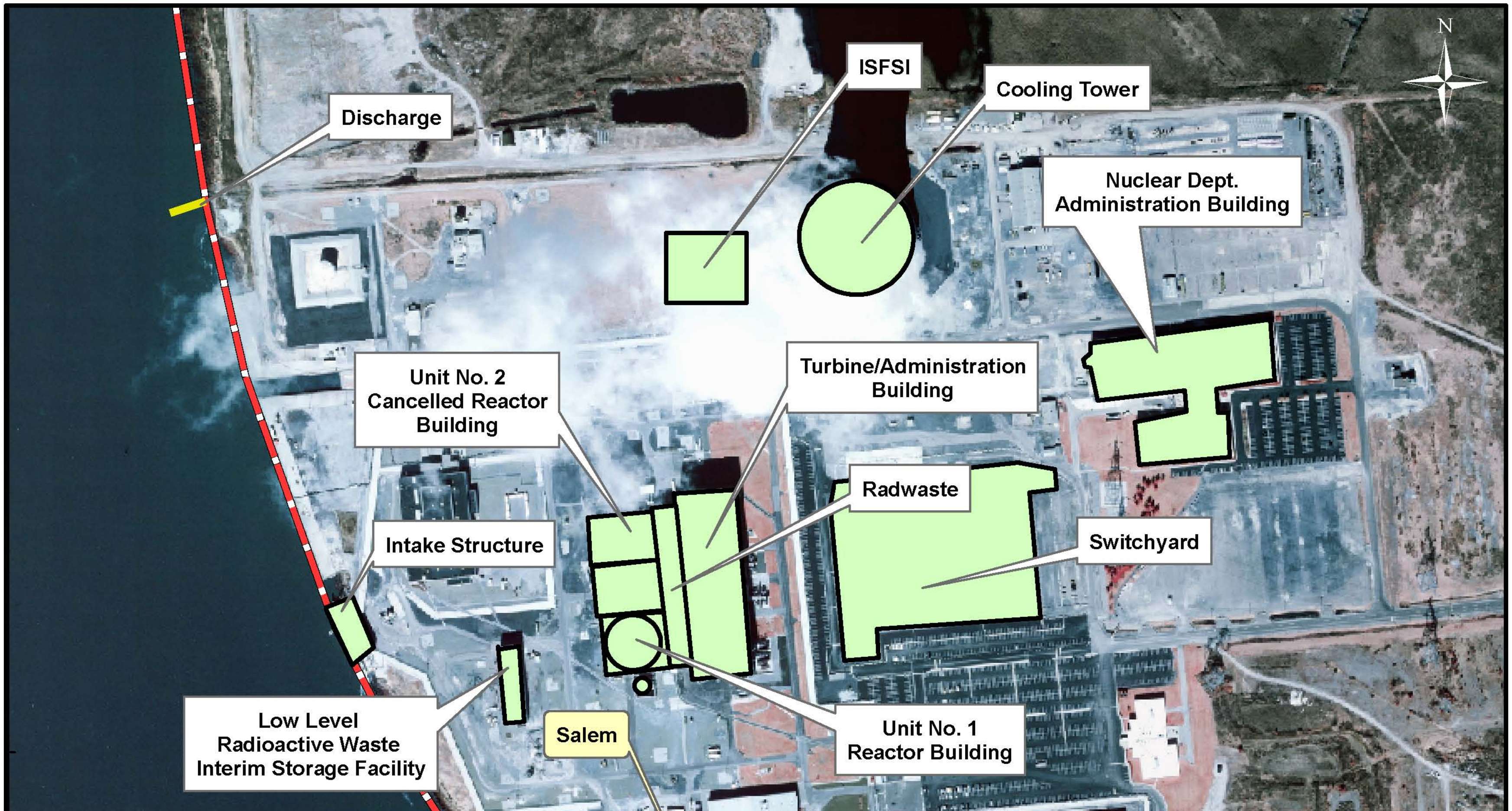
Source: TetraTech 2009

Table 3.1-4 Transmission Lines Associated with HCGS and Salem Nuclear Generating Station.

Present Name	Built during construction of	Segments	Presently Connected to	Analyzed in LR report for
Salem-New Freedom South	Salem	None	Salem	Salem
Salem-New Freedom North	Salem	None	HCGS	Salem
Salem-Keeney	Salem	HCGS to Red Lion, Red Lion to Keeney	HCGS	Salem
HCGS-New Freedom	HCGS	Salem to Orchard; Orchard to New Freedom	Salem	HCGS



Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 3.1-1 Site Boundary

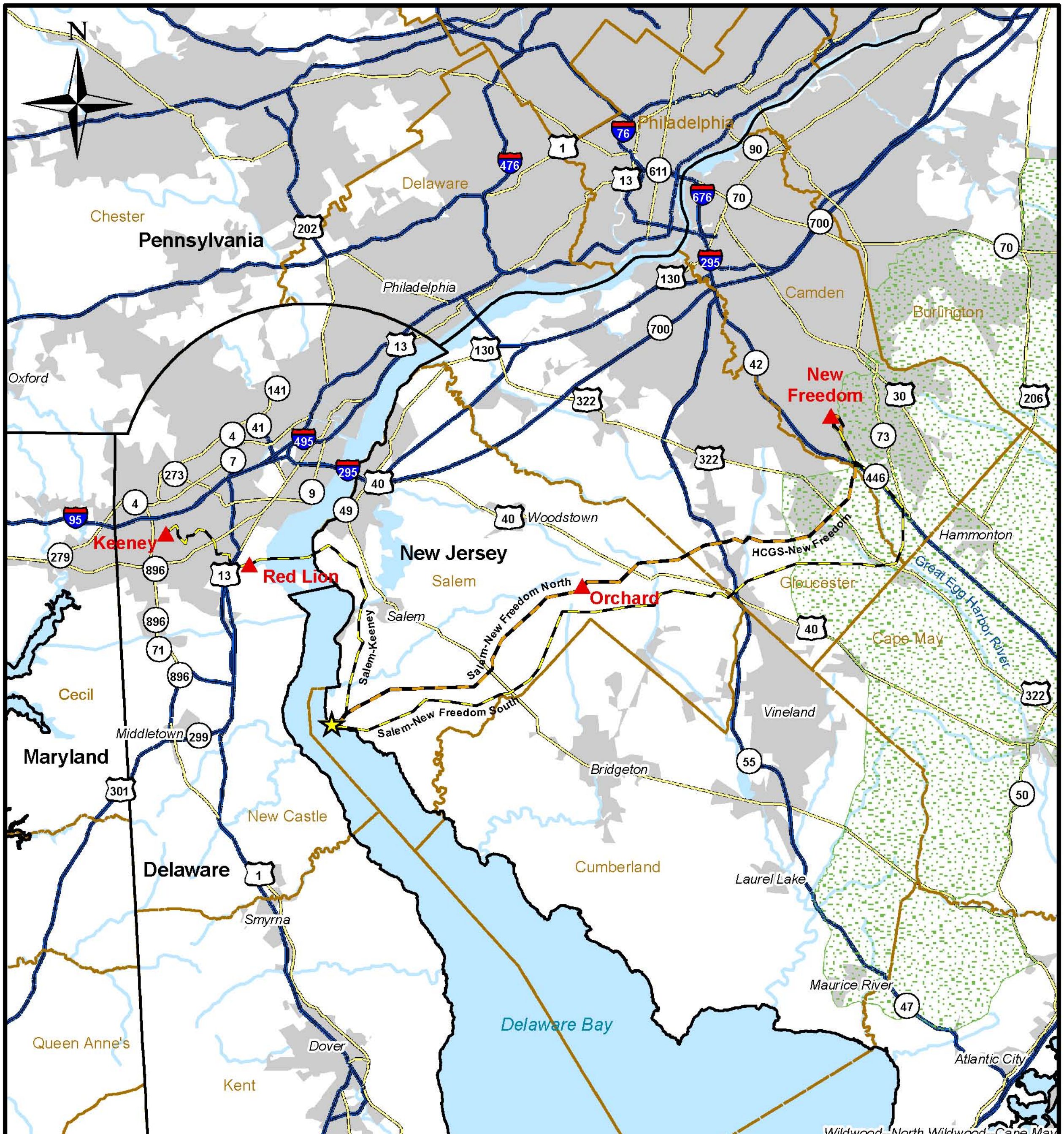


Legend

- Discharge
- Hope Creek Facility
- PSEG Boundary

0 0.05 0.1 0.2 0.3 Miles

Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 3.1-2 Hope Creek Site Layout

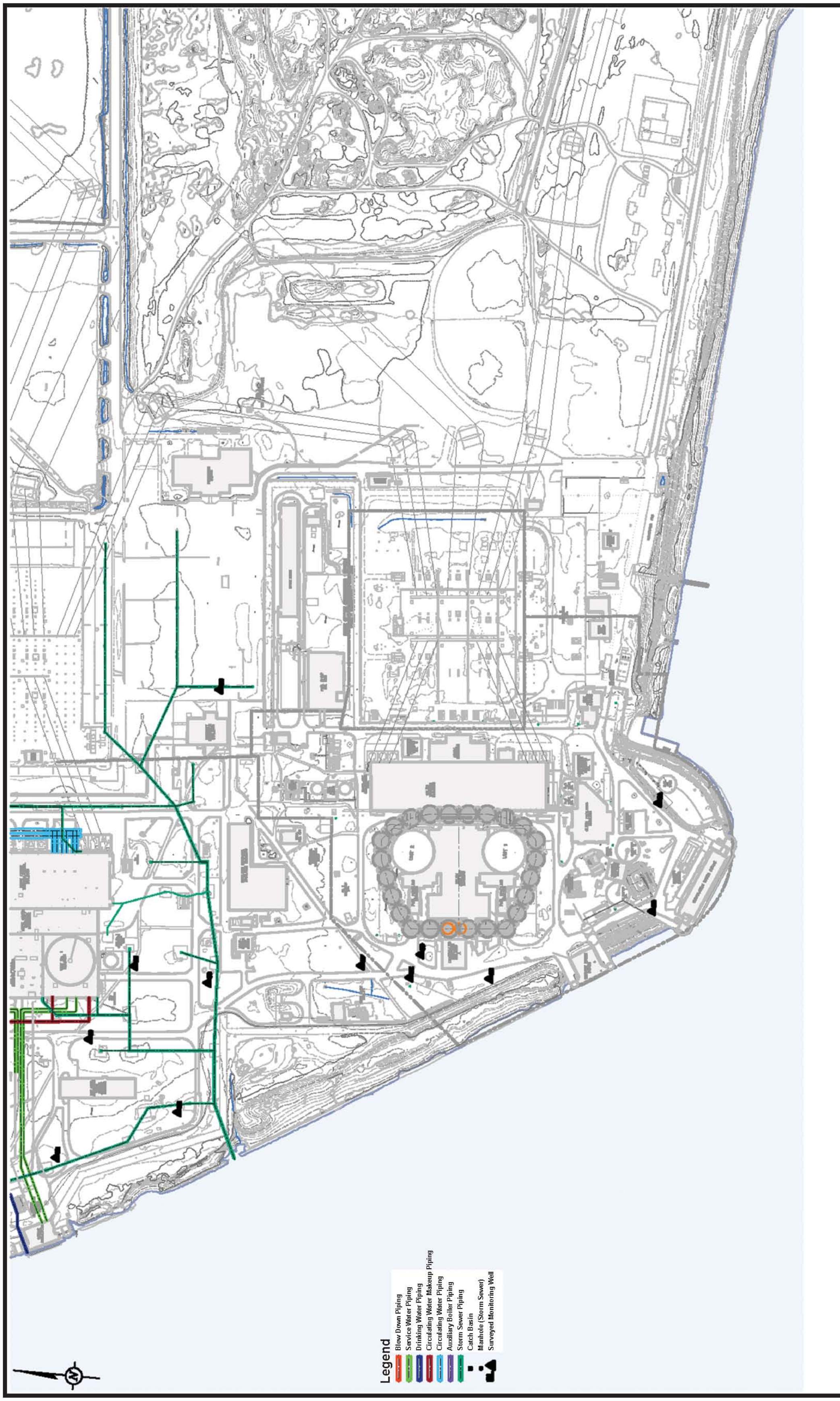


Legend

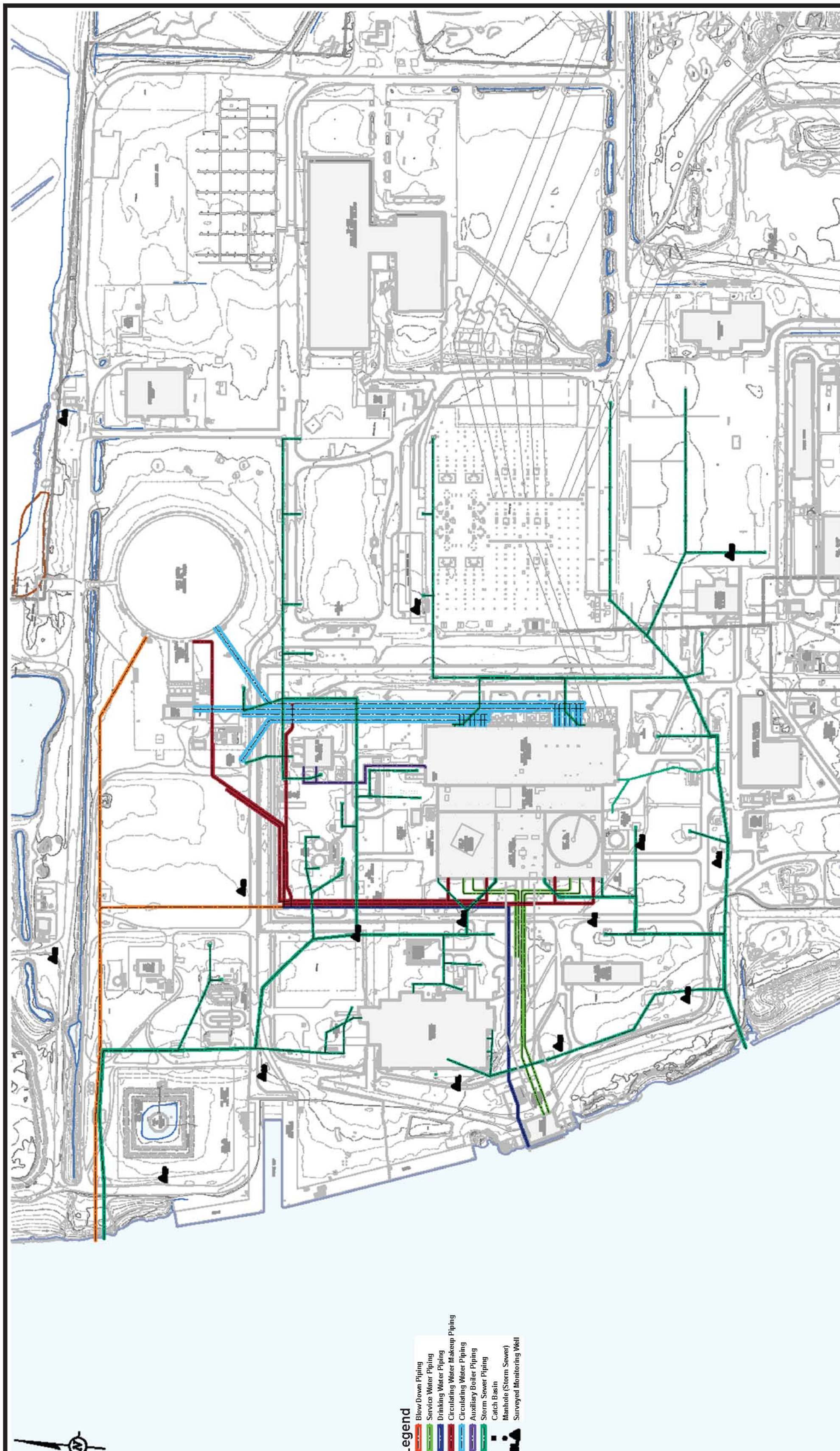
- Salem and Hope Creek Generating Stations
- Substation
- Transmission Line analyzed in Hope Creek ER
- Transmission Line analyzed in Salem ER
- State Boundary
- County Boundary
- Primary Highway with Limited Access
- Primary Highway
- Urban Area
- Pinelands
- Water

Miles: 0, 2.5, 5, 10, 15

Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 3.1-3 Transmission System



Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 3.1-4 Salem RGPP Wells



Hope Creek Generating Station
PSEG
License Renewal Environmental Report
Figure 3.1-5 HCGS RGPP Wells

3.2 Refurbishment Activities

NRC

> **"The report must contain a description of … the applicant's plans to modify the facility or its administrative control procedures as described in accordance with § 54.21...This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment…." 10 CFR 51.53(c)(2)**
>
> **"The environmental report must contain analyses of …refurbishment activities, if any, associated with license renewal…" 10 CFR 51.53 (c)(3)(ii)**
>
> **"…The incremental aging management activities carried out to allow operation of a nuclear power plant beyond the original 40-year license term will be from one of two broad categories:…(2) major refurbishment or replacement actions, which usually occur fairly infrequently and possibly only once in the life of the plant for any given item...." (NRC 1996b, Section 2.6.3.1, pg. 2-41)**

PSEG has no plans for refurbishment or replacement activities at HCGS. PSEG has addressed refurbishment activities in this Environmental Report in accordance with NRC regulations and complementary information in the NRC GEIS for license renewal (NRC 1996b). NRC requirements for the renewal of operating licenses for nuclear power plants include the preparation of an integrated plant assessment (IPA) (10 CFR 54.21). The IPA must identify and list systems, structures, and components subject to an aging management review. Items that are subject to aging and might require refurbishment include, for example, the reactor vessel piping, supports, and pump casings (see 10 CFR 54.21 for details), as well as items that are not subject to periodic replacement.

The HCGS IPA that PSEG conducted under 10 CFR 54 has not identified the need to undertake any major refurbishment or replacement actions to maintain the functionality of important systems, structures, and components during the HCGS renewed license period. PSEG has included the IPA as Section 2 of this HCGS license renewal application.

3.3 Programs and Activities for Managing the Effects of Aging

NRC

> **"The report must contain a description of … the applicant's plans to modify the facility or its administrative control procedures…. This report must describe in detail the modifications directly affecting the environment or affecting plant effluents that affect the environment…." 10 CFR 51.53(c)(2)**
>
> **"…The incremental aging management activities carried out to allow operation of a nuclear power plant beyond the original 40 year license term will be from one of two broad categories: (1) SMITTR actions, most of which are repeated at regular intervals …." (NRC 1996b, Section 2.6.3.1, pg. 2-41) (SMITTR is defined in NRC 1996b as surveillance, on-line monitoring, inspections, testing, trending, and recordkeeping.)**

The IPA required by 10 CFR 54.21 identifies the programs and inspections for managing aging effects at HCGS. These programs are described in the Hope Creek Generating Station License Renewal Application, Section 2, Scoping and Screening Methodology for Identifying Structures and Components Subject to Aging Management Review, and Implementation Results. Other than implementation of the programs and inspections identified in the IPA, there are no planned modifications of HCGS administrative control procedures associated with license renewal.

3.4 Employment

3.4.1 CURRENT WORK FORCE

HCGS currently employs a workforce of approximately 513 regular, full-time employees and shares up to an additional 270 PSEG corporate and 86 matrixed employees with Salem. To ensure conservatism, the analyses in this Environmental Report include the total complement of corporate and matrixed employees as part of the HCGS workforce. Approximately 81 percent of the employees live in Cumberland, Gloucester, and Salem counties, New Jersey, and New Castle County, Delaware. Addresses for permanent residences of the remaining employees are distributed across 27 counties in Connecticut, Florida, Indiana, Maryland, New Jersey, New York, Ohio, Pennsylvania, South Carolina, Virginia, and Wisconsin with numbers ranging from one to 40 employees per county. Less than three percent of the workforce has permanent residences located outside of New Jersey, Pennsylvania, or Delaware (see Table 2.6-2).

HCGS is on an 18-month refueling cycle. During refueling outages, site employment increases above the regular, shared, and matrixed work force by as many as 600 workers for approximately 23 days of temporary duty. This number of outage workers falls within the range (200 to 900 workers per reactor unit) reported in the GEIS for additional maintenance workers (NRC 1996b).

3.4.2 LICENSE RENEWAL INCREMENT

Performing the programs and activities for managing the effects of aging that are described in Section 3.3 would necessitate increasing the HCGS staff workload by some increment. The size of this increment would be a function of the schedule within which PSEG must accomplish the work and the amount of work involved. The analysis of license renewal employment increment focuses on programs and activities for managing the effects of aging.

The GEIS assumes that NRC would renew a nuclear power plant license for a 20-year period beyond the term of its initial license, and that NRC would issue the renewal approximately ten years before the initial license expires. In other words, the renewed license would be in effect for approximately 30 years. The GEIS further assumes that the utility would initiate surveillance, monitoring, inspections, testing, trending, and recordkeeping (SMITTR) activities at the time of issuance of the new license and would conduct license-renewal SMITTR activities throughout the remaining 30-year life of the plant, sometimes during full-power operation, but mostly during normal refueling and the five- and ten-year in-service inspection and refueling outages. (NRC 1996b)

PSEG has determined that the GEIS scheduling assumptions are reasonably representative of HCGS incremental license-renewal, workload scheduling. Many HCGS license-renewal SMITTR activities would have to be performed during outages. Although some HCGS license-renewal SMITTR activities would be one-time efforts, others would be recurring periodic activities that would continue for the life of the plant.

The GEIS estimates that the most additional personnel needed to perform license-renewal SMITTR activities would typically be 60 persons during the three-month duration of a ten-year in-service inspection and refueling outage. Having established this upper value for what would be a single event in 20 years, the GEIS uses this number as the expected number of additional permanent workers needed per unit attributable to license renewal. GEIS Section C.3.1.2 uses this approach in order to "...provide a realistic upper bound to potential population-driven impacts…." (NRC 1996b)

PSEG expects that its existing capability for temporarily supplementing the workforce for routine activities such as outages will enable PSEG to perform the increased SMITTR workload without adding workers to the HCGS staff. However, for purposes of analysis in this Environmental Report, PSEG conservatively assumes that HCGS would require 60 additional permanent workers to perform all license-renewal SMITTR activities and that all 60 employees would migrate into the 80-km (50-mi) radius. Adding 60 full-time employees to the plant work force for the period of extended operation creates additional indirect jobs. Considering the population in the 80-km (50-mi) radius and the fact that most indirect jobs would be service-related, PSEG assumes that all indirect workers would already reside within the 80-km (50-mi) radius.

Chapter 4

Environmental Consequences of the Proposed Action and Mitigating Actions

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NRC

> **The report must contain a consideration of alternatives for reducing adverse impacts…for all Category 2 license renewal issues….” 10 CFR 51.53(c)(3)(iii)**
>
> **“The environmental report must include an analysis that considers…the environmental effects of the proposed action…and alternatives available for reducing or avoiding adverse environmental effects….” 10 CFR 51.45(c) as adopted by 10 CFR 51.53(c)(2)**
>
> **The environmental report shall discuss the “…impact of the proposed action on the environment. Impacts shall be discussed in proportion to their significance….” 10 CFR 51.45(b)(1) as adopted by 10 CFR 51.53(c)(2)**
>
> **“…The information submitted…should not be confined to information supporting the proposed action but should also include adverse information.” 10 CFR 51.45(e) as adopted by 10 CFR 51.53(c)(2)**

Chapter 4 presents an assessment of the environmental consequences associated with the renewal of the HCGS operating license. The NRC has identified and analyzed 92 environmental issues that it considers to be associated with nuclear power plant license renewal and has designated the issues as Category 1, Category 2, or NA (not applicable). NRC designated an issue as Category 1 if, based on the result of its analysis, the following criteria were met:

- the environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristic;
- a single significance level (i.e., SMALL. MODERATE or LARGE) has been assigned to the impacts that would occur at any plant, regardless of which plant is being evaluated (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent-fuel disposal); and
- mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely to be not sufficiently beneficial to warrant implementation.

If the NRC analysis concluded that one or more of the Category 1 criteria could not be met, NRC designated the issue as Category 2.

Finally, NRC designated two issues as NA, signifying that the categorization and impact definitions do not apply to these issues.

NRC rules do not require analyses of Category 1 issues that NRC resolved using generic findings (10 Code of Federal Regulations [CFR] 51) as described in the Generic Environmental

Impact Statement for License Renewal of Nuclear Plants (GEIS) (NRC 1996b). An applicant may reference the generic findings or GEIS analyses for Category 1 issues.

NRC requires plant specific analyses for Category 2 issues. For the two issues designated as NA, applicants are not required to submit information to the NRC.

Of the 92 total issues, in addition to the two issues designated as NA, NRC designated 69 as Category 1 and 21 as Category 2. Appendix A of this report lists the 92 issues and identifies the Environmental Report section that addresses each issue.

Category 1 and NA License Renewal Issues

NRC

> **"The environmental report for the operating license renewal stage is not required to contain analyses of the environmental impacts of the license renewal issues identified as Category 1 issues in Appendix B to subpart A of this part." 10 CFR 51.53(c)(3)(i)**
>
> **"…[A]bsent new and significant information, the analyses for certain impacts codified by this rulemaking need only be incorporated by reference in an applicant's environmental report for license renewal…." (NRC 1996a, pg. 28483)**

Category 1 License Renewal Issues

PSEG has determined that 8 of the 69 Category 1 issues do not apply to HCGS because they are specific to design or operational features that are not found at the facility. Because HCGS is not planning any refurbishment activities, seven additional Category 1 issues related to refurbishment do not apply. Appendix A, Table A-1 lists the 69 Category 1 issues, indicates whether or not each issue is applicable to HCGS, and if inapplicable, provides PSEG's basis for this determination. Appendix A, Table A-1 also includes references to supporting analyses in the GEIS where appropriate.

PSEG has reviewed the NRC findings at Table B-1 in Appendix B to 10 CFR 51 and has not identified any new and significant information that would make the NRC findings, with respect to Category 1 issues, inapplicable to HCGS. Therefore, PSEG adopts by reference the NRC findings for these Category 1 issues.

"NA" License Renewal Issues

NRC determined that its categorization and impact-finding definitions did not apply to Issues 60 and 92; however, PSEG included these issues in Table A-1. NRC noted that applicants currently do not need to submit information on Issue 60, chronic effects from electromagnetic fields (10 CFR 51). For Issue 92, environmental justice, NRC does not require information from applicants, but noted that it will be addressed in individual license renewal reviews (10 CFR 51). PSEG has included environmental justice demographic information in Section 2.6.2.

Category 2 License Renewal Issues

NRC

> **"The environmental report must contain analyses of the environmental impacts of the proposed action, including the impacts of refurbishment activities, if any, associated with license renewal and the impacts of operation during the renewal term, for those issues identified as Category 2 issues in Appendix B to subpart A of this part…" 10 CFR 51.53(c)(3)(ii)**
>
> **"The report must contain a consideration of alternatives for reducing adverse impacts, as required by § 51.45(c), for all Category 2 license renewal issues…." 10 CFR 51.53(c)(3)(iii)**

NRC designated 21 issues as Category 2. Sections 4.1 through 4.20 (Section 4.17 addresses 2 issues) address the Category 2 issues, beginning with a statement of the issue. Twelve Category 2 issues apply to operational features that HCGS does not have or to an activity, refurbishment, which HCGS is not planning to undertake. If the issue does not apply to HCGS, the section explains the basis for inapplicability.

For the nine Category 2 issues that PSEG has determined to be applicable to HCGS, the appropriate sections contain the required analyses. These analyses include conclusions regarding the significance of the impacts relative to the renewal of the operating license for HCGS and, if applicable, discuss potential mitigative alternatives to the extent required. PSEG has identified the significance of the impacts associated with each issue as either small, moderate, or large, consistent with the criteria that NRC established in 10 CFR 51, Appendix B, Table B-1, Footnote 3 as follows:

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

In accordance with National Environmental Policy Act practice, PSEG considered ongoing and potential additional mitigation in proportion to the significance of the impact to be addressed (i.e., impacts that are small receive less mitigative consideration than impacts that are large).

