

March 29, 2005

Ms. Patricia Kurkul
NOAA Fisheries Northeast Region
Regional Administrator
One Blackburn Drive
Gloucester, MA 01930

SUBJECT: BIOLOGICAL ASSESSMENT FOR THE REINITIATION OF A FORMAL
CONSULTATION FOR CONTINUED OPERATION OF THE OYSTER CREEK
NUCLEAR GENERATING STATION (TAC MC4079)

Dear Ms. Kurkul:

The U.S. Nuclear Regulatory Commission (NRC) has prepared the enclosed Biological Assessment (BA) to reinitiate formal consultation, under Section 7 of the Endangered Species Act, regarding the continued operation of the Oyster Creek Nuclear Generating Station (OCNGS). In your July 18, 2001, Biological Opinion (BO), the current Incidental Take Statement (ITS), as amended by letter dated August 29, 2001, authorizes the annual take of five loggerheads (no more than two lethal), four Kemp's ridleys (no more than three lethal), and two greens (no more than one lethal) for the continued operation of OCNGS. In 2004, eight incidental takes (only three lethal) of Kemp's ridley turtles occurred at OCNGS. Because the take level authorized by the ITS was exceeded, the NRC is requesting a reinitiation of formal consultation with the submission of the enclosed BA.

As part of this reinitiation of consultation, the NRC requests a revision to the 2001 ITS. The staff believes that the increase in takes is a result of modifications to the Barnegat Bay Inlet and increases in turtle population, not changes in plant design or operating procedures. The NRC believes that this trend of increasing takes will continue. The NRC is requesting that there be no restriction on the total number of takes for any species of sea turtle and that the station have limits only on the number of lethal takes causally related to plant operation. Data on all turtles taken would continue to be collected, and all live specimens would continue to be appropriately returned to the wild. The staff also proposes that the licensee be required to perform a preliminary necropsy on all lethal takes. Past difficulties in the preparation, storage, and shipping of moribund turtles have resulted in the loss of valuable data on the possible causes of death.

Five nuclear power sites on the east coast have historically recorded incidental takes of Federally-protected species of sea turtles. The NRC staff would like to work with NOAA Fisheries and the licensees to explore the possibility of developing a consistent set of terms and conditions and an ITS that would be applicable to all nuclear power plant sites. We expect that this would provide consistency in the requirements and data collected, and reduce the frequency of reinitiating formal consultations due to fluctuations in sea turtle populations. The suggestions for the OCNGS ITS contained in the enclosed BA reflect our attempt to define such a standard. The NRC would like to meet with NOAA Fisheries to discuss the terms and conditions of a revised ITS as such requirements will become part of the OCNGS operating license. As sea turtle season begins on June 1st, the NRC aims to work with NOAA Fisheries to have a new ITS in place for OCNGS by early summer.

P. Kurkul

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If you have any questions regarding this BA or the staff's request, please contact Ms. Harriet Nash of the Environmental Section, at 301-415-4100 or by e-mail at hln@nrc.gov, or Dr. Michael Masnik, the NRC Senior Environmental Project Manager, at 301-415-1191 or by e-mail at mtm2@nrc.gov.

Sincerely,
/RA/

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Docket No.: 50-219

Enclosure: As stated

cc w/encl.: See next page

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-2-

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1. Letter to P. Kurkul w/Svc. List, Biological Assessment (BA): **ML050900162**

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Biological Assessment

**Oyster Creek Nuclear
Generating Station
Sea Turtle Impact Assessment**

Ocean County, New Jersey

March 2005

Docket No. 50-219

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

1.0 Summary and Conclusions

This Biological Assessment (BA) was prepared in support of reinitiating a formal consultation between the United States (U.S.) Nuclear Regulatory Commission (NRC) and National Oceanic and Atmospheric Administration (NOAA) Fisheries in compliance with Section 7 of the Endangered Species Act (ESA). The purpose of this BA is to examine the potential impacts associated with the continued operation of the Oyster Creek Nuclear Generating Station (OCNGS) on protected sea turtle species, and to support the NRC's August 26, 2004 request to NOAA Fisheries for reinitiation of formal Section 7 consultation on sea turtle takes at the OCNGS. The fifth incidental take of a Kemp's ridley turtle (*Lepidochelys kempii*) at the OCNGS on August 7, 2004 prompted the reinitiation. As a result of that event, the OCNGS exceeded the Incidental Take Statement (ITS) annual limit for that species.

The OCNGS is located along the western shore of Barnegat Bay between the South Branch of Forked River and Oyster Creek, in Ocean County, New Jersey. Monthly mean salinity values observed in western Barnegat Bay near the OCNGS vary seasonally from approximately 18.5 parts per thousand (ppt) to over 28 ppt. Monthly mean ambient water temperatures in this portion of the Bay range from a winter mean of 1EC (33.8EF) to approximately 28EC (82.4EF) during the summer (Kennish and Lutz, 1984).

The OCNGS consists of a single boiling water nuclear reactor with an electrical capacity of approximately 650 megawatts. When the OCNGS is in operation, water flows from Barnegat Bay into Forked River and the OCNGS, where the flow is used to cool the power plant. Heated water discharged from the OCNGS site flows eastward in Oyster Creek back into Barnegat Bay.

The OCNGS has two water intake structures, the circulating water system (CWS) intake and the dilution water system (DWS) intake. During normal operation, the circulating water system moves approximately 1,740 cubic meters per minute (m³/min) (0.46 million gallons per minute [gpm]) of water through the main condensers for cooling purposes. Additionally, up to two dilution pumps (each with a 984-m³/min or 0.26-million gpm capacity) divert water from the intake canal to the discharge canal to reduce the temperature of the circulating water discharge (Kennish, 1978). Both intakes utilize trash bars to remove debris from the water. The CWS intake also has vertical traveling screens which have been modified with Ristroph fish buckets and a fish return system to minimize the effects of impingement.

Five species of sea turtles have been reported from coastal New Jersey waters. These sea turtle species are loggerhead turtle (*Caretta caretta*), Kemp's ridley turtle, Atlantic green turtle (*Chelonia mydas*), leatherback turtle (*Dermochelys coriacea*), and hawksbill turtle (*Eretmochelys imbricata*). Three of these sea turtles species, Kemp's ridley, leatherback, and hawksbill, are listed as endangered. The loggerhead is listed as threatened. Atlantic green turtles in U.S. waters are listed as threatened except for the Florida breeding population that is listed as endangered. Due to the inability to distinguish between the two Atlantic green turtle populations away from the nesting beaches, Atlantic green turtles are considered endangered wherever they occur in U.S. waters (NOAA Fisheries 2004). Only the loggerhead, Kemp's ridley, and Atlantic green turtles have been captured at the OCNGS.

The loggerhead turtle is the most common sea turtle in the coastal waters of the U.S. and occurs in many other locations throughout the world. The adult female population in the Atlantic is estimated to be 44,780 (Turtle Expert Working Group 2000). The loggerhead population in the southeast is threatened by reductions in nesting and foraging habitats due to the continued development of coastal areas and losses resulting from incidental capture in shrimp trawls. An estimated 5,000 to 50,000 turtles have been lost annually from trawling without the use of turtle excluder devices (TEDs) (NMFS 1991a). As a result of the implementation of NOAA Fisheries regulations requiring the use of TEDs, and efforts to protect nesting beaches, the U.S. loggerhead population is widely believed to be increasing (Turtle Expert Working Group 2000).

The Kemp's ridley is the most endangered sea turtle species worldwide. A single colony, with almost all members nesting near Rancho Nuevo, Mexico, essentially represents the world population for this species. The population was estimated at less than 1,000 nesting females based on data from the early to mid 1990s (Caribbean Conservation Organization 2003b). The Kemp's ridley population is also impacted by coastal development, poaching, and shrimp trawling. Incidental take by the shrimp industry has been identified as the largest source of mortality (between 500 and 5,000 killed annually) for *Lepidochelys kempii* (Magnuson et al. 1990). However, subsequent to nest protection efforts and the implementation of the NOAA Fisheries TED regulations in 1989, significant increases in nesting activity have been observed, and the population appears to be increasing rapidly (Crouse et al. 1992; Turtle Expert Working Group 1998; Turtle Expert Working Group 2000; Marquez et al. 2001). More than 6,436 and 8,288 nests were laid in Mexico in 2002 and 2003, respectively, representing a significant increase from the 1985 low of only 702 nests (USFWS 2003).

For green turtles, the breeding populations off Florida and Mexico's Pacific coast are endangered while all other populations are threatened. Although population data are scarce, the best available abundance estimates indicate that there are 200 to 1100 nesting females on U.S. beaches (NOAA Fisheries 2005a). The biggest threats to green turtle populations are incidental catch in shrimp trawls as well as commercial harvests for eggs and meat. In the 1990s, increasing trends have been observed in the nesting populations in Florida and Costa Rica (NOAA Fisheries 2003).

Leatherback turtles have been endangered for about 35 years. Current estimates indicate there are 20,000 to 30,000 nesting female leatherbacks worldwide (NOAA Fisheries 2005c). While the status of the entire Atlantic population is unknown, it appears that the nesting population in the Atlantic and Caribbean is stable. Commercial fisheries, habitat destruction, egg and meat harvest, boat collisions, and marine pollution appear to be the biggest threats to leatherback populations in the U.S. Unfortunately, the TED regulations do not protect many leatherbacks; due to their large size, leatherbacks cannot fit through the openings of most TEDs.

Like the leatherback, the hawksbill turtle has been listed as endangered for about 25 years as well. While hawksbills are most common in Puerto Rico and the U.S. Virgin Islands, sightings have been reported in all east coast states, except Connecticut, as far north as Maine (NOAA Fisheries 2005b). Because hawksbills are solitary nesters, population estimates are unreliable, but based on nesting data from the 1990s, Meylan (1999) calculated an order-of-magnitude population estimate for the Caribbean region to be 5000 adult females. Available trends indicate that hawksbill populations are declining in most areas of the Caribbean, with the exceptions of increasing populations that nest on Mona Island, Puerto Rico and in parts of

Mexico (Meylan, 1999). Commercial exploitation, especially for the shell and eggs, is a major cause, in addition to marine debris, of decline for hawksbill populations.

Sea turtles have been observed and incidentally captured at the OCNGS from 1992 through 2004, but were never captured during more than 10 years of field sampling associated with the station, which began sampling in 1975. Their scarcity in Barnegat Bay is largely attributable to the fact that access to the bay is extremely limited. The only direct access to Barnegat Bay from the Atlantic Ocean is via Barnegat Inlet, narrow inlet approximately 300 meters (m) (1,000 feet [ft]) wide.

Only 32 sea turtles have been captured at the OCNGS during more than 35 years of operation. Nineteen turtles were alive at the time of capture (5 of 7 loggerheads; 11 of 21 Kemp's ridleys; 3 of 4 Atlantic greens) and safely returned to the wild.

Since 1992, a total of 13 turtles removed from the OCNGS intake were dead at the time of capture. Of these, two loggerheads exhibited severe boat prop wounds and were moderately decomposed indicating that death probably occurred prior to encountering the intake. One of the dead sea turtles was a juvenile green turtle captured during late October 1999. This individual exhibited no significant wounds, but given the time of year, its death may have been related to cold stunning. The remaining ten sea turtles found dead at the OCNGS intake structures were all Kemp's ridleys. The condition of four dead Kemp's ridleys at the time of capture suggests that their deaths may have been attributable to factors other than interaction with the OCNGS intake. One of the two dead Kemp's ridleys taken in 1994 exhibited a strong odor of decomposition, suggesting that it may have died prior to becoming impinged on the DWS intake. A Kemp's ridley taken in July 2001 had a deep slice wound on its neck that could have been caused by an encounter with a boat. Two of the three dead Kemp's ridleys taken during 2004 had puncture wounds on the carapace or neck that could have resulted from collisions with boats. The most likely cause of death of one individual taken in 1993 was determined by necropsy to be drowning at the DWS intake. The deaths of the remaining five Kemp's ridleys may also be attributable to drowning at either the DWS or CWS intake, although the cause of death was not definitively determined. In summary, a maximum of 11 and as few as 6 sea turtles have died as a result of OCNGS operations during the past 35 years. All sea turtles captured at the OCNGS were subadults or juveniles.

The occurrence of 32 sea turtles at the OCNGS between 1992 and 2004 is probably attributable to at least two factors. Modifications to Barnegat Inlet, completed in 1991 by the U.S. Army Corps of Engineers, and subsequent maintenance dredging of the inlet have resulted in significant increases in the depth of the inlet and the volume of water passing through the inlet during each tidal exchange. These changes may have made Barnegat Bay more accessible to sea turtles migrating along the Atlantic coast. In addition, there is a significant body of evidence indicating that sea turtle population levels, particularly the Kemp's ridley population, have been increasing rapidly during the past several years (Crouse et al. 1992; Turtle Expert Working Group 1998; Marquez et al. 1999; Turtle Expert Working Group 2000; Marquez et al. 2001). These increases in abundance are probably a result of decreased mortality associated with the implementation of the NOAA Fisheries TED regulations in 1989 as well as ongoing efforts to protect nesting beaches.

It is unknown whether the changes to Barnegat Inlet would be permanent or, as has happened in the past, shoaling would occur over time, reducing access to Barnegat Bay via the inlet.

Similarly, additional data on sea turtle populations and commercial fishing bycatch must be gathered to fully evaluate the effectiveness of the TED regulations at reducing sea turtle mortality.

No changes in the design or the mode of operation of the OCNGS could explain the incidental take of eight Kemp's ridley turtles at the facility during 2004, when the previous annual maximum had been two individuals. This phenomenon was most likely ascribable to the combined effects of the rapidly-increasing Kemp's ridley population and the unusually-warm ocean water temperatures along the New Jersey coast during the summer of 2004. Water temperatures during June through September 2004 were the third warmest since record keeping began in 1912 (National Weather Service 2004). These abnormally-high ocean water temperatures, along with the abundant food supply in the form of blue crabs found in Barnegat Bay (MacKenzie 2003), provided excellent conditions to attract the increasing numbers of juvenile and subadult Kemp's ridleys migrating along the Atlantic coast in search of productive foraging grounds during 2004.

Of the eight Kemp's ridley takes in 2004, five were alive and released into the ocean. The causes of death for the remaining three turtles were indeterminate; the turtles may have died before impingement, or their deaths could have been causally-related to OCNGS operations. The dead turtles were all found on the trash bars on an intake structure—two on the DWS intake structure and one on the CWS intake structure.

