CHAPTER 9

ALTERNATIVES

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ACRONYMS AND ABBREVIATIONS

Acronym	Definition
7Q10	7-day, 10-year low flow
ABWR	Advanced Boiling Water Reactor
ac.	acre
AP1000	Advanced Passive 1000
APWR	U.S. Advanced Pressurized Water Reactor
BMPs	best management practices
Btu	British thermal unit
CAES	compressed air energy storage
CCS	carbon capture and storage
CCW	coal combustion wastes
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO_2	carbon dioxide
COD	commercial operating date
COLA	combined license application
COL	combined license
CSP	concentrated solar power
CWS	circulating water system
dBA	A-weighted decibel
DOE	U.S. Department of Energy
DR	Demand Response
DRBC	Delaware River Basin Commission

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
DSM	demand side management
EA	Environmental Assessment
EE	Energy Efficiency
EIA	Energy Information Administration
EIF	equivalent impact factor
EMAAC	Eastern Mid-Atlantic Area Council
EPACT	Energy Policy Act of 2005
ER	Environmental Report
EPA	U.S. Environmental Protection Agency
EPR	U.S. Evolutionary Power Reactor
ESP	Early Site Permit
ESRI	Environmental Systems Research Institute
FERC	Federal Energy Regulatory Commission
FRA	Federal Railroad Administration
ft.	feet
GEIS	Generic Environmental Impact Statement
GIS	geographic information system
gpm	gallons per minute
GWh	gigawatt hour(s)
HCGS	Hope Creek Generating Station
IGCC	integrated gasification combined cycle
kV	kilovolt(s)

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
LMP	locational marginal prices
LOS	level of service
LULC	Land Use/Land Cover
MAPP	Mid-Atlantic Power Project
MGD	million gallons per day
MSW	municipal solid waste
MW	megawatt
MWe	megawatt electric
MWt	megawatt thermal
mi.	mile
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NJBPU	New Jersey Board of Public Utilities
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
NJEMP	New Jersey Energy Master Plan
NJHPO	New Jersey Historic Preservation Office
NJPDES	New Jersey Pollutant Discharge Elimination System
NJRHP	New Jersey Register of Historic Places
NOx	nitrogen oxide
NRC	U.S. Nuclear Regulatory Commission

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
OPEC	Organization of the Petroleum Exporting Countries
PECO	PECO Energy Co.
PJM	PJM Interconnection, LLC
PM	particulate matter
PSEG	PSEG Power, LLC and PSEG Nuclear, LLC
PSE&G	Public Service Electric and Gas
PV	photovoltaic
RCRA	Resource Conservation and Recovery Act
RG	regulatory guide
RGGI	Regional Greenhouse Gas Initiative
ROI	Region of Interest
ROW	right-of-way
RPM	Reliability Pricing Model
RSA	relevant service area
RTEP	regional transmission expansion plan
RTO	Regional Transmission Organization
SCR	selective catalytic reduction
SECA	Solid State Energy Conversion Alliance

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
SGS	Salem Generating Station
SMCRA	Surface Mining Control and Reclamation Act
SO_2	sulfur dioxide
SO_x	sulfur oxide
SWIS	service water intake structure
TES	thermal energy storage
USCB	U.S. Census Bureau
USGS	U.S. Geological Survey

CHAPTER 9

ALTERNATIVES

This chapter identifies and describes alternatives to siting, constructing, and operating the new plant at the PSEG Site, which is designed and operated as a baseload generator. The descriptions provide sufficient detail to facilitate evaluation of the impacts of the no-action alternative, energy alternatives, alternative sites, and alternative plant and transmission systems for the new plant proposed by PSEG Power, LLC and PSEG Nuclear, LLC (PSEG). The chapter is divided into four sections:

- No-Action Alternative (Section 9.1)

  Section 9.1 describes the environmental impact and energy consequences if an Early Site Permit (ESP) is not issued and the new plant is not constructed or operated.

- Energy Alternatives (Section 9.2)

  Section 9.2 examines the potential environmental impacts associated with alternatives to the construction of a new baseload nuclear generating facility.

- Alternative Sites (Section 9.3)

  Section 9.3 describes and evaluates alternative sites considered for the new plant.

- Alternative Plant and Transmission Systems (Section 9.4)

  Section 9.4 describes and evaluates plant and transmission system alternatives for the new plant.

9.1 NO-ACTION ALTERNATIVE

In this section, the No-Action Alternative is defined and the consequences of adopting the No-Action Alternative are described. The purpose of the ESP is to approve the site for eventual construction and operation of a nuclear power plant as a merchant generator to provide baseload power for sale on the wholesale market.

Under the No-Action Alternative, (1) the U.S. Nuclear Regulatory Commission (NRC) would not issue an ESP for the new plant at the PSEG Site, and (2) the construction and operation of the new plant would not occur. In accordance with NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan,* the No-Action Alternative presupposes that no other generating station, either nuclear or non-nuclear, would be constructed in place of the new plant. The No-Action Alternative also presupposes that no additional conservation measures beyond current levels would be enacted to decrease the amount of electrical capacity that would otherwise be required.

If the ESP is not issued and the new plant not built, the following benefits would not be realized:

- Resolution of siting and environmental issues before large investments of financial capital and human resources in new plant design and construction are made

- The ability to bank a site on which a nuclear plant may be located

- The need for power that could be met by the new plant would have to be met by means that involve no new generating capacity. This would result in the loss of up to 2200 megawatts electric (MWe) additional baseload generating capacity that the new plant will provide to the relevant service area (RSA), which is New Jersey (NJ). The RSA is where the majority of the power from the new plant is expected to be consumed.

Although the environmental impacts associated with construction and operation of the proposed plant would not occur under the No-Action Alternative, the following ancillary benefits of the new plant as described in Subsection 8.4.4 also would not occur:

- Reduces the amount of carbon dioxide (CO_2) generating imports needed to meet baseload demand in NJ

- Lowers locational marginal prices (LMP)[a] due to reduced generation from fossil fueled resources in NJ. Fossil fueled resources are projected to have increased generation costs due to costs associated with pending carbon legislation

- Reduces potential for transmission congestion

- Reduces emissions from fossil fueled generation in NJ and from imports

- Reduces reliance on imported petroleum to the extent that generation from oil-fired resources is reduced

- Increases the diversity of the NJ generation portfolio, which is currently comprised of 73 percent fossil fuel fired plants (Figure 8.3-1)

- Increases NJ reserve margins to improve the capability of generating resources within NJ to meet the summer peak load with less dependence on imports and their associated challenge to transmission congestion

The following paragraphs describe how selected federal, regional, state and corporate programs would be affected by the loss of the ancillary benefits of the new plant under the No Action Alternative.

PJM Interconnection, LLC, (PJM) is the regional transmission organization (RTO) that coordinates the movement of wholesale electricity and manages the high-voltage electric grid in NJ as part of a broader multi-state region. As discussed in Section 8.3, a number of factors continue to adversely impact system reliability in NJ. These factors include load growth, power

[a] Transmission constraints are relieved by dispatching higher cost units out of economic order to assure the reliability of the power grid in the congested area. LMPs are the cost of power where power is injected into or obtained from the transmission system, and reflect the higher cost of re-dispatched units. Higher LMPs ultimately result in higher prices to electricity customers.

exports to New York and Long Island, deactivation and retirement of existing generation facilities, modest development of new generation facilities, continued reliance on carbon-based imports to meet baseload needs and their resulting power flow challenges to bulk transmission facilities managed by PJM (Reference 9.1-1). The new plant at the PSEG Site improves system reliability by providing new baseload generation in NJ and reducing imports and their associated transmission, emissions and carbon challenges. These benefits are not realized under the No-Action Alternative.

Under the No-Action Alternative, the new plant would not be available to help avoid the economic, reliability, and environmental consequences of the business as usual scenario identified in the New Jersey Energy Master Plan (NJEMP). The NJEMP estimates that NJ will use 97,800 gigawatt hours (GWh) of electricity and 542 trillion British thermal units (Btu) of natural gas or heating oil in 2020 if no changes in energy supply and demand trends are made. This total energy consumption will cost consumers more than $30.7 billion in 2020, which is 96 percent more than the total annual energy expenditures in 2005. The NJEMP also indicates that if no changes in energy supply and demand trends are made, greenhouse gas emissions will increase, with CO_2 emissions totaling 84 million metric tons in 2020 (Reference 9.1-4). The new plant at the PSEG Site reduces LMPs and greenhouse gas emissions in NJ. These benefits are not realized under the No-Action Alternative.

If the No-Action Alternative is enacted, the current reliance on electricity produced by fossil-fueled generation would continue for the states participating in the Regional Greenhouse Gas Initiative (RGGI). The RGGI was developed by ten Northeast and Mid-Atlantic States to cap and then reduce power plant CO_2 emissions. New Jersey is one of the ten participating states. Under the RGGI agreement, states must stabilize CO_2 emissions from 2009 to 2014 and then reduce the emissions by 2.5 percent per year from 2015 to 2018 (10 percent total) (Reference 9.1-3).

Under the No-Action Alternative, the new plant would not be available to provide an alternative source of electric generation that produces almost none of the greenhouse gases subject to pending federal regulatory and legislative initiatives. The U.S. Environmental Projection Agency (EPA) has issued a finding that greenhouse gases contribute to air pollution that may endanger public health or welfare. This finding could result in regulations to reduce greenhouse gases under the Clean Air Act (Reference 9.1-6). In addition, the U.S. House of Representatives has passed the American Clean Energy and Security Act of 2009, which sets goals and establishes a cap-and-trade system for reductions in greenhouse gas emissions (Reference 9.1-5). Both the EPA finding and the House bill are indicative of an intention to require reductions in greenhouse gases. The new plant at the PSEG Site can replace generating sources that emit significant amounts of greenhouse gases affected by these initiatives, but would not be available under the No-Action Alternative.

PSEG currently is implementing several programs to reduce CO_2 emissions, one of the greenhouse gases subject to the EPA and House initiatives. PSEG has been pursuing a low-carbon business strategy since 1993, and voluntarily pledged to reduce its U.S. greenhouse gas emissions intensity by 18 percent from 2000 to 2008. It surpassed this goal by achieving a 31 percent reduction (Reference 9.1-2). Under the No-Action Alternative, PSEG would be less likely to meet its continuing CO_2 emissions reduction goals because of continued consumption of natural gas, heating oil and coal for electric generation. The construction of the new plant at the PSEG Site allows PSEG to further exceed its CO_2 emission reduction goals.

In summary, under the No-Action Alternative, the NRC does not issue an ESP, the construction and operation of the new plant at the PSEG Site would not occur, and the benefits of the ESP would not be realized. If the new plant were not constructed or operated, the environmental impacts associated with construction and operation would be avoided, but there would be negative consequences, including the loss of up to 2200 MWe additional baseload generating capacity and the loss of ancillary benefits of the new plant. The ancillary benefits described above that would not be realized include reduced electricity imports, reduced local transmission constraints resulting from imports, lower LMPs, reduced air pollution and CO_2 emissions. In addition, the avoidance of anticipated higher fossil-based generating costs in light of pending carbon legislation, reduced reliance on imported petroleum, increased diversity of generating resources, and increased reserve margins and improved system reliability in NJ would not occur.

9.1.1 REFERENCES

9.1-1 PJM Interconnection, LLC, "PJM 2008 Regional Transmission Expansion Plan," Section 6.1 – PJM Sub-Regional Key Issues, pg 113, February 27, 2009.

9.1-2 PSEG Media Centers, Press Release, "PSEG Exceeds EPA Climate Leaders Goal", July 23, 2009.

9.1-3 Regional Greenhouse Gas Initiative, About RGGI, website, http://www.rggi.org/about, accessed, September 16, 2009.

9.1-4 State of New Jersey, "New Jersey Energy Master Plan", October 2008, website, http://www.state.nj.us/emp/, accessed, November 9, 2009.

9.1-5 United States Congress, H.R.2425 American Clean Energy and Security Act of 2009, website, www.opencongress.org/bill/111-h2454/, accessed, November 16, 2009.

9.1-6 United States Environmental Protection Agency, Endangerment and Cause or Contribution Findings for Greenhouse Gases under the Clean Air Act, website, http://www.epa.gov/climatechange/endangerment.html, accessed, December 21, 2009.

9.2 ENERGY ALTERNATIVES

This section examines the potential environmental impacts associated with alternate ways to satisfy the purpose of the proposed action, which is to approve the site for eventual construction and operation of a nuclear power plant as a merchant generator to provide baseload power for sale on the wholesale market. This section is organized as follows

- Alternatives Not Requiring Generating Capacity (Subsection 9.2.1)

  This section assesses conservation (energy efficiency) programs, reactivation or life extension of existing plants in NJ, and purchasing power from other utilities or power generators outside of NJ.

- Alternatives Requiring New Generating Capacity (Subsection 9.2.2)

  This section assesses wind, geothermal, hydro, solar, biomass, petroleum liquids, fuel cells, coal, natural gas and Integrated Gasification Combined Cycle generation sources. Competitive alternatives are identified based on availability in the region, overall feasibility, ability to generate baseload power and environmental consequences.

- Assessment of Competitive Energy Alternatives and Systems (Subsection 9.2.3)

  Potentially competitive alternatives identified in Subsections 9.2.1 and 9.2.2 are assessed in further detail in Subsection 9.2.3.

9.2.1 ALTERNATIVES NOT REQUIRING NEW GENERATING CAPACITY

This subsection provides an assessment of the economic and technical feasibility of meeting the demand for energy without constructing new generating capacity. Alternatives considered in this section include the following:

- Initiating conservation measures
- Reactivating or extending the service life of existing plants within NJ
- Purchasing power from other utilities or power generators outside of NJ

As discussed in the following sections, none of these alternatives are potentially viable, and so are eliminated from further consideration.

9.2.1.1 Initiating Conservation Measures

Energy conservation measures and programs to reduce energy demand can be characterized as (1) energy efficiency programs, designed to permanently reduce the consumption of energy by residential, commercial and industrial users; (2) demand side management (DSM) programs, designed to reduce peak power demand by temporarily reducing load or by shifting peak period load to off-peak periods; and (3) distributed generation programs, designed to encourage the use of renewable technologies by end users to self-supply some of their electricity need. Subsection 8.2.2.2 provides a summary of the government and corporate programs that have been initiated to enact these programs.

The overall impact of these programs is not adequate to obviate the need for the new plant. The effect of these programs on future projections of power demand has been incorporated into PJM planning indirectly through the development of the load forecast and directly through the bidding of Energy Efficiency (EE) and Demand Response (DR) resources into the annual Reliability Pricing Model (RPM) auctions. As described in Subsection 8.2.1.1, PJM uses an econometric modeling approach to forecasting of future peak power demand and energy use. The effect of energy efficiency, DSM and distributed generation programs affect the forecast to the extent that the historical data used to develop the econometric model reflects the impact of the programs. As discussed in Section 8.3, the EE and DR resources that clear the RPM auction become part of the regional power supply and reduce the need for additional generation.

After including the impact of conservation programs, Subsection 8.4.2 shows 7900 MWe of additional baseload capacity is still needed by 2021, the expected year of commercial operation of the new plant at the PSEG Site. This means that conservation programs alone cannot replace the need for baseload capacity in NJ and therefore do not satisfy the purpose of the project. Accordingly, energy conservation is not a viable alternative to the construction of a merchant baseload generating facility, because it cannot reduce the use of electricity enough to eliminate the need for additional baseload capacity.

9.2.1.2 Reactivating or Extending Service Life of Existing Plants

This section discusses the alternative of reactivating plants that have been taken out of service, or of extending the service life of units scheduled for deactivation.

Retired fossil-fuel plants and those slated for retirement tend to be plants that have difficulty meeting current restrictions on air emissions or are otherwise uneconomical to operate. Accordingly, plant reactivations and/or service life extensions of fossil-fueled plants are typically not desirable or feasible due to the increasing stringency in state and federal air emissions standards as well as the higher operating and maintenance costs of older plants. In addition, the New Jersey High Electric Demand Day Rule implemented in May 2009 requires additional emissions reductions on days of peak power demand from high emitting fossil-fueled units to aid attainment of the federal 8-hour ozone standard (Reference 9.2-29). In light of increasingly rigorous environmental restrictions, delaying retirement or reactivating plants typically requires major construction to upgrade or replace plant components without increasing plant output, as is the case with PSEG's Mercer and Hudson steam plants. Both of these coal-fired power plants are undergoing significant retrofits to install pollution control technology that result in an overall net decrease in capacity.

PSEG retired several fossil-fueled units in recent years. Kearny Units 7 and 8 steam plants (150 MWe each) were retired in 2005. Hudson Unit 3 (129 MW) was retired due to generator damage in 2003. Burlington Units 101-105 (260 MW) were retired in 2004 and the turbine-generators were sold in 2005. There are no plans to return any of these units to service. Per Chapter 8 Appendix 8A, no future retirements are identified by PJM in NJ. Hudson Unit 1 is projected to be deactivated by September 2010, but is included in PJM RPM supply for later years and thus has been included in the supply projections in Section 8.3. As of 2009, PJM planning data show that no other fossil-fueled plants will be retired. None of the recently retired or to be retired fossil-fueled units are reasonable candidates for reactivation or life extension. These retirements of fossil-fueled units are predominantly the result of age, high maintenance costs and overall inefficiency resulting in uneconomic operation. In addition to the announced retirements, the potential exists for future deactivations of coal-fired units within PJM due to the expected increase in generation costs from pending carbon legislation.

All operating nuclear plants located in NJ have either been approved for license renewal or have license renewal applications under NRC review (such as PSEG's Salem Generating Station [SGS] and Hope Creek Generating Station [HCGS]) (Reference 9.2-21).

HCGS Unit 2 is not a candidate for reactivation. PSEG originally planned for a second unit at HCGS and was granted construction permits for both units in November 1974. Construction of HCGS Unit 2, which is structurally contiguous with HCGS Unit 1, was formally abandoned by PSEG in December 1981 due to financial constraints and a reduced demand for power at that time. The reactivation of the HCGS Unit 2 construction permit as an alternative to the new plant is not feasible. The containment shell and reactor vessel planned for HCGS Unit 2 were cut up for salvage as part of the rate case settlement with the New Jersey Board of Public Utilities (NJBPU) for cancellation of the unit. Additionally, HCGS Unit 2 is not a suitable location/alternative for a new nuclear unit for the following reasons:

1) Significant portions of the HCGS Unit 2 turbine building are now utilized for maintenance and administrative office space and laydown support for HCGS Unit 1.
2) The structural components of the HCGS Unit 2 Reactor Building currently provide flood and missile protection for HCGS Unit 1. Alteration of the HCGS Unit 2 Reactor Building to accommodate a new reactor could impact these protective functions, hence impacting the operation of HCGS Unit 1.
3) Constructing a new generation reactor design at the HCGS Unit 2 location is not feasible given the high likelihood that the existing HCGS Unit 2 footprint is not physically able to accommodate any of the standardized reactor designs.
4) Construction activities associated with the completion of HCGS Unit 2 would impact operation of HCGS Unit 1 due to the above described inter-reliance of structures and overall proximity of heavy construction (cranes, ultra-heavy modules, etc.) to critical HCGS Unit 1 structures systems and components.

Given the above negative impacts on the operation of HCGS Unit 1 that would result from constructing a new plant at the HCGS Unit 2 location, reactivation of the HCGS Unit 2 is not a reasonable or competitive alternative to the new plant.

In summary, there are no known plant reactivations or service life extensions identified in PJM long term planning (extending to the sixth year past commercial operating date) in NJ beyond those discussed above. Based on the current state of all active and retired plants in NJ as well as planned retirements, there are no available reactivations or service life extensions that can replace the baseload need that is provided by the new plant.

9.2.1.3 Purchasing Power from Other Utilities or Power Generators

This section discusses the alternative of purchasing power to provide the baseload capacity needed in NJ instead of constructing the new plant at the PSEG Site.

As discussed in Subsection 8.4.2, there currently is a need for approximately 5800 MWe of additional baseload capacity in NJ. Hence, NJ already is relying on the alternative of purchasing power through imports to serve baseload demand. The need for baseload capacity via imports or future new NJ generation is forecasted to grow to 7900 MWe by the year 2021.

As discussed in Section 8.3, PJM expects NJ to continue relying on transmission capability to replace retired generation and to meet growth in demand. Table 8.4-1 shows that reserves in the EMAAC area (of which NJ provides over half of the power) are inadequate to meet summer peak power demand. Consequently, imports are needed to meet the summer peak load. In addition, the potential for more power exports to New York City and Long Island further increase the demand for transmission capability, as discussed in Sections 8.1 and 8.3 and depicted in Figure 8.1-3. This increased demand challenges bulk transmission facilities and potentially increases congestion and reliability criteria violations in NJ.

Per Section 8.3, construction of new transmission lines and upgrades to existing transmission lines will be required to allow more purchase power imports. Three major new 500 kV transmission facilities have been approved by the PJM Board to resolve North American Electric Reliability Corporation (NERC) reliability criteria violations in the Middle Atlantic Area Council (MAAC) sub-region and will increase the capability to import power into and throughout NJ. Transmission projects in NJ present financial and permitting challenges due to the dense commercial and residential development in congested areas.

Although construction of grid upgrades and new transmission lines within NJ to increase import capability are feasible, it should be noted that relying on imported power purchases increases power costs to consumers and will likely lead to greater emissions from fossil-fueled plants. To assure the reliability of the power grid in congested areas of NJ, transmission congestion is relieved by dispatching regional higher-cost units out of economic order. These units are typically fossil-fueled. Even considering the congestion relief projected by the approved transmission projects planned within NJ, the types of generating units that supply imported power from the western portion of PJM are often fossil-fueled. In addition to the environmental impacts of these fossil-fueled generation resources, the prospect of federal limits on power plant emissions of greenhouse gases creates uncertainty about the cost of power from these sources. The uncertainty arises from the likelihood of paying emissions allowance for CO_2 and/or laws or regulations to remove or reduce CO_2 in the future. This increase in emissions cost of fossil-based generation, especially coal-fired generation, will likely lead to financially-driven deactivations of units that are currently relied on for imports. The Department of Energy's Energy Information Administration projects that 30,000 MW of coal capacity is projected to be retired by the next decade due to age and financial impacts from carbon legislation (Reference 9.2-23).

Overall, importing power may be a feasible alternative to construction of the new plant at the PSEG Site, but is undesirable due to significant cost uncertainties and environmental impacts. Accordingly, it is not considered to warrant further consideration.

9.2.1.4 Summary

As discussed in this section, conservation (energy efficiency) programs have already been factored into the need for power analysis, and so are not viable alternatives to building the new plant. The possible options for reactivating or extending the service life of existing plants within NJ are also not viable. Purchasing power from other utilities or power generators may be feasible but has significant undesirable attributes. Accordingly, none of these alternatives are considered to be viable, they do not satisfy the purpose of the proposed project, and therefore they are not considered further.

9.2.2 ALTERNATIVES REQUIRING NEW GENERATING CAPACITY

This section assesses possible alternative energy sources to determine if they are competitive or noncompetitive with the proposed new plant. The following alternative energy sources are considered in this assessment:

- Wind
- Geothermal
- Hydropower
- Solar Power
  - Solar Thermal Power
  - Photovoltaic Cells
- Biomass
  - Energy Crops and Forest Residues
  - Municipal Solid Waste and Urban Wood Residues
  - Methane from Landfills and Wastewater Treatment
- Petroleum Liquids (Oil)
- Fuel Cells
- Coal
- Natural Gas
- Integrated Gasification Combined Cycle

The alternative energy sources are analyzed in the subsequent sections based on the following evaluation criteria:

- The alternative energy conversion technology is developed, proven, and available in the RSA within the life of the new plant.

- The alternative energy source provides baseload-generating capacity equivalent to the capacity needed and to the same level as the proposed nuclear plant. The new plant at the PSEG Site is proposed to serve as a baseload generator; therefore, any feasible alternative would also need to be able to generate baseload power.

- The alternative energy source does not result in environmental impacts in excess of a nuclear plant.

Alternative energy sources are considered to be competitive only if they are able to satisfy all of these criteria. Accordingly, if an alternative energy source is unable to satisfy all of the criteria it is considered to be noncompetitive and is not given further consideration as a sole alternative energy source for the proposed plant. However, it may be a competitive alternative acting in combination with other alternatives. This section addresses alternative energy sources listed above when acting as sole replacement power, while Subsection 9.2.3 addresses alternative energy sources when they act in potential combinations with other alternatives.

Each of the potential alternative technologies considered in this analysis is consistent with national policy goals for energy use and are not prohibited by federal, state, or local regulations. NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, provides a useful analysis of alternative sources. The NRC considered these reasonable alternatives pursuant to its statutory responsibility under the National Environmental Policy Act (NEPA). Although NUREG-1437 is specific to license renewal, the analysis in it can be used to determine if the alternate energy source is a competitive alternative to the proposed new plant. Additionally, because NUREG-1437 is now more than ten years old and is undergoing a revision with a corresponding revision to 10 CFR 51 (74 FR 38,117), PSEG's evaluation also considers recent evaluations of generating technologies.

During the lifetime of the proposed new plant, technology is expected to continue to improve operational and environmental performance of the alternatives assessed in this section. Any analyses of future relative competitiveness or impacts of these alternatives are subject to that uncertainty. However, as in the case of alternatives evaluated in Subsection 9.2.1, PSEG believes that sufficient knowledge is currently available to make a reasonable assessment.

As discussed in the following sections, natural gas and coal are the only alternatives that are considered to be solely competitive alternate energy sources to the new plant, and are discussed further in Subsection 9.2.3. The other alternative energy sources are noncompetitive acting alone, and are only considered potentially competitive when considered in combination with other alternate energy sources.

9.2.2.1 Wind

Due to its low capacity factor, wind is not a competitive alternative energy source because it cannot reliably supply baseload-generating capacity equivalent to the proposed new plant. Capacity factor is an indication of how much energy a plant is able to produce compared to the plant's capacity, and is therefore related to the reliability of plant equipment, how often the plant is dispatched, fuel availability, and other factors that keep the plant from operating. For thermal power plants, fuel availability does not typically impact capacity factor because fuel can be purchased, transported, and stored. By its nature, wind is a limited and intermittent resource, and cannot be purchased, transported or stored. Overall, the typical capacity factor for wind generation is 30 percent (Reference 9.2-5), which is in the range identified as an intermediate resource in Section 8.3. Accordingly, wind power, by itself, cannot generate baseload power.

It should be noted that wind cannot become competitive solely by adding more facilities in the region to compensate for the low capacity factors. The capacity factor of a thermal power facility is typically independent of other thermal power facilities; i.e., equipment reliability problems at one plant do not impact the capacity factor at another plant. However, because wind acts over a large area or region, the low capacity of wind energy plants is not independent. In other words, the cause for a low capacity factor at one facility can also result in a low capacity factor at another facility.

In general, wind areas identified as Class 4 and above are regarded as potentially economical for energy production with current technology. As a result of technological advances and the current level of financial incentive support, other areas with a slightly lower wind resource (Class 3) could be suitable for wind development. Class 3 resource sites operate at a lower annual capacity factor than Class 4 areas. The majority of the wind resources along the NJ shoreline are rated as Class 3 resources. Offshore areas are rated as Class 4 and in limited areas, Class 5 (Reference 9.2-34). In June 2009, the first five renewable energy leases for the Outer Continental Shelf were granted to three NJ based wind developers to build meteorological testing facilities off the coast. PSEG is currently developing offshore wind energy resources in NJ and DE with one of these developers. The meteorological facilities will test the potential for producing offshore wind power on a commercial scale (Reference 9.2-16).

In terms of direct costs, larger wind farms in more favorable areas are now considered economically competitive with conventional fossil-fueled power plants in many locations (Reference 9.2-35). Even though large wind farms may be an economic alternative to traditional fossil fuel plants, there are several characteristics that make it unsuitable as a baseload resource:

- Wind generation is not considered dispatchable, meaning that the wind turbine generator cannot be controlled to match load and economic requirements. Energy from wind turbines is available as long as wind speeds are above a minimum threshold and below a maximum threshold, and hence is highly variable. If wind velocity is very high, wind turbines shut down to avoid overspeed conditions that can damage turbine equipment. Wind generation cannot provide baseload capacity without backup generation capabilities because of these characteristics.

- Wind generation is best sited where higher winds are most prevalent. These areas often are remote and valued for scenic quality:

    - Visual impacts – Critics of large-scale offshore wind farms, or wind farms located on the coastline, consider them to be an aesthetic problem. Local residents near the wind farms might lose what they consider their pristine scenic view of the area. High-speed wind turbine blades can also be noisy, although technological advancements continue to lessen this problem.

    - Interconnection of wind farms located in offshore areas requires new transmission lines to connect the wind farm to the grid. Existing transmission infrastructure might need to be upgraded to handle the additional supply. The choice of a location might be limited by land use regulations and the ability to obtain the required permits from local, regional, and national authorities. The farther a wind energy development project is from transmission lines, the higher the cost of connection to the transmission system.

- Wind farms occupy large amounts of land not only for the physical footprint of the wind turbine facilities themselves but also to allow sufficient spacing to avoid interference among turbines and to maximize capture of the available wind energy. If the turbines are too close together, one turbine can affect the efficiency of another turbine. Approximately 2025 2-MWe wind turbines operating at a typical capacity factor of 30 percent would be needed to replace the energy equivalent of a 1350 MWe nuclear unit operating at a capacity factor of 90 percent at the PSEG Site. The turbines would be distributed over an area of 243,000 acres to avoid interference between turbines, and approximately 12,150 acres would be disturbed to accommodate the physical turbine equipment and facilities. Depending upon the location, most of the adjoining land could be used for productive purposes, such as farming To replace the energy equivalent of 2200 MWe of nuclear capacity operating at a 90 percent capacity factor, approximately

3300 2-MWe wind turbines operating at a capacity factor of 30 percent would be required. These turbines would be sited on 396,000 acres (619 square miles) and disturb 19,800 acres (31 square miles) to accommodate the physical footprint of the towers themselves. As a point of comparison, the lower bound of this land area is almost 15 times the area of the city of Newark.

- Wind farms have other environmental impacts, such as bird mortality and noise. Bird mortalities per MWe average one to six per year, or less (Reference 9.2-4). Sound levels are typically 35 to 45 dBA at a distance of 350 meters (Reference 9.2-3). Additionally, offshore wind turbine foundations can present a hazard to recreational boaters.

Though wind is not suitable for baseload generation alone due to several factors, it may be possible to combine wind energy with other technologies to increase the capacity factor of wind energy to approach that of baseload resources. One potential combination is gas generation which could be dispatched when wind generation is not available to fill the gap; this is discussed further in Subsection 9.2.3.3. Another possibility is to store wind energy using pumped storage plants, in batteries or flywheel technology for use during periods of higher demand or for use in frequency regulation. Wind energy could also be combined with compressed air storage technology, which is currently under development.

Compressed air energy storage (CAES) technology stores off peak energy in the form of compressed air in an underground reservoir and releases the compressed air to a combustion turbine to produce electricity during peak hours. The compressed air from the underground storage increases the efficiency of the combustion turbine, but still requires natural gas or oil to heat already compressed air. In August 2008, PSEG Global LLC formed Energy Storage and Power LLC, a joint venture to exclusively market, license, support the development and supervise project execution of the second generation of CAES technology (Reference 9.2-24). However, there are currently no facilities in which CAES is used in conjunction with wind or other generating resources to produce baseload power, and there are no CAES projects planned on the scale of a 1350 to 2200 MWe plant. Overall, the combination of wind farms and storage technologies is in the development stage and is unproven as a baseload resource.

Using CAES in combination with a wind facility is not a feasible alternative to the new plant due to the size of the necessary wind farm as described above as well as the size of the air storage volume necessary to provide up to 2200 MWe of baseload power. The Atlantic Coastal Plain geology at the PSEG Site, and within southern NJ, is not conducive to underground storage as there are no salt domes or other underground geologic features that would allow for the large air storage volumes required to provide baseload power at the levels of the new plant. It is unlikely that the geology elsewhere in NJ can accommodate underground air storage at the volumes and capacities necessary to produce up to 2200 MWe of power for even brief periods of time.

The low capacity factor associated with wind generated power is due to the fact that wind resources are intermittent and can degrade to minimal levels for extended periods of time, ranging from several hours to days, especially during summer periods when electric demand is typically highest. The air storage capacity required to maintain 1350 to 2200 MWe of baseload power during periods of little to no wind would be substantially larger than any CAES installation planned or developed to date. It is estimated that an underground reservoir the size of a large stadium would be required to provide 900 MWe of power for 8 hours (Reference 9.2-38). Given the low capacity factor associated with wind, 8 hours is inadequate to serve as a backup baseload resource. The reservoir necessary to accommodate 1350 to 2200 MWe for the longer period of time necessary to constitute a baseload power resource, would be proportionally larger.

Similarly, construction of above ground tanks for air storage purposes to supply 1350 to 2200 MWe of power for a period of time commensurate with a baseload resource would require significant amounts of land, far in excess of the land requirements for a new nuclear plant. Finally, the wind farm associated with a combined wind-CAES installation would need to be built in excess of the size to support 1350 to 2200 MWe of capacity. This overbuild would be necessary in order to provide the required baseload wind power concurrent with the generation of excess power that is specifically designated for air compression and storage for use during times of little to no wind. It is for these reasons that CAES installations currently in service and under development are intended primarily to provide peaking margin for renewable energy sources. The most aggressive applications planned for CAES allow only up to limited intermediate generation capacity, whereas the new nuclear plant is intended to serve as baseload generation with an expected capacity factor in excess of 90 percent. As a result, CAES in combination with wind is not feasible as a combination of alternatives and is not evaluated further.

In summary, wind power (either alone or in combination with CAES or other energy storage technology such as battery or flywheel storage) is noncompetitive because it cannot provide baseload-generating capacity equivalent to the capacity needed and to the same level as the proposed nuclear plant. Additionally, wind energy has significant visual and land use impacts, impacts avian populations and requires additional transmission facilities to connect all of the turbines to the transmission system. Consequently, wind is not addressed further.

9.2.2.2 Geothermal

Geothermal energy is a non-competitive alternative to the new nuclear plant at the PSEG Site. Geothermal technologies such as geothermal heat pumps are considered a candidate renewable energy technology at the residential or commercial level as part of ongoing energy efficiency programs (Subsection 9.2.1.1). However, based on the known geothermal regions of the United States, NJ is not a candidate for geothermal generation technologies and could not produce the proposed 1350 to 2200 MWe of baseload energy (Reference 9.2-13). Geothermal plants are best located in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent. Consequently, geothermal is not addressed further.

9.2.2.3 Hydropower

Hydropower is not a competitive alternative to the new nuclear plant at the PSEG Site because the feasible hydropower available for development in NJ would not provide an adequate amount of baseload generation. Additionally, hydropower has potentially negative impacts to aquatic species in the region.

Hydroelectric power is a fully commercialized technology. The percentage of U.S. generating capacity is expected to level-off due to environmental concerns and a scarcity of new large-scale sites. The growth of conventional hydropower continues to be limited and from 2007 to 2030 its share of total generation is expected to remain stagnant between 6 percent and 7 percent (Reference 9.2-9).

New Jersey was evaluated to determine the total amount of MWe that is feasible for hydropower development. The evaluation is based on a January 2006 U.S. Department of Energy (DOE) study, *Feasibility Assessment of the Water Energy Resources for the United States for New Low Power and Small Hydro classes of Hydroelectric Plants*. The study examined all sources of hydropower, including large scale hydropower development opportunities (defined as greater than 30 MWe of equivalent annual energy), but found that 99 percent of sites across the U.S. were suitable only for small or low hydropower. No large scale hydro opportunities were found in NJ. Only 64 MWe was found to be feasible for development including 44 MWe for small hydropower projects (greater than 1 MWe in size) and 20 MWe for low power technologies (less than 1 MW) (Reference 9.2-36).

Land use for a large scale hydropower facility is estimated in NUREG-1437 to be approximately 1000 acres per MWe. This is compared to permanent changes in land use of 225 ac. for the new plant per Section 4.1.

Operation of a hydroelectric facility can alter the aquatic habitats above and below the dam being used to generate power, thereby affecting existing aquatic species. Constructed dams put constraints on migrating fish species in the area. New dams are extremely challenging to permit and license, and can be expected to face significant opposition. Construction of new dams entails large land usage and displacement of local populations by flooding a new reservoir. These activities disrupt the current use of the river system for recreational activities (but do create new recreational uses). In total, hydropower is not a competitive alternative to a new plant.

Technologies are being developed to convert waves, tides and ocean thermal gradients into electric energy. These technologies have only been recently demonstrated on a small exploratory scale and are not commercially available, and thus are noncompetitive alternatives.

In summary, due to the lack of suitable sites in NJ, the amount of land required and the adverse environmental impacts, hydropower is not a competitive alternative for baseload power to the new plant at the PSEG Site.

9.2.2.4 Solar Thermal Power

Solar thermal technologies include linear concentrator (trough) systems, dish/engine systems, and power tower systems. Trough and tower systems produce electric power by using various mirror configurations to transfer solar energy into high temperature heat transfer systems. The heat transfer systems are routed through heat exchangers where the heat is used to produce steam, which is subsequently used to generate electricity via a steam turbine driven generator. Solar trough and tower technologies use many of the same technologies and equipment used by conventional power plants, simply substituting the concentrated power of the sun for the combustion of fossil fuels to provide the heat necessary to generate steam. Dish engine systems use mirrors to heat gas in an enclosed piston, which then generates electricity as the piston moves due to the internal pressure variance. Each dish engine produces about 25kW (Reference 9.2-8); an array of dish engines is interconnected to create an integrated large scale power facility.

Concentrated solar thermal power (CSP) plants are designed to be large-scale grid-connected plants, but at present they generally cannot be used as baseload generators because of low capacity factors. Solar thermal plants without energy storage capabilities do not produce heat at night or during the times when clouds block the sun (Reference 9.2-11). The annual capacity factor of any solar thermal technology is generally limited to 25 percent (Reference 9.2-27). Some solar thermal systems use thermal energy storage (TES), setting aside heat transfer fluid in its hot phase during cloudy periods or at night. However, even if a thermal storage technique is used with a concentrating solar power system, the capacity factor has the potential to increase to only 40 percent (Reference 9.2-14). Consequently, even with thermal storage, solar thermal capacity factors are more typical of peaking or mid-merit intermediate resources as opposed to baseload resources.

Independent of the capacity factor of solar thermal power plants, however, solar thermal power is not considered to be a competitive alternative to the new plant primarily due to the limited nature of solar resources available in NJ. Solar energy is dependent on the availability and strength of sunlight in a given geographical location. Solar insolation (incoming solar radiation) is used to measure feasibility of solar resources for power production in a given geographical location. The amount of insolation received at the surface of the earth is determined by the angle of the sun, the state of the atmosphere, altitude at the given point and location. Solar insolation is expressed in kWh/m^2 per day (sun hours/day). Geographic locations with low insolation levels require larger surface area for collectors than locations with higher insolation levels (Reference 9.2-28). Figure 9.2-1 is an insolation map showing the feasibility of solar thermal technologies throughout the U.S. The southwest part of the U.S. is the most favorable region for development of solar thermal technologies due to the extensive period of intense sunlight and high solar-to-electric conversion efficiencies. Potential locations with insolation values below approximately 6.75 kWh/m^2 per day are typically eliminated as they generally have a higher cost of electricity (Reference 9.2-2). Insolation levels in the southwest U.S. are typically between 6 to 8 kWh/m^2 per day (Reference 9.2-20). The annual average solar thermal insolation for NJ is less than 4 kWh/m^2 per day for solar thermal technologies. Accordingly, CSP is not viable in NJ, and is noncompetitive and is not considered further.

9.2.2.5 Photovoltaic Cells

Solar Photovoltaic (PV) technologies convert sunlight directly into electricity by using photons from the sun’s light to excite electrons into higher states of energy. The resultant voltage differential across cells allows for a flow of electric current. Individual solar cells are small and produce a few watts of power at most and therefore are connected together in solar panels that can be arranged in arrays to increase electricity output (Reference 9.2-11).

Solar PV is not a competitive alternative to the proposed new plant because the resource is not suitable in the region for baseload power and the economics of solar PV power generation make it an impractical alternative compared to the proposed new plant. Figure 9.2-2 is an insolation map showing the feasibility of PV technology throughout the U.S. The annual average PV insolation value is 4.7 kWh/m^2/day in Atlantic City, NJ. The PV capacity factor in NJ, where the PSEG Site is located, is estimated to be 15 percent, which is significantly less than the capacity factor required for a baseload power plant (Reference 9.2-26). Similar to wind generation, the low capacity factor associated with solar PV in NJ precludes it from replacing baseload generation, making solar PV an uncompetitive alternative energy source.
Based on the annual average PV insolation value for NJ and technology efficiencies, it is estimated that 66,000 ac. of photovoltaic panels would be required to replace the energy equivalent of a 1350 MWe nuclear unit at the PSEG Site. To replace the energy equivalent of 2200 MWe of nuclear capacity, approximately 107,000 ac. of photovoltaic panels would be required.

While solar PV provides energy only in the presence of insolation, similar to wind it could be combined with energy storage technologies to transform intermittent production energy into baseload energy. For example, as discussed in Subsection 9.2.2.1, CAES can be used for load management of intermittent renewable energy resources. These energy storage technologies are either in the development or demonstration phase, or not developed to the scale of accommodating the quantity of power associated with the new nuclear plant for the durations commensurate with a baseload resource.

In summary, capacity factors for PV solar power are more typical of peaking power alternatives as compared to the required baseload capacity factor. Solar PV power requires a large area covered with photovoltaic panels to replace the energy equivalent of the new nuclear plant at the PSEG Site. This area is 300 to 500 times larger than the land requirements for the new nuclear plant. For these reasons, the solar PV alternative is not competitive with the proposed new plant at the PSEG Site as a sole energy source. Combination of solar PV with other sources is discussed further in Subsection 9.2.3.3.

9.2.2.6 Biomass

Per NUREG-1437, biomass energy includes a wide variety of sources and materials including agricultural crop residues and wastes, energy crops, forest residues, urban wood wastes, municipal solid waste, landfill gas, and refuse-derived fuel. Biomass resources are widely available throughout the U.S. Biomass energy conversion is accomplished using a variety of technologies, including:

- Direct combustion in a boiler or incinerator to produce steam
- Biomass co-firing along with fossil fuels (primarily coal) in boilers to produce steam,
- Production of synthetic liquid fuels that are subsequently combusted
- Gasification to produce gaseous fuels that are subsequently combusted
- Anaerobic digestion to produce biogas, which is typically consumed in combined heat and power plants

Although fossil and biomass-fueled facilities both release CO_2, biomass-fueled facilities using energy crops or forest industry wastes are said to be carbon-neutral since the energy crops offset the amount of CO_2 produced. This is not true for biomass facilities relying on municipal solid waste, refuse-derived fuel or landfill gas. Depending on the fuel, the combustion technology and the operating conditions, biomass energy systems impact air quality and generate solid wastes that must be properly managed.

Biomass co-firing with coal is technically feasible and is a potential near-term alternative for commercial power generation. Additionally, it would reduce emissions of criteria pollutants.[a] Wood has been the most widely used biomass fuel for electricity generation. Of the nearly 1000 operating biomass power plants, the majority involve direct biomass combustion while only a small number involve biomass co-firing with coal.

[a] EPA uses six criteria pollutants as indicators of air quality, and has established for each of them a maximum concentration above which adverse effects on human health may occur. The criteria pollutants are ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead.