4.1 Water Use Conflicts (Plants with Cooling Ponds or Cooling Towers Using Makeup Water from a Small River with Low Flow)

NRC

> **"If the applicant's plant utilizes cooling towers or cooling ponds and withdraws makeup water from a river whose annual flow rate is less than 3.15×10^{12} ft^3/year (9×10^{10} m^3/year), an assessment of the impact of the proposed action on the flow of the river and related impacts on instream and riparian ecological communities must be provided…." 10 CFR 51.53(3)(ii)(A)**
>
> **"The issue has been a concern at nuclear power plants with cooling ponds and at plants with cooling towers. Impacts on instream and riparian communities near these plants could be of moderate significance in some situations…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 13.**

NRC made surface water use conflicts a Category 2 issue because consultations with regulatory agencies indicate that water use conflicts are already a concern at two closed-cycle plants (Limerick and Palo Verde) and may be a problem in the future at other plants. In the GEIS, NRC notes two factors that may cause water use and availability issues to become important for some nuclear power plants that use cooling towers. First, some plants equipped with cooling towers are located on small rivers that are susceptible to droughts or competing water uses. Second, consumptive water loss associated with closed-cycle cooling systems may represent a substantial proportion of the flows in small rivers (NRC 1996b).

NRC has determined that HCGS uses a cooling tower and withdraws from and discharges to an estuary (NRC 1996b; Table 5.13). Therefore, this issue does not apply because HCGS does not use cooling ponds or withdraw cooling tower makeup water from a small river.

4.2 Entrainment of Fish and Shellfish in Early Life Stages

NRC

> **"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations…or equivalent State permits and supporting documentation. If the applicant can not provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from…entrainment." 10 CFR 51.53(c)(3)(ii)(B)**
>
> **"The impacts of entrainment are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems. Further, ongoing efforts in the vicinity of these plants to restore fish populations may increase the numbers of fish susceptible to intake effects during the license renewal period, such that entrainment studies conducted in support of the original license may no longer be valid…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 25**

NRC made impacts on fish and shellfish resources resulting from entrainment a Category 2 issue, because it could not assign a single significance level to the issue. The impacts of entrainment are small at many plants, but they may be moderate or large at others. Also, ongoing restoration efforts may increase the number of fish susceptible to intake effects during the license renewal period (NRC 1996b). Information needing to be ascertained includes: (1) type of cooling system (whether once-through or closed cycle), and (2) status of Clean Water Act (CWA) Section 316(b) determination or equivalent state documentation.

NJDEP has determined that the location, design, construction, and capacity of HCGS's cooling water system is the best technology available. This technology significantly minimizes the potential mortality of aquatic life typically associated with cooling water intake structures, namely impingement and entrainment, as CWA Section 316(b) requires. This minimization of mortality is primarily due to the lesser amount of intake flow of closed-cycle cooling systems as compared to once-through cooling systems. (NJDEP 2002)

The issue of entrainment of fish and shellfish in early life stages does not apply to HCGS because the plant does not use once-through cooling or cooling pond heat dissipation systems. As described in Section 3.1.2, HCGS uses a closed-cycle cooling system with a cooling tower that withdraws make-up water from the Delaware Estuary and discharges blowdown to the Delaware Estuary. Appendix B provides the current NJPDES permit for HCGS.

4.3 Impingement of Fish and Shellfish

NRC

> **"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act 316(b) determinations…or equivalent State permits and supporting documentation. If the applicant can not provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from…impingement…." 10 CFR 51.53(c)(3)(ii)(B)**
>
> **"The impacts of impingement are small at many plants but may be moderate or even large at a few plants with once-through and cooling-pond cooling systems." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 26**

NRC made impacts on fish and shellfish resources resulting from impingement a Category 2 issue because it could not assign a single significance level to the issue. The impacts of impingement are small at many plants, but they may be moderate or large at others (NRC 1996b). Information needing to be ascertained includes: (1) type of cooling system (whether once-through or closed cycle), and (2) status of CWA Section 316(b) determination or equivalent state documentation.

NJDEP has determined that the location, design, construction, and capacity of HCGS's cooling water system is the best technology available. Ristroph screens and very low velocities at the intake significantly minimize the potential mortality of aquatic life typically associated with cooling water intake structures, namely impingement and entrainment, as CWA Section 316(b) requires. This minimization of mortality is primarily due to the lesser amount of intake flow of closed-cycle cooling systems as compared to once-through cooling systems. (NJDEP 2002)

HCGS does not use once-through cooling or cooling pond heat dissipation systems. Therefore, the issue of impingement does not apply. As described in Section 3.1.2, HCGS uses a closed-cycle cooling system with a cooling tower that withdraws make-up water from the Delaware Estuary and discharges blowdown to the Delaware Estuary. Appendix B provides the current NJPDES permit for HCGS.

4.4 Heat Shock

NRC

> **"If the applicant's plant utilizes once-through cooling or cooling pond heat dissipation systems, the applicant shall provide a copy of current Clean Water Act… 316(a) variance in accordance with 40 CFR 125, or equivalent State permits and supporting documentation. If the applicant cannot provide these documents, it shall assess the impact of the proposed action on fish and shellfish resources resulting from heat shock …." 10 CFR 51.53(c)(3)(ii)(B)**
>
> **"Because of continuing concerns about heat shock and the possible need to modify thermal discharges in response to changing environmental conditions, the impacts may be of moderate or large significance at some plants…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 27**

NRC made impacts on fish and shellfish resources resulting from heat shock a Category 2 issue, because of continuing concerns about thermal discharge effects and the possible need to modify thermal discharges in the future in response to changing environmental conditions (NRC 1996b). Information to be ascertained includes: (1) type of cooling system (whether once-through or cooling tower), and (2) evidence of a CWA Section 316(a) variance or equivalent state documentation.

HCGS uses a cooling tower. Therefore, this issue does not apply because HCGS does not use once-through cooling or cooling pond heat dissipation systems. Appendix B provides the current NJPDES permit for HCGS.

4.5 Ground-Water Use Conflicts (Plants Using >100 gpm of Ground Water)

NRC

"If the applicant's plant…pumps more than 100 gallons (total onsite) of ground water per minute, an assessment of the impact of the proposed action on ground water use must be provided." 10 CFR 51.53(c)(3)(ii)(C)

"Plants that use more than 100 gpm may cause ground water use conflicts with nearby ground water users…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 33

NRC made ground-water use conflicts a Category 2 issue because, at a withdrawal rate of more than 100 gpm, a cone of depression could extend offsite. This could deplete the ground-water supply available to offsite users, an impact that could warrant mitigation. Information to be ascertained includes: (1) HCGS ground-water withdrawal rate (whether greater than 100 gpm), (2) drawdown at offsite locations, and (3) impact on neighboring wells.

Based on information presented in Section 3.1.4, HCGS used average rates of 518 to 749 liter per minute (137 to 198 gpm) of ground water from the two facility wells during the period from 2002 through 2008. Therefore, the issue of ground-water use conflicts does apply at HCGS because withdrawal rates exceed 100 gpm.

As discussed in Section 3.1.4, the two primary Salem ground-water production wells (PW-5 and PW-6) are installed in the Upper Raritan and Middle Raritan Formation of the Potomac-Raritan-Magothy Aquifer, respectively. The two HCGS ground-water production wells (HC-1 and HC-2) are installed in the Upper Raritan Formation of the Potomac-Raritan-Magothy Aquifer. Table 3.1-1 presents ground-water withdrawals for production wells at HCGS during 2002 through 2008. Table 3.1-3 presents water level elevation data for production wells at HCGS during 2000 through 2008.

Ground-water use in the Upper Raritan Formation has not been adversely impacted by HCGS withdrawals because, as Section 2.3 indicates, there are no off-site wells within 1.6 km (1 mi) of the HCGS site. Also, the nearest potable supply well is located more than 5.6 km (3.5 mi) from the site, across the Delaware River. PSEG utilizes less than half of the allocation authorized by DRBC and NJDEP for both HCGS and Salem. PSEG further concludes that impacts from the use of ground water at the current rates would be SMALL and would not warrant mitigation.

4.6 Ground-Water Use Conflicts (Plants Using Cooling Towers Withdrawing Makeup Water From a Small River)

NRC

> **"If the applicant's plant utilizes cooling towers or cooling ponds and withdraws make-up water from a river whose annual flow rate is less than 3.15×10^{12} ft^3 / year...[t]he applicant shall also provide an assessment of the impacts of the withdrawal of water from the river on alluvial aquifers during low flow." 10 CFR 51.53(3)(ii)(A)**
>
> **"…Water use conflicts may result from surface water withdrawals from small water bodies during low flow conditions which may affect aquifer recharge, especially if other ground water or upstream surface water users come on line before the time of license renewal…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 34**

NRC made this ground-water use conflict a Category 2 issue because consumptive use of water withdrawn from small rivers could adversely impact aquatic life, downstream users, and ground water-aquifer recharge. This is a particular concern during low-flow conditions and could create an adverse cumulative impact if there were additional large consumptive users withdrawing water from the same river. Cooling towers and cooling ponds lose water through evaporation, which is necessary to cool the heated water before it is discharged to the environment.

NRC has determined that HCGS surface water withdrawals and discharges are from and to a brackish estuary (NRC 1996b; Table 5.13). Therefore, this issue does not apply because HCGS does not use cooling tower technology that withdraws makeup water from a small river.

4.7 Ground-Water Use Conflicts (Plants Using Ranney Wells)

NRC

> **"If the applicant's plant uses Ranney wells…an assessment of the impact of the proposed action on ground water use must be provided." 10 CFR 51.53(c)(3)(ii)(C)**
>
> **"…Ranney wells can result in potential ground-water depression beyond the site boundary. Impacts of large ground-water withdrawal for cooling tower makeup at nuclear power plants using Ranney wells must be evaluated at the time of application for license renewal…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 35**

NRC made this ground-water use conflict a Category 2 issue because large quantities of ground water withdrawn from Ranney wells could degrade ground-water quality at river sites by induced infiltration of poor-quality river water into an aquifer.

As Section 3.1 describes, HCGS withdraws its service water, which is also used for cooling tower makeup water, from surface water. Ground water is only withdrawn for potable and other uses. Therefore, this issue does not apply because HCGS does not use Ranney wells.

4.8 Degradation of Ground-Water Quality

NRC

> **"If the applicant's plant is located at an inland site and utilizes cooling ponds, an assessment of the impact of the proposed action on ground water quality must be provided." 10 CFR 51.53(c)(3)(ii)(D)**
>
> **"…Sites with closed-cycle cooling ponds may degrade ground-water quality. For plants located inland, the quality of the ground water in the vicinity of the ponds must be shown to be adequate to allow continuation of current uses…." 10 CFR 51, Subpart A, Appendix B, Table B 1, Issue 39**

NRC made degradation of ground-water quality a Category 2 issue because evaporation from closed-cycle cooling ponds concentrates dissolved solids in the water and settles suspended solids. In turn, seepage into the water table aquifer could degrade ground-water quality.

HCGS is not at an inland site and does not use cooling ponds. Therefore, this issue does not apply.

4.9 Impacts of Refurbishment on Terrestrial Resources

NRC

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

"…Refurbishment impacts are insignificant if no loss of important plant and animal habitat occurs. However, it cannot be known whether important plant and animal communities may be affected until the specific proposal is presented with the license renewal application…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 40

"…If no important resource would be affected, the impacts would be considered minor and of small significance. If important resources could be affected by refurbishment activities, the impacts would be potentially significant…." (NRC 1996b, Section 3.6, pg. 3-6)

NRC made impacts to terrestrial resources from refurbishment a Category 2 issue, because the significance of ecological impacts cannot be determined without considering site- and project-specific details (NRC 1996b). Aspects of the site and project to be ascertained are: (1) the identification of important ecological resources, (2) the nature of refurbishment activities, and (3) the extent of impacts to plant and animal habitats.

As Section 3.2 describes, PSEG has no plans for refurbishment activities at HCGS. Therefore, this issue does not apply.

4.10 Threatened or Endangered Species

NRC

> **"…Additionally, the applicant shall assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act." 10 CFR 51.53(c)(3)(ii)(E)**
>
> **"Generally, plant refurbishment and continued operation are not expected to adversely affect threatened or endangered species. However, consultation with appropriate agencies would be needed at the time of license renewal to determine whether threatened or endangered species are present and whether they would be adversely affected." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 49**

NRC made impacts to threatened or endangered species a Category 2 issue because the status of many species is being reviewed, and site-specific assessment is required to determine whether any identified species could be affected by refurbishment activities or continued plant operations through the renewal period. In addition, compliance with the Endangered Species Act requires consultation with the appropriate federal agency (NRC 1996b, Sections 3.9 and 4.1).

Section 2.2 of this Environmental Report describes the aquatic communities of the Delaware Estuary in the vicinity of HCGS. Section 2.4 describes important terrestrial habitats at HCGS and along the associated transmission corridor (HCGS-New Freedom). Section 2.5 discusses threatened or endangered species that occur or may occur in the vicinity of HCGS and along its associated transmission corridor (HCGS-New Freedom).

As discussed in Section 3.2, no refurbishment activities at HCGS are planned during the license renewal term, and thus, no further analysis of refurbishment-related impacts is applicable.

With the exception of the species identified in Section 2.5, PSEG is not aware of any species that are listed as threatened or endangered, or have been nominated for listing, that could occur at HCGS or along its associated transmission corridor. Except for the potential impacts to aquatic species described below, current operations of HCGS are not believed to affect any listed terrestrial or aquatic species or their habitats. Similarly, PSE&G vegetation management practices along the transmission corridor are developed and implemented in conjunction with appropriate regulatory agencies to minimize potential impacts on threatened or endangered species. Furthermore, plant operations and transmission line maintenance practices are not expected to change significantly during the license renewal term. Therefore, no adverse impacts to threatened or endangered terrestrial or aquatic species from current or future operations beyond those previously identified are anticipated.

In 1993, the National Marine Fisheries Service (NMFS) issued a biological opinion and incidental take statement that determined that the continued operation of Salem and HCGS would not jeopardize threatened or endangered species, including sea turtles and shortnose sturgeon (NMFS 1993). That biological opinion, considering both Salem and HCGS, noted that no threatened or endangered sea turtle or turtles takes had been documented at HCGS, and that no additional measures were required at HCGS to protect sea turtles. It was silent on the impact of HCGS on shortnose sturgeon. The 1993 incidental take statement was reviewed and revised in 1999 (NMFS 1999b). The 1999 revised incidental take statement does not mention or modify prior NMFS findings regarding HCGS. No turtle takes have been documented at HCGS since 1999. Also, HCGS has appropriate controls in place at the service water system intake for managing the impacts of short-nosed sturgeon impingement. These controls have been reviewed by NMFS, as discussed above.

One plant species federally listed as threatened is known from one corridor not associated with HCGS. One reptile federally listed as threatened and state-listed as endangered, and one amphibian state listed as endangered occur in the vicinity of the transmission line associated with HCGS (see Section 2.5). PSE&G and PHI work cooperatively with state regulatory agencies, including the New Jersey Pinelands Commission, to ensure best management maintenance practices for the protection of these species are implemented, including limiting maintenance and vegetation control during specific times of the year.

PSEG has initiated contacts with the NJDEP, Delaware Department of Natural Resources and Environmental Control, the USFWS, and NMFS requesting information on any listed species or critical habitats that might occur on the HCGS site or along the associated transmission corridors, with particular emphasis on species that might be adversely affected by continued operation over the license extension term. All species and habitats identified have been considered. Contact letters and responses received are provided in Appendix C.

Renewal of the HCGS license is not expected to jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of any critical habitat. Because current operational practices that could affect the environment will not be modified by license renewal, PSEG concludes that impacts to threatened or endangered species from license renewal would be SMALL and do not warrant additional mitigation.

4.11 Air Quality During Refurbishment (Non-Attainment or Maintenance Areas)

NRC

> **"If the applicant's plant is located in or near a nonattainment or maintenance area, an assessment of vehicle exhaust emissions anticipated at the time of peak refurbishment workforce must be provided in accordance with the Clean Air Act as amended." 10 CFR 51.53(c)(3)(ii)(F)**
>
> **"Air quality impacts from plant refurbishment associated with license renewal are expected to be small. However, vehicle exhaust emissions could be cause for concern at locations in or near nonattainment or maintenance areas. The significance of the potential impact cannot be determined without considering the compliance status of each site and the numbers of workers expected to be employed during the outage…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 50**

NRC made impacts to air quality during refurbishment a Category 2 issue because vehicle exhaust emissions could be cause for some concern, and a general conclusion about the significance of the potential impact could not be drawn without considering the compliance status at each site and the number of workers expected to be employed during an outage (NRC 1996b). Information needed would include: (1) the attainment status of the area, and (2) the number of additional vehicles as a result of refurbishment activities.

As Section 3.2 describes, PSEG has no plans for refurbishment activities at HCGS. Therefore, this issue does not apply.

4.12 Microbiological Organisms

NRC

> **"If the applicant's plant uses a cooling pond, lake, or canal or discharges into a river having an annual average flowrate of less than 3.15×10^{12} ft^3/year (9×10^{10} m^3/year), an assessment of the impact of the proposed action on public health from thermophilic organisms in the affected water must be provided." 10 CFR 51.53(c)(3)(ii)(G)**
>
> **"These organisms are not expected to be a problem at most operating plants except possibly at plants using cooling ponds, lakes, or canals that discharge to small rivers. Without site-specific data, it is not possible to predict the effects generically…." 10 CFR 51,Subpart A, Appendix B, Table B-1, Issue 57**

NRC designated impacts to public health from thermophilic organisms a Category 2 issue, requiring plant-specific analysis, because the magnitude of the potential public health impacts associated with thermal enhancement of such organisms, particularly *Naegleria fowleri*, could not be determined generically. NRC noted in the GEIS that impacts of nuclear power plant cooling towers and thermal discharges are considered to be of small significance if they do not enhance the presence of microorganisms that are detrimental to water quality and public health (NRC 1996b).

NRC requires [10 CFR 51.53(c)(3)(ii)(G)] an assessment of the potential impact of thermophilic organisms in receiving waters on public health if a nuclear power plant uses cooling ponds, cooling lakes, or cooling canals or discharges to a river with an average annual flow rate less than 9 x 10^{10} cubic meters per year (3.15 x 10^{12} cubic feet per year).

NRC has determined that HCGS discharges to an estuary (NRC 1996b; Table 5.13). As discussed in Section 3.1.2, HCGS has a cooling tower that uses brackish water from an estuary and discharges to the same estuary. Water flow rate in the estuary is discussed in Section 2.2. HCGS does not use cooling ponds, cooling lakes, cooling canals, or discharge to a small river. Therefore, this issue does not apply.

4.13 Electric Shock from Transmission-Line-Induced Currents

NRC

> **The environmental report must contain an assessment of the impact of the proposed action on the potential shock hazard from transmission lines "...[i]f the applicant's transmission lines that were constructed for the specific purpose of connecting the plant to the transmission system do not meet the recommendations of the National Electric Safety Code for preventing electric shock from induced currents…" 10 CFR 51.53(c)(3)(ii)(H)**
>
> **"Electrical shock resulting from direct access to energized conductors or from induced charges in metallic structures have not been found to be a problem at most operating plants and generally are not expected to be a problem during the license renewal term. However, site-specific review is required to determine the significance of the electric shock potential at the site…." 10 CFR 51, Subpart A, Table B 1, Issue 59**

NRC made impacts of electric shock from transmission lines a Category 2 issue because, without a review of each plant's transmission line conformance with the National Electrical Safety Code (NESC) criteria (IEEE 2006), NRC could not determine the significance of the electric shock potential. This section provides an analysis of the HCGS transmission line's in conformance to the NESC standard.

<u>Production of Induced Currents</u>

Objects located near transmission lines can become electrically charged due to their immersion in the lines' electric field. This charge results in a current that flows through the object to the ground. The current is called "induced" because there is no direct connection between the line and the object. The induced current can also flow to the ground through the body of a person who touches the object. An object that is insulated from the ground can actually store an electrical charge, becoming what is called "capacitively charged." A person standing on the ground and touching a vehicle or a fence receives an electrical shock due to the sudden discharge of the capacitive charge through the person's body to the ground. After the initial discharge, a steady-state current can develop, the magnitude of which depends on several factors, including the following:

- the strength of the electric field which, in turn, depends on the voltage of the transmission line as well as its height and geometry;
- the size of the object on the ground; and
- the extent to which the object is grounded.

In 1977, the NESC adopted a provision that describes how to establish minimum vertical clearances to the ground for electric lines having voltages exceeding 98-kilovolt alternating current to ground. The clearance must limit the induced current due to electrostatic effects to 5 milliamperes if the largest anticipated truck, vehicle, or equipment were short-circuited to ground. By way of comparison, the setting of ground fault circuit interrupters used in residential wiring (special breakers for outside circuits or those with outlets around water pipes) is 4 to 6 milliamperes.

HCGS Transmission Lines

As described in Section 3.1.6, there is one 500-kilovolt line that was constructed to connect HCGS to the transmission system. This line is the following:

- HCGS-New Freedom (via Orchard substation)

In addition, two lines originally built for Salem have since been connected to HCGS. Although not part of this report's scope of analysis, results from the analysis in the Salem license renewal Environmental Report (PSEG 2009a) for these lines are provided in Table 4.13-1:

- Salem-New Freedom North

- Salem-Keeney (via Red Lion substation)

For completeness, the results from the analysis described in the Salem license renewal Environmental Report (PSEG 2009a) for the fourth transmission line associated with the Salem, Salem-New Freedom South, are also included in Table 4.13-1.

Induced Current Analysis

This analysis of the HCGS transmission lines is based on computer modeling of induced current under the line. The initial step of the analysis was identification of the line/road crossings to be analyzed. Only paved roads and highways were considered in the analysis; minor roads, i.e., "dirt" or service road crossings, were not included. The electric field strength and subsequently the induced current were then calculated for the transmission line at each location.

The electric field strength and induced current were calculated using a computer code called ACDCLINE, produced by the Electric Power Research Institute. The results of this analysis have been field-verified through actual electric field measurements by several utilities. The input parameters included design features of the limiting-case scenario and were taken from plan-and-profile drawings for the line. NESC requires that line sag measurements be determined at a minimum conductor temperature of 49°C (120°F). For analysis purposes, the maximum vehicle size under the lines is considered to be a tractor-trailer of 2.6 m (8.5 ft) wide, 3.7 m (12 ft) average height, and 20 m (65 ft) long.

Analysis Results

The induced current calculated at a conductor temperature of 49°C (120°F) resulted in a maximum induced current of 4.0 milliamperes (on HCGS-New Freedom line) (Table 4.13-1).

PSE&G, owner and operator of the transmission line, conducts regular aerial and ground surveillance and maintenance to ensure that design ground clearances do not change. The aerial patrols of all corridors include checks for encroachments, broken conductors, broken or leaning structures, and signs of burnt trees, any of which would be evidence of clearance problems. Ground inspections include examination for clearance at questionable locations, examination for integrity of structures, and surveillance for dead or diseased trees that might fall on the transmission line. Problems noted during any inspection are brought to the attention of the appropriate organizations for corrective action.

PSEG concludes that electric shock is of SMALL significance for the HCGS transmission line because the NESC standard is not exceeded at any location.

Table 4.13-1 Maximum Induced Current from HCGS and Salem Transmission Lines

Line Name	Maximum induced current (milliamperes)
Salem-New Freedom South	4.2
Salem-New Freedom North	4.1
Salem to Red Lion segment of Salem-Keeney	2.2
Red Lion to Keeney segment of Salem-Keeney	2.7
HCGS-New Freedom (via Orchard)	4.0

HCGS-New Freedom is the only line constructed to connect HCGS to the electric grid, and therefore the only line analyzed in this Environmental Report. The other lines are analyzed in the Salem Environmental Report (PSEG 2009a).

4.14 Housing Impacts

NRC

> **The environmental report must contain "...[a]n assessment of the impact of the proposed action on housing availability…" 10 CFR 51.53(c)(3)(ii)(I)**
>
> **"…Housing impacts are expected to be of small significance at plants located in a medium or high population area and not in an area where growth control measures that limit housing development are in effect. Moderate or large housing impacts of the workforce associated with refurbishment may be associated with plants located in sparsely populated areas or areas with growth control measures that limit housing development…." 10 CFR 51, Subpart A, Table B-1, Issue 63**
>
> **"...[S]mall impacts result when no discernible change in housing availability occurs, changes in rental rates and housing values are similar to those occurring statewide, and no housing construction or conversion occurs…." (NRC 1996b, Section 4.7.1.1, pg. 4-101)**

NRC made housing impacts a Category 2 issue because impact magnitude depends on local conditions that NRC could not predict for all plants at the time of GEIS publication (NRC 1996b). Local conditions that need to be ascertained are: (1) population categorization as small, medium, or high and (2) applicability of growth control measures.

Refurbishment activities and continued operations could result in housing impacts as a result of increased staffing. As described in Section 3.2, PSEG has no plans for refurbishment; therefore, no refurbishment-related increase in staff will occur and no refurbishment-related impacts to area housing will occur.

The following discussion focuses on impacts of continued operations on local housing availability and the assumption that PSEG would need to add up to 60 additional employees to support HCGS during the period of extended operation.

In 10 CFR 51, Subpart A, Appendix B, Table B-1, NRC concluded that impacts to housing are expected to be of small significance at stations located in high population areas where growth control measures are not in effect.

The maximum impact to area housing was calculated using the following assumptions: (1) all 60 direct jobs would be filled by in-migrating residents and any indirect jobs created by additional employees would be filled by people already residing within the 80-km (50-mi) radius; (2) the residential distribution of new residents would be similar to current operations worker distribution; and (3) each new direct job created would represent one housing unit. PSEG's estimate of 60 license renewal employees (Section 3.4) could generate the demand for 60 housing units.

As described in Section 2.6.1, HCGS is located in a high population area and 81 percent of the operations workforce lives in Salem, Cumberland, or Gloucester counties (in New Jersey) or

New Castle County (in Delaware). Salem County, which receives tax revenues from HCGS, is not subject to growth control measures that limit housing development (Rukenstein and Associates 2004). Gloucester, Cumberland, and New Castle counties also are not subject to growth control measures (Gloucester County 2007, Orth-Rogers 2002, New Castle County 2007). The area within an 80-km (50-mi) radius of HCGS has a population of approximately 5,201,842 people. Delaware averages 2.54 persons per household. Maryland averages 2.61, New Jersey averages 2.68, and Pennsylvania averages 2.48 persons per household (USCB 2000), suggesting the existence of approximately 2 million housing units in the 80-km (50-mi) radius. It is reasonable to conclude that 60 additional employees at HCGS would not create a discernible change in housing availability, rental rates, or housing values, or spur housing construction or conversion. PSEG concludes that impacts to housing availability resulting from station-related population growth would be SMALL and would not warrant mitigation.

4.15 Public Water Supply

NRC

The environmental report must contain "…an assessment of the impact of population increases attributable to the proposed project on the public water supply." 10 CFR 51.53(c)(3)(ii)(I)

"An increased problem with water shortages at some sites may lead to impacts of moderate significance on public water supply availability…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 65

"Impacts on public utility services are considered small if little or no change occurs in the ability to respond to the level of demand and thus there is no need to add capital facilities. Impacts are considered moderate if overtaxing of facilities during peak demand periods occurs. Impacts are considered large if existing service levels (such as quality of water and sewage treatment) are substantially degraded and additional capacity is needed to meet ongoing demands for services." (NRC 1996b, Section 3.7.4.5, pg. 3-19 as referenced by Section 4.7.3)

NRC made public utility impacts a Category 2 issue because an increased problem with water availability, resulting from pre-existing water shortages, could occur in conjunction with plant demand and station-related population growth (NRC 1996b). Local information needed would include: (1) a description of water shortages experienced in the area, and (2) an assessment of the public water supply systems' available capacity.

NRC's analysis of impacts to public water supply systems considered both station demand and station-related population growth demands on local water resources. As stated in Section 2.3, the station does not use water from an off-site public water system, there are no off-site wells within 1.6 km (1 mi) of the site, and the nearest potable supply well is more than 5.6 km (3.5 mi) from the site. Therefore, there would be no station demand-related impacts to the public water supply resources or private potable water wells. As discussed in Section 3.2, PSEG plans no refurbishment activities fort HCGS. Therefore, there also would be no refurbishment-related impacts on local public water supply supplies.

The following discussion focuses on impacts of the increased demand on local public water supplies from 60 additional employees needed to support operations at HCGS during the period of extended operation. As Section 3.4 indicates, PSEG analyzed a hypothetical 60-person increase in HCGS employment attributable to license renewal. Section 2.6 describes the HCGS regional demography. Section 2.9 describes the public water supply systems in the area, their permitted capacities, and current demands.

The maximum impact to local public water supply systems was assessed using the following assumptions: (1) all 60 direct jobs would be filled by in-migrating residents; (2) no indirect jobs would be filled by in-migrating residents; and (3) the residential distribution of the workers would resemble that of the current operations workforce. Impacts were determined by estimating the amount of water that would be required by the 60 new Salem employees and their families, which is 54,850 liters per day (14,490 gpd). This estimate was calculated by:

- Multiplying the estimated number of new jobs during the period of continued operation (60) by the average number of persons per household in New Jersey (2.68) (USCB 2000b) to determine the increase in population caused by license renewal (161 persons); and

- Multiplying the increase in population (161 persons) by the average American's daily water consumption for personal use (341 liters per day [90 gpd]) (EPA 2003).