The primary concern with sea turtles at the OCNGS is whether any station-related losses of these endangered or threatened species "jeopardizes their continued existence." Federal regulation defines this term as "engaging in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of that species." A comparison was made of sea turtle losses caused by OCNGS operations, assuming losses equivalent to the current ITS lethal take limit, with conservative population estimates for each species. The maximum estimated annual loss of loggerheads at the station is two turtles, which represents approximately 0.004 percent of the adult female population in the Atlantic. The estimated worst-case annual loss of Kemp's ridleys at the OCNGS is three turtles, which would represent 0.14 percent of the adult population using the 1989 estimate of 2,200 (Márquez 1989). The estimated worst-case annual loss of Atlantic green turtles at the OCNGS is one turtle, which would represent 0.1 percent of the estimated population size of nesting females. It is unlikely that losses at these levels would "appreciably reduce" the distribution or numbers of any of these species. Losses to reproduction would be restricted to "production foregone" due to the loss of juvenile/subadult animals that could potentially be recruited into the breeding population at some time in the future.

Thermal impacts from the operation of the OCNGS, such as acute and chronic thermal impacts and cold shock, are not a concern. The thermal effluent from the station forms only a shallow thermal plume within Barnegat Bay. All sea turtle species found in Barnegat Bay have strong swimming ability and can easily avoid thermally-affected areas where water temperatures exceed their preferences. In addition, no sea turtles have ever been observed within the discharge canal of the OCNGS.

To minimize the impact of OCNGS operations on threatened or endangered sea turtles, a variety of measures has been instituted, including all of the "reasonable and prudent measures

necessary to minimize the impact on listed species" specified in the ITS dated July 18, 2001. To ensure the timely removal of sea turtles from the both the CWS and DWS intake structures and optimize chances for turtle survival, a formal procedure has been developed for station personnel that defines the surveillance, handling and reporting requirements necessary to minimize the impact on sea turtles incidentally captured at the OCNGS. The procedure requires inspections of the CWS and DWS intake structures for the presence of sea turtles at least twice per eight-hour shift, and the cleaning of the intake trash bars on at least a daily basis, throughout the sea turtle season, which is June 1 to October 31. This represents a doubling of the frequency of intake structure inspections specified prior to 1994. The intake structures are provided with high-intensity lamps and floodlighting to facilitate inspection and removal efforts. Guidance on the identification, handling, and resuscitation of sea turtles is also included in the procedure. In addition, large color posters, which illustrate the distinguishing features of sea turtles, resuscitation techniques, and reporting requirements, are prominently posted at the intake structures. Custom-made dipnets and a sling designed to facilitate the gentle removal of sea turtles from the intake are stored at the intake structures during the sea turtle season. OCNGS procedures also includes precautions to be taken during routine cleaning of the intake trash bars to ensure that any sea turtles mixed in with the accumulated debris are removed and properly handled.

In accordance with the requirements of the ITS, the licensee has notified NOAA Fisheries and the NRC of all sea turtle captures at the OCNGS, by facsimile within two business days. All live sea turtles have been taken to the Marine Mammal Stranding Center, in Brigantine, NJ, an authorized agent of the Sea Turtle Stranding and Salvage Network. Dead sea turtles were submitted to Cornell University or the University of Pennsylvania for necropsy. Annual reports of sea turtle captures have been provided as part of the Annual Environmental Operating Report for the OCNGS.

In summary, the continued operation of OCNGS is not likely to jeopardize the continued existence of the loggerhead, Kemp's ridley or Atlantic green turtles. In light of the 2004 takes, the NRC suggests a change in the incidental take level at OCNGS for sea turtles; the suggestion is to have no limit on live takes but to retain the current limits on lethal takes caused by station operations. The estimated losses of these species attributable to the operation of the station, particularly the water intakes, would not "appreciably reduce" the distribution or numbers of these species. Losses to reproduction would be restricted to "production foregone" due to the loss of juvenile or subadult animals, which could potentially be recruited into the female breeding population in the future.

2.0 Introduction

2.1 Purpose

This Biological Assessment (BA) is submitted to National Oceanic and Atmospheric Administration (NOAA) Fisheries in compliance with Section 7 of the Endangered Species Act of 1973 (as amended) (ESA), and in support of the United States (U.S.) Nuclear Regulatory Commission's (NRC's) August 26, 2004 request to NOAA Fisheries for reinitiation of formal Section 7 consultation on sea turtles at the Oyster Creek Nuclear Generating Station (OCNGS), which is licensed to and owned by AmerGen Energy Company, LLC.

The purpose of this BA is to examine the potential impacts associated with the continued operation of the OCNGS on sea turtle species protected under the ESA. The primary species of concern are the loggerhead turtle (*Caretta caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), and green turtle (*Chelonia mydas*), all of which have been captured on the circulating water or dilution intake trash bars at the OCNGS. The Kemp's ridley turtle is listed as endangered, and the loggerhead turtle is listed as threatened (50 CFR 17.11). Atlantic green turtles in U.S. waters are listed as threatened except for the Florida breeding population, which is listed as endangered. Due to the inability to distinguish between these populations away from the nesting beach, these sea turtles are considered endangered wherever they occur in U.S. waters (NOAA Fisheries 2001). The leatherback turtle (*Dermochelys coriacea*) and the hawksbill turtle (*Eretmochelys imbricata*) are also listed as endangered in U.S. waters and are known to occur in New Jersey waters, but have not been observed at the OCNGS. NOAA Fisheries has jurisdiction for these species at sea (50 CFR 222.23(a) and 50 CFR 227.4(b)). The olive ridley turtle (*L. oliveacea*) is listed as threatened in U.S. waters but does not occur in New Jersey waters.

2.2 Endangered Species Act

This BA is part of the formal consultation process provided under Section 7 of the ESA. Detailed procedures for this consultation process are defined in 50 CFR 402.

2.3 Chronology of Events Leading up to This Assessment

A review of the sea turtle strandings at the OCNGS was requested in a letter from NOAA Fisheries to the NRC in November 1993 (Mantzaris 1993). This letter followed communications among OCNGS, NRC, and NOAA Fisheries regarding the capture of sea turtles at the OCNGS during 1992 in spite of the OCNGS having operated for many years (1969 to 1991) prior to any being taken.

The issue of sea turtles at the OCNGS was initially addressed in 1992 when sea turtles were first observed at the station's circulating water and dilution structure intake trash bars. The matter was discussed jointly by OCNGS, NRC, and NOAA Fisheries (informal Section 7 consultation). Subsequent to an additional sea turtle being captured in 1993, NOAA Fisheries advised the NRC that a formal consultation process including preparation of a BA would be

required (Mantzaris 1993). The BA was completed in 1994, and NOAA Fisheries issued a Biological Opinion (BO)/ITS on September 21, 1995.

The BA was updated in 2000 to include information on sea turtle incidental captures that occurred at the OCNGS between 1994 and July 2, 2000, in support of the renewal of the BO/ITS originally issued in September of 1995. NOAA Fisheries subsequently issued a new BO/ITS on July 18, 2001.

On August 7, 2004, the OCNGS recorded the fifth incidental take of a Kemp's ridley turtle since the beginning of the year, thereby exceeding the ITS limits for the facility. As a result, the NRC formally requested reinitiation of Section 7 consultation on sea turtles at the OCNGS (Kuo 2004). This update of the BA, issued in support of that request, includes detailed discussions of the incidental captures of sea turtles at the OCNGS that have occurred since the current BO/ITS was issued on July 18, 2001, and addresses "reasonable and prudent measures necessary to minimize impacts" on listed sea turtles taken by AmerGen Energy Company, LLC at the OCNGS.

3.0 Site Description

3.1 Location

The Oyster Creek Nuclear Generating Station (OCNGS) is located along the eastern edge of the coastal pine barrens of New Jersey in Lacey and Ocean Townships, Ocean County (Figure 3-1). The station site is approximately 55 kilometers (km) (34 miles [mi]) north of Atlantic City, New Jersey and 70 km (44 mi) east of Philadelphia, Pennsylvania. Approximately 15 km (9 mi) north of the site are several small residential communities: Toms River, South Toms River, Beachwood, Pine Beach, Ocean Gate, Island Heights, and Gilford Park. West of the Garden State Parkway the land is primarily undeveloped woodland, and wooded wetlands are found along the banks of small creeks to the north, south, and west of the site. East of the station along the shoreline of Barnegat Bay, the land is characterized by alternating sections of residential development and undeveloped coastal wetlands and adjacent uplands. The terrain surrounding the site is relatively flat along the shoreline to gently rolling inland.

The OCNGS site is located to the west of U.S. Route 9, and is bounded on the north, south and west by the South Branch of Forked River, Oyster Creek, and the man-made intake and discharge canals, respectively. Barnegat Bay forms the site's eastern boundary (Figure 3-2). The power plant structures are situated approximately midway between Oyster Creek and the South Branch of Forked River and about 425 meters (m) (1,394 feet [ft]) west of Route 9.

3.2 Barnegat Bay Morphology and Bathymetry

The OCNGS utilizes Barnegat Bay as a source of cooling water, via the South Branch of Forked River, and the bay serves as the receiving water body for thermal discharges via Oyster Creek (Figure 3-2). Barnegat Bay is a shallow, lagoon-type estuary typical of the back bay systems of barrier island coastlines. The long axis of Barnegat Bay extends approximately 50 km (31 mi) in roughly a north-south direction and parallels the mainland, forming an irregular tidal basin ranging from 1 to 6 km (0.6 to 3.7 mi) in width and 0.3 to 6 m (1 to 20 ft) in depth (Kennish and Olsson 1975; Kennish 1978). The bay is bordered on the west by the New Jersey mainland, on the north by Point Pleasant and Bay Head, on the east by Island Beach and Long Beach Island, and on the south by Manahawkin Causeway. Island Beach and Long Beach Island comprise a barrier island complex breached only at Barnegat Inlet, which is located 10.5 km (6.5 mi) southeast of the OCNGS. This single, relatively narrow inlet provides the only direct access to the bay from the Atlantic Ocean (Figure 3-1).

The estimated surface area of Barnegat Bay is 124 square kilometers (km²) (47.9 square miles [mi²]) (Seabergh et al. 2003a). About 73 percent of the estuary is less than 2 m (6.6 ft) deep at mean low water, which is characteristic of lagoon-barrier island systems (Barnes 1980). The bay's eastern perimeter is shallower (less than 0.9 m or 3.0 ft) than the central and western sectors which are 0.9 to 4.0 m (3.0 to 13.0 ft) deep, with extensive shoal areas exposed at low tide (Chizmadia et al. 1984). The greatest depths of 3 to 4 m (10 to 13 ft) occur along the Intracoastal Waterway, a narrow channel traversing the length of the bay. The Intracoastal Waterway is heavily utilized by both recreational boaters and commercial fishing boats, and is maintained at a depth of approximately 2 m (6.6 ft) for navigation purposes by the U.S. Army Corps of Engineers (Marcellus 1972).

3.3 Hydrology of Barnegat Bay

Barnegat Bay communicates with Manahawkin Bay to the south and, via the Bay Head-Manasquan Canal, with the Manasquan River to the north (Chizmadia et al. 1984). The primary exchange of ocean and bay water occurs through Barnegat Inlet, where Carpenter (1963) estimated an exchange rate of 7 percent per tide and a net discharge rate of 56.7 m³/sec (2,002 ft³/sec).

The salinity regime and circulation patterns within the bay are affected by the inflow of relatively high-salinity waters originating in the Atlantic Ocean and entering the northern and central bay via the Bay Head-Manasquan Canal and Barnegat Inlet, respectively. Because the proportion of bay water that escapes seaward each tidal cycle is relatively small, Chizmadia et al. (1984) estimate that 96 tidal cycles are required for complete turnover of estuarine water to take place. Marcellus (1972) reported a mean tidal current through Barnegat Inlet of 1.1 meters per second (m/sec) (3.6 feet per second [ft/sec]) during flood tide and 1.3 m/sec (4.3 ft/sec) during ebb tide. Ashley (1987) measured peak flood-tide-flow velocities of 1.1 m/sec (3.6 ft/sec) and peak ebb velocities of 1.0 m/sec (3.3 ft/sec).

3.3.1 Influence of Barnegat Inlet Modifications on Barnegat Bay Hydrology

Beginning in 1988, a multi-year project by the U.S. Army Corps of Engineers was undertaken to realign the south jetty at Barnegat Inlet and to dredge accumulated sediments from within the inlet. The new alignment of the inlet's south jetty so that it is nearly parallel to the north jetty was completed in 1991. The new jetty configuration has not changed the effective width of the inlet, which remains approximately 300 m (1000 ft) wide, through which Atlantic Ocean waters can enter Barnegat Bay. The mean tidal range at Barnegat Inlet was reported by Ashley (1987) to be approximately 0.6 m (2 ft) prior to the jetty modifications, and the tide range became progressively damped in a landward direction. The small size of Barnegat Inlet and the shallowness of the bay both restrict tidal flow and attenuate tidal energy, thereby minimizing tidal fluctuations. The depth of the inlet was significantly increased via dredging during the 1991-1993 period, and the realignment of the south jetty straightened the channel flow, which permits a freer interchange of ocean and bay waters. The less-restricted tidal flow due to the dredging and jetty modifications has resulted in a significantly-greater volume of water passing through Barnegat Inlet during a given tidal cycle (Table 3-1). U.S. Army Corps of Engineers data indicate that the average tidal prism has more than doubled since completion of the modifications, and the mean tide range at Barnegat Inlet has increased by over 30 percent (Ashley 1987; Seabergh et al. 2003b). The Waretown gauge, the one closest to OCNCS, showed a 33 percent increase in tide range from 1978 to 1993 (Seabergh et al., 2003a).

3.4 Barnegat Bay Salinity

Maximum Barnegat Bay salinities of over 30 ppt are found near Barnegat Inlet due to the input of Atlantic Ocean water. Most freshwater, however, enters the estuary from surface runoff and groundwater seepage along the western shore of the bay (Chizmadia et al. 1984). Several tributaries that drain the New Jersey Pine Barrens provide a mean surface runoff of 10.2 m³/sec (360 ft³/sec). Toms River provides the greatest freshwater input (5.7 m³/sec; 201 ft³/sec) to the

estuary, and Cedar Creek provides an additional 3.1 m³/sec (110 ft³/sec) (U.S. Atomic Energy Commission 1974). Other significant tributaries of the bay include Metedeconk River, Kettle Creek, Forked River, Oyster Creek, and Manahawkin Creek (Figure 3-1). The freshwater input from these tributaries creates a slight salinity gradient from west to east. The salinity of the central bay, in the vicinity of the OCNGS, is typically about 25 ppt (Chizmadia et al. 1984).