In 2005, DOE's National Renewable Energy Laboratory (NREL) conducted a review of biomass technologies and projected future performance based on anticipated technological advances through 2030. The results of the review are documented in a report entitled, *A Geographic Perspective on the Current Biomass Resource Availability in the United States*. The technologies studied included biomass-only integrated gasification combined-cycle facilities, direct burn biomass facilities, and biomass co-fired with coal facilities. Energy crops (wood) or agricultural crop residues offer the greatest potential for energy production. There are three types of municipal solid waste incinerators which are often co-fired with other fuels such as coal in modified burners. Landfill gas (methane) is another potential source of biomass energy for electric power production (Reference 9.2-1). Based on data for NJ in the 2005 NREL report, up to 240 MWe of biomass generation has the potential of being developed within NJ. However, some of the biomass sources evaluated in the 2005 report may already be developed or may have been put to alternative use, such as steam or heat production. Figure 8.3-3 shows that NJ currently has 179 MWe of biomass, municipal solid waste, municipal solid waste biogenic, and landfill gas generation.

A study completed in 2007 for the New Jersey Board of Public Utilities by Rutgers University estimated the maximum potential for biomass generation in NJ based on modifications to collection infrastructure, development of supporting governmental policies, development of biomass technologies, and cost reductions in generation technology and collection infrastructure (Reference 9.2-25). If the ideal conditions to produce the maximum potential as identified by the Rutgers study were in place, then 1124 MWe of biomass generation would be available in NJ. However, given that biomass energy production is costly and time-consuming to develop, the 240 MWe estimate developed using National Renewable Energy Laboratory (NREL) data is a more realistic representation of current potential for biomass generation in NJ. In either case, neither estimate of the potential biomass generation provides as much generation as the new plant.

9.2.2.6.1 Energy Crops and Forest Residues

The use of wood waste to generate electricity is mostly limited to those states with significant wood resources. Electric power is generated by the pulp, paper, and paperboard industries, which consume wood and wood waste for energy, benefiting from the use of waste materials that otherwise represent a disposal problem. The largest wood waste power plants are 50 to 75 MWe in size; therefore up to 45 wood waste power plants would be required to produce 2200 MWe of baseload capacity (Reference 9.2-7).

Nearly all of the wood-energy-using electricity generation facilities in the United States use steam turbine conversion technology. The technology is relatively simple to operate and it can accept a wide variety of biomass fuels. However, at the scale appropriate for biomass, the technology is expensive and inefficient. Therefore, the technology is relegated to applications where there is a readily available supply of low, zero, or negative cost delivered feedstock.

Biomass fuel from wood, energy crops or crop residues generate fewer criteria pollutants per unit of energy delivered than coal. 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 disposal (i.e., ash). Additionally, operation of wood-fired plants has environmental impacts, including impacts on the aquatic environment and air.

Gasifying energy crops (including wood waste) is another alternative for fueling electric generators. The overall level of construction impacts from a crop-fired plant is estimated to be the same as a wood-fired plant. Crop-fired plants have similar operational impacts, including impacts on the aquatic environment and air. In addition, these systems have the potential for significant impacts on land use because of the acreage needed to grow the energy crops.

Energy crop gasification is in the early stages of technological development and is not currently mature or reliable enough to be a competitive source of baseload capacity at the scale commensurate with the new plant.

9.2.2.6.2 Municipal Solid Waste and Urban Wood Residues

There are three types of municipal solid waste (MSW) incinerators: mass burn, modular and refuse-derived fuel incinerators. Mass burn incinerators generally burn unprocessed MSW. Modular units are smaller in capacity and more selective of the type of waste utilized as fuel and often contain dual combustion chambers to ensure more complete combustion. Refuse-derived fuel incinerators utilize processed MSW which removes hazardous and recyclable constituents. While it is technically feasible to operate a biomass combustion plant on MSW or refuse derived fuel, source material may not be reliable or consistent. The decision to burn MSW to generate energy is usually driven by the need for an alternative to landfills, rather than by energy considerations.

The initial capital costs for MSW plants are greater than those of comparable steam turbine technology at wood waste facilities. This difference in cost results from the need for specialized waste collection, separation, and handling equipment required for MSW plants along with increased transportation costs. The overall level of construction impacts from an MSW-fired power generation plant would be approximately the same as that for a coal-fired plant. Additionally, MSW-fired power generation plants have the same or greater operational impacts, including impacts on the aquatic environment, air, and waste disposal. Research shows that toxic pollutants may be released from unprocessed municipal solid waste due to incomplete combustion. These environmental threats have slowed the development of MSW-fired plants.

Almost 75 percent of NJ's biomass resource is produced directly by the state's population and the majority is solid waste. Increases in the population are expected which will ultimately lead to an increased amount of solid waste available (Reference 9.2-25). Of the 240 MWe of biomass generation that has the potential for being developed in NJ, approximately 150 MWe could be produced from urban wood and secondary mill residues. All of the energy produced by MSW would be baseload generators, but collection systems would have to be developed for each facility. To minimize transportation costs, a larger number of smaller, more dispersed units would be needed resulting in increased land usage and environmental impacts.

9.2.2.6.3 Methane from Landfills and Wastewater Treatment

Landfill gas is another potential source of biomass energy for electric power production. Per NUREG-1437, landfills in which organic materials are disposed represent the largest source of methane in the United States. Landfill gas composition varies depending on the type of waste. Collecting landfill gas is a relatively straightforward process that involves placing recovery wells and simple gas collection systems. Methane emissions from landfills depend on three key factors: (1) total waste in place; (2) landfill size; and (3) location in an arid or non-arid climate. Data on the landfill locations and the waste in place was obtained from EPA's Landfill Methane

Outreach Program (LMOP), 2003 database. A large landfill is one containing more than 1.1 million tons of waste in place. Landfills in non-arid climates are believed to produce more methane than those in arid climates (Reference 9.2-1). NUREG-1437 states that, of the approximately 2300 operating or recently closed landfills in the U.S., 427 landfills are currently equipped with gas collection systems. In 2006, landfills produced enough gas to generate 10 million MWh of electricity. An additional 560 landfills could be adapted to landfill gas-to-energy production. Landfill gas is produced continuously; thus landfill gas-to-energy plants can have capacity factors greater than 90 percent and can be relied upon as a source of replacement power. Landfill gas and wastewater treatment generation is located near each of these methane capture facilities and each one is generally less than 10 MW, as shown in Appendix 8A.

New Jersey, located along the Atlantic coast, is considered to be a non-arid climate and therefore has the ability to produce an increased supply of methane. Of the 240 MWe of biomass generation that has the potential for being developed in NJ, approximately 70 MWe of generation could be obtained from landfill gas and methane from wastewater treatment facilities. As shown in Appendix 8A, a portion of this 70 MWe of unutilized generation from landfill gas is under development in NJ. Landfill gas and wastewater treatment methane generation facilities would be small in capacity and widely dispersed in the region. The amount of methane-based generation available from sources within NJ is substantially smaller than the proposed 1350 to 2200 MWe of baseload energy output of the new nuclear plant and is not a viable alternative to the new plant.

9.2.2.6.4 Summary

Overall, biomass generation alone is not a competitive alternative to development of the new nuclear plant at the PSEG Site because of the minimal amount of biomass energy that is feasible for development. However, biomass generation is technically viable and could be considered in combination with other generation resources. This is discussed further in Subsection 9.2.3.3.

9.2.2.7 Petroleum Liquids (Oil)

Oil-fired generation is not a competitive option with the new plant at the PSEG Site due to its environmental impacts and the increasingly high cost of petroleum-based fuels.

New Jersey has several petroleum-fired units producing nine percent of the state's electricity (Figure 8.3-2). While capital costs for new petroleum-fired plants are similar to the cost of a new gas-fired plant, petroleum-fired operation is more expensive due to the high cost of petroleum. Future increases in petroleum prices are expected to make petroleum-fired generation increasingly more expensive relative to other alternatives.

The high cost of petroleum has prompted a steady decline in its use for electricity generation in recent decades and no new oil-fired units have been constructed in the U.S. since 1981 (Reference 9.2-30). Due to the constant fluctuations and the steady rise in oil prices experienced over the years, oil-fueled power (including units fired by distillate fuel oil, residential fuel oil, petroleum coke, jet fuel, kerosene, other petroleum and waste oil) continues to experience a decline.

Oil-fired steam plants produce more greenhouse gases than almost all electric generating systems, and have one of the largest carbon footprints of the electricity-generating systems analyzed. The average emissions rates in the U.S. from oil-fired generation are: 1672 lbs/MWh of CO_2, 12 lbs/MWh of sulfur dioxide (SO_2) and 4 lbs/MWh of nitrogen oxides (NOx). In addition, oil wells and oil collection equipment are a source of methane emissions, a potent greenhouse gas. Large engines used in the oil drilling, production, and transportation process burn natural gas or diesel that also produce emissions (Reference 9.2-31). The emissions from an oil-fired power plant are approximately 130 times higher than the carbon footprint of a nuclear power generation facility (Reference 9.2-22). Technological developments such as carbon capture and storage (CCS) and co-firing with biomass, have the potential to reduce the carbon footprint of oil-fired electricity generation. Ongoing small scale trials of CCS are currently underway in Norway, Algeria, Australia and the United States. However, utility-scale CCS technology has yet to be demonstrated, is currently extremely costly, and the impacts associated with large scale CO_2 storage pose significant permitting challenges (Reference 9.2-6).

Overall, an oil-fired power generation plant is a noncompetitive alternative to the new plant at the PSEG Site because of the unfavorable economics and environmental impacts associated with oil-fired generation, therefore, this alternative is not considered further.

9.2.2.8 Fuel Cells

Based on technical immaturity, high costs, and limited generation potential, fuel cell technology is not a competitive alternative for the proposed new plant. Fuel cells have not been developed to the point where they are technologically mature. Phosphoric acid fuel cells are the most mature fuel cell technology, but they are only in the initial stages of commercialization. Fuel cells are not cost effective when compared with other generation technologies, both renewable and fossil-based. DOE has launched an initiative, the Solid State Energy Conversion Alliance (SECA), to significantly reduce fuel cell cost. The DOE’s goal is to cut costs to as low as $400 per kW of installed capacity over the next few years, which would make fuel cells competitive for virtually every type of power application (Reference 9.2-37). However, the projected size of natural gas fuel cell plants (expected to be in the 50 to 100 MWe range as market acceptance and manufacturing capacity increase) is insufficient to meet the baseload demand that would be provided by the new plant. Accordingly, fuel cells are not considered further.

9.2.2.9 Coal

Coal is an affordable technology for reliable, near-term development. Coal can currently produce more energy than most forms of clean or renewable energy and is a competitive alternative to the new nuclear plant at the PSEG Site.

Coal plants currently generate 48.5 percent of the electric power in the U.S. (Reference 9.2-15). Coal generation currently accounts for 15 percent of the total generation in NJ (Figure 8.3-2). Conventional coal-fired plants generally include two or more generating units and have total capacities of 100 MWe to more than 2000 MWe. Although coal has been a reliable energy source for decades, the substitution of renewable energy and other alternatives having lower emissions and environmental impacts has caused a decrease in coal-fired power production in the U.S.

The Energy Information Administration (EIA) Annual Energy Outlook 2009 forecasts the growth of coal-fired power production to continue at a reduced rate. The average annual growth for coal-fired generation from 1980 to 2007 was 0.9 percent and is expected to shrink to 0.6 percent from 2007 to 2030. In 2008, U.S. coal consumption declined by every coal-consuming sector and U.S. exports of coal were significantly higher (Reference 9.2-10). Electricity produced by coal-fired plants in NJ between 2008 and 2009 decreased by over 44 percent (Reference 9.2-12).

The environmental impacts of constructing a typical coal-fired steam plant are well known because coal is the most prevalent type of power generating technology in the United States. The impacts of constructing a 1000 MWe coal plant on a location that has not previously been developed for any use (i.e., a greenfield site) can be substantial, particularly if it is sited in a rural area with considerable natural habitat. Per NUREG-1437, Supplement 35, an estimated 1700 acres would be needed, and this could amount to the loss of about three square miles of natural habitat and/or agricultural land for the coal-fired plant site alone, excluding land required for mining and other fuel cycle impacts.

The United States has abundant low-cost coal reserves, and the price of coal for electricity generation is likely to increase at a relatively slow rate. Pulverized coal-fired plants are likely to continue to be a reliable energy source well into the future, assuming environmental constraints do not cause the gradual substitution of other fuels. Even with recent environmental legislation, new coal capacity is expected to be an affordable technology for reliable, near term development.

In summary, based on the well-known technology, fuel availability and generally understood environmental impacts associated with constructing and operating a coal-fired power generation plant, new coal capacity is considered a potential replacement for nuclear power and is therefore further discussed in Subsection 9.2.3.

9.2.2.10 Natural Gas

Based on well-known technology, fuel availability, and known environmental impacts associated with constructing and operating a natural gas-fired power generation plant, this source of energy is considered a competitive alternative to development of the new nuclear plant at the PSEG Site.

Due to economic, environmental and technological changes over the past three decades, natural gas has become a preferred option for new power generation. In 2009 approximately 23,000 MWe of new generation capacity was planned in the U.S. and over 50 percent of the new generation was projected to be natural gas-fired additions (Reference 9.2-17). While environmental impacts of constructing natural gas-fired power generating plants are similar to those of other large power generating stations; natural gas is considered the cleanest of the fossil fuels (Reference 9.2-18). Siting at a greenfield location requires new transmission lines and increased land-related impacts; whereas, co-locating the gas-fired plant with an existing plant reduces land-related impacts. Also, gas-fired plants, particularly combined cycle and gas turbine, take significantly less time to construct than other baseload plants.

Natural gas-fired generation currently exists in NJ. Figure 8.3-1 shows that 73 percent of the current generating resources in NJ are fossil-fueled. Of these, Figure 8.3-2 shows that 73 percent are fueled by natural gas or dual fueled with natural gas as a primary fuel.

Based on the well-known technology, fuel availability, and generally understood environmental impacts associated with construction and operating a natural gas-fired power generation plant, natural gas is considered a competitive alternative and is therefore examined further in Subsection 9.2.3.

9.2.2.11 Integrated Gasification Combined Cycle (IGCC)

Integrated Gasification Combined Cycle (IGCC) power generation has not been demonstrated to achieve an acceptable level of reliability and cost competitiveness to be a competitive alternative to the construction of the new nuclear plant at the PSEG Site.

IGCC, also known as clean coal, is an emerging, advanced technology for generating electricity with coal that combines modern coal gasification technology with both gas turbine and steam turbine power generation. The technology is substantially cleaner than conventional pulverized coal plants because major pollutants can be removed from the gas stream before combustion.

The IGCC alternative generates substantially less solid waste than the pulverized coal-fired alternative. The largest solid waste stream produced by IGCC installations is slag, which is a black, glassy, sand-like material that is a potentially marketable byproduct. Slag production is a function of ash content. The other large-volume byproduct produced by IGCC plants is sulfur, which is extracted during the gasification process and can be marketed rather than placed in a landfill. IGCC units do not produce ash or scrubber wastes.

IGCC technology still has insufficient operating experience for widespread expansion into commercial-scale utility applications. Each major component of IGCC has been broadly used in industrial and power generation applications. However, the integration of coal gasification with a combined cycle power block to produce commercial electricity as a primary output is relatively new and has been demonstrated at only a handful of facilities around the world, including five in the United States.

Because IGCC technology has not been demonstrated to achieve an acceptable level of reliability and cost competitiveness, an IGCC facility is not a competitive alternative to the construction of the new nuclear plant at the PSEG Site.

9.2.3 ASSESSMENT OF COMPETITIVE ALTERNATIVE ENERGY SOURCES AND SYSTEMS

This section assesses energy sources that are competitive alternatives to the new plant at the PSEG Site. The alternative energy sources assessed include coal and natural gas, which are the only competitive alternative energy sources that could solely produce a baseload of up to 2200 MWe. Additionally, this section assesses combinations of alternative energy sources that include sources that are noncompetitive when acting alone (such as wind, solar PV, and biomass).
The alternatives are evaluated by comparing the environmental impact of the new plant to the environmental impacts of the competitive alternative energy sources and potential combinations of energy sources. The evaluations of the environmental impacts for coal-fired and natural gas generation are organized as follows:

- Land use and visual resources
- Air Quality and Noise
- Waste Management and Pollution Prevention
- Other impacts

Other impacts that are considered include Water Use and Quality, Ecology, Historic and Cultural Resources, Socioeconomics, Human Health, and Environmental Justice. The evaluation of combinations of alternative energy sources subsequently builds on the coal-fired and natural gas generation evaluations.

PSEG has characterized the significance of the impacts associated with each category as SMALL, MODERATE, or LARGE. This characterization is consistent with the criteria established in 10 CFR 51, Subpart A, Appendix B, Table B-1, footnote 3:

> SMALL–Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> 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 any important attributes of the resource.

Table 9.2-1 summarizes the characterizations associated with various impact categories. The environmental impacts of alternatives provided in this table and the discussion in the following sections is based upon NUREG-1437 and other references noted in the text and tables.

As shown in Table 9.2-1, and discussed in the following sections, none of the alternatives are environmentally preferable to the new nuclear plant. Accordingly, an economic analysis is not necessary.

9.2.3.1 Coal-Fired Generation

The following subsections discuss the significant environmental impacts associated with the coal-fired generation alternative.

9.2.3.1.1 Land Use and Visual Resources

Per NUREG-1437, coal-fired generation would require approximately 1700 ac. for a 1000 MWe plant and up to twice as much land would be required for a 2200 MWe new coal-fired plant. Construction of the power block and coal storage area would disturb land and associated terrestrial habitat. Additional land would also need to be developed for waste management. As a result, land use impacts would be MODERATE during construction and operation.

The PSEG Site is aesthetically altered by the presence of the existing HCGS and SGS units and structures. The coal-fired power plant buildings would be up to 200 ft. tall, and the stacks would be up to 600 ft. tall. These are similar to the size of the existing structures associated with the SGS and HCGS units; therefore, the aesthetic impact of a new coal-fired plant would be SMALL during operation. Visual impact of construction activities would be similar to that of the new plant, as discussed in Chapter 4. Therefore, visual impacts of construction and operations would be SMALL.

9.2.3.1.2 Air Quality and Noise

The air quality impacts of coal-fired generation are considerably different than those of nuclear power. A coal-fired plant emits sulfur dioxide (SO_2, as SOx surrogate), oxides of nitrogen (NOx), particulate matter (PM), and carbon monoxide (CO), all of which are regulated pollutants. Air quality impacts from fugitive dust, water quality impacts from acidic runoff, and aesthetic and cultural resources impacts are all potential adverse consequences of coal mining. Air emissions were estimated for a coal-fired generation facility based on the emission factors contained in NUREG-1437 Table 4.3.2.1-2. The emissions from this facility are based on a net power generation capacity of 2200 MWe. The coal-fired generation facility assumes the use of bituminous coal, fired in a supercritical pulverized coal boiler. The sulfur content of the coal is assumed to be 2.5 percent by weight. Emissions controls include a wet scrubber system to control acid gas emissions, selective catalytic reduction (SCR) to minimize NOx emissions, and a bag house to control PM emissions. Table 9.2-2 summarizes the air emissions produced by a 2200 MWe coal-fired facility.

Operating impacts of a new coal plant include concerns related to adverse human health effects. Air quality is impacted by the release of CO_2, regulated pollutants, and radionuclides. Carbon dioxide has been identified as a leading cause of climate change and is facing federal regulation within the Clean Air Act, and SO_2 and NOx emissions have been identified as contributing causes of acid rain.

Coal burning power systems have the largest carbon footprint of all the electricity generation systems analyzed. Conventional coal systems result in emissions of greater than 1000 gCO_2eq/kWh, which is 200 times the size of the carbon footprint of a nuclear power generation facility (approximately 5 gCO_2eq/kWh). Lower emissions (less than 800 gCO_2eq/kWh) can be achieved using new gasification plants, but this is still an emerging technology and not as widespread as proven combustion technologies. Future developments in CCS and co-firing with biomass have the potential to reduce the carbon footprint of coal-fired electricity generation (Reference 9.2-22). The NRC indicates that air emission impacts from fossil-fueled generation are greater than nuclear power generating facility air emission impacts. The NRC notes that human health effects from coal combustion are also greater based on the health effects from air emissions. Based on the emissions generated by a coal-fired facility, air impacts would be MODERATE.

Noise impacts during construction and operation of a coal-fired plant would be similar to that of the new nuclear plant; and therefore, the impact would be SMALL.

9.2.3.1.3 Waste Management and Pollution Prevention

Substantial solid waste, especially coal combustion wastes (CCWs) such as scrubber sludge bottom ash and fly ash, are produced during plant operation and require constant management. Per NUREG-1437, approximately 360 ac. would be required for waste disposal over a 40-year period for a coal-fired facility at the PSEG Site.

EPA has determined that CCWs do not warrant regulation as a hazardous waste under Subtitle C of the Resource Conservation and Recovery Act (RCRA). However, EPA has determined that CCWs disposed of in landfills and surface impoundments should be regulated under Subtitle D of RCRA (i.e., the solid waste regulations) and that CCWs used to fill surface or underground mines should be regulated under authority of Subtitle D of RCRA, the Surface Mining Control and Reclamation Act (SMCRA), or a combination of these authorities (Reference 9.2-32). This determination could cause owners of surface impoundments holding CCWs to undertake costly modifications or change to dry ash handling methods.

With proper placement of the facility, coupled with current waste management and monitoring practices, waste disposal would not destabilize any resources. As a result of the above mentioned factors, waste management impacts would be MODERATE. Impacts from construction wastes, such as debris from land clearing and solid wastes would be SMALL.

9.2.3.1.4 Other Impacts

Current regulations require control of discharges and land activities such that impacts to aquatic resources and surface water quality are minimized; the impact generally is SMALL. Losses to aquatic biota occur through impingement and entrainment and discharge of cooling water to natural water bodies.

Impacts from construction activities to surficial groundwater would be localized and SMALL. The groundwater would be expected to recover during operations mode; therefore, impact to groundwater would be SMALL. Although coal pile runoff could affect surface water quality, impacts to water resources and quality would be SMALL due to the coal power generating facility's use of a new cooling water system with cooling towers.

The proposed coal-fired plant would use previously disturbed areas near the HCGS and SGS units. As discussed in Section 4.3, best management practices (BMPs) would be used to minimize wetlands impacts, and wetland construction on PSEG-owned or other property would mitigate loss of wetland habitat. Wetland habitat loss during construction would be small in comparative acreage to the region but may be locally significant. Impacts from construction activity to other terrestrial habitats and the aquatic ecosystem would be limited and temporary; therefore, impacts during construction would be SMALL. Recovery of some species during operations is anticipated, and impacts would be SMALL. Impact to wetlands and wetland buffer would require mitigation and therefore, wetland impacts would be MODERATE.

As previously described, as a result of increased air emissions and public health risks associated with those emissions, such as cancer and emphysema, human health impacts during operation of a coal-fired generating plant would be MODERATE. Impacts during construction would be SMALL due to BMPs to curb fugitive dust emissions. As a result of improved safety practices, accident impacts would be SMALL. Mining safety is not considered within this impact category.

Environmental justice impacts during construction of a coal-fired plant would be similar to that of the new nuclear plant as discussed in Subsection 4.4.3, based on the distribution of environmental justice populations around the PSEG Site and the other characteristics of the site area, construction impacts are expected to be SMALL. Operation of a coal-fired plant would require transportation of large quantities of coal to the site and disposal of large quantities of CCWs. It is assumed that coal would be delivered to the site by barge and CCWs would be disposed of in undeveloped land near the site. As environmental justice populations are not located near the site, operation impacts would be SMALL.

The historic and cultural resource impact of the development of the PSEG Site for a coal-fired plant would be SMALL because the on-site soils consist of fill materials and the site is already altered by the presence of the existing HCGS and SGS units and structures.

Regarding socioeconomic impacts, it should be noted that there would be beneficial impacts related to construction, operations, and mining employment. A coal-fired plant would provide socioeconomic benefits from several hundred mining and construction and operation jobs as well as additional tax revenues associated with coal mining and plant operations.

9.2.3.1.5 Summary

Table 9.2-1 shows the environmental impacts associated with the coal-fired alternative as discussed above as well as the impacts of the new plant as discussed in Chapters 4 and 5. By comparison, it can be seen that a coal-fired generating facility is not environmentally preferable to the new nuclear plant at the PSEG Site.

9.2.3.2 Natural Gas Generation

The following sections discuss the significant environmental impacts associated with the gas-fired generation alternative.

9.2.3.2.1 Land Use and Visual Resources

Per NUREG-1437, gas-fired generation would require approximately 110 ac. for a 1000 MWe plant; up to twice as much land would be required for a 2200 MWe gas-fired plant. Additional land would be required for a gas pipeline that would be needed to connect to an existing line and for the gas well field, but this would have a minor impact on land use. As a result, land use impacts would be SMALL during construction and operation of this type of facility.

The PSEG Site is aesthetically altered by the presence of the existing HCGS and SGS units and structures, and the gas-fired plant structures would be smaller than the existing structures. Per NUREG-1437, gas-fired units would be approximately 100 ft. tall and the exhaust stacks would be at least 174 ft. tall, as compared to the existing HCGS cooling tower (in excess of 500 ft. tall) and the SGS and HCGS containments (approximately 250 ft. tall). A new turbine building and exhaust stacks would need to be constructed. Visual impacts would be SMALL.

9.2.3.2.2 Air Quality and Noise

Natural gas is a relatively clean-burning fossil fuel. Also, because the heat recovery steam generator in a combined cycle configuration typically does not receive supplemental fuel, the combined cycle operation is highly efficient (56 percent versus 33 percent for the coal-fired alternative). Therefore, the gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative. Control technology for gas-fired turbines typically focuses on the reduction of NO_x emissions.

Generally, air quality impacts for all natural gas technologies are less than for other fossil fuel technologies because fewer pollutants are emitted and SO_2, a contributor to acid precipitation, is emitted in negligible quantities compared to coal-fired generation. Air emissions were estimated for a gas-fired generation facility based on the emission factors contained in NUREG-1437 Table 4.3.2.1-2. The emissions from this facility are based on a net power generation capacity of 2200 MWe using combined cycle technology. Emissions controls include SCR to minimize NOx emissions. Table 9.2-2 summarizes the air emissions produced by a 2200 MWe natural gas-fired facility.

Current gas-powered electricity generation has a carbon footprint that is approximately 100 times higher than the carbon footprint of a nuclear power generation facility (approximately 5 gCO_2eq/kWh) (Reference 9.2-22). Like coal-fired plants, gas plants could co-fire biomass to reduce carbon emissions in the future.

Based on the emissions generated by a natural gas-fired power generation facility, air quality impacts would be MODERATE.

Noise impacts during construction and operation of a gas-fired plant would be similar to that of the new nuclear plant; therefore, the impact would be SMALL.

9.2.3.2.3 Waste Management and Pollution Prevention

Construction wastes (land clearing and solid wastes) would be minimal and would be subject to regulatory control. Therefore, the impact of construction waste management would be SMALL.

Gas-fired generation would result in very little solid waste generation, producing minor impacts. Spent SCR catalyst would be shipped off-site for disposal. As a result, waste management impacts would be SMALL.

9.2.3.2.4 Other Impacts

Water consumption is relatively low for combined cycle power generating facilities. Water quality impacts and potential impacts to aquatic biota through impingement and entrainment and increased water temperatures in receiving water bodies would be minimized; the overall impact would be SMALL. Impacts from construction activities to surficial groundwater would be localized and SMALL. The groundwater would be expected to recover during operation; therefore, impacts to groundwater would be SMALL.

The proposed gas-fired plant would use previously disturbed areas near the HCGS and SGS units. As discussed in Section 4.3, BMPs would be used to minimize wetlands impacts, and wetland construction on PSEG-owned or other property would mitigate loss of wetland habitat. Wetland habitat loss during construction would be small in comparative acreage to the region but may be locally significant. Impacts from construction activity to other terrestrial habitats and the aquatic ecosystem would be limited and temporary; therefore, impacts during construction would be SMALL. Recovery of some species during operations is anticipated, and impacts would be SMALL. Impact to wetlands and wetland buffer would require mitigation; therefore, wetland impacts would be MODERATE.

As previously mentioned, because of increased air emissions and associated public health risks, human health impacts during operation would be MODERATE. Impacts during construction would be SMALL due to BMPs to curb fugitive dust emissions. As a result of improved safety practices, accident impacts would be SMALL.

Environmental justice impacts during construction and operation of a gas-fired plant would be similar to that of the new nuclear plant; therefore, the impact would be SMALL.

The historic and cultural resource impact of the development of the PSEG Site for a gas-fired plant would be SMALL because the on-site soils consist of fill materials and the site is already altered by the presence of the existing HCGS and SGS units and structures.

Regarding socioeconomic impacts, there would be beneficial impacts related to construction and operations employment. A gas-fired plant would provide socioeconomic benefits from several hundred construction and operation jobs as well as additional tax revenues associated with plant operations.

9.2.3.2.5 Summary

Table 9.2-1 shows the environmental impacts associated with the gas-fired alternative as discussed above as well as the impacts of the proposed new plant as discussed in Subsection 9.2.3.1. By comparison, the gas-fired generating facility is not environmentally preferable to the new nuclear plant at the PSEG Site.

9.2.3.3 Combination of Alternatives

The new plant will operate as an independent merchant baseload power producer. The ability to generate baseload power in a consistent, predictable manner meets the business objectives for the new plant. Therefore, when examining combinations of alternatives, the ability to consistently generate baseload power must be a determining factor when analyzing the suitability of the combination. Based on the discussions in Subsection 9.2.2, the energy sources considered in combination with other sources are wind, solar PV, biomass, coal-fired generation, and natural gas generation. Subsection 9.2.2.1 addresses technologies that can be combined to increase the capacity factor of an intermittent resource, such as wind energy, to approach that of baseload generation. Energy storage technologies such as compressed air, which in combination with wind and PV energy might be able to provide the same baseload power levels of the new nuclear plant, are in the development stage and are unproven as a baseload resource. Therefore storage technologies are not included in the combination alternative.

As discussed in Subsections 9.2.2.1 and 9.2.2.4, wind and solar PV technologies are not sufficient on their own to generate the equivalent baseload capacity of the new plant because of the intermittent nature of the resources. This variability creates low capacity factors that are not suitable for baseload generation and that cannot be addressed by increasing the scale of the facility. Combining solar or PV generation with energy storage technologies such as CAES is not feasible due to the limitations of these technologies to provide baseload generation at the levels of the new nuclear plant. Accordingly, combinations that include an intermittent renewable power source (for either all or part of the capacity of the new plant) must be combined with a fossil-fueled facility equivalent to the generating capacity of the new nuclear plant. This combination allows the fossil-fueled portion of the combination alternative to produce the full amount of power needed if the renewable resource is unavailable. For example, if the renewable portion is provided by some amount of wind generation and that resource became unavailable, then the output of the fossil fueled generation portion of the combination alternative could be increased to offset the lost generation from the renewable portion. This facility, or facilities, would satisfy business objectives of the new plant in that it would be capable of providing the requisite baseload power regardless of the availability of the renewable power source.

As discussed in Subsections 9.2.3.1 and 9.2.3.2, and as shown in Table 9.2-1, coal and natural gas power generating facilities have been determined to have environmental impacts that are equivalent to or greater than the impacts of the new nuclear plant. Since a coal or natural gas power generation facility would be designed to deliver the full 2200 MWe during periods when any or all of the generation from the wind or solar sources is unavailable, the environmental impact of this combination would be equivalent to or greater than the coal or natural gas power generation alone and greater than the impact of a new nuclear plant. In addition, it should be noted that the environmental impacts would be even greater when considering the additional impacts that wind and solar PV facilities would have on the environment primarily due to the large additional land usage required by the solar PV or wind facility. Therefore, the combination of wind and solar PV with coal-fired or natural gas generation is not environmentally preferable to the new nuclear plant at the PSEG Site, and no additional analysis is required.

Biomass may be combined with coal-fired or natural gas generation to represent a potentially viable mix of non-nuclear alternative energy at the PSEG Site. Co-firing biomass alongside fossil fuels in existing power plants can increase efficiency and reduce carbon emissions. However, biomass fuels are much lower in energy than traditional fossil fuels and large quantities must be grown and harvested to produce enough feedstock for a generating station, thus effectively increasing the amount of land used for power generation. Biomass fuels are also more expensive than coal although purchasing renewable energy credits can make this an economical alternative (Reference 9.2-19).

The combination of biomass and coal-fired or natural gas generation would have a greater environmental impact than the new nuclear plant due to emissions as well as large land area required for the biomass planting and harvesting, for collection of urban wastes, and for the large number of biomass generation facilities needed due to the disperse locations of biomass resources. In addition, the combination of biomass generation and coal-fired or natural gas generation has higher air emissions and associated health impacts. Therefore, this combination would have equivalent or greater environmental impacts than a nuclear power generating facility at the PSEG Site. Accordingly, biomass in combination with other technologies is not an environmentally preferable option.

In summary, none of the potential combinations of energy sources (wind, solar PV, biomass, coal-fired generation, and natural gas generation) are environmentally preferable to the proposed new plant to provide baseload generation.

9.2.3.4 Conclusion

Overall, the new nuclear plant is environmentally preferable to an alternative power generating facility fueled by coal, natural gas, or a combination of alternatives including biomass, wind and/or PV solar power together with coal or gas-fired generating facilities. Furthermore, each of these types of alternatives has a significantly greater environmental impact on air quality than a new nuclear power generating facility. To achieve a SMALL air quality impact in the combination alternative by using larger amounts of wind or solar PV generation, a MODERATE to LARGE impact on land use results. Therefore, neither a power generating facility fueled by coal, nor one fueled by natural gas, nor a combination of coal-fired or natural gas generation with biomass, wind and/or solar PV alternatives, is environmentally preferable to the new nuclear plant at the PSEG Site to provide baseload generation.

None of the alternatives is considered to be environmentally preferable to the proposed action. Therefore, as allowed in NUREG-1555, additional cost data (e.g. decommissioning costs, and fuel cost estimates) are not provided for alternatives that are not deemed to be environmentally preferable to the proposed action.

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Table 9.2-1
Comparison of Environmental Impacts of Construction and Operation

Impact Category	Proposed New Plant at PSEG Site	Coal-Fired Generation	Gas-Fired Generation	Combination (wind, biomass and solar PV with natural gas)
Land Use and Visual Resources	SMALL	SMALL TO MODERATE	SMALL	SMALL TO LARGE
Air Quality & Noise	SMALL	SMALL TO MODERATE	SMALL TO MODERATE	SMALL TO MODERATE
Water Use and Quality	SMALL	SMALL	SMALL	SMALL
Ecology	SMALL TO MODERATE	SMALL TO MODERATE	SMALL TO MODERATE	SMALL TO MODERATE
Historic and Cultural Resources	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	SMALL	SMALL	SMALL
Human Health	SMALL	SMALL TO MODERATE	SMALL TO MODERATE	SMALL TO MODERATE
Environmental Justice	SMALL	SMALL	SMALL	SMALL
Waste Management and Pollution Prevention	SMALL	SMALL TO MODERATE	SMALL	SMALL

Table 9.2-2
Air Emissions from Alternative Power Generation Facilities

	PC Supercritical	
CO_2 capture	No	Yes
Net Power Output (MWe)	2,200	2,200
CO_2 emissions (Tons/yr)	15,375,434	2,202,765
SO_2 emissions (Tons/yr)	6410	Negligible
NOx emissions (Tons/yr)	5293	7611
PM emissions (Tons/yr)	982	1412
Hg emissions (Tons/yr)	0.085	0.124
	NGCC Advanced F Class	
CO_2 capture	No	Yes
Net Power Output (MWe)	2,200	2,200
CO_2 emissions (Tons/yr)	6,907,756	803,260
SO_2 emissions (Tons/yr)	63	Negligible
NOx emissions (Tons/yr)	528	614
PM emissions (Tons/yr)	662	662
Hg emissions (Tons/yr)	Negligible	Negligible

9.3 ALTERNATIVE SITES

As required by 10 CFR 52.17(a)(2), this section provides an evaluation of alternatives to the proposed PSEG Site for construction and operation of the new plant. The National Environmental Policy Act mandates the evaluation of reasonable alternatives to a proposed action. This section summarizes the process used to select the PSEG Site as the proposed location for the new plant and evaluates whether any alternative site is “environmentally preferable” to the PSEG Site, and if so, whether it is “obviously superior” for the eventual construction and operation of the new plant.

9.3.1 SITE SELECTION PROCESS

PSEG conducted a comprehensive site selection study in 2008 and 2009. The objective of this study was to select a Proposed Site for the new plant using a systematic process that considered relevant factors related to nuclear licensing, environmental acceptability, and engineering / cost issues. The process used in the study complied with the process outlined in NUREG-1555, including 10 CFR 100 criteria. It generally followed the site selection procedures described in an Electric Power Research Institute report on site selection for Early Site Permit Applications (Reference 9.3-2). The process also was generally consistent with other nuclear power plant siting studies as reported in licensing submittals to the NRC.

The basic parameters of the site selection study were determined based on regulatory guidance, benchmarking, and previous nuclear power plant experience. These basic parameters included the following:

- Site acreage and make-up water requirements should bound the requirements of the four reactor designs being considered by PSEG. The designs being considered are:
  - U.S. Evolutionary Power Reactor (U.S. EPR)
  - Advanced Boiling Water Reactor (ABWR)
  - U.S. Advanced Pressurized Water Reactor (US-APWR)
  - Advanced Passive 1000 (AP1000)
- Sites should be able to support one large unit (e.g., U.S. EPR) or two smaller units (i.e., AP1000) of the designs being considered.
- The potential to expand sites with additional units in the future should not be considered.
- The new plant has a maximum generating capacity of 2200 megawatts (MWe) (the nominal capacity of two AP1000 units).
- The new plant must interconnect with a transmission line or substation with a voltage of 500 kilovolts (kV) (the maximum voltage currently available in NJ, and the voltage considered necessary to provide maximum margin against thermal overloads).
- The minimum make-up water requirement for the new plant is 35,000 gpm (conservative estimate of cooling tower and essential service water make-up for one U.S. EPR unit).

The site selection study included the following major tasks, as defined in NUREG-1555:

- **Establish the Region of Interest (ROI).** The ROI is the area to be considered in searching for potential power plant sites.
- **Identify Candidate Areas.** Candidate Areas are areas within the ROI that remain after unsuitable areas are eliminated.
- **Identify Potential Sites.** Potential Sites are specific locations within the Candidate Areas that are identified for preliminary assessment in establishing Candidate Sites.
- **Identify Candidate Sites.** Candidate Sites are those Potential Sites that are considered to be among the best sites that can reasonably be found for the siting of a nuclear power plant.
- **Evaluate Candidate Sites.** The Candidate Sites were evaluated numerically and ranked according to their overall favorability.
- **Select the Proposed Site.** PSEG considered the preceding evaluations and other relevant factors in order to select the Proposed Site and Alternative Sites.

The methods and results of these tasks are summarized in the following subsections.

9.3.1.1 Region of Interest

NUREG-1555 defines the ROI as the area to be considered in searching for potential power plant sites. NUREG-1555 provides the following guidance on the selection of the ROI:

> The ROI is typically selected based on geographic boundaries (e.g., the state in which the proposed site is located) or the relevant service area for the proposed plant. In cases where the proposed plant would not have a service area, the applicant should define a reasonable ROI and provide a justification. The ROI must be more extensive if environmental diversity would be substantially improved or if candidate sites do not meet initial threshold criteria (including the site criteria in 10 CFR 100), and added geographic areas would not increase costs substantially. The ROI may be smaller if sufficient environmental diversity exists, threshold criteria are satisfied, and costs would be exorbitant for considering sites outside the state or relevant service area.

The new plant studied by PSEG is a merchant plant and will not have a regulated service area. However, PSEG's parent company, Public Service Enterprise Group, is primarily a NJ company, with its Corporate Headquarters located in Newark, NJ. As shown in Figure 9.3-1, Public Service Enterprise Group has power plants and offices located throughout NJ. One of Public Service Enterprise Group's principal subsidiaries is Public Service Electric and Gas (PSE&G), which is a regulated public utility company engaged in the transmission and distribution of gas and electricity. As shown in Figure 9.3-2, PSE&G's electric service area is limited to NJ and extends throughout much of the state, encompassing most of the higher population areas of the state. Public Service Enterprise Group's generation subsidiary is PSEG Power, LLC, one of the nation's largest independent power producers. PSEG Nuclear is a subsidiary of PSEG Power, LLC, with its nuclear headquarters located at the existing SGS-HCGS Nuclear Site in southern

NJ. Most of the electricity generated by the SGS and HCGS power plants is sold into NJ markets.

Given Public Service Enterprise Group's long corporate history (over 100 years) and strong presence in NJ, the new plant is expected to supply much of its output to important load centers in NJ via existing transmission circuits. Locating the facility in NJ facilitates the delivery of power to these load centers and allows Public Service Enterprise Group to make optimal use of its existing resources in the state. Locating the facility in NJ also promotes the state's energy self-sufficiency, which is one of the objectives of the New Jersey Energy Master Plan (Reference 9.3-7). In addition, NJ provides a good diversity of environmental and geographic conditions for potential power plant sites, as illustrated in Figure 9.3-3. It is unlikely that any reasonable expansion of the ROI beyond NJ will significantly improve environmental diversity.

Based on the considerations discussed above, NJ was established as the ROI for the site evaluation study. This ROI is shown in Figure 9.3-4. The ROI encompasses an area of approximately 8700 square miles, including water areas. Major cities located within the ROI include Newark, Jersey City, Paterson, Elizabeth, Camden, and Trenton, NJ. Major water bodies available as a potential source of cooling water for a nuclear power plant include the Delaware River, Hudson River, and Atlantic Ocean. Major highways within the ROI include Interstate Routes 78, 80, 95, 280, 287, and 295, as well as the New Jersey Turnpike, Garden State Parkway, and Atlantic City Expressway. There are several major railroads in the ROI, including Amtrak, Norfolk Southern/Canadian Pacific Railway, Southern Railroad Company of New Jersey, and New York & Atlantic Railroad. Major land and use categories found in the ROI include residential, agricultural, urban, industrial, commercial, public facilities, parks, public and private recreation areas, natural areas, transportation, communications, utilities, government special designation, and education. Topographic features in the ROI range from flat floodplains along the rivers and coastal areas to steep bluffs, rolling hills, deep ravines, and mountain ranges. There are several military bases in the ROI, including Fort Dix Military Reservation, McGuire Air Force Base, Lakehurst Naval Air Station, Fort Monmouth, and Earle Naval Weapons Station.

Information on the need for power is included in Chapter 8. Descriptions of other generating facilities in NJ and the regional transmission system are discussed in Chapter 8 and Sections 9.1, 9.2, and 9.4.

9.3.1.2 Identification of Candidate Areas

Candidate Areas were identified by constructing digitized Geographic Information System (GIS) maps of the entire ROI and applying exclusionary criteria to eliminate areas considered unsuitable for nuclear power plant siting. The purpose of the exclusionary criteria was to narrow-down the region to be considered for power plant siting and allow the study to focus on areas that have the greatest probability of containing desirable sites. The exclusionary criteria covered major factors that make licensing, permitting, or development of a nuclear power plant impractical. Exclusionary criteria included distances to highways, railroad or barge transportation, transmission, and water sources. In addition, proximity to designated lands (parks, recreational areas, natural areas, etc.) was considered, as was population density.

