

**Biological Assessment
Supplement
National Marine Fisheries Service**

**PSEG Site
Early Site Permit Application
Department of the Army Permit Application**

**U.S. Nuclear Regulatory Commission Early Site Permit Application
Docket Number 52-043**

**Salem County, New Jersey
August 2015**

**U.S. Nuclear Regulatory Commission
Rockville, Maryland**

**U.S. Army Corps of Engineers
Philadelphia District**

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ABBREVIATIONS/ACRONYMS

ac	acre(s)
BMPs	best management practices
CFR	<i>Code of Federal Regulations</i>
cm	centimeter(s)
COL	combined construction permit and operating license
CP	construction permit
DPS	distinct population segment(s)
DRBC	Delaware River Basin Commission
EEP	Estuary Enhancement Program
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1973, as amended
ESP	early site permit
ft	foot (feet)
gpm	gallon(s) per minute
HCGS	Hope Creek Generating Station
km	kilometer(s)
m	meter(s)
mi	mile(s)
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NMFS	National Marine Fisheries Service
NRC	U.S. Nuclear Regulatory Commission
OL	operating license
ppt	parts per thousand
PSEG	PSEG Power, LLC, and PSEG Nuclear, LLC
RKM	River Kilometer
RM	River Mile
SGS	Salem Generating Station, Units 1 and 2
USACE	U.S. Army Corps of Engineers
WMA	Wildlife Management Area
yd ³	cubic yard(s)

1.0 INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) review team is reviewing an application submitted by PSEG Power, LLC and PSEG Nuclear, LLC (PSEG) for an early site permit (ESP) for a site located adjacent to the existing Hope Creek Generating Station (HCGS) and Salem Generating Station (SGS) Units 1 and 2 on the eastern shore of the Delaware River Estuary in Lower Alloways Creek Township, Salem County, New Jersey. As part of its review of the ESP application, the NRC is preparing an environmental impact statement (EIS) as required by Title 10 of the *Code of Federal Regulations* (CFR) Part 51—the NRC regulations that implement the National Environmental Policy Act of 1969, as amended. The EIS includes an analysis of pertinent environmental issues, including endangered and threatened species and impacts to fish and wildlife. The U.S. Army Corps of Engineers (USACE) is participating in the preparation of the EIS as a cooperating agency and as a member of the review team, which consists of the NRC staff, its contractor staff, and the USACE staff. The discussion that follows describes the ESP application and Department of the Army permit application reviews, the proposed actions by the NRC and USACE, and the activities over which the USACE has jurisdiction.

An ESP is an NRC approval of a site for one or more nuclear power facilities that resolves safety and environmental issues related to site suitability. Issuance of an ESP is a process that is separate from the issuance of a construction permit (CP) and operating license (OL) or a combined license (COL) for such a facility, which would be needed to construct and operate a nuclear power plant on a site approved by an ESP. The ESP application and review process makes it possible to evaluate and resolve safety and environmental issues related to siting before the applicant makes a large commitment of resources. If the ESP is approved, the applicant can “bank” the site for up to 20 years for future reactor siting, but may not conduct activities defined as “construction” in 10 CFR 50.10(a)(1) without applying for and receiving further authorization. To construct and operate a nuclear power plant, an ESP holder must obtain a CP and an OL, or a COL, which are separate major Federal actions that require their own environmental reviews in accordance with 10 CFR 51 (10 CFR 51-TN250). An applicant for a CP or COL for a new nuclear plant to be located at a site for which an ESP has been issued may reference the ESP, and matters resolved in the ESP proceeding are considered resolved in any subsequent proceeding absent the identification of new and significant information. For a COL application that references an ESP, the NRC staff, pursuant to 10 CFR 51.75(c)(1), would prepare a supplement to the ESP EIS in accordance with 10 CFR 51.92(e) and would engage in new consultation in accordance with section 7(c) of the Endangered Species Act of 1973, as amended (ESA) (16 USC 1531-TN1010).

The proposed actions related to the PSEG ESP application are (1) NRC issuance of an ESP for the PSEG Site (10 CFR 52-TN251) and (2) USACE permit action on a Department of the Army permit application pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act; 33 USC 1251-TN662) and Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 USC 403-TN660). The U.S. Environmental Protection Agency (EPA) has the authority to review and veto USACE decisions on Section 404 permits.

As mentioned previously, the USACE is participating as a cooperating agency with the NRC in preparing the EIS and participates collaboratively on the review team. Upon issuance of the draft EIS, PSEG submitted a Section 10/404 permit application to the USACE on August 8, 2014 (PSEG 2014-TN4235); the Department of the Army permit application number is CENAP-OP-R-2009-0157-45. The NRC and USACE prepared this biological assessment (BA) to support their joint consultation with the National Marine Fisheries Service (NMFS) in accordance

with section 7(c) of the ESA (16 USC 1531-TN1010). The USACE permit decision will be made following issuance of the final EIS and would authorize preparation of a haul road bulkhead along the shoreline, building the barge storage area and unloading facility (also referred to as the barge unloading and mooring facility in the USACE public notice [USACE 2014-TN4235]), building the proposed 5-mi causeway, and installation of the cooling water system intake and discharge structures. Therefore, only these activities, which are identified in the Department of Army permit application, are described in this assessment.

In a final rule dated October 9, 2007 (72 FR 57416, 72 FR 57432), the NRC limited the definition of “construction” to the activities that fall within its regulatory authority, as provided in 10 CFR 50.10(a)(1) and 10 CFR 51.4. Many of the site-preparation activities associated with building a nuclear power plant are not part of the NRC action to license the plant. These activities, which are not regulated by the NRC and therefore not within the purview of the NRC action, are grouped under the term “preconstruction.” Preconstruction activities include clearing and grading, excavating, erecting support buildings and transmission lines, and other associated activities. These preconstruction activities may take place before the application for an ESP, CP/OL, or COL is submitted, during its review, or after it has been granted. Although preconstruction activities are outside the NRC’s regulatory authority, many of them are within the regulatory authority of local, State, or other Federal agencies, including the USACE.

While an NRC ESP does not authorize site-preparation activities denoted as “preconstruction” under NRC regulations, USACE permits would authorize some of those site-preparation activities. Because this is a joint supplemental BA for both the NRC and USACE, the distinction between construction and preconstruction is not carried forward in this BA; both are jointly discussed using the term “site-preparation activities” when discussing effects to species that would take place under the proposed actions.

By letter dated October 26, 2010 (NRC 2010-TN2203), the NRC initiated informal ESA section 7 consultation with NMFS and requested a list of endangered, threatened, candidate, and proposed species as well as designated and proposed critical habitat that may be in the vicinity of the PSEG Site. NMFS provided the requested information for species under their jurisdiction by letter dated December 9, 2010 (NMFS 2010-TN2171). An update for endangered, threatened, candidate, and proposed species was requested on July 31, 2013 (NRC 2013-TN2805). NMFS provided updated information by letter dated October 25, 2013 (NMFS 2013-TN2804). NMFS received the draft EIS and BA and provided comments on November 12, 2014 (NMFS 2014-TN4203), and additional clarification on comments January 26, 2015 (NRC 2015-TN4209). A revised species list is presented in Table 1. This supplemental document addresses the comments received and clarified related to the following:

- clarification of activities considered for consultation regarding the PSEG ESP and the Department of the Army permit (provided earlier in this section)
- additional information regarding dredging activities (i.e., type of equipment used, duration, and in-water work restrictions)
- additional information regarding pile-driving activities (i.e., type and number of piles, duration of installation activities, noise effects to ESA species, and mitigation measures)
- additional information regarding barging activities (i.e., number and type of vessels and assessment of impacts to ESA species from PSEG barge traffic)

- clarification of cumulative impacts assessed for ESA consultation
- revision of species-specific information to include current status of the SGS/HCGS Biological Opinion.

Table 1. Endangered (E) or Threatened (T) Species under the Jurisdiction of NMFS in the Vicinity of the PSEG Site that May Be Affected by the Proposed Action

Species Name	Common Name	ESA Status
Reptiles		
<i>Caretta caretta</i>	Loggerhead sea turtle ^(a)	T
<i>Chelonia mydas</i>	Atlantic green sea turtle ^(b)	E
<i>Lepidochelys kempii</i>	Kemp's ridley sea turtle	E
Fish		
<i>Acipenser brevirostrum</i>	Shortnose Sturgeon	E
<i>Acipenser oxyrinchus oxyrinchus</i>	Atlantic Sturgeon ^(c)	
(a) Northwest Atlantic distinct population segment (DPS)		
(b) Proposed DPS for North Atlantic (T) (80 CFR 15271-TN4272)		
(c) Gulf of Maine DPS (T), New York Bight DPS (E), Chesapeake Bay DPS (E), Carolina DPS (E), and South Atlantic DPS (E)		
Source: NMFS 2014-TN4238		

Accordingly, this supplemental BA focuses on evaluating the potential effects from site-preparation activities for a new nuclear plant at the PSEG Site, adjacent to SGS and HCGS, on the Federally listed species under NMFS's jurisdiction that occur in the Delaware River Estuary. However, because an ESP does not authorize the site-preparation activities as defined under 10 CFR 50.10(a)(2) that would take place under the proposed action, the effects discussed in this BA from those site-preparation activities are regulated by the USACE and not by the NRC.