It was then assumed that the resulting estimated license-renewal related water demand of 54,805 liters per day (14,490 gpd) (161 persons x 341 liters per day [90 gpd] per person) would be geographically distributed, in the same manner as the existing HCGS work force. That is, the increased demand would be imposed primarily on public water supply systems located in Salem, Gloucester, and Cumberland counties (in New Jersey) and New Castle County (in Delaware). These counties currently have excess public water supply capacity of approximately 129 million liters per day (34 million gallons) per day for Cumberland, Gloucester, and Salem counties (Table 2.9-1) and more than 132 million liters (35 million gallons) per day for New Castle County (Table 2.9-2). Any increase in demand resulting from renewal of the HCGS operating license would not create shortages in capacity for existing public water supply systems. PSEG concludes that impacts resulting from station-related population growth to public water supply systems would be SMALL, requiring no additional capacity and warranting no mitigation.

4.16 Education Impacts from Refurbishment

NRC

> **The environmental report must contain "…[a]n assessment of the impact of the proposed action on…public schools (impacts from refurbishment activities only) within the vicinity of the plant…." 10 CFR 51.53(c)(3)(ii)(I)**
>
> **"Most sites would experience impacts of small significance but larger impacts are possible depending on site- and project-specific factors…." 10 CFR 51, Subpart A, Table B-1, Issue 66**
>
> **"…[S]mall impacts are associated with project-related enrollment increases of 3 percent or less. Impacts are considered small if there is no change in the school systems' abilities to provide educational services and if no additional teaching staff or classroom space is needed. Moderate impacts are generally associated with 4 to 8 percent increases in enrollment. Impacts are considered moderate if a school system must increase its teaching staff or classroom space even slightly to preserve its pre-project level of service….Large impacts are associated with project-related enrollment increases above 8 percent…." (NRC 1996b, Section 3.7.4.1, pg. 3-15)**

NRC made refurbishment-related impacts to education a Category 2 issue because site- and project-specific factors determine the significance of impacts (NRC 1996b). Local factors to be ascertained include (1) project-related enrollment increases and (2) status of the student/teacher ratio.

As Section 3.2 describes, PSEG has no plans for refurbishment activities at HCGS. Therefore, this issue does not apply.

4.17 Offsite Land Use

4.17.1 OFFSITE LAND USE - REFURBISHMENT

NRC

The environmental report must contain "…[a]n assessment of the impact of the proposed action on... land-use... within the vicinity of the plant…." 10 CFR 51.53(c)(3)(ii)(I)

"…Impacts may be of moderate significance at plants in low population areas…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 68

"…[I]f plant-related population growth is less than 5 percent of the study area's total population, off-site land-use changes would be small, especially if the study area has established patterns of residential and commercial development, a population density of at least 60 persons per square mile (2.6 km^2), and at least one urban area with a population of 100,000 or more within 80 km (50 miles)…." (NRC 1996b, Section 3.7.5, pg. 3-21)

NRC made impacts to offsite land use as a result of refurbishment activities a Category 2 issue because land-use changes could be considered beneficial by some community members and adverse by others. Local conditions to be ascertained include (1) plant-related population growth, (2) patterns of residential and commercial development, and (3) proximity to an urban area with a population of at least 100,000.

As Section 3.2 describes, PSEG has no plans for refurbishment activities at HCGS. Therefore, this issue does not apply.

4.17.2 OFFSITE LAND USE - LICENSE RENEWAL TERM

NRC

> **The environmental report must contain "…[a]n assessment of the impact of the proposed action on…land-use…." 10 CFR 51.53(c)(3)(ii)(I)**
>
> **"Significant changes in land use may be associated with population and tax revenue changes resulting from license renewal…" 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 69**
>
> **"…[I]f plant-related population growth is less than five percent of the study area's total population, off-site land-use changes would be small…." (NRC 1996b, Section 3.7.5, pg 3-21)**
>
> **"…[I]f the plant's tax payments are projected to be small relative to the community's total revenue, new tax-driven land-use changes during the plant's license renewal term would be small, especially where the community has preestablished patterns of development and has provided adequate public services to support and guide development." (NRC 1996b, Section 4.7.4.1, pg. 4-108)**

NRC made impacts to offsite land use during the license-renewal term a Category 2 issue, because land-use changes may be perceived as beneficial by some community members and detrimental by others. Therefore, NRC could not assess the potential significance of site-specific offsite land-use impacts (NRC 1996b). Site-specific factors to consider in an assessment of land-use impacts include: (1) the size of plant-related population growth compared to the area's total population, (2) the size of the plant's tax payments relative to the community's total revenue, (3) the nature of the community's existing land-use pattern, and (4) the extent to which the community already has public services in place to support and guide development.

The GEIS presents an analysis of offsite land use for the renewal term that is characterized by two components: population-driven and tax-driven impacts (NRC 1996b).

Population-Related Impacts

Based on the GEIS case-study analysis, NRC concluded that all new population-driven land-use changes during the license-renewal term at all nuclear plants would be SMALL. Population growth caused by license renewal would represent a much smaller percentage of the local area's total population than the percent change resulting from the initial population growth that occurred at the start of operations (NRC 1996b).

Tax-Revenue-Related Impacts

Determining tax-revenue-related land-use impacts is a two-step process. First, the significance of the plant's tax payments on taxing jurisdictions' tax revenues is evaluated. Then, the impact of the tax contribution on land use within the taxing jurisdiction's boundaries is assessed.

NRC has determined that the significance of tax payments as a source of local government revenue would be large if the payments are greater than 20 percent of revenue, moderate if the payments are between 10 and 20 percent of revenue, and small if the payments are less than 10 percent of revenue (NRC 1996b).

NRC defined the magnitude of land-use changes as follows (NRC 1996b):

SMALL - very little new development and minimal changes to an area's land-use pattern.

MODERATE - considerable new development and some changes to land-use pattern.

LARGE - large-scale new development and major changes in land-use pattern.

NRC further determined that, "…[I]f the plant's tax payments are projected to be medium to large relative to the community's total revenue, new tax-driven land-use changes would be moderate. This is most likely to be true where the community has no pre-established patterns of development (i.e., land-use plans or controls) or has not provided adequate public services to support and guide development in the past, especially infrastructure that would allow industrial development (NRC 1996b).

Tax Impacts

Table 2.7-1 provides a comparison of the 2003 to 2007 tax payments made by PSEG to Lower Alloways Creek Township for HCGS and to the City of Salem for the Energy and Environmental Resource Center. Because PSEG's property tax payments to Lower Alloways Creek Township is so substantial (approximately 20 percent or more of the total property taxes collected), the residents of Lower Alloways Creek Township are relieved of local municipal, school, and optional open-space municipal taxes. Therefore, the significance of PSEG's property tax payments to Lower Alloways Creek Township is MODERATE to LARGE. However, while PSEG's property taxes are a large portion of Lower Alloways Creek Township taxes, the town forwards all of its tax revenues to Salem County in return for services Salem County provides to the township. PSEG's property tax payments are of SMALL significance for Salem County (less than 10 percent) and the City of Salem (less than 10 percent).

Land Use Impacts

As described in Section 2.6, Salem County has experienced an annual population growth rate of less than 1 percent for the last 30 years. Salem County has recently updated their comprehensive plan, which recognizes the value of open space, and continues to identify the goals of directing infrastructure development and planning to support smart growth, providing housing for all residents, and developing economic engines to ensure continued growth (Runkenstein and Associates 2004). Because no new construction activities would occur as a result of license renewal, there would be no change in HCGS's tax basis and, consequently, no changes to land use based on renewal of the license.

From 1990 to 2000, the population in Lower Alloways Creek Township remained almost constant. As described in Section 2.8, there has been little change in the Township's land-use patterns since the last Master Plan review in 1999. With no new construction activities planned as a result of license renewal, there would be no change in Lower Alloways Creek Township's tax basis, and consequently, no changes to land use based on renewal of the license.

The City of Salem has experienced a significant decline in population over the past several decades (Salem Main Street 2003). There is room for growth; however, PSEG's property tax is only a small portion of the City of Salem's total property tax revenues. With no new construction activities as a result of license renewal, there would be no change in Salem's tax basis, and consequently, no changes to land use based on renewal of the license.

Conclusion

As described in Section 3.2, PSEG has no plans for refurbishment activities at HCGS. Therefore, PSEG anticipates neither an increase in the assessed value of HCGS due to refurbishment-related improvements, nor any related tax-increase-driven changes to offsite land-use and development patterns. HCGS property tax payments are of LARGE significance to Lower Alloways Creek Township residents because they eliminate the need for most other taxes, but the magnitude of the tax revenues from HCGS has not affected land-use patterns. The HCGS property tax payments are of SMALL significance to Salem County, which provides services to Lower Alloways Creek Township, and land-use changes in the county have been minimal. PSEG's property tax payments to the City of Salem for the Energy and Environmental Resource Center are of SMALL significance, and land-use changes in the city have been minimal. Hence, PSEG concludes that the impacts of license renewal for HCGS on both tax revenues and land-use in Salem County would be SMALL.

Property Values

The City of Salem has experienced significant decline in population over the past several decades (Salem Main Street 2003). There is room for growth; however, PSEG's property tax is only a small portion of the City of Salem and Salem County's total property tax revenues. With no new construction activities as a result of license renewal, there would be no change in the tax basis, and consequently, no changes to land use based on renewal of the license.

PSEG considered whether the presence of HCGS has a depressing effect on property values that would be continued during the license-renewal term. NRC considered this question for seven nuclear plants in its GEIS and found no depressed property values resulting from construction and operation or license renewal of these plants (NRC 1996b). Published literature on the subject comes to varying conclusions. Of the studies claiming to show a depressing effect, the geographic extent of the claimed effect ranges from less than 3.2 km (2 mi) to as many as 96.5 km (60 mi; Blomquist 1974, Clark and Nieves 1994, Folland and Hough 2000, Sheppard 2007). Some studies demonstrate no effects (Gamble and Downing 1982, Nelson 1981, Rephann undated). The Nuclear Energy Institute (NEI) has studied economic benefits of several nuclear plants, including Salem (NEI 2006a), and found that property (housing) values are enhanced by the presence of nuclear plants, a conclusion that aligns with NRC 1996b and other studies (Bezdek and Wendling 2006; Clark et al. 1997; Farrell and Hall 2004; Metz et al. 1997; NEI 2003, NEI 2004a, NEI 2004b, NEI 2004c, NEI 2004d, NEI 2005a, NEI 2005b, and NEI 2006b).

Sheppard (2007), which concludes that property values are depressed within 3.2 km (2 mi) of a nuclear plant, is based on the Blomquist (1974) study of a single fossil-fueled plant located in a residential area. Blomquist (1974) noted that "[T]he findings of this study are based on a rather special instance…where the community is composed of primarily single-family residences…." The Blomquist proposition does not apply to HCGS because there are no residential properties within 3.2 km (2 mi) of HCGS. The area within 3.2 km (2 mi) of the HCGS site is water (Delaware River), dredged spoil disposal sites (owned by the U. S. government), and open space (marsh; owned by the U.S. government and State of New Jersey). Hence, given the ownership and New Jersey wetlands protection requirements, further development of these offsite areas for residential use is unlikely.

PSEG also notes that the plant that Blomquist (1974) studied was small, about 27 megawatts, burned oil and coal, and began commercial operation in 1949 (EIA 1996). The workforce at such a facility would likely be much smaller than one at a large nuclear plant such as HCGS. Accordingly, the multiplier effect of the HCGS workforce would be larger for tax contributions than the comparable multiplier effect for a 27-MW fossil-fueled facility. This could demonstrably increase, rather than decrease, property values. For this reason, PSEG believes the Blomquist (1974) methodology should not be applied to evaluate impacts of nuclear plants such as HCGS, on property values. PSEG suspects that such an affect, if any, is outweighed by positive benefits beyond as was done in Sheppard (2007).

Conclusion

Because the Sheppard (2007) assumptions do not apply to Salem, PSEG concludes, consistent with the GEIS (NRC 1996b), NEI (2006a), and the other studies cited above, that impacts on property values from HCGS, if any, are positive, and that license renewal would not alter this status.

4.18 Transportation

NRC

> **The environmental report must "...assess the impact of highway traffic generated by the proposed project on the level of service of local highways during periods of license renewal refurbishment activities and during the term of the renewed license." 10 CFR 51.53(c)(3)(ii)(J)**
>
> **"Transportation impacts…are generally expected to be of small significance. However, the increase in traffic associated with additional workers and the local road and traffic control conditions may lead to impacts of moderate or large significance at some sites…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 70**
>
> **Small impacts would be associated with U.S. Transportation Research Board Level of Service A, having the following condition: "…Free flow of the traffic stream; users are unaffected by the presence of others." and Level of Service B, having the following condition: "…Stable flow in which the freedom to select speed is unaffected but the freedom to maneuver is slightly diminished…." (NRC 1996b, Section 3.7.4.2, pg. 3-18)**

NRC made impacts to transportation a Category 2 issue, because impact significance is determined primarily by road conditions existing at the time of license renewal, which NRC could not forecast for all facilities (NRC 1996b). Local road conditions to be ascertained are: (1) level of service conditions and (2) incremental increases in traffic associated with refurbishment activities and license renewal staff.

As described in Section 3.2, no refurbishment is planned and no refurbishment impacts to local transportation are anticipated. Accordingly, the following discussion focuses on impacts of continued operations on transportation and the assumption that HCGS would add 60 additional employees during the period of extended operations. PSEG's HCGS workforce includes 513 employees and shares up to an additional 270 PSEG corporate and 86 matrixed employees with Salem. On an 18-month cycle, as many as 600 additional workers join the permanent workforce during a refueling outage, which typically lasts about 23 days. PSEG's projection of 60 additional employees associated with license renewal for HCGS represents a 12 percent increase above the 513 regular, full-time employees assigned to HCGS; a smaller percentage of the total employees of HCGS and Salem, including corporate and matrixed employees; and an even smaller percent of the total number of commuters accessing the site during a refueling outage.

Given these employment projections and the average number of vehicles per day currently using the roads in the vicinity of HCGS (Table 2.9-3), PSEG concludes that impacts to transportation would be SMALL and would not warrant mitigation.

4.19 Historic and Archaeological Resources

NRC

> **The environmental report must "…assess whether any historic or archaeological properties will be affected by the proposed project." 10 CFR 51.53(c)(3)(ii)(K)**
>
> **"Generally, plant refurbishment and continued operation are expected to have no more than small adverse impacts on historic and archaeological resources. However, the National Historic Preservation Act requires the Federal agency to consult with the State Historic Preservation Officer to determine whether there are properties present that require protection…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 71**
>
> **"…Sites are considered to have small impacts to historic and archaeological resources if (1) the State Historic Preservation Officer (SHPO) identifies no significant resources on or near the site; or (2) the SHPO identifies (or has previously identified) significant historic resources but determines they would not be affected by plant refurbishment, transmission lines, and license-renewal-term operations and there are no complaints from the affected public about altered historic character; and (3) if the conditions associated with moderate impacts do not occur." (NRC 1996b, Section 3.7.7, pg. 3-23)**

NRC made impacts to historic and archaeological resources a Category 2 issue, because determinations of impacts to historic and archaeological resources are site-specific in nature and the National Historic Preservation Act mandates that impacts must be determined through consultation with the State Historic Preservation Officer (SHPO) (NRC 1996b).

In the context of the National Historic Preservation Act, the NRC has determined that the area of potential effect for a license renewal action is the area at the power plant site and its immediate environs that may be impacted by post-license renewal land-disturbing activities specifically related to license renewal, regardless of ownership or control of the land of interest. HCGS is located on Artificial Island, an artificially created land mass that resulted, in the early part of the 20th century, when the U. S. Army Corps of Engineers dredged the Delaware River and placed the fill within a progressively enlarged diked area established around a natural bar that projected into the river. No historic or archaeological sites are known or expected to be located within the site boundary. No archaeological or historical sites are known to be located within the transmission line corridor.

Currently, PSEG is not aware of any historic or archaeological resources that have been affected by HCGS operations. Properties within 10 km (6 mi) of HCGS that are listed on the National Register of Historic Places are identified in Section 2.11. Operation and maintenance of the station and associated transmission line have not resulted in negative impacts to any listed property. PSEG has no plans to construct additional facilities related to license renewal. As discussed in Section 3.2, PSEG has no refurbishment plans and no refurbishment-related impacts are anticipated.

Through correspondence with the New Jersey SHPO, PSEG has requested concurrence that operation of HCGS during the term of license renewal would have no effect on historic and archaeological resources. Copies of the correspondence are presented in Appendix D. PSEG concludes that continued operation of HCGS over the license renewal term would not impact historic or archaeological resources over the period of extended operation. Therefore impacts would be SMALL, and mitigation would not be warranted.

4.20 Severe Accident Mitigation Alternatives (SAMA)

NRC

> **The environmental report must contain a consideration of alternatives to mitigate severe accidents "…if the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environment assessment..." 10 CFR 51.53(c)(3)(ii)(L)**
>
> **"…The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives…." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 76**

Section 4.20 summarizes an analysis of alternative ways to mitigate the impacts of severe accidents at HCGS. Appendix E provides a detailed description of the severe accident mitigation alternatives (SAMA) analysis.

The term "accident" refers to any unintentional event (i.e., outside the normal or expected plant operation envelope) that results in the release or a potential for the release of radioactive material to the environment. NRC categorizes accidents as "design basis" or "severe." Design-basis accidents are those for which the risk is great enough that NRC requires plant design and construction to prevent unacceptable accident consequences. Severe accidents are those that NRC considers too unlikely to warrant design controls.

NRC concluded in its license-renewal rulemaking that the unmitigated environmental impacts from severe accidents met its Category 1 criteria. However, NRC made consideration of mitigation alternatives a Category 2 issue because not all plants had completed ongoing regulatory programs related to mitigation (e.g., individual plant examinations [IPE] and accident management). Site-specific information to be presented in the license renewal environmental report includes: (1) potential SAMAs; (2) benefits, costs, and net value of implementing potential SAMAs; and (3) sensitivity of analysis to changes in key underlying assumptions.

PSEG maintains a probabilistic safety assessment (PSA) model to evaluate the most significant risks of radiological release from HCGS fuel into the reactor and from the reactor into the containment structure.

For the SAMA analysis, PSEG used the PSA model output as input to an NRC-approved consequence assessment code that calculates economic costs and dose to the public from hypothesized releases from the containment to the environment. The Level 3 Probabilistic Risk Assessment (PRA) uses the MELCOR Accident Consequences Code System Version 2 (MACCS2). MACCS2 requires certain agricultural-based economic data. These data were developed using data in the 2002 National Census of Agriculture (USDA 2004) and from the Bureau of Economic Analysis (BEA 2008) for each of the 23 counties surrounding the plant, to a distance of 50 miles. Then, using NRC regulatory analysis techniques, PSEG calculated the monetary value of the unmitigated HCGS severe accident risk. The result represents the monetary value of the base risk of dose to the public and workers, offsite and onsite economic costs, and replacement power. This value became a cost/benefit-screening tool for potential SAMAs; a SAMA whose cost of implementation exceeded the base cost-risk value could be rejected as being not cost-beneficial.

PSEG used industry, NRC, and HCGS-specific information to create a list of 23 SAMAs for consideration. PSEG analyzed this list to screen out any SAMAs that (1) would not apply to the HCGS design, (2) had already been implemented at HCGS, or (3) would achieve results that PSEG had already achieved at HCGS by other means. Two of the SAMAs were screened out based on these criteria. Therefore, PSEG prepared cost estimates for 21 SAMAs and used the base risk value to screen out SAMAs that would not be cost-beneficial.

PSEG calculated the cost-risk reduction that would be attributable to each of the remaining SAMAs (assuming SAMA implementation) and re-quantified the cost-risk value. The difference between the base cost-risk value and the SAMA-reduced cost-risk value became the averted cost-risk, or the value of implementing the SAMA. PSEG then performed a cost/benefit comparison for these SAMAs using this averted cost-risk value and the corresponding cost estimates for implementing the specific SAMA.

PSEG performed additional sensitivity analyses to evaluate how the SAMA analysis would change if certain key parameters were changed. The results of the sensitivity analyses are discussed in Appendix E.

Based on the results of this SAMA analysis, PSEG identified 13 SAMAs that have the potential to reduce plant risk and be cost-beneficial at the 95th percentile. None are related to managing the effects of plant aging during the period of extended operation. The potentially cost-beneficial SAMAs will be considered for implementation through the established HCGS Plant Health Committee processes.

4.21 Cumulative Impacts

PSEG considered the potential cumulative impacts of HCGS's operations during the license-renewal term. For the purposes of this analysis, past actions are those related to the resources at the time of plant licensing and construction, present actions are those related to the resources during current operations, and future actions are those actions that are reasonably foreseeable through the end of the plant operations, which would include the 20-year license-renewal term. The geographic area affected by cumulative impacts depends on the resource being impacted.

The impacts of the proposed action are combined with past, present, and reasonably foreseeable actions and could include individually minor but collectively significant actions taking place over a period of time. It is possible that a SMALL impact, when considered in combination with the impacts of other actions on the affected resources could result in MODERATE or LARGE impacts to the affected resource.

The principal facility with impacts that have the potential to be collectively significant when combined with impacts of HCGS is Salem. Salem is adjacent to HCGS on Artificial Island and uses Delaware Estuary water and ground water, as does HCGS. Both facilities release small amounts of radioactivity.

As indicated in Section 2.12.2.2, PSEG has notified the NRC of its intent to submit an ESP application during the second quarter of 2010 for potential new nuclear generating capacity on Artificial Island. This notification does not commit PSEG to submit an ESP application or to build new nuclear units, and does not project a timeframe for construction and operation of the new units, should the decision to proceed ultimately be made. Nor does PSEG's notification constitute approval of the ESP by the NRC. If the siting of new PSEG nuclear units proceeds, the cumulative impacts in the immediate vicinity of Salem and HCGS of that NRC licensing action in combination with issuance of licenses for the new units and renewal of the existing licenses for Salem and HCGS would be addressed in the ESP application and during the subsequent NRC approval process.

4.21.1 CUMULATIVE IMPACTS TO AQUATIC AND TERRESTRIAL RESOURCES

4.21.1.1 Aquatic Resources

Section 2.2 describes the aquatic environment affected by Salem and Hope Creek. Section 3.1 describes HCGS water use. The water use at Salem is described in the Salem license renewal Environmental Report, Section 3.1 (PSEG 2009a). Appendix F in that report describes restoration projects in the Delaware Estuary that are a requirement of the Salem NJPDES permit, and their results.

PSEG is authorized by the DRBC for HCGS consumptive and non-consumptive use of Delaware Estuary water. PSEG is authorized by the DRBC for Salem consumptive and non-consumptive use of no more than 367,000 million liters (97,000 million gallons) of Delaware Estuary water in a single 30-day period. The freshwater flow into the Delaware Estuary averages 645 m^3 per second (22,778 ft^3/sec; PSEG 1984), and the tidal flow (or "flux") near the site (at River Km 80 [River Mile 50]) has been estimated to be 11,324 m^3/sec (400,000 ft^3/sec), which equates to 3.6×10^{11} m^3/year (1.3×10^{13} ft^3 /year) (PSEG 2006a). There are no large industrial facilities downstream of Artificial Island on either side of the Estuary. Beginning with an oil refinery in Delaware about 13 km (8 mi) upstream of Artificial Island, there are many industrial facilities on the Delaware River farther upstream of Salem and Hope Creek that could affect water quality or quantity, including some power generation facilities permitted to withdraw water from the Delaware River. These facilities are permitted as required, and have spill prevention and control plans in place, also as required. Any impacts to water quality and quantity from these facilities would be small.

PSEG has restored or preserved more than 20,000 acres of wetlands and upland buffers in the Delaware Estuary and constructed 13 fish ladders on Delaware River tributaries in an effort to restore spawning runs of river herring. Estuarine wetlands are important for many reasons: they provide nursery areas for larval aquatic organisms, water filtration and storm surge buffers, to name a few. Fish ladders by-pass waterway obstructions, thus providing fish access to historic spawning locations. These projects were undertaken to address the potential for impacts to the fishery from Salem operations.

Over the years that the nuclear plants have been operating, the aquatic community in the Delaware Estuary has improved. Early results of the restoration projects indicate that they are successful. As a result of efforts to improve the Delaware Estuary water quality, and increase spawning and nursery habitats, between 1968, when monitoring began, and today, species richness in the vicinity of the plants has remained constant and density has increased (i.e., there are as many different kinds of fish now as in 1970, and the number of fish has increased). (PSEG 2006a).

PSEG has performed substantive analyses of the environmental effects of station operation on the Delaware Estuary aquatic community, generally in support of renewal of the best technology available determination in the Salem NJPDES permit (PSEG 2006a, Section 5). Analysis of the condition of the aquatic community does not distinguish between Salem and HCGS, and therefore would bound cumulative impacts. As discussed in Section 2.2, operation of both HCGS and Salem has had no adverse environmental impact on the Delaware Estuary aquatic community.

HCGS and Salem cumulative impacts to the Delaware Estuary aquatic communities are SMALL and are expected to remain SMALL during the license renewal term.

4.21.1.2 Terrestrial Resources

Section 2.4 describes the critical and important terrestrial habitats in the vicinity of Artificial Island. Artificial Island was created from dredge spoils in the early 20^{th} century, so has no pristine terrestrial habitats, although it does have suitable raptor, including eagle, foraging habitat. Typical coastal plant and animal species have been observed on the island.

The most important habitat that could be affected by the cumulative impacts of HCGS and Salem operations is the Pinelands National Reserve, which preserves New Jersey pine barrens. The pine barrens comprise 4,500 km^2 (1.1 million acres) of southern New Jersey Coastal Plain. The pine barrens' nutrient poor soils support fire-maintained pine communities and many rare and unusual species such as carnivorous plants, bog turtles, and the pine barrens tree frog.

Despite the fact that the Garden State Parkway and the Atlantic City Expressway run through it, the Pine Barrens is rural and undeveloped. Utility corridors, including two transmission corridors originating at Salem, cross parts of the pine barrens. The New Jersey Pinelands Commission is charged with preserving, protecting, and enhancing the Pinelands National Reserve. As part of this charge, the Commission developed a comprehensive management plan that includes requirements for siting, constructing, and maintaining transportation and utility corridor rights-of-way. PSE&G works with the Commission to ensure best vegetation management practices are used within the transmission corridors that cross a portion of the pine barrens. The third transmission corridor, which originates at HCGS, does not cross the pine barrens, but PSE&G and PHI (which share ownership of this corridor) employ best vegetation management practices in this corridor to ensure that sensitive resources are protected. PSE&G has no plans to construct additional corridors from HCGS or Salem. Any development in the Pinelands National Preserve must be approved by the Commission. Cumulative impacts of HCGS and Salem operations to terrestrial resources, which previously have been SMALL, will remain SMALL through the license renewal term.

4.21.2 CUMULATIVE IMPACTS TO GROUND WATER

Section 2.3 describes the ground-water resources available to the plants. PSEG has authorization from the NJDEP (NJDEP 2004) and DRBC (DRBC 2000) for consumptive use of up to 163 million liters (43.2 million gallons) of ground water per month at the Salem and HCGS sites combined. As noted in Section 4.21.1.1, there are no large industrial facilities within approximately 8 miles of the Artificial Island. Artificial Island is bounded on three sides by the Delaware Estuary, and on the fourth by a 3.2-km (2-mi) or more buffer of marsh. The nearest potable offsite well is more than 5.6 km (3.5 mi) from the stations, across the Estuary, in Delaware. Impacts of both plants on ground-water resources have been SMALL and will remain SMALL during the license renewal term. There are no sources of additional impacts to ground water in the vicinity of Artificial Island. Cumulative impacts of HCGS and Salem operations, which previously have been SMALL, will remain SMALL throughout the license-renewal term.

4.21.3 CUMULATIVE IMPACTS TO THREATENED OR ENDANGERED SPECIES

Section 2.5 describes the protected species that could be affected by facility operations. Five species of threatened or endangered sea turtles and the endangered shortnose sturgeon are known to occur in the Delaware Estuary. Salem and HCGS have been issued an incidental take statement by the NMFS that requires monitoring of the Salem intake screens for impinged sea turtles and shortnose sturgeon. Other provisions specify rescue and inspection procedures for any turtles impinged, limits on the number of turtles and shortnose sturgeon that can be impinged annually on the Salem intake screens, reporting requirements and a requirement for reinitiation of consultation with the NMFS under Section 7 of the Endangered Species Act of the number of incidental takes reaches the permitted limits or new information is identified. (NMFS 1999b)

In the biological opinion that accompanies the incidental take statement, the determined that the number of incidental takes of endangered species established in the incidental take statement for Salem and HCGS would not likely result in jeopardy to the continued existence of any threatened or endangered sea turtle species or the shortnose sturgeon.