It should be noted that the transmission criterion eliminated areas more than 20 mi. from an existing 500 kV transmission line or substation, thus ensuring that all sites would have a primary connection point within 20 mi. As discussed in later subsections, it was expected that all sites would require an additional transmission connection in order to address potential grid stability issues. This additional connection point was not subject to the 20-mi. exclusionary criterion because it required connection to a strong regional substation capable of providing synchronizing support to improve grid stability margin.

The application of the exclusionary criteria to the ROI is illustrated in Figures 9.3-5 through 9.3-10. As illustrated in these figures, distance from highways and rail / barge transportation did not result in the elimination of any parts of the ROI, distance from transmission and water sources eliminated relatively small parts of the ROI, but population density and designated lands eliminated significant parts of the ROI. After application of all the exclusionary criteria, seven Candidate Areas, located from northern NJ to southern NJ, remained. Figure 9.3-11 shows the locations of these seven Candidate Areas.

9.3.1.3 Identification of Potential Sites

Potential Sites were identified by examining topographic maps and aerial photographs of the Candidate Areas to find specific locations that appeared, on the basis of high-level screening criteria, to be suitable for nuclear power plant siting. A key consideration was the availability of sufficient land suitable for arrangement of the power plant and other required facilities, as well as a reasonable site boundary. Preliminary plant footprint blocks were developed and arranged on each Potential Site to confirm the adequacy of the available land. Other required conditions included site topography, as well as proximity to water, transmission, and transportation resources. Avoidance of flood areas, wetlands, residences, and other sensitive land use features were incorporated to the extent feasible.

Eleven Potential Sites were identified, including at least one site in each of the Candidate Areas. Figure 9.3-12 shows the locations of these Potential Sites in relation to the Candidate Areas.

9.3.1.4 Identification of Candidate Sites

Candidate Sites were identified by examining the Potential Sites to determine whether they had any significant environmental or other issues that would make them impractical or undesirable for licensing, permitting, or development with a nuclear power plant. Issues considered in this evaluation included the following:

- **Environmental Acceptability.** The sites were reviewed with regard to major environmental issues, such as proximity to designated lands or waters and potential encroachment on sensitive land uses.

- **Nuclear Licensing.** The sites were reviewed with regard to major nuclear licensing issues, such as proximity to capable faults, hazardous land uses, and population centers.

- **Engineering.** The sites were reviewed with regard to major engineering issues, such as the length and difficulty of required water, transmission, and rail connections, cooling water pumping head, and the ability to deliver large components to the site.

The issues evaluated during this screening were primarily environmental, combined with a qualitative assessment of the level of environmental impact and the necessary activities or considerations to mitigate or avoid the impact. While these issues often manifest themselves in either regulatory uncertainty or cost / schedule challenges, the focus of the reviews and screening was on the environmental suitability of the Potential Sites.

Identified issues were evaluated and considered to be significant if they introduced the potential for adverse environmental impacts or schedule delays associated with environmental / regulatory permitting or nuclear licensing. Other significant issues included environmental conditions that introduced overall regulatory uncertainty by raising the possibility of unusual and restrictive licensing or permit conditions or increased project costs by requiring unusual and costly site development efforts or impact mitigation measures.

Significant issues were identified at each of the Potential Sites. In most cases, these issues did not by themselves indicate that a site would not be feasible to license, permit, or develop. Rather, the issues identified would make licensing, permitting, or development of the site more difficult, complicated, and/or costly. In general, all sites being developed for a project of the size and magnitude of a nuclear power plant are expected to have some significant issues of this kind, but the extent of such issues is important in determining the overall desirability of a site.

Based on these evaluations, five sites (Sites 4-1, 7-1, 7-2, 7-3, and 7-4) were found to have notably fewer significant negative issues than the other sites. In addition, a qualitative evaluation of the negative issues identified at these sites indicated that all of the issues were manageable and could reasonably be expected to be resolved. Each site also had other highly desirable characteristics. Therefore, the sites with significantly more negative issues were eliminated from further consideration, and the following sites were retained as Candidate Sites:

- Site 4-1 (Hunterdon County, NJ)
- Site 7-1 (Salem County, NJ)
- Site 7-2 (Salem County, NJ)
- Site 7-3 (Cumberland County, NJ)
- Site 7-4 (PSEG Site, Salem County, NJ)

Figure 9.3-13 shows the locations of these Candidate Sites.

9.3.1.5 Evaluation of Candidate Sites

The Candidate Sites were evaluated in more detail in order to provide a quantifiable basis for comparison. The primary purpose of the evaluation was to develop numerical scores that would allow the Candidate Sites to be ranked according to their overall suitability for development of a nuclear power plant. In order to support the numerical scoring, various specific aspects of the Candidate Sites were investigated and assessed, including the following:

- **Environmental and Permitting Conditions.** Factors related to environmental acceptability and permittability were evaluated in more detail than considered previously for the Potential Sites. Maps were obtained showing the property parcels on and near each Candidate Site. Information on zoning and land use planning was collected. Reviews were conducted of applicable state and local regulations concerning air quality, ambient noise, water withdrawal, land use, and other environmental, regulatory, and permitting issues. Site-specific information on threatened and endangered species and cultural resources was obtained from appropriate state and federal government agencies.

- **Transmission Interconnection and Stability.** The feasibility of obtaining transmission interconnection for the Candidate Sites was evaluated through modeling of thermal overloads. The risk of transmission upgrades being required in order to maintain system stability was qualitatively evaluated. These evaluations allowed the sites to be scored based on potential interconnection and stability impacts.

- **Field Reconnaissance.** Field reconnaissance site visits were conducted. The field reconnaissance was intended to supplement and confirm the information collected from maps, aerial photographs, and other publicly available sources. Observations focused on issues such as the condition of wetlands and other natural habitats, recent residential developments, transportation routes, and constructability characteristics.

- **Refinement of Site Layouts**. Based on the information collected through the environmental evaluations and field reconnaissance, the preliminary site layouts developed earlier were revised to make the best use of existing property parcels and reduce impacts on environmentally sensitive areas.

The numerical scores covered 40 site characteristics related to Environmental Acceptability (15 characteristics), Nuclear Licensing (11 characteristics), and Engineering / Cost factors (14 characteristics). Many of the site characteristics categorized as Engineering / Cost factors are also relevant to environmental acceptability; for example, minimizing the length of required transmission, rail, and road connections serves to reduce environmental impacts as well as costs. The site characteristics considered in the numerical scoring are listed in Table 9.3-1. An importance weighting factor was assigned to each site characteristic.

The Candidate Sites were ranked according to the numerical scoring developed as described above. Based on total weighted scoring, Site 7-4 was the highest-ranked site, followed in order by Sites 7-3, 7-2, 7-1, and 4-1. Based on total unweighted scoring, the sites had the same ranking as the weighted scoring. Therefore, the importance weighting factors did not have a significant impact on the site evaluations.

As shown in Table 9.3-1, the site characteristics were grouped into issues related to Environmental Acceptability, Nuclear Licensing, and Engineering / Cost. To provide an additional check on the results of the site evaluations, the numerical scores were totaled within these three categories of site characteristics. Based on the scores for Environmental Acceptability issues only, Site 7-4 was the highest-ranked site, followed in order by Sites 7-2, 7-3, 7-1, and 4-1. Based on the scores for Nuclear Licensing issues only, Site 7-3 was the highest-ranked site, followed in order by Sites 7-4, 7-2, 4-1, and 7-1. Based on the scores for Engineering / Cost issues only, Site 7-1 was the highest-ranked site, followed in order by Sites 7-4, 7-3, 7-2, and 4-1.

The results summarized above indicate that Site 7-4 is the most favorable Candidate Site with regard to the issues considered in the numerical scoring. Site 7-4 was the highest-ranked site based on both weighted and unweighted overall scoring. In addition, Site 7-4 had the highest score on Environmental Acceptability issues and the second-highest scores for both Nuclear

Licensing issues and Engineering / Cost issues. No other site ranked among the top two sites in all three categories.

9.3.1.6 Selection of Proposed Site

As described in the previous subsections of this report, a standardized process was used to identify Candidate Areas, Potential Sites, and Candidate Sites. A systematic numerical scoring system was developed to provide an objective evaluation of the relative favorability of the Candidate Sites, using consistent criteria. The results of these evaluations indicate that all of the Candidate Sites are potentially licensable for a nuclear power plant, and that Site 7-4 is the most favorable Candidate Site with regard to the issues considered. The final step in the process was for PSEG to incorporate business considerations and any other relevant additional factors into the site evaluations and the selection of a Proposed Site.

In evaluating the five Candidate Sites, PSEG considered not only the Environmental Acceptability, Nuclear Licensing, and Engineering / Cost issues discussed above, but the additional technical and business considerations described below. In some cases, these considerations correlate to lower construction or operation costs. In addition, PSEG considered the synergies of colocating a new nuclear facility with the existing nuclear units at Site 7-4. These synergies are significant from environmental, financial and operational perspectives, and they include the following factors:

- Abundant existing site data, information and regulatory knowledge; familiarity with the site and environs. This includes pre-existing knowledge and data on the following:

  - Terrestrial and aquatic ecology
  - Site characteristics including geology and seismic data; known foundation conditions and foundation design
  - Over 30 years of on-site meteorological data
  - Regional socioeconomic conditions

- Significant community and key stakeholder support in Lower Alloways Creek Township and Salem County, NJ.

- Emergency management infrastructure and support agreements with NJ and DE, and with Salem and Cumberland counties in NJ and New Castle County in DE. Existing emergency plans can be used as necessary and a consistent Emergency Planning Zone can be maintained.

- Economic and operational synergies with existing operations:

  - Common operations support facilities and training infrastructure, including off-site visitor center and emergency response facilities, eliminating the need to construct new facilities.
  - Common operations support organization, including PSEG Corporate Nuclear Headquarters and support staffing. This provides a significant benefit and flexibility in retention of staff and ability to deploy shared resources to support the needs of either the new or operating plants.

- Regional nuclear presence provides potential recruiting base for staffing and retention.

- Security considerations:
  - Opportunity for an integrated security strategy and protected area
  - Pre-existing mutual aid, support, and response agreements

- Four existing 500 kV transmission circuits allow for the output of the new plant to be more readily integrated into the regional power grid, reducing the potential need for additional transmission circuits.

In addition, development of a new nuclear facility at Site 7-4 has the following advantages:

- Jobs creation in areas of NJ currently challenged by low per-capita income and high unemployment.

- Limited risk of substantial population growth in the Low Population Zone due to surrounding land use and land cover conditions.

- Minimal community and regional disruptions associated with the new transmission lines, new pipelines, and new road and rail systems that would be necessary to develop a greenfield site. These disruptions include the following:
  - Increased costs of greenfield development due to physical and support infrastructure requirements
  - Larger environmental footprints (i.e., larger site necessary) for greenfield development

In summary, PSEG considered business and other qualitative factors in addition to the numerical evaluations in making the final site selection. Site 7-4 was selected as the Proposed Site because it was the highest-ranked site using objective numerical criteria and it has significant additional benefits in community support, emergency response, existing infrastructure, and operational synergies. The other four Candidate Sites are considered to be Alternative Sites.

9.3.2 ENVIRONMENTAL ASSESSMENT OF ALTERNATIVE SITES

The site selection process described above resulted in the selection of Site 7-4, now designated the PSEG Site, as the Proposed Site for the new plant. The environmental impacts of the PSEG Site are evaluated in detail in other sections of this Environmental Report. This section evaluates the environmental impacts of the other Candidate Sites, now designated the Alternative Sites, using the resource categories suggested in NUREG-1555. The purpose of this evaluation is to determine if any of the Alternative Sites are “environmentally preferable” to the PSEG Site and, if so, whether any of the sites are “obviously superior” to the PSEG Site.

Regulatory Guide 4.2 states: “The applicant is not expected to conduct detailed environmental studies at alternative sites; only preliminary reconnaissance-type investigations need be conducted.” The Alternative Sites are evaluated here based on publicly available information, including field reconnaissance site visits, geographic information system (GIS) mapping, and a review of government agency websites.

In order to evaluate the environmental impacts of constructing and operating a nuclear power plant at the Alternative Sites, the general plant design described in Chapter 3 and the construction and operation practices described in Chapters 4 and 5 were consistently applied to each site. This allowed for a comprehensive and qualitatively consistent assessment of environmental impacts. The potential impact of plant construction and operation on each resource category was assigned a significance level according to the criteria established in 10 CFR 51, Subpart A, 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.
>
> MODERATE - Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attributes of the resource.
>
> LARGE - Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For some analyses, it was determined that the additional impact criteria established by the NRC in NUREG-1437, were appropriate, and those criteria were used to assign a significance level to certain impacts, as noted in specific subsections below.

The following subsections summarize the evaluation of each Alternative Site, using consistent criteria and assumptions applied to the attributes and features of each Alternate Site.

9.3.2.1 Evaluation of Site 4-1

Site 4-1 is a greenfield site in Hunterdon County, NJ. The site is located on relatively flat land approximately 5 mi. east of the Delaware River, which would be the primary water source. Elevations across the site range from 540 to 640 feet (ft.) above Mean Sea Level. Based on conceptual site boundaries identified by considering site development requirements and existing property parcels, the site has a total area of 1128 acres (ac.).

Site 4-1 would require the following off-site features in order to support a nuclear power plant:

- Road access to the site would be provided by existing public roads, but portions of those roads would have to be relocated around plant facilities or improved to allow them to carry plant-related traffic. It was assumed that all roads would be constructed on a right-of-way (ROW) 150 feet (ft.) wide. A total of 3.5 miles (mi.) of road construction was estimated to be required.
- A new rail spur would allow delivery of materials and equipment to the site. It was assumed that the rail spur would be constructed on a ROW 150 ft. wide. A conceptual route to the nearest active railroad line was identified based on existing terrain and land use features, and this route is 6.8 mi. long.
- A new makeup water pipeline would withdraw water from the Delaware River, and a new blowdown pipeline would discharge wastewater to the Delaware

River. It was assumed that the two pipelines would be constructed parallel to one another, on a single ROW 100 ft. wide. A conceptual route to the Delaware River was identified based on existing terrain and land use features, and this route is 6.6 mi. long.

- Three new 500 kV transmission lines would connect the site to the existing 500 kV transmission system. It was assumed that the three transmission lines would be constructed parallel to one another, each on a ROW 200 ft. wide. A conceptual route to the nearest existing 500 kV transmission line was identified based on existing terrain and land use features, and this route is 1.1 mi. long. It was expected that an interposing switchyard would be required at the connection point, and this switchyard was conceptually located on 25 ac. of land. In addition, it was expected that a new 500 kV transmission line from the switchyard to the Limerick Substation in PA would be required to address potential grid stability issues. The Limerick Substation is at the Limerick Generating Station, which would be capable of providing synchronizing support to Site 4-1 during grid disturbances, thus maintaining system stability. It was assumed that this transmission line would be constructed on a 200 ft. wide ROW parallel to existing transmission lines, for a total distance of 84 mi.

Subsections 9.3.2.1.1 through 9.3.2.1.8 discuss the potential environmental impacts of developing Site 4-1 and the off-site features listed above. Because the transmission corridors are significantly longer than the other off-site corridors and are not confined to the immediate site vicinity, quantitative estimates of potential impacts are presented separately for the transmission corridors.

9.3.2.1.1 Land Use

Existing land use across Site 4-1 is predominantly agricultural, with large areas planted in cultivated crops. Parts of the site are designated County Preserved Farms, a designation that would have to be addressed and mitigated for the site to be developed with a power plant. An agricultural extension research farm is located on part of the site. Soils classified as prime farmland occur across much of the site.

Residences (single family houses) are scattered across the site. There are approximately 25 houses located within the conceptual site boundaries, and most of these houses would have to be removed before the site could be developed with a power plant. Most of the site is zoned for residential use, with a zoning designation that specifies 3 ac. lots. Although the site is located 5 mi. from the nearest incorporated town, small concentrations of houses are located within 1 mi. of the site.

The off-site corridors for the access roads, rail spur, and water pipelines are largely confined to the immediate site vicinity, and the land use within these corridors is similar to the site itself, with most of the land in agricultural use and residences scattered throughout the area. It is anticipated that the corridors could be developed without removing existing houses, but some houses would be located in close proximity to the various ROW alignments.

No significant industrial land uses have been identified on the site, within the off-site corridors, or in close proximity.

Based on the conceptual plant layout developed for Site 4-1, development of the site would directly disturb (permanently and temporarily) 401 ac. of land. The remaining land within the site boundaries, which totals 727 ac., would not be directly disturbed, but access to this land would be controlled and it generally would be unavailable for non-power plant uses. In addition, development of the access road, rail spur, and water pipeline corridors would disturb 268 ac. of land. Cumulatively, 1396 ac. would be disturbed or made unavailable for non-power plant uses. The acreage of each major land use category currently found on this land was estimated based on GIS mapping data. Table 9.3-2 summarizes the acreages in the major land use categories and compares those quantities with the total acreages found in the site vicinity (within a 6 mi. radius of the site).

Table 9.3-2 shows that the acreage of each land use category potentially affected by project construction is a relatively small percentage of the total acreage of that land use available in the site vicinity. It is not expected that project construction would destabilize any important land use resources. However, construction would change the site and associated off-site corridors from predominantly rural land use with scattered housing and very little industrial development to intensive heavy industrial use. This would noticeably alter the existing land use resources. Therefore, the land use impact due to project construction would be MODERATE.

As discussed in Subsection 9.3.2.1, the potential transmission corridor to Limerick Substation is approximately 84 mi. long. This corridor, along with the transmission corridor from the site to the nearest existing 500 kV transmission line and an interposing switchyard at the connection point, includes 2136 ac. of land. Permanent land impacts associated with the transmission corridor, such as tower foundations, would be substantially less than the total acreage of the corridor.

The acreage of each major land use category currently found on this land was estimated based on GIS mapping data. Table 9.3-3 summarizes the acreages in the major land use categories and compares those quantities with the total acreages found in the 6 mi. site vicinity.

Table 9.3-3 shows that the acreage of each land use category potentially affected by transmission line construction is a relatively small percentage of the total acreage of that land use available in the site vicinity. It is not expected that transmission line construction would destabilize any important land use resources. However, transmission line construction would noticeably alter the existing land use on more than 2100 ac. of land. In addition, it is possible that some residences or other buildings would have to be removed to provide adequate clearance for the transmission lines. Therefore, the land use impact due to transmission line construction would be MODERATE.

During project operation, land use impacts would be reduced. Agricultural activities may be allowed in the transmission line and pipeline ROWs. No new land use impacts would occur beyond those described above for project construction, so land use resources that exist at the conclusion of the construction phase would not be noticeably altered. Therefore, the land use impact due to operation of the power plant, transmission lines, and other off-site features would be SMALL.

9.3.2.1.2 Air Quality

The air quality impacts of constructing and operating the new plant and off-site facilities for Site 4-1 would be similar to the impacts expected for the PSEG Site. Hunterdon County is classified as a non-attainment area for ozone, and it is considered to be in attainment with the National

Ambient Air Quality Standards (NAAQS) for all other criteria pollutants. This is the same classification as Salem County, where the PSEG Site is located.

Air quality impacts during project construction would include dust from earthmoving and material handling activities, and exhaust emissions from construction vehicles and equipment. These impacts would be similar to the impacts associated with any large construction project. To limit and mitigate the impacts, emission-specific strategies, plans and measures would be developed and implemented to ensure compliance with applicable federal and state regulations. Therefore, air quality impacts associated with construction would be SMALL.

During plant operation, the cooling towers would emit particulate matter. Auxiliary boilers and standby diesel or combustion turbine generators would emit particulate matter and gaseous pollutants such as nitrogen oxides. All emissions would be governed by a Prevention of Significant Deterioration Permit and a Title V Operating Permit, which would ensure compliance with the NAAQS and other applicable regulatory requirements. Therefore, air quality impacts associated with operation would be SMALL.

9.3.2.1.3 Hydrology, Water Use, and Water Quality

The Delaware River would be the primary source of water for a plant located at Site 4-1. The site is located 5 mi. from the river, so the only direct impact on the river during project construction would be disturbance of a relatively small section of the shoreline and river bottom for installation of a water intake structure and wastewater discharge structure. Barge access is not feasible in the Site 4-1 area, as it is north of the Delaware River Fall Line in Trenton, so a barge docking facility would not be constructed.

Water-related impacts associated with construction activities on the site itself would be similar to the impacts of any large construction project. Potential impacts include direct physical alteration of local surface water bodies; indirect alteration of nearby surface water bodies due to increased runoff volumes or diversions of runoff; degradation of downstream surface water quality as a result of erosion and sedimentation or discharges of pollutants associated with construction activities; and changes in groundwater flow patterns due to dewatering of excavations and soil retention management practices. Similar impacts would occur in the off-site corridors for construction of the rail spur, access roads, and other off-site facilities. The most significant impact would be that some existing streams on the site and within the off-site corridors would be directly disturbed, and some adjacent streams would experience a temporary increase in sediment loading due to increased runoff of disturbed soil.

Several federal, state, and local permits would govern construction activities that have the potential to impact water resources. Water-related impacts would be minimized by implementing best management practices, including erosion, grading, and sediment control measures; stormwater pollution prevention plans; spill prevention and countermeasure plans; and compliance with federal, state, and local regulations pertaining to disturbance of water bodies and pollution discharges. Withdrawal of either surface water or groundwater would be anticipated during project construction, but the quantities would be less than the quantities evaluated below for project operation. Therefore, impacts on water resources due to project construction would be SMALL.

During project operation, the new plant would withdraw make-up water from the Delaware River and discharge wastewater (primarily cooling tower blowdown) to the river. The water withdrawn from the river would either be returned to the river as blowdown or lost to the atmosphere through operation of the cooling towers. Water returned to the river as blowdown would not be lost to downstream users or aquatic communities.

As discussed in Section 3.3, the water withdrawal rate for the new plant at the PSEG Site is 78,196 gallons per minute (gpm), and the consumptive water loss (primarily due to evaporation from the cooling towers) is 26,420 gpm. These values assume that the cooling towers operate at 1.5 cycles of concentration, which is an appropriate value for the brackish water found in the Delaware River in the PSEG Site area. However, in the Site 4-1 area, the Delaware River contains fresh water, which would allow the cooling towers to operate at 3 cycles of concentration or more. At 3 cycles of concentration, the water withdrawal rate for cooling tower makeup would be approximately half that seen at 1.5 cycles of concentration. Considering additional withdrawals for plant water uses that are not affected by the cycles of concentration, the total water withdrawal for Site 4-1 is 40,300 gpm. Consumptive water use would remain the same at 26,420 gpm.

Based on U.S. Geological Survey (USGS) data (Reference 9.3-10) for the nearest available gauging station (near Belvidere, NJ), the annual mean river flow is 3,571,789 gpm, and the 7-day 10-year low flow (7Q10) is 484,736 gpm. Based on these statistics, the withdrawal rate (40,300 gpm) would divert approximately 1.1 percent of the annual mean river flow and 8.3 percent of the 7Q10 flow. The consumptive water loss (26,420 gpm) would reduce the annual mean river flow by 0.7 percent and the 7Q10 flow by 5.5 percent.

The Belvidere gauging station is more than 30 mi. upstream of the Site 4-1 area, which indicates that the actual river flows at the site would be higher than the flows discussed above, and the impacts of water withdrawal and consumption would be correspondingly lower. It also should be noted that PSEG is a co-owner of the Merrill Creek Reservoir and has an established allocation of water that can be released from the reservoir to offset consumptive use during periods of declared drought. Water withdrawal for the new plant could be supported by re-allocation of water among the existing PSEG plants, or additional existing water allocation rights would be acquired from other Merrill Creek co-owner(s).

The withdrawal of water from the Delaware River would be regulated by the Delaware River Basin Commission (DRBC) and the New Jersey Department of Environmental Protection (NJDEP), which would ensure that the diversion and consumption of river water did not adversely affect downstream users or aquatic communities. The discharge of wastewater to the Delaware River also would be regulated, ensuring compliance with applicable water quality standards and designated uses of the river. Discharges of stormwater runoff from the operational plant site and off-site facilities would be similarly regulated by the NJDEP. Therefore, impacts on surface water resources due to project operation would be SMALL.

Groundwater withdrawal would not be mandatory at Site 4-1, because the Delaware River in the site area is capable of providing fresh water for plant uses. A detailed water study would be performed if development of Site 4-1 was anticipated. However, in order to make a consistent comparison of impacts with the PSEG Site, it was assumed that the same amount of groundwater withdrawal for the PSEG Site (210 gpm average and 953 gpm maximum, per Section 3.3) would be required at Site 4-1.

Based on data provided by the USGS (Reference 9.3-11) and the New Jersey Water Science Center (Reference 9.3-6), groundwater wells in the Site 4-1 area would withdraw water from the

Newark Group Aquifers. The aquifer materials consist of fractured rock (shale, sandstone, and some conglomerate). The aquifers are unconfined to partially-confined to a depth of approximately 200 ft., and confined at greater depths. Well depths in these aquifers typically range from 30 to 1500 ft., with groundwater yields of up to 1500 gpm.

The above information indicates that the plant groundwater requirements could be supplied by one or two wells drilled to the Newark Group Aquifers. Although some parts of these aquifers may have experienced groundwater drawdown, it is likely that properly located wells could supply the plant water needs. In addition, groundwater withdrawal would be regulated by both the DRBC and the NJDEP. Therefore, impacts on groundwater resources due to project operation would be SMALL.

9.3.2.1.4 Terrestrial Biological Resources Including Protected Species

Any large construction project impacts terrestrial ecology primarily by disturbing natural habitats and making those habitats unavailable to plants and animals. Although construction activities may result in direct mortality to some plants and animals, most animal species are able to move away to avoid direct impacts. Even those species, however, may experience disruptions due to loss of habitat. In addition, noise, lights, and dust may cause some animals to leave areas near construction activities. This is also experienced as a loss of usable habitat.

As described in the New Jersey Wildlife Action Plan (Reference 9.3-4), Site 4-1 is located in the Southern Highlands Zone of the Skylands Landscape Region. The Southern Highlands Zone is dominated by agricultural fields and pastures. Forest habitat is highly fragmented and exists primarily in small patches interspersed with agricultural land and developed areas. Wetlands are scattered throughout the zone, but many have been impacted by human activity. Terrestrial species of concern in the Southern Highlands Zone are associated primarily with wetland, forest, or grassland habitats.

Ecological conditions on Site 4-1 are generally similar to the conditions described above for the Southern Highlands Zone. Most of the land is used for agriculture. Forest is restricted to scattered woodlots and strips of trees along streams. Wetlands are found primarily in isolated low areas, and some of the wetlands are farmed. Grasslands are virtually absent. The off-site corridors for the access roads, rail spur, and water pipelines are largely confined to the immediate site vicinity, and the natural habitats within these corridors are similar to the site itself.

As discussed in Subsection 9.3.2.1.1, development of the site would directly disturb (permanently and temporarily) 401 ac. of land. The remaining land within the site boundaries, which totals 727 ac., would not be directly disturbed, but construction activities would subject much of this land to indirect disturbance (noise, dust, etc.) and impede the movement of wildlife within this area. In addition, development of the access road, rail spur, and water pipeline corridors would disturb 268 ac. of land. Cumulatively, 1396 ac. would be directly or indirectly disturbed. The acreage of forest, wetlands, and grassland habitat currently found on this land was estimated based on GIS mapping data. Table 9.3-4 summarizes the acreage of each habitat that would be potentially impacted and compares those quantities with the total acreage found in the site vicinity (within a 6 mi. radius of the site).

Table 9.3-4 shows that the acreage of each habitat potentially affected by project construction is a relatively small percentage of the total acreage of that habitat available in the site vicinity. In addition, the specific habitat areas that would be disturbed generally are small and isolated from larger habitat areas. Therefore, the overall impacts on terrestrial ecology due to project construction would be SMALL. However, based on the acreage of wetlands that would be potentially affected (approximately 92 ac.), the wetlands impact due to project construction would be considered MODERATE.

As discussed in Subsection 9.3.2.1, the potential transmission corridor to Limerick Substation is 84 mi. long. This corridor, along with the transmission corridor from the site to the nearest existing 500 kV transmission line and an interposing switchyard at the connection point, includes 2136 ac. of land. The acreage of forest, wetlands, and grassland habitat currently found on this land was estimated based on GIS mapping data. Table 9.3-5 summarizes the acreage of each habitat that would be potentially impacted and compares those quantities with the total acreages found in the 6 mi. site vicinity.

Table 9.3-5 shows that the acreage of each habitat potentially affected by transmission line construction is a relatively small percentage of the total acreage of that habitat available in the site vicinity. It is not expected that transmission line construction would destabilize terrestrial ecological resources. However, the acreage of both wetlands and forest that would be potentially affected (36 ac. and 581 ac., respectively) is significant. It should be noted that wetlands impacts would be limited to the areas of tower construction, and final routing of the transmission line would take wetlands avoidance into consideration. Clearing of the forested areas would noticeably alter the plant and animal species found in these areas. Therefore, the impacts on terrestrial ecology due to transmission line construction would be MODERATE.

The terrestrial ecology impacts of project operation would be similar to the impacts of construction but reduced. Areas that are paved or occupied by project facilities would be permanently unavailable to plants and animals, but areas that are used for construction laydown or other temporary activities may be re-colonized by some species after construction is finished. Therefore, impacts on terrestrial ecology due to operation of the power plant, transmission lines, and other off-site features would be SMALL.

Information on protected and rare species that may occur in the Site 4-1 area was obtained from the NJDEP (Reference 9.3-3). According to this information, 13 animal species and 1 plant species have been recorded within approximately 1 mi. of the site. These species are listed in Table 9.3-6. Detailed field studies would be required to determine whether any of these species make significant use of the site or off-site corridors, and as reconnaissance level data was used for evaluation, such studies were not conducted for the alternative sites. However, based on the relatively minor impacts on natural habitats described above, it is unlikely that any of these species would be significantly affected by project construction or operation. Therefore, impacts on protected and rare terrestrial species would be expected to be SMALL.

9.3.2.1.5 Aquatic Biological Resources Including Protected Species

As discussed in Subsection 9.3.2.1.3, project construction would result in the disturbance of a section of the Delaware River shoreline and river bottom due to installation of a water intake structure and wastewater discharge structure. Some aquatic organisms that use this area might suffer direct impacts from construction activities, but most organisms would move away from the area and be affected primarily by the loss of a limited amount of habitat. In addition, some aquatic species might be affected by increased turbidity and siltation resulting from construction activities, but such effects would be temporary and localized.

Construction activities on the site and in the off-site corridors would result in direct disturbance to some existing streams, and some adjacent streams would experience a temporary increase in sediment loading due to increased runoff of disturbed soil. There is no indication that any of the streams that would be affected have any exceptional or high ecological value. Similar streams are common in the 6 mi. vicinity around Site 4-1.

Based on GIS mapping data, the total length of streams that would be directly affected by construction on the site and in the access road, rail spur, and water pipeline corridors is 2946 ft. This represents 0.1 percent of the total length of streams in the 6-mi. site vicinity (2,253, 912 ft.). In addition, the total length of streams included within the transmission corridors and interposing switchyard is 32,704 ft., which represents 1.5 percent of the stream length in the site vicinity. Most of the streams in the transmission corridors would not be directly affected; it is estimated that 95 percent of the streams could be avoided during transmission line construction.

The expected stream disturbance is a very small percentage of the total length of streams available in the site vicinity. In addition, construction impacts on streams and on the Delaware River would be regulated under federal, state, and local permits. Therefore, impacts on aquatic ecology due to construction of the power plant, transmission lines, and other off-site features would be SMALL.

During operation of the power plant, transmission lines, and other off-site features, there would be little if any additional impact on streams. The primary source of potential impacts during operation would be the withdrawal of water from the Delaware River. Some aquatic organisms would be entrained with the intake water or impinged on the intake screens. However, federal regulations (40 CFR Part 125) require cooling water intake structures to meet stringent criteria designed to protect organisms from entrainment and impingement. In addition, the amount of water withdrawn would be a relatively small percentage of the overall river flow, as discussed in Subsection 9.3.2.1.3. Therefore, impacts on aquatic ecology due to project operation would be SMALL.

Information provided by the NJDEP on protected and rare species that may occur in the site area (Reference 9.3-3) did not identify any aquatic species. Detailed field studies would be required to determine whether any protected or rare species make significant use of any streams or the part of the Delaware River that could be affected by the project, and as reconnaissance level data was used for evaluation, such studies were not conducted for the alternative sites. However, based on the relatively minor impacts on aquatic habitats described above, it is unlikely that any of aquatic species would be significantly affected by project construction or operation. Therefore, impacts on protected and rare aquatic species would be expected to be SMALL.

9.3.2.1.6 Socioeconomics

This subsection evaluates the social and economic impacts that could result from constructing and operating the new plant at Site 4-1. The evaluation includes the impacts of construction and operation activities and demands placed by the construction and operation workforces on the site and the surrounding region. It is assumed that all construction activities would occur within the site boundaries and off-site corridors described in Subsection 9.3.2.1, and physical impacts would be restricted to these construction areas and nearby properties. Other socioeconomic impacts generally occur on a regional basis, and in the following subsections they are evaluated for Hunterdon County and the region within 50 mi. of Site 4-1.

9.3.2.1.6.1 Physical Impacts

Any large construction project can cause temporary and localized physical impacts such as noise, vibration, dust, vehicle exhaust, and odors. In addition, construction materials, equipment, and workers must be transported to the construction areas, and these transportation activities also cause noise, vibration, dust, vehicle exhaust, and odors. For Site 4-1, a new rail spur would be constructed, and this rail line would be used to transport large equipment and materials to the site. Public roadways would be used to transport smaller equipment, as well as large numbers of construction workers. Appropriate measures would be taken to minimize noise, dust, and other impacts due to both construction and transportation activities. However, because residences are located throughout the area surrounding Site 4-1, it would not be possible to avoid close proximity to some residences. Based on field reconnaissance and examination of aerial photographs, it is estimated that more than 100 residences are located within 0.5 mi. of the conceptual site boundaries. Other residences are located in close proximity to the conceptual rail spur and other off-site corridors. Despite the implementation of appropriate mitigation measures, many of these residences probably would experience some impact due to construction-related noise, vibration, and dust. This would noticeably alter the existing physical conditions in the immediate site area. For this reason, the physical impact due to project construction would be MODERATE.

The physical impacts of project operation would be similar to the impacts of construction but somewhat reduced. Operating plant equipment would produce some noise, but the noise levels generally would be lower than the levels associated with construction activities. Workers and some materials and equipment would be transported to the site during project operation, but the amount of traffic and size of shipments generally would be less than during project construction. Periodic maintenance would be required for both on-site and off-site facilities, and the maintenance activities would create some noise, vibration, and dust, but these impacts would be more localized and of shorter duration than during project construction. Therefore, the physical impact due to project operation would be SMALL.

9.3.2.1.6.2 Demography

Impacts on demography would be associated with construction workers and operation workers moving into the region surrounding the project site, potentially causing changes in off-site land use and development patterns. Construction employment is inherently temporary, but construction workers sometimes move their families into the region, magnifying the population increase. However, in densely populated states such as NJ and the adjacent states, a substantial number of construction workers may commute from their existing residences and not need to move into the region.

Per NUREG-1437, demographic impacts are expected to be SMALL if project-related population growth represents less than 5 percent of the study area's total population, MODERATE if 5 to 20 percent, and LARGE if more than 20 percent.

The analysis presented in Subsection 4.4.2.1 indicates that if the new plant were constructed at the PSEG Site, 634 of the 4100 construction workers could be expected to move into the four-county Region of Influence. The analysis conservatively assumes that all of the workers who move into the region would bring their families, resulting in a total population increase of 1712 people. For purposes of evaluating demographic impacts at Site 4-1, it was assumed that the same population increase would occur in Hunterdon County. For the purpose of this comparison, this is considered a conservative assumption, because the same population increase for the four counties surrounding the PSEG Site is being applied to one county for Site 4-1 and the impact is not noticeable.

Based on U.S. Census Bureau (USCB) data (Reference 9.3-9), the population of Hunterdon County was 121,989 in the year 2000, and the population was estimated to have increased to 129,031 in 2008. Using the year 2000 population (121,989) and the conservative population increase discussed above (1712), project-related population growth due to the construction workforce would be approximately 1.4 percent. Therefore, the construction-related demographic impact in Hunterdon County would be SMALL.

Another conservative assumption that can be made is that the entire peak construction workforce (4100 people) would move into and bring families into the 50-mi. region surrounding the project site. Applying the average NJ household size of 2.70 people per household (Subsection 4.4.2.1), the total population increase would be 11,070. Based on USCB data (Reference 9.3-9), the population of the region within a 50- mi. radius of Site 4-1 was 10,808,154 in the year 2000. Using this population value and a population increase of 11,070, project-related population growth due to the construction workforce would be 0.1 percent. Therefore, the construction-related demographic impact in the 50 mi. region would be SMALL.

The analysis presented in Subsection 5.8.2.1 indicates that if the new plant were constructed at the PSEG Site, 496 of the 600 operation workers could be expected to move into the four-county Region of Influence. Conservatively assuming that all of these workers moved into Hunterdon County and brought families with an average of 2.70 people per household, the resulting population increase would be 1338 people. Obviously, this would be a smaller impact than the construction-related population increase discussed above. In addition, the total number of operation workers is significantly smaller than the peak construction workforce discussed above. Therefore, the operation-related demographic impact in both Hunterdon County and the 50-mi. region would be SMALL.

9.3.2.1.6.3 Economy

Impacts on the economy would be caused primarily by the jobs provided to construction and operation workers. The wages paid to workers result in additional spending, which tends to stimulate the economy, particularly in the retail and service sectors. This can provide opportunities for new businesses and new jobs. These effects are considered to be beneficial and would be expected to occur primarily in the area within which the workers reside.

Per NUREG-1437, economic impacts are considered SMALL if project-related employment represents less than 5 percent of the study area’s total employment, MODERATE if 5 to 10 percent, and LARGE if more than 10 percent.

In the previous subsection it was conservatively estimated that if the new plant were constructed at Site 4-1, 634 construction workers would move into Hunterdon County and 4100 construction workers would move into the 50-mi. region surrounding the site.

Based on USCB data for the year 2000 (Reference 9.3-9), the total number of employees in Hunterdon County was 63,448, and the total number of employees in the 50-mi. region was 5,018,984. Using the county value for total employment (63,448) and the conservative county employment increase discussed above (634), project-related employment due to the construction workforce would be 1.0 percent. Therefore, the construction-related economic impact in Hunterdon County would be SMALL. Using the regional value for total employment (5,018,984) and the conservative regional employment increase discussed above (4100), project-related employment due to the construction workforce would be less than 0.1 percent. Therefore, the construction-related economic impact in the 50-mi. region would be SMALL.

As discussed in the previous subsection, the number of operation workers estimated to move into both Hunterdon County and the 50-mi, region is significantly smaller than the number of construction workers. Therefore, the operation-related economic impact in both Hunterdon County and the 50-mi. region would be SMALL.

9.3.2.1.6.4 Taxes

Property taxes, sales taxes, and other taxes paid during construction and operation of the new plant would benefit the state and local jurisdictions that collect the taxes. Per NUREG-1437, tax impacts are considered SMALL if project-related tax revenues represent less than 10 percent of the total tax revenues of the local taxing jurisdictions, MODERATE if 10 to 20 percent, and LARGE if more than 20 percent.

The analysis presented in Subsections 4.4.2.2.2 indicates that the taxes paid by the new plant during project construction are expected to be significantly less than 10 percent of the total tax revenues for Salem County, resulting in a SMALL tax impact. The analysis presented in Subsection 5.8.2.2.2 indicates that the taxes paid by the new plant during project operation also are expected to result in a SMALL tax impact.

Based on 2008 county budget documents (Reference 9.3-1), Salem County has total annual tax revenues of $45,672,000, while Hunterdon County has total annual tax revenues of $70,858,000. Therefore, the taxes paid by the new plant would be a smaller percentage of the total tax revenues for Hunterdon County than for Salem County, and the tax impact associated with both construction and operation would be SMALL.

9.3.2.1.6.5 Transportation

Transportation in the vicinity of the new plant could be affected by the increase in vehicle traffic associated with construction and operation workers commuting to the site and the delivery of materials and equipment to the site. The increase in vehicle traffic could cause delays on local roads. The severity of such impacts would depend primarily on the existing traffic volumes and level-of-service (LOS) on local roads compared with the expected volume of project-related traffic.

Road access to the Site 4-1 area is provided primarily by NJ Routes 513 and 579. Both are considered secondary state routes, but both are relatively wide two-lane highways. Road access to the site itself is provided primarily by Hunterdon County Road 615. This is a relatively narrow two-lane road and appears to be used mostly by local traffic.

The New Jersey Department of Transportation (NJDOT) does not publish LOS designations for roads in the state. However, NJDOT data (Reference 9.3-5) indicates that the following average daily traffic volumes (both directions) occur on the roads listed above:

- NJ Route 513 = 3284
- NJ Route 579 = 4504
- Hunterdon County Road 615 = 2005

As discussed in Subsection 4.4.1.5, maximum construction-related traffic volumes are expected to occur during shift changes (twice per day) in the peak construction workforce. During such shift changes, 2200 vehicles are expected to use local roads. Delivery of construction materials and equipment is expected to add another 50 vehicles per day over the construction period.

Considering the nature of the roads in the Site 4-1 area and the current volume of traffic on those roads, it is likely that the peak construction traffic would noticeably alter existing transportation conditions (cause noticeable delays on local roads) but not be sufficient to destabilize important transportation resources. Therefore, the transportation impact associated with project construction would be MODERATE.

As discussed in Subsection 5.8.1.2, maximum traffic volumes associated with plant operation are expected to occur when fuel-reloading is being conducted for one generating unit and another unit is operating. The peak traffic volume at such times could be 1200 vehicles. Because this number of vehicles is significantly smaller than the peak construction traffic volume, it would not be expected to noticeably alter transportation conditions. Therefore, the transportation impact associated with project operation would be SMALL.

9.3.2.1.6.6 Aesthetics

Aesthetics in the vicinity of the new plant could be affected by the visual intrusion of large industrial structures and equipment. During project construction, dust could create additional visual intrusions. During operation, water vapor plumes from the cooling towers would be readily visible at certain times. Given that the Site 4-1 area currently has predominantly rural scenery, project construction and operation would dramatically alter the existing visual conditions. However, the severity of visual impacts on the human population would depend primarily on the visibility of the plant and off-site facilities from sensitive viewing areas.

As discussed in Subsection 9.3.2.1.6.1, field reconnaissance and examination of aerial photographs indicate that more than 100 residences are located within 0.5 mi. of the conceptual site boundaries. Although trees and existing buildings may block the view of some of these residences, many would be expected to have at least a partial view of the power plant during construction and operation. In addition, some residences are located near the conceptual off-site corridors and would have at least a partial view of the transmission lines, rail spur, and other off-site facilities during construction and operation.

Other sensitive viewing areas also are located in relatively close proximity to the site and off-site corridors. The nearest boundary of the New Jersey Highlands, an area designated by the state legislature for special preservation and planning measures, is located within 1 mi. of the conceptual site boundaries. During project construction and operation, the power plant would be at least partially visible from portions of the New Jersey Highlands. In addition, the conceptual rail spur corridor passes through a portion of the New Jersey Highlands. In order to avoid the Highlands it would be necessary to connect with a different railroad line, resulting in much longer than 6.8 mi. rail spur with greater costs and environmental impacts.