2.0 DESCRIPTION OF PROPOSED ACTION

PSEG is seeking an ESP from the NRC for a site approval for a potential new nuclear power plant at a site (the PSEG Site) located adjacent to the existing HCGS and SGS. PSEG is also seeking a Department of the Army permit from the USACE for certain site-preparation activities described below. Site-preparation activities authorized by USACE and the New Jersey Department of Environmental Protection (NJDEP) (but not an NRC ESP) that could directly affect onsite and offsite aquatic ecosystems include preparation of a haul road bulkhead along the shoreline, building the barge storage area and unloading facility (also referred to as the barge unloading and mooring facility in the USACE public notice [USACE 2014-TN4235]), building the proposed 5-mi causeway, installation of the cooling water system intake and discharge structures, dredging, installation of piles, and transport of building materials by barge to the PSEG Site. As these actions require a Department of the Army permit and are permissible, but not authorized, under an NRC ESP, they are assessed in detail below.

2.1 Site Location and Description

The PSEG Site is located on the southern part of Artificial Island in Lower Alloways Creek Township, Salem County, New Jersey. Artificial Island was formed from dredge spoils produced as a result of maintenance dredging of the Delaware River navigation channel by the USACE. The site is approximately 7 mi east of Middletown, Delaware; 7.5 mi southwest of Salem, New Jersey; and 9 mi south of Pennsville, New Jersey (PSEG 2014-TN3452). Figure 1

shows the location of the PSEG Site and the areas within a 6-mi (10-km) radius and 50-mi (80-km) radius of the facility.

The PSEG Site is located adjacent to HCGS and SGS on the northwestern portion of the existing PSEG property. Figure 2 depicts the PSEG Site in relation to the existing units and nearby water bodies. PSEG owns 734 ac of the PSEG Site and is developing an agreement with the USACE to acquire 85 ac immediately north of the site. Thus, the total PSEG Site would encompass 819 ac. Figure 3 provides aerial plan view of the proposed site layout for a new nuclear power plant at the PSEG Site.

The region within 15 mi (24 km) of the site is used primarily for agriculture. This region also includes numerous parks, wildlife refuges, and preserves (e.g., Mad Horse Creek Wildlife Management Area [WMA] to the east; Cedar Swamp State WMA to the south in Delaware; Appoquinimink, Silver Run, and Augustine State WMAs to the west in Delaware; and Supawna Meadows National Wildlife Refuge to the north) (PSEG 2014-TN3452).

2.1.1 Delaware River Estuary

The Delaware River and Delaware Bay are a part of the larger Delaware Estuary and River Basin that extends from headwaters in New York State to the coastal plains near Cape Henlopen in Delaware (PDE 2012-TN2191). The Delaware Bay extends from the confluence of the Delaware River with the Atlantic Ocean from Delaware River Mile (RM) 0 to RM 54 (River Kilometer [RKM] 0 to RKM 87). The Delaware River Estuary includes the Delaware Bay and extends up the tidal Delaware River, which is characterized by brackish water between Delaware RM 54 and RM 80 (RKM 87 and RKM 129) and becomes freshwater at Delaware RM 80 (RKM 129) (BBL and Integral 2007-TN2126). The PSEG Site near the mouth of Alloway Creek is at Delaware RM 52 (RKM 84) (DRBC 2011-TN2412) and is considered to be in the lower estuary watershed unit of the Delaware River Estuary (PDE 2012-TN2191).

The boundary of salinity intrusion in the Delaware River Estuary, also known as the salt line, fluctuates with flow changes. The salt line moves in response to the tides and variations in Delaware River Estuary freshwater discharge. During most of the year, the salt line is located between the Commodore Barry Bridge at Delaware RM 82 (RKM 132) and Reedy Island at Delaware RM 54 (RKM 87) (DRBC 2008-TN2277). Salinity measurements taken over a number of years between RM 51 and RM 49 (RKM 82 and RKM 79) report a minimum salinity of 0.1 parts per thousand (ppt) and a maximum of 17.9 ppt (PSEG 2014-TN3452).

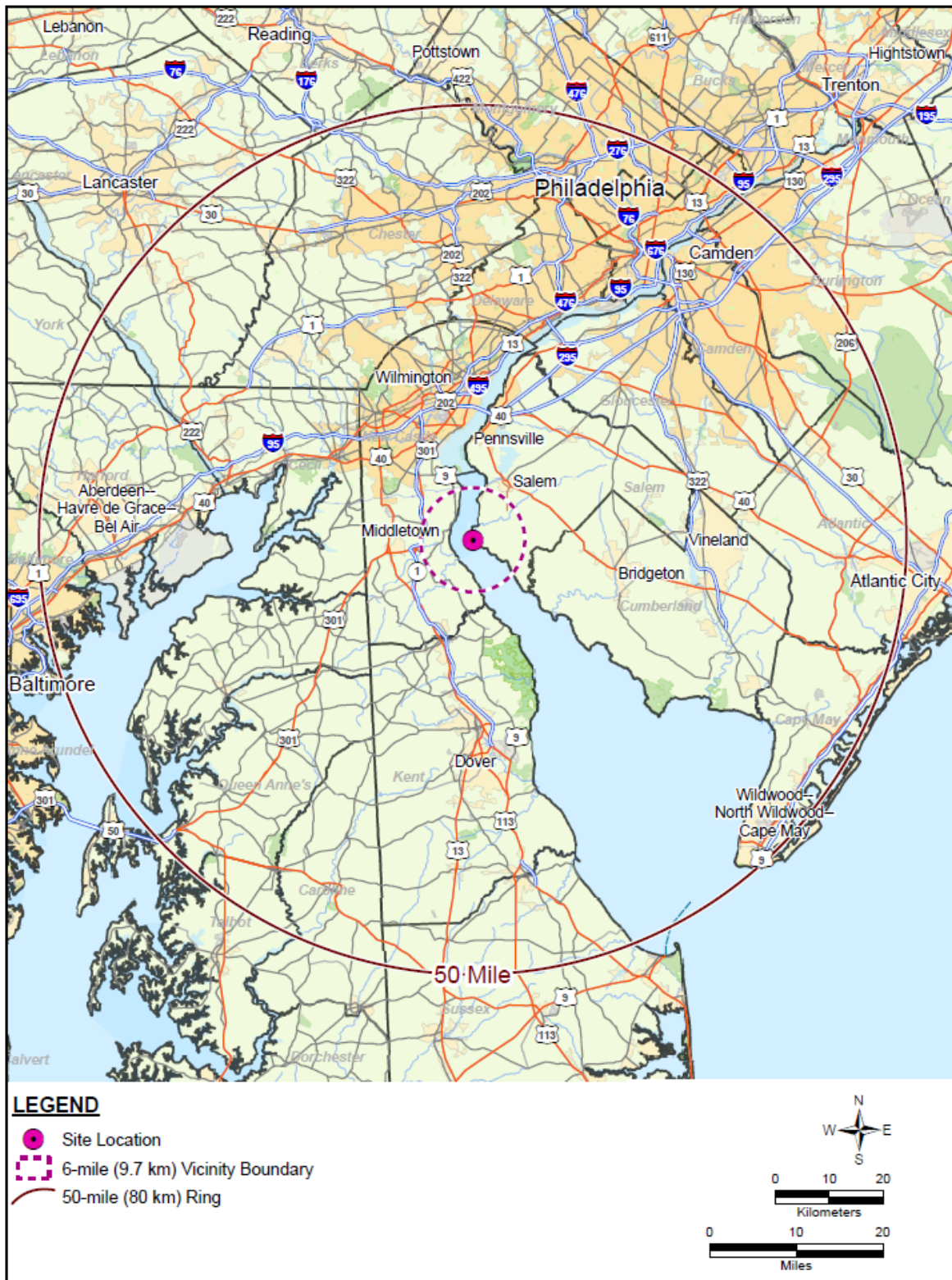


Figure 1. Location of the PSEG Site Within 6-Mile and 50-Mile Radius (Source: Modified from PSEG 2014-TN3452).