A relatively-pronounced salinity gradient occurs along the north-south axis of the bay due to the freshwater input of Pine Barrens streams in the northwestern portion of the bay and the location of Barnegat Inlet in the southern portion (Figure 3-3). Relatively-high-salinity waters entering the northernmost section of the bay through the Bay Head-Manasquan Canal result in elevated salinities in that portion of the bay (Chizmadia et al. 1984).

3.5 Water Temperature in Barnegat Bay

Barnegat Bay is a meteorological transition zone between the continent and the ocean. The temperature extremes of both the summer and winter seasons are moderated within the bay by the proximity of the ocean. On an average annual basis, the warmest months of the year are July and August, and the coldest months are January and February. Tatham et al. (1977) reported winter water temperatures in western Barnegat Bay as low as -1.5EC (29.3EF) and summer temperatures approaching 30EC (86EF). Periods of relatively-rapid temperature change occur in spring and fall.

Atlantic Ocean water that enters the estuary typically exhibits a somewhat narrower annual range of temperature; however, year-to-year variations can be considerable. According to the National Weather Service (2004), ocean water temperatures along the southern New Jersey coast during the summer (June-September) of 2004 were the third warmest since record keeping began more than 90 years ago in 1912. The average ocean water temperature during the summer of 2004 (measured at Atlantic City, NJ) was 21.7EC (71.1EF), or 1.4EC (2.5EF) above normal and 3.0EC (5.4EF) warmer than the previous year. Ocean water temperatures during the summer of 2003 were among the coolest on record, averaging 18.7EC (65.7EF).

Ice typically forms each winter adjacent to the shoreline of Barnegat Bay, but more extensive ice covering across a major portion of the bay has occurred only during the coldest of recent winters. Periodically, during winter or early spring, ice from Barnegat Bay is drawn into the OCNGS intake canal.

3.6 Water Transparency in Barnegat Bay

Water transparency in Barnegat Bay, as measured by Secchi depth, ranges from 0.2 to 2.5 m (0.7 to 8.2 ft). The annual average Secchi depth in the vicinity of Oyster Creek is 1.1 m (3.6 ft) (Vouglitois 1983).

Table 3-1
Barnegat Inlet average tidal prisms, adjusted to mean tidal conditions

DATE	AVERAGE TIDAL PRISM (x 10 ⁷ m ³)
June 1932	2.29
December 1940	3.21
April 1941	3.45
November 1941	3.31
September 1943	2.12
June 1945	2.01
May 1968	1.39
March 1980	1.17
September 1987	1.17
June 1993	2.55
Note: New south jetty constructed 1981-1991. Sources: Ashley 1988; Seabergh et al. 2003b.	

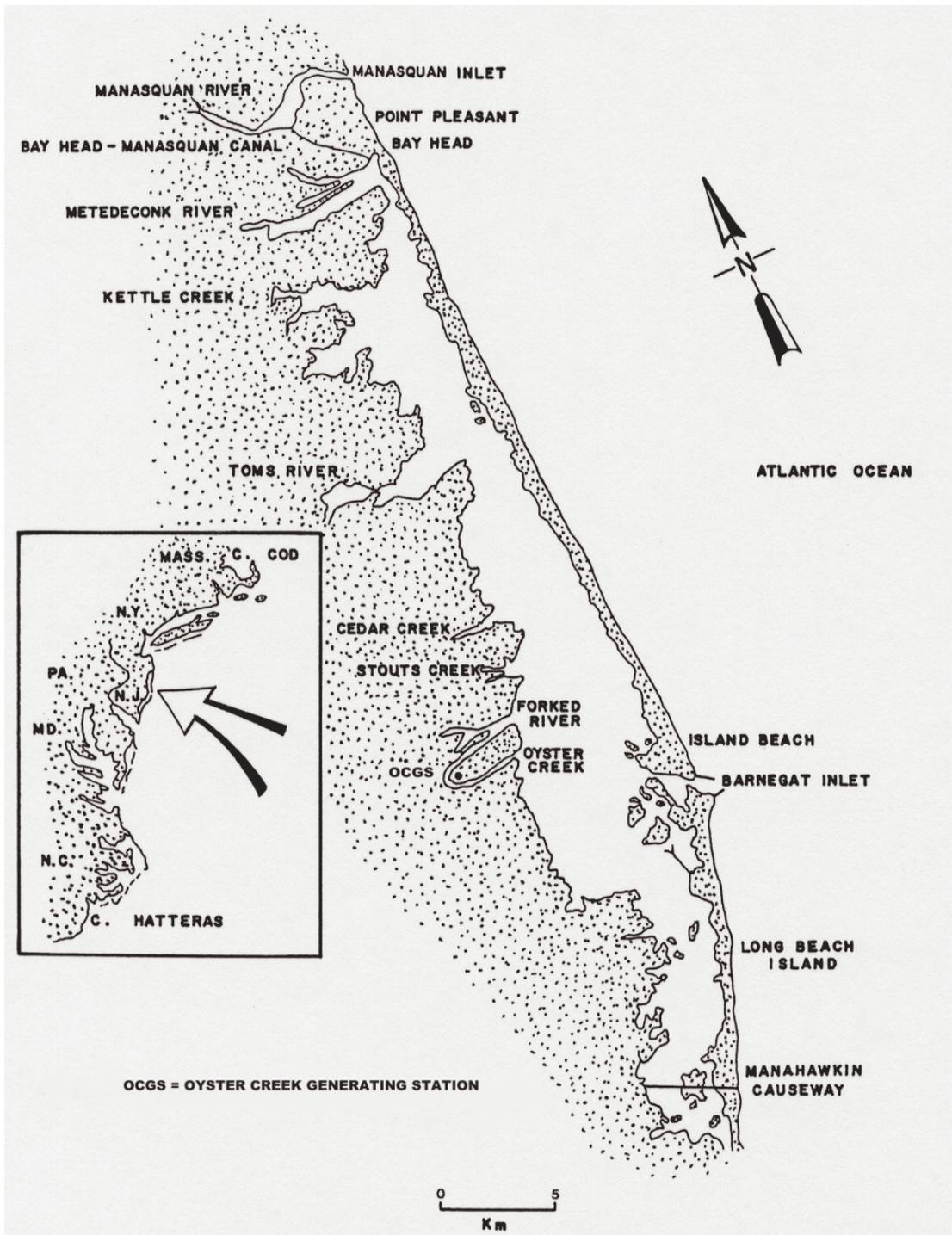


Figure 3-1
 Map of Barnegat Bay, New Jersey showing the location of the Oyster Creek Nuclear Generating Station. Inset shows Barnegat Bay in relationship to the Mid-Atlantic Bight (after Kennish and Lutz 1984). Note: OCGS in this figure is OCNGS.

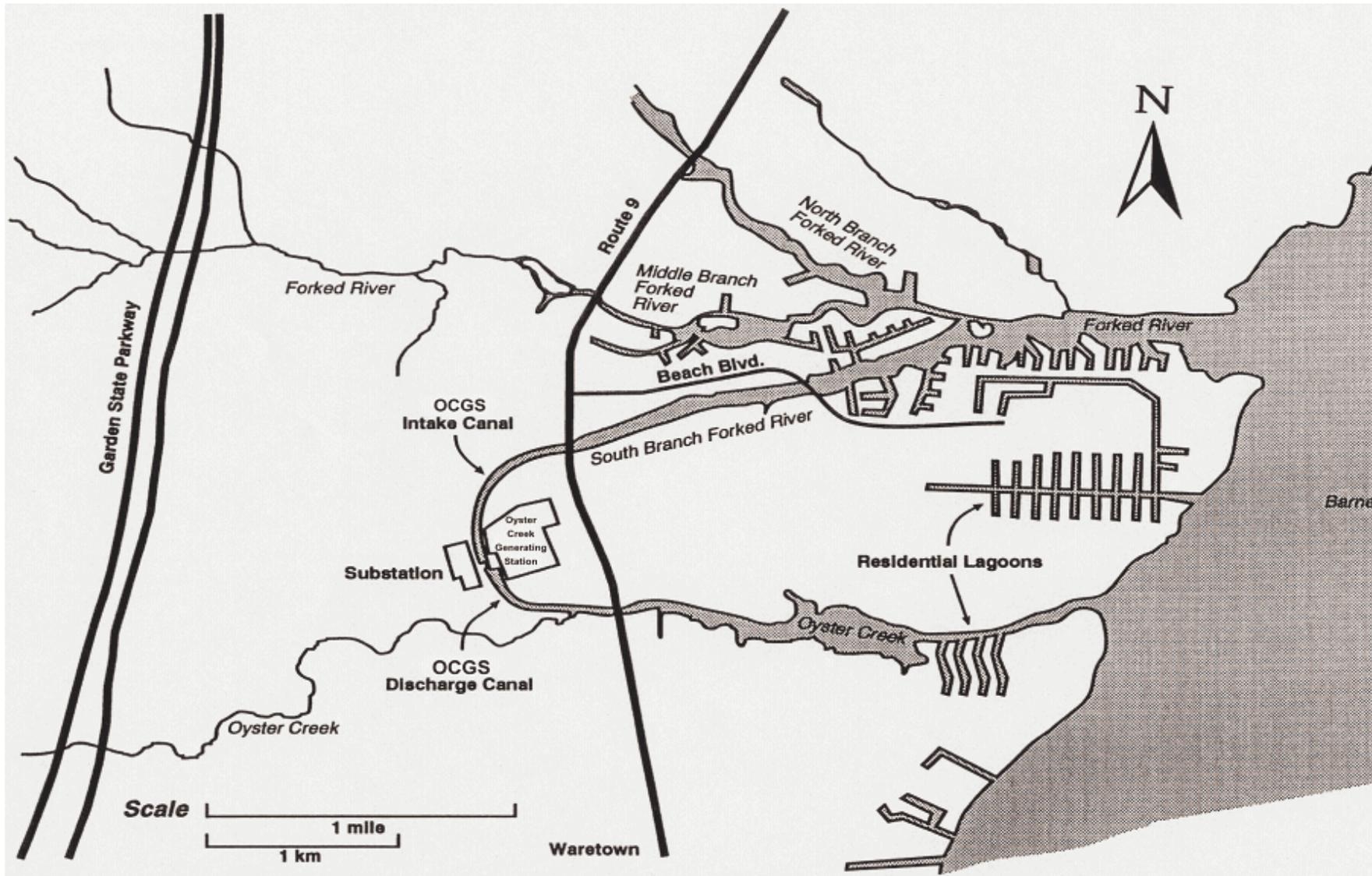


Figure 3-2
 Location map of the Oyster Creek Nuclear Generating Station and vicinity. Note: OCGS in this figure is OCNGS.

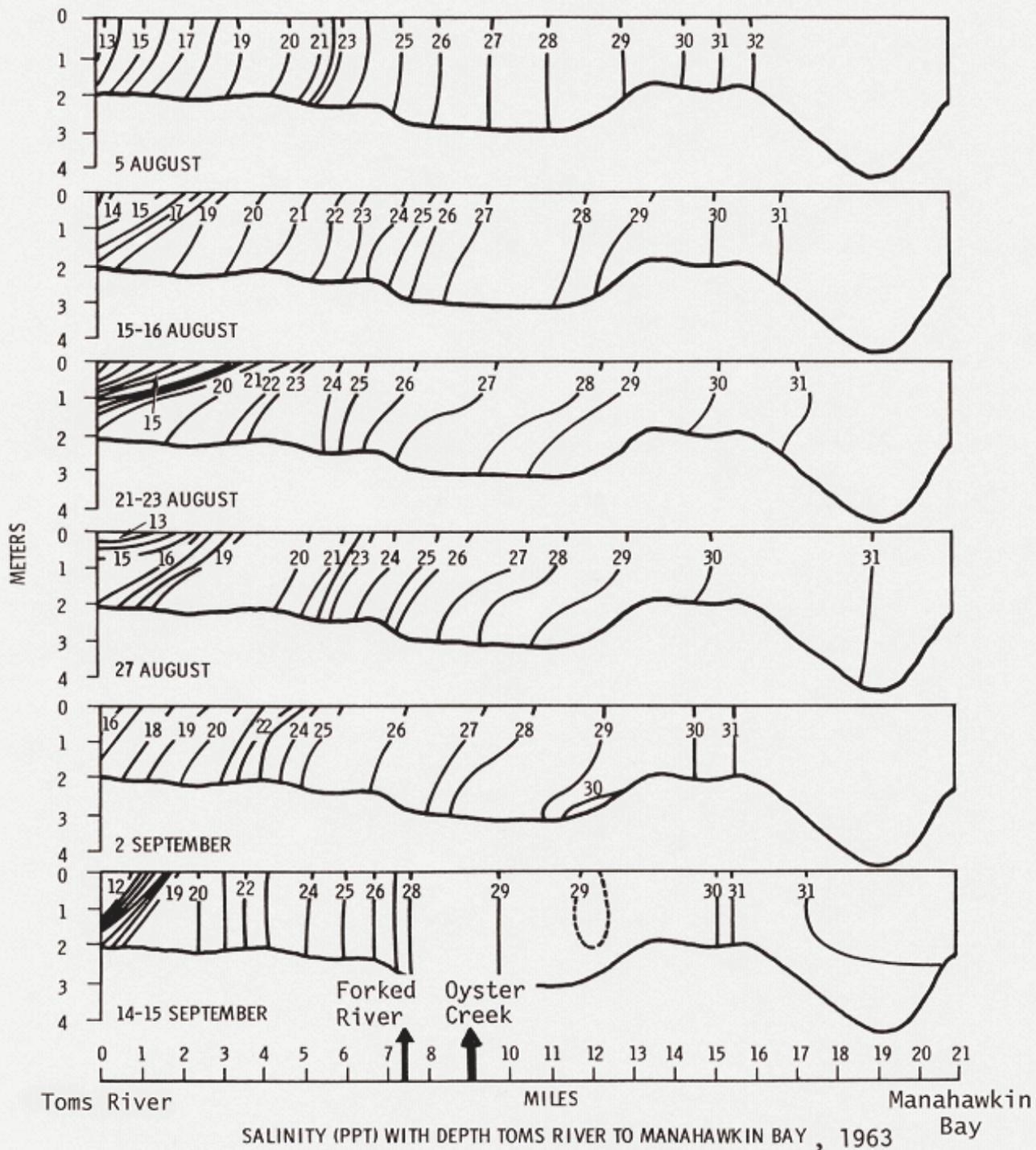


Figure 3-3
Salinity profile of Barnegat Bay from Toms River to Manahawkin Bay for August and September 1963 (after Carpenter 1963).