St. Thomas Episcopal Church, an active church with a historic building and cemetery, is located 0.5 mi. from the conceptual site boundaries and less than 0.5 mi. from the conceptual rail spur corridor. During project construction and operation, the power plant and rail spur probably would be at least partially visible from the church grounds.

Franklin Township Elementary School is located 1.0 mi. from the conceptual site boundaries, and the school grounds may have partial views of the power plant during construction and operation.

NUREG-1437 establishes the following criteria for judging the severity of aesthetic impacts:

> SMALL - No complaints from affected public about a changed sense of place or a diminution in enjoyment of the physical environment, and no measurable impact on socioeconomic institutions and processes.
>
> MODERATE - Some complaints from affected public about a changed sense of place or a diminution in enjoyment of the physical environment, and measurable impacts that do not alter the continued functioning of socioeconomic institutions and processes.
>
> LARGE - Continuing and widely shared opposition to the project based on a perceived degradation of the area's sense of place or diminution in enjoyment of the physical environment, and measurable social impacts that perturb the continued functioning of community institutions and processes.

Considering that the power plant and off-site facilities would be visible from several sensitive viewing areas, and considering that project construction would dramatically alter the existing rural scenery, it is likely that project construction would generate public complaints related to a changed sense of place and diminished enjoyment of the physical environment. It is likely that there would be general opposition to the project, and possible that there could be measurable social impacts that perturb the continued functioning of institutions such as St. Thomas Episcopal Church. Therefore, the aesthetic impact associated with project construction would be MODERATE to LARGE.

Although project operation would not result in significant further alteration of aesthetic conditions, the power plant, cooling tower plumes, transmission lines, and rail spur traffic would continue to be visible from sensitive viewing areas. It is likely that there would be public complaints related to diminished enjoyment of the physical environment, and possible that there could be general opposition to the project and measurable social impacts that perturb the continued functioning of community institutions and processes. Therefore, the aesthetic impact associated with project operation would be MODERATE to LARGE.

9.3.2.1.6.7 Housing

Impacts on housing could be caused by construction and operation workers moving, either permanently or temporarily, into the region surrounding the project site. This influx of workers could decrease the availability of unoccupied housing units and increase the cost to buy or rent housing. The severity of such impacts would depend primarily on the existing availability of unoccupied housing units compared with the number of workers who would move into the area.

NUREG-1437 establishes the following criteria for judging the severity of housing impacts:

> SMALL - Small and not easily discernible change in housing availability. Increases in rental rates or housing values equal or slightly exceed the statewide inflation rate.
>
> MODERATE - Discernible but short-lived reduction in available housing units. Rental rates and housing values rise slightly faster than the inflation rate, but prices realign quickly once new housing units became available or project-related demand diminishes.
>
> LARGE - Project-related demand for housing units results in very limited housing availability and increases in rental rates and housing values well above normal inflationary increases in the state.

In Subsection 9.3.2.1.6.2 it was conservatively estimated that if the new plant were constructed at Site 4-1, 634 construction workers would move into Hunterdon County and 4100 construction workers would move into the 50-mi. region surrounding the site.

Based on USCB data for the year 2000 (Reference 9.3-9), the total number of housing units in Hunterdon County was 45,032, and the number of vacant units was 1354. The conservative estimate of in-migrating construction workers discussed above (634) represents 46.8 percent of the unoccupied housing units in the county. Because more than half of the unoccupied housing units would remain available, it is unlikely that there would be an easily discernible change in housing availability or a significant increase in housing costs. Therefore, the construction-related housing impact in Hunterdon County would be SMALL.

Based on USCB year 2000 data, the total number of housing units in the 50-mi. region surrounding Site 4-1 was 4,227,052, and the number of vacant units was 249,272. The conservative estimate of in-migrating construction workers discussed above (4100) represents 1.6 percent of the unoccupied housing units in the region. Because a large percentage of the unoccupied housing units would remain available, it is very unlikely that there would be a discernible change in housing availability or increase in housing costs. Therefore, the construction-related housing impact in the 50-mi. region would be SMALL.

As discussed in Subsection 9.3.2.1.6.2, the number of operation workers estimated to move into both Hunterdon County and the 50-mi. region is significantly smaller than the number of construction workers. Therefore, the operation-related housing impact in both Hunterdon County and the 50-mi. region would be SMALL.

9.3.2.1.6.8 Public Services

Public services include police, fire and medical services; social services; water supply and waste water treatment facilities; and recreation facilities. Impacts on public services could be caused by construction and operation workers moving into the region surrounding the project site. This influx of workers could increase the demand for public services, potentially requiring local governments to add facilities, programs, and/or staff.

Per NUREG-1437, impacts on public services generally are considered to be SMALL if there is little or no need to add facilities, programs, and/or staff because of the influx of workers, and MODERATE or LARGE if additional facilities, programs, and/or staff are required.

As discussed in Subsection 9.3.2.1.6.2, the number of construction and operation workers estimated to move into both Hunterdon County and the 50-mi, region is insignificant compared with the existing populations. Because there would not be a noticeable increase in the population demanding public services, it is very unlikely that there would be a need to add facilities, programs, and/or staff. Therefore, the construction-related and operation-related impact on public services in both Hunterdon County and the 50-mi. region would be SMALL.

9.3.2.1.6.9 Education

Impacts on education could be caused by construction and operation workers moving into and bringing school-aged children into the region surrounding the project site. This increase in the number of school-aged children could cause crowding of local schools and potentially require school systems to add facilities and/or staff.

Per NUREG-1437, impacts on education are considered to be SMALL if the project-related increase in school enrollment represents less than 3 percent of the total school enrollment in affected school systems, MODERATE if 4 to 8 percent, and LARGE if more than 8 percent.

The analysis presented in Subsection 4.4.2.2.7 indicates that if the new plant were constructed at the PSEG Site, 315 school-aged children could be expected to move into the four-county Region of Influence. For purposes of evaluating education impacts at Site 4-1, it was assumed that the same increase in the number of school-aged children would occur in Hunterdon County. For the purpose of this comparison, this is considered a conservative assumption, because the same increase for the four counties surrounding the PSEG Site is being applied to one county for Site 4-1 and the impact is not noticeable.

Based on USCB data for the year 2000 (Reference 9.3-9), the total school enrollment (kindergarten through 12th grade) in Hunterdon County was 23,496. The conservative increase in school-aged children discussed above (315) represents 1.3 percent of the total school enrollment in the county. Therefore, the construction-related education impact in Hunterdon County would be SMALL.

In Subsection 9.3.2.1.6.2 it was conservatively estimated that the total construction-related population increase in the 50-mi. region surrounding Site 4-1 would be 11,070. As discussed in Subsection 4.4.2.2.7, school-aged children account for 14.0 to 18.4 percent of the total county populations in the four-county Region of Influence. Using the highest percentage (18.4), the construction-related population increase (11,070) would result in 2037 school-aged children moving into the 50-mi. region surrounding Site 4-1.

Based on USCB year 2000 data, the total school enrollment (kindergarten through 12th grade) in the 50-mi. region surrounding Site 4-1 was 2,038,194. The conservative increase in school-aged children discussed above (2037) represents 0.1 percent of the total school enrollment in the region. Therefore, the construction-related education impact in the 50-mi. region would be SMALL.

As discussed in Subsection 6.3.2.1.6.2, the number of operation workers estimated to move into both Hunterdon County and the 50-mi. region is significantly smaller than the number of construction workers. The number of school-aged children would be correspondingly smaller. Therefore, the operation-related education impact in both Hunterdon County and the 50-mi. region would be SMALL.

9.3.2.1.7 Historical and Archaeological Resources

Historical and archaeological resources could be directly disturbed by construction activities or indirectly disturbed by noise, dust, vehicle emissions, or visual intrusion during project construction and operation. The severity of such impacts would depend on the historic significance of the resources and the degree of disturbance.

Several properties listed on the National Register of Historic Places (NRHP) and/or the New Jersey Register of Historic Places (NJRHP) are located in the immediate vicinity of Site 4-1. In addition, one archaeological site that is not listed on either register but is reported in files maintained by the New Jersey Historic Preservation Office (NJHPO) is located within the conceptual plant footprint. This archaeological site would be directly disturbed by project construction, and it would have to be investigated before construction could proceed. If it was determined to be potentially eligible for the NRHP or NJRHP, the site would have to be excavated and any significant archaeological artifacts curated before the area was disturbed.

St. Thomas Episcopal Church, which is listed on both the NRHP and the NJRHP, is located 0.5 mi. from the conceptual site boundaries and less than 0.5 mi. from the conceptual rail spur corridor. The church would not be directly disturbed, but during project construction and operation it would be subject to noise and visual intrusion.

The Rockhill Agricultural Historic District, which is listed on both the NRHP and the NJRHP, is located less than 0.5 mi. from the conceptual rail spur corridor. The historic district would not be directly disturbed, but during construction and operation of the rail spur it would be subject to noise and visual intrusion.

The rail spur would connect to an active railroad line that runs along the Lehigh Valley Railroad Historic District, which is not listed on the NRHP but is listed on the NJRHP. Construction and operation of the rail spur would directly affect this historic district, but given that a railroad line currently operates in the historic district, it is not clear whether disturbance due to the rail spur would have a significant impact. This issue would require detailed discussion with the NJHPO.

The impacts summarized above would noticeably alter the existing historical and archaeological resources in the immediate site area during project construction. Depending on the significance of the impacts experienced by the Lehigh Valley Railroad Historic District, it is possible that construction could destabilize important attributes of this resource. Therefore, the impact on historical and archaeological resources due to project construction would be MODERATE to LARGE.

The impacts of project operation would be similar to the impacts of construction but somewhat reduced. The noise levels of operating plant equipment generally would be lower than the levels associated with construction activities. Traffic on the rail spur generally would be less frequent and involve smaller shipments than during project construction. Therefore, the impact on historical and archaeological resources due to project operation would be SMALL.

9.3.2.1.8 Environmental Justice

Environmental justice issues involve aspects of the project that could disproportionately impact minority or low income populations. The potential for disproportionate impacts depends primarily on the location of the power plant and off-site facilities in relation to existing minority and low income populations.

USCB data for the year 2000 (Reference 9.3-8) were used to determine the percentage of minority and low-income populations within the 6-mi. site vicinity, and to identify any census block groups that contain a higher than average percentage of minority or low-income populations. The percentages for the site vicinity and each census block group were compared to the percentages for NJ.

Minorities comprise 9.1 percent of the population within 6 mi. of Site 4-1, compared with 34.0 percent for NJ. People with incomes below the poverty level comprise 3.1 percent of the population within 6 mi. of Site 4-1, compared with 8.5 percent for NJ. Of the 25 census block groups that have at least 50 percent of their area within 6 mi. of the site, only one has minority or poverty populations above the state average. Minorities comprise 37.3 percent of the population within this block group, and people with incomes below the poverty level comprise 14.2 percent. The nearest boundary of this block group is 4.9 mi. east-southeast of the conceptual site boundaries. The block group is not crossed by any of the conceptual off-site corridors and would not be expected to experience any direct impacts from construction or operation of the power plant or off-site facilities.

Based on the above information there does not appear to be a significant potential for the project to disproportionately impact minority or low income populations. Therefore, environmental justice impacts due to project construction and operation would be SMALL.

9.3.2.2 Evaluation of Site 7-1

Site 7-1 is a greenfield site in Salem County, NJ. The site is located on flat land 5 mi. east of the Delaware River, which would be the primary water source. Elevations across the site range from 15 to 35 ft. above Mean Sea Level. Based on conceptual site boundaries identified by considering site development requirements and existing property parcels, the site has a total area of 987 ac.

Site 7-1 would require the following off-site features in order to support a nuclear power plant:

- Road access to the site would be provided by existing public roads, but portions of those roads would have to be relocated around plant facilities or improved to allow them to carry plant-related traffic. It was assumed that all roads would be constructed on a ROW 150 ft. wide. A total of 3.3 mi. of road construction was estimated to be required.
- A new rail spur would allow delivery of materials and equipment to the site. It was assumed that the rail spur would be constructed on a ROW 150 ft. wide. A conceptual route to the nearest active railroad line was identified based on existing terrain and land use features, and this route is 6.9 mi. long.
- A new makeup water pipeline would withdraw water from the Delaware River, and a new blowdown pipeline would discharge wastewater to the Delaware River. It was assumed that the two pipelines would be constructed parallel to one another, on a single ROW 100 ft. wide. A conceptual route to the Delaware River

was identified based on existing terrain and land use features, and this route is 5.1 mi. long.

- Three new 500 kV transmission lines would connect the site to the existing 500 kV transmission system. It was assumed that the three transmission lines would be constructed parallel to one another, each on a ROW 200 ft. wide. A conceptual route to the nearest existing 500 kV transmission line was identified based on existing terrain and land use features, and this route is 5.4 mi. long. It was expected that an interposing switchyard would be required at the connection point, and this switchyard was conceptually located on 25 ac. of land. In addition, it was expected that a new 500 kV transmission line from the switchyard to the Indian River Substation in Delaware would be required to address potential grid stability issues. The Indian River Substation is a strong regional 500 kV substation that would be capable of providing synchronizing support to Site 7-1 during grid disturbances, thus maintaining system stability. It was assumed that this transmission line would be constructed on a 200 ft. wide ROW generally following existing transmission lines, for a total distance of 96 mi.

Subsections 9.3.2.2.1 through 9.3.2.2.8 discuss the potential environmental impacts of developing Site 7-1 and the off-site features listed above. Because the transmission corridors are significantly longer than the other off-site corridors and are not confined to the immediate site vicinity, quantitative estimates of potential impacts are presented separately for the transmission corridors.

9.3.2.2.1 Land Use

Existing land use across Site 7-1 is predominantly agricultural, with large fields planted in cultivated crops. Most of the site is zoned for agricultural use. Soils classified as prime farmland or Farmland of Statewide Importance occur across much of the site.

Residences (single family houses) are scattered across the site. There are approximately 17 houses located within the conceptual site boundaries, and most of these houses would have to be removed before the site could be developed with a power plant. The site is located less than 4 mi. from the nearest incorporated town, and small groups of houses are located within 1 mi. of the site.

An active church and cemetery are located inside the conceptual site boundaries. Based on preliminary site development plans, the church and cemetery would not be directly disturbed, and public access could be maintained during project construction. However, it is possible that emergency planning could limit public access to the church and cemetery during project operation.

The off-site corridors for the access roads, rail spur, and water pipelines are largely confined to the immediate site vicinity, and the land use within these corridors is similar to the site itself, with most of the land in agricultural use and residences scattered throughout the area. It is anticipated that the corridors could be developed without removing existing houses, but some houses would be located in close proximity to the various ROW alignments.

No significant industrial land uses have been identified on the site, within the associated off-site corridors, or in close proximity.

Based on the conceptual plant layout developed for Site 7-1, development of the site would directly disturb (permanently and temporarily) 432 ac. of land. The remaining land within the site boundaries, which totals 555 ac., would not be directly disturbed, but access to this land would be controlled and it generally would be unavailable for non-power plant uses. In addition, development of the access road, rail spur, and water pipeline corridors would disturb 246 ac. of land. Cumulatively, 1233 ac. would be disturbed or made unavailable for non-power plant uses. The acreage of each major land use category currently found on this land was estimated based on GIS mapping data. Table 9.3-7 summarizes the acreages in the major land use categories and compares those quantities with the total acreages found in the site vicinity (within a 6 mi. radius of the site).

Table 9.3-7 shows that the acreage of each land use category potentially affected by project construction is a relatively small percentage of the total acreage of that land use available in the site vicinity. Therefore, it is not expected that project construction would destabilize any important land use resources. However, construction would change the site and associated off-site corridors from predominantly rural land use with scattered housing and very little industrial development to intensive heavy industrial use. This would noticeably alter the existing land use resources. Therefore, the land use impact due to project construction would be MODERATE.

As discussed in Subsection 9.3.2.2, the potential transmission corridor to Indian River Substation is approximately 96 mi. long. This corridor, along with the transmission corridor from the site to the nearest existing 500 kV transmission line and an interposing switchyard at the connection point, includes 2857 ac. of land. Permanent land impacts associated with the transmission corridor, such as tower foundations, would be substantially less than the total acreage of the corridor.

The acreage of each major land use category currently found on this land was estimated based on GIS mapping data. Table 9.3-8 summarizes the acreages in the major land use categories and compares those quantities with the total acreages found in the 6 mi. site vicinity.

Table 9.3-8 shows that the acreage of each land use category potentially affected by transmission line construction is a relatively small percentage of the total acreage of that land use available in the site vicinity. It is not expected that transmission line construction would destabilize any important land use resources. However, transmission line construction would noticeably alter the existing land use on more than 2800 ac. of land. It is possible that some residences or other buildings would have to be removed to provide adequate clearance for the transmission lines. Therefore, the land use impact due to transmission line construction would be MODERATE.

During project operation, land use impacts generally would be reduced. Agricultural activities might be allowed in the transmission line and pipeline ROWs. Most land use resources that exist at the conclusion of the construction phase would not be noticeably altered during operation. However, as discussed above, it is possible that emergency planning for the operational power plant could limit public access to the church and cemetery located within the conceptual site boundaries. If the church and cemetery had to be closed, that aspect of the site land use would be noticeably altered. Therefore, the land use impact due to project operation would be SMALL to MODERATE.

9.3.2.2.2 Air Quality

The air quality impacts of constructing and operating the new plant and off-site facilities for Site 7-1 would be similar to the impacts expected for the PSEG Site. Salem County is classified as a non-attainment area for ozone, and it is considered to be in attainment with the NAAQS for all other criteria pollutants. The PSEG Site is located in the same county.

Air quality impacts during project construction would include dust from earthmoving and material handling activities, and exhaust emissions from construction vehicles and equipment. These impacts would be similar to the impacts associated with any large construction project. To limit and mitigate the impacts, emission-specific strategies, plans and measures would be developed and implemented to ensure compliance with applicable federal and state regulations. Therefore, air quality impacts associated with construction would be SMALL.

During plant operation, the cooling towers would emit particulate matter. Auxiliary boilers and standby diesel or combustion turbine generators would emit particulate matter and gaseous pollutants such as nitrogen oxides. All emissions would be governed by a Prevention of Significant Deterioration Permit and a Title V Certificate to Operate, which would ensure compliance with the NAAQS and other applicable regulatory requirements. Therefore, air quality impacts associated with operation would be SMALL.

9.3.2.2.3 Hydrology, Water Use, and Water Quality

The Delaware River would be the primary source of water for a plant located at Site 7-1. The site is located 5 mi. from the river, so the only direct impact on the river during project construction would be disturbance of a section of the shoreline and river bottom for installation of required facilities. At a minimum, the required facilities include a water intake structure and wastewater discharge structure, which would disturb a relatively small area of the shoreline and river bottom. Barge access is feasible on the Delaware River in the Site 7-1 area, but because any potential barge unloading area would be at least 5 mi. from the site, it is not clear whether a barge docking facility would be constructed. If constructed, a barge docking facility would result in additional disturbance of the shoreline and river bottom.

Water-related impacts associated with construction activities on the site itself would be similar to the impacts of any large construction project. Potential impacts include direct physical alteration of local surface water bodies; indirect alteration of nearby surface water bodies due to increased runoff volumes or diversions of runoff; degradation of downstream surface water quality as a result of erosion and sedimentation or discharges of pollutants associated with construction activities; and changes in groundwater flow patterns due to dewatering of excavations and soil retention management practices. Similar impacts would occur in the off-site corridors for construction of the rail spur, access roads, and other off-site facilities. The most significant impact would be that some existing streams on the site and within the off-site corridors would be directly disturbed, and some adjacent streams would experience a temporary increase in sediment loading due to increased runoff of disturbed soil.

Several federal, state, and local permits would govern construction activities that have the potential to impact water resources. Water-related impacts would be minimized by implementing BMPs, including erosion, grading, and sediment control measures; stormwater pollution prevention plans; spill prevention and countermeasure plans; and compliance with federal, state, and local regulations pertaining to disturbance of water bodies and pollution discharges.

Withdrawal of either surface water or groundwater would be anticipated during project construction, but the quantities would be less than the quantities evaluated below for project operation. Therefore, impacts on water resources due to project construction would be SMALL. During project operation, the new plant would withdraw make-up water from the Delaware River and discharge wastewater (primarily cooling tower blowdown) to the river. The water withdrawn from the river would either be returned to the river as blowdown or lost to the atmosphere through operation of the cooling towers. Water returned to the river as blowdown would not be lost to downstream users or aquatic communities.

As discussed in Section 3.3, the water withdrawal rate for the new plant at the PSEG Site is 78,196 gpm, and the consumptive water loss (primarily due to evaporation from the cooling towers) is 26,420 gpm. These values assume that the cooling towers operate at 1.5 cycles of concentration, which is appropriate for the brackish water found in the Delaware River at the PSEG Site. Site 7-1 would withdraw water from the same part of the Delaware River, so the same values can be used for Site 7-1.

Based on USGS data (Reference 9.3-10) for the nearest available gauging station (near Trenton, NJ), the annual mean river flow is 5,318,636 gpm, and the 7Q10 flow is 771,988 gpm. Based on these statistics, the withdrawal rate (78,196 gpm) would divert 1.5 percent of the annual mean river flow and 10.1 percent of the 7Q10 flow. The consumptive water loss (26,420 gpm) would reduce the annual mean river flow by 0.5 percent and the 7Q10 flow by 3.4 percent.

As stated above, Site 7-1 is located in an area where the Delaware River water is brackish. Because consumptive water use at locations with brackish water has a lesser impact on salinity intrusion than an equal consumption of fresh water, the DRBC has developed an “equivalent impact factor” (EIF) to account for the difference. As discussed in Subsection 5.2.1.2, the EIF in the PSEG Site area is 0.18. The factor applicable to Site 7-1 would nominally be the same as the value for the PSEG Site. Using this factor, the 26,420 gpm consumptive use of Delaware River water is equivalent to a freshwater consumptive use impact of a 4756 gpm. This impact represents approximately 0.1 percent of the annual average river flow and 0.6 percent of the 7Q10 flow.

It should be noted that the Trenton gauging station is more than 60 mi. upstream of the Site 7-1 area. Therefore, the actual river flows in the site area are expected to be considerably higher than the flows discussed above, and the impacts of water withdrawal and consumption would be correspondingly lower. It also should be noted that PSEG is a co-owner of the Merrill Creek Reservoir and has an established allocation of water that can be released from the reservoir to offset consumptive use during periods of declared drought. Water withdrawal for the new plant could be supported by re-allocation of water among the existing PSEG plants, or additional existing water allocation rights would be acquired from other Merrill Creek co-owner(s).

The withdrawal of water from the Delaware River would be regulated by the DRBC and NJDEP, which would ensure that the diversion and consumption of river water did not adversely affect downstream users or aquatic communities. The discharge of wastewater to the Delaware River would also be regulated, ensuring compliance with applicable water quality standards and designated uses of the river. Discharges of stormwater runoff from the operational plant site and off-site facilities would be similarly regulated by the NJDEP. Therefore, impacts on surface water resources due to project operation would be SMALL.

Because the Delaware River is brackish in the Site 7-1 area, groundwater withdrawal would be necessary to provide fresh water for plant uses. In order to make a consistent comparison of impacts with the PSEG Site, it was assumed that the same amount of groundwater withdrawal for the PSEG Site (210 gpm average, 953 gpm maximum) would be required.

Based on data provided by the USGS (Reference 9.3-11) and the New Jersey Water Science Center (Reference 9.3-6), groundwater wells in the Site 7-1 area would withdraw water from either the Kirkwood-Cohansey Coastal Plain Aquifer or the Atlantic City Sand Aquifer. Both aquifers consist of fine-to-coarse grained sand. The Kirkwood-Cohansey Aquifer is unconfined, and typical well yields range from 500 to 1000 gpm. The Atlantic City Sand Aquifer is confined, and typical well yields range from 600 to 800 gpm.

The above information indicates that the plant groundwater requirements could be supplied by one or two wells drilled to the Kirkwood-Cohansey Coastal Plain Aquifer or the Atlantic City Sand Aquifer. Although some parts of these aquifers may have experienced groundwater drawdown, it is likely that properly located wells could supply the plant water needs with no expected problems. Section 2.3 provides additional discussion of groundwater resources. In addition, groundwater withdrawal would be regulated by both the DRBC and the NJDEP. Therefore, impacts on groundwater resources due to project operation would be SMALL.

9.3.2.2.4 Terrestrial Biological Resources Including Protected Species

Any large construction project impacts terrestrial ecology primarily by disturbing natural habitats and making those habitats unavailable to plants and animals. Although construction activities may result in direct impacts to some plants and animals, most animal species are able to move away to avoid direct impacts. Even those species, however, may experience population declines due to loss of habitat. In addition, noise, lights, and dust may cause some animals to leave areas near construction activities. This is also experienced as a loss of usable habitat.

As described in the New Jersey Wildlife Action Plan (Reference 9.3-4), Site 7-1 is located in the Southern Zone of the Piedmont Plains Landscape Region. This zone is extensively farmed, but relatively large forest and wetland complexes remain in some areas. Many of the wetland areas have been farmed or otherwise disturbed by human activities. Terrestrial species of concern in the Southern Piedmont Plains Zone are associated primarily with wetland, forest, or grassland habitats.

Ecological conditions on and near Site 7-1 are typical of the extensively farmed parts of the Southern Piedmont Plains Zone. Most of the land is used for agriculture. Forest is restricted to scattered woodlots and strips of trees along streams. Wetlands are found primarily in isolated low areas, and some of the wetlands are farmed. Grasslands are virtually absent. The off-site corridors for the access roads, rail spur, and water pipelines are largely confined to the immediate site vicinity, and the natural habitats within these corridors are similar to the site itself.

As discussed in Subsection 9.3.2.2.1, development of the site would directly disturb (permanently and temporarily) 432 ac. of land. The remaining land within the site boundaries, which totals 555 ac., would not be directly disturbed, but construction activities would subject much of this land to indirect disturbance (noise, dust, etc.) and impede the movement of wildlife within this area. In addition, development of the access road, rail spur, and water pipeline corridors would disturb 246 ac. of land. Cumulatively, 1233 ac. would be directly or indirectly disturbed. The acreage of forest, wetlands, and grassland habitat currently found on this land was estimated based on GIS mapping data. Table 9.3-9 summarizes the acreage of each habitat that would be potentially affected and compares those quantities with the total acreage found in the site vicinity (within a 6 mi. radius of the site).

Table 9.3-9 shows that the acreage of each habitat potentially affected by project construction is a relatively small percentage of the total acreage of that habitat available in the site vicinity. In addition, the specific habitat areas that would be disturbed generally are small and isolated from larger habitat areas. Therefore, the overall impacts on terrestrial ecology due to project construction would be SMALL. However, based on the acreage of wetlands that would be potentially affected (114 ac.), the wetlands impact due to project construction would be considered MODERATE.

As discussed in Subsection 9.3.2.2, the potential transmission corridor to Indian River Substation is 96 mi. long. This corridor, along with the transmission corridor from the site to the nearest existing 500 kV transmission line and an interposing switchyard at the connection point, includes 2857 ac. of land. The acreage of forest, wetlands, and grassland habitat currently found on this land was estimated based on GIS mapping data. Table 9.3-10 summarizes the acreage of each habitat that would be potentially impacted and compares those quantities with the total acreages found in the 6 mi. site vicinity.

Table 9.3-10 shows that the acreage of each habitat potentially affected by transmission line construction is a relatively small percentage of the total acreage of that habitat available in the site vicinity. It is not expected that transmission line construction would destabilize terrestrial ecological resources. However, the acreage of both wetlands and forest that would be potentially affected (963 ac. and 428 ac., respectively) is somewhat significant. It should be noted that wetlands impacts would be limited to the areas of tower construction, and final routing of the transmission line would take wetlands avoidance into consideration. Clearing of the forested areas would noticeably alter the plant and animal species found in these areas. Therefore, the impacts on terrestrial ecology due to transmission line construction would be MODERATE.

The terrestrial ecology impacts of project operation would be similar to the impacts of construction but reduced. Areas that are paved or occupied by project facilities would be permanently unavailable to plants and animals, but areas that are used for construction laydown or other temporary activities may be re-colonized by some species after construction is finished. Therefore, impacts on terrestrial ecology due to operation of the power plant, transmission lines, and other off-site features would be SMALL.

Information on protected and rare species that may occur in the Site 7-1 area was obtained from the NJDEP (Reference 9.3-3). According to this information, nine animal species and one plant species have been recorded within 1 mi. of the site. These species are listed in Table 9.3-11. Detailed field studies would be required to determine whether any of these species make significant use of the site or off-site corridors, and as reconnaissance level data was used for evaluation, such studies were not conducted for the alternative sites. However, based on the relatively minor impacts on natural habitats described above, it is unlikely that any of these species would be significantly affected by project construction or operation.

As shown in Table 9.3-11, the NJDEP also identified two Natural Heritage Priority Sites (specific habitats associated with protected and rare species) in the Site 7-1 area. Both of these Natural

Heritage Priority Sites are more than 1 mi. from the Site 7-1 boundaries, and neither is crossed by any of the off-site corridors. Therefore, it does not appear that either Natural Heritage Priority Site would be significantly affected by the project. Overall, impacts on protected and rare terrestrial species would be expected to be SMALL.

9.3.2.2.5 Aquatic Biological Resources Including Protected Species

As discussed in Subsection 9.3.2.2.3, project construction would result in the disturbance of a section of the Delaware River shoreline and river bottom due to installation of a water intake structure, wastewater discharge structure, and possibly a barge docking facility. Some aquatic organisms that use this area might suffer direct impacts from construction activities, but most organisms would move away from the area and be affected primarily by the loss of a limited amount of habitat. In addition, some aquatic species might be affected by increased turbidity and siltation resulting from construction activities, but such effects would be temporary and localized.

Construction activities on the site and in the off-site corridors would result in direct disturbance to some existing streams, and some adjacent streams would experience a temporary increase in sediment loading due to increased runoff of disturbed soil. There is no indication that any of the streams that would be affected have any exceptional or high value. Similar streams are common in the 6-mi. vicinity around Site 7-1.

Based on GIS mapping data, the total length of streams that would be directly affected by construction on the site and in the access road, rail spur, and water pipeline corridors is 8967 ft. This represents 0.3 percent of the total length of streams in the 6-mi. site vicinity (2,722,667 ft.). In addition, the total length of streams included within the transmission corridors and interposing switchyard is 100,104 ft., which represents 3.7 percent of the stream length in the site vicinity. Most of the streams in the transmission corridors would not be directly affected; it is estimated that 95 percent of the streams could be avoided during transmission line construction.

The expected stream disturbance is a very small percentage of the total length of streams available in the site vicinity. In addition, construction impacts on streams and on the Delaware River would be regulated by several federal, state, and local permits. Therefore, impacts on aquatic ecology due to construction of the power plant, transmission lines, and other off-site features would be SMALL.

During operation of the power plant, transmission lines, and other off-site features, there would be little if any additional impact on streams. The primary source of potential impacts during operation would be the withdrawal of water from the Delaware River. Some aquatic organisms would be entrained with the intake water or impinged on the intake screens. However, federal regulations (40 CFR 125) require cooling water intake structures to meet stringent criteria designed to protect organisms from entrainment and impingement. In addition, the amount of water withdrawn would be a relatively small percentage of the overall river flow, as discussed in Subsection 9.3.2.2.3. Therefore, impacts on aquatic ecology due to project operation would be SMALL.

Information provided by the NJDEP on protected and rare species that may occur in the site area (Reference 9.3-3) did not identify any aquatic species. Detailed field studies would be required to determine whether any protected or rare species make significant use of any streams or the part of the Delaware River that could be affected by the project, and as reconnaissance level data was used for evaluation, such studies were not conducted for the alternative sites. However, based on the relatively minor impacts on aquatic habitats described above, it is unlikely that any aquatic species would be significantly affected by project construction or operation. Therefore, impacts on protected and rare aquatic species would be expected to be SMALL.

9.3.2.2.6 Socioeconomics

This subsection evaluates the social and economic impacts that could result from constructing and operating the new plant at Site 7-1. The evaluation includes the impacts of construction and operation activities and demands placed by the construction and operation workforces on the site and the surrounding region. It is assumed that all construction activities would occur within the site boundaries and off-site corridors described in Subsection 9.3.2.2, and physical impacts would be restricted to these construction areas and nearby properties. Other socioeconomic impacts generally occur on a regional basis, and in the following subsections they are evaluated for Salem County and the region within 50 mi. of Site 7-1.

9.3.2.2.6.1 Physical Impacts

Any large construction project can cause temporary and localized physical impacts such as noise, vibration, dust, vehicle exhaust, and odors. In addition, construction materials, equipment, and workers must be transported to the construction areas, and these transportation activities also cause noise, vibration, dust, vehicle exhaust, and odors. For Site 7-1, a new rail spur would be constructed, and this rail line would be used to transport large equipment and materials to the site. Public roadways would be used to transport smaller equipment, as well as large numbers of construction workers. Appropriate measures would be taken to minimize noise, dust, and other impacts due to both construction and transportation activities. However, because residences are located throughout the area surrounding Site 7-1, it would not be possible to avoid close proximity to some residences. Based on field reconnaissance and examination of aerial photographs, it is estimated that 40 residences are located within 0.5 mi. of the conceptual site boundaries. Other residences are located in close proximity to the conceptual rail spur and other off-site corridors. Despite the implementation of appropriate mitigation measures, many of these residences probably would experience some impact due to construction-related noise, vibration, and dust.

Other sensitive areas also would be subject to physical impacts during project construction. As discussed in Subsection 9.3.2.2.1, an active church and cemetery are located inside the conceptual site boundaries. Based on preliminary site development plans, the church and cemetery would not be directly disturbed by construction, but they would be exposed to significant noise, vibration, and dust. In addition, Salem River Wildlife Management Area, a state-owned property that is open to the public for hunting and fishing, is adjacent to the conceptual site boundaries and the transmission corridor, and the transmission corridor passes through 1 mi. of the Supawna Meadows National Wildlife Refuge. It would not be feasible to re-route the transmission corridor so as to completely avoid these features. During project construction, parts of the Wildlife Management Area and Wildlife Refuge would be subject to noise, vibration, and dust.

Considering the conditions summarized above, project construction would noticeably alter the existing physical conditions in the site area and might destabilize sensitive resources such as the church, Wildlife Management Area, and/or Wildlife Refuge. For this reason, the physical impact due to project construction would be MODERATE to LARGE.

The physical impacts of project operation would be similar to the impacts of construction but somewhat reduced. Operating plant equipment would produce some noise, but the noise levels generally would be lower than the levels associated with construction activities. Workers and some materials and equipment would be transported to the site during project operation, but the amount of traffic and size of shipments generally would be less than during project construction. Periodic maintenance would be required for both on-site and off-site facilities, and the maintenance activities would create some noise, vibration, and dust, but these impacts would be more localized and of shorter duration than during project construction. Therefore, the physical impact due to project operation would be SMALL.

9.3.2.2.6.2 Demography

Impacts on demography would be associated with construction workers and operation workers moving into the region surrounding the project site. The significance of demographic impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-1 as for the PSEG Site. Site 7-1 is in the same county as the PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional demographic impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.1 indicates that the demographic impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.1 indicates that the demographic impact of plant operation at the PSEG Site also is expected to be SMALL. Therefore, the construction-related and operation-related demographic impact at Site 7-1 would be expected to be SMALL.

9.3.2.2.6.3 Economy

Impacts on the economy would be caused primarily by the jobs provided to construction and operation workers. The significance of economic impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-1 as for the PSEG Site. Site 7-1 is in the same county as the PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional economic impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.2.1 indicates that the regional economic impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.2.1 indicates that the regional economic impact of plant operation at the PSEG Site also is expected to be SMALL. Therefore, the construction-related and operation-related economic impacts at Site 7-1 would be expected to be SMALL.

9.3.2.2.6.4 Taxes

Property taxes, sales taxes, and other taxes paid during construction and operation of the new plant would benefit the state and local jurisdictions that collect the taxes. The significance of tax impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-1 as for the PSEG Site. Site 7-1 is in the same county as the

PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional tax impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.2.2 indicates that the tax impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.2.2 indicates that the tax impact of plant operation at the PSEG Site also is expected to be SMALL. Therefore, the construction-related and operation-related tax impact at Site 7-1 would be expected to be SMALL.

9.3.2.2.6.5 Transportation

Transportation in the vicinity of the new plant could be affected by the increase in vehicle traffic associated with construction and operation workers commuting to the site and the delivery of materials and equipment to the site. The increase in vehicle traffic could cause delays on local roads. The severity of such impacts would depend primarily on the existing traffic volumes and LOS on local roads compared with the expected volume of project-related traffic.

Road access to the Site 7-1 area is provided primarily by NJ Route 540. This is considered a secondary state route, but it is a relatively wide two-lane highway. Road access to the site itself is provided primarily by Salem County Road 631 and Salem County Road 646. Salem County Road 631 is a narrow two-lane road that appears to be used mostly by local traffic, but County Road 646 is a relatively wide two-lane highway.

The NJDOT does not publish LOS designations for roads in the state. However, NJDOT data (Reference 9.3-5) indicates that the average daily traffic volume (both directions) on NJ Route 540 is 5406 vehicles. NJDOT data does not include traffic volumes for Salem County Roads 631 and 646.

As discussed in Subsection 4.4.1.5, maximum construction-related traffic volumes are expected to occur during shift changes (twice per day) in the peak construction workforce. During such shift changes, 2200 vehicles are expected to use local roads. Delivery of construction materials and equipment is expected to add another 50 vehicles per day over the construction period.

Considering the nature of the roads in the Site 7-1 area and the current volume of traffic on those roads, it is likely that the peak construction traffic would noticeably alter existing transportation conditions (cause noticeable delays on local roads) but not be sufficient to destabilize important transportation resources. Therefore, the transportation impact associated with project construction would be MODERATE.

As discussed in Subsection 5.8.1.2, maximum traffic volumes associated with plant operation are expected to occur when fuel-reloading is being conducted for one generating unit and another unit is operating. The peak traffic volume at such times could be 1200 vehicles. Because this number of vehicles is significantly smaller than the peak construction traffic volume, it would not be expected to noticeably alter transportation conditions. Therefore, the transportation impact associated with project operation would be SMALL.

9.3.2.2.6.6 Aesthetics

Aesthetics in the vicinity of the new plant could be affected by the visual intrusion of large industrial structures and equipment. During project construction, dust could create additional visual intrusions. During operation, water vapor plumes from the cooling towers would be readily visible at certain times. Given that the Site 7-1 area currently has predominantly rural scenery, project construction and operation would dramatically alter the existing visual conditions. However, the severity of visual impacts on the human population would depend primarily on the visibility of the plant and off-site facilities from sensitive viewing areas.

As discussed in Subsection 9.3.2.2.6.1, field reconnaissance and examination of aerial photographs indicate that approximately 40 residences are located within 0.5 mi. of the conceptual site boundaries. Although trees and existing buildings may block the view of some of these residences, many would be expected to have at least a partial view of the power plant during construction and operation. In addition, some residences are located near the conceptual off-site corridors and would have at least a partial view of the transmission lines, rail spur, and other off-site facilities during construction and operation.

Other sensitive viewing areas also are located in close proximity to the site and off-site corridors. As discussed in Subsection 9.3.2.2.1, an active church and cemetery are located inside the conceptual site boundaries. Based on preliminary site development plans, the church and cemetery would not be directly disturbed, but they would experience significant visual intrusion during project construction and operation.

Another active church is located 0.8 mi. from the conceptual site boundaries, and 0.2 mi. from the conceptual transmission corridor. During project construction and operation, the power plant and transmission lines probably would be at least partially visible from the church grounds. A third active church is located 0.3 mi. from the conceptual rail spur corridor and probably would have at least a partial view of the rail spur during construction and operation.

Salem River Wildlife Management Area, a state-owned property that is open to the public for hunting and fishing, is adjacent to the conceptual site boundaries and the transmission corridor. During project construction and operation, the power plant and transmission lines probably would be at least partially visible from parts of the Wildlife Management Area.

Finally, the primary transmission corridor passes through 1 mi. of the Supawna Meadows National Wildlife Refuge. It would not be feasible to re-route the transmission corridor so as to avoid the Wildlife Refuge. Parts of the Wildlife Refuge would have a clear view of the transmission lines during construction and operation.

NUREG-1437 establishes the following criteria for judging the severity of aesthetic impacts:

> SMALL - No complaints from affected public about a changed sense of place or a diminution in enjoyment of the physical environment, and no measurable impact on socioeconomic institutions and processes.
>
> MODERATE - Some complaints from affected public about a changed sense of place or a diminution in enjoyment of the physical environment, and measurable impacts that do not alter the continued functioning of socioeconomic institutions and processes.
>
> LARGE - Continuing and widely shared opposition to the project based on a perceived degradation of the area's sense of place or diminution in enjoyment of the physical environment, and measurable social impacts that perturb the continued functioning of community institutions and processes.

Considering that the power plant and off-site facilities would be visible from several sensitive viewing areas, and considering that project construction would dramatically alter the existing rural scenery, it is very likely that project construction would generate public complaints related to a changed sense of place and diminished enjoyment of the physical environment. It is likely that there would be general opposition to the project, and possible that there could be measurable social impacts that perturb the continued functioning of institutions such as the churches located in close proximity to construction areas. Therefore, the aesthetic impact associated with project construction would be MODERATE to LARGE.

Although project operation would not result in significant further alteration of aesthetic conditions, the power plant, cooling tower plumes, transmission lines, and rail spur traffic would continue to be visible from sensitive viewing areas. It is likely that there would be public complaints related to diminished enjoyment of the physical environment, and possible that there could be general opposition to the project and measurable social impacts that perturb the continued functioning of community institutions and processes. Therefore, the aesthetic impact associated with project operation would be MODERATE to LARGE.

9.3.2.2.6.7 Housing

Impacts on housing could be caused by construction and operation workers moving, either permanently or temporarily, into the region surrounding the project site. The significance of housing impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-1 as for the PSEG Site. Site 7-1 is in the same county as the PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional housing impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.2.4 indicates that the housing impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.2.4 indicates that the housing impact of plant operation at the PSEG Site also is expected to be SMALL. Therefore, the construction-related and operation-related housing impact at Site 7-1 would be expected to be SMALL.

9.3.2.2.6.8 Public Services

Public services include police, fire and medical services; social services; water supply and waste water treatment facilities; and recreation facilities. Impacts on public services could be caused by construction and operation workers moving into the region surrounding the project site. The significance of public service impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-1 as for the PSEG Site. Site 7-1 is in the same county as the PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional public service impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.2.5 indicates that the public service impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.1 indicates that the public service impact of plant operation at the PSEG Site also is expected to be SMALL. Therefore, the construction-related and operation-related public service impact at Site 7-1 would be expected to be SMALL.

9.3.2.2.6.9 Education

Impacts on education could be caused by construction and operation workers moving into and bringing school-aged children into the region surrounding the project site. The significance of education impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-1 as for the PSEG Site. Site 7-1 is in the same county as the PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional education impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.2.7 indicates that the education impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.2.7 indicates that the education impact of plant operation at the PSEG Site also is expected to be SMALL. Therefore, the construction-related and operation-related education impact at Site 7-1 would be expected to be SMALL.

9.3.2.2.7 Historical and Archaeological Resources

Historical and archaeological resources could be directly disturbed by construction activities or indirectly disturbed by noise, dust, vehicle emissions, or visual intrusion during project construction and operation. The severity of such impacts would depend on the location and historic significance of the resources.