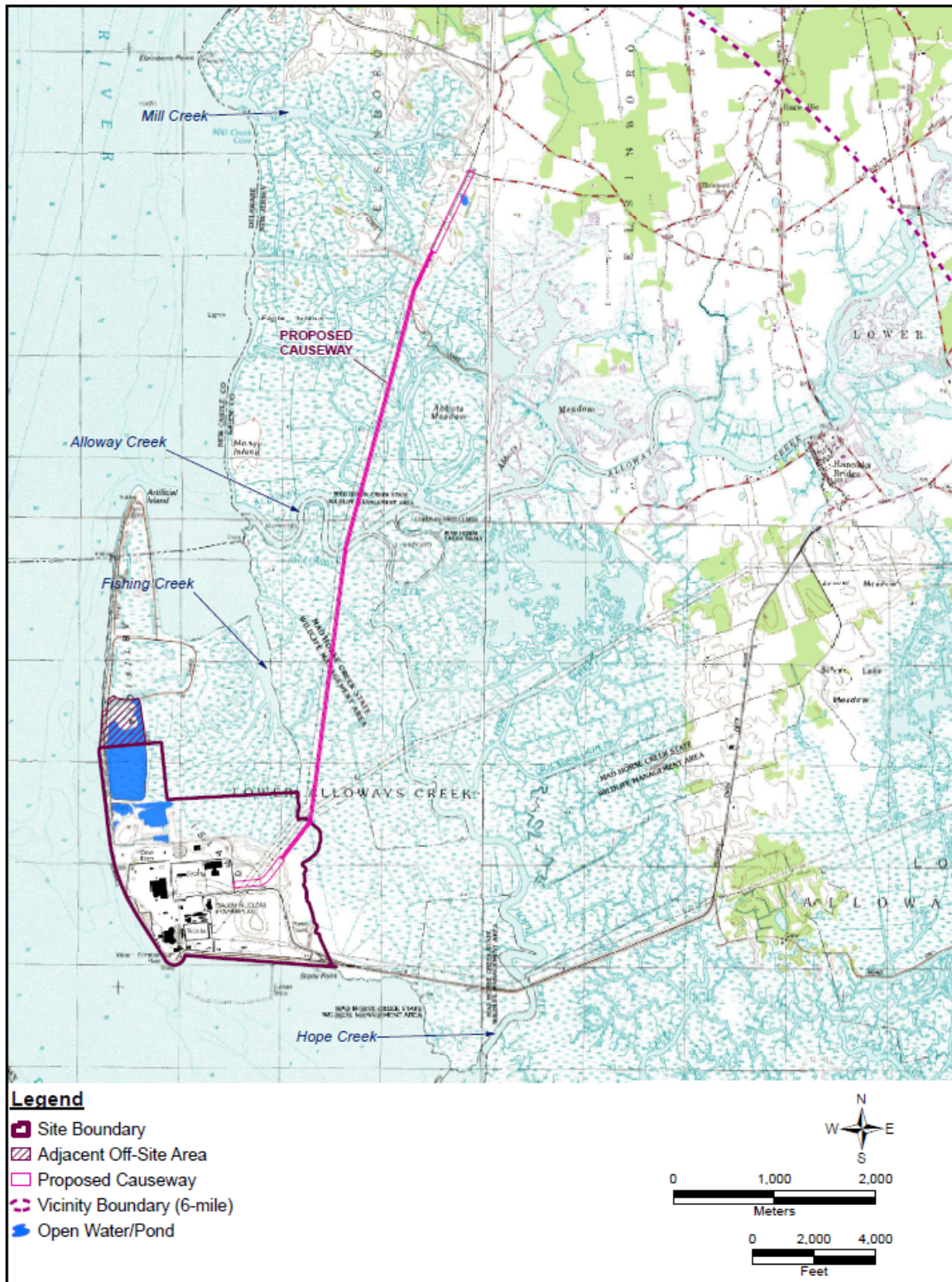


Figure 2. PSEG Site with Nearby Water Bodies and Proposed Causeway (Source: Modified from PSEG 2014-TN3452).

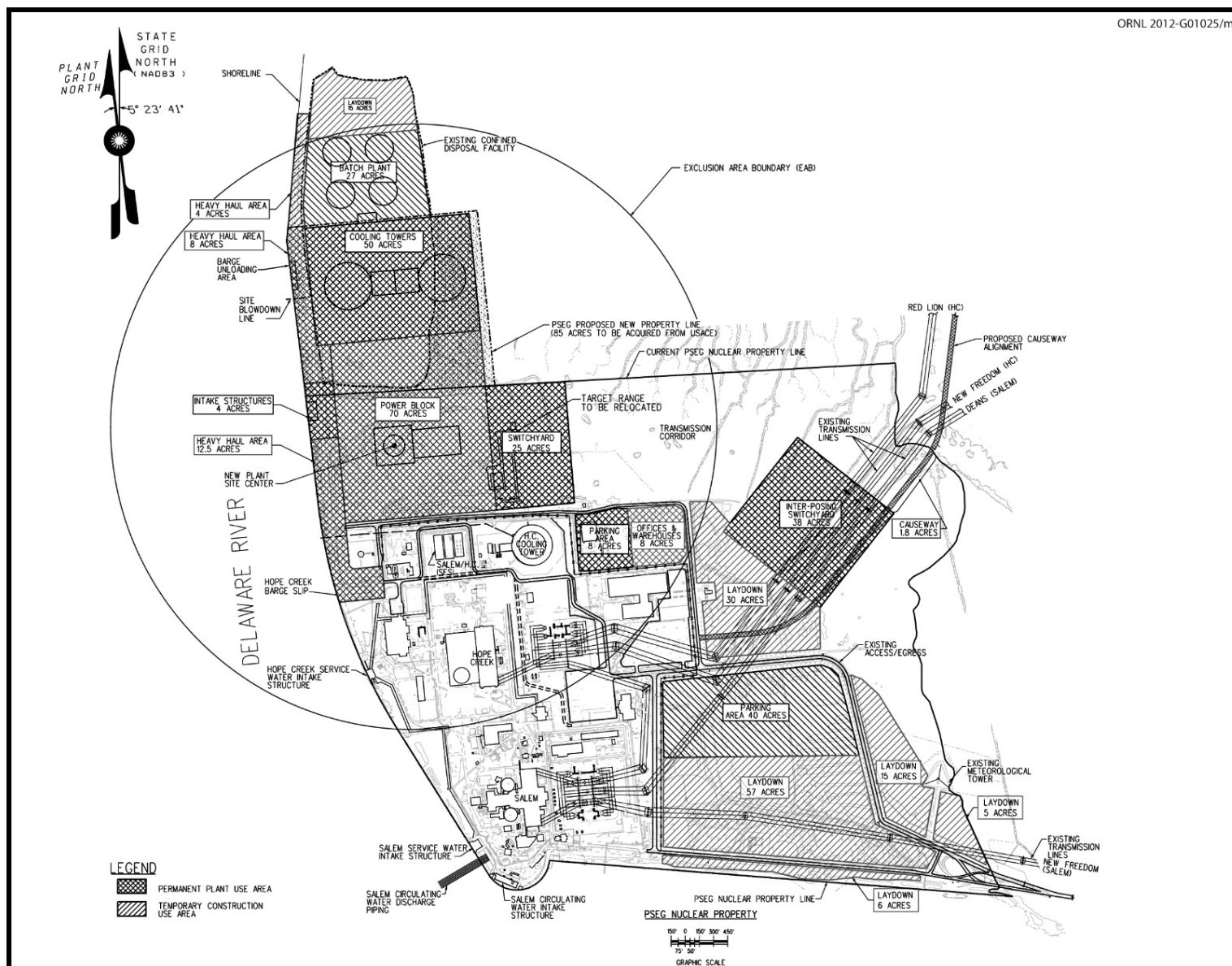


Figure 3. PSEG Site Utilization Plan (Source: PSEG 2012-TN1489).

At the PSEG Site on Artificial Island, the estuary is tidal with a net flow to the south. The USACE maintains a dredged navigation channel near the center of the estuary about 6,600 ft (2,000 m) west of the shoreline of the PSEG Site. The navigation channel is about 40 ft (12 m) deep and 1,300 ft (400 m) wide; however, starting in 2010, the USACE began implementing the Delaware River Main Channel Deepening Project to deepen the existing navigation channel from 40 to 45 ft (USACE 2011-TN2262). On the New Jersey side of the channel, water depths in the open estuary at mean low water are fairly uniform at about 20 ft (6 m). Predominant tides in the area are semi-diurnal, with a period of approximately 12 hours and a mean tidal range of 5.3 ft (1.6 m) at RM 52 (RKM 84) (PSEG 2014-TN3452).

Submerged aquatic vegetation has not historically been observed in the Delaware River Estuary primarily because of the high levels of turbidity (Miller et al. 2012-TN2686) and no submerged aquatic vegetation was observed in the sampling areas near the PSEG Site (PSEG 2014-TN3452). The Delaware River Estuary is a complex ecosystem with many species playing different roles throughout their lifecycles. Major assemblages of organisms within the estuarine community include plankton, benthic invertebrates, and fish. Detailed descriptions of these assemblages can be found in Section 2.4.2.1 of the EIS.