Based on the information provided above, PSEG concludes that the cumulative impact of Salem and HCGS operations on protected aquatic species, which previously have been SMALL, will remain SMALL during the license renewal term.

No protected terrestrial species are known from the PSEG property on Artificial Island, though one plant species does occur on one transmission line, and several protected animals are known to occur in the vicinity of the transmission lines. Resource agencies are responsible for ensuring that activities that could adversely affect protected species are controlled to minimize such impacts. As noted PSE&G and PHI use best vegetation management practices on transmission corridors. Hence, the cumulative impacts of HCGS and Salem operations, which previously have been SMALL, will remain SMALL throughout the license renewal term.

4.21.4 SOCIOECONOMIC CUMULATIVE IMPACTS

Sections 2.6 through 2.9 describe the aspects of the region's socioeconomics that could be affected by renewal of the HCGS and Salem operating licenses. The stations are in Lower Alloways Creek Township in Salem County. PSEG pays property taxes to Lower Alloways Creek Township which transfers most of its property tax revenues to Salem County in exchange for services. PSEG's tax payments to Lower Alloways Creek Township are a MODERATE to LARGE share of the total tax revenues collected by Lower Alloways Creek Township. Total tax payments by PSEG for both facilities are a SMALL percentage of the taxes collected by Salem County.

More than half of Salem County is tidal and freshwater wetlands, lakes, ponds, and forests, and more than one-third of the total area is farmland. Only 10 percent of Salem County's land area is developed. Approximately 80 percent of the PSEG employees reside in Salem, Cumberland, or Gloucester counties in New Jersey or in New Castle County, Delaware. The annual growth rate in each of these counties since 1970 has been less than 2 percent, and usually less than 1 percent. PSEG is not aware of any major industrial or commercial facility planned for Salem County that would affect land use, or draw significant numbers of new residents.

PSEG does not anticipate adding additional staff to either facility during the license renewal term, but the environmental reports' analyses assumed an additional 60 staff at each plant, for a total of 120 additional households in the four-county region where most of the current staff reside.

During refueling outages, the workforce traveling to Artificial Island increases by approximately 600 people. The roads in the area accommodate this increase in traffic. Therefore, PSEG concludes that an additional 120 staff would not adversely impact traffic on local roads.

PSEG analyzed the impact of 120 additional staff and their families on housing and public water supply using the following assumptions: (1) all 120 direct jobs would be filled by in-migrating residents, (2) no indirect jobs would be filled by in-migrating residents, and (3) the residential distribution of the workers would resemble that of the current operations workforce.

PSEG assumed that 120 new staff would require 120 housing units. The area within an 80-km (50-mi) radius of Artificial Island has a population of approximately 5,000,000 people. Delaware averages 2.54 persons per household. Maryland averages 2.61, New Jersey averages 2.68, and Pennsylvania averages 2.48 persons per household (USCB 2000b), suggesting the existence of approximately 2 million housing units in the 80-km (50-mi) radius. It is reasonable to conclude that 120 additional employees would not create a discernible change in housing availability, rental rates, or housing values, or spur housing construction or conversion.

Impacts to the public water supply were determined by estimating the amount of water that would be required by the 120 new PSEG employees and their families, which is 109,701 liters per day (28,980 gpd; see Section 4.15). The increased demand would be imposed primarily on public water supply systems located in Salem, Gloucester, and Cumberland counties (in New Jersey) and New Castle County (in Delaware). These counties currently have excess public water supply capacity of approximately 129 million liters (34 million gallons) per day for Cumberland, Gloucester, and Salem counties (see Table 2.9-1) and more than 132 million liters (35 million) gallons per day for New Castle County (see Table 2.9-2). Any increase in water demand resulting from renewal of the HCGS and Salem operating licenses would not create shortages in capacity for the existing public water supply systems.

Based on the information provided above, PSEG concludes that the cumulative impacts of the continued operation of Salem and HCGS on regional socioeconomics, which previously have been SMALL, will remain SMALL throughout the license renewal term.

4.21.5 CUMULATIVE IMPACTS TO HUMAN HEALTH

Both Salem and HCGS discharge to a large brackish, tidally influenced water body that allows their thermal plumes to disperse quickly. There are no other facilities that release thermal discharges to the estuary in the vicinity of HCGS and Salem. Hence, the potential for enhancement of thermophilic organisms due to the cumulative impacts of HCGS and Salem, which previously has been SMALL, will remain SMALL throughout the license renewal term.

The electric-field induced currents from transmission lines constructed to connect HCGS and Salem to the electric transmission grid are less than the NESC recommendations for preventing electric shock from induced currents. Therefore, these transmission lines do not significantly affect the overall potential for electric shock from induced currents within the analysis area. Hence, the Salem and HCGS cumulative impacts due to continued use of transmission lines constructed to connect the stations to the electric transmission grid, which previously have been SMALL, will remain SMALL during the license renewal term.

Radiological dose limits for protection of the public and workers have been developed by EPA and NRC to address the cumulative impacts of acute and long-term exposure to radiation and radioactive material. These dose limits are codified in 10 CFR 20 and 40 CFR 190. For the purpose of this analysis, the area within an 80-km (50-mi) radius of the three units was included.

The radiological environmental monitoring program conducted by PSEG in the vicinity of the site measures radiation and radioactive materials from all sources; therefore, the monitoring program measures cumulative radiological impacts. Levels of radioactivity measured are typical for an estuarine environment, and are mostly the result of natural-occurring nuclides or residual nuclides from atmospheric testing of atomic weapons. Thermoluminescent dosimeter (TLD) measurements in 2006 at offsite locations averaged 50 millirem for the year. TLD measurements at 2006 control locations averaged 52 millirem for the year. Preoperational measurements (1973 to 1976) averaged 55 millirem per year. (PSEG 2007b)

HCGS and Salem cumulative radiological impacts are limited by the provisions in 10 CFR 20 and 40 CFR 190. These impacts, which previously have been SMALL, will remain SMALL through the license-renewal term.

Chapter 5

Assessment of New and Significant Information

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5.1 Discussion

NRC

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

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

While NRC regulations do not require an applicant's environmental report to contain analyses of the impacts of those Category 1 environmental issues that have been generically resolved [10 CFR 51.53(c)(3)(i)], the regulations do require that an applicant identify any new and significant information of which the applicant is aware [10 CFR 51.53(c)(3)(iv)]. The purpose of this requirement is to alert NRC staff to such information, so the staff can determine whether to seek the Commission's approval to waive or suspend application of the rule with respect to the affected generic analysis. NRC has explicitly indicated, however, that an applicant is not required to perform a site-specific validation of Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) conclusions (NRC 1996b).

PSEG expects that new and significant information would include:

- Information that identifies a significant environmental issue not covered in the GEIS and codified in the regulation; or
- Information that was not covered in the GEIS analyses and that leads to an impact finding different from that codified in the regulation.

NRC does not specifically define the term "significant." For the purpose of its review, PSEG used guidance available in Council on Environmental Quality (CEQ) regulations. The National Environmental Policy Act authorizes CEQ to establish implementing regulations for federal agency use. NRC requires license renewal applicants to provide NRC with input, in the form of an environmental report, that NRC will use to meet National Environmental Policy Act requirements as they apply to license renewal (10 CFR 51.10).

CEQ guidance provides that federal agencies should prepare environmental impact statements for actions that would significantly affect the environment (40 CFR 1502.3), focus on significant environmental issues (40 CFR 1502.1), and eliminate from detailed study issues that are not significant [40 CFR 1501.7(a)(3)]. The CEQ guidance includes a lengthy definition of "significantly" that requires consideration of the context of the action and the intensity or severity of the impact(s) (40 CFR 1508.27). PSEG considered that MODERATE or LARGE impacts, as defined by NRC, would be significant. Chapter 4 presents the NRC definitions of SMALL, MODERATE, and LARGE impacts.

The new and significant assessment that PSEG conducted during preparation of this license renewal application included: (1) interviews with PSEG subject matter experts on the validity of the conclusions in the GEIS as they relate to HCGS, (2) an extensive review of documents related to environmental issues at HCGS, (3) correspondence with state and federal agencies to determine if the agencies had concerns relevant to their resource areas that had not been addressed in the GEIS, (4) credit for PSEG environmental monitoring and reporting required by regulations and oversight of station facilities and operations by state and federal regulatory agencies (permanent activities that would bring significant issues to PSEG's attention), and (5) review of previous license renewal applications for issues relevant to the HCGS application.

As a result of this review, PSEG is not aware of any new and significant information regarding the station's environment or operations that would make any generic conclusion codified by the NRC for Category 1 issues not applicable to HCGS, that would alter regulatory or GEIS statements regarding Category 2 issues, or that would suggest any other measure of license renewal environmental impact.

As part of its investigation for new and significant information at Salem, PSEG evaluated information about tritium in the ground water beneath the Salem site (Section 3.1.3). The information indicates that tritium remediation is in progress at Salem, HCGS is hydraulically upgradient of Salem, and the Radiological Groundwater Protection Program at HCGS has not identified any impacts on ground water at HCGS as a result of tritium released at Salem. Furthermore, tritium has not been detected in ground water beneath HCGS in any concentrations that exceed the EPA Drinking Water Standard or that suggest an adverse trend (PSEG 2008a), and there is no human exposure pathway for tritium in the vicinity of HCGS. Hence, PSEG has concluded that changes in tritium-related ground-water quality are not significant at HCGS and would not preclude current or future uses of the ground water.

In its entirety, PSEG's assessment did not identify any new and significant information regarding the HCGS environment or operations that would (1) make any generic conclusion codified by the NRC for Category 1 issues not applicable to HCGS, (2) alter regulatory or GEIS statements regarding Category 2 issues, or (3) suggest any other measure of license renewal environmental impact.

Chapter 6

Summary of License Renewal Impacts and Mitigating Actions

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6.1 License Renewal Impacts

PSEG has reviewed the environmental impacts of renewing the HCGS operating license and has concluded that impacts would be SMALL and would not require mitigation. This Environmental Report documents the basis for PSEG's conclusion. Chapter 4 incorporates by reference NRC findings for the 54 Category 1 issues that apply to HCGS, all of which have impacts that are SMALL (Appendix A, Table A-1). The rest of Chapter 4 analyzes Category 2 issues, all of which are either not applicable or have impacts that are SMALL. PSEG identified minority and low-income populations, evaluated potential impacts to these populations alone, and determined that there are no issues that could have disproportionately high adverse impacts on environmental justice populations.

Table 6.1-1 identifies the impacts that the HCGS license renewal would have on resources associated with Category 2 issues. Because HCGS and Salem are on adjacent sites that share several attributes, including a common ground-water withdrawal permit, a common access road and matrixed employees, it is unreasonable to evaluate the impacts of one without considering the impacts of the other. In those instances when the cumulative impacts of both facilities provides a more appropriate assessment of impacts, the discussion in Table 6.1-1 includes those cumulative impacts.

Table 6.1-1 Environmental Impacts Related to License Renewal at HCGS Unit 1

No.	Category 2 Issue	Environmental Impact
Surface Water Quality, Hydrology, and Use (for all plants)		
13	Water use conflicts (plants with cooling ponds or cooling towers using makeup water from a small river with low flow)	**NONE.** This issue does not apply because HCGS does not withdraw make-up water from a small river.
Aquatic Ecology (for plants with once-through or cooling pond heat dissipation systems)		
25	Entrainment of fish and shellfish in early life stages	**NONE.** This issue does not apply because HCGS does not use a once-through cooling system or cooling ponds for heat dissipation.
26	Impingement of fish and shellfish	**NONE.** This issue does not apply because HCGS does not use a once-through cooling system or cooling ponds for heat dissipation.
27	Heat shock	**NONE.** This issue does not apply because HCGS does not use a once-through cooling system or cooling ponds for heat dissipation.
Ground-Water Use and Quality		
33	Ground-water use conflicts (potable and service water, and dewatering; plants that use > 100 gpm)	**SMALL.** The combined permit for Salem and HCGS limits ground-water withdrawal to 1.135 million liters (300 million gallons) a year. Ground-water elevation data and the distance to off-site wells indicate that the Salem and HCGS use of ground water results in minimal impacts to off-site users.
34	Ground-water use conflicts (plants using cooling towers or cooling ponds and withdrawing makeup water from a small river)	**NONE.** This issue does not apply because HCGS does not withdraw make-up water from a small river.
35	Ground-water use conflicts (Ranney wells)	**NONE.** This issue does not apply because HCGS does not use Ranney wells.
39	Ground-water quality degradation (cooling ponds at inland sites)	**NONE.** This issue does not apply because HCGS does not use cooling ponds.
Terrestrial Resources		
40	Refurbishment impacts	**NONE.** This issue does not apply because refurbishment is not planned for HCGS.
Threatened or Endangered Species		
49	Threatened or endangered species	**SMALL.** HCGS operations have no impact on threatened or endangered species or their habitats. NMFS has issued a biological opinion that operation of HCGS is not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, and green sea turtles, or shortnose sturgeon. One federally threatened plant grows on a section of one transmission corridor in Salem County and two protected terrestrial animal species are known from the vicinity of the two transmission corridors in Salem County. Vegetation management practices along the transmission corridors are developed and implemented in conjunction with appropriate regulatory agencies to minimize potential impacts on threatened or endangered species.

Table 6.1-1 Environmental Impacts Related to License Renewal at HCGS Unit 1 (Continued)

No.	Category 2 Issue	Environmental Impact
Air Quality		
50	Air quality during refurbishment (non-attainment and maintenance areas)	**NONE.** This issue does not apply because refurbishment is not planned for HCGS.
Human Health		
57	Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	**NONE.** This issue does not apply because HCGS does not use a lake or canals, and does not use cooling towers or cooling ponds that discharge to a small river.
59	Electromagnetic fields, acute effects (electric shock)	**SMALL.** For the one transmission line constructed to connect HCGS to the electric grid, modeling predicts induced currents of 4.0 millamperes or less, which is less than the maximum induced current recommended by the National Electrical Safety Code (i.e., 5 milliamperes) for preventing electric shock from induced current.
Socioeconomics		
63	Housing impacts	**SMALL.** The addition of 60 jobs would not noticeably affect a potential housing market of more than two million housing units.
65	Public water supply: public utilities	**SMALL.** Water suppliers in Salem, Gloucester, and Cumberland counties, New Jersey, and New Castle County, Delaware, have excess capacity. The addition of 60 jobs would not adversely affect the available public water supply.
66	Public services: education (refurbishment)	**NONE.** This issue does not apply because refurbishment is not planned for HCGS.
68	Off-site land use (refurbishment)	**NONE.** This issue does not apply because refurbishment is not planned for HCGS.
69	Off-site land use (license renewal term)	**SMALL.** No station-induced changes to off-site land use are expected from license renewal because although HCGS taxes represent approximately 20 percent of the taxes paid to Lower Alloways Creek Township, the Township's property tax payments are forwarded to Salem County in return for services. HCGS taxes comprise less than two percent of Salem County tax revenues. Taxes on the Energy and Environmental Resources Center are less than three percent of Salem city property tax revenues.
70	Public services: transportation	**SMALL.** The addition of 60 employees would not noticeably increase traffic or adversely affect level of service in the vicinity of Salem.
71	Historic and archaeological resources	**SMALL.** HCGS is located on Artificial Island, which is a manmade land area created during the early 1900s. As such, the site never contained historical or archaeological resources. In addition, no archaeological or historical resources are known to exist on the transmission line corridor associated with HCGS, and construction is not planned on-site or in the transmission corridor during the license renewal terms. Hence, no impacts to historic or archaeological resources are expected.

Table 6.1-1 Environmental Impacts Related to License Renewal at HCGS Unit 1 (Continued)

No.	Category 2 Issue	Environmental Impact
Postulated Accidents		
76	Severe accidents	**SMALL.** PSEG identified 13 potentially cost-beneficial SAMAs that could be examined further, but none is related to managing the effects of plant aging during the period of extended operation. The potentially cost beneficial SAMAs will be considered for implementation through the established HCGS Plant Health Committee process.

6.2 Mitigation

NRC

> **"The report must contain a consideration of alternatives for reducing adverse impacts…for all Category 2 license renewal issues…" 10 CFR 51.53(c)(3)(iii)**
>
> **"The environmental report must include an analysis that considers and balances…alternatives available for reducing or avoiding adverse environmental effects…" 10 CFR 51.45(c) as incorporated by 10 CFR 51.53(c)(2) and 10 CFR 51.45(c)**

Impacts of license renewal activities have been determined to be SMALL and would not require mitigation.

Current operations include monitoring activities that would continue during the license renewal term. PSEG performs routine monitoring to ensure the safety of workers, the public, and the environment. These activities include the gaseous and liquid radiological environmental monitoring program, non-radiological air quality emissions monitoring, radiological ground-water protection program, and the NJPDES permit effluent monitoring. These monitoring programs ensure that the plant's permitted emissions and discharges are within regulatory limits and any unusual or off-normal emissions/discharges would be quickly detected, allowing for the mitigation of potential impacts.

This Environmental Report identified no additional mitigation measures that are sufficiently beneficial to be warranted.

6.3 Unavoidable Adverse Impacts

NRC

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

This Environmental Report adopts by reference NRC findings for applicable Category 1 issues, including discussions of any unavoidable adverse impacts (Appendix A, Table A-1). PSEG examined 21 Category 2 issues and identified the following unavoidable adverse impacts of license renewal and refurbishment activities:

- Solid radioactive wastes are a product of plant operations and permanent disposal of these materials must be arranged. Procedures for the disposal of nonradioactive and radioactive wastes are intended to reduce adverse impacts from these sources to acceptably low levels. A small impact will occur as long as the plant is in operation.

- Operation of HCGS results in a very small increase in radioactivity in the air and water. Based on data collected since initial operation, the increase is less than the fluctuation in natural background levels and is expected to remain so over the renewal period. Operation of HCGS also creates a very low probability of accidental radiation exposure to inhabitants of the area.

- Operations of HCGS results in consumptive use of Delaware Estuary water and in discharges to the Estuary. It also results in the consumptive use of ground water. PSEG is required to maintain ground-water use at 1.135 billion liters (300 million gallons) per year or less (for HCGS and Salem combined) and is required to maintain discharges at or below NJPDES permit requirements.

6.4 Irreversible and Irretrievable Resource Commitments

NRC

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

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

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

6.5 Short-Term Use Versus Long-Term Productivity of the Environment

NRC

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

The current balance between short-term use and long-term productivity at the HCGS site was established with the decision to convert approximately 62 hectares (153 acres) of Artificial Island, a marginally productive natural area created by the disposal of dredge spoils during the first half of the 1900s, to industrial use. Natural resources that would be subjected to short-term use include land and water. Artificial Island and its immediate vicinity are largely undeveloped and rural. Currently, approximately 738.5 hectares (1,825 acres) in 60 km (43 mi) of transmission corridor are associated with the HCGS project.

HCGS consumes relatively small amounts of brackish water from the Delaware Estuary, and ground water, thus the impacts are minor and would cease once the reactor ceases operation.

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

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

Chapter 7

Alternatives to the Proposed Action

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NRC

> **The environmental report shall discuss "Alternatives to the proposed action…" 10 CFR 51.45(b)(3), as adopted by reference at 10 CFR 51.53(c)(2).**
>
> **"...The report is not required to include discussion of need for power or economic costs and benefits of ... alternatives to the proposed action except insofar as such costs and benefits are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation..." 10 CFR 51.53(c)(2).**
>
> **"…While many methods are available for generating electricity, and a huge number of combinations or mixes can be assimilated to meet a defined generating requirement, such expansive consideration would be too unwieldy to perform given the purposes of this analysis. Therefore, NRC has determined that a reasonable set of alternatives should be limited to analysis of single, discrete electric generation sources and only electric generation sources that are technically feasible and commercially viable…" (NRC 1996b, Section 8.1, pg. 8-1).**
>
> **"…The consideration of alternative energy sources in individual license renewal reviews will consider those alternatives that are reasonable for the region, including power purchases from outside the applicant's service area..." (NRC 1996d)**

Chapter 7 evaluates alternatives to renewal of the HCGS operating license. The chapter identifies actions that PSEG might take and associated environmental impacts, if the NRC does not renew the plant's operating license. The chapter also addresses actions that PSEG has considered, but would not take, and discusses the bases for determining that such actions would be unreasonable.

The alternatives discussed in this chapter are "no-action" and "alternatives that meet system generating needs." In considering the level of detail and analysis that it should provide for each category, PSEG relied on the NRC decision-making standard for license renewal:

> "…the NRC staff, adjudicatory officers, and Commission shall determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decision makers would be unreasonable." [10 Code of Federal Regulations (CFR) 51.95(c)(4)].

PSEG has determined that the Environmental Report would support NRC decision-making as long as the document provides sufficient information to clearly indicate whether an alternative would have a smaller, comparable, or greater environmental impact than the proposed action. Providing additional detail or analysis serves no function if it only brings to light additional adverse impacts of alternatives to license renewal. This approach is consistent with regulations of the Council on Environmental Quality, which provide that the consideration of alternatives (including the proposed action) should enable reviewers to evaluate their comparative merits

(40 CFR 1500-1508). PSEG believes that Chapter 7 provides sufficient detail about alternatives to establish the basis for necessary comparisons to the Chapter 4 discussion of impacts from the proposed action.

In characterizing environmental impacts from alternatives, the same definitions of SMALL, MODERATE, and LARGE presented in the introduction to Chapter 4 are used in this chapter.

7.1 No-Action Alternative

The "no-action alternative" refers to a scenario in which NRC does not renew the HCGS operating license.

HCGS is a generator of electricity in New Jersey owned by PSEG (PSEG 2008b). In 2008, upgrades to HCGS increased the power level of the reactor to approximately 1,265 MWe (NRC 2007). This power would be unavailable to customers in the event the HCGS operating license was not renewed. PSEG thinks that any alternative to renewal of the HCGS license would be unreasonable if it did not include replacing the capacity of the HCGS unit. Replacement could be accomplished by (1) building new base-load generating capacity, (2) purchasing power from the wholesale market, or (3) reducing power requirements through demand reduction. Section 7.2.1 describes each of these possibilities in detail, and Section 7.2.2 describes environmental impacts from feasible alternatives.

The Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS) (NRC 1996b) defines decommissioning as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license. NRC-evaluated decommissioning options include immediate decontamination and dismantlement and safe storage of the stabilized and defueled facility for a period of time, followed by additional decontamination and dismantlement. Regardless of the option chosen, decommissioning must be completed within a 60-year period. Under the no-action alternative, PSEG would continue operating HCGS until the existing license expires, then initiate decommissioning activities in accordance with NRC requirements. The GEIS describes decommissioning activities based on an evaluation of the equivalently sized 1,155-megawatt-electric [MWe] Washington Public Power Supply System Nuclear Project 2 (the "reference" boiling-water reactor). As the HCGS unit is nominally rated at 1,265 MWe, this description is applicable to decommissioning activities that PSEG would conduct at HCGS.

As the GEIS notes, the NRC has evaluated environmental impacts from decommissioning. NRC-evaluated impacts include impacts of occupational and public radiation dose; impacts of waste management; impacts to air and water quality; and ecological, economic, and socioeconomic impacts. The NRC indicated in the Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities; Supplement 1 (NRC 2002) that the environmental effects of greatest concern (i.e., radiation dose and releases to the environment) are substantially less than the same effects resulting from reactor operations. PSEG adopts by reference the NRC conclusions regarding environmental impacts of decommissioning analyzed in the Decommissioning EIS.

PSEG considered whether the no-action alternative would have any beneficial impact on housing values in the socioeconomic region of influence. As discussed in Section 4.17.2, published studies of the impacts of nuclear plant operations on property (housing) values have conflicting results, but after considering these results in the context of site-specific circumstances, PSEG has concluded that HCGS's operational impacts on property values, if any, are positive. PSEG also notes that the full impact of the no-action alternative on property values would not be realized until completion of decommissioning. Because the HCGS license would not expire until 2026 without renewal, decommissioning under the no-action alternative may not be complete until 2086, assuming that decommissioning takes no more than the allowed 60 years from permanent cessation of operations (10 CFR 50.82 (a)(3)). Hence, decommissioning under the no action alternative may not be complete until more than 75 years beyond the date of this Environmental Report. PSEG believes that predicting property value impacts so far into the future would be too speculative to allow a useful comparison among alternatives.

Nevertheless, PSEG notes that decommissioning activities and their impacts are not discriminators between the proposed action and the no-action alternative. HCGS will have to be decommissioned regardless of the NRC decision on license renewal; license renewal would only postpone decommissioning for another 20 years. NRC has established in the GEIS that the timing of decommissioning operations does not substantially influence the environmental impacts of decommissioning. PSEG adopts by reference the NRC findings (10 CFR 51, Appendix B, Table B 1, Decommissioning) to the effect that delaying decommissioning until after the renewal term would have small environmental impacts. PSEG concludes that the decommissioning impacts under the no-action alternative would not substantially differ from those occurring following license renewal, as identified in the GEIS (NRC 1996b) and in the NRC's Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities (NRC 2002). These impacts would be temporary and would occur at the same time as the impacts from meeting system generating needs. Hence, the discriminators between the proposed action and the no-action alternative lay within the choice of generation replacement options to be part of the no-action alternative. Section 7.2.2 analyzes the impacts from these options.

7.2 Alternatives That Meet System Generating Needs

The power consumed in New Jersey is not limited to electricity generated within the state. New Jersey is a net importer of electric power, using more electricity than is generated within the state. In 2005, 83 terawatt-hours of electricity, approximately 60 percent of the power consumed in New Jersey, were supplied by generators located outside the state (EIA 2008a). New Jersey relies on electricity drawn from the PJM Interconnection to provide this imported power. The PJM Interconnection is a regional network that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia.

The current mix of power generation options within the PJM region is one indicator of what PSEG considers to be feasible alternatives. In 2006, electric generators connected to the PJM network had a total generating capacity of 164,905 MWe (PJM 2007a). This capacity includes units fueled by coal (41 percent), nuclear (19 percent), oil (eight percent), natural gas (26 percent), hydroelectric (five percent), and renewable sources (1 percent) (PJM 2007b). In 2006, the electric industry in the PJM region provided 729 terawatt-hours of electricity (PJM 2007a). Power generation in the PJM region was dominated by coal (57 percent), followed by nuclear (35 percent), natural gas (six percent), hydroelectric (two percent), renewable sources (<one percent), and oil (0.3 percent) (PJM 2007b). Figures 7.2-1 and 7.2-2 illustrate the electric industry generating capacity and energy output by fuel type for the PJM region. The entire PJM region is a net exporter of electric power, using less electricity than is generated within the region. In 2006, 45 terawatt-hours (gross) were exported out of the PJM region and 27 terawatt-hours (gross) were imported. Therefore, the net result is 18 terawatt-hours exported (PJM 2007c).

Comparison of generating capacity with actual utilization of this capacity indicates that coal and nuclear are used by PJM substantially more relative to their PJM capacity than either oil-fired or gas-fired generation. This condition reflects the relatively low fuel cost and base-load suitability for nuclear power and coal-fired plants, and relatively higher use of gas- and oil-fired units to meet peak loads. Comparison of capability and energy production for oil and gas-fired facilities indicates a strong preference for gas firing over oil firing, indicative of the higher cost and greater air emissions associated with oil firing. Energy production from hydroelectric sources is similarly preferred from a cost standpoint, but capacity is limited and utilization can vary substantially depending on water availability.

7.2.1 ALTERNATIVES CONSIDERED

Technology Choices

For the purposes of this Environmental Report, alternative generating technologies were evaluated to identify candidate technologies that would be capable of replacing HCGS's nominal base-load capacity of 1,265 MWe. PSEG accounted for the fact that HCGS is a base-load generator and that any feasible alternative to HCGS would also need to be able to generate base-load power. PSEG assumed that the region of interest (ROI) for purposes of this alternatives analysis includes the states of Delaware, Maryland, New Jersey, and Pennsylvania, which are the states within the PJM Interconnection's network that are geographically closest to HCGS.

Based on these evaluations, it was determined that new plant systems capable of replacing the capacity of HCGS are limited to new nuclear, pulverized-coal, or gas-fired combined-cycle units for base-load operation. This conclusion is supported by the generation utilization information presented above that identifies coal as the most heavily used non-nuclear generating fuel type in the region. PSEG would use natural gas as the primary fuel in its combined-cycle turbines because of the economic and environmental advantages of gas over oil. Manufacturers now have large standard sizes of combined-cycle gas turbines that are economically attractive and suitable for high-capacity base-load operation.