No properties listed on the NRHP or the NJRHP have been identified in the immediate vicinity of Site 7-1. However, one archaeological site that is not listed on either register but is reported in files maintained by the NJHPO is located within the conceptual transmission corridor. This archaeological site might be directly disturbed by transmission line construction, and it probably would have to be investigated before construction could proceed. If it was determined to be potentially eligible for the NRHP or NJRHP, the site would have to be excavated and any significant archaeological artifacts curated before the area was disturbed.

In addition, two archaeological sites reported in NJHPO files are located on or near the conceptual pipeline corridor. Depending on the exact location of these archaeological sites and the final routing of the pipeline corridor, either or both of the sites might be disturbed by pipeline construction and might have to be investigated as described above.

The impacts summarized above would noticeably alter the existing archaeological resources in the site area during project construction but it is very unlikely that they would destabilize any important attributes of these resources. Therefore, the impact on historical and archaeological resources due to project construction would be MODERATE.

It does not appear that any additional disturbance of historical and archaeological resources would occur during project operation. Therefore, the impact on historical and archaeological resources due to project operation would be SMALL.

9.3.2.2.8 Environmental Justice

Environmental justice issues involve aspects of the project that could disproportionately impact minority or low income populations. The potential for disproportionate impacts depends primarily on the location of the power plant and off-site facilities in relation to existing minority and low income populations.

USCB data for the year 2000 (Reference 9.3-8) were used to determine the percentage of minority and low-income populations within the 6-mi. site vicinity, and to identify any census block groups that contain a higher than average percentage of minority or low-income populations. The percentages for the site vicinity and each census block group were compared to the percentages for NJ.

Minorities comprise 27.8 percent of the population within 6 mi. of Site 7-1, compared with 34.0 percent for NJ. People with incomes below the poverty level comprise 11.8 percent of the population within 6 mi. of Site 7-1, compared with 8.5 percent for NJ. Of the 35 census block groups that have at least 50 percent of their area within 6 mi. of the site, 15 have minority and/or poverty populations above the state average. The site is located in a census block group with poverty populations above the state average; minorities comprise 28.5 percent of the population within this block group, and people with incomes below the poverty level comprise 9.0 percent. Almost the entire length of the conceptual rail spur corridor is located within this block group. In addition, the conceptual pipeline corridor crosses part of another census block group with poverty populations above the state average (9.3 percent).

Based on the above information there appears to be a potential for the project to disproportionately impact low income populations. The severity of the impacts would depend on exactly how low income populations use the site area and the extent to which they would be exposed to the adverse impact of project construction and operation. Detailed field investigations would be performed to determine the level of impact if development of this site progresses. Based on available information, it appears that environmental justice impacts due to project construction and operation could be MODERATE to LARGE.

9.3.2.3 Evaluation of Site 7-2

Site 7-2 is a greenfield site in Salem County, NJ. The site is located on flat land 12 mi. east of the Delaware River, which would be the primary water source. Elevations across the site range from 120 to 140 ft. above Mean Sea Level. Based on conceptual site boundaries identified by considering site development requirements and existing property parcels, the site has a total area of 996 ac.

Site 7-2 would require the following off-site features in order to support a nuclear power plant:

- Road access to the site would be provided by existing public roads, but portions of those roads would have to be relocated around plant facilities or improved to allow them to carry plant-related traffic. It was assumed that all roads would be constructed on a ROW 150 ft. wide. A total of 2.2 mi. of road construction was estimated to be required.
- A new rail spur would allow delivery of materials and equipment to the site. It was assumed that the rail spur would be constructed on a ROW 150 ft. wide. A conceptual route to the nearest active railroad line was identified based on existing terrain and land use features, and this route is 5.4 mi. long.
- A new makeup water pipeline would withdraw water from the Delaware River, and a new blowdown pipeline would discharge wastewater to the Delaware River. It was assumed that the two pipelines would be constructed parallel to one another, on a

single ROW 100 ft. wide. A conceptual route to the Delaware River was identified based on existing terrain and land use features, and this route is 12.9 mi. long.

- An existing 500 kV transmission line crosses the site, and this line would provide a two-circuit connection to the 500 kV transmission system (incoming and outgoing portions of the line). A portion of the existing line would have to be re-routed to avoid plant facilities, for a total distance of 1.8 mi. A third circuit connection to the transmission system would be provided by a new transmission line from Site 7-2 to a second existing 500 kV corridor, which originates from the SGS/HCGS site. It is assumed that this new transmission line would be constructed on a ROW 200 ft. wide. A conceptual route to the existing 500 kV transmission corridor was identified based on existing terrain and land use features, and this route is 4.1 mi. long. It was expected that an interposing switchyard would be required at the connection point, and this switchyard was conceptually located on 25 ac. of land. In addition, it was expected that a new 500 kV transmission line would be required to address potential grid stability issues. A new line between the Indian River Substation in Delaware and the SGS/HCGS site (which, in turn, is electrically tied to the new interposing switchyard) would fulfill this purpose. The Indian River Substation is capable of providing synchronizing support to maintain system stability during grid disturbances. It was assumed that this transmission line would be constructed on a 200 ft. wide ROW generally following existing transmission lines, for a total distance of 107 mi.

Subsections 9.3.2.3.1 through 9.3.2.3.8 discuss the potential environmental impacts of developing Site 7-2 and the off-site features listed above. Because the transmission corridors are significantly longer than the other off-site corridors and are not confined to the immediate site vicinity, quantitative estimates of potential impacts are presented separately for the transmission corridors.

9.3.2.3.1 Land Use

Existing land use across Site 7-2 is predominantly agricultural, with large fields planted in cultivated crops. Most of the site is zoned for agricultural use. Soils classified as prime farmland or Farmland of Statewide Importance occur across much of the site.

Residences (single family houses) are scattered across the site. There are approximately 46 houses located within the conceptual site boundaries, and most of these houses would have to be removed before the site could be developed with a power plant. Although the site is located more than 6 mi. from the nearest incorporated town, and new housing developments are located within 1 mi. of the site.

A private school is located immediately outside the conceptual site boundaries. The school would not be directly disturbed, and public access could be maintained during project construction. However, it is possible that emergency planning could limit public access to the school during project operation.

The off-site corridors for the access roads, rail spur, and water pipelines are largely confined to the immediate site vicinity, and the land use within these corridors is similar to the site itself, with most of the land in agricultural use and residences scattered throughout the area. It is anticipated that the corridors could be developed without removing existing houses, but some houses would be located in close proximity to the various ROW alignments.

No significant industrial land uses have been identified on the site, within the associated off-site corridors, or in close proximity.

Based on the conceptual plant layout developed for Site 7-2, development of the site would directly disturb (permanently and temporarily) 394 ac. of land. The remaining land within the site boundaries, which totals 602 ac., would not be directly disturbed, but access to this land would be controlled and it generally would be unavailable for non-power plant uses. In addition, development of the access road, rail spur, and water pipeline corridors would disturb 294 ac. of land. Cumulatively, about 1290 ac. would be disturbed or made unavailable for non-power plant uses. The acreage of each major land use category currently found on this land was estimated based on GIS mapping data. Table 9.3-12 summarizes the acreages in the major land use categories and compares those quantities with the total acreages found in the site vicinity (within a 6 mi. radius of the site).

Table 9.3-12 shows that the acreage of each land use category potentially affected by project construction is a relatively small percentage of the total acreage of that land use available in the site vicinity. It is not expected that project construction would destabilize any important land use resources. However, construction would change the site and associated off-site corridors from predominantly rural land use with scattered housing and very little industrial development to intensive heavy industrial use. This would noticeably alter the existing land use resources. Therefore, the land use impact due to project construction would be MODERATE.

As discussed in Subsection 9.3.2.3, the potential transmission corridor to Indian River Substation is approximately 107 mi. long. This corridor, along with the transmission corridor from the site to the nearest existing 500 kV transmission corridor and an interposing switchyard at the connection point, includes 2896 ac. of land. The acreage of each major land use category currently found on this land was estimated based on GIS mapping data. Table 9.3-13 summarizes the acreages in the major land use categories and compares those quantities with the total acreages found in the 6 mi. site vicinity.

Table 9.3-13 shows that the acreage of each land use category potentially affected by transmission line construction is a relatively small percentage of the total acreage of that land use available in the site vicinity. It is not expected that transmission line construction would destabilize any important land use resources. However, transmission line construction would noticeably alter the existing land use on more than 2800 ac. of land. Permanent land impacts associated with the transmission corridor, such as tower foundations, would be substantially less than the total acreage of the corridor. It is possible that some residences or other buildings would have to be removed to provide adequate clearance for the transmission lines. Therefore, the land use impact due to transmission line construction would be MODERATE.

During project operation, land use impacts would be reduced. Agricultural activities might be allowed in the transmission line and pipeline ROWs. Most land use resources that exist at the conclusion of the construction phase would not be noticeably altered during operation. However, as discussed above, it is possible that emergency planning for the operational power plant could limit public access to the school located adjacent to the conceptual site boundaries. If the school had to be closed, that aspect of the site land use would be noticeably altered. Therefore, the land use impact due to project operation would be SMALL to MODERATE.

9.3.2.3.2 Air Quality

The air quality impacts of constructing and operating the new plant and off-site facilities for Site 7-2 would be similar to the impacts expected for the PSEG Site. Salem County is classified as a non-attainment area for ozone, and it is considered to be in attainment with the NAAQS for all other criteria pollutants. The PSEG Site is located in the same county.

Air quality impacts during project construction would include dust from earthmoving and material handling activities, and exhaust emissions from construction vehicles and equipment. These impacts would be similar to the impacts associated with any large construction project. To limit and mitigate the impacts, emission-specific strategies, plans and measures would be developed and implemented to ensure compliance with applicable federal and state regulations. Therefore, air quality impacts associated with construction would be SMALL.

During plant operation, the cooling towers would emit particulate matter. Auxiliary boilers and standby diesel generators or combustion turbines would emit particulate matter and gaseous pollutants such as nitrogen oxides. All emissions would be governed by a Prevention of Significant Deterioration Permit and a Title V Certificate to Operate, which would ensure compliance with the NAAQS and other applicable regulatory requirements. Therefore, air quality impacts associated with operation would be SMALL.

9.3.2.3.3 Hydrology, Water Use, and Water Quality

The Delaware River would be the primary source of water for a plant located at Site 7-2. The site is located approximately 12 mi. from the river, so the only direct impact on the river during project construction would be disturbance of a section of the shoreline and river bottom for installation of required facilities. At a minimum, the required facilities would include a water intake structure and wastewater discharge structure, which would disturb a relatively small area of the shoreline and river bottom. Barge access is feasible on the Delaware River in the Site 7-2 area, but because any potential barge unloading area would be at least 12 mi. from the site, it is not clear whether a barge docking facility would be constructed. If constructed, a barge docking and offloading facility would result in additional disturbance of the shoreline and river bottom.

Water-related impacts associated with construction activities on the site itself would be similar to the impacts of any large construction project. Potential impacts include direct physical alteration of local surface water bodies; indirect alteration of nearby surface water bodies due to increased runoff volumes or diversions of runoff; degradation of downstream surface water quality as a result of erosion and sedimentation or discharges of pollutants associated with construction activities; and changes in groundwater flow patterns due to dewatering of excavations and soil retention management practices. Similar impacts would occur in the off-site corridors for construction of the rail spur, access roads, and other off-site facilities. The most significant impact would be that some existing streams on the site and within the off-site corridors would be directly disturbed, and some adjacent streams would experience a temporary increase in sediment loading due to increased runoff of disturbed soil.

Several federal, state, and local permits would govern construction activities that have the potential to impact water resources. Water-related impacts would be minimized by implementing BMPs, including erosion, grading, and sediment control measures; stormwater pollution prevention plans; spill prevention and countermeasure plans; and compliance with federal, state, and local regulations pertaining to disturbance of water bodies and pollution discharges.

Withdrawal of either surface water or groundwater would be anticipated during project construction, but the quantities would be less than the quantities evaluated below for project operation. Therefore, impacts on water resources due to project construction would be SMALL.

During project operation, the new plant would withdraw make-up water from the Delaware River and discharge wastewater (primarily cooling tower blowdown) to the river. The water withdrawn from the river would either be returned to the river as blowdown or lost to the atmosphere through operation of the cooling towers. Water returned to the river as blowdown would not be lost to downstream users or aquatic communities.

As discussed in Section 3.3, the water withdrawal rate for the new plant at the PSEG Site is 78,196 gpm, and the consumptive water loss (primarily due to evaporation from the cooling towers) is 26,420 gpm. These values assume that the cooling towers operate at 1.5 cycles of concentration, which is appropriate for the brackish water found in the Delaware River at the PSEG Site. Site 7-2 would withdraw water from the same part of the Delaware River, so the same values can be used for Site 7-2.

Based on USGS data (Reference 9.3-10) for the nearest available gauging station (near Trenton, NJ), the annual mean river flow is 5,318,636 gpm, and the 7Q10 flow is 771,988 gpm. Based on these statistics, the withdrawal rate (78,196 gpm) would divert approximately 1.5 percent of the annual mean river flow and 10.1 percent of the 7Q10 flow. The consumptive water loss (26,420 gpm) would reduce the annual mean river flow by 0.5 percent and the 7Q10 flow by 3.4 percent.

As stated above, Site 7-2 is located in an area where the Delaware River water is brackish. Because consumptive water use at locations with brackish water has a lesser impact on salinity intrusion than an equal consumption of fresh water, the DRBC has developed an EIF to account for the difference. As discussed in Subsection 5.2.1.2, the EIF in the PSEG Site area is 0.18. The factor applicable to Site 7-2 would nominally be the same as the value for the PSEG Site. Using this factor, the 26,420 gpm consumptive use of Delaware River water is equivalent to a freshwater consumptive use impact of a 4756 gpm. This impact represents 0.1 percent of the annual average river flow and 0.6 percent of the 7Q10 flow.

It should be noted that the Trenton gauging station is more than 60 mi. upstream of the Site 7-2 area. Therefore, the actual river flows in the site area are expected to be considerably higher than the flows discussed above, and the impacts of water withdrawal and consumption would be correspondingly lower. It also should be noted that PSEG is a co-owner of the Merrill Creek Reservoir and has an established allocation of water that can be released from the reservoir to offset consumptive use during periods of declared drought. Water withdrawal for the new plant could be supported by re-allocation of water among the existing PSEG plants, or additional existing water allocation rights would be acquired from other Merrill Creek co-owner(s).

The withdrawal of water from the Delaware River would be regulated by the DRBC and NJDEP, which would ensure that the diversion and consumption of river water did not adversely affect downstream users or aquatic communities. The discharge of wastewater to the Delaware River also would be regulated, ensuring compliance with applicable water quality standards and designated uses of the river. Discharges of stormwater runoff from the operational plant site and off-site facilities would be similarly regulated by the NJDEP. Therefore, impacts on surface water resources due to project operation would be SMALL.

Because the Delaware River is brackish in the Site 7-2 area, groundwater withdrawal would be necessary to provide fresh water for plant uses. In order to make a consistent comparison of impacts with the PSEG Site, it was assumed that the same amount of groundwater withdrawal for the PSEG Site (210 gpm average, 953 gpm maximum) would be required.

Based on data provided by the USGS (Reference 9.3-11) and the New Jersey Water Science Center (Reference 9.3-6), groundwater wells in the Site 7-2 area would withdraw water from either the Kirkwood-Cohansey Coastal Plain Aquifer or the Atlantic City Sand Aquifer. Both aquifers consist of fine-to-coarse grained sand. The Kirkwood-Cohansey Aquifer is unconfined, and typical well yields range from 500 to 1000 gpm. The Atlantic City Sand Aquifer is confined, and typical well yields range from 600 to 800 gpm.

The above information indicates that the plant groundwater requirements could be supplied by one or two wells drilled to the Kirkwood-Cohansey Coastal Plain Aquifer or the Atlantic City Sand Aquifer. Although some parts of these aquifers may have experienced groundwater drawdown, it is likely that properly located wells could supply the plant water needs with no expected problems. Section 2.3 for additional discussion of groundwater resources. In addition, groundwater withdrawal would be regulated by both the DRBC and the NJDEP. Therefore, impacts on groundwater resources due to project operation would be SMALL.

9.3.2.3.4 Terrestrial Biological Resources Including Protected Species

Any large construction project impacts terrestrial ecology primarily by disturbing natural habitats and making those habitats unavailable to plants and animals. Although construction activities may result in direct mortality to some plants and animals, most animal species are able to move away to avoid direct impacts. Even those species, however, may experience population declines due to loss of habitat. In addition, noise, lights, and dust may cause some animals to leave areas near construction activities. This is also experienced as a loss of usable habitat.

As described in the New Jersey Wildlife Action Plan (Reference 9.3-4), Site 7-2 is located in the Southern Zone of the Piedmont Plains Landscape Region. This zone is extensively farmed, but relatively large forest and wetland complexes remain in some areas. Many of the wetland areas have been farmed or otherwise disturbed by human activities. Terrestrial species of concern in the Southern Piedmont Plains Zone are associated primarily with wetland, forest, or grassland habitats.

Ecological conditions on and near Site 7-2 are typical of the extensively farmed parts of the Southern Piedmont Plains Zone. Most of the land is used for agriculture. Forest is restricted to scattered woodlots and strips of trees along streams. Wetland areas are very small and restricted to isolated low areas. Grasslands are virtually absent. The off-site corridors for the access roads, rail spur, and water pipelines are largely confined to the immediate site vicinity, and the natural habitats within these corridors are similar to the site itself.

As discussed in Subsection 9.3.2.3.1, development of the site would directly disturb (permanently and temporarily) 394 ac. of land. The remaining land within the site boundaries, which totals 602 ac., would not be directly disturbed, but construction activities would subject much of this land to indirect disturbance (noise, dust, etc.) and impede the movement of wildlife within this area. In addition, development of the access road, rail spur, and water pipeline corridors would disturb 294 ac. of land. Cumulatively, about 1290 ac. would be directly or indirectly disturbed. The acreage of forest, wetlands, and grassland habitat currently found on this land was estimated based on GIS mapping data. Table 9.3-14 summarizes the acreage of each habitat that would be potentially affected and compares those quantities with the total acreage found in the site vicinity (within a 6 mi. radius of the site).

Table 9.3-14 shows that the acreage of each habitat potentially affected by project construction is a relatively small percentage of the total acreage of that habitat available in the site vicinity. In addition, the specific habitat areas that would be disturbed generally are small and isolated from larger habitat areas. Therefore, the overall impacts on terrestrial ecology due to project construction would be SMALL. However, based on the acreage of wetlands that would be potentially affected (87 ac.), the wetlands impact due to project construction is considered MODERATE.

As discussed in Subsection 9.3.2.3, the potential transmission corridor between the SGS/HCGS site and Indian River Substation is approximately 107 mi. long. This corridor, along with the transmission corridor from Site 7-2 to the nearest existing 500 kV transmission corridor and an interposing switchyard at the connection point, includes 2896 ac. of land. The acreage of forest, wetlands, and grassland habitat currently found on this land was estimated based on GIS mapping data. Table 9.3-15 summarizes the acreage of each habitat that would be potentially impacted and compares those quantities with the total acreages found in the 6 mi. site vicinity.

Table 9.3-15 shows that the acreage of each habitat potentially affected by transmission line construction is a relatively small percentage of the total acreage of that habitat available in the site vicinity. It is not expected that transmission line construction would destabilize terrestrial ecological resources. However, the acreage of both wetlands and forest that would be potentially affected (825 ac. and 464 ac., respectively) is somewhat significant. It should be noted that wetlands impacts would be limited to the areas of tower construction, and final routing of the transmission line would take wetlands avoidance into consideration. Clearing of the forested areas would noticeably alter the plant and animal species found in these areas. Therefore, the impacts on terrestrial ecology due to transmission line construction would be MODERATE.

The terrestrial ecology impacts of project operation would be similar to the impacts of construction but reduced. Areas that are paved or occupied by project facilities would be permanently unavailable to plants and animals, but areas that are used for construction laydown or other temporary activities may be re-colonized by some species after construction is finished. Therefore, impacts on terrestrial ecology due to operation of the power plant, transmission lines, and other off-site features would be SMALL.

Information on protected and rare species that may occur in the Site 7-2 area was obtained from the NJDEP (Reference 9.3-3). According to this information, eight animal species and two plant species have been recorded within 1 mi. of the site. These species are listed in Table 9.3-16. Detailed field studies would be required to determine whether any of these species make significant use of the site or off-site corridors, and as reconnaissance level data was used for evaluation, such studies were not conducted for the alternative sites. However, based on the relatively minor impacts on natural habitats described above, it is unlikely that any of these species would be significantly affected by project construction or operation.

As shown in Table 9.3-16, the NJDEP also identified two Natural Heritage Priority Sites (specific habitats associated with protected and rare species) in the Site 7-2 area. One of these Natural Heritage Priority Sites is 0.6 mi. from the Site 7-2 boundaries, and the other is 0.8 mi. from the

Site 7-2 boundaries. Neither is crossed by any of the off-site corridors. Therefore, it does not appear that either Natural Heritage Priority Site would be significantly affected by the project. Overall, impacts on protected and rare terrestrial species would be expected to be SMALL.

9.3.2.3.5 Aquatic Biological Resources Including Protected Species

As discussed in Subsection 9.3.2.3.3, project construction would result in the disturbance of a relatively small section of the Delaware River shoreline and river bottom due to installation of a water intake structure, wastewater discharge structure, and possibly a barge docking and offloading facility. Some aquatic organisms that use this area might suffer direct mortality from construction activities, but most organisms would move away from the area and be affected primarily by the loss of a limited amount of habitat. In addition, some aquatic species might be affected by increased turbidity and siltation resulting from construction activities, but such effects would be temporary and localized.

Construction activities on the site and in the off-site corridors would result in direct disturbance to some existing streams, and some adjacent streams would experience a temporary increase in sediment loading due to increased runoff of disturbed soil. There is no indication that any of the streams that would be affected have any exceptional or high value. Similar streams are common in the 6-mi. vicinity around Site 7-2.

Based on GIS mapping data, the total length of streams that would be directly affected by construction on the site and in the access road, rail spur, and water pipeline corridors is 9710 ft. This represents approximately 0.7 percent of the total length of streams in the 6-mi. site vicinity (1,384,973 ft.). In addition, the total length of streams included within the transmission corridors and interposing switchyard is 79,218 ft., which represents 5.7 percent of the stream length in the site vicinity. Most of the streams in the transmission corridors would not be directly affected; it is estimated that 95 percent of the streams could be avoided during transmission line construction.

From the numbers discussed above, it is clear that the expected stream disturbance is a very small percentage of the total length of streams available in the site vicinity. In addition, construction impacts on streams and on the Delaware River would be regulated by several federal, state, and local permits. Therefore, impacts on aquatic ecology due to construction of the power plant, transmission lines, and other off-site features would be SMALL.

During operation of the power plant, transmission lines, and other off-site features, there would be little if any additional impact on streams. The primary source of potential impacts during operation would be the withdrawal of water from the Delaware River. Some aquatic organisms would be entrained with the intake water or impinged on the intake screens. However, federal regulations (40 CFR Part 125) require cooling water intake structures to meet stringent criteria designed to protect organisms from entrainment and impingement. In addition, the amount of water withdrawn would be a relatively small percentage of the overall river flow, as discussed in Subsection 9.3.2.3.3. Therefore, impacts on aquatic ecology due to project operation would be SMALL.

Information provided by the NJDEP on protected and rare species that may occur in the site area (Reference 9.3-3) did not identify any aquatic species. Detailed field studies would be required to determine whether any protected or rare species make significant use of any streams or the part of the Delaware River that could be affected by the project, and as reconnaissance level data was used for evaluation, such studies were not conducted for the alternative sites. However, based on the relatively minor impacts on aquatic habitats described above, it is unlikely that any aquatic species would be significantly affected by project construction or operation. Therefore, impacts on protected and rare aquatic species would be expected to be SMALL.

9.3.2.3.6 Socioeconomics

This subsection evaluates the social and economic impacts that could result from constructing and operating the new plant at Site 7-2. The evaluation includes the impacts of construction and operation activities and demands placed by the construction and operation workforces on the site and the surrounding region. It is assumed that all construction activities would occur within the site boundaries and off-site corridors described in Subsection 9.3.2.3, and physical impacts would be restricted to these construction areas and nearby properties. Other socioeconomic impacts generally occur on a regional basis, and in the following subsections they are evaluated for Salem County and the region within 50 mi. of Site 7-2.

9.3.2.3.6.1 Physical Impacts

Any large construction project can cause temporary and localized physical impacts such as noise, vibration, dust, vehicle exhaust, and odors. In addition, construction materials, equipment, and workers must be transported to the construction areas, and these transportation activities also cause noise, vibration, dust, vehicle exhaust, and odors. For Site 7-2, a new rail spur would be constructed, and this rail line would be used to transport large equipment and materials to the site. Public roadways would be used to transport smaller equipment, as well as large numbers of construction workers. Appropriate measures would be taken to minimize noise, dust, and other impacts due to both construction and transportation activities. However, because residences are located throughout the area surrounding Site 7-2, it would not be possible to avoid close proximity to some residences. Based on field reconnaissance and examination of aerial photographs, it is estimated that more than 75 residences are located within 0.5 mi. of the conceptual site boundaries. Other residences are located in close proximity to the conceptual rail spur and other off-site corridors. Despite the implementation of appropriate mitigation measures, many of these residences probably would experience some impact due to construction-related noise, vibration, and dust.

Other sensitive areas also would be subject to physical impacts during project construction. As discussed in Subsection 9.3.2.3.1, a private school is located immediately outside of the conceptual site boundaries. The school would not be directly disturbed by construction, but it would be exposed to noise, vibration, and dust. In addition, the conceptual pipeline corridor crosses parts of three Wildlife Management Areas, state-owned properties that are open to the public for hunting and fishing. It would not be feasible to re-route the pipeline corridor so as to completely avoid these areas. During installation of the pipelines, parts of the Wildlife Management Areas would be subject to noise, vibration, and dust.

Considering the conditions summarized above, project construction would noticeably alter the existing physical conditions in the site area and might destabilize sensitive resources such as the school or the Wildlife Management Areas. For this reason, the physical impact due to project construction would be MODERATE to LARGE.

The physical impacts of project operation would be similar to the impacts of construction but somewhat reduced. Operating plant equipment would produce some noise, but the noise levels generally would be lower than the levels associated with construction activities. Workers and some materials and equipment would be transported to the site during project operation, but the amount of traffic and size of shipments generally would be less than during project construction. Periodic maintenance would be required for both on-site and off-site facilities, and the maintenance activities would create some noise, vibration, and dust, but these impacts would be more localized and of shorter duration than during project construction. Therefore, the physical impact due to project operation would be SMALL.

9.3.2.3.6.2 Demography

Impacts on demography would be associated with construction workers and operation workers moving into the region surrounding the project site. The significance of demographic impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-2 as for the PSEG Site. Site 7-2 is in the same county as the PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional demographic impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.1 indicates that the demographic impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.1 indicates that the demographic impact of plant operation at the PSEG Site also is expected to be SMALL. Therefore, the construction-related and operation-related demographic impact at Site 7-2 would be expected to be SMALL.

9.3.2.3.6.3 Economy

Impacts on the economy would be caused primarily by the jobs provided to construction and operation workers. The significance of economic impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-2 as for the PSEG Site. Site 7-2 is in the same county as the PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional economic impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.2.1 indicates that the regional economic impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.2.1 indicates that the regional economic impact of plant operation at the PSEG Site also is expected to be SMALL. Therefore, the construction-related and operation-related economic impact at Site 7-2 would be expected to be SMALL.

9.3.2.3.6.4 Taxes

Property taxes, sales taxes, and other taxes paid during construction and operation of the new plant would benefit the state and local jurisdictions that collect the taxes. The significance of tax impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-2 as for the PSEG Site. Site 7-2 is in the same county as the PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional tax impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.2.2 indicates that the tax impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.2.2 indicates that the tax impact of plant operation at the PSEG Site also is expected to be

SMALL. Therefore, the construction-related and operation-related tax impact at Site 7-2 would be expected to be SMALL.

9.3.2.3.6.5 Transportation

Transportation in the vicinity of the new plant could be affected by the increase in vehicle traffic associated with construction and operation workers commuting to the site and the delivery of materials and equipment to the site. The increase in vehicle traffic could cause delays on local roads. The severity of such impacts would depend primarily on the existing traffic volumes and LOS on local roads compared with the expected volume of project-related traffic.

Road access to the Site 7-2 area is provided primarily by NJ Route 540. This is considered a secondary state route, but it is a relatively wide two-lane highway. Road access to the site itself is provided primarily by Salem County Road 635. This is a narrow two-lane road that appears to be used mostly by local traffic.

The NJDOT does not publish LOS designations for roads in the state. However, NJDOT data (Reference 9.3-5) indicates that the average daily traffic volume (both directions) on NJ Route 540 is 5406 vehicles. NJDOT data does not include traffic volumes for Salem County Road 635.

As discussed in Subsection 4.4.1.5, maximum construction-related traffic volumes are expected to occur during shift changes (twice per day) in the peak construction workforce. During such shift changes, 2200 vehicles are expected to use local roads. Delivery of construction materials and equipment is expected to add another 50 vehicles per day over the construction period.

Considering the nature of the roads in the Site 7 -2 area and the current volume of traffic on those roads, it is likely that the peak construction traffic would noticeably alter existing transportation conditions (cause noticeable delays on local roads) but not be sufficient to destabilize important transportation resources. Therefore, the transportation impact associated with project construction would be MODERATE.

As discussed in Subsection 5.8.1.2, maximum traffic volumes associated with plant operation are expected to occur when fuel-reloading is being conducted for one generating unit and another unit is operating. The peak traffic volume at such times could be 1200 vehicles. Because this number of vehicles is significantly smaller than the peak construction traffic volume, it would not be expected to noticeably alter transportation conditions. Therefore, the transportation impact associated with project operation would be SMALL.

9.3.2.3.6.6 Aesthetics

Aesthetics in the vicinity of the new plant could be affected by the visual intrusion of large industrial structures and equipment. During project construction, dust could create additional visual intrusions. During operation, water vapor plumes from the cooling towers would be readily visible at certain times. Given that the Site 7-2 area currently has predominantly rural scenery, project construction and operation would dramatically alter the existing visual conditions. However, the severity of visual impacts on the human population would depend primarily on the visibility of the plant and off-site facilities from sensitive viewing areas.

As discussed in Subsection 9.3.2.3.6.1, field reconnaissance and examination of aerial photographs indicate that more than 75 residences are located within 0.5 mi. of the conceptual site boundaries. Although trees and existing buildings may block the view of some of these residences, many would be expected to have at least a partial view of the power plant during construction and operation. In addition, some residences are located near the conceptual off-site corridors and would have at least a partial view of the transmission lines, rail spur, and other off-site facilities during construction and operation.

Other sensitive viewing areas also are located in relatively close proximity to the site and off-site corridors. As discussed in Subsection 9.3.2.3.1, a private school is located immediately outside of the conceptual site boundaries. The school would not be directly disturbed, but it would experience significant visual intrusion during project construction and operation.

In addition, the conceptual pipeline corridor passes through parts of three Wildlife Management Areas, state-owned properties that are open to the public for hunting and fishing. It would not be feasible to re-route the pipeline corridor so as to completely avoid these areas. Parts of the Wildlife Management Areas would have a clear view of the pipeline corridor during installation of the pipelines.

NUREG-1437 establishes the following criteria for judging the severity of aesthetic impacts:

> SMALL - No complaints from affected public about a changed sense of place or a diminution in enjoyment of the physical environment, and no measurable impact on socioeconomic institutions and processes.
>
> MODERATE - Some complaints from affected public about a changed sense of place or a diminution in enjoyment of the physical environment, and measurable impacts that do not alter the continued functioning of socioeconomic institutions and processes.
>
> LARGE - Continuing and widely shared opposition to the project based on a perceived degradation of the area's sense of place or diminution in enjoyment of the physical environment, and measurable social impacts that perturb the continued functioning of community institutions and processes.

Considering that the power plant and off-site facilities would be visible from several sensitive viewing areas, and considering that project construction would dramatically alter the existing rural scenery, it is very likely that project construction would generate public complaints related to a changed sense of place and diminished enjoyment of the physical environment. It is likely that there would be general opposition to the project, and possible that there could be measurable social impacts that perturb the continued functioning of institutions such as the private school and Wildlife Management Areas. Therefore, the aesthetic impact associated with project construction would be MODERATE to LARGE.

Although project operation would not result in significant further alteration of aesthetic conditions, the power plant, cooling tower plumes, transmission lines, and rail spur traffic would continue to be visible from sensitive viewing areas. It is likely that there would be public complaints related to diminished enjoyment of the physical environment, and possible that there could be general opposition to the project and measurable social impacts that perturb the continued functioning of community institutions and processes. Therefore, the aesthetic impact associated with project operation would be MODERATE to LARGE.

9.3.2.3.6.7 Housing

Impacts on housing could be caused by construction and operation workers moving, either permanently or temporarily, into the region surrounding the project site. The significance of housing impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-2 as for the PSEG Site. Site 7-2 is in the same county as the PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional housing impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.2.4 indicates that the housing impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.2.4 indicates that the housing impact of plant operation at the PSEG Site also is expected to be SMALL. Therefore, the construction-related and operation-related housing impact at Site 7-2 would be expected to be SMALL.

9.3.2.3.6.8 Public Services

Public services include police, fire and medical services; social services; water supply and waste water treatment facilities; and recreation facilities. Impacts on public services could be caused by construction and operation workers moving into the region surrounding the project site. The significance of public service impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-2 as for the PSEG Site. Site 7-2 is in the same county as the PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional public service impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.2.5 indicates that the public service impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.1 indicates that the public service impact of plant operation at the PSEG Site also is expected to be SMALL. Therefore, the construction-related and operation-related public service impact at Site 7-2 would be expected to be SMALL.

9.3.2.3.6.9 Education

Impacts on education could be caused by construction and operation workers moving into and bringing school-aged children into the region surrounding the project site. The significance of education impacts would be determined primarily by regional conditions, and those conditions are essentially the same for Site 7-2 as for the PSEG Site. Site 7-2 is in the same county as the PSEG Site and is located less than 15 mi. away from the PSEG Site. Therefore, regional education impacts would be essentially the same at both sites.

The analysis presented in Subsection 4.4.2.2.7 indicates that the education impact of constructing the new plant at the PSEG Site is expected to be SMALL. The analysis presented in Subsection 5.8.2.2.7 indicates that the education impact of plant operation at the PSEG Site also is expected to be SMALL. Therefore, the construction-related and operation-related education impact at Site 7-2 would be expected to be SMALL.

9.3.2.3.7 Historical and Archaeological Resources

Historical and archaeological resources could be directly disturbed by construction activities or indirectly disturbed by noise, dust, vehicle emissions, or visual intrusion during project construction and operation. The severity of such impacts would depend on the historic significance of the resources and the degree of disturbance.

Several properties listed on the NRHP and/or the NJRHP are located in the immediate vicinity of Site 7-2 and the off-site corridors. The Philip Fries House, which is listed on both the NRHP and the NJRHP, is located 0.3 mi. from the conceptual site boundaries. The house would not be directly disturbed, but it would be subject to noise and visual intrusion during project construction and operation.

Deerfield Presbyterian Church, which is listed on both the NRHP and the NJRHP, is located 0.3 mi. from the conceptual rail spur corridor. The church would not be directly disturbed, but it would be subject to noise and visual intrusion during construction and operation of the rail spur.

In addition, three historical sites and one archaeological site are located on or near the conceptual pipeline corridor. It would be feasible to route the pipeline corridor so as to avoid direct disturbance to these sites, but they probably would be subject to noise and visual intrusion during construction of the pipelines.

The impacts summarized above would noticeably alter the existing historical and archaeological resources in the site area during project construction, but it is very unlikely that they would destabilize any important attributes of these resources. Therefore, the impact on historical and archaeological resources due to project construction would be MODERATE.

It does not appear that any additional disturbance of historical and archaeological resources would occur during project operation. Therefore, the impact on historical and archaeological resources due to project operation would be SMALL.

9.3.2.3.8 Environmental Justice

Environmental justice issues involve aspects of the project that could disproportionately impact minority or low income populations. The potential for disproportionate impacts depends primarily on the location of the power plant and off-site facilities in relation to existing minority and low income populations.

USCB data for the year 2000 (Reference 9.3-8) were used to determine the percentage of minority and low-income populations within the 6-mi. site vicinity, and to identify any census block groups within 6 mi. that contain a higher than average percentage of minority or low-income populations. The percentages for the site vicinity and each census block group were compared to the percentages for NJ.

Minorities comprise 20.9 percent of the population within 6 mi. of Site 7-2, compared with 34.0 percent for NJ. People with incomes below the poverty level comprise 11.5 percent of the population within 6 mi. of Site 7-2, compared with 8.5 percent for NJ. Of the 16 census block groups that have at least 50 percent of their area within 6 mi. of the site, 6 have minority and/or poverty populations above the state average. A census block group with poverty populations above the state average is located 0.5 mi. from the conceptual site boundaries; minorities comprise 22.6 percent of the population within this block group, and people with incomes below the poverty level comprise 9.4 percent. The conceptual pipeline corridor crosses part of this same block group. In addition, the conceptual rail spur corridor crosses part of a block group with both minority and poverty populations above the state average; minorities comprise 70.2

percent of the population within this block group, and people with incomes below the poverty level comprise 16.2 percent.

Based on the above information there appears to be a potential for the project to disproportionately impact minority and low income populations. The severity of the impacts would depend on exactly how minority and low income populations use the site area and the extent to which they would be exposed to the adverse impacts of project construction and operation. Detailed field investigations would be performed to determine the level of impact if development of this site progresses. Based on available information, it appears that environmental justice impacts due to project construction and operation could be MODERATE to LARGE.

9.3.2.4 Evaluation of Site 7-3

Site 7-3 is a greenfield site in Cumberland County, NJ. The site is located on flat land less than 1 mi. east of the Delaware River, which would be the primary water source. Elevations across the site range from 0 to 20 ft. above Mean Sea Level. Based on conceptual site boundaries identified by considering site development requirements and existing property parcels, the site has a total area of 886 ac.

Site 7-3 would require the following off-site features in order to support a nuclear power plant:

- Road access to the site would be provided by existing public roads, but portions of those roads would have to be relocated around plant facilities or improved to allow them to carry plant-related traffic. It was assumed that all roads would be constructed on a ROW 150 ft. wide. A total of 4.2 mi. of road construction was estimated to be required.
- A new makeup water pipeline would withdraw water from the Delaware River, and a new blowdown pipeline would discharge wastewater to the Delaware River. It was assumed that the two pipelines would be constructed parallel to one another, on a single ROW 100 ft. wide. A conceptual route to the Delaware River was identified based on existing terrain and land use features, and this route is 0.7 mi. long
- Three new 500 kV transmission lines would connect the site to the existing 500 kV transmission system. It was assumed that the three transmission lines would be constructed parallel to one another, each on a ROW 200 ft. wide. A conceptual route to the nearest existing 500 kV transmission line (which originates from the SGS/HCGS site) was identified based on existing terrain and land use features, and this route is 6.8 mi. long. It was expected that an interposing switchyard would be required at the connection point, and this switchyard was conceptually located on 25 ac. of land. In addition, it was expected that a new 500 kV transmission line would be required to address potential grid stability issues. A new line between the Indian River Substation in Delaware and the SGS/HCGS site (which, in turn, is electrically tied to the new interposing switchyard) would fulfill this purpose. The Indian River Substation is capable of providing synchronizing support to maintain system stability during grid disturbances. It was assumed that this transmission line would be

constructed on a 200 ft. wide ROW generally following existing transmission lines, for a total distance of approximately 107 mi.

Because Site 7-3 is located less than 1 mi. from the Delaware River and the intervening land is suitable for delivery of materials and large equipment off-loaded from a barge, a rail spur would not be required for delivery of materials and equipment to the site. However, the impact assessment includes a new road between the potential barge unloading area and the conceptual plant footprint. It was assumed that this road would be constructed parallel to the makeup and blowdown pipelines, on a ROW 150 ft. wide.

Subsections 9.3.2.4.1 through 9.3.2.4.8 discuss the potential environmental impacts of developing Site 7-3 and the off-site features listed above. Because the transmission corridors are significantly longer than the other off-site corridors and are not confined to the immediate site vicinity, quantitative estimates of potential impacts are presented separately for the transmission corridors.

9.3.2.4.1 Land Use

Existing land use across Site 7-3 is predominantly agricultural, with large fields planted in cultivated crops. Soils classified as prime farmland occur across much of the site. In addition, portions of the site are covered by a Deed of Conservation Restriction filed by PSEG. This restriction would have to be removed and mitigated in order to develop the site for a power plant.

Residences (single family houses) are scattered across the site. There are nine houses located within the conceptual site boundaries, and most of these houses would have to be removed before the site could be developed with a power plant. Most the site is zoned for Rural Residential use. Although the site is located more than 6 mi. from the nearest incorporated town, small concentrations of houses are located within 2 mi. of the site.

The off-site corridors for the access roads and water pipelines are largely confined to the immediate site vicinity, and the land use within these corridors is similar to the site itself, with most of the land in agricultural use. It is anticipated that the corridors could be developed without removing existing houses, but some houses would be located in close proximity to the various ROW alignments.

No significant industrial land uses have been identified on the site, within the associated off-site corridors, or in close proximity.

Based on the conceptual plant layout developed for Site 7-3, development of the site would directly disturb (permanently and temporarily) 395 ac. of land. The remaining land within the site boundaries, which totals 491 ac., would not be directly disturbed, but access to this land would be controlled and it generally would be unavailable for non-power plant uses. In addition, development of the access road and water pipeline corridors would disturb 84 ac. of land. Cumulatively, 970 ac. would be disturbed or made unavailable for non-power plant uses. The acreage of each major land use category currently found on this land was estimated based on GIS mapping data. Table 9.3-17 summarizes the acreages in the major land use categories and compares those quantities with the total acreages found in the site vicinity (within a 6 mi. radius of the site).

Table 9.3-17 shows that the acreage of each land use category potentially affected by project construction is a relatively small percentage of the total acreage of that land use available in the site vicinity. It is not expected that project construction would destabilize any important land use resources. However, construction would change the site and associated off-site corridors from predominantly rural land use with scattered housing and very little industrial development to intensive heavy industrial use. This would noticeably alter the existing land use resources. Therefore, the land use impact due to project construction would be MODERATE.

As discussed in Subsection 9.3.2.4, the potential transmission corridor from the SGS/HCGS site to the Indian River Substation is approximately 107 mi. long. This corridor, along with the transmission corridor from Site 7-3 to the nearest existing 500 kV transmission line and an interposing switchyard at the connection point, includes 3238 ac. of land. The acreage of each major land use category currently found on this land was estimated based on GIS mapping data. Table 9.3-18 summarizes the acreages in the major land use categories and compares those quantities with the total acreages found in the 6 mi. site vicinity.

Table 9.3-18 shows that the acreage of each land use category potentially affected by transmission line construction is a relatively small percentage of the total acreage of that land use available in the site vicinity. It is not expected that transmission line construction would destabilize any important land use resources. However, transmission line construction would noticeably alter the existing land use on more than 3200 ac. of land. Permanent land impacts associated with the transmission corridor, such as tower foundations, would be substantially less than the total acreage of the corridor. It is possible that some residences or other buildings would have to be removed to provide adequate clearance for the transmission lines. Therefore, the land use impact due to transmission line construction would be MODERATE.