4.0 Oyster Creek Nuclear Generating Station Description

4.1 Oyster Creek Nuclear Generating Station

The Oyster Creek Nuclear Generating Station (OCNGS) consists of a boiling water nuclear reactor with an electrical capability of approximately 650 megawatts. The OCNGS began commercial operation late in 1969. The facility was owned and operated by Jersey Central Power & Light Company/GPU Nuclear until August 2000 when it was sold to the current owner/operator, AmerGen Energy Company, LLC.

The containment structure housing the reactor and the turbine, and auxiliary and service buildings for the OCNGS are located on a semicircular plot of land bounded by the intake and discharge canals and by U.S. Route 9 (Figure 4-1). Water is withdrawn from Barnegat Bay via the Forked River through an intake canal to two separate intake structures (Figures 4-2 through 4-9). The circulating water system (CWS) intake provides cooling water for the main condensers and also provides cooling water for safety-related heat exchangers and other equipment within the station. The dilution water system (DWS) minimizes the thermal effects on the discharge canal and Barnegat Bay by "thermally diluting" the circulating water from the condenser with colder water drawn from the intake canal. Water from both systems is discharged via discharge tunnels to the head of the discharge canal, located immediately west of the plant (Figure 4-2). The discharge canal debouches into Oyster Creek, which flows into Barnegat Bay.

4.1.1 Circulating Water System

The once-through CWS is designed to remove waste heat from the stations main condensers. The CWS withdraws cooling water from the intake canal, routes it to the condensers, and returns warmed water to the discharge canal (Figure 4-2). During normal plant operation, four 435-m³/min (0.115-million-gallons-per-minute [gpm]) circulating water pumps (Figures 4-3 and 4-4) withdraw a total of 1740 m³/min (0.46 million gpm). The typical temperature rise across the condensers in this operating mode is 11 to 12.8 EC (20 to 23 EF). Measurements of the intake velocity of water approaching the CWS intake ports show flows of 17-20 centimeters per second (cm/sec) (0.56-0.66 ft/sec) with four circulating water pumps operating and all six intake bays open.

The station's New Jersey Pollutant Discharge Elimination System (NJPDES) Discharge to Surface Water Permit regulates the intake velocity as well as the effluent characteristics of the CWS. The maximum permissible average intake velocity for water approaching the CWS intake ports is 30 cm/sec (1 ft/sec). The maximum temperature difference between the intake and discharge water is 12.8EC (23EF); the maximum effluent temperature is 41.1EC (106EF). Both temperature limits apply during normal operating conditions (i.e.; when four circulating water pumps are operating and condenser backwashing is not underway.)

When fewer than four circulating water pumps are operating, or during condenser backwashing, alternate temperature limitations apply. The maximum temperature difference between the intake and discharge water under those conditions is 18.3EC (33EF); the alternate maximum effluent temperature is 43.3EC (110EF). The operation of dilution pumps (see Section 4.1.2) reduces the

water temperature in the discharge canal by approximately 2.8EC (5EF) for each pump operated. Two dilution pumps are typically operated during the summer months, thereby providing a 5.6EC (10EF) reduction in discharge canal temperature.

4.1.1.1 Circulating Water System Intake Structure

The CWS intake consists of six separate, independent intake bays or port cells (Figures 4-3 and 4-4). Each intake bay is equipped with its own trash bars and traveling screens. Provisions for stop logs are made within each port to facilitate dewatering the intake bays for maintenance.

Originally, the circulating water intake structure consisted of trash bars followed by conventional traveling screens whose primary purpose was to collect and remove debris from intake water. Traveling screens were intermittently cleaned via a front wash, high-pressure spray system activated by differential pressure, a timer, or manual intervention.

To mitigate fish impingement losses, modifications have been made to the original installation by adding horizontal, water-filled fish survival buckets on the traveling screen baskets (Ristroph modification); a low pressure rear spray wash fish removal system; and a modified fish and trash sluiceway system specifically designed to gently return fish to the discharge canal.

4.1.1.1.1 Trash Bars and Trash Rake Assembly

Six sets of trash bars protect each of the six port cells from large debris, mats of eel grass, marine algae, or detritus entrained in the intake water flow (Figure 4-5). The trash bar assemblies, sometimes referred to as trash racks, are 7.3 m (24 ft) high and extend from the deck of the CWS intake structure at elevation +6.0 ft MSL (mean sea level) to the bottom of each CWS intake port, elevation -18.0 MSL, and are approximately 3.3 m (11 ft) wide. Constructed of 0.95 cm (3/8 inches [in]) wide steel bars on 7.5 cm (3.0 in) centers, the trash bars have openings between them that are 6.6 cm (2.6 in) wide.

The trash bars are inspected at least twice during each eight-hour work shift, throughout the sea turtle season (see Section 7 and Appendix A), and debris is removed as needed by a mobile mechanical trash rake. The trash rake/trash cart assembly is a self-contained unit that traverses the entire width of the intake on rails; it contains a trash hopper that transports the material removed from the bars to a debris container at the south end of the intake. Figures 4-5 through 4-8 illustrate the trash rake/trash cart assembly at the CWS and DWS intake structures.

The trash rake is 1.8 m (6.0 ft) wide and is controlled by a single operator from a manual pushbutton control panel that is mounted on the unit's frame assembly. The trash rake unit consists of an integral frame assembly that houses the traversing drive, hoisting machinery, hopper, and hydraulic control assemblies. The hoisting machinery includes a cable-operated raking device that is designed to remove large, floating or submerged objects that may accumulate on the trash bars. Wide-flanged wheels permit the raking device to travel along the face of the inclined trash bars and guide the cleaning device vertically over the bars. The curved tines of the trash rake extend approximately 2.5 cm (1.0 in) beyond the plane of the trash bars to ensure effective cleaning of the trash bars.

Lighting the intake bays and trash bars is provided by nearby high-intensity lamps, as well as downward-facing floodlights mounted on each corner of the trash cart (Figures 4-5 and 4-8). The floodlights attached to the trash rake unit are utilized during the evening hours to aid station personnel in spotting sea turtles. Personnel cleaning the CWS and DWS intake trash racks during the period from June 1 to October 31 observe the trash rake during the cleaning operation so the rake may be stopped if a sea turtle is sighted. The debris gathered from the trash racks is hand raked into the trash car hopper. Personnel performing this task are instructed to look for sea turtles and to take particular care to ensure that sea turtles are not mistaken for horseshoe crabs.

4.1.1.1.2 Traveling Screens

Each CWS intake cell is equipped with a vertical traveling screen. Each traveling screen unit contains thirty-five, stainless steel mesh (0.95 cm [3/8 in]), fish-removal screen panels. Each screen panel has a 5.1-cm (2-in) -wide lip, which creates a water-filled bucket. As the screen is raised through and out of the water, most impinged organisms such as small fish or invertebrates drop off the screen into the bucket, which prevents them from falling back into the screen well and becoming re-impinged. These organisms are subsequently washed into a fish-return system that gently returns them to the discharge canal.

For maximum fish survival, the screen wash operates with both low-pressure and high-pressure spray headers. As the screen basket travels over the head sprocket, organisms slide onto the screen face and are washed by one low-pressure spray header located outside the screen unit, and two low-pressure spray headers located inside the screen unit, into an upper sluice. This spray wash is designed to minimize de-scaling and other injuries that would occur with conventional high-pressure spray headers. Subsequently, heavier debris is washed into a lower sluice by two high-pressure spray headers.

Normally the screens operate at a speed of 75 cm/sec (2.5 ft/sec). They can also be operated at an alternate speed of 300 cm/sec (10 ft/sec) to accommodate large debris loads.

Because all sea turtles captured at the OCNGS have measured at least 18.3 cm (7.2 in) in straight carapace length (SCL), it is not anticipated that a sea turtle small enough to pass through the 6.6-cm (2.6-in) openings of the trash racks would ever occur at the OCNGS. However, in the unlikely event that such a small sea turtle occurs at the OCNGS, the fish return system would gently return it to the discharge canal automatically (i.e., without the need for manual intervention by OCNGS personnel).

4.1.1.1.3 Circulating Water Pumps

There are four circulating water pumps located on the CWS intake structure (Figure 4-4). They are vertical wet-pit-type pumps rated at 435 m³/min (0.115 million gpm), which discharge through lines 1.7 m (6.0 ft) long to the main condensers and ultimately to a square concrete discharge tunnel 3.2 m (10.5 ft) in length. The once-through cooling system piping running from the intake to the discharge is approximately 200 m (650 ft) in length. A 1.5 m (5 ft) concrete recirculation pipe for ice control runs below the water level from the discharge tunnel back to the intake structure. The area in close proximity to the CWS intake is kept from freezing by the intake deicing system and the turbulence induced by the circulating water and dilution pumps.

4.1.1.1.4 Sea Turtle Retrieval/Rescue Equipment

As indicated in Section 4.3.2 of Procedure 106.12, "Sea Turtle Surveillance, Handling, and Reporting Instructions" (Appendix A), a rescue sling suitable for lifting large sea turtles (in excess of 20 kilograms [kg] or 44 pounds [lbs]) is kept at the CWS intake structure. The sea turtle rescue sling (Figure 4-10) consists of a weighted tubular metal frame of 2.5-cm (1-in) outer diameter stainless steel measuring 120 cm (48 in) on a side from which 6.4-cm (2.5-in) mesh nylon netting is suspended. Ropes attached at each corner of the rescue sling are joined into a bridle and single lift rope, which are designed to allow the user to drop the sling below a turtle at the trash bars, then lift it out of the water to the intake structure deck.

Custom-made long-handled dipnets suitable for retrieving the smaller turtles most commonly encountered at the OCNCS have also been fabricated for use at the CWS and DWS intake structures (Figure 4-11). The turtle dipnets are constructed of 3.3-cm (1.3-in) outer diameter aluminum tubing and consist of a 240-cm (8-ft) handle attached to a rounded rectangular net frame measuring 75 by 45 cm (2.5 by 1.5 ft). Nylon netting of 0.63-cm (0.25-in) mesh is suspended from the dipnet frame. These dipnets are stored within easy reach, attached to fences, railings, or buildings at the CWS and DWS intake structures during the sea turtle season (June 1 to October 31).

Both the rescue sling and the long-handled dipnets are only adequate for retrieving turtles from the water surface or within about 1 m (3.3 ft) of the surface because the use of either device requires that the sea turtle be visible from the surface.

4.1.1.2 Condensers

There are three sections to the main condenser, one located immediately below each low-pressure turbine (Figure 4-9). There are 14,560 tubes in each main condenser section carrying circulating water from the intake canal. This provides approximately 13,000 m² (139,880 ft²) of cooling surface area. Each section is 12.2 m (40 ft) long, almost 6.1 m (20 ft) wide, and 9.9 m (32.5 ft) high. Two 1.8-m (6-ft) diameter pipes deliver circulating water to each section of the main condensers.

The discharge piping from the main condenser is joined through 1.8-m (6-ft) lines into a common 3.2-m (10.5-ft) square concrete discharge tunnel. The discharge tunnel transports the condenser cooling water across the site to the discharge canal (Figures 4-2 and 4-9).

4.1.2 Dilution Water System

The DWS is designed to minimize thermal effects on the environment by withdrawing ambient temperature water from the intake canal and routing it to the discharge canal where it mixes with the main condenser discharge flows (Figure 4-2). The dilution flow is provided by three low-speed, 984-m³/min (0.26-million-gpm) axial flow dilution pumps, with 2.1-m (7-ft) diameter impellers (Figure 4-6). The number of dilution pumps operated is governed by the station's NJPDES Discharge to Surface Water Permit and a maximum of two pumps (1,968 m³/min; 0.52 million gpm) are operated at one time.

To reduce the attraction of migratory fish to the station's discharge canal in the fall, when these species would normally leave Barnegat Bay, two dilution pumps are put into operation when the

ambient (intake) water temperature is less than 15.5 EC (60 EF). To reduce the temperature of the discharge canal during the summer months, when the water temperature as measured at the U.S. Route 9 Bridge over Oyster Creek (Figure 4-1) exceeds 30.5 EC (87 EF), one dilution pump is put into operation. If, after one dilution pump has been in operation for at least two hours, the water temperature at the U.S. Route 9 Bridge continues to exceed 30.5 EC (87 EF), a second dilution pump is put into operation. The station's third dilution pump is held in reserve to be put into operation within 40 minutes of such time as an insufficient number of dilution pumps are operable to meet the intent of the permit requirements.

The operation of two dilution pumps during the seasonal periods required by the NJPDES permit reduces the discharge canal temperature by approximately 5.6 EC (10 EF). During the remainder of the year, one dilution pump is typically operated, providing a temperature reduction of approximately 2.8 EC (5 EF). Following this seasonal operational regime results in the operation of two dilution pumps during about 70 percent of the June-to-October sea turtle season.

The average intake velocity in front of the DWS intake, with two pumps in operation, is approximately 73 cm/sec (2.4 ft/sec).

4.1.2.1 Dilution Water System Intake Structure

The DWS intake is a reinforced concrete structure located on the west side of the intake canal (Figures 4-2 and 4-6). It consists of six intake bays. Each intake bay is fitted with trash bars identical to those employed at the CWS intake (Figures 4-5 and 4-6). Unlike the CWS, the DWS intake structure has no traveling screens or fish-return system.

4.1.2.1.1 Trash Bars

The DWS trash bars are 0.95-cm (3/8-in) steel bars set on 7.5-cm (3.0-in) centers. There are six DWS trash bar assemblies, each 3.3 m (11 ft) wide. The DWS is fitted with a mobile mechanical trash rake similar in design and operation to the trash rake used at the CWS intake (Figures 4-5 through 4-8). The process of inspecting and cleaning the trash bars at the DWS is identical to that described for the CWS in Section 4.1.1.1.1, Section 7.3, and Appendix A.