2.2 Dredging Activities

Before initiating any site-preparation or development activities, PSEG would be required to obtain, from the USACE, the appropriate authorizations regulating alterations to waters of the United States, including ponds and creeks. Site-preparation activities that could directly affect onsite and offsite aquatic ecosystems include installing the haul road bulkhead, building the barge storage area and unloading facility, installing the cooling water system intake and discharge structures, and building the proposed causeway (Figure 2 and Figure 3). Aquatic habitats potentially affected include habitats associated with the Delaware River Estuary and the interconnected system of tidal wetlands and marsh creeks primarily north of the PSEG Site. Potential direct impacts on aquatic resources as a result of site-preparation activities would involve physical alteration of habitat (e.g., infilling, dredging) including temporary or permanent removal of associated benthic organisms, sedimentation, changes in hydrological regimes, and changes in water quality. Potential indirect impacts would include increased runoff from impervious surfaces and subsequent erosion, as well as sedimentation (PSEG 2014-TN3452). Benthic habitats in the areas for proposed dredging consist of fine-grained sediments composed of clay, silt, and sand. Shoreline depths drop quickly to 10 to 12 ft (3.0 to 3.7 m) and then gradually increase in depth to between 15 to 25 ft (4.6 to 7.6 m) nearshore (PSEG 2014-TN3452). The depth of the areas identified for dredging is a minimum of 10 ft (3.0 m) relative to mean low water with the exception of the western boundary of Artificial Island, which is shallower than 10 ft (3.0 m) and consists of artificially placed rock. Mitigation is not warranted as there is no shallow water habitat conversion to deep water habitat (PSEG 2015-TN4234), and compensatory mitigation is generally not required where a habitat change does not occur. The nearshore benthic macroinvertebrate community and fish diversity is described in Section 2.4.2.1 of the EIS.

Shoreline-installation and site-preparation activities would require a stormwater pollution prevention plan, developed as part of the New Jersey Pollutant Discharge Elimination System (NJPDDES) stormwater permit, which would describe best management practices (BMPs) to control sedimentation and erosion and provide stormwater management. Shoreline structures would be hardened to protect from shoreline erosion using placement of concrete or riprap (PSEG 2014-TN3452). Approximately 1 ac of open water would be filled (average width of fill

would be 10 ft) due to placement of the bulkhead cap and sheeting along the bulkhead shoreline (PSEG 2014-TN4235).

The new barge storage area and unloading facility would require dredging about 440,000 yd³ of sediment to lower the river bottom by 4.5 ft over 61 ac (PSEG 2014-TN3452). An additional 0.05 ac of river bottom habitat would be removed for installation of seven 20-ft-diameter barge mooring caissons. Installation of a new intake structure would require dredging of about 225,000 yd³ of sediment to lower the river bottom by 4.5 ft over 31 ac (PSEG 2014-TN3452). Dredging, grading, and backfilling activities would be required for installation of a new discharge structure; approximately 0.2 ac of tidal waters would be affected (PSEG 2014-TN4235). As dredging will be done by one hydraulic suction dredge, dredged material disposal would be by direct pipeline to Artificial Island (PSEG 2015-TN4234). No maintenance dredging is planned under the Department of the Army permit application. In total, approximately 92 ac of open water habitat would be permanently affected by dredging, which would occur over a 2-month period (USACE 2015-TN4277).

The installation of the barge storage and unloading facilities as well as the intake and discharge structures would result in temporary disturbances to the aquatic habitat in those portions of the Delaware River Estuary. An increase in suspended sediments could occur during dredging activities; however, PSEG determined that due to the natural high turbidity of the Delaware Estuary at the project location, any increase in sedimentation would not be noticeable (PSEG 2015-TN4234). PSEG would comply with NJDEP and USACE permitting regulations regarding timing and duration of dredging to avoid sensitive aquatic life stage development or spawning (e.g., the current USACE work window to avoid dredge activities occurs between March 1 and June 30). The review team reviewed a recent report on sediment analysis for the Delaware River Basin that describes sediment samples near the PSEG Site as probably/potentially suitable for aquatic habitat restoration projects (DERSMPW 2013-TN4204). Therefore, dredging in this area near the PSEG Site is unlikely to introduce adverse exposure from sediment contaminants to nearby aquatic biota. PSEG proposes to use a hydraulic suction dredge to further minimize increases in turbidity and sedimentation, to limit the duration of dredging, and to avoid the need to handle dredged material twice (PSEG 2015-TN4234). PSEG also would use appropriate BMPs to minimize sedimentation effects as required for Federal and State permitting. Motile invertebrates, fish, and sea turtles might swim into this portion of the Delaware River Estuary, but they would be able to swim away or likely would avoid the area due to dredging activity and noise from pile driving that may occur simultaneously.

Mobile macroinvertebrates in this area might be able to occupy adjacent habitat in the Delaware River Estuary as the species composition and abundance of the macroinvertebrate community in the Delaware River Estuary near the site are similar to those of benthic communities in adjacent benthic areas of the estuary. Although permanent alteration of at least 92 ac of river bottom habitat would occur, the impacts to aquatic communities in the vicinity are expected to be minimal as benthic organisms would begin to re-colonize the area following the completion of dredging activities (Wilber and Clarke 2007-TN4271).

2.3 Pile Installation

PSEG estimated acoustic effects from representative pile-driving studies to determine pile-installation effects on aquatic biota. In-water activities included daytime installation of 24-in.-wide steel sheeting in the Delaware Estuary for the intake structure (650 sheet piles), the haul road bulkhead (2,400 sheet piles), and the barge unloading facility 20-ft-diameter caissons (1,200 sheet piles) with a vibratory hammer. Causeway installation would also occur during the

daytime, and analysis was conducted for approximately 1,000 30-in.-square concrete piles using an impact hammer with additional cushioning to reduce pile head damage (PSEG 2015-TN4234) (Table 2). PSEG used the NMFS Pile Driving Calculations spreadsheet model (CALTRANS 2013-TN4236) to calculate isopleths for the peak sound pressure level (SPL_{peak}), cumulative sound exposure level (SEL_{cum}), and behavioral root mean square sound pressure level (SPL_{rms}) using specific information on piles such as installation method, number of piles, and type of pile. For SPL_{peak} and SPL_{rms} noise isopleth estimates, the NMFS model can apply a default transmission loss of 15 m as a conservative assumption under a practical spreading loss model that considers the noise attenuation (transmission loss) when site-specific attenuation is not known (PSEG 2015-TN4234). The modeled isopleths for SEL_{cum} account for the number of pile-driving strikes per day, and the number of piles per day is provided in Table 2.

Table 2. Pile Material and Installation Information (PSEG 2015-TN4234).

Pile Information	Structure			
	Intake Structure	Haul Road Bulkhead	Barge Caissons	Causeway
Type of pile	Sheeting	Sheeting	Sheeting	Concrete
Length/number of piles	1,200 linear ft	4,500 linear ft	2,200 linear ft	1,000
Piles installed/day	120 linear ft	240 linear ft	120 linear ft	20
Duration of pile driving (days)	10	20	20	50

The criteria for fish are as follows: 206 dB re: $1\mu Pa$ SPL_{peak} , 187 dB re: $1\mu Pa^2 \cdot s$ SEL_{cum} for fish > 2 cm, 183 dB re: $1\mu Pa^2 \cdot s$ SEL_{cum} for fish < 2 cm, and 150 dB re: $1\mu Pa$ SPL_{rms} . The determination for potential onset of physical injury is determined by exceedance of both the peak pressure (SPL_{peak}) and cumulative sound exposure level (SEL_{cum}). A determination for potential behavioral effects is made using exceedance of the root mean square sound pressure level (SPL_{rms}) (CALTRANS 2013-TN4236). Distances from the pile-driving activity that exceed these criteria are presented in Table 3.

Table 3. Estimated Acoustic Area of Effect for Fish from Pile-Driving Activities (PSEG 2015-TN4234).

Acoustic Criteria	Exceedance Distance in m (ft)			
	Intake Structure	Haul Road Bulkhead	Barge Caissons	Causeway
Peak pressure (206 dB)	0	0	0	1 (3)
Cumulative sound exposure level (187 dB/183 dB)	40/74 (131/243)	40/74 (131/243)	40/74 (131/243)	216/398 (709/1,306)
Adverse behavioral effects (150 dB)	74 (243)	74 (243)	74 (243)	1,166 (3,825)

Criteria that may be used for sea turtles are as follows: onset of injury from impulsive sound (pile driving) for cetaceans is 180 dB re: $1\mu Pa$ SPL_{rms} and disruption of natural behavior from impulsive sound is 160 dB re: $1\mu Pa$ SPL_{rms} (NMFS 2015-TN4273). While these criteria may be used conservatively for sea turtles, a recent study used a 190 dB re: $1\mu Pa$ SPL_{rms} threshold for onset of injury in sea turtles (NAVSEA 2013-TN4237).

Based on the NMFS model, the 206 dB SPL_{peak} is only exceeded immediately adjacent to pile-driving activity and does not extend 1 m out except for causeway installation. The exceedance distance of 187/183 dB SEL_{cum} for fish, which is similar to 190/180 dB SPL_{rms} for sea turtles, for

the proposed causeway is 216/398 m (709/1,306 ft); however, this distance extends over mostly vegetated marsh plain and shallow marsh creeks, not open water (Figure 4).