During project operation, land use impacts would be reduced. Agricultural activities may be allowed in the transmission line and pipeline ROWs. No new land use impacts would occur beyond those described above for project construction, so land use resources that exist at the conclusion of the construction phase would not be noticeably altered. Therefore, the land use impact due to project operation would be SMALL.

9.3.2.4.2 Air Quality

The air quality impacts of constructing and operating the new plant and off-site facilities for Site 7-3 would be similar to the impacts expected for the PSEG Site. Cumberland County is classified as a non-attainment area for ozone, and it is considered to be in attainment with the NAAQS for all other criteria pollutants. This is the same classification as Salem County, where the PSEG Site is located.

Air quality impacts during project construction would include dust from earthmoving and material handling activities, and exhaust emissions from construction vehicles and equipment. These impacts would be similar to the impacts associated with any large construction project. To limit and mitigate the impacts, emission-specific strategies, plans and measures would be developed and implemented to ensure compliance with applicable federal and state regulations. Therefore, air quality impacts associated with construction would be SMALL.

During plant operation, the cooling towers would emit particulate matter. Auxiliary boilers and standby diesel generators or combustion turbines would emit particulate matter and gaseous pollutants such as nitrogen oxides. All emissions would be governed by a Prevention of

Significant Deterioration Permit and a Title V Certificate to Operate, which would ensure compliance with the NAAQS and other applicable regulatory requirements. Therefore, air quality impacts associated with operation would be SMALL.

9.3.2.4.3 Hydrology, Water Use, and Water Quality

The Delaware River would be the primary source of water for a plant located at Site 7-3. The site is located 5 mi. from the river, so the only direct impact on the river during project construction would be disturbance of a relatively small section of the shoreline and river bottom for installation of a water intake structure, wastewater discharge structure, and barge docking and offloading facility.

Water-related impacts associated with construction activities on the site itself would be similar to the impacts of any large construction project. Potential impacts include direct physical alteration of local surface water bodies; indirect alteration of nearby surface water bodies due to increased runoff volumes or diversions of runoff; degradation of downstream surface water quality as a result of erosion and sedimentation or discharges of pollutants associated with construction activities; and changes in groundwater flow patterns due to dewatering of excavations and soil retention management practices. Similar impacts would occur in the off-site corridors for construction of the rail spur, access roads, and other off-site facilities. The most significant impact would be that some existing streams on the site and within the off-site corridors would be directly disturbed, and some adjacent streams would experience a temporary increase in sediment loading due to increased runoff of disturbed soil.

Several federal, state, and local permits would govern construction activities that have the potential to impact water resources. Water-related impacts would be minimized by implementing BMPs, including erosion, grading, and sediment control measures; stormwater pollution prevention plans; spill prevention and countermeasure plans; and compliance with federal, state, and local regulations pertaining to disturbance of water bodies and pollution discharges. Withdrawal of either surface water or groundwater would be anticipated during project construction, but the quantities would be less than the quantities evaluated below for project operation. Therefore, impacts on water resources due to project construction would be SMALL.

During project operation, the new plant would withdraw make-up water from the Delaware River and discharge wastewater (primarily cooling tower blowdown) to the river. The water withdrawn from the river would either be returned to the river as blowdown or lost to the atmosphere through operation of the cooling towers. Water returned to the river as blowdown would not be lost to downstream users or aquatic communities.

As discussed in Section 3.3, the water withdrawal rate for the new plant at the PSEG Site is 78,196 gpm, and the consumptive water loss (primarily due to evaporation from the cooling towers) is 26,420 gpm. These values assume that the cooling towers operate at 1.5 cycles of concentration, which is appropriate for the brackish water found in the Delaware River at the PSEG Site. Site 7-3 would withdraw water from the same part of the Delaware River, so the same values can be used for Site 7-3.

Based on USGS data (Reference 9.3-10) for the nearest available gauging station (near Trenton, NJ), the annual mean river flow is 5,318,636 gpm, and the 7Q10 flow is 771,988 gpm. Based on these statistics, the withdrawal rate (78,196 gpm) would divert approximately 1.5 percent of the annual mean river flow and 10.1 percent of the 7Q10 flow. The consumptive water loss (26,420 gpm) would reduce the annual mean river flow by 0.5 percent and the 7Q10 flow by 3.4 percent.

As stated above, Site 7-3 is located in an area where the Delaware River water is brackish. Because consumptive water use at locations with brackish water has a lesser impact on salinity intrusion than an equal consumption of fresh water, the DRBC has developed an EIF to account for the difference. As discussed in Subsection 5.2.1.2, the EIF in the PSEG Site area is 0.18. The factor applicable to Site 7-3 would nominally be the same as the value for the PSEG Site. Using this factor, the 26,420 gpm consumptive use of Delaware River water is equivalent to a freshwater consumptive use impact of a 4756 gpm. This impact represents approximately 0.1 percent of the annual average river flow and 0.6 percent of the 7Q10 flow.

It should be noted that the Trenton gauging station is more than 60 mi. upstream of the Site 7-3 area. Therefore, the actual river flows in the site area are expected to be considerably higher than the flows discussed above, and the impacts of water withdrawal and consumption would be correspondingly lower. It also should be noted that PSEG is a co-owner of the Merrill Creek Reservoir and has an established allocation of water that can be released from the reservoir to offset consumptive use during periods of declared drought. Water withdrawal for the new plant could be supported by re-allocation of water among the existing PSEG plants, or additional existing water allocation rights would be acquired from other Merrill Creek co-owner(s).

The withdrawal of water from the Delaware River would be regulated by the DRBC and NJDEP, which would ensure that the diversion and consumption of river water did not adversely affect downstream users or aquatic communities. The discharge of wastewater to the Delaware River also would be regulated, ensuring compliance with applicable water quality standards and designated uses of the river. Discharges of stormwater runoff from the operational plant site and off-site facilities would be similarly regulated by the NJDEP. Therefore, impacts on surface water resources due to project operation would be SMALL.

Because the Delaware River is brackish in the Site 7-3 area, groundwater withdrawal would be necessary to provide fresh water for plant uses. In order to make a consistent comparison of impacts with the PSEG Site, it was assumed that the same amount of groundwater withdrawal for the PSEG Site (210 gpm average, 953 gpm maximum) would be required.

Based on data provided by the USGS (Reference 9.3-11) and the New Jersey Water Science Center (Reference 9.3-6), groundwater wells in the Site 7-3 area would withdraw water from either the Kirkwood-Cohansey Coastal Plain Aquifer or the Atlantic City Sand Aquifer. Both aquifers consist of fine-to-coarse grained sand. The Kirkwood-Cohansey Aquifer is unconfined, and typical well yields range from 500 to 1000 gpm. The Atlantic City Sand Aquifer is confined, and typical well yields range from 600 to 800 gpm.

The above information indicates that the plant groundwater requirements could be supplied by one or two wells drilled to the Kirkwood-Cohansey Coastal Plain Aquifer or the Atlantic City Sand Aquifer. Although some parts of these aquifers may have experienced groundwater drawdown, it is likely that properly located wells could supply the plant water needs with no expected problems. Section 2.3 provides additional discussion of groundwater resources. In addition, groundwater withdrawal would be regulated by both the DRBC and the NJDEP. Therefore, impacts on groundwater resources due to project operation would be SMALL.

9.3.2.4.4 Terrestrial Biological Resources Including Protected Species

Any large construction project impacts terrestrial ecology primarily by disturbing natural habitats and making those habitats unavailable to plants and animals. Although construction activities may result in direct mortality to some plants and animals, most animal species are able to move away to avoid direct impacts. Even those species, however, may experience population declines due to loss of habitat. In addition, noise, lights, and dust may cause some animals to leave areas near construction activities. This is also experienced as a loss of usable habitat.

As described in the New Jersey Wildlife Action Plan (Reference 9.3-4), Site 7-3 is located in the Shoreline Zone of the Delaware Bay Landscape Region. Critical habitats in this zone include beaches, dunes, and tidal and freshwater. Rich farmlands are found inland from the Delaware Bay shoreline.

Ecological conditions on Site 7-3 are typical of the farmlands found in the Shoreline Zone. Most of the land is used for agriculture. Forest is restricted to scattered woodlots and strips of trees along streams. Wetlands, both tidal and freshwater, are found primarily in isolated low areas, and some of the wetlands are farmed. Grasslands are virtually absent. The off-site corridors for the access roads and water pipelines are largely confined to the immediate site vicinity, and the natural habitats within these corridors are similar to the site itself.

As discussed in Subsection 9.3.2.4.1, development of the site would directly disturb (permanently and temporarily) 395 ac. of land. The remaining land within the site boundaries, which totals 491 ac., would not be directly disturbed, but construction activities would subject much of this land to indirect disturbance (noise, dust, etc.) and impede the movement of wildlife within this area. In addition, development of the access road and water pipeline corridors would disturb 84 ac. of land. Cumulatively, 970 ac. would be directly or indirectly disturbed. The acreage of forest, wetlands, and grassland habitat currently found on this land was estimated based on GIS mapping data. Table 9.3-19 summarizes the acreage of each habitat that would be potentially affected and compares those quantities with the total acreage found in the site vicinity (within a 6 mi. radius of the site).

Table 9.3-19 shows that the acreage of each habitat potentially affected by project construction is a relatively small percentage of the total acreage of that habitat available in the site vicinity. In addition, the specific habitat areas that would be disturbed generally are small and isolated from larger habitat areas. Therefore, the overall impacts on terrestrial ecology due to project construction would be SMALL. However, based on the acreage of wetlands that would be potentially affected (173 ac.), the wetlands impact due to project construction would be considered MODERATE.

As discussed in Subsection 9.3.2.4, the potential transmission corridor from the SGS/HCGS site to Indian River Substation is approximately 107 mi. long. This corridor, along with the transmission corridor from Site 7-3 to the nearest existing 500 kV transmission line and an interposing switchyard at the connection point, includes 3238 ac. of land. The acreage of forest, wetlands, and grassland habitat currently found on this land was estimated based on GIS mapping data. Table 9.3-20 summarizes the acreage of each habitat that would be potentially impacted and compares those quantities with the total acreages found in the 6 mi. site vicinity.

Table 9.3-20 shows that the acreage of each habitat potentially affected by transmission line construction is a relatively small percentage of the total acreage of that habitat available in the site vicinity. It is not expected that transmission line construction would destabilize terrestrial ecological resources. However, the acreage of both wetlands and forest that would be potentially affected (936 ac. and 632 ac., respectively) is somewhat significant. It should be noted that wetlands impacts would be limited to the areas of tower construction, and final routing of the transmission line would take wetlands avoidance into consideration. Clearing of the forested areas would noticeably alter the plant and animal species found in these areas. Therefore, the impacts on terrestrial ecology due to transmission line construction would be MODERATE.

The terrestrial ecology impacts of project operation would be similar to the impacts of construction but somewhat reduced. Areas that are paved or occupied by project facilities would be permanently unavailable to plants and animals, but areas that are used for construction laydown or other temporary activities may be re-colonized by some species after construction is finished. Therefore, impacts on terrestrial ecology due to operation of the power plant, transmission lines, and other off-site features would be SMALL.

Information on protected and rare species that may occur in the Site 7-3 area was obtained from the NJDEP (Reference 9.3-3). According to this information, 13 animal species have been recorded within approximately 1 mi. of the site. These species are listed in Table 9.3-21. Detailed field studies would be required to determine whether any of these species make significant use of the site or off-site corridors, and as reconnaissance level data was used for evaluation, such studies were not conducted for the alternative sites. However, based on the relatively minor impacts on natural habitats described above, it is unlikely that any of these species would be significantly affected by project construction or operation. Therefore, impacts on protected and rare terrestrial species would be expected to be SMALL.

9.3.2.4.5 Aquatic Biological Resources Including Protected Species

As discussed in Subsection 9.3.2.4.3, project construction would result in the disturbance of a relatively small section of the Delaware River shoreline and river bottom due to installation of a water intake structure, wastewater discharge structure, and barge docking facility. Some aquatic organisms that use this area might suffer direct mortality from construction activities, but most organisms would move away from the area and be affected primarily by the loss of a limited amount of habitat. In addition, some aquatic species might be affected by increased turbidity and siltation resulting from construction activities, but such effects would be temporary and localized.

Construction activities on the site and in the off-site corridors would result in direct disturbance to some existing streams, and some adjacent streams would experience a temporary increase in sediment loading due to increased runoff of disturbed soil. There is no indication that any of the streams that would be affected have any exceptional or high value. Similar streams are common in the 6-mi. vicinity around Site 7-3.

Based on GIS mapping data, the total length of streams that would be directly affected by construction on the site and in the access road, rail spur, and water pipeline corridors is 3747 ft. This represents less than 0.1 percent of the total length of streams in the 6-mi. site vicinity (4,121,978 ft.). In addition, the total length of streams included within the transmission corridors and interposing switchyard is 86,596 ft., which represents approximately 2.1 percent of the stream length in the site vicinity. Most of the streams in the transmission corridors would not be directly affected; it is estimated that 95 percent of the streams could be avoided during transmission line construction.

From the numbers discussed above, it is clear that the expected stream disturbance is a very small percentage of the total length of streams available in the site vicinity. In addition, construction impacts on streams and on the Delaware River would be regulated by several federal, state, and local permits. Therefore, impacts on aquatic ecology due to construction of the power plant, transmission lines, and other off-site features would be SMALL.

During operation of the power plant, transmission lines, and other off-site features, there would be little if any additional impact on streams. The primary source of potential impacts during operation would be the withdrawal of water from the Delaware River. Some aquatic organisms would be entrained with the intake water or impinged on the intake screens. However, federal regulations (40 CFR Part 125) require cooling water intake structures to meet stringent criteria designed to protect organisms from entrainment and impingement. In addition, the amount of water withdrawn would be a relatively small percentage of the overall river flow, as discussed in Subsection 9.3.2.4.3. Therefore, impacts on aquatic ecology due to project operation would be SMALL.

Information provided by the NJDEP on protected and rare species that may occur in the site area (Reference 9.3-3) identified one aquatic species, the Shortnose Sturgeon. This species is known to occur throughout the lower reaches of the Delaware River. Detailed field studies would be required to determine whether the Shortnose Sturgeon or any other protected or rare aquatic species make significant use of the part of the Delaware River or any streams that could be affected by the project, and as reconnaissance level data was used for evaluation, such studies were not conducted for the alternative sites. However, based on the relatively minor impacts on aquatic habitats described above, it is unlikely that any aquatic species would be significantly affected by project construction or operation. Therefore, impacts on protected and rare aquatic species would be expected to be SMALL.

9.3.2.4.6 Socioeconomics

This subsection evaluates the social and economic impacts that could result from constructing and operating the new plant at Site 7-3. The evaluation includes the impacts of construction and operation activities and demands placed by the construction and operation workforces on the site and the surrounding region. It is assumed that all construction activities would occur within the site boundaries and off-site corridors described in Subsection 9.3.2.4, and physical impacts would be restricted to these construction areas and nearby properties. Other socioeconomic impacts generally occur on a regional basis, and in the following subsections they are evaluated for Cumberland County and the region within 50 mi. of Site 7-3.

9.3.2.4.6.1 Physical Impacts

Any large construction project can cause temporary and localized physical impacts such as noise, vibration, dust, vehicle exhaust, and odors. In addition, construction materials, equipment, and workers must be transported to the construction areas, and these transportation activities also cause noise, vibration, dust, vehicle exhaust, and odors. For Site 7-3, public roadways would be used to transport equipment and materials that were not delivered by barge. Large numbers of construction workers also would use public roadways to reach the site. Appropriate measures would be taken to minimize noise, dust, and other impacts due to both construction and transportation activities. However, because residences are located throughout the area surrounding Site 7-3, it would not be possible to avoid close proximity to some residences. Based on field reconnaissance and examination of aerial photographs, approximately 17 residences are located within 0.5 mi. of the conceptual site boundaries. Other residences are located in close proximity to the conceptual transmission corridor. Despite the implementation of appropriate mitigation measures, some of these residences probably would experience some impact due to construction-related noise, vibration, and dust. This would noticeably alter the existing physical conditions in the immediate site area. For this reason, the physical impact due to project construction would be MODERATE.

The physical impacts of project operation would be similar to the impacts of construction but somewhat reduced. Operating plant equipment would produce some noise, but the noise levels generally would be lower than the levels associated with construction activities. Workers and some materials and equipment would be transported to the site during project operation, but the amount of traffic and size of shipments generally would be less than during project construction. Periodic maintenance would be required for both on-site and off-site facilities, and the maintenance activities would create some noise, vibration, and dust, but these impacts would be more localized and of shorter duration than during project construction. Therefore, the physical impact due to project operation would be SMALL.

9.3.2.4.6.2 Demography

Impacts on demography would be associated with construction workers and operation workers moving into the region surrounding the project site, potentially causing changes in off-site land use and development patterns. Construction employment is inherently temporary, but construction workers sometimes move their families into the region, magnifying the population increase. However, in densely populated states such as NJ and the adjacent states, a substantial number of construction workers may commute from their existing residences and not need to move into the region.

Per NUREG-1437, demographic impacts are expected to be SMALL if project-related population growth represents less than 5 percent of the study area's total population, MODERATE if 5 to 20 percent, and LARGE if more than 20 percent.

The analysis presented in Subsection 4.4.2.1 indicates that if the new plant were constructed at the PSEG Site, 634 of the 4100 construction workers could be expected to move into the four-county Region of Influence. The analysis conservatively assumes that all of the workers who move into the region would bring their families, resulting in a total population increase of 1712 people. For purposes of evaluating demographic impacts at Site 7-3, it was assumed that the same population increase would occur in Cumberland County. For the purpose of this comparison, this is considered a conservative assumption, because the same population increase for the four counties surrounding the PSEG Site is being applied to one county for Site 7-3 and the impact is not noticeable.

Based on USCB data (Reference 9.3-9), the population of Cumberland County was 146,438 in the year 2000, and the population was estimated to have increased to 156,830 in 2008. Using the year 2000 population (146,438) and the conservative population increase discussed above (1712), project-related population growth due to the construction workforce would be approximately 1.2 percent. Therefore, the construction-related demographic impact in Cumberland County would be SMALL.

Another conservative assumption that can be made is that the entire peak construction workforce (4100 people) would move into and bring families into the 50-mi. region surrounding the project site. Applying the average NJ household size of 2.70 people per household (Subsection 4.4.2.1), the total population increase would be 11,070. Based on USCB data (Reference 9.3-9), the population of the region within a 50-mi. radius of Site 7-3 was 5,047,429 in the year 2000. Using this population value and a population increase of 11,070, project-related population growth due to the construction workforce would be 0.2 percent. Therefore, the construction-related demographic impact in the 50-mi. region would be SMALL.

The analysis presented in Subsection 5.8.2.1 indicates that if the new plant were constructed at the PSEG Site, 496 of the 600 operation workers could be expected to move into the four-county Region of Influence. Conservatively assuming that all of these workers moved into Cumberland County and brought families with an average of 2.70 people per household, the resulting population increase would be 1338 people. Obviously, this would be a smaller impact than the construction-related population increase discussed above. In addition, the total number of operation workers is significantly smaller than the peak construction workforce discussed above. Therefore, the operation-related demographic impact in both Cumberland County and the 50-mi. region would be SMALL.

9.3.2.4.6.3 Economy

Impacts on the economy would be caused primarily by the jobs provided to construction and operation workers. The wages paid to workers result in additional spending, which tends to stimulate the economy, particularly in the retail and service sectors. This can provide opportunities for new businesses and new jobs. These effects are considered to be beneficial and would be expected to occur primarily in the area within which the workers reside.

Per NUREG-1437, economic impacts are considered SMALL if project-related employment represents less than 5 percent of the study area’s total employment, MODERATE if 5 to 10 percent, and LARGE if more than 10 percent.

In the previous subsection it was conservatively estimated that if the new plant were constructed at Site 7-3, 634 construction workers would move into Cumberland County and 4100 construction workers would move into the 50-mi. region surrounding the site.

Based on USCB data for the year 2000 (Reference 9.3-9), the total number of employees in Cumberland County was 59,129, and the total number of employees in the 50-mi. region was 2,283,341. Using the county value for total employment (59,129) and the conservative county employment increase discussed above (634), project-related employment due to the construction workforce would be 1.1 percent. Therefore, the construction-related economic impact in Cumberland County would be SMALL. Using the regional value for total employment (2,283,341) and the conservative regional employment increase discussed above (4100), project-related employment due to the construction workforce would be less than 0.2 percent. Therefore, the construction-related economic impact in the 50-mi. region would be SMALL.

As discussed in the previous subsection, the number of operation workers estimated to move into both Cumberland County and the 50-mi. region is significantly smaller than the number of construction workers. Therefore, the operation-related economic impact in both Cumberland County and the 50-mi. region would be SMALL.

9.3.2.4.6.4 Taxes

Property taxes, sales taxes, and other taxes paid during construction and operation of the new plant would benefit the state and local jurisdictions that collect the taxes. Per NUREG-1437, tax impacts are considered SMALL if project-related tax revenues represent less than 10 percent of the total tax revenues of the local taxing jurisdictions, MODERATE if 10 to 20 percent, and LARGE if more than 20 percent.

The analysis presented in Subsections 4.4.2.2.2 indicates that the taxes paid by the new plant during project construction are expected to be significantly less than 10 percent of the total tax revenues for Salem County, resulting in a SMALL tax impact. The analysis presented in Subsection 5.8.2.2.2 indicates that the taxes paid by the new plant during project operation also are expected to result in a SMALL tax impact.

Based on 2008 county budget documents (Reference 9.3-1), Salem County has total annual tax revenues of $50,139,854, while Cumberland County has total annual tax revenues of $76,100,000. Therefore, the taxes paid by the new plant would be a smaller percentage of the total tax revenues for Cumberland County than for Salem County, and the tax impact associated with both construction and operation would be SMALL.

9.3.2.4.6.5 Transportation

Transportation in the vicinity of the new plant could be affected by the increase in vehicle traffic associated with construction and operation workers commuting to the site and the delivery of materials and equipment to the site. The increase in vehicle traffic could cause delays on local roads. The severity of such impacts would depend primarily on the existing traffic volumes and LOS on local roads compared with the expected volume of project-related traffic.

Road access to the Site 7-3 area is provided primarily by Cumberland County Roads 623 and 639. Access to the site itself is provided by Cumberland County Road 642. All of these are relatively narrow two-lane roads that appear to be used mostly by local traffic.

The NJDOT does not publish LOS designations for roads in the state. However, NJDOT data (Reference 9.3-5) indicates that the average daily traffic volume (both directions) on Cumberland County Road 642 is 230 vehicles. NJDOT data does not include traffic volumes for Cumberland County Roads 623 and 639.

As discussed in Subsection 4.4.1.5, maximum construction-related traffic volumes are expected to occur during shift changes (twice per day) in the peak construction workforce. During such shift changes, 2200 vehicles are expected to use local roads. Delivery of construction materials and equipment is expected to add another 50 vehicles per day over the construction period.

Considering that the only roads that currently provide access to the Site 7-3 area are narrow, two-lane, local roads with very low traffic volumes, it is likely that the peak construction traffic would cause significant delays on those roads and might be sufficient to destabilize local transportation resources. Therefore, the transportation impact associated with project construction would be MODERATE to LARGE.

As discussed in Subsection 5.8.1.2, maximum traffic volumes associated with plant operation are expected to occur when fuel-reloading is being conducted for one generating unit and another unit is operating. The peak traffic volume at such times could be 1200 vehicles. Because this number of vehicles is significantly smaller than the peak construction traffic volume, it would not be expected to noticeably alter transportation conditions. Therefore, the transportation impact associated with project operation would be SMALL.

9.3.2.4.6.6 Aesthetics

Aesthetics in the vicinity of the new plant could be affected by the visual intrusion of large industrial structures and equipment. During project construction, dust could create additional visual intrusions. During operation, water vapor plumes from the cooling towers would be readily visible at certain times. Given that the Site 7-3 area currently has predominantly rural scenery, project construction and operation would dramatically alter the existing visual conditions. However, the severity of visual impacts on the human population would depend primarily on the visibility of the plant and off-site facilities from sensitive viewing areas.

As discussed in Subsection 9.3.2.4.6.1, field reconnaissance and examination of aerial photographs indicate that approximately 17 residences are located within 0.5 mi. of the conceptual site boundaries. Although trees and existing buildings may block the view of some of these residences, some would be expected to have at least a partial view of the power plant during construction and operation. In addition, some residences are located near the conceptual off-site corridors and would have at least a partial view of the transmission lines or access road during construction and operation.

The only other sensitive viewing area identified in close proximity to the site or off-site corridors is Stow Creek Wildlife Management Area, a state-owned property that is open to the public for hunting and fishing. The nearest boundary of this area is 1.3 mi. away from the conceptual site boundaries; at that distance, the power plant might be partially visible from parts of the Wildlife Management Area during construction and operation. In addition, part of the Wildlife Management Area is adjacent to a section of the conceptual transmission corridor. The transmission lines would be partially visible from that part of the Wildlife Management Area during construction and operation.

NUREG-1437 establishes the following criteria for judging the severity of aesthetic impacts:

> SMALL - No complaints from affected public about a changed sense of place or a diminution in enjoyment of the physical environment, and no measurable impact on socioeconomic institutions and processes.
>
> MODERATE - Some complaints from affected public about a changed sense of place or a diminution in enjoyment of the physical environment, and measurable impacts that do not alter the continued functioning of socioeconomic institutions and processes.
>
> LARGE - Continuing and widely shared opposition to the project based on a perceived degradation of the area's sense of place or diminution in enjoyment of the physical environment, and measurable social impacts that perturb the continued functioning of community institutions and processes.

Considering that the power plant and off-site facilities would be visible from some sensitive viewing areas, and considering that project construction would dramatically alter the existing rural scenery, it is very likely that construction would generate public complaints related to a changed sense of place and diminished enjoyment of the physical environment. It is possible that there could be general opposition to the project, but it is unlikely that there would be measurable social impacts that perturb the continued functioning community institutions and processes. Therefore, the aesthetic impact associated with project construction would be MODERATE.

Although project operation would not result in significant further alteration of aesthetic conditions, the power plant, cooling tower plumes, and transmission lines would continue to be visible from sensitive viewing areas. It is likely that there would be public complaints related to diminished enjoyment of the physical environment, be but it is unlikely that there would general opposition to the project or measurable social impacts that perturb the continued functioning of community institutions and processes. Therefore, the aesthetic impact associated with project operation would be MODERATE.

9.3.2.4.6.7 Housing

Impacts on housing could be caused by construction and operation workers moving, either permanently or temporarily, into the region surrounding the project site. This influx of workers could decrease the availability of unoccupied housing units and increase the cost to buy or rent housing. The severity of such impacts would depend primarily on the existing availability of unoccupied housing units compared with the number of workers who would move into the area.

NUREG-1437 establishes the following criteria for judging the severity of housing impacts:

> SMALL - Small and not easily discernible change in housing availability. Increases in rental rates or housing values equal or slightly exceed the statewide inflation rate.
>
> MODERATE - Discernible but short-lived reduction in available housing units. Rental rates and housing values rise slightly faster than the inflation rate, but prices realign quickly once new housing units became available or project-related demand diminishes.
>
> LARGE - Project-related demand for housing units results in very limited housing availability and increases in rental rates and housing values well above normal inflationary increases in the state.

In Subsection 9.3.2.4.6.2 it was conservatively estimated that if the new plant were constructed at Site 7-3, 634 construction workers would move into Cumberland County and 4100 construction workers would move into the 50-mi. region surrounding the site.

Based on USCB data for the year 2000 (Reference 9.3-9), the total number of housing units in Cumberland County was 52,863, and the number of vacant units was 3720. The conservative estimate of in-migrating construction workers discussed above (634) represents 17.0 percent of the unoccupied housing units in the county. Because a large percentage of the unoccupied housing units would remain available, it is unlikely that there would be an easily discernible change in housing availability or a significant increase in housing costs. Therefore, the construction-related housing impact in Cumberland County would be SMALL.

Based on USCB year 2000 data, the total number of housing units in the 50-mi. region surrounding Site 7-3 was 2,112,404, and the number of vacant units was 211,511. The conservative estimate of in-migrating construction workers discussed above (4100) represents

1.9 percent of the unoccupied housing units in the region. Because a large percentage of the unoccupied housing units would remain available, it is very unlikely that there would be a discernible change in housing availability or increase in housing costs. Therefore, the construction-related housing impact in the 50-mi. region would be SMALL.

As discussed in Subsection 9.3.2.4.6.2, the number of operation workers estimated to move into both Cumberland County and the 50-mi. region is significantly smaller than the estimated number of construction workers. Therefore, the operation-related housing impact in both Cumberland County and the 50-mi. region would be SMALL.

9.3.2.4.6.8 Public Services

Public services include police, fire and medical services; social services; water supply and waste water treatment facilities; and recreation facilities. Impacts on public services could be caused by construction and operation workers moving into the region surrounding the project site. This influx of workers could increase the demand for public services, potentially requiring local governments to add facilities, programs, and/or staff.

Per NUREG-1437, impacts on public services generally are considered to be SMALL if there is little or no need to add facilities, programs, and/or staff because of the influx of workers, and MODERATE or LARGE if additional facilities, programs, and/or staff are required.

As discussed in Subsection 9.3.2.4.6.2, the number of construction and operation workers estimated to move into both Cumberland County and the 50-mi, region is insignificant compared with the existing populations. Because there would not be a noticeable increase in the population demanding public services, it is very unlikely that there would be a need to add facilities, programs, and/or staff. Therefore, the construction-related and operation-related impact on public services in both Cumberland County and the 50-mi. region would be SMALL.

9.3.2.4.6.9 Education

Impacts on education could be caused by construction and operation workers moving into and bringing school-aged children into the region surrounding the project site. This increase in the number of school-aged children could cause crowding of local schools and potentially require school systems to add facilities and/or staff.

Per NUREG-1437, impacts on education are considered to be SMALL if the project-related increase in school enrollment represents less than 3 percent of the total school enrollment in affected school systems, MODERATE if 4 to 8 percent, and LARGE if more than 8 percent.

The analysis presented in Subsection 4.4.2.2.7 indicates that if the new plant were constructed at the PSEG Site, 315 school-aged children could be expected to move into the four-county Region of Influence. For purposes of evaluating education impacts at Site 7-3, it was assumed that the same increase in the number of school-aged children would occur in Cumberland County. For the purpose of this comparison, this is considered a conservative assumption, because the same increase for the four counties surrounding the PSEG Site is being applied to one county for Site 7-3 and the impact is not noticeable.

Based on USCB data for the year 2000 (Reference 9.3-9), the total school enrollment (kindergarten through 12th grade) in Cumberland County was 29,889. The conservative increase in school-aged children discussed above (315) represents 1.1 percent of the total school enrollment in the county. Therefore, the construction-related education impact in Cumberland County would be SMALL.

In Subsection 9.3.2.4.6.2 it was conservatively estimated that the total construction-related population increase in the 50-mi. region surrounding Site 7-3 would be 11,070. As discussed in Subsection 4.4.2.2.7, school-aged children account for 14.0 to 18.4 percent of the total county populations in the four-county Region of Influence. Using the highest percentage (18.4), the construction-related population increase (11,070) would result in 2037 school-aged children moving into the 50-mi. region surrounding Site 7-3.

Based on USCB year 2000 data, the total school enrollment (kindergarten through 12th grade) in the 50-mi. region surrounding Site 7-3 was 982,273. The conservative increase in school-aged children discussed above (2037) represents 0.2 percent of the total school enrollment in the region. Therefore, the construction-related education impact in the 50-mi. region would be SMALL.

As discussed in Subsection 6.3.2.1.6.2, the number of operation workers estimated to move into both Cumberland County and the 50-mi. region is significantly smaller than the estimated number of construction workers. The number of school-aged children would be correspondingly smaller. Therefore, the operation-related education impact in both Cumberland County and the 50-mi. region would be SMALL.

9.3.2.4.7 Historical and Archaeological Resources

Historical and archaeological resources could be directly disturbed by construction activities or indirectly disturbed by noise, dust, vehicle emissions, or visual intrusion during project construction and operation. The severity of such impacts would depend on the historic significance of the resources and the degree of disturbance.

Two properties listed on the NRHP and the NJRHP are located in the immediate vicinity of Site 7-3. The Thomas Maskel House, which is listed on both the NRHP and the NJRHP, is located 0.3 mi. from the conceptual site boundaries. The house would not be directly disturbed, but it would be subject to noise and visual intrusion during project construction and operation.

The Greenwich Historic District, which is listed on both the NRHP and the NJRHP, is located 1.2 mi. from the conceptual site boundaries, and might experience some visual intrusion during project construction and operation. More importantly, a small section of the Greenwich Historic District is crossed by a public road that would have to be widened and improved to provide access to the site. Impacts on the Historic District would be mitigated somewhat by the fact that a road is already present, but the Historic District would be subject to some direct disturbance as well as noise, dust, and visual intrusion during project construction.

In addition, two archaeological sites that are not listed on either register but are reported in NJHPO files are located along the conceptual transmission corridor. These archaeological sites might be directly disturbed by project construction, and if so they would have to be investigated before construction could proceed. If they were determined to be potentially eligible for the NRHP or NJRHP, the site would have to be excavated and any significant archaeological artifacts curated before the area was disturbed.

The impacts summarized above would noticeably alter the existing historical and archaeological resources in the immediate site area during project construction. However, it is unlikely that the impacts would destabilize important attributes of these resources. Therefore, the impact on historical and archaeological resources due to project construction would be MODERATE.

The impacts of project operation would be similar to the impacts of construction but somewhat reduced. The noise levels of operating plant equipment generally would be lower than the levels associated with construction activities. No new disturbance of historical and archaeological resources would be expected to occur during project operation. Therefore, the impact on historical and archaeological resources due to project operation would be SMALL.

9.3.2.4.8 Environmental Justice

Environmental justice issues involve aspects of the project that could disproportionately impact minority or low income populations. The potential for disproportionate impacts depends primarily on the location of the power plant and off-site facilities in relation to existing minority and low income populations.

USCB data for the year 2000 (Reference 9.3-8) were used to determine the percentage of minority and low-income populations within the 6-mi. site vicinity, and to identify any census block groups that contain a higher than average percentage of minority or low-income populations. The percentages for the site vicinity and each census block group were compared to the percentages for NJ.

Minorities comprise 26.6 percent of the population within 6 mi. of Site 7-3, compared with 34.0 percent for NJ. People with incomes below the poverty level comprise approximately 7.7 percent of the population within 6 mi. of Site 7-3, compared with 8.5 percent for NJ. Of the six census block groups that have at least 50 percent of their area within 6 mi. of the site, three have minority or poverty populations above the state average. The nearest boundary of the nearest block group with minority or poverty populations above the state average is more than 1 mi. away from the conceptual site boundaries. None of the block groups with minority or poverty populations above the state average are crossed by any of the conceptual off-site corridors, and none would be expected to experience any direct impacts from construction or operation of the power plant or off-site facilities.

Based on the above information there does not appear to be a significant potential for the project to disproportionately impact minority or low income populations. Therefore, environmental justice impacts due to project construction and operation would be SMALL.

9.3.2.5 Summary of the Environmental Assessment

This subsection compares the environmental impacts discussed above for the Alternative Sites with the impacts expected at the PSEG Site, and evaluates whether any of the Alternative Sites can be considered “environmentally preferable” to the PSEG Site. As noted in NUREG-1555, an “environmentally preferable” Alternative Site is a site for which the environmental impacts are sufficiently less than for the Proposed Site such that environmental preference can be established.

Table 9.3-22 summarizes the expected environmental impacts of project construction at each of the alternative sites and at the PSEG Site. Construction impacts at the PSEG Site are SMALL for every resource category except Land Use associated with transmission facilities, Historical / Archaeological Resources, and Transportation. The impacts in these three categories are MODERATE. All of the Alternative Sites have at least a MODERATE impact in these same categories, and Site 4-1 has a MODERATE to LARGE impact in Historical / Archaeological Resources, while Site 7-3 has a MODERATE to LARGE impact in Transportation. In addition, each of the Alternative Sites has a MODERATE or MODERATE to LARGE impact in at least three categories where the PSEG Site has a SMALL impact. These differences in the impact ratings reflect real differences in site characteristics that would be expected to result in more severe construction-related impacts at the Alternative Sites.

Table 9.3-23 summarizes the expected environmental impacts of project operation at each of the alternative sites and at the PSEG Site. It can be seen that operation impacts at the PSEG Site are SMALL for every resource category, whereas each of the Alternative Sites has a MODERATE or MODERATE to LARGE impact in at least one category. Again, these differences in the impact ratings reflect real differences in site characteristics that would be expected to result in more severe operation-related impacts at the Alternative Sites.

Potential impacts related to human health (due to both radiological and non-radiological releases), postulated accidents, and the uranium fuel cycle are not explicitly evaluated for the Alternative Sites, because they are not site selection factors that would likely impact the siting decision. A detailed evaluation of these effects requires detailed site-specific information (e.g. meteorological data) that is not available to PSEG. None of the Alternative Sites currently have operating nuclear facilities, therefore, potential radiological exposures due to existing facilities would be lower at the Alternative Sites compared to the PSEG Site. However, since human health impacts are dependent on population density near the proposed facility, the low population density near the PSEG Site should lessen potential health effects. Subsections 9.3.2.1.6.1, 9.3.2.2.6.1, 9.3.2.3.6.1, and 9.3.2.4.6.1, show that each of the Alternative Sites has a significant number of existing residences within 0.5 mi. of the site boundaries. As discussed in Subsection 2.1.2, the PSEG Site has no residences closer than 2.8 mi. from the site. Therefore, with regard to nearby residences, the PSEG Site has a distinct advantage compared with the Alternative Sites.

Based on the information summarized above, none of the Alternative Sites are environmentally preferable to the PSEG Site.

9.3.3 CONCLUSIONS

The PSEG Site was selected as the Proposed Site on the basis of a comprehensive site selection study. The site selection study included computerized GIS screening of a large and diverse Region of Interest, identification of seven Candidate Areas and eleven Potential Sites, evaluation of the Potential Sites to select five Candidate Sites, and numerical scoring of the Candidate Sites. The numerical scores and other objective evaluations indicate that Site 7-4, now known as the PSEG Site, is the most favorable site for the new plant. Site 7-4 had the highest total score for all evaluation factors together and the highest score for those evaluation factors specifically related to environmental acceptability.

The environmental impacts for all of the Alternative Sites were evaluated to determine that none of the Alternative Sites are environmentally preferable to the PSEG Site, and therefore none are obviously superior to the PSEG Site.

9.3.4 REFERENCES

9.3-1 County Budgets:

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Hunterdon County, New Jersey, 2008 County Budget, http://www.co.hunterdon.nj.us/pdf/finance/2008BUDGET.pdf, accessed December 10, 2009.

Salem County, New Jersey, 2008 County Budget, http://www.salemcountynj.gov/cmssite/downloads/departments/Treasury/2008AdoptedBudget.pdf, accessed December 10, 2009.

9.3-2 Electric Power Research Institute, Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application. Final Report, March 2002. (Document 1006878)

9.3-3 New Jersey Department of Environmental Protection Correspondence:

Natural Heritage Program Letter to Michael Clayton, Environmental Feasibility Study – Franklin Township, October 26, 2009.