4.1.2.1.2 Floating Debris/Ice Barrier

A floating barrier has been designed and installed upstream of the CWS and DWS intake structures to divert floating debris such as wood, eelgrass or ice away from the CWS intake and towards the DWS intake. The barrier is intended to prevent excessive amounts of debris or ice from accumulating on the CWS traveling screens or trash bars. The floating barrier is of wooden construction and extends approximately 60 cm (2 ft) below the surface from just upstream of the CWS intake to just upstream of the DWS intake (Figure 4-2).

4.1.3 Thermal Plume Studies

Heated condenser cooling water discharged from the CWS and ambient temperature intake canal water discharged from the DWS meet and mix in the discharge canal and ultimately are returned to Barnegat Bay via the discharge canal (Figures 4-1 and 4-2).

The cooling water discharged from the OCNGS has been studied on several occasions to determine the distribution, geometry, and dynamic behavior of the thermal plume. Dye studies as well as real-time mobile mapping of the plume track have been performed (Carpenter 1963; Starosta et al. 1981; JCP&L 1986).

Three rather different thermal regimes can be observed in Oyster Creek and Barnegat Bay. In Oyster Creek, initial mixing of the condenser discharge with dilution water produces a reduction in discharge temperature of between 2.8 to 5.6 EC (5 to 10 EF) depending upon whether one or two dilution pumps are operating. Little temperature decay is observable east of U.S. Route 9 until the discharge reaches Barnegat Bay. Minimal horizontal or vertical temperature change occurs in Oyster Creek between U.S. Route 9 and the bay because of the relatively-short residence time and the lack of turbulence or additional dilution. In Barnegat Bay, temperatures are rapidly reduced as substantial mixing with ambient temperature bay water and heat rejection to the atmosphere occurs. In the bay, the plume spreads on the surface, thereby facilitating heat rejection by direct radiation and evaporation to the atmosphere. Thus, there is a very small area near the OCNGS condenser discharge of relatively-high excess temperature in which turbulent dilution mixing produces rapid temperature reductions; a somewhat larger area in Oyster Creek between the OCNGS and Barnegat Bay in which little further temperature reduction occurs; and a still larger area in the bay in which the plume spreads on the surface.

About 150 m (492 ft) east of the mouth of Oyster Creek the water depth decreases from approximately 3.4 m (11 ft) to 1.5 m (5 ft), causing turbulence and mixing and directing the plume toward the surface. In general, excess temperatures do not remain on the bottom of the bay except in the area immediately adjacent to the mouth of Oyster Creek. Shoreline plumes may extend from the surface to the bottom since the water depths are usually less than 1.5 m (5 ft). In Barnegat Bay, the plume occupies a relatively large surface area with low excess temperatures where the balance of the heat discharged by the OCNGS is dissipated to the atmosphere or diluted by entrained bay water. The surface excess temperature isotherm of 2.2 EC (4 EF) under all operating conditions is contained in a rectangle approximately 1.6 km (1 mi) along the east-west axis by 5.6 km (3.5 mi) along the north-south axis bounding the mouth of Oyster Creek. For the 0.8 EC (1.5 EF) isotherm, the rectangle is 2.4 km (1.5 mi) by 7.2 km (4.5 mi). All measured plumes exhibited a plume length of approximately two to three times their width (JCP&L 1986).

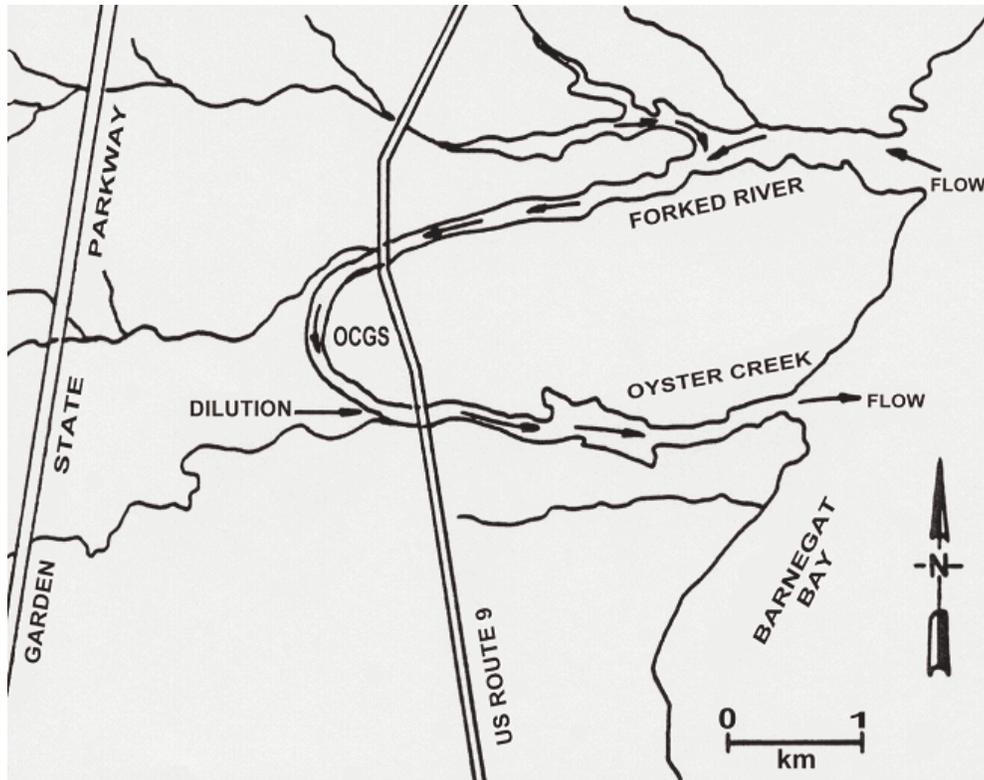


Figure 4-1

Flow characteristics at Forked River, Oyster Creek, and adjacent bay localities. (After Kennish and Olsson, 1975.) Note: OCGS in this figure is OCNGS.

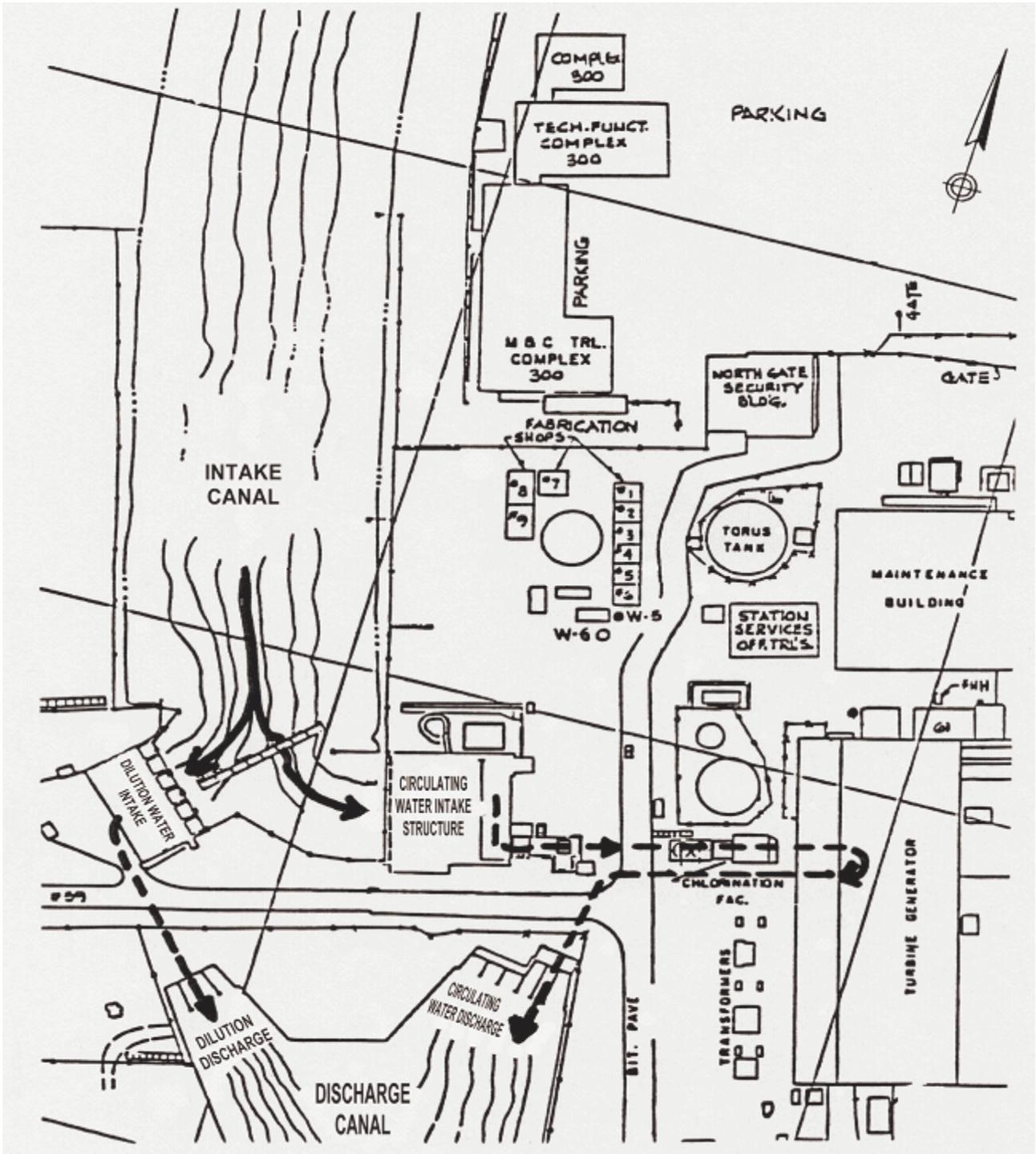


Figure 4-2
Schematic diagram of the Oyster Creek Nuclear Generating Station Circulating Water System (CWS) and Dilution Water System (DWS) flows.

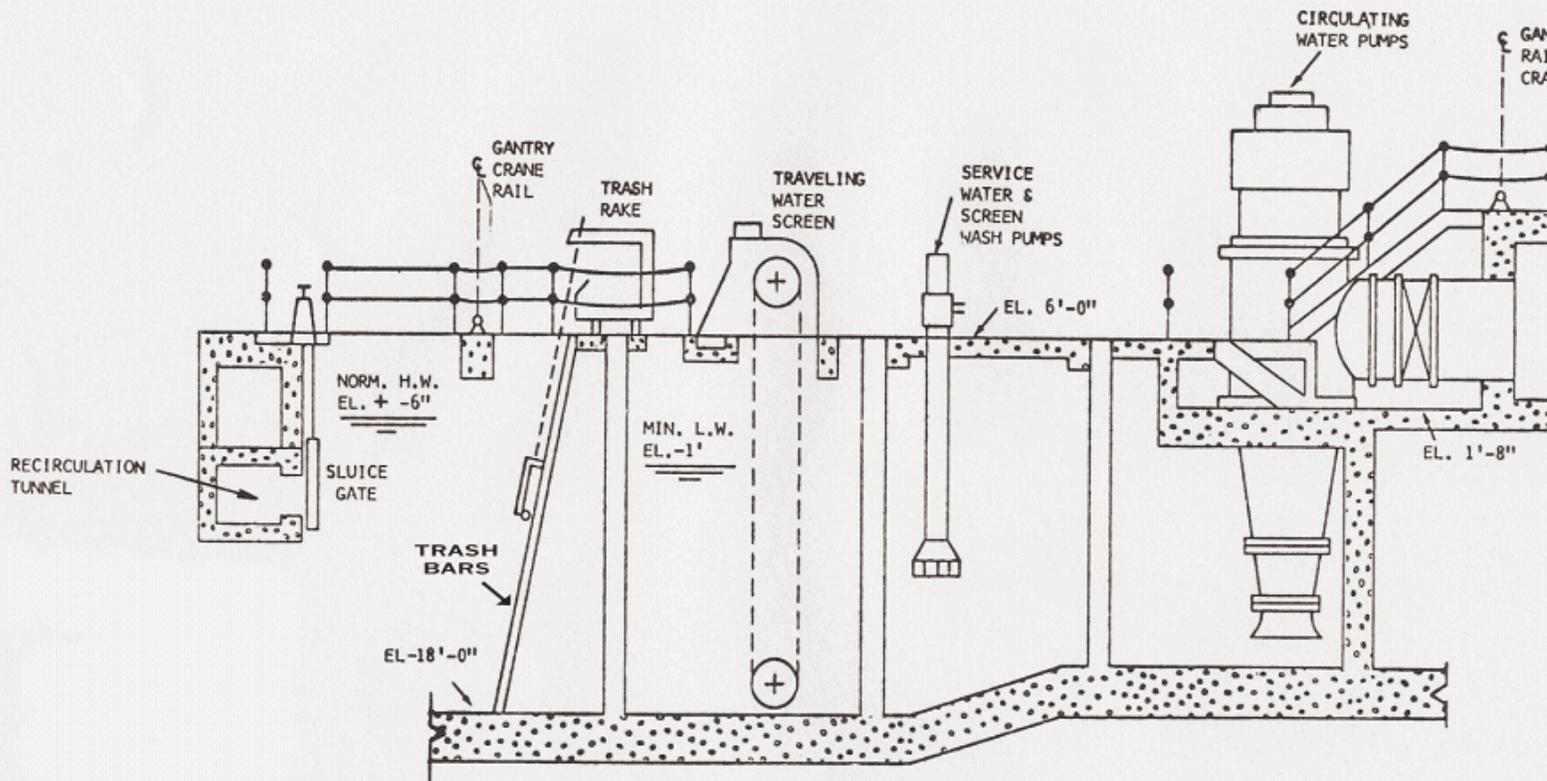


Figure 4-3

Oyster Creek Nuclear Generating Station Circulating Water System intake structure, section view.