Recently, members of both industry and government have expressed interest in the development of nuclear power plants to provide new baseload generating capacity. Beginning in 2007, several utilities submitted applications for combined construction and operating licenses for new nuclear generating units. PSEG plans to submit an Early Site Permit application to the NRC during the second quarter of 2010 for new nuclear generating capacity in the immediate vicinity of Salem and HCGS on Artificial Island. An Early Site Permit would give PSEG the option at any time within 20 years of the permit's approval date to submit an application to the NRC to construct and operate the new nuclear facility. Considering that the existing HCGS operating license expires in 2026, PSEG believes construction of new nuclear capacity may be a feasible alternative to license renewal for HCGS.

For the purposes of the HCGS license renewal environmental report, PSEG's analysis of new generating capacity alternatives includes the technologies it considers feasible: pulverized coal-fired units, gas-fired units, and new nuclear units. PSEG chose to evaluate combined-cycle turbines in lieu of simple-cycle turbines because the combined-cycle option is more economical. The benefits of lower operating costs for the combined-cycle option outweigh its higher capital costs.

Effects of Restructuring

Nationally, the electric power industry has been undergoing a transition from a regulated industry to a competitive market environment. Efforts to deregulate the electric utility industry began with passage of the National Energy Policy Act of 1992. Provisions of this act required electric utilities to allow open access to their transmission lines and encouraged development of a competitive wholesale market for electricity. The Act did not mandate competition in the retail market, leaving that decision to the states. Over the past few years, some states within the PJM region (Delaware, Illinois, Maryland, Michigan, New Jersey, Ohio, Pennsylvania, and the District of Columbia) have transitioned to competitive wholesale and retail markets. Indiana, Kentucky, North Carolina, Tennessee, and West Virginia are not restructuring their electric power industry. Virginia signed restructuring legislation (House Bill 1172) into law in April 1998, but in February 2007 passed legislation that would replace the state's deregulated electric power market with a regulated one. (EIA 2007a)

In 1999, New Jersey enacted the "Electric Discount and Energy Competition Act." Provisions of the Act opened New Jersey's retail electric power market to competition and provided retail customers with a ten percent rate reduction phased in over four years. The Act also required the State's electric utilities to divest their electric generation assets. Consequently, PSEG sold its generation assets, including HCGS, to a separate unregulated wholesale power affiliate. The New Jersey Board of Public Utilities (NJBPU) provides strategic direction and policy guidance for energy production and use in the State, including the restructuring initiative (New Jersey Statutes § 48:3-49 et seq). Similarly, in March 1999, Delaware passed the "Electric Utility Restructuring Act" of 1999, House Bill (HB 10) which included provisions to phase-in retail competition beginning October 1999 and ending April 2001. Pennsylvania enacted the "Electricity Generation Customer Choice and Competition Act" in December 1996 that allowed consumers to choose among competitive generation suppliers beginning with one third of the State's consumers by January 1999, two thirds by January 2000, and finally all consumers by January 2001. In December 1997, Maryland issued Order 8738 that established a framework for the restructuring of the electric power industry in that state. The plan's schedule was for a third of the State's consumers to have retail access by July 2000, another third by July 2001, and the entire state by July 2002. (EIA 2007a)

In 2001, New Jersey adopted Renewable Portfolio Standards (RPS), which require all suppliers selling retail electricity in New Jersey (retail electric suppliers) to include renewable energy sources in the mix of energy that they sell (New Jersey Administrative Code § 14:8-2.1 et seq). Eligible resources may be located anywhere within the PJM region. The RPS divides renewables into two classes: Class I consists of energy produced from solar technologies, photovoltaic technologies, wind energy, fuel cells, geothermal technologies, wave or tidal action, and methane gas from landfills or sustainable biomass facilities. Class II consists of solid waste incinerators and hydropower facilities that are located in retail competition areas and meet certain environmental criteria. In 2006, the RPS were revised, significantly increasing the required percentages of Class I and Class II renewable energy, as well as specifying the required percentage of solar energy. In 2009, the energy sold in New Jersey is required to be 0.16 percent solar power, 3.8 percent Class I, and 2.5 percent Class II. These percentages increase incrementally until the year 2021 when 22.5 percent of the retail electric energy sold in New Jersey must be from renewable sources. Suppliers have the option of satisfying these requirements either by participating in a trading program or by auctioning their production in the wholesale market to other suppliers (New Jersey Statutes § 48:3-49 et seq). Maryland and Pennsylvania established similar RPS programs in 2004 and Delaware in 2005 (DSIRE 2007).

The Electric Discount and Energy Competition Act requires suppliers to provide customers with emission data and the fuel mix used by the provider. Suppliers are also required to offer net metering for wind or solar photovoltaic systems of residential and small commercial customers at non-discriminatory rates. Net metering occurs when electric utilities permit customers to reduce their electric bills by generating their own power using small-scale renewable energy systems. The excess power that customers generate can be fed back to their utilities, actually running their electric meters backwards.

Alternatives

The following sections present fossil-fuel-fired generation (Section 7.2.1.1), new nuclear generating capacity (Section 7.2.1.2), and purchased power (Section 7.2.1.3) as reasonable alternatives to HCGS license renewal. Section 7.2.1.4 discusses reduced demand (referred to as demand side management) and presents the basis for concluding that it is not a reasonable alternative to license renewal. Section 7.2.1.5 discusses other alternatives that PSEG has determined are not reasonable and the bases for these determinations.

7.2.1.1 Construct and Operate Fossil-Fuel-Fired Generation

PSEG considered locating hypothetical new coal- and gas-fired units at an existing PSEG power plant site and at an undetermined greenfield site. PSEG concluded that an existing power plant site is preferred over any greenfield site for new construction because this approach would minimize environmental impacts by building on previously disturbed land and by making the most use possible of existing facilities, such as transmission lines, roads and parking areas, office buildings, and components of the cooling system. For the purpose of this analysis, HCGS is used as an example of a representative brownfield site containing an existing PSEG power plant. The impacts of locating hypothetical coal- and gas-fired units at the HCGS site serve as a surrogate analysis for any PSEG site with an existing power plant.

It must be emphasized, however, that the scenarios discussed in this section for new gas- and coal-fired units are hypothetical scenarios. PSEG does not have plans for such construction.

Gas-Fired Generation

One unit with a nominal net capacity of approximately 1,265 MWe could be assumed to replace the total 1,265 MWe HCGS nominal net capacity. However, PSEG's experience indicates that, although custom-sized gas-fired units can be built, using standardized sizes is more economical. For purposes of this analysis, PSEG assumed development of a modern natural gas-fired combined-cycle plant with design characteristics similar to those being developed elsewhere in the PJM region, and with a generating capacity similar to HCGS. The hypothetical plant would be composed of three pre-engineered natural gas-fired combined-cycle systems producing 420 MWe of net plant power for a total of 1,260 MWe (GE Power 2001). Although this provides less capacity than the existing unit, it ensures against overestimating environmental impacts from the alternatives. The shortfall in capacity could be replaced by other methods.

The characteristics of this plant and other relevant resources were used to define the gas-fired alternative. Table 7.2-1 presents the basic characteristics for the gas-fired alternative.

Coal-Fired Generation

NRC has routinely evaluated coal-fired generation alternatives for nuclear plant license renewal. For comparability to the gas-fired generation scenario, PSEG set the net power of the coal-fired unit equal to the gas-fired plants (1,260 MWe). The hypothetical plant would be composed of two pre-engineered super-critical pulverized coal-fired units producing 630 MWe of net plant power for a total of 1,260 MWe. In defining the coal-fired alternative to HCGS, New Jersey-specific input has been applied for direct comparison with this combined-cycle gas-fired plant.

Table 7.2-2 presents the basic coal-fired alternative emission control characteristics. The emissions control assumptions are based on the technologies recognized by the EPA for minimizing emissions and estimated emissions based on the EPA published removal efficiencies (EPA 1998a). For the purpose of analysis, PSEG has assumed that coal and limestone (calcium carbonate) would be delivered to the site via barge.

7.2.1.2 Construct and Operate New Nuclear Generating Capacity

Since 1997, the NRC has certified four new standard designs for nuclear power plants under 10 CFR 52, Subpart B. Four additional designs are undergoing certification reviews, and four others are undergoing pre-application reviews. All of the plants currently certified or undergoing certification reviews are light-water reactors; several of the designs in precertification review are not, including the Pebble Bed Modular Reactor and the Advanced Candu Reactor, ACR-700. (NRC 2009)

The NRC staff considered new nuclear generating capacity as an alternative to license renewal for the Beaver Valley Power Station (NRC 2009). In its analysis, the NRC staff assumed that

1,900 MWe of new nuclear generation would be installed in the form of either one or two units having a certified design. Impact analyses did not reference a particular design, and impacts generally applicable to all certified designs were assumed. PSEG has reviewed the NRC analysis of new nuclear capacity for Beaver Valley, believes it to be sound, and notes that it addresses more capacity than the approximately 1,260 MWe discussed in this analysis. PSEG has assumed construction at the HCGS site of one new nuclear unit having a certified design, and has scaled from the NRC analysis for Beaver Valley where appropriate. See Table 8.0-2 more details.

7.2.1.3 Purchased Power

As noted in Section 7.2.1, electric industry restructuring initiatives in New Jersey and other states in the PJM region are designed to promote competition in energy supply markets by facilitating participation by generation companies. PJM has implemented market rules to appropriately anticipate and meet electricity demands in the resulting wholesale electricity market. As an additional facet of this restructuring effort, retail customers in the region now may choose any company with electric generation to supply their power. In view of these conditions, PSEG assumes for purposes of this analysis that adequate supplies of electricity would be available, and that purchased power would be a reasonable alternative to meet the HCGS's load requirements in the event the existing operating license for HCGS is not renewed.

The source of this purchased power may reasonably include new generating facilities developed elsewhere in the PJM region. The technologies that would be used to generate this purchased power are similarly speculative. PSEG assumes that the generating technology used to produce purchased power would be one of those that NRC analyzed in the GEIS. For this reason, PSEG is adopting by reference the GEIS description of the alternative generating technologies as representative of the purchased power alternative. Of these technologies, facilities fueled by coal and combined-cycle facilities fueled by natural gas are the most cost effective for providing base-load capacity.

PSEG anticipates that additional transmission infrastructure would be needed in the event purchased power must replace HCGS capacity. From a local perspective, loss of HCGS could require construction of new transmission lines to ensure local system stability. From a regional perspective, PJM's inter-connected transmission system is highly reliable, and the market-driven process for adding capacity in the region is expected to have a positive impact on overall system reliability.

7.2.1.4 Demand-Side Management

Demand side management (DSM) programs include energy conservation and load management measures. As discussed in the GEIS (NRC 1996b), the DSM alternative does not fulfill the stated purpose and need of the proposed action because it does not "provide power generation capability."

Historically, state regulatory bodies required regulated utilities to institute programs designed to reduce demand for electricity. In a deregulated market, however, electric power generators may not be able to offer competitively priced power if they must retain an extensive conservation and load-modification-incentive program. In addition, a private company engaged in generating energy for the wholesale market, such as PSEG Nuclear, has no business connection to the end users of its electricity and, therefore, no ability to implement DSM. Because a company whose sole business is that of generating electricity and selling energy at wholesale has no ability to implement DSM, the NRC determined that NEPA does not require that an alternative involving electricity demand reduction through DSM be considered when the project purpose is to authorize a power plant to supply existing and future electricity demand (NRC 2005). The NRC determination was upheld by the U.S. Court of Appeals for the Seventh Circuit (2006). Nevertheless, DSM is considered here because energy conservation and peak load management are important tools for meeting projected demand.

In New Jersey, the State of New Jersey Board of Public Utilities (NJBPU) promotes and advances DSM in the deregulated retail electric market. The NJBPU works in partnership with other state agencies, electric transmission/distribution utilities, business organizations, and environmental organizations to develop and implement "tools" to save energy. New Jersey's DSM program offerings are diverse, ranging from load curtailment incentives during periods of peak demand to rebates and financial incentives for commercial, industrial, and residential customers that install energy-efficient appliances and equipment and to the adoption by the New Jersey Department of Consumer Affairs of updated energy codes for new building construction.

A 2004 study commissioned by the NJBPU estimated the technical, economic, and achievable potential electricity savings in New Jersey from DSM measures through 2020. The study indicated that by the year 2020 the technical potential electricity savings, if all technically feasible conservation measures were implemented regardless of economics, would be approximately 16,999 gigawatt-hours (GWh) of electricity per year. If only the cost-effective measures were implemented, the economic potential electricity savings would be approximately 12,832 GWh per year. Capturing the entire economic potential through program activity was estimated to cost more than $5 billion over the 2004 to 2020 period. The achievable electricity savings at the 2004 program funding level of $85 million per year (Business as Usual) was estimated at 2,831 GWh per year or roughly one third the amount of electricity produced by HCGS in a given year. Under a very aggressive scenario (Advanced Efficiency), with a program funding level of $180 million per year, the achievable electricity savings was estimated to be 5,183 GWh per year or about 60 percent of the electricity produced by HCGS in a given year. Net program peak-demand savings potential estimates ranged from approximately 540 MWe by the year 2020 under the Business as Usual scenario to approximately 970 MWe under the Advanced Efficiency scenario (KEMA 2004).

In 2008, the Center for Energy, Economic & Environmental Policy (CEEEP) compared actual New Jersey electricity savings data for the years 2004 to 2007 to the estimates under both the Business as Usual case and the Advanced Efficiency case presented in the 2004 study. Between 2004 and 2007, conservation programs achieved approximately 939 GWh per year of avoided electricity use. This represents over 78 percent of the 2004 to 2007 Business as Usual savings potential of 1,205 GWh and almost 44 percent of the Advanced Efficiency scenario of 2,116 GWh (CEEEP 2008). Overall, the New Jersey Clean Energy Program reduced peak electric demand by a total of 87 MWe in 2007 (NJBPU 2008). It is evident that the New Jersey energy efficiency programs captured significantly less electricity savings than estimated by the 2004 study. However, CEEEP estimates that continuing the programs "as-is" would likely result in New Jersey meeting the Business as Usual case; however, the savings estimated under the Advanced Efficiency case are not likely to be attained (CEEEP 2008).

Because PSEG Nuclear sells power into the wholesale electricity market through the PJM Interconnection (PJM), DSM measures are not within the Company's control. However, PJM has instituted measures to capture energy conservation potential and load management in its resource planning. Consequently, additional DSM measures in other nearby states that could, in addition to the programs promoted by the NJBPU, also offset some of the demand for electricity from HCGS are already incorporated in the load forecast. As a practical matter, it would be highly unlikely that energy savings from demand reductions could be increased by an additional 1,265 MWe by 2026 to replace the HCGS nominal base-load capacity of approximately 1,265 MWe.

The DSM alternative would produce different impacts than the other alternatives addressed. Unlike the discrete generation options, there would be no major generating facility construction and few ongoing operational impacts. However, the loss of HCGS capacity could require construction of new transmission lines to ensure local system stability. The most significant effects would likely occur during installation or implementation of conservation measures, when old appliances may be replaced, buildings climate control systems may be retrofitted, or new control devices may be installed. In some cases, increases in efficiency may come from better management of existing control systems. While replaced or removed items may be recycled, volumes of land-filled trash could still increase.

The GEIS generally indicates that impacts from a DSM alternative are small and that some postulated effects (like increases in mercury, polychlorinated biphenyls [PCBs], or chlorofluorocarbon [CFC] releases as fluorescent bulbs, old transformers, or old refrigerators are replaced) may not prove to be significant because effective disposal methods can prevent health effects, and because more environmentally benign alternatives are available (NRC 1996b).

Implementation of the DSM alternative reduces direct fuel use and environmental emissions from plant fuel cycles, workers' commuting, and plant operation and maintenance. Improvements in efficiency may also reduce consumption of fuels used for space or water heating at the same time they reduce electrical consumption. The DSM alternative would likely cause only minor and short-duration air quality impacts—use of best management practices during any construction activities and during retrofits or upgrades would minimize air quality impacts. New more energy-efficient appliances would further reduce already low air emissions. The overall impacts on air quality of the DSM alternative would be SMALL.

Implementation of the recycling programs in conjunction with disposing of old appliances, retrofitting buildings, or installing new control devices would decrease the volumes of waste requiring disposal, though volumes of the trash sent to the landfills as a result of these DSM measures may still increase over a baseline. Overall, the impacts on waste generation would be SMALL.

The loss of HCGS capacity could require construction of new transmission lines to ensure local system stability. The construction of these new lines could require clearing new rights-of-way and would likely cause only minor and short-duration land use and terrestrial ecology impacts—use of best management practices would minimize the impacts. Replacing and disposing of old inefficient appliances could potentially increase the size of landfills. Overall, impacts to land use and ecological resources would be SMALL.

Impacts to aquatic resources and water quality would be SMALL, but positive, as withdrawals from and discharges to the Delaware Estuary would cease. If more energy is conserved than is produced by HCGS, then positive impacts to aquatic resources could extend beyond the Delaware Estuary to other water bodies. This net conservation of energy could result in less demand for power production at other plants and could lead to lower rates of water withdrawal and discharge at these power plants. The implementation of conservation measures, such as the increased use of mercury-containing compact fluorescent light bulbs and their impact to the environment after landfill disposal, would result in SMALL impacts to the aquatic environment. While mercury in landfills could leach into adjacent waterways, State and local landfill regulations could reduce or eliminate such pollution.

As noted in the GEIS, implementation of the DSM alternative would likely employ additional workers. The new jobs would be widely distributed across the state and possibly the entire U.S., and socioeconomic impacts would not be noticeable. However, shutdown of HCGS would result in a sizable reduction in operating personnel compared to the current workforce of 869 personnel, and the impact on the local community employment, taxes, housing, off-site land use, and public services could be significant. Thus, reduction in workforce would result in adverse socioeconomic impacts on the local community that are characterized as MODERATE. Lower-income families could benefit from weatherization and insulation programs. This positive effect would be greater than the adverse effect on the general population from loss of jobs because low-income households experience home energy burdens more than four times larger than the average household (OMB 2008).

In conclusion, although DSM is an important tool for meeting projected electricity demand and the impacts from the DSM alternative are generally small, DSM does not fulfill the stated purpose and need for license renewal of nuclear power plants, which is to "provide power generation capability" (NRC 1996b). DSM measures are already captured in state and regional load projections and additional DSM measures would offset only a fraction of the energy supply lost by the shutdown of HCGS. In addition, the purpose for HCGS license renewal is to allow PSEG Nuclear to sell wholesale power generated by HCGS to meet future demand. Because PSEG Nuclear engages solely in the sale of wholesale electric power, the Company has no business connection to end users of its electricity and therefore no ability to implement DSM. For these reasons, PSEG Nuclear does not consider DSM to represent a reasonable alternative to renewal of the HCGS operating license.

7.2.1.5 Other Alternatives

This section identifies alternatives that PSEG has determined are not reasonable for replacing HCGS and the bases for these determinations. PSEG accounted for the fact that HCGS is a base-load generator and that any feasible alternative to HCGS would also need to be able to generate base-load power. PSEG assumed that only the states of Delaware, Maryland, New Jersey, and Pennsylvania comprise the ROI for purposes of this analysis. In performing this evaluation, PSEG relied heavily upon NRC's GEIS (NRC 1996b).

Wind

Wind power, due to its intermittent nature, is not suitable for base-load generation. As discussed in Section 8.3.1 of the GEIS, wind power systems produce power only when the wind is blowing at a sufficient velocity and duration. While recent advances in technology have improved wind turbine capacity, average annual capacity factors for wind power systems are relatively low (30 percent) compared to 90 to 95 percent industry average for a base-load plant such as a nuclear plant (EPRI 2006; NRRI 2007). In conjunction with energy storage mechanisms, wind power might serve as a means of providing base-load power. However, current energy storage technologies are too expensive to permit wind power to serve as a large base-load generator (Schainker 2006).

The energy potential in the wind is expressed by wind generation classes ranging from 1 (least energetic) to 7 (most energetic). Current wind technology can operate economically on Class 4 sites with the support of the federal production tax credit (AWEA 2008a), while Class 3 wind regimes will require further technical development for utility-scale application. In the ROI, the primary areas of good wind energy resources are the Atlantic coast and exposed hilltops, ridge crests, and mountain summits (EERE 2003). Offshore wind resources are abundant but the technology is not sufficiently demonstrated at this time. A panel review of New Jersey offshore wind issues completed in 2006 concluded that there are insufficient data to fully assess the impact of offshore wind in New Jersey and recommended the construction of a test wind farm, with a capacity of no more than 350 MWe, which could be used to study the impacts of offshore wind power development. Including this test wind farm, there are six offshore wind farms proposed along the coast of the ROI (Offshore Wind 2008). PSEG Renewable Generation is in a joint venture with Deepwater Wind as the preferred developer of a 350-megawatt wind farm located 16 to 20 miles off the coast of New Jersey. The New Jersey Energy Master Plan (New Jersey Governor's Office 2008) has a goal of providing at least 1,000 MW of offshore wind capacity by 2012, and by 2020, providing at least 3,000 MW of offshore wind capacity and 200 MW of onshore wind capacity.

Based on American Wind Energy Association estimates (AWEA 2008b), the ROI has the technical potential (the upper limit of renewable electricity production and capacity that could be brought online, without regard to cost, market acceptability, or market constraints) for roughly 6,855 MWe of installed wind power capacity. The full exploitation of wind energy is constrained by a variety of factors including land availability and land-use patterns, surface topography, infrastructure constraints, environmental constraints, wind turbine capacity factor, wind turbine availability, and grid availability. By 2008, a total of 301 MWe of wind energy had been developed in the ROI. Projected new capacity in various stages of planning or permit review within the ROI includes an additional 70 MWe of wind energy. (AWEA 2008b)

Wind farms generally consist of 10 to 50 turbines in the range of one to three MWe. Estimates based on existing installations indicate that a utility-scale wind farm would be spread over 12 to 20 hectares (30 to 50 acres) per MWe of installed capacity (McGowan and Connors 2000). However, the actual area occupied by turbines, substations, and access roads may only be from three percent to five percent of the wind farm's total acreage. Thus, the remaining area is available for other uses. When the wind farm is located on land already used for intensive agriculture, the additional impact to wildlife and habitat will likely be minor, while disturbance caused by wind farms in more remote areas may be more significant. Therefore, replacement of the HCGS nominal base-load generating capacity of 1,265 MWe with wind power, assuming a capacity factor of 30 percent, would require a large greenfield site about 61,400 hectares (151,800 acres) in size, of which approximately 2,460 hectares (6,070 acres) would be disturbed and unavailable for other uses. Although the State of New Jersey promotes wind power as a component of its Renewable Portfolio Standards, it concludes that wind, due to its intermittent nature, is unsuitable to provide base-load generating capacity (NJDEP 2005, New Jersey Governor's Office 2008). Similarly, PSEG has concluded that wind power is not a reasonable alternative to HCGS license renewal.

<u>Solar</u>

By its nature, solar power (photovoltaic and thermal) is intermittent and not suitable for base-load generation. As discussed in Section 8.3.2 of the GEIS, solar power systems produce power only when sunlight is available. The average annual capacity factors for solar power systems are relatively low (16 to 40 percent) compared to 90 to 95 percent industry average for a base-load plant such as a nuclear plant (NRRI 2007). In conjunction with energy storage mechanisms, solar power might serve as a means of providing base-load power. However, current energy storage technologies are too expensive to permit solar power to serve as a large base-load generator (Schainker 2006). Even without consideration of storage capacity, solar power technologies (photovoltaic and thermal) cannot currently compete with conventional fossil-fueled technologies in grid-connected applications, due to high costs per kilowatt of capacity (NRC 1996b, EERE 2006a).

Solar power is not a technically feasible alternative for base-load generating capacity in the ROI. The ROI receives three to five kilowatt hours of solar radiation per square meter per day compared with 5.5 to 7.5 kilowatt hours per square meter per day in areas of the West, such as California, which are most promising for solar technologies (EERE 2008).

Finally, land requirements for solar plants are high. Estimates based on existing installations indicate that utility-scale plants would occupy 1 hectare (2.5 acres) per MWe for photovoltaic and two hectares (4.9 acres) per MWe for solar thermal systems (EERE 2004). Utility-scale solar plants have mainly been used in regions that receive high concentrations of solar radiation such as the western U.S. A utility-scale solar plant located in the ROI would occupy about 1.3 hectares (3.3 acres) per MWe for photovoltaic and 4.0 hectares (9.9 acres) per MWe for solar thermal systems. Therefore, replacement of HCGS generating capacity with solar photovoltaic power, assuming a capacity factor of 16 percent, would require dedication of about 9,500 hectares (23,400 acres). Replacement of HCGS generating capacity with solar thermal power, assuming a capacity factor of 40 percent would require dedication of about 11,400 hectares (28,100 acres). Both would have large environmental impacts at a greenfield site.

PSEG has concluded that, due to the high cost of both generation and storage technologies, limited availability of sufficient incident solar radiation, and the amount of land needed, solar power is not a reasonable alternative to HCGS license renewal.

Hydropower

About 209 MWe of utility generating capacity in the ROI comes from hydropower. The total amount of undeveloped hydropower that could feasibly be utilized in the ROI equals 1,113 MWe, which is less than HCGS nominal baseload capacity. This capacity is distributed over 5,376 different sites and would require a large amount of resources to develop. In addition, this capacity is less than needed to replace the HCGS nominal base-load capacity of approximately 1,265 MWe. There are no undeveloped sites in the ROI that would be environmentally suitable for a single hydroelectric facility similar in generation size to HCGS. (EERE 2006b, INEEL 1998)

As the GEIS points out in Section 8.3.4, hydropower's percentage of United States generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern over flooding, destruction of natural habitat, and alteration of natural river courses. A small number of hydropower projects, totaling 260 MWe, are being considered in the ROI (FERC 2006). The largest of these projects is 100 MWe. Even if they were built, these small hydropower projects could not replace the HCGS nominal base-load capacity of 1,265 MWe.

The GEIS estimates that hydroelectric power plants have a land use requirement of 400,000 hectares (1,000,000 acres) per 1,000 MWe (NRC 1996b). Based on this estimate, replacement of HCGS generating capacity would require flooding approximately 508,900 hectares (1,257,600 acres), resulting in a large impact on land use. Further, operation of a hydroelectric facility would alter aquatic habitats above and below the dam, which would impact existing aquatic communities.

PSEG has concluded that, due to the lack of suitable sites in the ROI for a large hydroelectric facility and the large amount of land needed, hydropower is not a reasonable alternative to HCGS license renewal.

Tidal, Ocean Thermal, and Wave

The most developed technologies to harness electrical power from the ocean are tidal power, ocean thermal energy, and wave power conversion. These technologies are still in the early stages of development and are not commercially available to replace a large baseload generator such as HCGS.

Tidal power technologies extract energy from the diurnal flow of tidal currents caused by the gravitational pull of the moon. Unlike wind and wave power, tidal streams offer entirely predictable output. All coastal areas consistently experience two high and two low tides over a period of approximately 25 hours. However, because the lunar cycle is longer than a 24-hour day, the peak outputs differ by about an hour each day, and so tidal energy cannot be guaranteed at times of peak demand (Feller 2003).

Tidal power technologies consist of tidal turbines and barrages. Tidal turbines are similar in appearance to wind turbines that are mounted on the seabed. They are designed to exploit the higher energy density, but lower velocity, of tidal flows compared to wind. Tidal barrages are similar to hydropower dams in that they are dams with gates and turbines installed along the dam. When the tides produce an adequate difference in the level of the water on opposite sides of the dam, the gates are opened and water is forced through turbines, which turns a generator.

For those tidal differences to be harnessed into electricity, the difference in water height between the high and low tides must be at least 4.9 m (16 ft). There are only about 40 sites on Earth with tidal ranges of this magnitude (EERE 2005a). The only sites with adequate tidal differences within the United States are in Maine and Alaska (CEC 2009). Therefore, tidal resources off the coast of the ROI do not provide a viable tidal energy resource.

Ocean thermal energy conversion (OTEC) technology capitalizes on the fact that the water temperatures decrease with depth. As long as the temperature between the warm surface water and the cold deep water differs by about 20°C (36°F), an OTEC system can produce a significant amount of power. The temperature gradient off of the coast of the ROI is less than 18°C (32°F) and not a good resource for OTEC technology. (NREL 2008)

Wave energy conversion takes advantage of the kinetic energy in the ocean waves (which are mainly caused by interaction of wind with the surface of the ocean). Wave energy offers an irregular, oscillatory, low-frequency energy source that must be converted to a 60-Hertz frequency before it can be added to the power grid (CEC 2009). Wave energy resources are best between 30 and 60 degrees latitude in both hemispheres, and the potential tends to be greatest on western coasts (RNP 2007). Ocean Power Technologies, Inc. deployed a 40-kilowatt PowerBuoy wave energy converter off the coast of New Jersey in November 2005 (EERE 2005b).