The behavioral effects criterion of 150 dB SPL_{rms} for fish is exceeded for the causeway pile installation up to 1,166 m (3,825 ft) from the source, which is mostly vegetated marsh plain and shallow marsh creeks (PSEG 2015-TN4234). For vibratory shoreline steel sheet pile installation at Artificial Island, caisson installation, and intake installation, the behavioral effects criterion exceedance for fish extends from the source out to 74 m (243 ft) into the Delaware River (Figure 4), which could also be a conservative estimate for sea turtles (criterion of 160 dB SPL_{rms}).

As a comparison, PSEG also assessed vessel-related sounds for large container transport ships moving at 22.7 knots and smaller tugboats. Both vessel types have a small behavioral exceedance zone for fish—349 m (1,118 ft) and 10.9 m (36 ft), respectively (PSEG 2015-TN4234)—and are shown on Figure 4.

2.4 Barge Traffic

Vessel use during dredging or installation of the in-water structures and transportation of building materials and large system components to the PSEG Site may affect the aquatic resources of the Delaware River Estuary, particularly the benthos or benthic dwelling organisms (PSEG 2014-TN3452). The main impacts of using vessels would include turbulence from propellers (prop wash), collisions with aquatic species, and accidental spills of materials overboard. PSEG estimated the annual number of vessel trips for the installation activities correlated to the activities described for the Department of the Army permit to be between 247 and 357. This is an incremental increase to the reported annual average of 4,485 commercial vessel trips in the Delaware River and Estuary between 2007 and 2014 (PSEG 2015-TN4234). PSEG estimated that general construction materials shipped by barge over a 3- to 7-year period, would originate at the Ports of Camden, Philadelphia, and Salem, and use shipping routes in the Delaware Bay and River (USACE 2015-TN4281).

The NRC review team determined that vessel traffic during site-preparation activities would result in minimal disturbance to benthic habitats associated with the PSEG Site as it would occur in deeper waters associated with the installation of piles or dredging activities and should not affect the general resources in the region along this coast of the Delaware River Estuary.

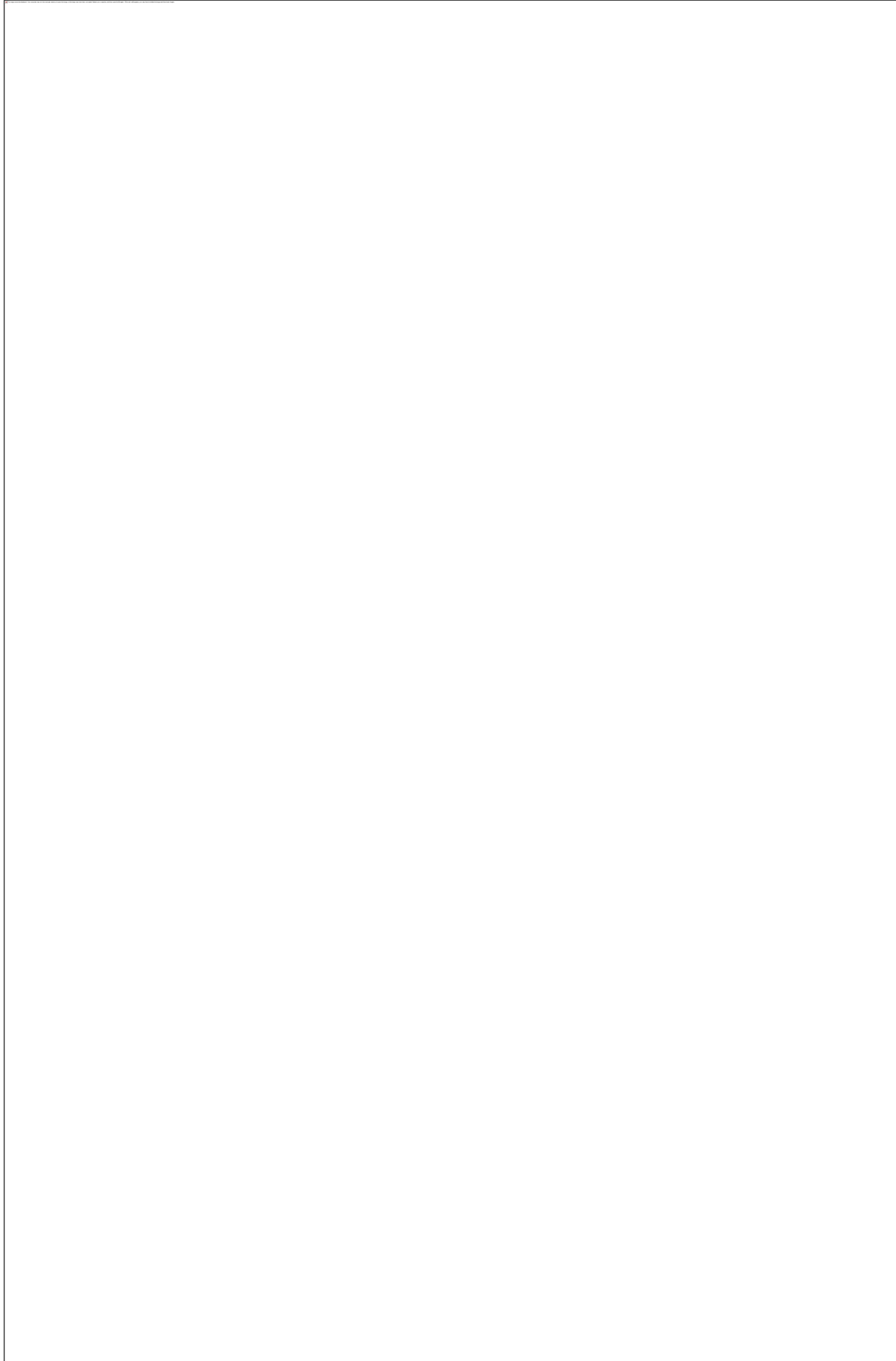


Figure 4. Acoustic Criteria Isopleths for In-Water and Nearshore Pile-Driving Activities (PSEG 2015-TN4275).

3.0 FEDERALLY LISTED SPECIES CONSIDERED

NMFS (NMFS 2010-TN2171) identified aquatic species under its jurisdiction that are Federally listed as threatened or endangered and one species (i.e., Atlantic Sturgeon [*Acipenser oxyrinchus oxyrinchus*]) that was listed as a candidate species that may occur in the Delaware River Estuary in the vicinity of a new nuclear power plant at the PSEG Site. By 2013, the Atlantic Sturgeon was updated to endangered, and an updated list of Federally protected species near the PSEG Site was provided by NMFS (NMFS 2013-TN2804). These species are listed in Table 1.

3.1 Sea Turtle Species Known to Occur Near the PSEG Site

Loggerhead sea turtles (*Caretta caretta*) are historically the most commonly observed sea turtle species in the vicinity of PSEG, and Kemp's ridley sea turtles (*Lepidochelys kempii*) are known to occur in Delaware Bay waters near the PSEG Site (Eggers 1989-TN2778). Three Atlantic green sea turtles (*Chelonia mydas*) were reported at the SGS intake between 1980 and 1992 (PSEG 2014-TN3452). More recently, two Kemp's ridley turtles were reported at the SGS intake in 2013 (PSEG 2013-TN2690; PSEG 2013-TN3137), and another two Kemp's ridley turtles at the SGS intake in 2014 (PSEG 2015-TN4262). Therefore, these three sea turtle species are considered below with regard to site-preparation effects from dredging, pile installation, and barge traffic.

3.2 Sturgeon Species Known to Occur Near the PSEG Site

The Shortnose Sturgeon (*Acipenser brevirostrum*) and the Atlantic Sturgeon are anadromous, primitive bony fish that occur in Delaware River Estuary (NMFS 2013-TN2791; NMFS 2012-TN2797). The Shortnose Sturgeon is believed to spawn earlier in the year than Atlantic Sturgeon species. Shortnose adults begin to migrate upstream to freshwater in the winter, spend most of the winter in deep waters of rivers and estuaries, and spawn between January and mid-May (Dadswell et al. 1984-TN2780). Atlantic Sturgeon adults migrate upriver later in the spring to spawn (ASSRT 2007-TN2082; Gilbert 1989-TN2149). Juveniles of both species feed on benthic insects and crustaceans, and as adults, feed on mollusks and large crustaceans (Shepherd 2006-TN2785; NMFS 2012-TN2797).

4.0 PROPOSED ACTION EFFECTS ANALYSIS

Site-preparation activities for a new nuclear power plant at the PSEG Site that would be authorized under the USACE permitting action may affect Federally listed species in the Delaware River Estuary in the following ways:

1. dredging activities associated with a new barge storage area and unloading facility and the intake structure
2. noise generated from installation of piles for building of a barge facility, causeway, shoreline haul road bulkhead, and intake structure
3. barge traffic during building activities may cause localized sedimentation and scouring, or may collide with protected species.