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Table 9.3-1 (Sheet 1 of 2)
Site Characteristics Considered in the Numerical Evaluation of Candidate Sites

Environmental Acceptability Issues
Wetlands
Other Natural Habitats
Threatened and Endangered Species
Designated Natural Areas
Existing Land Use On-Site
Existing Land Use within 1 Mile
Zoning/Land Use Planning
Prime Farmland
Proximity to Airports
Proximity to Federal Airways
Socioeconomic Impact Potential
Cultural Resources Impact Potential
Aesthetic and Noise Impact Potential
Community Acceptance
Potential for Hazardous Material Contamination
Nuclear Licensing Issues
Proximity to Population Centers
Low Population Zone Feasibility
Exclusion Area Feasibility
Emergency Planning Zone Feasibility
Proximity to Capable Faults
Safe Shutdown Earthquake Maximum Acceleration
Liquefaction Potential
Proximity to Off-Site Hazards
Protection Against Malevolent Watercraft or Vehicles
Response Time for Local Law Enforcement
Suitable Terrain for Protected Area Fence and Surveillance

Table 9.3-1 (Sheet 2 of 2)
Site Characteristics Considered in the Numerical Evaluation of Candidate Sites

Engineering and Cost Issues
Site Topography
Flood Potential
Foundation, Earthwork, and Pipe Installation Conditions
Constructability
Distance from Highway Access
Distance from Railroad Access
Distance from Barge Access
Distance from Transmission Access
Transmission Upgrade Requirements
Transmission System Stability
Distance from Adequate Water Source
Adequacy of Water Source
Water Source Static Head
Potential to Impact Water Quality

Table 9.3-2
Site 4-1 Potential Land Use Impacts - Non-Transmission

Land Use Category (acres)	Plant Footprint Area	Remaining Area within Site Boundary	Total Site Impact	Off-Site Corridors (Non-Transmission)	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	401.3	726.8	1128.1	267.8	1395.9	93,750.4	1.5%
Total Planted/Cultivated Land	323.0	435.8	758.8	168.0	926.8	43,670.9	2.1%
Pasture/Hay	144.9	240.2	385.1	60.1	445.2	14,328.0	3.1%
Cultivated Crops	178.1	195.6	373.7	107.9	481.7	29,342.9	1.6%
Developed Land	6.9	5.1	12.0	4.7	16.7	6535.4	0.3%
Barren Land	46.7	113.3	159.9	18.7	178.6	4759.0	3.8%
Prime Farmland	323.4	369.4	692.7	150.4	843.2	24,503.3	3.4%
Farmland of Statewide Importance	77.8	329.6	407.4	100.0	507.4	46,122.9	1.1%
100-Year Floodplain	0.0	0.0	0.0	1.3	1.3	6101.0	<0.1%

Table 9.3-3
Site 4-1 Potential Land Use Impacts - Transmission

Land Use Category (acres)	Primary Transmission Corridor and Interposing Switchyard	Additional Transmission Corridor Area	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	100.0	2035.6	2135.6	93,750.4	2.3%
Total Planted/Cultivated Land	79.1	1195.8	1274.9	43,670.9	2.9%
Pasture/Hay	27.3	301.1	328.3	14,328.0	2.3%
Cultivated Crops	51.8	894.8	946.6	29,342.9	3.2%
Developed Land	0.2	171.0	171.2	6535.4	2.6%
Barren Land	2.6	58.9	61.5	4759.0	1.3%
Prime Farmland	66.1	529.2	595.3	24,503.3	2.4%
Farmland of Statewide Importance	24.4	798.0	822.4	46,122.9	1.8%
100-Year Floodplain	0.0	102.8	102.8	6101.0	1.7%

Table 9.3-4
Site 4-1 Potential Natural Habitat Impacts - Non-Transmission

Resource Category (acres)	Plant Footprint Area	Remaining Area within Site Boundary	Total Site Impact	Off-Site Corridors (Non-Transmission)	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	401.3	726.8	1128.1	267.8	1395.9	93,750.4	1.5%
Forest	11.8	138.9	150.7	69.1	219.8	35,232.2	0.6%
Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Total Wetlands (acres)	1.8	72.6	74.4	17.3	91.6	7167.3	1.3%
Estuarine and Marine Deepwater	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Estuarine and Marine Wetland	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Freshwater Emergent Wetland	0.0	9.6	9.6	0.1	9.6	635.9	1.5%
Freshwater Forested/Shrub Wetland	1.8	58.1	59.9	15.2	75.1	5174.8	1.5%
Other Wetland	0.0	4.9	4.9	2.0	6.9	1356.7	0.5%

Table 9.3-5
Site 4-1 Potential Natural Habitat Impacts - Transmission

Resource Category (acres)	Primary Transmission Corridor and Interposing Switchyard	Additional Transmission Corridor	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	100.0	2035.6	2135.6	93,750.4	2.3%
Forest	16.4	564.8	581.2	35,232.2	1.6%
Grassland	0.0	0.0	0.0	0.0	0.0%
Total Wetlands	0.4	35.6	36.1	7167.3	0.5%
Estuarine and Marine Deepwater	0.0	0.0	0.0	0.0	0.0%
Estuarine and Marine Wetland	0.0	0.0	0.0	0.0	0.0%
Freshwater Emergent Wetland	0.0	15.8	15.8	635.9	2.5%
Freshwater Forested/Shrub Wetland	0.0	10.0	10.0	5174.8	0.2%
Other Wetland	0.4	9.9	10.3	1356.7	0.8%

Table 9.3-6
State and Federal Threatened, Endangered, and Rare Species Recorded in the Site 4-1 Area (a)

Common Name	Scientific Name / Description	State or Regional Status – Rank	Federal Status
Plants			
Bush's Sedge	*Carex bushii*	E, LP, HL – S1	
Birds			
Bobolink	*Dolichonyx oryzivorus*	T/SC – S2B, S3N	
Eastern Meadowlark	*Sturnella magna*	SC/SC – S3B, S3N	
Great Blue Heron	*Ardea herodias*	SC/S – S3B, S4N	
Red-Shouldered Hawk	*Buteo lineatus*	E/T – S1B, S2N	
Savannah Sparrow	*Passerculus sandwichensis*	T/T – S2B, S4N	
Veery	*Catharus fuscescens*	S/S – S3B	
Vesper Sparrow	*Pooecetes gramineus*	E – S1B, S2N	
Wood Thrush	*Hylocichla mustelina*	SC/S – S3B	
Amphibians			
Longtail Salamander	*Eurycea longicauda longicauda*	T – S2	
Northern Spring Salamander	*Gyrinophilus p. porphyriticus*	D – S3	
Reptiles			
Eastern Box Turtle	*Terrapene carolina carolina*	SC – S3	
Wood Turtle	*Glyptemys insculpta*	T – S2	
Mammals			
Bobcat	*Lynx rufus*	E – S1	

a) S1 = Critically Imperiled (typically 5 or fewer occurrences)
S2 = Imperiled (typically 6 to 20 occurrences)
S3 = Vulnerable (typically 21 to 100 occurrences)
S4 = Apparently Secure (typically more than 100 occurrences)
S5 = Secure
S#S# = Rank Range to indicate the range of uncertainty about exact status
x/x = Dual status: State breeding population/State migratory or winter population
B = Breeding population
N = Nonbreeding population
S = Stable species
D = Declining species
E = Endangered species
LP = Listed by Pinelands Commission as endangered or threatened within their jurisdiction
HL = Protected by Highlands Water Protection and Planning Act within Highlands Preservation Area
T = Threatened species
SC = Special Concern

Table 9.3-7
Site 7-1 Potential Land Use Impacts - Non-Transmission

Resource Category (acres)	Plant Footprint Area	Remaining Area within Site Boundary	Total Site Impact	Off-Site Corridors (Non-Transmission) Area	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	432.3	555.0	987.3	246.0	1233.2	93,243.0	1.3%
Total Planted/Cultivated Land	365.4	430.0	795.4	175.8	971.2	41,354.2	2.3%
Pasture/Hay	133.8	176.6	310.3	37.5	347.8	13,172.6	2.6%
Cultivated Crops	231.6	253.5	485.1	138.3	623.4	28,181.6	2.2%
Developed Land	1.5	2.7	4.2	9.2	13.5	9827.7	<0.1%
Barren Land	18.1	22.0	40.0	6.4	46.4	2260.6	2.1%
Prime Farmland	27.4	80.3	107.7	94.8	202.5	30,145.2	0.7%
Farmland of Statewide Importance	271.7	275.7	547.4	60.5	608.0	16,090.9	3.8%
100-Year Floodplain	4.8	48.9	53.7	27.7	81.4	24,608.0	0.3%

Table 9.3-8
Site 7-1 Potential Land Use Impacts - Transmission

Resource Category (acres)	Primary Transmission Corridor and Interposing Switchyard	Additional Transmission Corridor	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	412.1	2445.0	2857.1	93,243.0	3.1%
Total Planted/Cultivated Land	140.6	1217.0	1357.6	41,354.2	3.3%
Pasture/Hay	55.4	275.0	330.4	13,172.6	2.5%
Cultivated Crops	85.2	942.0	1027.2	28,181.6	3.6%
Developed Land	4.6	130.0	134.6	9827.7	1.4%
Barren Land	8.9	28.0	36.9	2260.6	1.6%
Prime Farmland	93.1	750.0	843.1	30,145.2	2.8%
Farmland of Statewide Importance	101.0	576.0	677.0	16,090.9	4.2%
100-Year Floodplain	252.0	920.0	1172.0	24,608.0	4.8%

Table 9.3-9
Site 7-1 Potential Natural Habitat Impacts - Non-Transmission

Resource Category (acres)	Plant Footprint Area	Remaining Area within Site Boundary	Total Site Impact	Off-Site Corridors (Non-Transmission) Area	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	432.3	555.0	987.3	246.0	1233.2	93,243.0	1.3%
Forest	36.5	41.5	78.0	38.1	116.0	13,014.5	0.9%
Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Total Wetlands	17.6	62.8	80.4	33.2	113.5	33,621.4	0.3%
Estuarine and Marine Deepwater	0.0	0.0	0.0	1.3	1.3	10,170.3	<0.1%
Estuarine and Marine Wetland	0.0	0.0	0.0	0.0	0.0	5196.7	0.0%
Freshwater Emergent Wetland	0.0	2.9	2.9	5.1	8.0	2261.7	0.4%
Freshwater Forested/Shrub Wetland	17.6	44.2	61.8	24.0	85.8	12,610.3	0.7%
Other Wetland	0.0	15.7	15.7	2.8	18.5	3382.3	0.5%

Table 9.3-10
Site 7-1 Potential Natural Habitat Impacts - Transmission

Resource Category (acres)	Primary Transmission Corridor and Interposing Switchyard	Additional Transmission Corridor	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	412.1	2445.0	2857.1	93,243.0	3.1%
Forest	63.2	365.0	428.2	13,014.5	3.3%
Grassland	0.0	0.0	0.0	0.0	0.0%
Total Wetlands	233.4	730.0	963.4	33,621.3	2.9%
Estuarine and Marine Deepwater	59.2	97.0	156.2	10,170.3	1.5%
Estuarine and Marine Wetland	69.7	381.0	450.7	5196.7	8.7%
Freshwater Emergent Wetland	5.6	42.0	47.6	2261.7	2.1%
Freshwater Forested/Shrub Wetland	89.8	189.0	278.8	12,610.3	2.2%
Other Wetland	9.2	21.0	30.2	3382.3	0.9%

Table 9.3-11
State and Federal Threatened, Endangered, and Rare Species Recorded in the Site 7-1 Area [(a)]

Common Name	Scientific Name / Description	State or Regional Status – Rank	Federal Status
Plants			
Leatherwood	*Dirca palustris*	HL – S2	
Birds			
Bald Eagle	*Haliaeetus leucocephalus*	E – S1B,S1N	
Bobolink	*Dolichonyx oryzivorus*	T/SC – S2B, S3N	
Cooper's Hawk	*Accipiter cooperii*	T/S – S2B, S4N	
Great Blue Heron	*Ardea herodias*	SC/S – S3B, S4N	
Osprey	*Pandion haliaetus*	T/T – S2B	
Upland Sandpiper	*Bartramia longicauda*	E – S1B, S1N	
Vesper Sparrow	*Pooecetes gramineus*	E – S1B, S2N	
Reptiles			
Bog Turtle	*Glyptemys muhlenbergii*	E – S1	LT
Eastern Box Turtle	*Terrapene carolina carolina*	SC – S3	
Natural Heritage Priority Sites			
Culliers Run	*Floodplain in rich wooded ravine*	B4	
Mannington Marsh	*Freshwater intertidal marsh*	B4	

a) S1 = Critically Imperiled (typically 5 or fewer occurrences)
S2 = Imperiled (typically 6 to 20 occurrences)
S3 = Vulnerable (typically 21 to 100 occurrences)
S4 = Apparently Secure (typically more than 100 occurrences)
S5 = Secure
S#S# = Rank Range to indicate the range of uncertainty about exact status
x/x = Dual status: State breeding population/State migratory or winter population
B = Breeding population
N = Nonbreeding population
S = Stable species
HL = Protected by Highlands Water Protection and Planning Act within Highlands Preservation Area
E = Endangered species
T = Threatened species
SC = Special Concern
LT = Formally listed as Threatened
B4 = Moderate significance on global level

Table 9.3-12
Site 7-2 Potential Land Use Impacts - Non-Transmission

Resource Category (acres)	Plant Footprint Area	Remaining Area within Site Boundary	Total Site Impact	Off-Site Corridors (Non-Transmission) Area	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	393.8	601.8	995.7	293.6	1289.2	92,912.0	1.4%
Total Planted/Cultivated Land	381.1	548.4	929.5	173.0	1102.4	53,694.0	2.1%
Pasture/Hay	219.4	337.0	556.4	59.2	615.5	20,782.7	3.0%
Cultivated Crops	161.7	211.4	373.1	113.8	486.9	32,911.3	1.5%
Developed Land	0.4	3.1	3.4	7.3	10.7	3783.3	0.3%
Barren Land	6.0	18.5	24.5	4.7	29.2	1869.0	1.6%
Prime Farmland	349.5	503.8	853.3	159.0	1012.3	56,000.1	1.8%
Farmland of Statewide Importance	26.5	57.5	84.0	60.9	144.9	21,528.0	0.7%
100-Year Floodplain	0.0	0.0	0.0	57.5	57.5	5760.0	1.0%

Table 9.3-13
Site 7-2 Potential Land Use Impacts - Transmission

Resource Category (acres)	Primary Transmission Corridor and Interposing Switchyard	Additional Transmission Corridor	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	167.6	2728.0	2895.6	92,912.0	3.1%
Total Planted/Cultivated Land	105.3	1358.0	1463.3	53,694.0	2.7%
Pasture/Hay	26.6	307.0	333.6	20,782.7	1.6%
Cultivated Crops	78.7	1051.0	1129.7	32,911.3	3.4%
Developed Land	2.6	146.0	148.6	3783.3	3.9%
Barren Land	1.2	31.0	32.2	1869.0	1.7%
Prime Farmland	84.3	837.0	921.3	56,000.1	1.6%
Farmland of Statewide Importance	15.8	642.0	657.8	21,528.0	3.1%
100-Year Floodplain	0.0	1026.0	1026.0	5760.0	17.8%

Table 9.3-14
Site 7-2 Potential Natural Habitat Impacts - Non-Transmission

Resource Category (acres)	Plant Footprint Area	Remaining Area within Site Boundary	Total Site Impact	Off-Site Corridors (Non-Transmission) Area	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	393.8	601.8	995.7	293.6	1289.2	92,912.0	1.4%
Forest	5.3	30.5	35.8	59.4	95.1	28,082.9	0.3%
Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Total Wetlands	3.4	9.0	12.4	74.5	86.9	13,087.3	0.7%
Estuarine and Marine Deepwater	0.0	0.0	0.0	6.8	6.8	137.6	5.0%
Estuarine and Marine Wetland	0.0	0.0	0.0	32.8	32.8	291.2	11.3%
Freshwater Emergent Wetland	2.6	0.0	2.6	2.0	4.6	767.6	0.6%
Freshwater Forested/Shrub Wetland	0.0	5.6	5.6	31.3	36.9	10,839.2	0.3%
Other Wetland	0.8	3.4	4.2	1.5	5.7	1051.7	0.5%

Table 9.3-15
Site 7-2 Potential Natural Habitat Impacts - Transmission

Resource Category (acres)	Primary Transmission Corridor and Interposing Switchyard	Additional Transmission Corridor	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	167.6	2728.0	2895.6	92,912.0	3.1%
Forest	56.4	408.0	464.4	28,082.9	1.7%
Grassland	0.0	0.0	0.0	0.0	0.0%
Total Wetlands	11.1	814.0	825.1	13,087.3	6.3%
Estuarine and Marine Deepwater	0.0	109.0	109.0	137.6	79.2%
Estuarine and Marine Wetland	0.0	425.0	425.0	291.2	145.9%
Freshwater Emergent Wetland	0.0	47.0	47.0	767.6	6.1%
Freshwater Forested/Shrub Wetland	10.9	210.0	220.9	10,839.2	2.0%
Other Wetland	0.2	23.0	23.2	1051.7	2.2%

Table 9.3-16
State and Federal Threatened, Endangered, and Rare Species Recorded in the Site 7-2 Area [(a)]

Common Name	Scientific Name / Description	State or Regional Status – Rank	Federal Status
Plants			
Chinquapin	*Castanea pumila*	E, LP, HL – S1	
Swamp-pink	*Helonias bullata*	E, LP, HL – S3	LT
Birds			
American Kestrel	*Falco sparverius*	SC – S3B, S3N	
Bald Eagle	*Haliaeetus leucocephalus*	E – S1B,S1N	
Cooper's Hawk	*Accipiter cooperii*	T/S – S2B, S4N	
Great Blue Heron	*Ardea herodias*	SC/S – S3B, S4N	
Red-Headed Woodpecker	*Melanerpes erythrocephalus*	T/T – S2B, S2N	
Wood Thrush	*Hylocichla mustelina*	SC/S – S3B	
Amphibians			
Fowler's Toad	*Bufo woodhousii fowleri*	SC – S3	
Reptiles			
Eastern Box Turtle	*Terrapene carolina carolina*	SC – S3	
Natural Heritage Priority Sites			
Franks Cabin Site	*Narrow headwater stream corridor*	B3	
Pecks Corner	*Hardwood-evergreen swamp*	B5	

a) S1 = Critically Imperiled (typically 5 or fewer occurrences)
S2 = Imperiled (typically 6 to 20 occurrences)
S3 = Vulnerable (typically 21 to 100 occurrences)
S4 = Apparently Secure (typically more than 100 occurrences)
S5 = Secure
S#S# = Rank Range to indicate the range of uncertainty about exact status
x/x = Dual status: State breeding population/State migratory or winter population
B = Breeding population
N = Nonbreeding population
S = Stable species
E = Endangered species
LP = Listed by Pinelands Commission as endangered or threatened within their jurisdiction
HL = Protected by Highlands Water Protection and Planning Act within Highlands Preservation Area
T = Threatened species
SC = Special Concern
LT = Formally listed as Threatened
B3 = High significance on global level
B5 = General biodiversity interest on global level

Table 9.3-17
Site 7-3 Potential Land Use Impacts - Non-Transmission

Resource Category (acres)	Plant Footprint Area	Remaining Area within Site Boundary	Total Site Impact	Off-Site Corridors (Non-Transmission) Area	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	395.4	490.9	886.3	83.8	970.1	91,276.7	1.1%
Total Planted/Cultivated Land	306.3	216.4	522.8	52.4	575.1	19,393.0	3.0%
Pasture/Hay	172.5	94.5	267.0	16.8	283.8	5810.2	4.9%
Cultivated Crops	133.8	121.9	255.8	35.5	291.3	13,582.8	2.1%
Developed Land	1.9	0.0	1.9	1.1	3.0	640.2	0.5%
Barren Land	35.0	79.1	114.1	0.7	114.8	1192.1	9.6%
Prime Farmland	382.3	348.9	731.2	46.1	777.3	18,290.6	4.2%
Farmland of Statewide Importance	2.3	63.7	66.0	15.2	81.2	11,449.6	0.7%
100-Year Floodplain	44.9	159.8	204.7	15.4	220.0	26,894.6	0.8%

Table 9.3-18
Site 7-3 Potential Land Use Impacts - Transmission

Resource Category (acres)	Primary Transmission Corridor and Interposing Switchyard	Additional Transmission Corridor	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	510.4	2728.0	3238.4	91,276.7	3.5%
Total Planted/Cultivated Land	209.2	1358.0	1567.2	19,393.0	8.1%
Pasture/Hay	76.2	307.0	383.2	5810.2	6.6%
Cultivated Crops	133.0	1051.0	1184.0	13,582.8	8.7%
Developed Land	0.3	146.0	146.3	640.2	22.9%
Barren Land	19.1	31.0	50.1	1192.1	4.2%
Prime Farmland	211.5	837.0	1048.5	18,290.6	5.7%
Farmland of Statewide Importance	137.0	642.0	779.0	11,449.6	6.8%
100-Year Floodplain	39.4	1026.0	1065.4	26,894.6	4.0%

Table 9.3-19
Site 7-3 Potential Natural Habitat Impacts - Non-Transmission

Resource Category (acres)	Plant Footprint Area	Remaining Area within Site Boundary	Total Site Impact	Off-Site Corridors (Non-Transmission) Area	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	395.4	490.9	886.3	83.8	970.1	91,276.7	1.1%
Forest	29.9	81.2	111.1	11.2	122.3	9704.2	1.3%
Grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Total Wetlands	13.0	135.6	148.6	24.0	172.6	63,459.0	0.3%
Estuarine and Marine Deepwater	0.1	3.2	3.2	3.4	6.7	37,691.0	<0.1%
Estuarine and Marine Wetland	7.4	76.0	83.4	13.8	97.2	19,684.4	0.5%
Freshwater Emergent Wetland	1.4	5.2	6.6	0.0	6.6	810.9	0.8%
Freshwater Forested/Shrub Wetland	4.2	51.1	55.3	5.8	61.2	4743.6	1.3%
Other Wetland	0.0	0.0	0.0	0.9	0.9	529.0	0.2%

Table 9.3-20
Site 7-3 Potential Natural Habitat Impacts - Transmission

Resource Category (acres)	Primary Transmission Corridor and Interposing Switchyard	Additional Transmission Corridor	Grand Total Impact	6-Mile Vicinity	Percentage of Vicinity Impacted
Total Area	510.4	2728.0	3238.4	91,276.7	3.5%
Forest	224.5	408.0	632.5	9704.2	6.5%
Grassland	0.0	0.0	0.0	0.0	0.0%
Total Wetlands	121.9	814.0	935.9	63,459.0	1.5%
Estuarine and Marine Deepwater	2.1	109.0	111.1	37,691.0	0.3%
Estuarine and Marine Wetland	23.5	425.0	448.5	19,684.4	2.3%
Freshwater Emergent Wetland	0.3	47.0	47.3	810.9	5.8%
Freshwater Forested/Shrub Wetland	95.6	210.0	305.6	4743.6	6.4%
Other Wetland	0.4	23.0	23.4	529.0	4.4%

Table 9.3-21
State and Federal Threatened, Endangered, and Rare Species Recorded in the Site 7-3 Area [(a)]

Common Name	Scientific Name / Description	State or Regional Status – Rank	Federal Status
Insects			
Bronze Copper	*Lycaena hyllus*	E – S1	
Fish			
Shortnose Sturgeon	*Acipenser brevirostrum*	E – S1	LE
Birds			
Bald Eagle	*Haliaeetus leucocephalus*	E – S1B,S1N	
Black Rail	*Laterallus jamaicensis*	T/T – S2B, S2N	
Great Blue Heron	*Ardea herodias*	SC/S – S3B, S4N	
Northern Harrier	*Circus cyaneus*	E/U – S1B, S3N	
Osprey	*Pandion haliaetus*	T/T – S2B	
Red-Shouldered Hawk	*Buteo lineatus*	E/T – S1B, S2N	
Wood Thrush	*Hylocichla mustelina*	SC/S – S3B	
Amphibians			
Fowler's Toad	*Bufo woodhousii fowleri*	SC – S3	
Reptiles			
Eastern Box Turtle	*Terrapene carolina carolina*	SC – S3	
Eastern King Snake	*Lampropeltis g. getula*	U – S3	
Northern Diamondback Terrapin	*Malaclemys terrapin terrapin*	SC – S3	

a) S1 = Critically Imperiled (typically 5 or fewer occurrences)
S2 = Imperiled (typically 6 to 20 occurrences)
S3 = Vulnerable (typically 21 to 100 occurrences)
S4 = Apparently Secure (typically more than 100 occurrences)
S5 = Secure
S#S# = Rank Range to indicate the range of uncertainty about exact status
x/x = Dual status: State breeding population/State migratory or winter population
B = Breeding population
N = Nonbreeding population
S = Stable species
E = Endangered species
T = Threatened species
U = Undetermined species (not enough information available)
SC = Special Concern
LE = Formally listed as Endangered

Table 9.3-22
Characterization of Construction Impacts at the PSEG Site and Alternative Sites

Category	Site 4-1	Site 7-1	Site 7-2	Site 7-3	Site 7-4 (PSEG Site)
Land Use Impacts					
The Site and Vicinity [a]	MODERATE	MODERATE	MODERATE	MODERATE	SMALL
Transmission Facilities [b]	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Air Quality Impacts	SMALL	SMALL	SMALL	SMALL	SMALL
Water Related Impacts					
Water Use	SMALL	SMALL	SMALL	SMALL	SMALL
Water Quality	SMALL	SMALL	SMALL	SMALL	SMALL
Ecological Impacts					
Terrestrial Ecosystems [c, d]	SMALL	SMALL	SMALL	SMALL	SMALL
Aquatic Ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL
Protected Species	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomic Impacts					
Physical Impacts	MODERATE	MODERATE to LARGE	MODERATE to LARGE	MODERATE	SMALL
Demography	SMALL	SMALL	SMALL	SMALL	SMALL
Economy	SMALL	SMALL	SMALL	SMALL	SMALL
Taxes	SMALL	SMALL	SMALL	SMALL	SMALL
Transportation	MODERATE	MODERATE	MODERATE	MODERATE to LARGE	MODERATE
Aesthetics	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	MODERATE	SMALL
Housing	SMALL	SMALL	SMALL	SMALL	SMALL
Public Services	SMALL	SMALL	SMALL	SMALL	SMALL
Education	SMALL	SMALL	SMALL	SMALL	SMALL
Historical and Archaeological Impacts	MODERATE to LARGE	MODERATE	MODERATE	MODERATE	MODERATE
Environmental Justice Impacts	SMALL	MODERATE to LARGE	MODERATE to LARGE	SMALL	SMALL

a) The evaluation of site impacts includes the off-site corridors expected to be required for access roads, rail spur, and water pipelines.

b) The evaluation of transmission impacts includes off-site transmission corridors and an interposing switchyard as required for each site.

c) Impacts on wetlands due to construction of the power plant and access road, rail spur, and water pipeline corridors are expected to be MODERATE for all sites.

d) Impacts on terrestrial ecosystems due to construction of the transmission facilities are expected to be MODERATE for all sites.

Table 9.3-23
Characterization of Operation Impacts at the PSEG Site and Alternative Sites

Category	Site 4-1	Site 7-1	Site 7-2	Site 7-3	Site 7-4 (PSEG Site)
Land Use Impacts					
The Site and Vicinity [a]	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL
Transmission Facilities [b]	SMALL	SMALL	SMALL	SMALL	SMALL
Air Quality Impacts	SMALL	SMALL	SMALL	SMALL	SMALL
Water Related Impacts					
Water Use	SMALL	SMALL	SMALL	SMALL	SMALL
Water Quality	SMALL	SMALL	SMALL	SMALL	SMALL
Ecological Impacts					
Terrestrial Ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL
Aquatic Ecosystems	SMALL	SMALL	SMALL	SMALL	SMALL
Protected Species	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomic Impacts					
Physical Impacts	SMALL	SMALL	SMALL	SMALL	SMALL
Demography	SMALL	SMALL	SMALL	SMALL	SMALL
Economy	SMALL	SMALL	SMALL	SMALL	SMALL
Taxes	SMALL	SMALL	SMALL	SMALL	SMALL
Transportation	SMALL	SMALL	SMALL	SMALL	SMALL
Aesthetics	MODERATE to LARGE	MODERATE to LARGE	MODERATE to LARGE	MODERATE	SMALL
Housing	SMALL	SMALL	SMALL	SMALL	SMALL
Public Services	SMALL	SMALL	SMALL	SMALL	SMALL
Education	SMALL	SMALL	SMALL	SMALL	SMALL
Historical and Archaeological Impacts	SMALL	SMALL	SMALL	SMALL	SMALL
Environmental Justice Impacts	SMALL	MODERATE to LARGE	MODERATE to LARGE	SMALL	SMALL

a) The evaluation of site impacts includes the off-site corridors expected to be required for access roads, rail spur, and water pipelines.

b) The evaluation of transmission impacts includes off-site transmission corridors and an interposing switchyard as required for each site.

9.4 ALTERNATIVE PLANT AND TRANSMISSION SYSTEMS

This section describes the evaluation of the alternative heat dissipation, circulating water, and power transmission systems for the new plant at the PSEG Site. Because PSEG has not yet finalized a reactor selection, a Plant Parameter Envelope approach to defining the various plant systems is utilized. Chapter 3 presents the proposed heat dissipation, circulating water, and power transmission systems for the new plant.

As discussed in Chapters 4 and 5, potential SMALL adverse impacts were noted for the construction and operation of the proposed heat dissipation system and circulating water system. Impacts associated with the placement of any new transmission lines that may be required will be minimized by routing the lines on or adjacent to existing corridors to the extent possible. The discussion of alternative systems in the following subsections provides the bases for these conclusions.

9.4.1 HEAT DISSIPATION SYSTEMS

This subsection discusses alternatives to the proposed heat dissipation system presented in Section 3.4. This subsection utilizes the methodology and format presented in NUREG-1555 to first perform an initial screening of the alternatives to eliminate any technologies that are obviously unsuitable for the PSEG Site. Following the initial screening any remaining alternatives are reviewed to determine if they are environmentally preferable, equivalent or inferior to the proposed heat dissipation system.

NUREG-1555 recommends considering the following classes of heat dissipation systems:

- Once-through systems
- Closed cycle systems
    - Mechanical draft wet cooling towers
    - Natural draft cooling towers
    - Dry cooling towers
    - Wet-dry cooling towers
    - Cooling ponds
    - Spray ponds

Of the alternatives recommended by NUREG-1555, the mechanical draft wet cooling towers and natural draft cooling towers, along with fan-assisted natural draft cooling towers, comprise the proposed heat dissipation system options for the new plant at the PSEG Site.

9.4.1.1 Proposed Heat Dissipation System

The purpose of a heat dissipation system is to dissipate waste heat to the environment. The condenser creates the low pressure required to draw steam through and increase the efficiency of the turbines. The lower the pressure of the exhaust steam leaving the low-pressure turbine, the more efficiency is gained. The limiting factor is the temperature of the cooling water supplied to the main turbine condenser.

For the PSEG Site, the preferred method for dissipating the waste heat is a closed-cycle cooling system that consists of either natural draft, mechanical draft or fan assisted natural draft cooling towers, which draw makeup water via a new intake structure on the Delaware River. At this phase in the licensing effort, specific cooling tower configurations have not been established, because the range of possible heat rejection requirements varies with the potential reactor technology selections.

9.4.1.2 Screening of Alternatives to the Proposed Heat Dissipation System

This subsection presents the initial screening of the alternative heat dissipation systems against criteria specified in NUREG-1555 to eliminate those systems that are obviously unsuitable for use at the PSEG Site. Factors considered in this initial screening include land use, water use, and legislative or regulatory restrictions.

Heat dissipation systems differ in how the energy transfer takes place, and therefore, have different environmental impacts. There are generally two types of heat dissipation systems: once-through cooling and closed-cycle cooling.

Once-through cooling systems involve the use of a large quantity of cooling water, withdrawn from and returned to a large water source after its circulation through the main condenser. Normal system losses are due to evaporation of the heated water as it is returned to the water source.

Closed-cycle cooling systems involve substantially less water usage because the water performing the cooling is recirculated through the main condenser, and only makeup water for normal system losses is required. Normal system losses include evaporation, blowdown, and drift. Evaporation occurs as part of the cooling process in wet systems. Blowdown is the discharge of a portion of the circulating water in order to control dissolved solids concentrations in the water and to help protect surfaces from scaling or corrosion. Drift is water that escapes from the heat dissipation system in the form of unevaporated droplets during operation. Closed-cycle systems include cooling towers (wet, dry and wet-dry hybrid) and cooling ponds or spray ponds. The relevant characteristics of these systems, as well as once-through cooling, are discussed in the following subsections.

9.4.1.2.1 Once-Through Cooling System

In a once-through cooling system, water is withdrawn from the Delaware River, routed through the main condenser, and discharged back to the Delaware River at an elevated temperature. The water requirements for a once-through system are on the order of 1.7 to 2.1 million gpm for a 2200 MWe plant. Once-through cooling systems have practical advantages of providing the condenser cooler water to lower turbine backpressure and thus increase plant efficiency. While once-through systems consume less water through evaporation, utilize less land and have minimal visual impacts, U.S. Environmental Protection Agency (EPA) regulations (40 CFR 125) governing cooling water intake structures under Section 316(b) of the Clean Water Act effectively prohibit newly constructed steam electric generating plants from using once-through cooling systems. As such, once-through cooling was eliminated from further consideration.

9.4.1.2.2 Dry Cooling Towers

Dry cooling is an alternative cooling method in which heat is dissipated directly to the atmosphere using a tower. This tower transfers the heat to the air by conduction and convection rather than by evaporation. Heat transfer is therefore based on the temperature of the ambient air and the thermal transport properties of the piping material. A natural-draft or mechanical-draft configuration is used to move the air.

While a wet tower uses the processes of evaporation, convection and conduction to reject heat, a dry tower is dependent on conduction and convection only. As a result, heat rejection is limited by the dry bulb temperature of the ambient air at the site. The higher the ambient temperature, the higher the steam saturation pressure, resulting in higher turbine backpressure.

In a 2001 study of cooling technologies, the EPA rejected dry cooling as the best available technology because dry cooling carries high capital, operating and maintenance costs that are sufficient to pose a barrier to entry into the marketplace for some projected new facilities (Reference 9.4-6). In addition, dry cooling has a detrimental effect on electricity production by reducing the efficiency of steam turbines. Mechanical draft dry cooling requires a power plant to use more energy to produce the same amount of electricity than is required with wet cooling towers. This energy penalty is most significant in the summer months when the demand for electricity is at its peak. The energy penalty results in an increase in environmental impacts, because replacement generating capacity is needed to offset the loss in efficiency from dry cooling. EPA concluded that dry cooling may be appropriate in areas with limited water available for cooling or where the source of cooling water is associated with extremely sensitive biological resources (e.g., endangered species, specially protected areas) (Reference 9.4-6). The conditions at the PSEG Site do not warrant use of dry cooling based on either of these exceptions.

Despite the problems summarized above, dry cooling has some advantages in that cooling water makeup requirements are reduced or eliminated, and potential issues with cooling tower blowdown, circulating water chemical treatment, and fogging / icing are reduced or eliminated. Therefore, the following subsections discuss available dry cooling technologies in more detail. The two available technologies are the air-cooled condenser and the indirect dry cooling tower.

9.4.1.2.2.1 Air Cooled Condenser

The most common form of dry cooling tower technology is the air-cooled condenser (ACC). In this design, steam from the turbine exhaust is piped through large ducts to a separate air-cooled condenser located next to the turbine building. Fans draw air through cooling coils to reject heat from the exhaust steam. As the steam loses its heat, it condenses to water and is returned as steam generator feedwater.

Available information on ACC technologies indicates that they require condenser and turbine designs that differ significantly from the standardized designs provided by reactor vendor manufacturers in the designs currently being reviewed under the 10 CFR 52 Design Certification process. Therefore, incorporation of ACC technology would require large-scale changes to the standardized designs being considered by PSEG. ACC technology would require extensive revisions to fundamental design elements of the main steam, feedwater and heater drains systems. Essential elements of the turbine building foundation, structure, and turbine missile evaluation also would require revision.

ACC technologies also have significant disadvantages related to land requirements, plant efficiency, and plant stability. These disadvantages are summarized below.

The cooling units for an ACC must be located in immediate proximity to the turbine building, and the size of the units requires extensive land use. An ACC tower requires much larger heat transfer surfaces and is much larger in size than a comparable wet cooling tower. An ACC tower generally requires approximately three to four times the land use of a wet cooling tower for a comparable cooling capacity (Reference 9.4-5). Extensive changes to the turbine building footprint and standardized plant layouts are required to accommodate this land requirement.

Because of the larger volume of air required for heat rejection, fan horsepower requirements for an ACC are typically 3 to 4 times higher than for a fan-assisted wet cooling tower. This significantly decreases the net electrical output of a power plant. In addition, an ACC is not as thermally efficient as a wet cooling tower system, which has a negative impact on plant performance. An ACC is unable to maintain design plant thermal performance during the hottest months of the year. Depending on weather conditions and the design heat rate, a plant can experience capacity reductions of up to 10 percent on the steam side alone, because of increased turbine backpressure (Reference 9.4-6). For the new plant at the PSEG Site, these increased losses in net plant generation would result in importing additional power from fossil-fueled power sources in the PJM region.

In addition to plant generation reductions due to thermal efficiency, turbine generator reliability is also of concern. The main turbine low pressure stage designs in the standardized designs being reviewed for certification require operation at a condenser backpressure of 2.5 to 3 inches of mercury (in. Hg) absolute to produce the rated electrical output, with turbine backpressure alarm and trip setpoints approximately 3 in. Hg higher. State-of-the-art ACC designs can not operate within these parameters during the summer temperature conditions expected at the PSEG Site. This increases the probability of forced power reductions and turbine trips due to encroachment on turbine backpressure limits.

In summary, use of ACC technology at the PSEG Site would: require extensive revisions to the standardized plant designs being reviewed under the 10 CFR 52 Design Certification process, significantly increase the amount of land used for the heat dissipation system on the site, reduce the thermal efficiency of the new plant resulting in the need to import more power, and greatly increase the probability of forced power reductions and turbine trips during summer operation when electricity demand is highest. Therefore, an ACC based dry cooling system is not preferable to the proposed wet tower system for the PSEG Site.

9.4.1.2.2.2 Indirect Dry Tower

The second type of dry cooling tower technology is the indirect dry tower. In this design, the proposed wet tower is replaced with a large air-water heat exchanger. Circulating water from the condenser is piped through metal-finned tubes, and fans force air over the tubes to reject heat to the air and atmosphere.

As with ACC technology, the indirect dry cooling towers currently in use are combined with turbines specially designed to operate at higher backpressures than the turbines associated with the standardized designs being reviewed under the 10 CFR 52 Design Certification process. Therefore, using an indirect dry cooling tower system would require large-scale changes to the standardized designs being considered by PSEG.

The other disadvantages of indirect dry cooling towers are similar to the disadvantages of ACC technology. However, indirect dry cooling is much less efficient than ACC because heat rejection is dependent on two thermal exchanges (steam to circulating water and circulating water to air), rather than the single interface used in the ACC technology (steam to air). This makes some of the disadvantages of indirect dry cooling towers more severe.

The most significant disadvantage of indirect dry cooling towers are their increased land use requirements. Based on relative efficiencies of the processes, an indirect dry cooling tower requires 30 percent more space than an ACC tower and would be up to five times the footprint of a wet cooling tower proposed for the PSEG Site (Reference 9.4-3).

An indirect dry cooling tower requires an even larger volume of air for heat rejection than an ACC tower because of the loss of efficiency. Therefore, fan horsepower requirements increase beyond the ACC design, which is itself 3 to 4 times greater than a fan-assisted wet cooling tower. In addition, the turbine backpressure limitations discussed with regard to ACC technology are applicable to the indirect dry cooling technology (Reference 9.4-3). These limitations lead to both decreased plant output and increased probability of forced power reductions and turbine trips during summer operation. As a result, indirect dry cooling decreases the plant net electrical output even more than ACC, further increasing the need to import power into the PJM region.

In summary, using indirect dry cooling technology at the PSEG Site would require extensive revisions to the standardized plant designs being reviewed under the 10 CFR 52 Design Certification process, significantly increase the amount of land used for the heat dissipation system on the site, reduce the thermal efficiency of the new plant resulting in the need to import more power, and greatly increase the probability of forced power reductions and turbine trips during summer operation when electricity demand is highest. Therefore, an indirect dry cooling system is not preferable to the proposed wet tower system for the PSEG Site.

9.4.1.2.3 Wet-Dry Cooling Towers

Hybrid wet-dry cooling towers employ both a wet section and a dry section. Consumptive water use for the hybrid wet-dry cooling alternative is bounded by the water use of the wet section. Compared to full wet cooling towers, less evaporation, make-up water, and blowdown are involved in the hybrid wet-dry process, therefore reducing water-related impacts. In addition, the visible water vapor plumes associated with wet cooling towers are reduced or eliminated. However, the disadvantages of dry cooling still apply to the dry cooling portion of this heat dissipation process. The dry cooling process is not as efficient as the wet cooling process because it requires the movement of a large amount of air through the heat exchanger to achieve the necessary cooling. This results in a net loss of approximately 22 MW of electrical power for distribution. Consequently, there would be an increase in environmental impacts as replacement generating capacity would be needed to offset the loss in efficiency from hybrid wet-dry cooling. In addition, the hybrid wet-dry cooling towers occupy more land than a wet cooling tower system due to the decreased thermal efficiency, affecting site land use and increasing terrestrial impacts. Therefore, a hybrid wet-dry cooling system is not preferable to the proposed wet tower system for the PSEG Site.

9.4.1.2.4 Cooling Ponds

Power plants that use cooling ponds compose a unique subset of closed-cycle systems. Such facilities operate as once-through power plants (i.e., large condenser flow rates) that withdraw from and discharge to relatively small bodies of water created for the plant. Cooling ponds reduce the heat load to natural bodies of water from power plant operations without the construction and operational expenses of cooling towers. The natural body of water is not relied on for heat dissipation but is used as a source of makeup water to replace that lost to evaporation and as a receiving stream for blowdown from the cooling pond. (Reference 9.4-7)

Plant output as a function of land use at commercial nuclear power plants utilizing cooling ponds ranges from approximately 0.5 to 2.1 megawatt thermal (MWt) per acre due to many factors including local meteorology and land costs. Utilizing the high end of the land use range and the smallest nuclear facility under consideration equates to over 1800 acres of land required. This requirement exceeds the entire amount of land available on the PSEG Site including the already developed areas. Therefore, cooling ponds are not considered a viable alternative for heat dissipation at the PSEG Site.

9.4.1.2.5 Spray Ponds

Spray ponds offer significant advantages over conventional cooling ponds by requiring significantly less land use to dissipate the same amount of heat. Spray ponds consist of a series of spray nozzles located in a relatively long and narrow pond. Water from the condenser is sprayed into the air, cooled by evaporation, and finally falls back to the pond where it is drawn into the intake structure to be pumped back to the condenser.

Due to the evaporation, water is lost through this process, requiring makeup from a natural body of water. Water quality in the pond would also require monitoring and discharge to the Delaware River to control solids. In this regard the spray pond system is similar to the proposed heat dissipation system and does not offer an environmental advantage.

The evaporative heat transfer due to the nozzles spraying the water into the air is inherently less efficient when compared to a cooling tower which utilizes either forced or natural draft effects to increase airflow over a sprayed water pattern. The relatively lesser airflows associated with a spray pond equates to a decrease in efficiency of the heat transfer and an increase in the amount of land area required for the spray pond to dissipate an equivalent amount of heat when compared with a wet cooling tower. Plant output as a function of land use at power plants utilizing spray ponds is approximately 1 acre per 15 MWe. Utilizing the smallest nuclear facility under consideration equates to approximately 90 acres of land required.

A spray pond requires increased land use, negatively affecting terrestrial and wetland ecosystems, and does not offer a significant improvement over the proposed system when considering impacts to water availability, water quality, or aquatic resources. Therefore, a spray pond heat dissipation system is not preferable to the proposed wet tower system for the PSEG Site.

9.4.1.2.6 Conclusions

As discussed in the above subsections, none of the alternative heat dissipation systems represent an environmentally preferable alternative for the PSEG Site. The options among the proposed wet cooling towers (natural draft, mechanical or fan assisted natural draft) for the PSEG Site will be evaluated after reactor technology selection as part of a CWS optimization study prior to detailed design.

9.4.2 CIRCULATING WATER SYSTEMS

In accordance with the NUREG-1555, this subsection presents a discussion of alternatives to the following components of the circulating water system: intake systems, discharge systems, water supply and water treatment processes. This review only considers those alternatives that are applicable to the PSEG Site and compatible with the proposed heat dissipation system presented in Section 3.4.

As applicable, the following factors were considered in the initial environmental screening of the alternative CWS components considered viable alternatives on the PSEG Site:

- Plant water requirements
- Site terrain and relationships to water bodies
- Water body geometry
- Other water use
- Ecological considerations
- Legislative or regulatory requirements

9.4.2.1 Alternatives to the Proposed Circulating Water System

This subsection summarizes the CWS components proposed for the new plant, as presented in Chapter 3, and identifies whether alternatives applicable to the PSEG Site are appropriate for further evaluation.

9.4.2.1.1 Intake System

The intake structure is designed to meet the bounding makeup requirements of the heat dissipation system by drawing water directly from the Delaware River to supply makeup to the closed cycle wet cooling tower. Makeup water flow rates drawn into the intake structure are discussed Section 3.3. The intake structure is located along the east shoreline of the Delaware River, west of the plant site. The design of the intake structure consists of a bar rack at the inlet that prevents debris in the river from entering the intake bays. Debris on the bar rack is cleared by the trash rake which can traverse across the track installed above the forebay along the intake structure’s inlet. To minimize impingement and entrainment, the intake water passes through traveling water screens. The intake structure bay sizes and intake screens will be designed such that the average intake flow velocity through the screens is less than 0.5 feet per second (fps), as required by Clean Water Act, Section 316(b) Phase I requirements specified in 40 CFR 125.84. Debris and aquatic biota from the traveling water screens are returned to the Delaware River per the requirements of the New Jersey Pollutant Discharge Elimination System (NJPDES) permit for the new plant.

While the impacts due to the construction and operation of the proposed intake system are considered SMALL as discussed in Section 5.3, alternative intake systems and design modifications were considered and are presented below. Alternative intake system designs and locations were evaluated to determine if any are environmentally preferable to the proposed system. The below options were considered as alternatives to the proposed system. Options such as an intake canal were not considered as they do not fit into the site terrain and the site’s relationship to the Delaware River.

9.4.2.1.1.1 Collector Well System and other Filtration Based Alternatives

A radial collector well system can be used to develop a filtered water supply by projecting well screens laterally adjacent to and underneath the water source from a central caisson. The central shaft or caisson serves as the collection point for the water that enters the system through the network of well screens. The wells would be primarily recharged from the Delaware River, combining the desirable features of higher well yields with induced seabed filtration of suspended particulates. This improves the raw water quality, simplifies the treatment process and minimizes impingement and entrainment concerns.

Due to the soil conditions near the shoreline of the PSEG Site, expected well production capacity would be on the order of 5 MGD (approximately 3500 gpm). In order to support the required makeup conditions at least 22 wells would be required. Spacing between collector wells is typically 1500 ft. or more to minimize impact on the surrounding aquifer and adjacent wells (Reference 9.4-1). This equates to a shoreline requirement of over six miles. The PSEG Site has less than half of the required shoreline, even when including the developed areas. Thus, collector wells are not a technically feasible alternative for the PSEG Site.