PSEG believes that this technology has not matured sufficiently to support production for a facility the size of HCGS, and PSEG has concluded that, due to cost and production limitations, tidal, ocean thermal, and wave technologies are not reasonable alternatives to HCGS license renewal.

Geothermal

Geothermal energy is a proven resource for power generation. Geothermal power plants use naturally heated fluids as an energy source for electricity production. To produce electric power, underground high-temperature reservoirs of steam or hot water are tapped by wells and the steam rotates turbines that generate electricity. Typically, water is then returned to the ground to recharge the reservoir.

Geothermal energy can achieve capacity factors of 93 percent and can be used for base-load power where this type of energy source is available (NRRI 2007). Widespread application of geothermal energy is constrained by the geographic availability of the resource. In the U.S., high-temperature hydrothermal reservoirs are located in the western continental U.S., Alaska, and Hawaii. The ROI has low- to moderate-temperature resources that can be tapped for direct heat or for geothermal heat pumps, but electricity generation is not feasible with these resources (GHC 2008; EERE 2008).

Wood Energy

As discussed in the GEIS (NRC 1996b), the use of wood waste to generate electricity is largely limited to those states with significant wood resources. The pulp, paper, and paperboard industries in states with adequate wood resources generate electric power by consuming wood and wood waste for energy, benefiting from the use of waste materials that could otherwise represent a disposal problem. According to the National Renewable Energy Laboratory, the ROI produces approximately 5.9 million dry metric tons (6.5 million dry tons) of wood waste annually (consisting of forest mill, and urban wood residues) (NREL 2005). Assuming the fuel has a nominal heat content of 9.961 million Btu per dry ton and a thermal conversion efficiency of 25 percent, the annual power potential of the ROI would be 4.7 million MW-hours (EIA 2008b; NRC 1996b). This is the equivalent to a 488-MWe base-load (90 percent capacity factor) power plant which is substantially less than the 1,265-MWe nominal base-load capacity of HCGS. The largest existing wood waste power plants in operation are 40 to 50 MWe in size.

Furthermore, Section 8.3.6 of the GEIS (NRC 1996b), states that construction of a wood-fired plant would have an environmental impact that would be similar to that for a coal-fired plant, although facilities using wood waste for fuel would be built on smaller scales. Like coal-fired plants, wood-waste plants require large areas for fuel storage, processing, and waste (i.e., ash) disposal. Additionally, operation of wood-fired plants has environmental impacts, including impacts on the aquatic environment and air. Wood has a low heat content that makes it unattractive for base-load applications. It is also difficult to handle and has high transportation costs.

While some wood resources are available in the ROI there is not enough to replace the capacity of HCGS. PSEG has concluded that, due to the lack of an environmental advantage, low heat content, handling difficulties, and high transportation costs, wood energy is not a reasonable alternative to HCGS license renewal.

Municipal Solid Waste

As discussed in Section 8.3.7 of the GEIS (NRC 1996b), the initial capital costs for municipal solid waste plants are greater than for comparable steam turbine technology at wood-waste facilities. This is due to the need for specialized waste separation and handling equipment and stricter environmental emission controls.

The decision to burn municipal solid waste to generate energy is usually driven by the need for an alternative to landfills, rather than by energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term; however, it is unlikely that many landfills will begin converting waste to energy because of unfavorable economics.

Estimates in the GEIS suggest that the overall level of construction impacts from a waste-fired plant should be approximately the same as that for a coal-fired plant. Additionally, waste-fired plants have the same or greater operational impacts (including impacts on the aquatic environment, air, and waste disposal). Some of these impacts would be moderate, but still larger than the environmental effects of HCGS license renewal.

PSEG has concluded that, due to the high costs and lack of environmental advantages, burning municipal solid waste to generate electricity is not a reasonable alternative to HCGS license renewal.

Other Biomass-Derived Fuels

In addition to wood and municipal solid waste fuels, there are several other concepts for fueling electric generators, including burning energy crops, converting crops to a liquid fuel such as ethanol (ethanol is primarily used as a gasoline additive), and gasifying energy crops (including wood waste). As discussed in the GEIS, none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a base-load plant such as HCGS.

Further, estimates in the GEIS suggest that the overall level of construction impacts from a crop-fired plant should be approximately the same as that for a wood-fired plant. Additionally, crop-fired plants would have similar operational impacts (including impacts on the aquatic environment and air). These systems also have large impacts on land use, due to the acreage needed to grow the energy crops.

PSEG has concluded that, due to the high costs and lack of environmental advantage, burning other biomass-derived fuels is not a reasonable alternative to HCGS license renewal.

Petroleum

The ROI has several existing petroleum (oil)-fired power plants (PJM 2007d). The percentage of power generated by oil-fired electricity plants has decreased from 4.7 to 0.8 percent from 1990 to 2006 in the ROI (EIA 2007b). Petroleum prices are volatile but the expected long-term trend is for prices to increase. As a result, at some point in the future oil-fired operations will likely be more expensive than nuclear or coal-fired.

Also, construction and operation of an oil-fired plant would have environmental impacts. For example, Section 8.3.11 of the GEIS (NRC 1996b) estimates that construction of a 1,000-MWe oil-fired plant would require about 49 hectares (120 acres). Building an oil-fired plant with a net capacity equal to HCGS would require about 62 hectares (152 acres). Additionally, operation of oil-fired plants would have impacts on the aquatic environment and air that would be similar to those from a coal-fired plant.

PSEG has concluded that, due to the high costs and lack of obvious environmental advantage, oil-fired generation is not a reasonable alternative to HCGS license renewal.

Fuel Cells

Fuel cell power plants are in the initial stages of commercialization. Although nearly 900 large stationary fuel cell systems have been built and operated worldwide, the global stationary fuel cell electricity generation capacity in 2007 was about 150 MWe (FCT 2007). The largest stationary fuel cell power plant ever built is the 11-MWe Goi Power Station in Ichihara, Japan (FC2000 2008). Even so, fuel cell power plants typically generate much less (2 MWe or lower) power (NRRI 2007). Accordingly, PSEG believes that fuel cell technology has not matured sufficiently to support production for a facility the size of HCGS and that it is not a reasonable alternative to HCGS license renewal.

Delayed Retirement

As the NRC noted in Section 8.3.13 of the GEIS (NRC 1996b), extending the lives of existing non-nuclear generating plants beyond the time they were originally scheduled to be retired represents another potential alternative to license renewal. Fossil plants slated for retirement are old enough to have difficulty meeting today's restrictions on air contaminant emissions. In the face of increasingly stringent air quality restrictions, delaying retirement to compensate for a station the size of HCGS would appear to be unreasonable without major construction to upgrade or replace plant components.

Power-generating merchants within the PJM region have retired a large number of electricity generators, totaling over 5,700 MWe, with another 1,800 MWe pending. This has resulted in multiple reliability criteria violations. The problem has been magnified by steady load growth and sluggish generation additions (PJM 2007b). Some potential reliability issues have been forestalled through a combination of short lead-time transmission upgrades, voluntary deactivation deferrals, and implementation of a process that compensates generators that remain online beyond announced retirement dates. However, the Federal Energy Regulatory Commission recently determined that PJM cannot compel the owners of units scheduled for retirement to remain in service (PJM 2007b). For these reasons, the delayed retirement of non-nuclear generating units is not considered a reasonable alternative to HCGS license renewal.

Combination of Alternatives

NRC indicated in Section 8.1 of the GEIS that, while many methods are available for generating electricity and a huge number of combinations or mixes can be assimilated to meet system needs, it would be impractical to analyze all the combinations. Therefore, NRC determined that alternatives evaluation should be limited to analysis of single discrete electrical generation sources and only those electric generation technologies that are technically reasonable and commercially viable (NRC 1996b).

Nevertheless, for the purpose of comparison, PSEG has assumed that a 400-MWe wind farm, along with two 400-MWe natural gas combined-cycle units and 65 MWe of power purchased from the wholesale electricity market could replace the HCGS nominal generating capacity

(1,265 MWe net). When operating, the combined cycle plant can "follow" the wind load by ramping up and down quickly. When the wind is blowing hard, the combined-cycle plant can be ramped down; when the wind is not blowing or is blowing too softly to turn the wind turbines, the combined-cycle plant can be ramped up. Power purchased from other generators in the PJM market would provide the balance of electricity needed.

Operation of the new natural gas-fired power plant would result in increased air emissions and other impacts. The impacts associated with the wind portion of the alternative – land-use impacts, noise impacts, visual impacts, impacts on wildlife, etc. – would be more than the stand-alone natural gas alternative. The environmental impacts associated with power purchased from other generators would be similar to the impacts associated with the coal- and gas-fired alternatives, but would be located elsewhere within the PJM region.

PSEG concludes that it is very unlikely that the environmental impacts of any combination of generating and conservation options would be reduced to the level of impacts associated with renewal of the HCGS operating license. Therefore, a combination of alternatives is not considered a reasonable alternative to HCGS license renewal.

7.2.2 ENVIRONMENTAL IMPACTS OF ALTERNATIVES

This section evaluates the environmental impacts of alternatives that PSEG has determined to be reasonable alternatives to HCGS license renewal: gas-fired generation, coal-fired generation, new nuclear generation, and purchased power. For the impacts of coal- and gas-fired generation that are not specifically discussed in this Environmental Report, the findings of the GEIS (NRC 1996b) regarding the impacts of such generation are adopted.

7.2.2.1 Gas-Fired Generation

NRC evaluated environmental impacts from gas-fired generation alternatives in the GEIS, focusing on combined-cycle plants. Section 7.2.1.1 presents PSEG's reasons for defining the gas-fired generation alternative as a three-unit combined-cycle plant at HCGS. Construction of a gas-fired unit would impact land use and could impact ecological, aesthetic, and cultural resources, but construction on an existing power plant site would minimize any impacts to these resources. Human health effects associated with air emissions would be of concern. Gas-fired generation facilities use much less water than nuclear power plants; therefore, aquatic biota losses due to cooling water withdrawals would be easily offset by the concurrent shutdown of the nuclear generator. The following subsections describe the effects of combined-cycle gas-fired generation in greater detail.

Air Quality

Natural gas is a relatively clean-burning fossil fuel that primarily emits nitrogen oxides (NO_X), a regulated pollutant, during combustion. A natural-gas-fired plant would also emit small quantities of sulfur oxides (SO_X), particulate matter, and carbon monoxide (CO), all of which are regulated pollutants. In addition, a natural-gas-fired plant would produce carbon dioxide (CO_2) a greenhouse gas. Control technology for gas-fired turbines focuses on NO_X emissions. From data published by EPA (EPA 2000a), the emissions from the natural-gas-fired plant are estimated to be:

SO_X = 17 metric tons (19 tons) per year

NO_X = 291 metric tons (321 tons) per year

CO = 60 metric tons (66 tons) per year

CO_2 = 2,940,000 metric tons (3,240,000 tons) per year

Particulates:

Filterable Particulate Matter = 51 metric tons (56 tons) per year (all particulate matter from natural gas combustion are particulates with diameters less than 2.5 microns [$PM_{2.5}$])

In 2006, New Jersey was ranked 37th nationally in sulfur dioxide (SO_2) emissions and 43rd nationally in NO_X emissions from electric power plants (EIA 2007b). The acid rain requirements of the Clean Air Act Amendments of 1990 capped the nation's SO_2 emissions from power plants. Each company with fossil-fuel-fired units was allocated SO_2 allowances. To be in compliance with the Act, the companies must hold enough allowances to cover their annual SO_2 emissions. PSEG would need to obtain SO_2 credits to operate a fossil-fuel-fired plant.

In 1998, the EPA promulgated the NO_X SIP (State Implementation Plan) Call regulation that required 22 states, including New Jersey, Maryland, Delaware, and Pennsylvania, to reduce their NO_X emissions to address regional transport of ground-level ozone across state lines (EPA 1998b). In 2005 EPA issued the Clean Air Interstate Rule (CAIR), which was overturned in courts during July 2008. The CAIR would have permanently capped emissions of SO_2 and NO_X in 28 eastern states and the District of Columbia using a cap and trade program. In December 2008 the court reversed its vacatur of CAIR. The EPA is now charged with making changes consistent with the Court's July opinion, including changing methodologies for allowance allocations. The Court did not set a deadline for the EPA to establish a new rule. The new EPA rule might be substantially different from the CAIR but would likely require PSEG to obtain enough NO_X credits to cover annual emissions either from the set-aside pool or by buying NO_X credits from other sources. Additionally, because all of New Jersey is treated as a non-attainment area for ozone, a new fossil-fuel-fired plant at an existing PSEG power plant site annually would need to purchase enough NO_X emission reduction credits to cover its emissions.

New Jersey has implemented the CO_2 Budget Trading Program cap-and-trade program for the electric power sector consistent with companion rules in nine other states. The Regional Greenhouse Gas Initiative (RGGI) is an ongoing effort, commenced in September 2003, among Northeast and Mid-Atlantic States to develop and implement a regional CO_2 cap-and-trade program aimed at stabilizing and then reducing CO_2 emissions from large fossil fuel-fired electricity generating units in the region, New Jersey is a signatory state to the RGGI Memorandum of Understanding (MOU). The participating states agreed to stabilize power sector CO_2 emissions over the first six years of program implementation (2009 through 2014) at a level roughly equal to current emissions, and then initiating an emissions decline of 2.5 percent per year for the four years 2015 through 2018. This approach will result in a 2018 annual emissions budget that is 10 percent smaller than the initial 2009 annual emissions budget. The initial regional cap is 170.5 metric tons (188 million short tons) of CO_2 per year, which is approximately four percent above annual average regional emissions during the period 2000 through 2004 for electric generating units that will be subject to the program. New Jersey is auctioning the CO_2 allowances and the availability of adequate allowances for a new fossil generation unit cannot be determined at this time. Although, the cost of each CO_2 allowance in the initial September 2008 auction was $3.07, future prices cannot be predicted. Additional information on the RGGI is available at http://www.rggi.org/home.

Locating the gas-fired units in the ROI would increase the CO_2 emissions by over 2.72 million metric tons (3 million short tons) per year. In comparison, the CO_2 emission budget for the entire RGGI, which includes the ROI plus six other states, is 170.5 metric tons (188 million short tons) of CO_2 per year in 2018, as was explained above. Accordingly, the addition of 1,260 MWe of gas-fired generation would likely challenge compliance with this budget. HCGS does not emit CO_2 in the generation of electric power for sale.

NO_X effects on ozone levels, SO_2 allowances, CO_2 credits and NO_X credits could all be issues of concern for gas-fired combustion. While gas-fired turbine emissions are less than coal-fired boiler emissions, the emissions are still substantial. PSEG concludes that emissions from the gas-fired alternative would noticeably alter local air quality, but would not cause or contribute to violations of National Ambient Air Quality Standards in the region. Air quality impacts would therefore be SMALL to MODERATE.

Waste Management

The GEIS concludes that the solid waste generated from a natural-gas-fired combined cycle power plant would be minimal (NRC 1996b). The only noteworthy waste would be from spent selective catalytic reduction (SCR) used for NO_X control. PSEG concludes that gas-fired generation waste management impacts would be SMALL.

Other Impacts

Construction of the gas-fired alternative on an existing plant site would impact the construction site and the supporting utility corridors. If the gas-fired units were located at HCGS, PSEG estimates that 18 hectares (44 acres) on the previously disturbed HCGS site would be needed for a plant site, and impacts to land use and terrestrial resources would be SMALL. Aesthetic impacts, erosion and sedimentation, fugitive dust, and construction debris impacts would be noticeable but SMALL with appropriate controls.

A new gas pipeline would likely be required to supply the fuel for the gas turbine generators in this alternative. To the extent practicable, PSEG would route the pipeline along existing, previously disturbed, rights-of-way to minimize impacts. A new pipeline of approximately 40.6 cm (16-inch) diameter would require a 30.5 m (100-ft) wide corridor. This new construction may also necessitate an upgrade of the statewide pipeline network. Impacts to land use would be SMALL.

PSEG estimates an average construction workforce of 560 employees with a peak of 1,010 workers. Socioeconomic impacts from the construction workforce would be minimal, if worker relocation is not required, which would be the case if, like HCGS, the site is near metropolitan areas such as the cities of Salem, Wilmington, Bridgeton, and Vineland. However, PSEG estimates a reduced workforce of 48 for gas operations, resulting in adverse socioeconomic impacts due to the loss of 869 personnel responsible for HCGS operational activities and the 600 additional personnel employed during outages. Loss of the operational and temporary personnel would impact various aspects of the local community including employment, taxes, housing, offsite land use, economic structure, and public services (NRC 1996b). PSEG believes these impacts would be MODERATE in the GEIS-defined high population area surrounding HCGS (see Section 2.6).

If the gas-fired units were located at HCGS, impacts to aquatic resources and water quality would be smaller than the impacts of the existing HCGS due to changes in the plant's cooling water withdrawals from and discharges to the Delaware River. These impacts would be offset by the concurrent shutdown of HCGS. PSEG considers that impacts to water resources would be SMALL. The stacks and boilers would have visual impacts but be consistent with the industrial nature of the site. Impacts to cultural resources would be unlikely because the site is an artificial island as described in Section 2.11.

7.2.2.2 Coal-Fired Generation

NRC evaluated environmental impacts from coal-fired generation alternatives in the GEIS (NRC 1996b). NRC concluded that construction impacts could be substantial, due in part to the large land area required (which can result in natural habitat loss) and the large workforce needed. NRC identified major adverse impacts from operations as human health concerns associated with air emissions, waste generation, and losses of aquatic biota due to cooling water withdrawals and discharges.

The coal-fired alternative that PSEG has defined in Section 7.2.1.1 would be located at an existing PSEG power plant site and, for the purpose of evaluating impacts, that site is assumed to be HCGS. A coal plant comparable to the 1,260-MWe gas plant chosen for this alternatives analysis could comprise two 630-MWe (net) units.

Air Quality

A coal-fired plant would emit SO_2, NO_X, particulate matter, CO, and carbon dioxide (CO_2), which is a greenhouse gas. A coal-fired plant also would emit mercury, which is a regulated pollutant in New Jersey. As Section 7.2.1.1 indicates, PSEG has assumed a plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. Using data published by the Energy Information Administration (EIA 2007c) and the EPA (EPA 1998a; EPA 2006a), the coal-fired alternative emissions are estimated to be as follows:

SO_2 = 2,946 metric tons (3,247 tons) per year

NO_X = 881 metric tons (971 tons) per year

CO = 881 metric tons (971 tons) per year

CO_2 = 9,700,000 metric tons (10,700,000 tons) per year

Mercury = 146 kilograms (322 pounds) per year

Particulates:

PM_{10} (particulates having a diameter of less than 10 microns) = 24 metric tons (27 tons) per year

$PM_{2.5}$ (particulates having a diameter of less than 2.5 microns) = 6 metric tons (7 tons) per year

The discussion in Section 7.2.2.1 of regional air quality is applicable to the coal-fired generation alternative. In addition, NRC noted in the GEIS that adverse human health effects from coal combustion have led to important federal legislation in recent years and that public health risks, such as cancer and emphysema, have been associated with coal combustion. NRC also mentioned global climate change and acid rain as potential impacts. In 2005 EPA issued the Clean Air Mercury Rule, which has now been overturned by the courts. While the future is unclear, EPA likely will have to promulgate a new rule to address limits on mercury emissions. Notwithstanding, New Jersey has adopted mercury emissions control standards applicable to coal-fired boilers (see N.J.A.C. 7:27-27).

New Jersey has implemented the CO_2 Budget Trading Program cap-and-trade program for the electric power sector consistent with companion rules in nine other states. The Regional Greenhouse Gas Initiative (RGGI) is an ongoing effort, begun in September 2003, among Northeast and Mid-Atlantic States to develop and implement a regional CO_2 cap-and-trade program aimed at stabilizing and then reducing CO_2 emissions from large fossil fuel-fired electricity generating units in the region. New Jersey is a signatory state to the RGGI Memorandum of Understanding (MOU). The participating states agreed to stabilize power sector CO_2 emissions over the first six years of program implementation (2009 through 2014) at a level roughly equal to current emissions, and then initiating an emissions decline of 2.5 percent per year for the four years 2015 through 2018. This approach will result in a 2018 annual emissions budget that is 10 percent smaller than the initial 2009 annual emissions budget. The initial regional cap is 170.5 metric tons (188 million short tons) of CO_2 per year, which is approximately 4 percent above annual average regional emissions during the period 2000 through 2004 for electric generating units that will be subject to the program. New Jersey is auctioning the CO_2 allowances and the availability of adequate allowances for a new fossil generation unit can not be determined at this time. Although the cost of each CO_2 allowance in the initial September 2008 auction was $3.07, future prices cannot be predicted. More information on the RGGI is available at http://www.rggi.org/home.

Locating the coal-fired units in the ROI would increase the CO_2 emissions by over 10 million tons per year. In comparison the CO_2 emission budget for the entire RGGI, which includes the ROI plus six other states, is 170.5 metric tons (188 million short tons) of CO_2 per year in 2018, as was explained above. Accordingly, the addition of 1260 MWe of coal-fired generation would likely challenge compliance with this budget. HCGS does not emit CO_2 in the generation of electric power for sale.

PSEG concludes that federal legislation and large-scale issues, such as global climate change and acid rain, are indications of concerns about destabilizing important attributes of air resources. However, SO_2 emission allowances, mercury emission allowances, CO_2 credits, NO_X credits, low NO_X burners, overfire air, fabric filters or electrostatic precipitators, and scrubbers are now, or likely will be in the future, regulatory-imposed mitigation measures. As such, PSEG concludes that the coal-fired alternative would have MODERATE impacts on air quality; the impacts would be noticeable and greater than those of the gas-fired alternative, but would not destabilize air quality in the area.

Waste Management

PSEG concurs with the GEIS assessment that the coal-fired alternative would generate substantial solid waste. The coal-fired plant would annually consume about 3.52 million metric tons (3.88 million tons) of coal having an ash content of 6.13 percent. After combustion, 45 percent of this ash, approximately 96,750 metric tons (107,000 tons) per year, would be marketed for beneficial reuse. The remaining ash, approximately 119,000 metric tons (131,000 tons) per year, would be collected and disposed of in an authorized disposal facility. In addition, approximately 74,600 metric tons (82,300 tons) of scrubber sludge would be disposed of each year (based on annual limestone usage of about 96,900 metric tons [107,000 tons]). PSEG estimates that ash and scrubber waste disposal over a 20-year plant life (the time considered for license renewal) would require approximately 26 hectares (65 acres).

PSEG believes that proper siting, current waste management practices, and current waste monitoring practices would prevent waste disposal from destabilizing any resources. After closure of the waste site and revegetation, the land would be available for other uses. For these reasons, PSEG believes that waste disposal for the coal-fired alternative would have MODERATE impacts; the impacts of increased waste disposal would be noticeable, but would not destabilize any important resource, and further mitigation would not be warranted.

Other Impacts

PSEG estimates that construction of the power block for a coal-fired power plant would require 70 hectares (174 acres) and ash disposal would require an additional 52 hectares (130 acres) of land and associated terrestrial habitat over 40 years, or 26 hectares (65 acres over the 20-year license renewal term. Because much of this construction would be on previously disturbed land, impacts to land use and ecological resources would be SMALL to MODERATE.

Delivery of coal and limestone by barge would require construction of a barge offloading facility and a conveyor system to the coal yard which would affect the terrestrial habitat along the waterfront as well as aqueous habitat associated with the construction, maintenance, and operation of the offloading facility. Only 5 percent of the coal delivered to New Jersey is transported by barge but Logan Generating Company and Mercer Generating Station located further up the Delaware River than HCGS, receive coal via barge (EIA 2008c, EIA 2008d).

PSEG estimates an average construction workforce of 1,010 employees with a peak of 1,955 workers. Socioeconomic impacts from the construction workforce would be minimal, if worker relocation is not required, for a site located near a large metropolitan area. PSEG estimates an operational workforce of 172 workers for the coal-fired alternative. This is a sizable reduction in operating personnel compared to HCGS's 869 personnel, and the impact on the local community employment, taxes, housing, off-site land use, and public services could be significant. Thus, reduction in workforce would result in adverse socioeconomic impacts characterized as MODERATE.

Impacts to aquatic resources and water quality would be similar to impacts of HCGS, due to the new plant's use of the cooling water from and discharge to the Delaware Estuary, and would be offset by the concurrent shutdown of HCGS. Therefore PSEG concludes that impacts to aquatic resources would be SMALL. As with any large construction project, some erosion and sedimentation and fugitive dust emissions could be anticipated, but would be minimized by using best management practices. Debris from clearing and grubbing could be disposed of onsite. The stacks, boilers, and barge deliveries would increase the visual impact but be consistent with the industrial nature of the site. Impacts to cultural resources would be unlikely because the site is an artificial island. Impacts to visual resources and cultural resources would be SMALL.

7.2.2.3 New Nuclear Capacity

As discussed in Section 7.2.1.2, under the new nuclear capacity alternative, PSEG would construct one or two new nuclear generating units using an NRC certified standard design.

Air Quality

Air quality impacts would be minimal. Air emissions are primarily from non-facility equipment and diesel generators and would be comparable to those associated with the continued operation of HCGS. Overall, emissions and associated impacts would be considered SMALL.

Waste Management

High-level radioactive wastes would be similar to those associated with the continued operation of HCGS. Low-level radioactive waste impacts from a new nuclear plant would be slightly greater but similar to the continued operation of HCGS. The overall impacts are characterized as SMALL.

Other Impacts

PSEG estimates that construction of the reactor(s) and auxiliary facilities would affect 255 to 510 hectares (630 to 1260 acres) of land and associated terrestrial habitat. Because most of this construction would be on previously disturbed land, impacts at the HCGS site would be SMALL to MODERATE. For the purposes of analysis, PSEG has assumed that the existing barge facilities would be used for reactor vessel and other deliveries under this alternative. Visual impacts would be consistent with the industrial nature of the site. As with any large construction project, some erosion and sedimentation and fugitive dust emissions could be anticipated, but would be minimized by using best management practices. Debris from clearing and grubbing could be disposed of onsite.

PSEG estimates a peak construction work force of approximately 3650 workers. The surrounding communities would experience moderate to large demands on housing and public services. Long-term job opportunities would be comparable to continued operation of HCGS. Therefore, PSEG concludes that socioeconomic impacts during construction and operation would be SMALL TO LARGE.

Impacts to aquatic resources and water quality would be similar to impacts of HCGS, due to use by the new unit(s) of the existing cooling water intake and discharge structures. If two units were to be constructed, a second cooling tower may be required increasing impacts to aquatic resources and water quality.

PSEG estimates that other construction and operation impacts would be SMALL. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these other impacts, mitigation would not be warranted beyond that previously mentioned.

7.2.2.4 Purchased Power

As discussed in Section 7.2.1.2, PSEG assumes that the generating technology used under the purchased power alternative would be one of those that NRC analyzed in the GEIS. PSEG is also adopting by reference the NRC analysis of the environmental impacts from those technologies. Under the purchased power alternative, therefore, environmental impacts would still occur, but they would likely originate from a power plant located elsewhere in the ROI. PSEG believes that imports from outside the PJM region would not be required. However, the replacement capacity, wherever located in the ROI, would have similar environmental impacts as those described above on a regional basis.

As also indicated in Section 7.2.1.2 new transmission lines are essential for New Jersey to meet the growing demand for electricity. PJM has already identified a number of areas in which additional transmission facilities are needed to ensure the continued reliability of the region's electric grid (PJM 2007d). Long-term power purchases, therefore, would require the construction of additional transmission capacity. Additions and changes to the present transmission network would occur on previously undisturbed land either along existing transmission line rights-of-way or along new transmission corridors. PSEG concludes that the land use impact of such transmission line additions would be SMALL to MODERATE. In general, land use changes would be so minor that they would neither destabilize nor noticeably alter any important land use resources. Given the potential length of new transmission corridors into southern New Jersey, it is reasonable to assume that in some cases land use changes would be clearly noticeable, which is a characteristic of an impact that is MODERATE.

PSEG believes that impacts associated with the purchase of power would be SMALL to MODERATE; the impacts could be noticeable, but would not destabilize any important resource, and further mitigation would not be warranted.