4.1 Dredging

PSEG proposes to use one hydraulic dredge over a 2-month period (USACE 2015-TN4277), which would serve to reduce dredging duration and handling of dredged material to limit the extent of impacts on aquatic resources (PSEG 2015-TN4234). Although use of an environmental hopper dredge may be less likely to be directly injurious to fish species, this method requires a longer work window, increases turbidity, and requires additional handling of material for disposal. Because hydraulic dredging could potentially entrain or impinge smaller sturgeon, PSEG would adhere to the seasonal in-water timing restrictions imposed by the USACE (currently March 1 through June 30) and NJDEP for dredging and other in-water work to avoid sensitive spawning or recruitment windows to minimize these effects (PSEG 2015-TN4234). PSEG did not detect any sturgeon species from fish sampling in the areas associated with the barge unloading facility and intake (i.e., between RKM 80 and 100) between 2003 and 2010 (PSEG 2014-TN3452); however, sturgeon may still migrate through this area.

Some dredging will likely coincide with pile-driving activities previously described, and thus discourage sea turtle and fish species from foraging in the immediate area (NMFS 2014-TN4239). The review team reviewed a recent report on sediment analysis for the Delaware River Basin that describes sediment samples near the PSEG Site as probably/potentially suitable for aquatic habitat restoration projects (DERSMPW 2013-TN4204). Therefore, dredging in this area near the PSEG Site is unlikely to introduce adverse exposure from sediment contaminants to nearby aquatic biota. An increase in suspended sediments could occur during dredging activities; however, PSEG determined that due to the natural high turbidity of the Delaware Estuary at the project location, any increase in sedimentation would not be noticeable (PSEG 2015-TN4234). Disruption of habitat for foraging in these areas of the Delaware River is expected to be minor and temporary, due to use of hydraulic dredge technology and compliance with USACE and NJDEP work window requirements. Sea turtles, juvenile and adult sturgeon, and their prey that may be present should be able to use adjacent unaffected habitats during dredge activities. Therefore, adverse effects to sea turtles, sturgeon, and their prey from dredging operations would be minor.

4.2 Pile Installation

Sturgeon and sea turtles may be affected by noise from installation of piles. In addition, sturgeon and some sea turtles rely on fish prey species that may also be affected by pile-installation noise. PSEG provided an analysis using criteria accepted by NMFS for estimating exceedance distances to determine cumulative sound exposure effect, and behavioral adverse effects to fish from pile-driving activities. Figure 4 shows the areas for noise effects which will occur over a period of approximately 50 days for causeway piling installation, 10 days for intake structure sheet piles, and 20 days each for shoreline and caisson sheet pile installation (See Table 2) (PSEG 2015-TN4234). While sea turtle effects were not specifically assessed, the exceedance distances provide a conservative analysis for sea turtle for injury effect and adverse behavioral effect. Given the short duration of activity and the abundance of nearby, adjacent unaffected habitat, it is likely that sturgeon, sea turtles, and their mobile prey will avoid the zones of cumulative sound and adverse behavioral effects (NMFS 2014-TN4239). Therefore, effects to sturgeon, sea turtles, and their prey from pile-driving activities would be minor.

4.3 Barge Traffic

Disruption of habitat in the Delaware River Estuary from sedimentation and scouring due to propeller wash is expected to be localized and temporary (PSEG 2014-TN3452). Sea turtles and sturgeon species likely would avoid habitats in the area of incoming and outgoing barge traffic and could find unaffected habitat nearby for foraging activities. Vessels for site preparation include bulk material delivery scow barges with a draft of 11 ft maximum and a speed of 1 to 7 knots (after leaving the Federal Navigation Channel); work vessels (e.g., barge, tugboat, and crane barges) with drafts ranging from 6 to 10.5 ft; and dredges with a maximum draft of 10 ft (PSEG 2015-TN4234). Bulk material scow barges (200 ft long by 35 ft wide) and some work craft vessels (up to 300 ft long by 50 ft wide) would be used following completion of the barge unloading facility. Dredge depths would allow for at least 2 feet of clearance at mean low water for the deepest draft vessels at the barge unloading facility and transit area (PSEG 2015-TN4234). Barges used for dredging (up to 270 ft long by 65 ft wide) in the areas for the intake and barge unloading facility would use a slow approach speed of 1 to 2 knots within 500 ft of the dredge area and would not significantly increase the overall traffic volume in the Delaware River; therefore these barges would not significantly increase the probability of sea turtle or sturgeon collisions. A recent Biological Opinion written for the Tappan Zee Bridge Replacement Project in the Hudson River concluded that vessels with a draft of less than 15 ft (e.g., construction barges and scows) reduce the likelihood of sturgeon strikes and are expected to have low vessel-related mortality (NMFS 2014-TN4239).

5.0 CUMULATIVE EFFECTS ANALYSIS

Cumulative effects, as defined in 50 CFR 402.02, are those effects of future State or private activities, not involving Federal activities, which are reasonably certain to occur within the action area. Future Federal actions are not considered in the definition of cumulative effects. Other actions in the vicinity that have reasonably foreseeable future impacts on the Delaware River Estuary include the continued operation of SGS and HCGS, continued recreational and commercial fishing, continued water use and discharge by other power-producing plants and wastewater facilities, and potential construction of a new transmission corridor and transmission line by PJM Interconnection, LLC, for grid stability. Planning and development for the new transmission corridor would avoid or span channelized waterways, perennial streams, and intermittent streams (PSEG 2014-TN3452). Development for new transmission line crossings would require BMPs to protect water quality and minimize effects to aquatic habitats that may be at risk from clearing activities, runoff, and bank erosion. An estimated 77,088 linear ft of stream habitat (S&L 2010-TN2671) is within the 5-mi-wide macro-corridor for the hypothetical transmission line discussed in Sections 7.1 and 7.3.2 of the draft EIS. The hypothetical transmission line would cross the Delaware River and would require installation of footings. Placement of footings would result in permanent benthic habitat loss, but this loss would be minimal when compared to available adjacent habitat. Installation activities would be managed through use of BMPs required for Federal and State permitting to minimize siltation and protect adjacent aquatic habitats. PSEG would consult with Federal and State agencies, as required, when an exact route is identified and installation effects to protected species can be directly assessed (PSEG 2014-TN3452).

Water quality in the region may be affected by continued withdrawal and discharge of water to support power generation. Large commercial and recreational fisheries harvest fish and invertebrates that make up the ecological community within the Delaware River Estuary.

In addition, the effects of natural environmental stressors (e.g., climate change and extreme weather events) would affect aquatic communities in the region.

Boat hull collisions and entrainment through propellers from vessel traffic in the Delaware River and Estuary are a significant source of anthropogenic sturgeon mortality. Brown and Murphy (2010-TN4274) examined the prevalence of these vessel strike mortalities between 2005 and 2008 and determined that 14 of the total 28 Atlantic Sturgeon mortalities in the Delaware Estuary had injuries consistent with vessel strike. Brown and Murphy (2010-TN4274) further concluded that any increase in mortality to Atlantic Sturgeon females may have significant effects on future population recovery of all DPS groups and recruitment due to the slow maturation rate of the species.

Each of the reasonably foreseeable future activities may influence the structure and function of estuarine food webs and result in observable changes to the aquatic resources in the Delaware River Estuary. In most cases, it is not possible to determine quantitatively the impact of individual stressors or groups of stressors on aquatic resources because they affect the region simultaneously, and their effects are cumulative.

5.1 Continued Operation of the SGS Once-Through Cooling System

Based on the assessment presented in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants—Supplement 45: Regarding Hope Creek Generating Station and Salem Nuclear Generating Station, Units 1 and 2 Final Report* (NRC 2011-TN3131), NRC staff concluded that “entrainment, impingement, and thermal discharge impacts on aquatic resources from the operation of SGS Units 1 and 2 collectively have not had a noticeable adverse effect on the balanced indigenous community of the Delaware Estuary.” However, operation of SGS Units 1 and 2 continues to impinge and entrain aquatic species and would contribute, in part, to the cumulative loss of these species in the Delaware River Estuary. Several improvements to the cooling water intake structures have been made to reduce impingement mortality at SGS. Some of these improvements included installation of modified traveling screens, installation of improved screen mesh, and modifications to spray wash nozzle configurations (PSEG 2009-TN2513). Decades of monitoring and survey data for finfish and aquatic invertebrates have been used to assess species density and richness in the vicinity of SGS as directed under NJPDES permits starting in 1994 and in subsequent renewals (PSEG 2014-TN3452). Impingement, entrainment, and fish assemblage sampling by trawling and seining are conducted each year, in accordance with NJPDES permit requirements for biological monitoring. The reporting emphasis is on targeted representative important species that include Blueback Herring (*Alosa aestivalis*), Alewife (*A. pseudoharengus*), American Shad (*A. sapidissima*), Atlantic Menhaden (*Brevoortia tyrannus*), Bay Anchovy (*Anchoa mitchilli*), Atlantic Silverside (*Menidia menidia*), White Perch (*Morone americana*), Striped Bass (*M. saxatilis*), Bluefish (*Pomatomus saltatrix*), Weakfish (*Cynoscion regalis*), Spot (*Leiostomus xanthurus*), and Atlantic Croaker (*Micropogonias undulatus*) (PSEG 2014-TN3452). All of these representative important species are considered either recreationally or commercially important or are ecologically important as forage fish for sustainability of the ecosystem within the Delaware River Estuary. They are discussed in more detail in Section 2.4.2.3 of the EIS. Although individual species abundances change year to year, the overall trends in community abundances and diversity show no significant changes (PSEG 2014-TN3452).