Figure 4-4
 Oyster Creek Nuclear Generating Station
 Circulating Water System Intake Structure
 Plan View

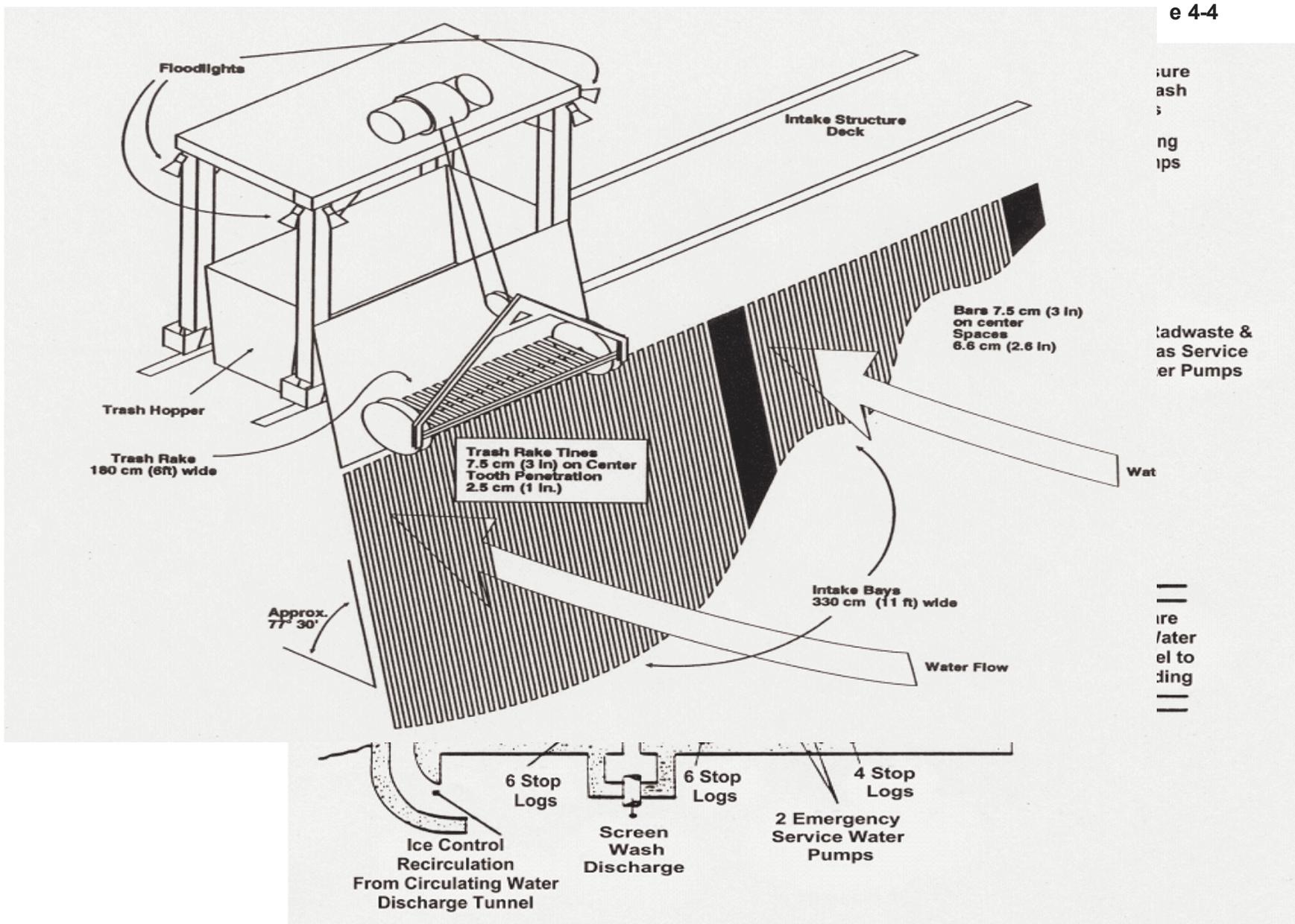


Figure 4-5
Schematic of the Oyster Creek Nuclear Generating Station Circulating Water System (CWS) and Dilution Water System (DWS) intake structures showing trash cart, trash rake and trash bars.

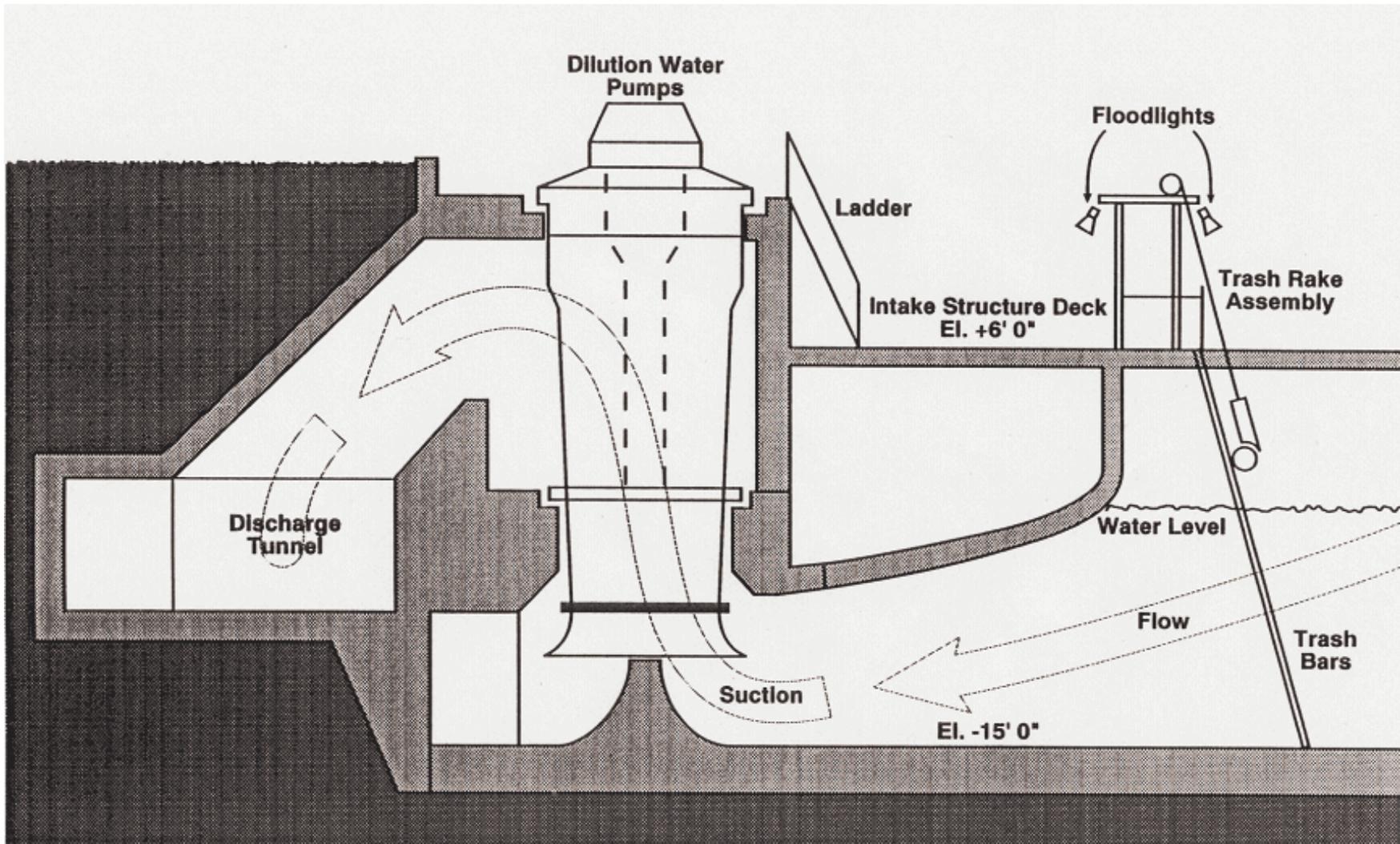


Figure 4-6
Oyster Creek Nuclear Generating Station Dilution Water System intake structure, section view.



Figure 4-7
View of the Oyster Creek Nuclear Generating Station Intake Canal looking upstream from the Dilution Water System Intake (top); closeup of trash rake and trash cart (bottom).



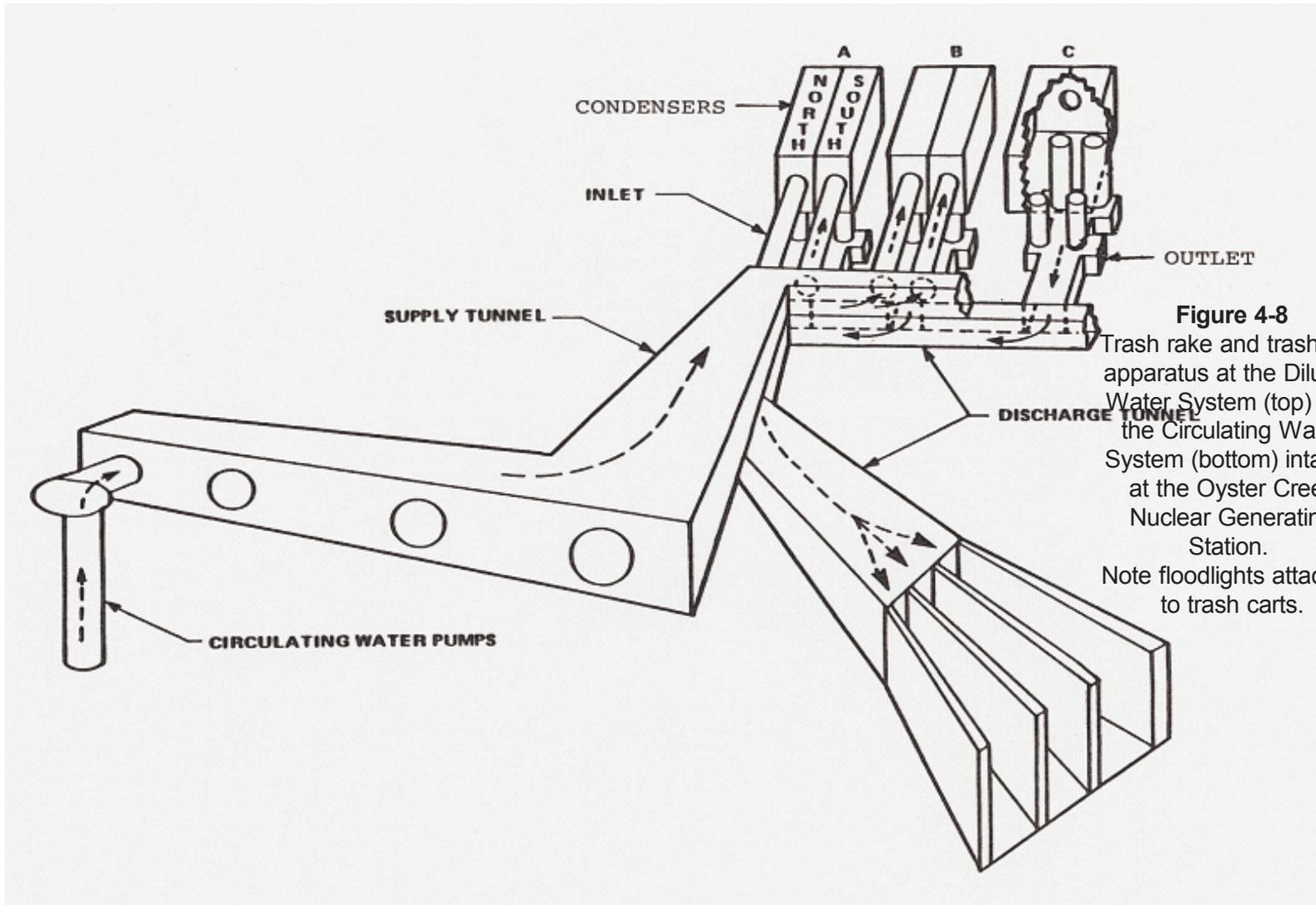


Figure 4-8
 Trash rake and trash cart apparatus at the Dilution Water System (top) and the Circulating Water System (bottom) intakes at the Oyster Creek Nuclear Generating Station.
 Note floodlights attached to trash carts.

Figure 4-9
Schematic (oblique view) of the intake and discharge tunnels at the Oyster Creek Nuclear
Generating Station.

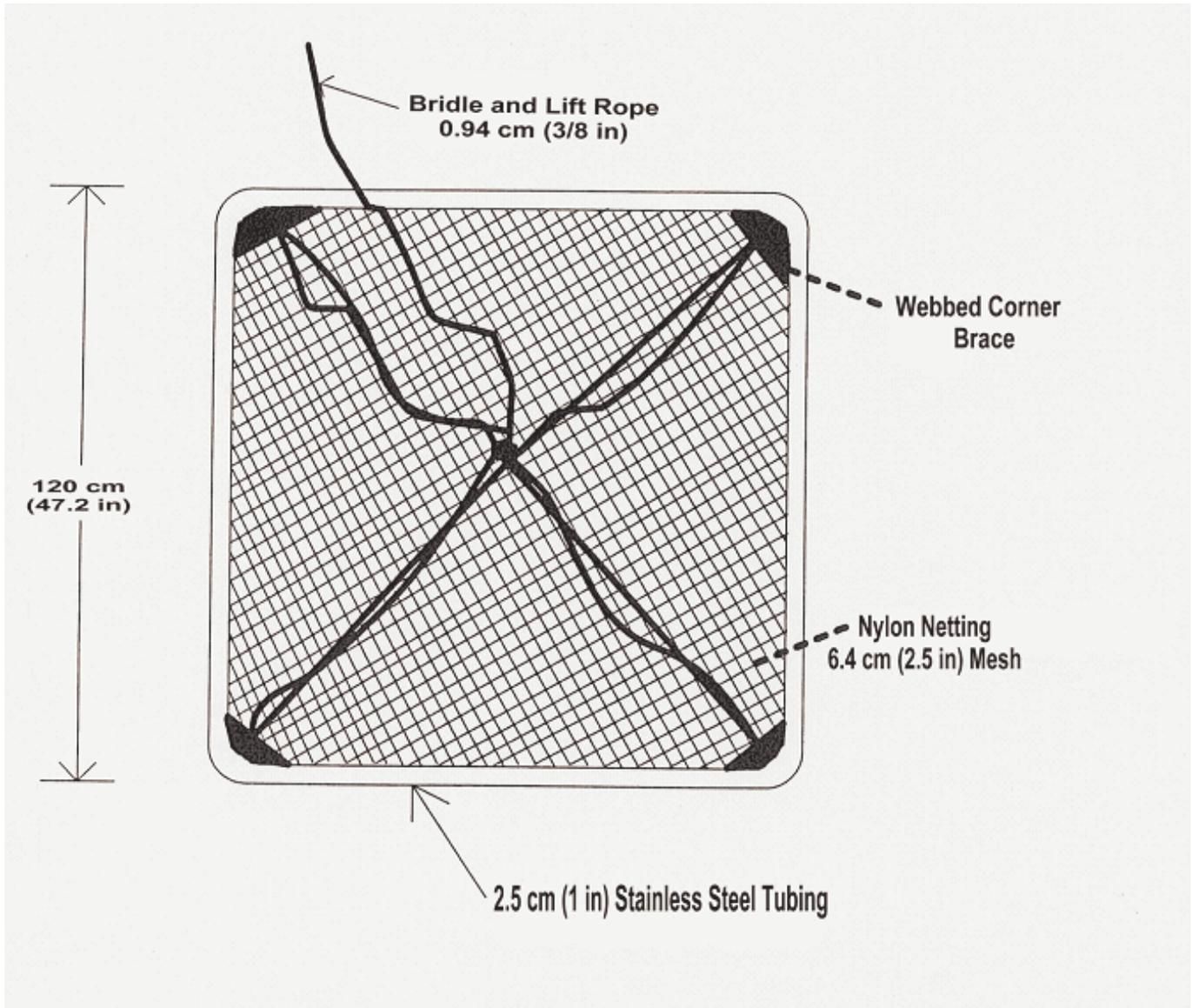


Figure 4-10
Sea turtle rescue sling/lift net.