Other options, such as artificial filter beds and porous dikes, are intake options which minimize or eliminate impingement and entrainment. However, artificial filter beds and porous dikes are only feasible on water bodies with low concentrations of suspended solids and where the potential for biofouling is low. The water quality characteristics of the Delaware River in the vicinity of the PSEG Site do not meet either of these conditions.

Due to these limitations, collector wells and other filtration based intake alternatives were determined to not be feasible at the PSEG Site. No further evaluation of this option was considered.

9.4.2.1.1.2 Intake Pipe

An intake pipe feeding the forebay of a traditional shoreline intake structure allows the entrance of the intake to be located a significant distance offshore, in areas of the river with deeper bottom and potentially less productive biological habitat.

An intake pipe or tunnel is typically made up of reinforced concrete pipe. The area along the alignment of the piping is dredged, crushed stone bedding provided along the bottom, the pipe backfilled with crushed stone, sand or gravel, and protected with riprap or armor stone. The intake pipe is typically sized based on flow velocities with consideration given to both higher flow velocities to minimize sediment deposition in the pipe and lower flow velocities to minimize impact to aquatic life. Intake pipes are fitted with a velocity cap to draw in water horizontally and to minimize vortexing and in some cases, subsequent entrainment of aquatic biota and detritus. The intake pipe system would be designed in such a manner to keep velocity cap entrance velocities less than 0.5 fps, as required by Clean Water Act, Section 316(b) Phase I requirements specified in 40 CFR 125.84. The utilization of a velocity cap would be the preferred choice for a multi-directional flow (flood and ebb tides), and brackish water environment, as this type of intake pipe cap has been successfully used at coastal locations.

Construction of an intake pipe into the Delaware River would increase the disruption of the Delaware River aquatic habitat over the proposed intake design. The intake pipe is not likely to have any significant difference in impact to aquatic ecology in the Delaware River. As discussed in Section 5.3, the impacts on the aquatic ecology of the Delaware River due to the proposed intake are SMALL. An intake pipe would also represent an increase in capital and maintenance costs over the proposed intake design.

Due to these limitations, an intake pipe based alternative is not environmentally preferable to the proposed intake at the PSEG Site. No further evaluation of this option was considered.

9.4.2.1.1.3 Hope Creek SWIS

Modifications to the existing HCGS service water intake structure (SWIS) were considered. The existing HCGS SWIS was reviewed to determine if it would be feasible to utilize the empty intake bays from the cancelled HCGS Unit 2. The HCGS service water system provides river water to cool the safety auxiliary cooling system heat exchangers and the reactor auxiliary cooling system heat exchangers during normal and emergency conditions and supplies the filling and makeup requirements for the circulating water system. The HCGS SWIS houses four pumps capable of supplying rated flow of 16,500 gpm per pump and two 36-in. diameter headers, one redundant.

The HCGS SWIS has two empty bays that were originally designed for the cancelled HCGS Unit 2. These bays could be used to provide intake water for the new plant on the PSEG Site; however, the new plant requires up to approximately 80,000 gpm of intake water. This flow rate, when combined with the open area of the HCGS SWIS intake bays, leads to exceeding the through screen velocity limitations of 0.5 fps, as required by Clean Water Act, Section 316(b) Phase I requirements specified in 40 CFR 125.84. Expansion of the intake structure and routing new intake piping from the existing HCGS SWIS to the new plant location would present various interferences with existing buried commodities, including potential impacts to station service water, fire protection piping, fuel oil piping and cooling tower blowdown line, on the PSEG Site.

In addition to the physical limitations, consideration must be given to the differences in design bases and licensing of the two distinct nuclear power plants. The HCGS SWIS is a safety-related structure as defined in its licensing documentation. The intake structure associated with the new plant is required to meet the site characteristics associated with this licensing effort and specific design requirements specified by the reactor vendors in the Design Control Document, which will likely differ from those associated with the HCGS. Additionally, HCGS is currently licensed to operate until 2026, but is seeking license renewal potentially extending its operating license until 2046. However, the new plant on the PSEG Site has a design operating life extending until 2081, beyond that currently planned for HCGS.

Due to these limitations, utilization of the existing HCGS SWIS is not feasible for the new plant on the PSEG Site. No further evaluation of this option was considered.

9.4.2.1.2 Discharge System

The proposed plant discharge consists of cooling tower blowdown and other site wastewater streams, including the domestic water treatment and service water treatment systems. The volume and concentration of each constituent discharged to the environment will meet requirements established in the NJPDES permit. As described in Section 3.4, the proposed discharge outfall from the new plant is a single 48 in. pipe located approximately 100 ft. from the shoreline. The discharge pipe is similar to that utilized at the adjacent HCGS, but extends further into the Delaware River to improve mixing as discussed in Section 5.2.

Dilution and dissipation of the discharge heat as well as other effluent constituents are affected by both the design of the discharge structure and the flow characteristics of the receiving water. Section 5.3 concludes that the impacts of the discharge system to aquatic ecosystems from thermal, chemical and physical impacts are SMALL.

Alternative systems and design modifications such as multi-port diffusers, modified discharge velocity, or discharges into deeper waters are options to the proposed system. During evaluation of the proposed system, as discussed in Section 5.2 and 5.3, consideration was given to selecting a more complex diffuser design if the impacts due to the proposed system were to cause unreasonable physical, thermal, or aquatic impacts to the environment. As discussed in Section 5.2 and 5.3, the impacts associated with the discharge system are SMALL and do not warrant further evaluation of system or design alternatives.

Alternative discharge system locations were considered to determine if an environmentally preferable configuration could be used. Shore locations along the PSEG Site were investigated to determine the feasibility of routing a discharge pipeline. The shoreline immediately south of the proposed location for the discharge is developed and used for facilities associated with the SGS and HCGS. However, east of the SGS circulating water intake structure is an undeveloped portion of shoreline at the southern boundary of the PSEG Site. This location was identified as a potential alternate location for discharge. Additionally, north of PSEG Site along the tip of Artificial Island in the vicinity of Alloways Creek was considered potentially feasible for a discharge location.

Both of these locations increase land usage to route the piping to these locations during construction, adversely impacting additional terrestrial ecology habitats. At both the south shore location and Alloways Creek location, the Delaware River depths are less than 5 ft. below mean lower low water. At these depths, discharge effluent does not mix as efficiently and could cause river bottom scour. To meet the appropriate mixing requirements, the discharge pipe would need to be extended much further off shore than the proposed system, increasing impacts to aquatic biota during construction.

Due to these increased environmental impacts of these alternative locations when compared with the proposed system and minimal environmental impact of the proposed system, utilization of an alternate discharge location was determined to not provide an environmentally preferable option for the new plant on the PSEG Site. No further evaluation of an alternative discharge location option was considered.

9.4.2.1.3 Water Supply

The selected water supply for makeup to the heat dissipation system at the PSEG Site is the Delaware River. No alternative sources of water supply are available. As described in Section 3.3, the maximum amount of water introduced into the system from the Delaware River is 78,196 gpm for the new plant. The annual mean flow of the Delaware River at Trenton, NJ is 7110 cfs (3,200,000 gpm) and tidal flow past the PSEG Site ranges between 400,000 and 472,000 cfs (180,000,000 to 212,000,000 gpm). Based on the anticipated maximum intake flow of 78,196 gpm for the new plant, the intake withdraws less than one percent of the tidal flows which dominate the river in the area of the PSEG Site.

Groundwater was evaluated and not considered a viable alternative water source because the local groundwater aquifers are not able to support the continuous cooling makeup water requirement of 78,196 gpm for the new plant. Groundwater is used for miscellaneous plant water makeup needs such as fire protection, potable and sanitary, and demineralizer makeup. The environmental impact of using the Delaware River water supply for CWS is SMALL as discussed in Section 5.3. No environmentally feasible alternative water supply source for makeup to the CWS is identified. Environmental impacts are SMALL.

9.4.2.1.4 Water Treatment

Evaporation of water from closed cycle cooling systems leads to an increase in chemical and solids concentrations in the circulating water, which in turn increases the scaling tendencies of the water. The new plant will be operated so that the concentration of total dissolved solids in the cooling tower blowdown is monitored to meet the requirements of the NJPDES permit for the site. The selected water treatment system is described in Subsection 3.3.2.

Sulfuric acid will be used to control calcite scale as required, and acid addition will maintain a slightly alkaline pH level. The combination of low cycles of concentration and acid addition will be used so that other scale inhibitors are not required. Chlorination will control microbial growth in the piping and condenser to prevent biofouling and microbiological deposits. Sodium hypochlorite solution will be injected as required at the intake structure and the cooling tower basin.

Alternate anti-scaling chemicals include sodium hydroxide. Alternative biocides include hydrogen peroxide or ozone. The final choice of chemicals or combination of chemicals is dictated by makeup water conditions, technical feasibility, economics, and discharge permit requirements. The discharges from the CWS are subject to NJPDES permit limitations that consider aquatic impacts and all water treatment chemicals used in the system will be reviewed by NJDEP to assure that they are environmentally equivalent.

The new plant is required to obtain an NJPDES permit to discharge effluents. The NJPDES permitting process and periodic renewals allow for changes and modifications to be appropriately reviewed and approved by NJDEP.

The environmental impact due to the proposed water treatment system is SMALL as discussed in Section 5.3. No environmentally equivalent or superior alternative water treatment option is identified because any system selected for use will meet the NJDPES requirements for discharge into the Delaware River. The discharge will meet regulatory standards and therefore environmental impacts are SMALL.

9.4.3 TRANSMISSION SYSTEMS

The four existing 500 kV transmission lines that leave the PSEG Site provide adequate thermal capacity for the new plant. However, there may be a need for additional off-site transmission to address potential transient grid stability limitations. Future needs for off-site transmission for the new plant are dependent on the reactor technology selected by PSEG and external factors not under PSEG control (e.g., PJM’s regional transmission planning process). Any required transmission upgrades will be determined by PJM based on formal transmission impact studies performed as part of the interconnection queue process. A limited GIS study of two potential transmission macro-corridors was performed to provide a preliminary evaluation of the transmission routing alternatives that may be considered when the need for additional off-site transmission has been established.

9.4.3.1 Macro-Corridor Study

The purpose of this study was to provide an approximation of the magnitude of potential environmental impacts associated with two conceptual 500 kV transmission macro-corridors. The termination points were selected to link the new plant to a strong regional 500 kV substation that could provide synchronizing support to improve grid stability margin. Because a transmission routing study has not been completed and precise transmission line routes have not been established, each macro-corridor was evaluated as a 5 mi. wide band generally following existing transmission line corridors. The following macro-corridors were evaluated:

- The South Macro-Corridor runs north from the PSEG Site, turns west to cross the Delaware River, and then runs south to the Indian River Substation in Delaware. The South Macro-Corridor generally follows existing transmission line corridors, and it has a total length of approximately 94 mi. This routing was preliminarily identified as the final segment of the Mid-Atlantic Power Project (MAPP) transmission line, but the segment has not been approved by PJM and is not in the current Regional Transmission Expansion Plan (RTEP). Although this segment of the MAPP line has been deferred by PJM for future study, it provided a logical conceptual route for the macro-corridor.

- The West Macro-Corridor runs north from the PSEG Site, turns west to cross the Delaware River, and then continues west to the Peach Bottom Substation in PA. The West Macro-Corridor generally follows existing transmission line corridors, and it has a total length of approximately 55 mi.

Each of these macro-corridors was developed with a common segment. From the PSEG Site the common segment extends north and then west across the Delaware River to the Red Lion Substation in DE, following the existing Hope Creek to Red Lion right-of-way. From this location, the macro-corridors diverge, extending to the west (Peach Bottom Substation) or south (Indian River Substation). When a specific route is selected, this segment may pursue a more direct path (e.g., crossing the river closer to the PSEG Site); however, crossing the Delaware River in the same area as existing transmission lines was selected for the purposes of defining the bounding conceptual macro-corridors.

As stated above, each macro-corridor was evaluated as a 5 mi. wide band that generally followed existing transmission line corridors between the end points. These 5 mi. wide bands were simplified so as not to follow the detailed alignments of the existing corridors. This approach allowed a general characterization of environmental resources within the existing corridors as well as those adjacent lands that might be subject to new transmission routing. When detailed routing studies are performed, it is anticipated that existing transmission line ROWs or alignments adjacent to existing ROWs will be used as much as possible.

Table 9.4-1 identifies the counties potentially crossed by the South and West Macro-Corridors. Figures 9.4-1 and 9.4-2 illustrate the counties potentially crossed by each macro-corridor.

The land along the South Macro-Corridor is characterized by low elevations and low topographic relief that is typical of the Coastal Lowlands subregion of the Mid-Atlantic Coastal Plain. This subregion is characterized by poor drainage, shallow water tables, abundant wetlands, and tidal streams and rivers (Reference 9.4-2). The land along the West Macro-Corridor is also characterized by low elevations along the eastern half of the macro-corridor, but as the macro-corridor travels further west, it passes into more upland areas that are characteristic of the Northeastern Highland physiographic province.

The following subsection describes the methods used to evaluate the potential environmental impacts of these macro-corridors.

9.4.3.1.1 Methods

In the context of this study, environmental features were considered to be the factors important in environmental impact assessment and transmission corridor development. The environmental features considered included the following:

- U.S. Geological Survey (USGS) Land Use/Land Cover (LULC)
- Wetlands
- Hydrography (streams, rivers)
- Infrastructure
- Parklands
- Nature Preserves/Natural Areas
- Wildlife Refuges
- Forest Preserve Lands
- Historic Properties
- Prime and unique farmland
- Natural Heritage Data
- Floodplains

Available GIS coverages for the above listed environmental features were obtained from a variety of available public sources for each corridor including:

- **Land Use/Land Cover** – USGS Land Cover Institute. Multi-Resolution Land Characteristics Consortium, National Land Cover Database. Available at: http://www.mrlc.gov/nlcd.php
- **Wetlands** – U.S. Fish and Wildlife Service National Wetlands Inventory (NWI). Available at: http://www.fws.gov/wetlands/Data/DataDownloadState.html
- **Hydrography** – USGS National Hydrography Dataset (High Resolution-24k). Available at: http://nhd.usgs.gov/index.html
- **Prime Farmland** – Natural Resources Conservation Service (NRCS) SSURGO Soil Database. Available at: http://soildatamart.nrcs.usda.gov/State.aspx
- **Pennsylvania State Parks and Forested Areas** – Pennsylvania Spatial Data Access (Penn State University). Available at: http://www.pasda.psu.edu/
- **New Jersey State Parks** – New Jersey Department of Environmental Protection GIS. Available at: http://www.state.nj.us/dep/gis/

- **Maryland Public, Protected, Heritage Lands, Sensitive Areas** – Maryland Department of Natural Resources. Available at: http://dnrweb.dnr.state.md.us/gis/data/data.asp
- **Historic Properties** – National Register of Historic Places (NRHP). Available at: http://nrhp.focus.nps.gov/natreg/docs/Download.html
- **Natural Heritage Data –** New Jersey Natural Heritage Program (NJNHP). Available at: http://www.nj.gov/dep/parksandforests/natural/heritage/
- **Roads/Highways** – Tele Atlas North America, Inc., Geographic Data Technology, Inc., Environmental Systems Research Institute, Inc. (ESRI; 2005)
- **Railroads** – Federal Railroad Administration (FRA), Bureau of Transportation Statistics, ESRI (2005)
- **Terrain** – United States Geological Survey (USGS). Available at: http://ned.usgs.gov/
- **Floodplains** – National Flood Hazard Database and Q3 Digital Flood Data. Available at: http://msc.fema.gov/

After compilation of the GIS coverages, each macro-corridor was analyzed to provide a summary of the number and type of each resource within the 5 mi. wide band. The data was summarized into tables and expressed in terms of area, length, or number of occurrences, depending on the resource. These measurements were compiled separately for the portion of each macro-corridor within a 6 mi. radius and within a 50 mi. radius of the PSEG Site. Most resource coverages were then scaled from the total macro-corridor values to a “projected” impact value for a hypothetical 200 ft. wide (typical 500 kV width) ROW potentially located within each macro-corridor. An adjustment factor was applied to the projected value for the hypothetical 200 ft. wide ROW to account for the actual transmission line length along existing ROWs relative to the simplified conceptual route. For example, the length of the simplified conceptual route for the West Macro-Corridor is approximately 55 mi., but the actual length along the existing ROWs is approximately 59 mi. Therefore, the estimated value for each resource within the West Macro-Corridor hypothetical ROW was increased by 7 percent (the percentage increase from 55 mi. to 59 mi.) to derive values for an adjusted hypothetical ROW. Similarly, the length of the simplified conceptual route for the South Macro-Corridor is approximately 94 mi., but the actual length along the existing ROWs is approximately 107 mi. Therefore, the estimated value for each resource within the South Macro-Corridor hypothetical ROW was increased by 14 percent (the percentage increase from 94 mi. to 107 mi.) to derive values for an adjusted hypothetical ROW.

The following subsections describe the results of the GIS evaluations in each major resource area.

9.4.3.1.2 Results

9.4.3.1.2.1 Land Use and Land Cover

The existing land use and land cover areas crossed by the 5 mi. wide macro-corridors and the 200 ft. wide hypothetical ROWs are summarized in Table 9.4-2. Cultivated cropland is the largest land use/land cover type crossed by the South Macro-Corridor, representing 39 percent of the macro-corridor area. Based on this percentage, the adjusted hypothetical ROW is estimated to cross 1051 ac. of cultivated cropland. Other major land uses within the South Macro-Corridor include wetlands, pasture hay, and deciduous forest (Table 9.4-2).

Pasture hay (lands that are either pastured or periodically cut and baled for domestic livestock forage) is the largest land use/land cover type crossed by the West Macro-Corridor, representing 24 percent of the macro-corridor area. Based on this percentage, the adjusted hypothetical ROW is estimated to cross 374 ac. of pasture hay land. Other major land uses within the West Macro-Corridor include cultivated cropland, deciduous forest, wetlands, and open water (Table 9.4-2).

9.4.3.1.2.2 Streams

The Delaware River is tidal in the study area, with flow rates and water levels dominated by tidal cycles. There are numerous other streams and channels along both macro-corridors. These streams are essentially all interconnected to some degree as tidal waterways. Table 9.4-3 presents the length of the streams within each macro-corridor and hypothetical ROW. There are a total of 1697 mi. of streams within the South Macro-Corridor and 970 mi. of streams within the West Macro-Corridor. Based on the adjusted hypothetical ROWs, the South Macro-Corridor ROW crosses 14.6 mi. of streams and the West Macro-Corridor ROW crosses 7.9 mi. of streams.

It is expected that approximately 95 percent of stream channels could be avoided in the location of transmission towers. Crossing of major rivers (Delaware River, Susquehanna River) would require the placement of in-stream structures. Structures placed near the navigation channel would be expected to also require the placement of dikes, bulkheading, rip rap, or other protective structures to guard against collisions with marine vessels.

9.4.3.1.2.3 Wetlands

Wetlands are a subset of waters of the United States defined as “...areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (33 CFR 328.3(b)).

As is shown in Table 9.4-2, Land Use Land Cover (LULC) data on wetlands includes two major classifications. The NWI wetlands coverage contains several classifications, including:

- Estuarine and marine deepwater
- Estuarine and marine wetland
- Freshwater emergent wetland
- Freshwater Forested/Shrub wetland
- Freshwater pond
- Lake
- Riverine
- Other (farmed, excavated, etc.)

NWI data is presumed to be a better indicator of potential wetland impacts than LULC data, as the NWI database has been developed with a particular focus on wetland resources. NWI mapping will be augmented with field delineation of jurisdictional wetlands as part of the permitting process if an actual transmission ROW is proposed.

Table 9.4-4 summarizes the wetland areas within each macro-corridor and hypothetical ROW based on NWI data. There are a total of 94,413 ac. of wetlands within the South Macro-Corridor and 35,516 ac. within the West Macro-Corridor. The adjusted hypothetical ROWs are estimated to cross 814 ac. along the South Macro-Corridor and 289 ac. along the West Macro-Corridor.

In general, the wetlands within a transmission ROW would not be directly impacted except in the limited footprints of transmission towers and any necessary access points. It is expected that 85 percent of wetlands could be avoided in the location of transmission towers.

9.4.3.1.2.4 Prime Farmland and Farmland of Special Status

The National Soils Survey Handbook (Reference 9.4-4) defines prime farmland as soils that have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and are available for these uses. Farmland of statewide or unique importance is also considered a valuable agricultural resource and is tabulated here along with prime farmland. Prime farmland within the study area was quantified using soil types and slopes specified as prime by the NRCS. In contrast, farmlands of unique importance correspond to lands within the coastal wetlands and likely correspond to the use of these areas for salt hay farming.

The prime farmland and farmlands of special status within each macro-corridor and hypothetical ROW are summarized in Table 9.4-5. Soils data was not available in GIS format for New Castle County, DE; consequently, the USGS LULC cultivated crops data for New Castle County was used as a surrogate for this analysis. Within the South and West Macro-Corridors there are, respectively, 231,992 ac. and 146,827 ac. of prime and special status farmland. The adjusted hypothetical ROWs cross 2000 ac. along the South Macro-Corridor and 992 ac. along the West Macro-Corridor.

Most farmland would be unaffected by a transmission line except in the limited footprints of transmission towers and any necessary access points.

9.4.3.1.2.5 Sensitive Resources

Sensitive resources identified within the macro-corridors are summarized in Table 9.4-6. This information was obtained through several public sources, and the manner and level of detail in which each particular agency describes these sensitive resources varies. The sensitive resources that are described in Table 9.4-6 include parks, public lands, refuges, natural heritage resources (rare, threatened or endangered species or habitats of unusual natural quality), and state/federal lands. Many of these lands are available for such recreational uses as hunting, fishing, bird watching, and other low intensity uses. The natural heritage GIS data was quite limited and subject to the public domain availability of such data within each state. Resource agencies typically do not make precise sensitive species locations readily available in order to guard against potential human interference with the resource. This data was generally not available for DE, MD, and PA. Within NJ, data is represented by USGS quadrangles that have historically had an occurrence of an endangered or sensitive plant species. Any available qualitative information is provided descriptively in Table 9.4-6.

Some of the resources shown in Table 9.4-6 are expected to be sensitive and would be actively avoided during route development (e.g., listed threatened or endangered species, state parks, historic sites, etc.). In contrast, other features (e.g., state wildlife management areas) may be considered sensitive but represent a manageable issue during routing studies. Unidentified natural heritage features are available only on a USGS quadrangle basis, therefore, any attempt at quantification of this potential constraint would be an exaggeration. Further, the quality of the available natural heritage data is considered low. Accordingly, no scaling or adjustment of these features to hypothetical ROWs was performed.

9.4.3.1.2.6 Historical Places

The number of historic places (based on NRHP data) identified within each macro-corridor by county is summarized in Table 9.4-7. Within the South and West Macro-Corridors there are 147 and 52 historic places, respectively. Within the adjusted hypothetical ROWs there are estimated to be two historic places for the South Macro-Corridor and none for the West Macro-Corridor.

It is expected that most historic and cultural resources could be avoided during the detailed design of transmission facilities.

9.4.3.1.2.7 Infrastructure

Infrastructure (roads and railroads) are summarized in Table 9.4-8. There are 325 mi. of roads and railroads within the South Macro-Corridor and 282 mi. within the West Macro-Corridor. The adjusted hypothetical ROWs crosses 2.8 mi. of these features along the South Macro-Corridor and 2.3 mi. along the West Macro-Corridor.

9.4.3.1.2.8 Floodplains

The acreage of 100-year floodplains within each macro-corridor and hypothetical ROW is summarized in Table 9.4-9. There are a total of 119,065 ac. of floodplains within the South Macro-Corridor and 60,496 ac. within the West Macro-Corridor. The adjusted hypothetical ROWs cross 1026 ac. along the South Macro-Corridor and 492 ac. along the Macro-West Corridor. Most floodplains would be unaffected except in the limited footprints of transmission towers and any necessary access points.

9.4.3.1.3 Summary

An analysis of potential future off-site transmission corridors that may be needed to support system stability was performed using publicly available GIS data. Because precise routes have not yet been developed, this analysis utilized a macro-corridor approach to characterize potential impacts. The macro-corridor approach entailed the use of simplified 5 mi. wide bands along two primary routing alternatives chosen to support potential transmission stability needs. One alternative (the South Macro-Corridor) extends from the PSEG Site to the Indian River Substation in DE. The second alternative (the West Macro-Corridor) extends from the PSEG Site to the Peach Bottom Substation in PA.

The results of this analysis demonstrate that the South Macro-Corridor, by virtue of its greater length, represents a bounding condition that, for most resource categories examined, exceeds the impacts of the West Macro-Corridor. The total area potentially included within the 200 ft. wide adjusted hypothetical ROW for the South Macro-Corridor is 2728 ac., as compared to 1557 ac. for the West Macro-Corridor.

Both macro-corridors have similarities in the dominant land uses crossed. Agricultural lands (cultivated crops and pasture hay), forested lands, and wetlands are the dominant land cover types crossed by each macro-corridor. Wetland and stream resources are also similarly represented within each macro-corridor. Perennial streams are slightly more abundant (by percentage) within the West Macro-Corridor relative to the South Macro-Corridor. In contrast, wetlands are represented by a greater percentage within the South Macro-Corridor as compared to the West Macro-Corridor. Prime and unique farmland is more abundant (by percentage) within the West Macro-Corridor, and floodplains are more abundant within the South Macro-Corridor.

Sensitive resources including parkland, refuges, and publicly owned wildlife management areas were also evaluated. Notably, the West Macro-Corridor contained a greater number of potentially sensitive features as compared to the South Macro-Corridor. Natural Heritage features were difficult to characterize due to the unavailability of site-specific data in publicly available GIS databases. Historic properties were demonstrated to be low in number within each macro-corridor and are likely avoidable.

The resources characterized as part of this analysis are a general indicator of potential impacts associated with off-site transmission corridor development. Additionally, these data serve as a baseline from which to initiate detailed studies as part of future route selection activities. In many cases, detailed studies will allow the avoidance of resources characterized by this macro-corridor analysis, thereby reducing potential impacts, particularly to sensitive features such as wetlands, streams, and historic properties.

Although the purpose of this analysis was not to select a transmission corridor for development, the values for the 200 ft. wide adjusted hypothetical ROW for the South Macro-Corridor are considered useful as bounding estimates for the potential environmental impacts that could result from any off-site transmission that may be required for the new plant. Accordingly, environmental impact evaluations in other parts of this Environmental Report are based on the South Macro-Corridor adjusted ROW. Additional analysis during specific transmission line routing studies will allow a detailed determination of environmental impacts. The potential impacts indicated by the South Macro-Corridor adjusted ROW likely over-estimate actual environmental impacts.

9.4.3.2 Design Considerations

Detailed design parameters will not be determined until the need for off-site transmission has been established. However, any new off-site transmission line will be 500 kV and will be expected to have characteristics similar to existing PSEG 500 kV transmission lines. Characteristics relevant to the macro-corridors under consideration includes the following:

- Typical tower spacing of five spans per mi.
- Delaware River Crossing – Assumes five towers located on piers placed parallel to the existing transmission line
- Susquehanna River Crossing – Assumes a single tower
- Piers to support towers needed for major river crossings assumed to be colocated (side-by-side) with existing piers
- Typical transmission support structure to consist of lattice tower or mono-pole construction

- Typical transmission support structure to have a height of 145 to 180 ft.

The above characteristics represent reasonable assumptions regarding the likely design of a potential new 500 KV transmission line. During detailed design, efforts will be made to minimize environmental impacts while providing safe, reliable, and cost-effective transmission design.

9.4.4 REFERENCES

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9.4-7 U.S. Nuclear Regulatory Commission, "NUREG-1437: Generic Environmental Impact Statement for License Renewal of Nuclear Plants," May 1996, http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/v1/index.html.

Table 9.4-1
Counties Potentially Intersected by Each Transmission Macro-Corridor

	West Macro-Corridor	South Macro-Corridor
Salem County, NJ	X	X
New Castle County, DE	X	X
Kent County, DE		X
Sussex County, DE		X
Cecil County, MD	X	
Harford County, MD	X	
Chester County, PA	X	
Lancaster County, PA	X	
York County, PA	X	

Table 9.4-2
Land Use/Land Cover (acres) within Macro-Corridors and Hypothetical Rights-of-Way

	5-Mi. Wide Corridor			Projected 200-ft Wide Right-of-Way			Adjusted 200-ft Wide Right-of-Way[a]			
South Corridor	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**Percent**
Open Water	4468	21,686	26,154	34	164	198	39	187	225	8.3%
Developed - Open Space	282	6360	6642	2	48	50	2	55	57	2.1%
Developed - Low Intensity	199	5696	5895	2	43	45	2	49	51	1.9%
Developed - Medium Intensity	90	2684	2774	1	20	21	1	23	24	0.9%
Developed - High Intensity	192	1394	1586	1	11	12	2	12	14	0.5%
Barren Land	493	3110	3603	4	24	27	4	27	31	1.1%
Deciduous Forest	2243	39,052	41,295	17	296	313	19	337	356	13.1%
Evergreen Forest	58	4106	4165	0	31	32	1	35	36	1.3%
Mixed Forest	11	1807	1817	0	14	14	0	16	16	0.6%
Pasture Hay	3416	32,175	35,591	26	244	270	29	277	307	11.2%
Cultivated Crops	11,704	110,191	121,895	89	835	923	101	950	1051	38.5%
Woody Wetlands	7742	18,707	26,448	59	142	200	67	161	228	8.4%
Emergent Herbaceous Wetlands	11,648	26,915	38,563	88	204	292	100	232	332	12.2%
Total	**42,545**	**273,884**	**316,429**	**322**	**2075**	**2397**	**367**	**2361**	**2728**	**100.0%**
West Corridor										
Open Water	1976	18,744	20,721	15	142	157	16	152	168	10.8%
Developed - Open Space	98	7609	7706	1	58	58	1	62	63	4.0%
Developed - Low Intensity	97	8769	8867	1	66	67	1	71	72	4.6%
Developed - Medium Intensity	64	3726	3789	0	28	29	1	30	31	2.0%
Developed - High Intensity	191	1420	1610	1	11	12	2	12	13	0.8%
Barren Land	351	2570	2921	3	19	22	3	21	24	1.5%
Deciduous Forest	1086	33,969	35,055	8	257	266	9	276	285	18.3%
Evergreen Forest	13	1064	1077	0	8	8	0	9	9	0.6%
Mixed Forest	9	32	42	0	0	0	0	0	0	0.0%
Pasture Hay	934	45,122	46,055	7	342	349	8	367	374	24.0%
Cultivated Crops	4310	31,396	35,706	33	238	270	35	255	290	18.6%
Woody Wetlands	4276	11,534	15,810	32	87	120	35	94	129	8.3%
Emergent Herbaceous Wetlands	7675	4490	12,164	58	34	92	62	36	99	6.4%
Total	**21,077**	**170,446**	**191,523**	**160**	**1291**	**1451**	**171**	**1386**	**1557**	**100.0%**

a) 200-ft projected corridor was adjusted to account for the actual route length, 14% adjustment for the South Corridor and 7% adjustment for the West Corridor.

Table 9.4-3
Stream Length (miles) within Macro-Corridors and Hypothetical Rights-of-Way

	5-Mi. Wide Corridor			Projected 200-ft Wide Right-of-Way			Adjusted 200-ft Wide Right-of-Way[a]			
South Corridor	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**Percent**
Channelized Waterway	197.3	431.2	628.5	1.5	3.3	4.8	1.7	3.7	5.4	37.0%
Intermittent Stream	0.2	130.0	130.2	0.0	1.0	1.0	0.0	1.1	1.1	7.7%
Perennial Stream	320.4	617.6	938.0	2.4	4.7	7.1	2.8	5.3	8.1	55.3%
Total	**518.0**	**1178.8**	**1696.7**	**3.9**	**8.9**	**12.9**	**4.5**	**10.2**	**14.6**	**100.0%**
West Corridor										
Channelized Waterway	140.0	184.0	324.1	1.1	1.4	2.5	1.1	1.5	2.6	33.4%
Intermittent Stream	0.0	79.7	79.7	0.0	0.6	0.6	0.0	0.6	0.6	8.2%
Perennial Stream	236.0	330.3	566.3	1.8	2.5	4.3	1.9	2.7	4.6	58.4%
Total	**376.0**	**594.0**	**970.1**	**2.8**	**4.5**	**7.3**	**3.1**	**4.8**	**7.9**	**100.0%**

a) 200-ft projected corridor was adjusted to account for the actual route length, 14% adjustment for the South Corridor and 7% adjustment for the West Corridor.

Table 9-4-4
Wetlands (acres) within Macro-Corridors and Hypothetical Rights-of-Way

	5-Mi. Wide Corridor			Projected 200-ft Wide Right-of-Way			Adjusted 200-ft Wide Right-of-Way[a]			
South Corridor	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**Percent**
Estuarine and Marine Deepwater	3858	8749	12,607	29	66	96	33	75	109	13.4%
Estuarine and Marine Wetland	16,551	32,707	49,257	125	248	373	143	282	425	52.2%
Freshwater Emergent Wetland	1522	3934	5457	12	30	41	13	34	47	5.8%
Freshwater Forested/Shrub Wetland	1677	22,730	24,408	13	172	185	14	196	210	25.9%
Freshwater Pond	284	1017	1301	2	8	10	2	9	11	1.4%
Lake	1	766	767	0	6	6	0	7	7	0.8%
Riverine	17	328	344	0	2	3	0	3	3	0.4%
Other[b]	63	208	271	0	2	2	1	2	2	0.3%
Total	**23,973**	**70,440**	**94,413**	**182**	**534**	**715**	**207**	**607**	**814**	**100.0%**
West Corridor										
Estuarine and Marine Deepwater	2347	4333	6680	18	33	51	19	35	54	18.8%
Estuarine and Marine Wetland	10,121	5241	15,362	77	40	116	82	43	125	43.3%
Freshwater Emergent Wetland	1400	2788	4188	11	21	32	11	23	34	11.8%
Freshwater Forested/Shrub Wetland	1164	6173	7337	9	47	56	9	50	60	20.7%
Freshwater Pond	172	833	1005	1	6	8	1	7	8	2.8%
Lake	1	335	336	0	3	3	0	3	3	0.9%
Riverine	17	414	430	0	3	3	0	3	3	1.2%
Other[b]	63	114	177	0	1	1	1	1	1	0.5%
Total	**15,285**	**20,231**	**35,516**	**116**	**153**	**269**	**124**	**164**	**289**	**100.0%**

a) 200-ft projected corridor was adjusted to account for the actual route length, 14% adjustment for the South Corridor and 7% adjustment for the West Corridor.
b) Other wetlands include those classified as farmed wetlands, excavated/disturbed wetlands, and seasonal wetlands.

Table 9.4-5
Prime and Special Status Farmland (acres) within Macro-Corridors and Hypothetical Rights-of-Way (a)

	5-Mi. Wide Corridor			Projected 200-ft Wide Right-of-Way			Adjusted 200-ft Wide Right-of-Way(b)			
South Corridor	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**Percent**
NRCS Prime Farmland	8361	88,679	97,040	63	672	735	72	765	837	41.83%
Farmland of Unique Importance	19,381	12,954	32,335	147	98	245	167	112	279	13.94%
Farmland of Statewide Importance	5349	36,790	42,139	41	279	319	46	317	363	18.16%
Prime farmland if protected from flooding or not frequently flooded during the growing season	0	0	0	0	0	0	0	0	0	0.00%
Prime farmland if irrigated	0	31,385	31,385	0	238	238	0	271	271	13.53%
Prime farmland if drained	0	811	811	0	6	6	0	7	7	0.35%
New Castle County, DE Cultivated Cropland	7394	20,889	28,283	56	158	214	64	180	244	12.19%
Total	**40,484**	**191,507**	**231,992**	**307**	**1451**	**1758**	**349**	**1651**	**2000**	**100.00%**
West Corridor										
NRCS Prime Farmland	8361	105,055	113,416	63	796	859	68	854	922	92.90%
Farmland of Unique Importance	19,381	0	19,381	0	0	0	0	0	0	0.00%
Farmland of Statewide Importance	5349	0	5349	0	0	0	0	0	0	0.00%
Prime farmland if protected from flooding or not frequently flooded during the growing season	0	14	14	0	0	0	0	0	0	0.00%
Prime farmland if irrigated	0	0	0	0	0	0	0	0	0	0.00%
Prime farmland if drained	0	0	0	0	0	0	0	0	0	0.00%
New Castle County, DE Cultivated Cropland	0	8667	8667	0	66	66	0	70	70	7.10%
Total	**33,091**	**113,737**	**146,827**	**63**	**862**	**925**	**68**	**924**	**992**	**100.00%**

a) Soils data used in determining prime farmland was not available for New Castle County, DE. Cultivated cropland data from USGS was used as a surrogate.
b) 200-ft projected corridor was adjusted to account for the actual route length, 14% adjustment for the South Corridor and 7% adjustment for the West Corridor.

Table 9.4-6
Sensitive Resources within Macro-Corridors[(a)]

South Corridor	6-Mile Vicinity	6-50+ Mile Region	Description
Unspecified Natural Heritage Resource, NJ	X		18 quadrangles with at least 1 sensitive plant occurrence
Abbott's Meadow Wildlife Management Area, NJ	X		1324 acres
Hancock House State Historic Site, NJ	X		2 acres
Mad Horse Creek Wildlife Management Area, NJ	X		4694 acres
Fort duPont State Park, DE		X	274 acres
Bombay Hook National Wildlife Refuge, DE		X	3640 acres
Prime Hook National Wildlife Refuge, DE		X	492 acres
Supawna National Wildlife Refuge, NJ		X	2479 acres
Dover Air Base, DE		X	2804 acres
Unspecified Natural Heritage Resource, NJ		X	2 endangered plant occurrences within 197 acres
Unspecified Natural Heritage Resource, NJ		X	endangered plant occurrence within 68 acres
Unspecified Natural Heritage Resource, NJ		X	29 quadrangles with at least 1 sensitive plant occurrence
Unspecified Natural Heritage Resource, NJ		X	22 quadrangles with at least 1 sensitive plant occurrence
Salem River State Park, NJ		X	204 acres
Fort Mott State Park, NJ		X	92 acres
West Corridor			
Unspecified Natural Heritage Resource, NJ	X		18 quadrangles with at least 1 sensitive plant occurrence
Abbott's Meadow Wildlife Management Area, NJ	X		1324 acres
Hancock House State Historic Site, NJ	X		2 acres
Mad Horse Creek Wildlife Management Area, NJ	X		4694 acres
Unspecified Natural Heritage Resource, NJ		X	2 endangered plant occurrences within 197 acres
Unspecified Natural Heritage Resource, NJ		X	endangered plant occurrence within 68 acres
Unspecified Natural Heritage Resource, NJ		X	29 quadrangles with at least 1 sensitive plant occurrence
Unspecified Natural Heritage Resource, NJ		X	22 quadrangles with at least 1 sensitive plant occurrence
Fort duPont State Park, DE		X	15 acres
Supawna National Wildlife Refuge, NJ		X	2479 acres
Salem River State Park, NJ		X	204 acres
Fort Mott State Park, NJ		X	92 acres
County Owned Land, MD		X	496 acres
DNR Owned Land, MD		X	557 acres
Nature Conservancy Land, MD		X	30 acres
Fair Hill Rural Legacy Area, MD		X	4142 acres
State Forest, PA		X	79 acres
Humanistic Forest, PA		X	10,514 acres
Naturalistic Forest, PA		X	14,454 acres
Fort Delaware State Park, DE		X	289 acres
Sensitive Species Project Areas, MD		X	18,623 acres
Forest Interior Habitat, MD		X	16,773 acres

a) Available data identified no sensitive resources outside of the 50-mile radius for either macro-corridor.

Table 9.4-7
Number of NRHP[a] Historic Properties within Macro-Corridors and Hypothetical Rights-of-Way[b]

	5-Mi. Wide Corridor			Projected 200-ft Wide Right-of-Way			Adjusted 200-ft Wide Right-of-Way[c]			
South Corridor	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**Percent**
NJ-Salem County	6	5	11	† [d]	†	†	†	†	†	7.5%
DE-New Castle County	18	43	61	†	†	1	†	†	1	41.5%
DE-Kent County	0	54	54	†	†	†	†	1	1	36.7%
DE-Sussex County	0	21	21	†	†	†	†	†	†	14.3%
Total	**24**	**123**	**147**	**0**	**0**	**1**	**0**	**1**	**2**	**100.0%**
West Corridor										
NJ-Salem County	6	5	11	†	†	†	†	†	†	21.2%
DE-New Castle County	0	21	21	†	†	†	†	†	†	40.4%
MD-Cecil County	0	20	20	†	†	†	†	†	†	38.5%
MD-Harford County	0	0	0	†	†	†	†	†	†	0.0%
PA-Chester County	0	0	0	†	†	†	†	†	†	0.0%
PA-Lancaster County	0	0	0	†	†	†	†	†	†	0.0%
PA-York County	0	0	0	†	†	†	†	†	†	0.0%
Total	**6**	**46**	**52**	**0**	**0**	**0**	**0**	**0**	**0**	**100.0%**

a) National Register of Historic Places

b) The projected and adjusted values are fractions because they are modified using percentages.

c) 200-ft projected corridor was adjusted to account for the actual route length, 14% adjustment for the South Corridor and 7% adjustment for the West Corridor.

d) † Calculated value between 0 and 1.

Table 9.4-8
Infrastructure (miles) within Macro-Corridors and Hypothetical Rights-of-Way

	5-Mi. Wide Corridor			Projected 200-ft Wide Right-of-Way			Adjusted 200-ft Wide Right-of-Way[(a)]			
South Corridor	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**6-Mile Vicinity**	**6-50+ Mile Region**	**Total**	**Percent**
Road/Highways	28.87	268.67	297.54	0.22	2.04	2.25	0.25	2.32	2.57	91.5%
Railroad	0.00	27.68	27.68	0.00	0.21	0.21	0.00	0.24	0.24	8.5%
Total	**28.87**	**296.35**	**325.22**	**0.22**	**2.25**	**2.46**	**0.25**	**2.55**	**2.80**	**100.0%**
West Corridor										
Road/Highways	10.01	225.00	235.00	0.08	1.70	1.78	0.08	1.83	1.91	83.3%
Railroad	0.00	47.07	47.07	0.00	0.36	0.36	0.00	0.38	0.38	16.7%
Total	**10.01**	**272.07**	**282.08**	**0.08**	**2.06**	**2.14**	**0.08**	**2.21**	**2.29**	**100.0%**

a) 200-ft projected corridor was adjusted to account for the actual route length, 14% adjustment for the South Corridor and 7% adjustment for the West Corridor.

Table 9.4-9
100-Year Floodplain (acres) within Macro-Corridors and Hypothetical Rights-of-Way

	5-Mi. Wide Corridor			Projected 200-ft Wide Right-of-Way			Adjusted 200-ft Wide Right-of-Way[(a)]			
	6-Mile Vicinity	6-50+ Mile Region	Total	6-Mile Vicinity	6-50+ Mile Region	Total	6-Mile Vicinity	6-50+ Mile Region	Total	Percent of Right-of-Way
South Corridor	30,922	88,143	119,065	234	668	902	267	760	1026	38%
West Corridor	18,392	42,104	60,496	139	319	458	150	342	492	32%

(a) 200-ft projected corridor was adjusted to account for the actual route length, 14% adjustment for the South Corridor and 7% adjustment for the West Corridor.