5.2 Continued Operation of the HCGS Closed-Cycle Cooling System

HCGS uses closed-cycle cooling and therefore requires substantially less water volume for cooling operations (i.e., a maximum of 66,000 gpm from the Delaware River Estuary).

Accordingly, effects on the aquatic community through impingement, entrainment, and discharge also are expected to be reduced when compared with the once-through cooling system at SGS (NRC 2011-TN3131). Impingement studies at HCGS were performed only in 1986 and 1987 at the commencement of operation for the single unit and showed a reduced overall impingement rate when compared to SGS (see EIS Section 5.3.2). Because HCGS was operating concurrently with SGS, the NJPDES permit-directed biological monitoring of the aquatic community through trawling and seining studies also reflected the combined effect of both HCGS and SGS operations. Therefore, the conclusions regarding the effect of continued operation of SGS also apply to HCGS in that the overall species diversity and community abundances near the PSEG Site are expected to continue to show no noticeable effects from operations (NRC 2011-TN3131).

5.3 SGS and HCGS Effects on Protected Species

Coordination pursuant to section 7 of the ESA regarding the nearby SGS and HCGS has been ongoing between the NRC and NMFS since 1979. In 1980, NMFS issued a Biological Opinion that concluded that the continued operation of these facilities was not likely to jeopardize the Shortnose Sturgeon and set a take limit of up to 11 Shortnose Sturgeon per year at SGS. Sea turtles were not included in the 1980 Biological Opinion.

The NRC reinitiated consultation on August 19, 1988, because SGS had impinged a number of sea turtles. NMFS issued a revised Biological Opinion on January 2, 1991, to include sea turtles. In this Biological Opinion, NMFS concluded that continued operation of SGS and HCGS would affect sea turtles but would not jeopardize the continued existence of any populations of threatened or endangered species. The 1991 Biological Opinion also reduced the number of allowable Shortnose Sturgeon takes based on actual levels of impingement at SGS and HCGS up to that point.

NMFS modified the 1991 Biological Opinion on August 4, 1992, to increase the total allowable take limit for loggerheads and Shortnose Sturgeon. However, between June and October 1992, SGS and HCGS exceeded their take limit for Kemp's ridley mortalities and met their take limit for Shortnose Sturgeon mortalities. NMFS issued another Biological Opinion on May 14, 1993 (PSEG 1999-TN2787), which did not change the take limits of listed species but specified that SGS and HCGS should develop a research program using mark/recapture to determine whether SGS has features that attract sea turtles. Also in 1993, PSEG implemented a policy of removing the ice barriers from the trash racks on the intake structure between May 1 and October 24, which resulted in substantially lower turtle impingement rates at SGS.

The NRC reinitiated section 7 consultation in 1998 to remove the study requirement from the SGS and HCGS Incidental Take Statement. The NRC cited the change in PSEG procedure regarding removal of ice barriers during the spring and summer. In response, NMFS issued a revised Biological Opinion on January 21, 1999, that removed the study requirement and decreased the number of annual allowable takes of Shortnose Sturgeon from 10 individuals to 5 individuals based on the review of Shortnose Sturgeon capture rates at SGS and HCGS. The Biological Opinion also formalized ice barrier removal from May 1 through October 24 by making it a requirement in the "Terms and Conditions" section of the Biological Opinion. To implement the 1999 Biological Opinion, PSEG developed associated guidance documents, *Biological Opinion Compliance* and *Species Management* (PSEG 1999-TN2787).

NMFS issued a new Biological Opinion in 2014 for the continued operation of SGS and HCGS under the terms of the facilities' renewed licenses (NMFS 2014-TN4238). The 2014 Biological

Opinion allows for the incidental take of all five DPSs of Atlantic Sturgeon at SGS Units 1 and 2 trash bars and intake screens and revises incidental take limits for sea turtles and Shortnose Sturgeon (Table 4).

Table 4. SGS Incidental Take Statement Exemption (NMFS 2014-TN4238)

Species	Incidental Take Combined for SGS Units 1 and 2^(a)
Loggerhead sea turtle ^(b)	9 (2 dead)
Green sea turtle ^(b)	1 at either SGS Unit 1 or 2 (alive or dead)
Kemp's ridley sea turtle ^(b)	4 (3 dead)
Shortnose Sturgeon ^(b)	26 (22 dead, 11 due to impingement)
Atlantic Sturgeon ^(c)	
(at trash bars)	200 (61 dead, 18 due to impingement)
(at traveling screens)	300 (26 injury or mortality)

(a) For the life of the renewed license for both SGS Unit 1 and 2
(b) At trash bars only
(c) All ages and DPSs combined, see NMFS 2014-TN4238 for specific information

The "Terms and Conditions" section of the Biological Opinion requires PSEG to report all incidental takes to NMFS within 30 days of the take and to include appropriate documentation in the report. In addition, the "Terms and Conditions" section details a number of requirements for sea turtle resuscitation, live sea turtle inspection, dead sea turtle necropsy reports, and sturgeon tagging and inspection.

Between 1992 and 2001, 16 loggerhead turtles were stranded at SGS (NRC 2010-TN2811). No loggerhead turtles have been impinged since 2001 (NMFS 2014-TN4238). Only two Atlantic green turtles have been captured at SGS since it began operations—one in 1991 (alive) and one in 1992 (dead) (NMFS 2014-TN4238). In 1992, two live and two dead Kemp's ridley sea turtles were found at the SGS cooling water intake; the cause of mortality was not reported (PSEG 1992-TN3173). In 1993, a live Kemp's ridley sea turtle was found at the SGS cooling water intake (PSEG 1999-TN2787). Implementation of mitigation measures in 1993 reduced the likelihood of additional turtle strandings; however, two Kemp's ridley turtles were stranded at SGS in 2013 (PSEG 2013-TN2690; PSEG 2013-TN3137) and two more in 2014 (PSEG 2015-TN4262). Table 5 summarizes incidental takes of sea turtle and sturgeon species at SGS between 2000 and 2015.

Table 5. SGS Incidental Takes of Sea Turtle Species and Sturgeon Species Between 2000 and 2015^(a)

Species	Year	Number of Takes	Condition^(b)
Sea turtle			
Loggerhead	2000	2	1 live, 1 dead
	2001	1	dead
Kemp's ridley	2013	2	1 live, 1 dead
	2014	2	2 dead
Sturgeon			
Shortnose	2000	1	dead
	2003	1	dead
	2004	1	dead
	2007	1	dead
	2008	1	dead

Atlantic ^(c)	2011	2	2 dead
	2012	1	live
	2013	4	2 live, 2 dead
	2014	6	4 live, 2 dead
	2012	2	1 live, 1 dead
	2013	18	12 live, 6 dead
	2014	18	10 live, 8 dead
	2015 ^(d)	1	live

(a) References provided in text.

(b) Found alive or dead in intake area; counted as dead if found live but died shortly afterward.

(c) Atlantic Sturgeon reported at SGS between 2012 and 2014.

(d) Total impingement reported for January 1 through May 31, 2015.

Since 2000, 7 live and 11 dead Shortnose Sturgeon have been collected on SGS intake structures (PSEG 2000-TN3150; PSEG 2003-TN3149; PSEG 2004-TN3144; PSEG 2007-TN3148; PSEG 2008-TN3147; PSEG 2011-TN3146; PSEG 2011-TN3365; PSEG 2013-TN2707; PSEG 2013-TN2691; PSEG 2013-TN2692; PSEG 2013-TN2695; PSEG 2013-TN2704; PSEG 2014-TN4246; PSEG 2014-TN4253; PSEG 2014-TN4254; PSEG 2014-TN4255; PSEG 2014-TN4256; PSEG 2014-TN4257; PSEG 2014-TN4260).