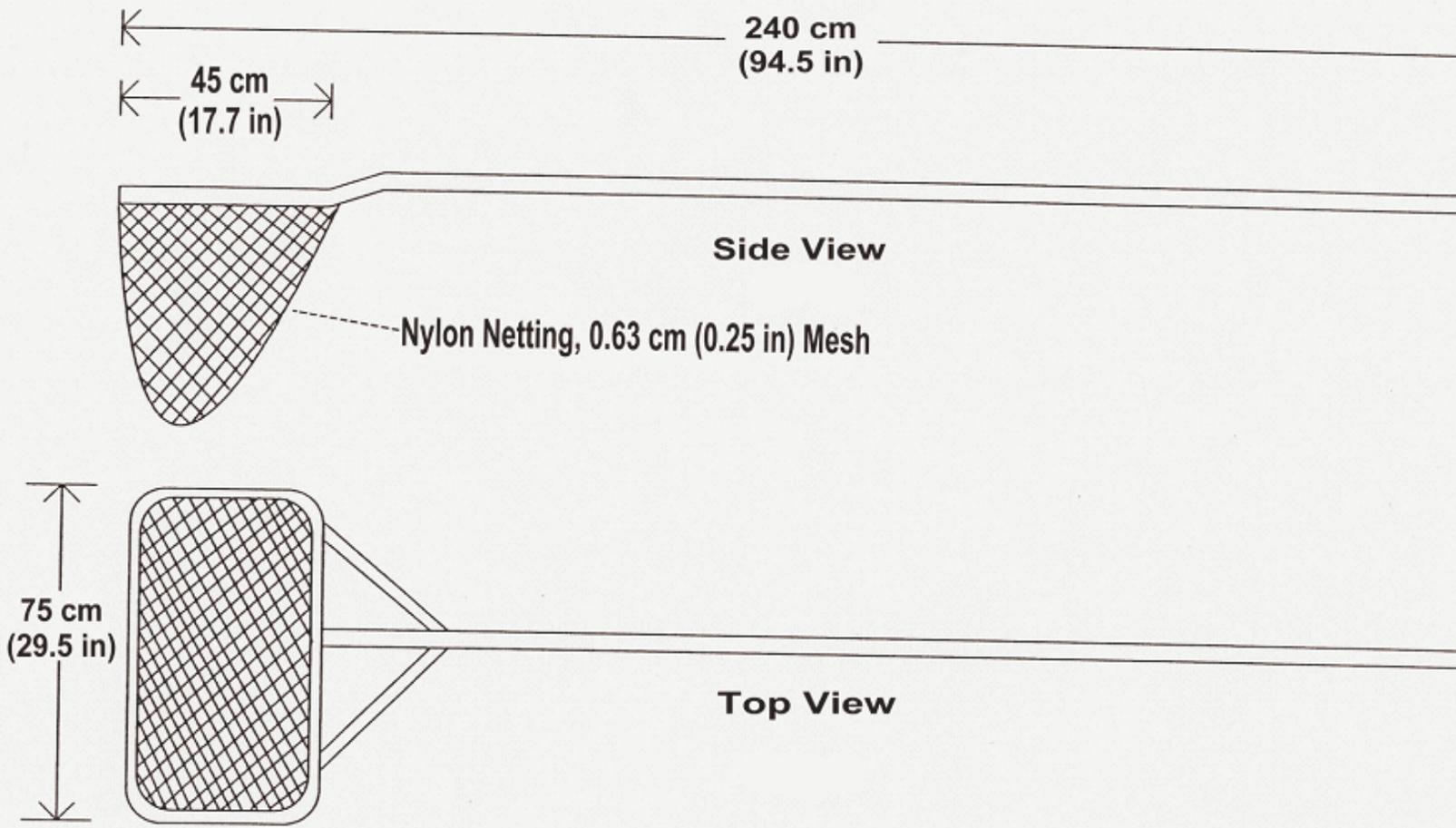


Figure 4-11
Long handled dipnet for sea turtle retrieval at the Oyster Creek Nuclear Generating Station.

5.0 Information on Sea Turtle Species

5.1 General Sea Turtle Information

Living sea turtles are taxonomically represented by two families, five genera, and seven species (Hopkins and Richardson 1984; Carr 1952). The family Cheloniidae is comprised of four genera and six distinct species. These species are *Caretta caretta* (loggerhead turtle), *Chelonia mydas* (green turtle), *Natador depressa* (flatback turtle), *Eretmochelys imbricata* (hawksbill turtle), *Lepidochelys kempii* (Kemp's ridley turtle), and *L. olivacea* (olive ridley turtle). The family Dermochelyidae is comprised of only one genus and species, *Dermochelys coriacea*, commonly referred to as the leatherback turtle.

Most sea turtle species are distributed throughout all of the tropical oceans. The flatback turtle is a major exception as it has a very limited range only in Pacific waters near Australia and Papua New Guinea. Also, the loggerhead occurs primarily in temperate latitudes, and the leatherback, although nesting in the tropics, frequently migrates into cold waters at higher latitudes because of its unique physiology (Mager 1985).

Sea turtles are believed to be descended from species known from the late Jurassic and Cretaceous periods that were included in the extinct family Thallasemyidae (Carr 1952; Hopkins and Richardson 1984). Modern sea turtles have short, thick, incompletely retractile necks, and legs that have been modified to become flippers (Bustard 1972; Carr 1952). All species, except the leatherback, have a hard, bony carapace modified for marine existence by streamlining and weight reduction (Bustard 1972). Chelonians have only a thin layer of bone covered by overlaying scutes and *D. coriacea* has a smooth scaleless black skin and soft carapace with seven longitudinal keels (Carr 1952). These differences in structure are the principal reason for their designation as the only species in the monotypic family Dermochelyidae (Carr 1952).

Sea turtles spend most of their lives in an aquatic environment, and males of many species may never leave the water (Hopkins and Richardson 1984; Nelson 1988). The recognized life stages for these turtles are egg, hatchling, juvenile/subadult, and adult (Hirth 1971). A generalized sea turtle life cycle is presented in Figure 5-1.

Reproductive cycles in adults of all species involve some degree of migration in which the animals return to nest at the same beach year after year (Hopkins and Richardson 1984). Nesting generally begins about mid April and continues into September (Hopkins and Richardson 1984; Nelson 1988; Carr 1952). Mating and copulation occur just off the nesting beach, and it is theorized that sperm from one nesting season may be stored by the female and thus fertilize a later season's eggs (Ehrhart 1980). A nesting female moved shoreward by the surf lands on the beach and crawls to a point above the high water mark (Carr 1952). She then proceeds to excavate a

shallow body pit by twisting her body in the sand (Bustard 1972). After digging the body pit she proceeds to excavate an egg chamber using her rear flippers (Carr 1952). Clutch size, egg size, and egg shape are species specific (Bustard 1972). Incubation periods for loggerhead, Kemp's ridley, Atlantic green, olive ridley, and flatback turtles average 55 days but range from 45 to 65 days depending on local conditions (Nelson 1988). Hawksbill and leatherback turtles have a slightly longer incubation period ranging from 50 to 74 days (Pacific Whale Foundation 2003; Connecticut Department of Environmental Protection 2000).

Hatchlings emerge from the nest at night, breaking the eggshell and digging their way out of the nest (Carr 1952). They find their way across the beach to the surf by orienting to light reflecting off the breaking surf (Hopkins and Richardson 1984). Once in the surf, hatchlings exhibit behavior known as "swim frenzy," during which they swim in a straight line for many hours (Carr 1986). Once into the waters off the nesting beach, hatchlings enter a period known as the "lost year." Researchers are presently trying to determine where young sea turtles spend their earliest years, what habitat(s) they prefer at this age, as well as typical survival rates during the "lost year" (i.e., during their post-hatchling early pelagic stage). It is currently believed the period encompassed by the "lost year" may actually turn out to be several years, and various hypotheses have been put forth regarding sea turtle activities during this period. One is that hatchlings may become associated with floating Sargassum rafts offshore. These rafts provide shelter and are dispersed randomly by the currents (Carr 1986). Another hypothesis is that the "lost year" of some species may be spent in a salt marsh/estuarine system (Garmon 1981).

The functional ecology of sea turtles in the marine and/or estuarine ecosystem is varied. The loggerhead is primarily carnivorous and has jaws well-adapted to crushing molluscs and crustaceans and grazing on encrusted organisms attached to reefs, pilings, and wrecks; the Kemp's ridley is omnivorous and feeds on swimming crabs, crustaceans, and molluscs (Seney et al. 2002); the Atlantic green turtle is a herbivore and grazes on marine grasses and algae; the leatherback is a specialized feeder preying primarily upon jellyfish; the olive ridley feeds mostly on shrimp, crabs, sea urchins, and jellyfish; the hawksbill is an omnivorous scavenger feeding mostly on sponges affixed to coral reefs as well as a few other invertebrates; the flatback prefers to eat sea cucumbers, soft corals, and jellyfish. Until recently, sea turtle populations were relatively large and subsequently played a significant role in the marine ecosystem. This role has been greatly reduced in most locations as a result of declining turtle populations. These population declines were a result of, among other things, natural factors such as disease and predation, habitat loss, commercial overutilization, commercial fishing bycatch mortality and the lack of comprehensive regulatory mechanisms to ensure their protection throughout their geographic range. This has led to several species being threatened with extinction.

Due to changes in habitat use during different life history stages and seasons, sea turtle populations are difficult to census (Meylan 1982). Because of these problems, estimates of population numbers have been derived from various indices such as numbers of nesting females, numbers of hatchlings per kilometer of nesting beach and number of subadult carcasses (strandings) washed ashore (Hopkins and Richardson 1984). Six of the seven extant species of sea turtles are protected under the Endangered Species Act. Three turtles, Kemp's ridley, hawksbill, and leatherback, are listed as endangered. The Florida nesting population of Atlantic green turtle and Mexican west coast population of olive ridley are also endangered. All of the remaining populations of Atlantic green turtle, olive ridley, and loggerhead are threatened. The only unlisted species is the locally-protected Australian flatback turtle (Hopkins and Richardson 1984). Only three species of sea turtles (loggerheads, Kemp's ridleys and occasionally Atlantic greens) have been reported from Barnegat Bay and coastal waters near the OCNCS. Leatherbacks do occur in coastal New Jersey waters but typically are found at considerable distances offshore. Although they have been reported, occurrences of hawksbills are rare north of Florida. This BA addresses

loggerheads, Kemp's ridleys, Atlantic greens, and leatherbacks; the ranges for olive ridleys, hawksbills, and flatbacks are beyond the scope of this BA and will not be discussed in detail. Regional sea turtle distribution will be discussed in more detail later in this section.

5.2 Loggerhead (*Caretta caretta*)

5.2.1 Description

The adult loggerhead turtle has a slightly-elongated, heart-shaped carapace that tapers towards the posterior and has a broad, triangular head (Pritchard et al. 1983). Loggerheads normally weigh up to 200 kg (450 lb) and attain a SCL up to 120 cm (48 in) (Pritchard et al. 1983). Their general coloration is reddish-brown dorsally and cream-yellow ventrally (Hopkins and Richardson 1984). Morphologically, the loggerhead is distinguishable from other sea turtle species by the following characteristics: 1) a hard shell; 2) two pairs of scutes on the front of the head; 3) five pairs of lateral scales on the carapace; 4) plastron with three pairs of enlarged scutes connecting the carapace; 5) two claws on each flipper; and, 6) reddish-brown coloration (Nelson 1988; Dodd 1988; Wolke and George 1981).

Loggerhead hatchlings are brown dorsally with light margins ventrally and have five pairs of lateral scales (Pritchard et al. 1983).

5.2.2 Distribution

Loggerhead turtles are circumglobal, inhabiting continental shelves, bays, lagoons, and estuaries in the temperate, subtropical and tropical waters of the Atlantic, Pacific, and Indian Oceans (Dodd 1988; Mager 1985).

In the western Atlantic Ocean, loggerhead turtles occur from Argentina northward to Newfoundland including the Gulf of Mexico and the Caribbean Sea (Carr 1952; Dodd 1988; Mager 1985; Nelson 1988; Squires 1954). Sporadic nesting is reported throughout the tropical and warmer temperate range of distribution, but the most important nesting areas are the Atlantic coast of Florida, Georgia, and South Carolina (Hopkins and Richardson 1984). The Florida nesting population of loggerheads has been estimated to be the second largest in the world (Ross 1982).

The foraging range of the loggerhead sea turtle extends throughout the warm waters of the U.S. continental shelf (Shoop et al. 1981). On a seasonal basis, loggerhead turtles are common as far north as the Canadian portions of the Gulf of Maine (Lazell 1980), but during cooler months of the year, distributions shift to the south (Shoop et al. 1981). Loggerheads frequently forage around coral reefs, rocky places, and old boat wrecks; they commonly enter bays, lagoons and estuaries (Dodd 1988). Aerial surveys of loggerhead turtles at sea indicate that they are most common in waters less than 50 m (164 ft) in depth (Shoop et al. 1981), but they occur pelagically as well (Carr 1986).