7.2.2.5 Conclusion

Based on the analyses done for reasonable alternatives that could generate the same amount of electricity as generated by HCGS, PSEG concludes that no alternative is environmentally preferable. Furthermore, the gas-fired and coal-fired generation alternatives would have significant carbon emissions in comparison to HCGS license renewal.

Table 7.2-1 Gas-Fired Alternative

Characteristic	Basis
Plant size = 1,260 MWe ISO rating net combined cycle consisting of three 420 MWe systems with heat recovery steam generators	Manufacturer's standard size gas-fired combined-cycle plant (≤ HCGS net capacity of 1,265 MWe) (GE Energy 2007)
Plant size = 1,314 MWe ISO rating gross	Based on 4 percent onsite power usage
Number of units = 3	Assumed
Fuel type = natural gas	Assumed
Fuel heating value = 1,034 Btu/ft^3	2007 value for gas used in New Jersey (EIA 2008e, Table 14.A)
Fuel SO_X content = 0.00066 lb/MMBtu	(EPA 2000a, Table 3.1-2a; INGAA 2000)
NO_X control = selective catalytic reduction (SCR) with steam/water injection	Best available technology for minimizing NO_X emissions (EPA 2000a, Table 3.1-1)
Fuel NO_X content = 0.0109 lb/MMBtu	Typical for large selective catalytic reduction controlled gas fired units with water injection (EPA 2000b, Table 3.1 Database)
Fuel CO content = 0.00226 lb/MMBtu	Typical for large SCR-controlled gas fired units (EPA 2000b, Table 3.1 Database)
Fuel PM_{10} content = 0.0019 lb/MMBtu	(EPA 2000a, Table 3.1-2a)
Fuel CO_2 content = 110 lb/MMBtu	(EPA 2000a, Table 3.1-2a)
Heat rate = 5,687 Btu/kWh	(GE Power 2001)
Capacity factor = 0.90	Assumed based on performance of modern baseload plants

Note: The difference between "net" and "gross" is electricity consumed onsite.
Note: The heat recovery steam generators do not contribute to air emissions.
Btu = British thermal unit
CO = carbon monoxide
CO_2 = carbon dioxide
ft^3 = cubic foot
ISO rating = International Organization for Standardization rating at standard atmospheric conditions of 59°F, 60 percent relative humidity, and 14.696 pounds of atmospheric pressure per square inch
kWh = kilowatt-hour
MM = million
MWe = megawatt electrical
NO_X = nitrogen oxides
PM_{10} = particulates having diameter of 10 microns or less
SOx = oxides of sulfur
≤ = less than or equal to

Table 7.2-2 Coal-Fired Alternative

Characteristic	Basis
Plant size = 1,260 MWe ISO rating net consisting of two 630 MWe (net) units	Size set = to gas-fired alternative (≤ HCGS nominal base-load capacity of 1,265 MWe)
Plant size = 1,340 MWe ISO rating gross	Based on 6 percent onsite power usage
Number of units = 2	Assumed
Boiler type = supercritical tangentially fired, dry-bottom	Minimizes nitrogen oxides emissions (EPA 1998a)
Fuel type = bituminous, pulverized coal	Typical for coal used in New Jersey
Fuel heating value = 11,890 Btu/lb	2007 value for coal used in New Jersey (EIA 2008e, Table 15.A)
Fuel ash content by weight = 6.13 percent	2007 value for coal used in New Jersey (EIA 2008e, Table 15.A)
Fuel sulfur content by weight = 0.88 percent	2007 value for coal used in New Jersey (EIA 2008e, Table 15.A)
Uncontrolled NO_X emission = 10.0 lb/ton	Typical for pulverized coal, tangentially fired, dry-bottom, NSPS (EPA 1998a)
Uncontrolled CO emission = 0.5 lb/ton	Typical for pulverized coal, tangentially fired, dry-bottom, NSPS (EPA 1998a)
Uncontrolled CO_2 emission = 5510 lb/ton	Typical for pulverized bituminous coal, tangentially fired, dry-bottom, NSPS (EPA 1998a)
Heat rate = 8,740 Btu/kWh	EIA forecast for a new supercritical coal-fired plant beginning operation in 2026 (EIA 2008f, Table 47)
Capacity factor = 0.90	Typical for large coal-fired units
NO_X control = low NO_X burners, over-fire air and selective catalytic reduction (95 percent reduction)	Best available technology and widely demonstrated for minimizing NO_X emissions (EPA 1998a)
Particulate control = fabric filters (baghouse-99.9 percent removal efficiency)	Best available technology for minimizing particulate emissions (EPA 1998a)
SO_X control = Wet scrubber - limestone (95 percent removal efficiency)	Best available technology for minimizing SO_X emissions (EPA 1998a)
Hg control = wet limestone scrubber with fabric filter (baghouse – 96 percent removal efficiency)	Best available technology and widely demonstrated for minimizing Hg (EPA 1998a)

Note: The difference between “net” and “gross” is electricity consumed onsite.
Btu = British thermal unit
CO = carbon monoxide
CO_2 = carbon dioxide
ISO rating = International Organization for Standardization rating at standard atmospheric conditions of 59°F, 60 percent relative humidity, and 14.696 pounds of atmospheric pressure per square inch
kWh = kilowatt-hour
NSPS = New Source Performance Standard
lb = pound
MWe = megawatt electrical
NO_X = nitrogen oxides
SO_X = oxides of sulfur
Hg = mercury
≤ = less than or equal to

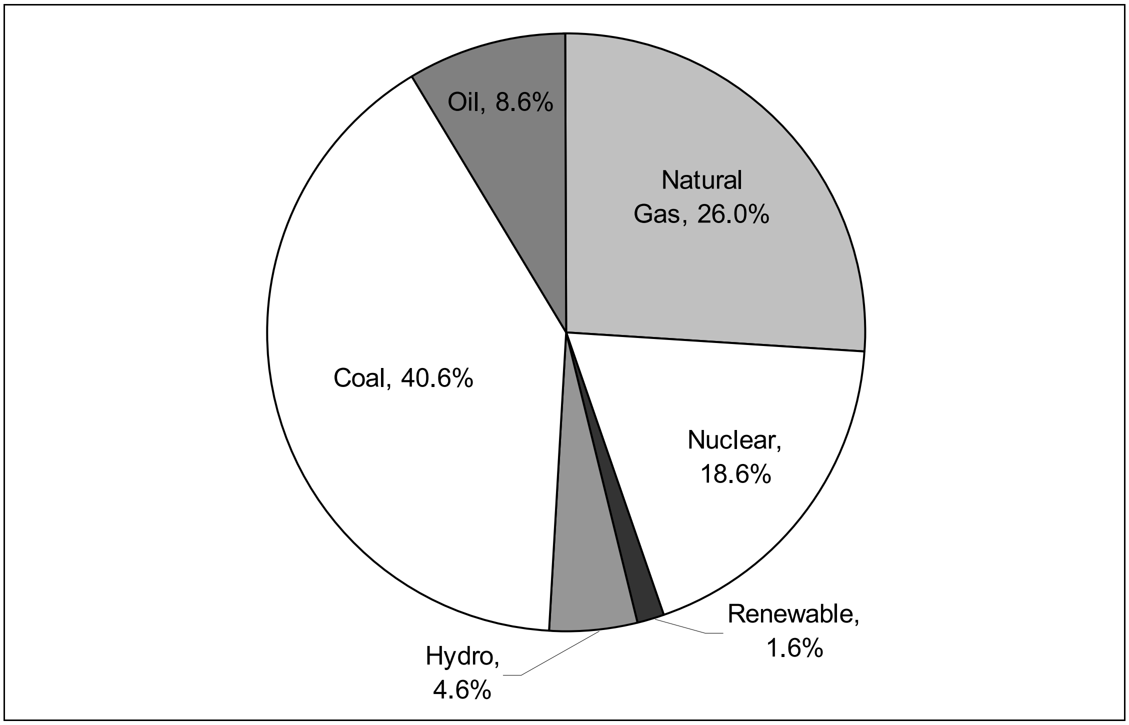

Figure 7.2-1 PJM Regional Generating Capacity (2006)

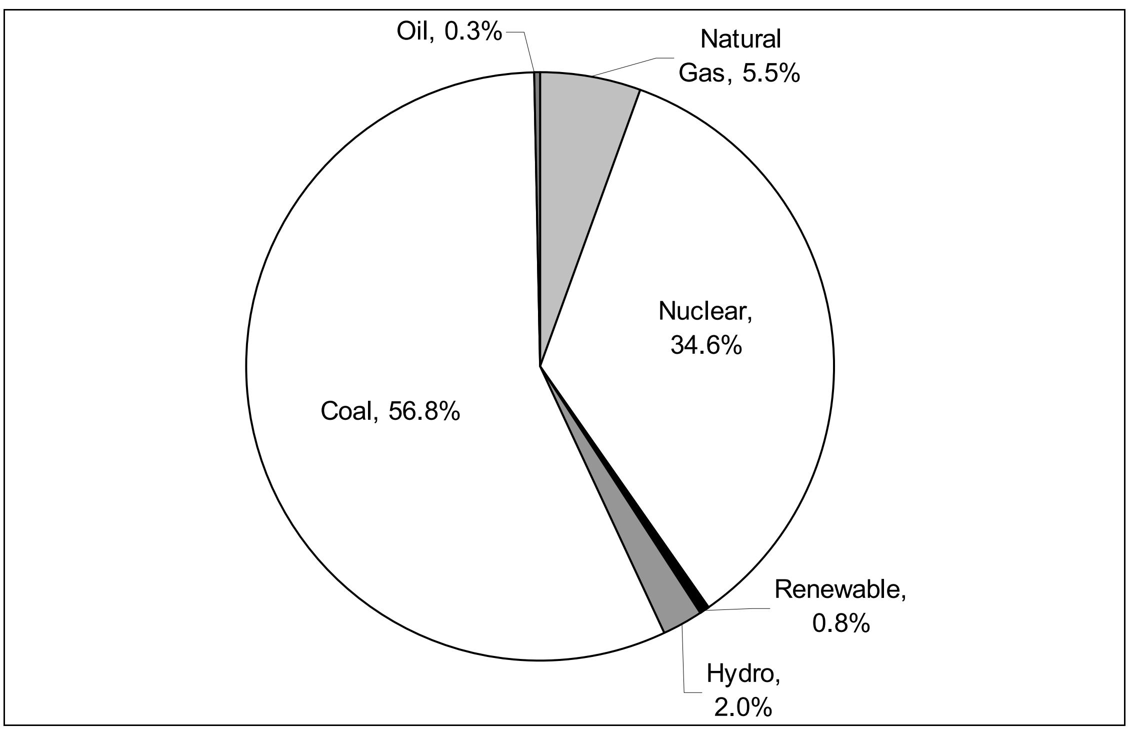

Figure 7.2-2 PJM Regional Energy Output by Fuel Type (2006)

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Chapter 8

Comparison of Environmental Impacts of License Renewal with the Alternatives

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NRC

> **"…To the extent practicable, the environmental impacts of the proposal and the alternatives should be presented in comparative form..." 10 CFR 51.45(b)(3) as adopted by 51.53(c)(2)**

Chapter 4 analyzes environmental impacts of HCGS license renewal and Chapter 7 analyzes impacts of reasonable alternatives. Table 8.0-1 summarizes environmental impacts of the proposed action (license renewal) and the reasonable alternatives, for comparison purposes. The environmental impacts compared in Table 8.0-1 are those that are either Category 2 issues for the proposed action or are issues that the GEIS (NRC 1996b) identified as major considerations in an alternatives analysis. For example, although the NRC concluded that air quality impacts from the proposed action would be small (Category 1), the GEIS identified major human health concerns associated with air emissions from alternatives (Section 7.2.2). Therefore, Table 8.0-1 includes a comparison of the air impacts from the proposed action to those of the alternatives. Table 8.0-2 is a more detailed comparison of the alternatives.

Table 8.0-1 Impacts Comparison Summary

Impact	Proposed Action (License Renewal)	No-Action Alternatives				
		Base (Decommissioning)	With New Nuclear Power	With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
Land Use	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE
Water Quality	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE
Air Quality	SMALL	SMALL	SMALL	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Ecological Resources	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE
Threatened or Endangered Species	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Human Health	SMALL	SMALL	SMALL	MODERATE	SMALL	SMALL to MODERATE
Socioeconomics	SMALL	SMALL	SMALL TO LARGE	MODERATE	MODERATE	MODERATE
Waste Management	SMALL	SMALL	SMALL	MODERATE	SMALL	SMALL to MODERATE
Aesthetics	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE
Cultural Resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL

SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource.
LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.
10 CFR 51, Subpart A, Appendix B, Table B-1, Footnote 3.

Table 8.0-2 Impacts Comparison Detail

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives			
		With New Nuclear Power	With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
Alternative Descriptions					
HCGS license renewal for 20 years, followed by decommissioning	Decommissioning following expiration of current HCGS license. Adopting by reference, as bounding for HCGS decommissioning, GEIS description (NRC 1996b, Section 7.1)	New construction at an existing site, assumed to be HCGS	New construction at an existing site, assumed to be HCGS	New construction at an existing site, assumed to be HCGS	Would involve construction of new generation capacity in the PJM region. Adopting by reference GEIS description of alternate technologies (Section 7.2.1.2)
		Upgrade of barge slip or installation of a new rail spur	Upgrade of barge slip or installation of a new rail spur	Construct 40.6-cm (16-inch) diameter gas pipeline in a 30.5-m (100-ft) wide corridor. May require upgrades to existing pipelines	
					Construct new transmission lines to interconnect to the PJM region
		One or two units using a certified NRC standard design producing 1,260 MWe net, capacity factor 0.90	Two 630-MWe (net) tangentially fired, dry bottom units producing 1,260 MWe net; capacity factor 0.90	Three pre-engineered 420-MWe gas-fired combined-cycle systems with heat recovery steam generators, producing combined total of 1,260 MWe. capacity factor: 0.90	

Table 8.0-2. Impacts Comparison Detail (Continued)

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives			
		With New Nuclear Power	With Coal-Fired Generation	With Gas-Fired Generation	With Purchased Power
			Construct cooling tower(s) and construct/modify intake/discharge system	Construct /modify intake/discharge system	
			Pulverized bituminous coal, 11,890 Btu/lb; 8,740 Btu/kWh; 6.13% ash; 0.88% sulfur; 10 lb/ton nitrogen oxides; 3.52 x 10^6 metric tons (3.88 x 10^6 tons) coal/yr	Natural gas, 1,034 Btu/ft^3; 5,687 Btu/kWh; 0.00066 lb sulfur/MMBtu; 0.0109 lb NO_x/MMBtu; 5.3 x 10^8 m^3 (1.9 x 10^{10} ft^3) gas/yr	
			Low NO_x burners, over-fire air and selective catalytic reduction (95% NO_x reduction efficiency)	Selective catalytic reduction with steam/water injection	
			Wet scrubber – lime/limestone desulfurization system (95% SO_x removal efficiency); 96,900 metric tons (107,000 tons) lime/yr		
			Fabric filters or electrostatic precipitators (99.9% particulate removal efficiency)		
513 permanent, 270 corporate, and 86 matrixed employees		Comparable to present HCGS workforce (Section 7.2.2.3)	172 workers (Section 7.2.2.2)	48 workers (Section 7.2.2.1)	

Table 8.0-2. Impacts Comparison Detail (Continued)

		No-Action Alternatives			
Proposed Action (License Renewal)	**Base (Decommissioning)**	**With New Nuclear Power**	**With Coal-Fired Generation**	**With Gas-Fired Generation**	**With Purchased Power**
Land Use Impacts					
SMALL – Adopting by reference Category 1 issue findings (Appendix A, Table A-1, Issues 52, 53)	SMALL – Not an impact evaluated by GEIS (NRC 1996b)	SMALL to MODERATE – 255 to 510 hectares (630 to 1260 acres) required for the power block and associated facilities at HCGS location (Section 7.2.2.3)	SMALL to MODERATE – 70 hectares (174 acres) required for the power block and associated facilities at HCGS location; 26 hectares (65 acres) for ash/sludge disposal during 20-year license renewal term (Section 7.2.2.2)	SMALL– 18 hectares (44 acres) for facility at HCGS location (Section 7.2.2.1). New gas pipeline would be built to connect with existing gas pipeline corridor	SMALL to MODERATE – most transmission facilities could be constructed along existing transmission corridors (Section 7.2.2.3). Adopting by reference GEIS description of land use impacts from alternate technologies (NRC 1996b)
Water Quality Impacts					
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 3, 4, and 6-11). One Category 2 ground-water issue applies (Section 4.5, Issue 33). Four Category 2 ground-water issues don't apply (Section 4.1, Issue 13; Section 4.6, Issue 34; Section 4.7, Issue 35; and Section 4.8, Issue 39).	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 89).	SMALL – Construction impacts minimized by use of best management practices. Operational impacts similar to HCGS by using cooling tower and discharging to the Delaware Estuary. (Section 7.2.2.3)	SMALL – Construction impacts minimized by use of best management practices. Operational impacts similar to HCGS by using cooling tower and discharging to the Delaware Estuary. (Section 7.2.2.2)	SMALL – Reduced cooling water demands, inherent in combined-cycle design (Section 7.2.2.1)	SMALL to MODERATE – Adopting by reference GEIS description of water quality impacts from alternate technologies (NRC 1996b)

Table 8.0-2. Impacts Comparison Detail (Continued)

		No-Action Alternatives			
Proposed Action (License Renewal)	**Base (Decommissioning)**	**With New Nuclear Power**	**With Coal-Fired Generation**	**With Gas-Fired Generation**	**With Purchased Power**
Air Quality Impacts					
SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 51). One Category 2 issue does not apply (Section 4.11, Issue 50).	SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issue 88)	SMALL – Air emissions are primarily from non-facility equipment and diesel generators and are comparable to those associated with the continued operation of HCGS (Section 7.2.2.3)	MODERATE – 2,946 metric tons (3,247 tons) SO_X/yr 881 metric tons (971 tons) NO_X/yr 881 metric tons (971 tons) CO/yr 6 metric tons (7 tons) $PM_{2.5}$/yr 24 metric tons (27 tons) PM_{10}/yr 146 kilograms (322 pounds) mercury/yr 9,700,000 metric tons (10,700,000 tons) CO_2 /yr (Section 7.2.2.2)	SMALL to MODERATE – 17 metric tons (19 tons) SO_X/yr 291 metric tons (321 tons) NO_X/yr 60 metric tons (66 tons) CO/yr 51 metric tons (56 tons) $PM_{2.5}$/yr 2,940,000 metric tons (3,240,000 tons) CO_2 /yr (Section 7.2.2.1)	SMALL to MODERATE – Adopting by reference GEIS description of air quality impacts from alternate technologies (NRC 1996b)
Ecological Resource Impacts					
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 15-24, 28-30, and 45-48). Four Category 2 issues do not apply (Section 4.2, Issue 25; Section 4.3, Issue 26; and Section 4.4, Issue 27; Section 4.9, Issue 40).	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 90)	SMALL – Impacts would be comparable to those associated with continued operation of HCGS (Section 7.2.2.3)	SMALL to MODERATE – 26 hectares (65 acres) of the existing site could be required for ash/sludge disposal over a 20-year period. (Section 7.2.2.2)	SMALL – Construction of pipeline could alter the terrestrial habitat. (Section 7.2.2.1)	SMALL to MODERATE – Adopting by reference GEIS description of ecological resource impacts from alternate technologies (NRC 1996b)

Table 8.0-2. Impacts Comparison Detail (Continued)

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives: With New Nuclear Power	No-Action Alternatives: With Coal-Fired Generation	No-Action Alternatives: With Gas-Fired Generation	No-Action Alternatives: With Purchased Power
Threatened or Endangered Species Impacts					
SMALL –No Federally threatened or endangered species are known residents at the site. One federally threatened species occurs in a transmission corridor, and two other protected species are known to occur in the vicinity of transmission corridors (Section 4.10, Issue 49)	SMALL – Not an impact evaluated by GEIS (NRC 1996b)	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats	SMALL – Federal and state laws prohibit destroying or adversely affecting protected species and their habitats
Human Health Impacts					
SMALL – Adopting by reference Category 1 issues (Table A-1, Issues 56, 58, 61, 62). One Category 2 issue does not apply (Section 4.12, Issue 57). Risk due to transmission-line induced currents minimal due to conformance with consensus code (Section 4.13, Issue 59)	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 86)	SMALL – Impacts would be comparable to continued operation of HCGS (Section 7.2.2.3)	MODERATE – Adopting by reference GEIS conclusion that risks such as cancer and emphysema from emissions are likely (NRC 1996b)	SMALL – Adopting by reference GEIS conclusion that some risk of cancer and emphysema exists from emissions (NRC 1996b)	SMALL to MODERATE – Adopting by reference GEIS description of human health impacts from alternate technologies (NRC 1996b)

Table 8.0-2. Impacts Comparison Detail (Continued)

		No-Action Alternatives			
Proposed Action (License Renewal)	**Base (Decommissioning)**	**With New Nuclear Power**	**With Coal-Fired Generation**	**With Gas-Fired Generation**	**With Purchased Power**
Socioeconomic Impacts					
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 64, 67). Two Category 2 issues findings are not applicable (Section 4.16, Issue 66 and Section 4.17.1, Issue 68). Location in high population area with no growth controls minimizes potential for housing impacts. Section 4.14, Issue 63). Station property tax payments represents approximately 20 percent of the tax revenues paid to Lower Alloways Creek Township, and less than 10 percent each of the city of Salem and Salem County's total tax revenues (Section 4.17.2, Issue 69). Because the tax revenues collected from HCGS are provided to Salem County by Lower Alloways Creek Township in exchange for government services, and impacts to the county are small, the impacts of license renewal are considered SMALL.	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 91)	Construction: MODERATE to LARGE – Peak construction workforce of 3650 could affect housing and public services in surrounding counties. Operation: SMALL – Impacts would be comparable to those associated with the continued operation of HCGS (Section 7.2.2.3)	MODERATE – Reduction in permanent workforce at HCGS could adversely affect surrounding counties. (Section 7.2.2.2)	MODERATE – Reduction in permanent workforce at HCGS could adversely affect surrounding counties. (Section 7.2.2.1)	MODERATE – Adopting by reference GEIS description of socioeconomic impacts from alternate technologies (NRC 1996b)

Table 8.0-2. Impacts Comparison Detail (Continued)

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives: With New Nuclear Power	No-Action Alternatives: With Coal-Fired Generation	No-Action Alternatives: With Gas-Fired Generation	No-Action Alternatives: With Purchased Power
Capacity of public water supply and transportation infrastructure minimizes potential for related impacts (Section 4.15, Issue 65 and Section 4.18, Issue 70) Two Category 2 issues do not apply (Section 4.16, Issue 66 and Section 4.17.1, Issue 68)					
Waste Management Impacts					
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 77-85)	SMALL – Adopting by reference Category 1 issue finding (Table A-1, Issue 87)	SMALL – radioactive wastes would be similar to those associated with the continued operation of HCGS (Section 7.2.2.3)	MODERATE – 191,000 metric tons (131,000 tons) of coal ash and 74,600 metric tons (82,300 tons) of scrubber sludge annually would require 26 hectares (65 acres) over a 20-year period. (Section 7.2.2.2)	SMALL – The only noteworthy waste would be from spent selective catalytic reduction (SCR) used for NO_X control. (Section 7.2.2.1)	SMALL to MODERATE – Adopting by reference GEIS description of waste management impacts from alternate technologies (NRC 1996b)
Aesthetic Impacts					
SMALL – Adopting by reference Category 1 issue findings (Table A-1, Issues 73, 74)	SMALL – Not an impact evaluated by GEIS (NRC 1996b)	SMALL – Visual impacts would be comparable to those from existing HCGS facilities (Section 7.2.2.3)	SMALL – Visual impacts would be consistent with the industrial nature of the site. (Section 7.2.2.2)	SMALL– Steam turbines and stacks would create visual impacts comparable to those from existing HCGS facilities (Section 7.2.2.1)	SMALL to MODERATE – Adopting by reference GEIS description of aesthetic impacts from alternate technologies (NRC 1996b)

Table 8.0-2. Impacts Comparison Detail (Continued)

Proposed Action (License Renewal)	Base (Decommissioning)	No-Action Alternatives: With New Nuclear Power	No-Action Alternatives: With Coal-Fired Generation	No-Action Alternatives: With Gas-Fired Generation	No-Action Alternatives: With Purchased Power
Cultural Resource Impacts					
SMALL – SHPO consultation minimizes potential for impact (Section 4.19, Issue 71). Because the site is an artificial island made of dredge spoils, impacts to cultural resources are unlikely.	SMALL – Not an impact evaluated by GEIS (NRC 1996b)	SMALL – Impacts to cultural resources would be unlikely due to developed nature of the site. (Section 7.2.2.3)	SMALL – Impacts to cultural resources would be unlikely due to developed nature of the site. (Section 7.2.2.2)	SMALL – Impacts to cultural resources would be unlikely due to developed nature of the site. (Section 7.2.2.1)	SMALL – Adopting by reference GEIS description of cultural resource impacts from alternate technologies (NRC 1996b)

SMALL - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource.
LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource (10 CFR 51, Subpart A, Appendix B, Table B 1, Footnote 3).
[a]. All TSP for gas-fired alternative is PM-2.5.

Btu = British thermal unit
ft^3 = cubic foot
gal = gallon
GEIS = Generic Environmental Impact Statement (NRC 1996)
kWh = kilowatt-hour
lb = pound
m^3 = cubic meter
MM = million
MW = megawatt
NO_X = nitrogen oxide
PJM = regional electric distribution network
$PM_{2.5}$ = particulates having diameter less than 2.5 microns
PM_{10} = particulates having diameter less than 10 microns
SHPO = State Historic Preservation Officer
SO_X = sulfur dioxide
TSP = total suspended particulates
yr = year

Chapter 9

Status of Compliance

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9.1 Proposed Action

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> **"The environmental report shall list all federal permits, licenses, approvals and other entitlements which must be obtained in connection with the proposed action and shall describe the status of compliance with these requirements. The environmental report shall also include a discussion of the status of compliance with applicable environmental quality standards and requirements including, but not limited to, applicable zoning and land-use regulations, and thermal and other water pollution limitations or requirements which have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection." 10 CFR 51.45(d), as adopted by 10 CFR 51.53(c)(2)**

9.1.1 GENERAL

Table 9.1-1 lists environmental authorizations PSEG has obtained for current HCGS operations. In this context, PSEG uses "authorizations" to include any permits, licenses, approvals, or other entitlements. PSEG expects to continue renewing these authorizations, where appropriate, during the current license period and throughout the period of extended operation associated with renewal of the HCGS operating license. Because the NRC regulatory focus is prospective, Table 9.1-1 does not include authorizations that PSEG obtained for past activities that did not include continuing obligations.

Preparatory to applying for renewal of the HCGS license to operate, PSEG conducted an assessment to identify any new and significant environmental information (Chapter 5). The assessment included interviews with subject experts, review of HCGS environmental documentation, and communication with state and federal environmental protection agencies. Based on this assessment, PSEG concludes that HCGS is in substantive compliance with applicable environmental standards and requirements. Minor deviations from applicable standards or requirements are corrected, and notification is provided to regulatory agencies, as required. For example, HCGS identified an error in an emission factor in the Air Operating Permit, which would cause emissions to be calculated in excess of the limitation. PSEG immediately terminated operation of the equipment and worked with NJDEP to obtain an Administrative Consent Order allowing continued operation of the equipment pending a modification to the Air Operating Permit. The Air Operating Permit modification was received in May 2009, and actions are in progress to terminate the Administrative Consent Order.

Table 9.1-2 lists additional environmental authorizations and consultations related to NRC renewal of the HCGS license to operate. As indicated, PSEG anticipates needing relatively few such authorizations and consultations. Sections 9.1.2 through 9.1.4 discuss some of these items in more detail.

9.1.2 THREATENED OR ENDANGERED SPECIES

Section 7 of the Endangered Species Act (16 USC 1531 et seq.) requires federal agencies to ensure that agency action is not likely to jeopardize the continued existence of any species that is listed, or proposed for listing, as endangered or threatened. Depending on the action involved, the Act requires consultation with the USFWS regarding effects on non-marine species, and with NMFS for marine species, or both. USFWS and NMFS have issued joint procedural regulations at Title 50 in the Code of Federal Regulations (CFR), Part 402, Subpart B, that address consultation, and USFWS maintains the joint list of threatened or endangered species at 50 CFR 17.