Atlantic Sturgeon were not reported at the SGS intake screens until after this species was considered for listing as a Federally endangered species, and are reported here since 2012. NMFS revised the Biological Opinion in 2014 to include Atlantic Sturgeon (NMFS 2014-TN4238), with the New York Bight DPS being the majority of the take over the license period for SGS Units 1 and 2, although there may be incidental take of the other four DPSs. Between 2012 and May 31, 2015, 24 live and 15 dead Atlantic Sturgeon were reported at the SGS intake system (PSEG 2012-TN3143; PSEG 2012-TN3142; PSEG 2013-TN2693; PSEG 2013-TN2694; PSEG 2013-TN2696; PSEG 2013-TN2697; PSEG 2013-TN2698; PSEG 2013-TN2699; PSEG 2013-TN2700; PSEG 2013-TN2701; PSEG 2013-TN2702; PSEG 2013-TN2703; PSEG 2013-TN2705; PSEG 2013-TN3138; PSEG 2013-TN3139; PSEG 2013-TN3140; PSEG 2013-TN3141; PSEG 2013-TN3198; PSEG 2014-TN4240; PSEG 2014-TN4241; PSEG 2014-TN4242; PSEG 2014-TN4243; PSEG 2014-TN4244; PSEG 2014-TN4245; PSEG 2014-TN4247; PSEG 2014-TN4248; PSEG 2014-TN4249; PSEG 2014-TN4250; PSEG 2014-TN4251; PSEG 2015-TN4258; PSEG 2015-TN4261).

5.4 Commercial and Recreational Harvest of Fish and Shellfish

The Delaware River Estuary supports a diverse commercial and recreational fishery for finfish and invertebrates. Losses to the ecosystem from fishery harvest are managed at the Federal and State levels through catch limits, regulations on fishing gear, and seasonal closures. Unintended harvest or mortality is another source of loss through bycatch while targeting a different species. These activities have the potential to contribute to cumulative effects on aquatic species in the Delaware River Estuary. However, the direct contribution is difficult to assess because many of these fish populations have life histories that involve a large migratory territory offshore and along the Atlantic coast of the United States, and therefore, effects to populations are difficult to directly attribute to Delaware River Estuary habitat effects.

5.5 Habitat Loss and Restoration

Future land-use development for industry, agriculture, or other habitat alterations in the Delaware River Estuary watershed may affect water quality. These types of activities may also

result in shoreline habitat loss. While aquatic habitats continue to be affected by natural and anthropogenic activities in the Delaware River Estuary, efforts to restore salt marsh and estuary habitat have met with some success and are expected to continue in the future. For example, ongoing restoration activities within the Mad Horse Creek WMA, located 4 mi east of the PSEG Site, would restore nearly 200 ac of the Mad Horse Creek WMA to address injuries to shoreline and bird resources resulting from the 2004 *Athos I* oil spill (NOAA 2008-TN2721). NJDEP and the National Oceanic and Atmospheric Administration proposed a tidal wetland restoration project that would allow development of smooth cordgrass (*Spartina alterniflora*) habitat to improve habitat quality in the area. Restoration would be accomplished through fill material removal to lower the marsh elevation and allow tidal inundation (PSEG 2014-TN3452). As described in EIS Section 4.3.1, unavoidable impacts to wetlands during site-preparation activities at the PSEG Site and the proposed causeway would be mitigated by habitat restoration and enhancement, using experience and proven techniques developed by the PSEG Estuary Enhancement Program (EEP). Sensitive species that utilize such marsh habitats would be affected positively by the proposed Mad Horse Creek WMA restoration effort and by the proposed mitigation for a new nuclear power plant at the PSEG Site and causeway (i.e., restoration of low quality marsh habitats) (PSEG 2014-TN3452).

5.6 Climate Change

The potential impacts of climate change on aquatic organisms and habitat in the geographic area of interest are not precisely known. In addition to rising sea levels, climate change could lead to regional increases in the frequency and intensity of extreme precipitation events, increases in annual precipitation, and increases in average temperature (GCRP 2014-TN3472). Such changes in climate could alter aquatic community composition on or near the PSEG Site through changes in species diversity, abundance, and distribution. In 2012, Hurricane Sandy created increased storm surge during this event within the Delaware River Estuary and had moderate effects on water quality and coastal habitats within the southernmost portion of the Delaware River Estuary through erosion, sedimentation, and resuspension of contaminants within sediments (ALS 2012-TN2720). Elevated water temperatures, droughts, and severe weather phenomena could adversely affect or severely reduce aquatic habitat; however, specific predictions on aquatic habitat changes in this region due to climate change are inconclusive at this time. The level of impact resulting from these events would depend on the intensity of the perturbation and the resiliency of the aquatic communities. The Delaware River Basin Commission (DRBC) stated in the State of the Delaware River Basin report for 2013 that increases in temperature and salinity are expected with future sea level rise and climate change (DRBC 2013-TN2609). These potential changes are likely to result in movement of populations of more marine and euryhaline species farther up the Delaware River Estuary. For example, in a recent report, hard bottom areas north and south of the Chesapeake and Delaware Canal (upriver of the PSEG Site) were identified as having potential as reef sites for the establishment of new oyster beds and were discussed as a future conservation target due to changing climate conditions resulting in increases in salinity farther upriver (PDE 2011-TN2190).

5.7 Summary of Cumulative Effects

Aquatic resources of the Delaware River Estuary will be cumulatively affected to varying degrees by multiple activities and processes that are likely to occur in the future. The food web and the abundance of important aquatic forage species and other species may be affected by these stressors associated with human activities, but can be addressed by management actions (e.g., cooling system operation, regulation of fishing pressure, water quality improvements, and habitat restoration).

Other stressors, such as climate change and increased human population and associated development in the Delaware River Basin, cannot be directly managed, and their effects are more difficult to quantify and predict. It is likely, however, that future anthropogenic and natural environmental stressors would cumulatively affect the aquatic community of the Delaware River Estuary sufficiently that they would noticeably alter important attributes, such as species ranges, populations, diversity, habitats, and ecosystem processes, just as they have in the past. These stressors have modified important attributes of aquatic resources and would continue to exert an influence in the future, potentially destabilizing some of the attributes of the aquatic ecosystem. Based on these observations, the review team concludes that cumulative effects may be noticeable for some aquatic resources, primarily based on future use and climate change affecting aquatic resources in the Delaware Estuary and River Basin.

Cumulative effects on aquatic ecology resources are estimated based on the information provided by PSEG, NMFS, and the review team's independent review. Future operation of SGS and HCGS will continue to have effects on the aquatic resources in the Delaware River Estuary; however, the PSEG EEP as a form of mitigation may reduce the overall impacts to the aquatic ecosystems in the area. The review team concludes that the incremental contribution of the site-preparation activities for the PSEG Site would be negligible.

6.0 CONCLUSION AND DETERMINATION OF EFFECTS

Site-preparation activities associated with dredging, pile installation, and barge traffic may temporarily affect ESA protected species and their prey species in the immediate vicinity of those activities. These activities would be permissible under Department of the Army and NJDEP authorizations, but would not be authorized under an NRC ESP. Installation of cooling water intake structures, barge storage area and unloading facility, shoreline haul road bulkhead, and a 5-mi causeway may cause increased siltation and disturbance of benthic habitats, and produce intermittent noise from installation activities that could affect protected species and their prey. In addition, there will be an increase in barge vessel use and traffic in the area of these site-preparation activities. However, Federal and State permitting requires BMPs associated with minimization practices (e.g., restricted activity windows and dredge technologies) that minimize the potential for adverse impacts to protected species.

Dredging and installation of barge unloading facility, shoreline bulkhead for a haul road, and intake structures would be permissible under a Department of the Army and NJDEP authorization, but not authorized under an NRC ESP, and would occur in a portion of the Delaware River Estuary that is used by sea turtles and anadromous fish. Installation activities are expected to be temporary and localized, and any increase in siltation would be negligible given the high turbidity in these areas. The presence of any of the species described in this document within the installation area may occur, although these species should be able to migrate around the dredge areas and forage in adjacent, unaffected habitat.

Noise effects from pile-driving activities may induce behavioral modifications that deter sea turtles and sturgeon from migrating or foraging in the areas affected by pile-driving activities (NMFS 2014-TN4239). However, the duration of pile installation will be brief and PSEG would comply with USACE and NJDEP requirements to avoid work during seasons deemed critical for protected species (PSEG 2015-TN4234).

Any increase in barge traffic and use for site-preparation activities is not expected to be noticeable given the annual barge traffic reported for the Delaware Estuary. In addition, vessels

approaching the in-water work areas or PSEG barge unloading facility would have slower approach speeds of 1 to 2 knots within 500 ft of these areas (PSEG 2015-TN4234).

The review team has determined that site-preparation activities for a new nuclear power plant at the PSEG Site as described herein and included in Department of the Army permit application number CENAP-OP-R-2009-0157-45 may affect, but are not likely to adversely affect, Atlantic Sturgeon from the New York Bight, Gulf of Maine, Chesapeake Bay, South Atlantic, and Carolina DPSs; Shortnose Sturgeon; the Northwest Atlantic DPS of loggerhead sea turtles; green sea turtle; and Kemp's ridley sea turtle.

7.0 REFERENCES

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