Although not required of an applicant by federal law or NRC regulation, PSEG has chosen to invite comment from federal and state agencies regarding potential effects that HCGS license renewal might have. Appendix C includes copies of PSEG correspondence with USFWS, NMFS, and NJDEP and replies that have been received. In 1993, NMFS issued a biological opinion that the continued operation of HCGS would not jeopardize threatened or endangered aquatic species (NMFS 1993). NMFS reviewed that opinion in 1999 and found that HCGS does not jeopardize any threatened or endangered aquatic species (NMFS 1999b).

9.1.3 HISTORIC PRESERVATION

Section 106 of the National Historic Preservation Act (16 USC 470 et seq.) requires federal agencies having the authority to license any undertaking to, prior to issuing the license, take into account the effect of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation an opportunity to comment on the undertaking. Advisory Council regulations provide for the State Historic Preservation Officer (SHPO) to have a consulting role (35 CFR 800.2). Although not required of an applicant by federal law or NRC regulation, PSEG has chosen to invite comment on the proposed license renewal for HCGS by the New Jersey and Delaware SHPOs. Appendix D contains a copy of PSEG's letter to the New Jersey and Delaware SHPOs and the SHPO responses that have been received.

9.1.4 WATER QUALITY (401) CERTIFICATION

Federal Clean Water Act Section 401 requires an applicant seeking a federal license for an activity that may result in a discharge to navigable waters to provide the licensing agency with a certification by the state where the discharge would originate indicating that applicable state water quality standards will not be violated as a result of the discharge (33 USC 1341). HCGS's 401 Certification is provided in Appendix F. The NRC indicated in its Generic Environmental Impact Statement for License Renewal that issuance of an NPDES permit by a state implies continued Section 401 certification by the state (NRC 1996b, Section 4.2.1.1). Section 402(b) of the Clean Water Act provides that the Governor of any State can apply to the Administrator of the Environmental Protection Agency to administer the NPDES Program in the State. On April 13, 1982, the New Jersey State NJPDES Permit Program, Pretreatment Program, and State regulation of Federal facilities were approved by the EPA. The incorporated rules at N.J.A.C. 7:14A were adopted March 6, 1981, giving the State of New Jersey authorization to implement the NPDES permitting program. Accordingly, as evidence of continued Section 401 certification by New Jersey, PSEG is providing the existing HCGS NJPDES permit (NJ0025411) (included in Appendix B). In addition, the cover letter to the NJDEP dated October 18, 2007, transmitting the application for renewal of the permit, and NJDEP's acknowledgment of receipt for the application is also provided in Appendix B. Issuance of the renewed permit remains pending. Because the NJPDES permit was filed in a timely manner, HCGS continues to operate under an authorized administratively continued permit.

9.1.5 COASTAL ZONE MANAGEMENT PROGRAM COMPLIANCE

The federal Coastal Zone Management Act (16 USC 1451 et seq.) imposes requirements on applicants for a federal license to conduct an activity that could affect a state's coastal zone. HCGS, located in Salem County, is within the New Jersey Coastal Management Area (NJDEP 2007c). Therefore, a determination is necessary from the NJDEP Land Use Regulation Program that the proposed NRC license renewal is consistent with New Jersey's Coastal Management Program. The certification package prepared by PSEG, which provides the basis for the required determination, has been prepared and submitted to the NJDEP Land Use Regulation Program at the time of submittal of this application in accordance with applicable regulations.

HCGS is not within the Delaware Coastal Management Area.

Table 9.1-1 Authorizations for Current HCGS Operations

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
U. S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011, et seq.), 10 CFR 50.10	License to operate	NPF-57	Issued: 4/11/1986 Expires: 4/11/2026	Operation of HCGS
U. S. Army Corps of Engineers	33 CFR 330	Nationwide Permit	CENAP-OP-R-2006-6232-45	Issued: 7/14/2008 Expires: 7/14/2010	Maintenance Dredging
U. S. Department of Transportation	49 CFR Part 107, Subpart G, 49 U.S.C. 5108	Certificate of Registration	US DOT ID 997370 061908 002 018QS	Issued: 7/1/2008 Expires: 6/30/2011	Hazardous Material Registration Statement
Delaware River Basin Commission	Delaware River Basin Compact, Section 3.8	Groundwater Allocation Permit	D-90-71	Issued: 11/15/2000 Expires: 11/15/2010	Ground-water withdrawal of up to 43.2 million gallons/month (30-days) and 300 million gallons/year
Delaware River Basin Commission	Delaware River Basin Compact, Section 3.8	Surface Water Permit	DRBC Docket No. D-73-193 CP (Revised)	Issued: 4/27/1984 Expires: None	Construction and operation of HCGS
Delaware River Basin Commission	Delaware River Basin Compact (DRBC) Resolutions Nos. 71-4 and 71-4	Water Use Contract	84-9-E-741	Issued: 12/12/1984 Expires: None	Water Use contract for Delaware River water withdrawal in compliance with D-73-193 CP
Delaware River Basin Commission	Delaware River Basin Compact, Section 3.8	Oxygen Demand Wasteload Allocation	D-85-60	Issued: 3/3/1986 Expires: None	Allocation for First Stage Oxygen Demand discharge to Delaware Estuary
Delaware River Basin Commission	Delaware River Basin Compact, Section 3.8	Sewage Treatment Plant	D-87-70	Issued: 11/2/1987 Expires: None	Installation of new Sewage Treatment Plant

Table 9.1-1 Authorizations for Current HCGS Operations (Continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
U.S. Department of Commerce, National Oceanic and Atmospheric Administration, and National Marine Fisheries Service	Section 7 of the Endangered Species Act of 1973 (16 USC 1531-1544)	Incidental Take Statement - sea turtles and shortnose sturgeon	NA	Issued: 5/14/1993 Amended: 1/21/1999 Expires: None	Possession and disposition of impinged or stranded sea turtles and shortnose sturgeon
New Jersey Department of Environmental Protection	Clean Water Act (33 USC 1251 et seq.), NJ Statutes Annotated (N.J.S.A.) Water Pollution Control Act 58:10A et seq. and N. J. Administrative Code (N.J.A.C.)7:14A et seq.	Hope Creek New Jersey Pollutant Discharge Elimination System Permit – Surface Water	NJ0025411	Issued: 12/31/2003 Effective: 3/1/2003 Expires: 2/29/08 Administratively continued while current application is being reviewed.	Wastewater (industrial surface water, thermal surface water and stormwater runoff) discharges to Delaware River.
New Jersey Department of Environmental Protection	New Jersey Water Supply Management Act, N.J.S.A. 58:1A-1 et seq.	Water Allocation Permit for Salem and HCGS	Activity No: WAP040001 Program Interest ID: 2216P	Issued: 12/30/2004 Effective: 1/1/2005 Expires: 1/31/2010	Ground-water withdrawal of up to 43.2 million gallons/month (30 days) and 300 million gallons/year
New Jersey Department of Environmental Protection	Clean Air Act (42 USC 7401)	Air Pollution Control Operating Permit (Title V Operating Permit)	BOP080001	Issued: 2/2/2005 Modified: 3/26/09 Expires: 2/1/2010	Air emissions from all sources
New Jersey Department of Environmental Protection	N.J.S.A. 23:8A-1 and N.J.S.A. 13:8A-1 et seq	Grant of Permanent Right-of-Way	None	Issued: 11/4/1971 Expires: None	Transmission Corridor

Table 9.1-1 Authorizations for Current Hope Creek Operations (Continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
New Jersey Department of Environmental Protection	N.J.A.C., Title 7, Chapter 1E (NJAC 7:1E-1 et seq.)	Discharge Prevention, Containment, and Countermeasure (DPCC) Plan and Discharge Cleanup and Removal (DCR) Plan	107040041000	Issued: 3/4/2009 Expires: 7/27/2011	DPCC/DCR Program: Discharge Prevention, Containment and Countermeasure Plan; Discharge Cleanup and Removal Plan; Spill Prevention, Control and Countermeasure Plan; Hazardous Waste Contingency Plan; Stormwater Pollution Prevention Plan; Core Plan
New Jersey Department of Environmental Protection	Safe Drinking Water Act	Public Water Supply Identification Number	1704300	Issued: 9/14/1980 Expires: None	Water quality data input into compliance database
New Jersey Department of Environmental Protection	N.J.A.C. 7:26-38.8	Medical Waste Generator Certificate	34571	Issued: 8/14/1992 Expires: Renewed annually	Generation of regulated medical waste
New Jersey Department of Environmental Protection	N.J.S.A. 13:19-1	Coastal Areas Facility Review Act (CAFRA) Permit	1704-02-0001.3 CAF 040001	Issued: 9/23/2004 Expires: 9/23/2009	Land use associated with the construction of DM Plant

Table 9.1-1 Authorizations for Current Hope Creek Operations (Continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
New Jersey Department of Environmental Protection	N.J.S.A. 13:19-1, 13:9B-1 and 13:1D-1	CAFRA Permit	1704-02-0001.4 CAF 050003	Issued: 12/1/2005 Expires: 12/1/2010	Land use associated with the construction of NAB Parking Lot
New Jersey Department of Environmental Protection	N.J.S.A. 13:19-1, 13:9B-1 and 13:1D-1	Freshwater Wetlands (FWW) Permit	1704-02-0001.4 FWW 050002	Issued: 12/1/2005 Expires: 12/1/2010	Land use associated with the construction of NAB Parking Lot
New Jersey Department of Environmental Protection	N.J.S.A. 12:5-1, 13:19-1, 13:9B-1 and 13:1D-1	CAFRA Permit	1704-02-0001.4 CAF 050002	Issued: 8/16/2005 Expires: 8/16/2010	Land use associated with the construction of Security Vehicle Barrier System
New Jersey Department of Environmental Protection	N.J.S.A. 12:5-1, 13:19-1, 13:9B-1 and 13:1D-1	FWW Permit	1704-02-0001.4 FWW 050001	Issued: 8/16/2005 Expires: 8/16/2010	Land use associated with the construction of Security Vehicle Barrier System
New Jersey Department of Environmental Protection	N.J.S.A. 12:5-1, 13:19-1, 13:9B-1 and 13:1D-1	FWW Permit	1704-02-0001.4 FWW 050002	Issued: 8/16/2005 Expires: 8/16/2010	Land use associated with the construction of Security Vehicle Barrier System
New Jersey Department of Environmental Protection	N.J.S.A. 12:5-1, 13:19-1, 13:9B-1 and 13:1D-1	Waterfront Development Permit	1704-02-0001.4 WFD 050001	Issued: 8/16/2005 Expires: 8/16/2010	Land use associated with the construction of Security Vehicle Barrier System
New Jersey Department of Environmental Protection	N.J.A.C. 13:19-1 et seq.	CAFRA Permit	74-014	Issued: 9/3/1975 Expires: None	Land use associated with HCGS

Table 9.1-1 Authorizations for Current Hope Creek Operations (Continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
New Jersey Department of Environmental Protection	N.J.A.C. 7: 1C-1.5 (C) and 7:7-4.10,	CAFRA Permit	1704-90-0014-5-CAM	Issued: 4/25/1995 Expires: None	Land use associated with Sandblast Facility Modifications
New Jersey Department of Environmental Protection	N.J.A.C. 13: 9A-4	Type "B" Wetlands Permit	W74-02	Issued: 2/28/1975 Extended: 8/19/1995 Expires: None	Construction of HCGS
U.S. Environmental Protection Agency	RCRA, Section 3010	Acknowledgement of Notification of Hazardous Waste Activity	NJD077070811	Acknowledged: 9/13/1989 Expires: None	Hazardous Waste Generation
U.S. Environmental Protection Agency	USEPA FRP (40 CFR 9 and 112), and the USEPA Hazardous Waste Contingency Plan (40 CFR 265 Subparts C and D)	Facility Response Plan Approval	0200087	Submitted: 2/15/2008	Spill/Discharge Response Program
U.S. Environmental Protection Agency	Spill Prevention, Control, and Countermeasure (SPCC) rule (40 CFR 112), Appendix F, Sections 1.2.1 and 1.2.2	SPCC Plan		Submitted: 2/15/2008	Spill/Discharge Prevention Plan
Lower Alloways Creek Township	Lower Alloways Creek Township Code, Land Development Chapter, Section 5.07B2	Conditional Use Approval/Preliminary Site Plan Approval	SP-1-04	Issued: 5/26/2004 Expires: 5/26/2009	Construction of ISFSI Facility and Temporary Storage of Spent Nuclear Fuels
Lower Alloways Creek Township	Lower Alloways Creek Township Code	Preliminary and Final Site Plan Approval	SP-1-05	Issued: 5/25/2005 Expires: None	Operating a Shooting Range

Table 9.1-1 Authorizations for Current Hope Creek Operations (Continued)

Agency	Authority	Requirement	Number	Issue or Expiration Date	Activity Covered
Lower Alloways Creek Township	Lower Alloways Creek Township Code	Preliminary and Final Site Plan Approval	SP-2-05	Issued: 8/24/2005 Expires: None	Improvements to Employee Parking Lots B & C
South Carolina Department of Health and Environmental Control – Division of Waste Management	South Carolina Radioactive Waste Transportation and Disposal Act (Act No. 429)	South Carolina Radioactive Waste Transport Permit	0018-29-09-X	Issued: 10/23/2008 Expires: 12/31/2009	Transportation of radioactive waste into the State of South Carolina
State of Tennessee Department of Environment and Conservation Division of Radiological Health	Tennessee Department of Environment and Conservation Rule 1200-2-10.32	Tennessee Radioactive Waste License-for-Delivery	T-NJ002-L09	Issued: 10/28/2008 Expires: 12/31/2009	Transportation of radioactive waste into the State of Tennessee into the State of Virginia

Table 9.1-2 Authorizations for Hope Creek License Renewal[a]

Agency	Authority	Requirement	Remarks
U.S. Nuclear Regulatory Commission	Atomic Energy Act (42 USC 2011 et seq.)	License renewal	Environmental Report submitted in support of license renewal application
U.S. Fish and Wildlife Service	Endangered Species Act Section 7 (16 USC 1536)	Consultation	Requires federal agency issuing a license to consult with the U.S. Fish and Wildlife Service if there is reason to believe that an endangered or threatened species may be present in the area and that implementation of such action will likely affect such species (Appendix C)
New Jersey Department of Environmental Protection	Clean Water Act Section 401 (33 USC 1341)	Certification	State issuance of NPDES permit (Section 9.1.5) constitutes 401 certification (Appendix B)
New Jersey Department of Environmental Protection, Land Use Regulations	Federal Coastal Zone Management Act (16 USC 1452 et seq.)	Certification	Requires the federal agency issuing the license (NRC) to verify that the State of New Jersey has determined that renewal of HCGS operating license would be consistent with the federally approved State Coastal Zone Management program. The applicant (PSEG) has requested the consistency determination from the NJDEP by submitting a certification of consistency for review.
New Jersey Department of Environmental Protection, Division of Parks and Forestry	National Historic Preservation Act Section 106 (16 USC 470f)	Consultation	Requires the federal agency issuing a license to consider cultural impacts and consult with State Historic Preservation Officer (SHPO). SHPO must concur that license renewal will not affect any sites listed or eligible for listing on the National Register of Historic Places (Appendix D)

a. No renewal-related requirements identified for local or other agencies.

9.2 Alternatives

NRC

> **"…The discussion of alternatives in the report shall include a discussion of whether the alternatives will comply with such applicable environmental quality standards and requirements." 10 CFR 51.45(d), as required by 10 CFR 51.53(c)(2)**

The coal, gas, and purchased power alternatives discussed in Section 7.2 probably could be constructed and operated to comply with applicable environmental quality standards and requirements. PSEG notes that increasingly stringent air quality protection requirements could make the construction of a large fossil-fueled power plant infeasible in many locations. PSEG also notes that the EPA has revised its requirements for design and operation of cooling water intake structures at new and existing facilities (40 CFR 125 Subparts I and J). These requirements could necessitate construction of cooling towers for the coal- and gas-fired alternatives.

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Chapter 10

References

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Appendix A

NRC NEPA Issues for License Renewal of Nuclear Power Plants

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PSEG has prepared this environmental report in accordance with the requirements of U.S. Nuclear Regulatory Commission (NRC) regulation 10 CFR 51.53. NRC included in the regulation a list of National Environmental Policy Act (NEPA) issues for license renewal of nuclear power plants.

Table A-1 lists these 92 issues and identifies the section in which PSEG addressed each applicable issue in this environmental report. For organization and clarity, PSEG has assigned a number to each issue and uses the issue numbers throughout the environmental report.

Table A-1. HCGS Environmental Report Discussion of License Renewal NEPA Issues[a]

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
Surface Water Quality, Hydrology, and Use (for all plants)			
1. Impacts of refurbishment on surface water quality	1	NA	Issue applies to an activity, refurbishment, that HCGS has no plans to undertake.
2. Impacts of refurbishment on surface water use	1	NA	Issue applies to an activity, refurbishment, that HCGS has no plans to undertake.
3. Altered current patterns at intake and discharge structures	1	4 Introduction	4.2.1.2.1/4-5
4. Altered salinity gradients	1	4 Introduction	4.2.1.2.2/4-4
5. Altered thermal stratification of lakes	1	NA	Issue applies to a plant feature, discharge to a lake, that HCGS does not have.
6. Temperature effects on sediment transport capacity	1	4 Introduction	4.2.1.2.3/4-8
7. Scouring caused by discharged cooling water	1	4 Introduction	4.2.1.2.3/4-6
8. Eutrophication	1	4 Introduction	4.2.1.2.3/4-9
9. Discharge of chlorine or other biocides	1	4 Introduction	4.2.1.2.4/4-10
10. Discharge of sanitary wastes and minor chemical spills	1	4 Introduction	4.2.1.2.4/4-10
11. Discharge of other metals in waste water	1	4 Introduction	4.2.1.2.4/4-10
12. Water use conflicts (plants with once-through cooling systems)	1	NA	Issue applies to a plant feature, once-through cooling that HCGS does not have.
13. Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow)	2	NA, and discussed in Section 4.1	Issue applies to a plant feature, cooling towers using make-up water from a small river, that HCGS does not have.
Aquatic Ecology (for all plants)			
14. Refurbishment impacts to aquatic resources	1	NA	Issue applies to an activity, refurbishment, that HCGS has no plans to undertake.
15. Accumulation of contaminants in sediments or biota	1	4 Introduction	4.2.1.2.4/4-10
16. Entrainment of phytoplankton and zooplankton	1	4 Introduction	4.2.2.1.1/4-15
17. Cold shock	1	4 Introduction	4.2.2.1.5/4-18
18. Thermal plume barrier to migrating fish	1	4 Introduction	4.2.2.1.6/4-19

Table A-1. HCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
19. Distribution of aquatic organisms	1	4 Introduction	4.2.2.1.6/4-19
20. Premature emergence of aquatic insects	1	4 Introduction	4.2.2.1.7/4-20
21. Gas supersaturation (gas bubble disease)	1	4 Introduction	4.2.2.1.8/4-21
22. Low dissolved oxygen in the discharge	1	4 Introduction	4.2.2.1.9/4-23
23. Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses	1	4 Introduction	4.2.2.1.10/4-24
24. Stimulation of nuisance organisms (e.g., shipworms)	1	4 Introduction	4.2.2.1.11/4-25
Aquatic Ecology (for plants with once-through and cooling pond heat dissipation systems)			
25. Entrainment of fish and shellfish in early life stages for plants with once-through and cooling pond heat dissipation systems	2	NA, and discussed in Section 4.2	Issue applies to a plant feature, once-through cooling or a cooling pond, that HCGS does not have.
26. Impingement of fish and shellfish for plants with once-through and cooling pond heat dissipation systems	2	NA, and discussed in Section 4.3	Issue applies to a plant feature, once-through cooling or a cooling pond, that HCGS does not have.
27. Heat shock for plants with once-through and cooling pond heat dissipation systems	2	NA, and discussed in Section 4.4	Issue applies to a plant feature, once-through cooling or a cooling pond, that HCGS does not have.
Aquatic Ecology (for plants with cooling-tower-based heat dissipation systems)			
28. Entrainment of fish and shellfish in early life stages for plants with cooling-tower-based heat dissipation systems	1	4 Introduction	4.3.3/4-33
29. Impingement of fish and shellfish for plants with cooling-tower-based heat dissipation systems	1	4 Introduction	4.3.3/4-33
30. Heat shock for plants with cooling-tower-based heat dissipation systems	1	4 Introduction	4.3.3/4-33
Groundwater Use and Quality			
31. Impacts of refurbishment on groundwater use and quality	1	NA	Issue applies to an activity, refurbishment, that HCGS has no plans to undertake.

Table A-1. HCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
32. Groundwater use conflicts (potable and service water; plants that use < 100 gpm)	1	NA	Issue applies to an activity, using less than 100 gpm of groundwater, that HCGS does not do.
33. Groundwater use conflicts (potable, service water, and dewatering; plants that use > 100 gpm)	2	4.5	4.8.1.1/4-116 and 4.8.2.1/4-118
34. Groundwater use conflicts (plants using cooling towers withdrawing make-up water from a small river)	2	NA, and discussed in Section 4.6	Issue applies to a plant feature, cooling towers withdrawing make-up water from a small river, that HCGS does not have.
35. Groundwater use conflicts (Ranney wells)	2	NA, and discussed in Section 4.7	Issue applies to a plant feature, Ranney wells, that HCGS does not have.
36. Groundwater quality degradation (Ranney wells)	1	NA	Issue applies to a feature, Ranney wells, that HCGS does not have.
37. Groundwater quality degradation (saltwater intrusion)	1	4 Introduction	4.8.2/4-118
38. Groundwater quality degradation (cooling ponds in salt marshes)	1	NA	Issue applies to a feature, cooling ponds, that HCGS does not have.
39. Groundwater quality degradation (cooling ponds at inland sites)	2	NA, and discussed in Section 4.8	Issue applies to a feature, cooling ponds, that HCGS does not have.
Terrestrial Resources			
40. Refurbishment impacts to terrestrial resources	2	NA, and discussed in Section 4.9	Issue applies to an activity, refurbishment, that HCGS has no plans to undertake.
41. Cooling tower impacts on crops and ornamental vegetation	1	NA	Issue applies to a feature, mechanical draft cooling towers, which HCGS does not have.
42. Cooling tower impacts on native plants	1	NA	Issue applies to a feature, mechanical draft cooling towers, which HCGS does not have.
43. Bird collisions with cooling towers	1	4 Introduction	4.3.5.2/4-45
44. Cooling pond impacts on terrestrial resources	1	NA	Issue applies to a feature, cooling ponds, that HCGS does not have.

Table A-1. HCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
45. Power line right-of-way management (cutting and herbicide application)	1	4 Introduction	4.5.6.1/4-71
46. Bird collisions with power lines	1	4 Introduction	4.5.6.2/4-74
47. Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	1	4 Introduction	4.5.6.34-77
48. Floodplains and wetlands on power line right-of-way	1	4 Introduction	4.5.7.7/4-81
Threatened or Endangered Species (for all plants)			
49. Threatened or endangered species	2	4.10	4.1/4-1
Air Quality			
50. Air quality during refurbishment (non-attainment and maintenance areas)	2	NA, and discussed in Section 4.11	Issue applies to an activity, refurbishment, that HCGS does not plan to undertake.
51. Air quality effects of transmission lines	1	4 Introduction	4.5.2/4-62
Land Use			
52. Onsite land use	1	4 Introduction	3.2/3-1
53. Power line right-of-way land use impacts	1	4 Introduction	4.5.3/4-62
Human Health			
54. Radiation exposures to the public during refurbishment	1	NA	Issue applies to an activity, refurbishment, that HCGS has no plans to undertake.
55. Occupational radiation exposures during refurbishment	1	NA	Issue applies to an activity, refurbishment, that HCGS has no plans to undertake.
56. Microbiological organisms (occupational health)	1	4 Introduction	4.3.6/4-48
57. Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river)	2	NA, and discussed in Section 4.12	Issue applies to plant features, cooling ponds or , canals that discharge to a small river, that HCGS does not have.
58. Noise	1	4 Introduction	4.3.7/4-49
59. Electromagnetic fields, acute effects	2	4.13	4.5.4.1/4-66
60. Electromagnetic fields, chronic effects	NA	4 Introduction	
61. Radiation exposures to public (license renewal term)	1	4 Introduction	4.6.2/4-87

Table A-1. HCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
62. Occupational radiation exposures (license renewal term)	1	4 Introduction	4.6.3/4-95
Socioeconomics			
63. Housing impacts	2	4.14	3.7.2/3-10 (refurbishment - not applicable to HCGS) 4.7.1/4-101 (renewal term)
64. Public services: public safety, social services, and tourism and recreation	1	4 Introduction	Refurbishment (not applicable to HCGS) Renewal Term 4.7.3/4-104 (public safety) 4.7.3.3/4-106 (safety) 4.7.3.44-107 (social) 4.7.3.6/4-107 (tourism, recreation)
65. Public services: public utilities	2	4.15	3.7.4.5/3-19 (refurbishment - not applicable to HCGS) 4.7.3.5/4-107 (renewal term)
66. Public services: education (refurbishment)	2	NA, and discussed in Section 4.16	Issue applies to an activity, refurbishment, that HCGS does not plan to undertake.
67. Public services: education (license renewal term)	1	4 Introduction	4.7.3.1/4-106
68. Offsite land use (refurbishment)	2	NA, and discussed in Section 4.17.1	Issue applies to an activity, refurbishment, that HCGS does not plan to undertake.
69. Offsite land use (license renewal term)	2	4.17.2	4.7.4/4-107
70. Public services: transportation	2	4.18	3.7.4.2/3-17 (refurbishment - not applicable to HCGS) 4.7.3.2/4-106 (renewal term)
71. Historic and archaeological resources	2	4.19	3.7.7/3-23 (refurbishment - not applicable to HCGS) 4.7.7/4-114 (renewal term)
72. Aesthetic impacts (refurbishment)	1	NA	Issue applies to an activity, refurbishment, that HCGS has no plans to undertake.
73. Aesthetic impacts (license renewal term)	1	4 Introduction	4.7.6/4-111
74. Aesthetic impacts of transmission lines (license renewal term)	1	4 Introduction	4.5.8/4-83

Table A-1. HCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
Postulated Accidents			
75. Design basis accidents	1	4 Introduction	5.3.2/5-11 (design basis) 5.5.1/5-114 (summary)
76. Severe accidents	2	4.20	5.3.3/5-12 (probabilistic analysis) 5.3.3.2/5-19 (air dose) 5.3.3.3/5-49 (water) 5.3.3.4/5-65 (groundwater) 5.3.3.5/5-95 (economic) 5.4/5-106 (mitigation) 5.5.2/5-114 (summary)
Uranium Fuel Cycle and Waste Management			
77. Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste)	1	4 Introduction	6.2/6-8
78. Offsite radiological impacts (collective effects)	1	4 Introduction	Not in GEIS.
79. Offsite radiological impacts (spent fuel and high-level waste disposal)	1	4 Introduction	Not in GEIS.
80. Nonradiological impacts of the uranium fuel cycle	1	4 Introduction	6.2.2.6/6-20 (land use) 6.2.2.7/6-20 (water use) 6.2.2.8/6-21 (fossil fuel) 6.2.2.9/6-21 (chemical)
81. Low-level waste storage and disposal	1	4 Introduction	6.4.2/6-36 (low-level def) 6.4.3/6-37 (low-level volume) 6.4.4/6-48 (renewal effects)
82. Mixed waste storage and disposal	1	4 Introduction	6.4.5/6-63
83. Onsite spent fuel	1	4 Introduction	6.4.6/6-70
84. Nonradiological waste	1	4 Introduction	6.5/6-86
85. Transportation	1	4 Introduction	6.3/6-31, as revised by Addendum 1, August 1999.
Decommissioning			
86. Radiation doses (decommissioning)	1	4 Introduction	7.3.1/7-15
87. Waste management (decommissioning)	1	4 Introduction	7.3.2/7-19 (impacts) 7.4/7-25 (conclusions)
88. Air quality (decommissioning)	1	4 Introduction	7.3.3/7-21 (air) 7.4/7-25 (conclusions)
89. Water quality (decommissioning)	1	4 Introduction	7.3.4/7-21 (water) 7.4/7-25 (conclusions)

Table A-1. HCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)

Issue	Category	Section of this Environmental Report	GEIS Cross Reference[b] (Section/Page)
90. Ecological resources (decommissioning)	1	4 Introduction	7.3.5/7-21 (ecological) 7.4/7-25 (conclusions)
91. Socioeconomic impacts (decommissioning)	1	4 Introduction	7.3.7/7-19 (socioeconomic) 7.4/7-24 (conclusions)
Environmental Justice			
92. Environmental justice	NA	2.6.2	

a. Source: 10 CFR 51, Subpart A, Appendix A, Table B-1. (Issue numbers added to facilitate discussion.)

b. Source: Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437).