5.2.3 Food

Loggerheads are primarily carnivorous (Mortimer 1982). They eat a variety of benthic organisms including molluscs, crabs, shrimp, jellyfish, sea urchins, sponges, squids, and fishes (Nelson 1988; Seney et al. 2002). Adult loggerheads have been observed feeding in reef and hard bottom areas (Mortimer 1982). In the seagrass lagoons of Mosquito Lagoon, Florida, subadult loggerheads fed almost exclusively on horseshoe crab (Mendonca and Ehrhart 1982). Loggerheads may also eat animals discarded by commercial trawlers (Shoop and Ruckdeschel 1982). This benthic feeding characteristic may contribute to the capture of these turtles in trawls.

5.2.4 Nesting

The nesting season of the loggerhead is confined to the warmer months of the year in the temperate zones of the northern hemisphere. In south Florida nesting may occur from April through September but usually peaks in late June and July (Dodd 1988; Florida Power & Light Company 1983).

Loggerhead females generally nest every other year or every third year (Hopkins and Richardson 1984) but multi-annual remigration intervals ranging from one to six years have been reported (Bjorndal et al. 1983; Richardson et al. 1978). When a loggerhead nests, it usually lay two to three clutches of eggs per season and lay 35 to 180 eggs per clutch (Hopkins and Richardson 1984). The eggs hatch in 46 to 68 days and hatchlings emerge two or three days later (Crouse 1985; Hopkins and Richardson 1984; Kraemer 1979).

Hatchling loggerheads are a little less than 5 cm (2 in) in length when they emerge from the nest (Hopkins and Richardson 1984; Florida Power & Light Company 1983). They emerge from the nest as a group at night, orient themselves seaward and rapidly move towards the water (Hopkins and Richardson 1984). Many hatchlings fall prey to sea birds and other predators following emergence. Those hatchlings that reach the water quickly move offshore and exist pelagically (Carr 1986).

There are at least four loggerhead nesting subpopulations in the western North Atlantic (Turtle Expert Working Group 2000). The Northern Nesting Subpopulation occurs from North Carolina to northeast Florida. The Southern Florida Nesting Subpopulation is the largest loggerhead nesting assemblage in the Atlantic, occurring from 29° N on the east coast to Sarasota on the west coast. The Florida Panhandle Nesting Subpopulation is found at Eglin Air Force Base and the beaches near Panama City, Florida. The Yucatan Nesting Subpopulation occurs on the eastern Yucatan Peninsula, Mexico. Historically, only minor nesting activity has occurred elsewhere in the western North Atlantic, with the exception of Central America (Turtle Expert Working Group 2000).

Nesting by loggerheads as far north as the New Jersey coast is considered rare. Anecdotal reports of loggerhead nests at Ocean City, NJ and Island Beach State Park during the 1980s are among the few known nesting activities in local waters (Schoelkopf, personal communication, 1993). More recently, a loggerhead nest was found at Holgate, NJ on Long Beach Island during the summer of 1994 (Schoelkopf, personal communication, 1994).

5.2.5 Population Size

Loggerhead sea turtles are the most common sea turtle in the coastal waters of the United States. Population size and temporal trends in abundance have been estimated using nesting data, stranding data and aerial surveys.

Based on numbers of nesting females, hatchlings per kilometer of nesting beach, and subadult carcasses (strandings) washed ashore, the total number of mature loggerhead females in the southeastern United States has been estimated to be from 35,375 to 72,520 (Hopkins and Richardson 1984; Gordon 1983). The annual average adult female population along the U.S. Atlantic and Gulf coasts for the period 1989-1998 was estimated to be 44,780 individuals based upon nesting data (Turtle Expert Working Group 2000).

Adult and subadult (shell length greater than 60 cm [24 in]) population estimates have also been based on aerial surveys of pelagic animals observed by NOAA Fisheries during 1982 to 1984. Based on these studies, the number of adult and subadult loggerhead sea turtles from Cape Hatteras, North Carolina to Key West, Florida was estimated to be 387,594 individuals (NMFS 1987). This number was arrived at by taking the number of observed turtles and converting it to a population abundance estimate using information on the amount of time loggerheads typically spend at the surface.

Some sea turtles that die at sea wash ashore and are found stranded. The NOAA Fisheries Sea Turtle Salvage and Stranding Network (STSSN) collects stranded sea turtles along both the Atlantic and Gulf Coasts (Turtle Expert Working Group 2000; STSSN 2004). The largest number of loggerhead strandings during the period 1986-2001 (Figure 5-2) occurred along the southeast Atlantic Coast (14,404 turtles; 61 percent of total), followed by the Gulf Coast (5,320 turtles; 22 percent of total) and the northeast Atlantic Coast (4,047 turtles; 17 percent of total). Strandings in the southeast U.S. and the Gulf of Mexico declined in the early 1990's, but have generally increased since then. Strandings in the northeast have more than doubled during the same time period (Turtle Expert Working Group 2000; STSSN 2004).

Frazer (1986) suggested that loggerhead turtle nesting populations in the U.S. were declining, but positive steps have been taken to reverse that trend. In September of 1989, NOAA Fisheries regulations requiring the use of turtle excluder devices (TEDs) on commercial shrimp trawls were implemented. Based upon onboard observations of offshore shrimp trawling in the southeast Atlantic, NOAA Fisheries estimated that over 43,000 loggerheads were captured in shrimp trawls annually. The number of loggerhead mortalities from this activity was estimated to be 9,874 turtles annually (NMFS 1987). An estimated 5,000 to 50,000 loggerheads were killed annually during commercial shrimp fishing activities prior to regulations requiring the use of TEDs (NMFS 1991a). The use of TEDs may reduce sea turtle mortality in shrimp trawls by as much as 97 percent (Crouse et al. 1992). Studies of TED effects on reducing strandings in South Carolina and Georgia during the period 1980-1997 demonstrated reductions in strandings ranging from 40 to 58 percent (Crowder et al. 1995; Royle and Crowder 1998). Following the implementation of the TED requirement, strandings of drowned threatened and endangered sea turtle species, in areas where strandings were historically high, were dramatically lower for a few years (Figure 5-2), suggesting a

reduction in shrimp trawl related mortality (Crouse et al. 1992; Turtle Expert Working Group 2000). Increases in strandings since 1993 are indicative of an increasing loggerhead population (Turtle Expert Working Group 2000).

Sea turtle nesting activity on two key beaches also increased considerably subsequent to the implementation of the TED regulations (Crouse et al. 1992). The total number of loggerhead nests laid along the U.S. Atlantic and Gulf coasts from 1989 through 1998 ranged from 53,014 to 92,182 per year. The number of nests increased at an average rate of approximately 3.6 percent per year and reached the maximum observed number (92,182) in 1998 (Turtle Expert Working Group 2000).

In addition to the apparent success of the TED program, restrictions on development in coastal areas have become more widespread in recent years and may reduce the rate of nesting habitat loss for sea turtles.

The observed trends in strandings and nesting activity in recent years, along with some evidence of a shift in size class distribution toward smaller turtles, suggest that the U.S. loggerhead population is increasing (Turtle Expert Working Group 2000) and that effective measures have been taken to mitigate a major source of loggerhead mortality. Various population estimates suggest that the number of adult and subadult turtles is probably in the hundreds of thousands in the southeastern United States alone. In addition, large populations of loggerheads occur in many other parts of the world (Ross and Barwani 1982; NMFS 1991a). These facts suggest that although this species needs to be conserved, it is not in any immediate risk of becoming endangered.

5.3 Kemp's Ridley (*Lepidochelys kempii*)

5.3.1 Description

The adult Kemp's ridley has a circular carapace and a medium-sized pointed head. Kemp's ridleys are the smallest of extant sea turtles. They normally weigh up to 42 kg (90 lb) and attain a SCL up to 70 cm (27 in) (Pritchard et al. 1983). Their general coloration is olivegreen dorsally and yellow ventrally (Hopkins and Richardson 1984). Morphologically, the Kemp's ridley is distinguishable from other sea turtle species by the following characteristics: 1) a hard shell; 2) two pairs of scutes on the front of the head; 3) five pairs of lateral scutes on the carapace; 4) plastron with four pairs of scutes, with pores, connecting the carapace; 5) one claw on each front flipper and two on each back flipper; and, 6) olive green coloration (Pritchard et al. 1983; Pritchard and Marquez 1973).

Kemp's ridley hatchlings are dark grey-black dorsally and white ventrally (Pritchard et al. 1983; Pritchard and Marquez 1973).

5.3.2 Distribution

Kemp's ridley turtles inhabit sheltered coastal areas and frequent larger estuaries, bays, and lagoons in the temperate, subtropical and tropical waters of the northwestern Atlantic Ocean and Gulf of Mexico (Mager 1985).

The foraging range of adult Kemp's ridley turtles appears to be restricted to the Gulf of Mexico. However, juveniles and subadults occur throughout the warm coastal waters of the U.S. Atlantic coast (Hopkins and Richardson 1984; Pritchard and Marquez 1973). Juveniles and subadults travel northward with vernal warming to feed in the productive coastal waters of Georgia through New England, but return southward with the onset of winter to escape the cold (Henwood and Ogren 1987; Lutcavage and Musick 1985; Morreale et al. 1988; Ogren 1989).

5.3.3 Food

Kemp's ridleys are omnivorous and feed on swimming crabs, crustaceans, fish, jellyfish, and molluscs (Pritchard and Marquez 1973; Seney et al. 2002).

5.3.4 Nesting

Nesting of Kemp's ridleys is mainly restricted to a stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Pritchard and Marquez 1973; Hopkins and Richardson 1984). Occasional nesting has been reported in Padre Island, Texas and Veracruz, Mexico (Mager 1985; Turtle Expert Working Group 2000). An estimated 40,000 females nested on a single day in 1947, but between 1978 and 1990 there were less than 1,000 nests per season (Figures 5-3 and 5-4).

The nesting season of the Kemp's ridley is confined to the warmer months of the year primarily from April through July. Kemp's ridley females generally nest every year to every third year (Márquez et al. 1982; Pritchard et al. 1983). They lay two to three clutches of eggs per season and lay 50 to 185 eggs per clutch. The eggs hatch in 45 to 70 days and hatchlings emerge two to three days later (Hopkins and Richardson 1984).

Hatchling Kemp's ridleys are about 4.2 cm (a little less than 2 in) in length when they emerge from the nest (Hopkins and Richardson 1984). They emerge from the nest as a group at night, orient themselves seaward and rapidly move towards the water (Hopkins and Richardson 1984). Following emergence, many hatchlings fall prey to sea birds, raccoons, and crabs. Those hatchlings that reach the water quickly move offshore. Their existence after emerging is not well understood but is probably pelagic (Carr 1986). The post-pelagic stages are commonly found dwelling over crab-rich sandy or muddy bottoms. Juveniles frequent bays, coastal lagoons, and river mouths (NMFS 1992b).

5.3.5 Population Size

The Kemp's ridley is the most endangered of the sea turtle species. Based on nesting information from Rancho Nuevo, Ross (1989) estimated that the population was declining at a rate of approximately three percent per year. The lowest number of nests was observed in 1985 (740 nests), but since that time the number of nests has increased by approximately 11.3 percent per year (Turtle Expert Working Group 2000). In 1994, 1,565 nests were observed at Rancho Nuevo, and more Kemp's ridley nests have been laid each year since 1990 than in any previous year on record since 1978 (Byles, 1994). By 2000, the number of nests found at Rancho Nuevo increased to 3,788 (Marquez et al. 2001). It has been suggested that this increase in nesting activity reflects the reduction in shrimp trawl related mortality realized since the implementation of the NMFS TED regulations in September of 1989 (Crouse et al. 1992; Turtle Expert Working Group 2000). This hypothesis is supported by analyses of the number of nests counted versus hatchlings released (Turtle Expert Working Group 2000). The results of those analyses indicate that there has been an increase in survivorship from hatchling to maturity during the late 1980s and early 1990s. The increase in nesting activity is also likely to be attributable in part to an increase in recruitment to the population as a result of beach and nest protection efforts at Rancho Nuevo (Marquez et al. 1999; Turtle Expert Working group 2000). The adult Kemp's ridley population was estimated by Márquez (1989) to be approximately 2,200 adults based on the numbers of nests produced at Rancho Nuevo, this species's nesting cycle, male-female ratios, and fecundity. More recently, the Turtle Expert Working Group (1998; 2000) reported that age-based population models suggest that the Kemp's ridley population is increasing rapidly and that the trend was expected to continue into the future. While there is no current population estimate, the nesting population is estimated to be increasing ten percent each year (NOAA Fisheries 2003). As a result, we can expect to find increasing numbers of juveniles and subadults migrating northward each year as Atlantic coastal waters warm, to feed in the productive coastal estuaries.

Population estimates of immature *Lepidochelys kempii* are difficult to develop. Increases have been noted in the number of juvenile captures during the late 1980's and early 1990's in long-term tagging studies in the northeast Gulf of Mexico (Ogren, unpublished data). If this increase is indicative of an overall increase in the juvenile population, more recruitment into the adult population should occur in the future (NMFS 1991a).

Kemp's ridleys also die at sea and wash ashore. The NOAA Fisheries Sea Turtle Salvage and Stranding Network (STSSN) collects stranded sea turtles along both the Atlantic and Gulf Coasts (Turtle Expert Working Group 2000; STSSN 2004; Figure 5-5). The largest number of Kemp's ridley strandings during the period 1986-2001 occurred along the Gulf Coast (3,495 turtles; 60 percent of total), followed by the southeast Atlantic Coast (1,555 turtles; 27 percent of total) and the northeast Atlantic Coast (748 turtles; 13 percent of total). The number of strandings along the Gulf Coast increased sharply in 1994 and 1995 but subsequently remained fairly constant (Turtle Expert Working Group 2000). Along the southeast Atlantic Coast, the number of strandings decreased somewhat during the early 1990s but tended to increase from 1993 through 2001. The number of strandings along the northeast Atlantic Coast was low and variable through 1997, but a noticeable increase was observed during the 1998-2001 period (Figure 5-5). A dramatic increase in strandings of Kemp's

ridleys was also observed along the North Carolina coast from 1993 to 1999 (Boettcher 2002). Prior to 1993, 20 or fewer Kemp's ridley strandings were reported annually. The number of stranded individuals steadily increased from 12 in 1992 to a maximum of 122 in 1999. The timing of these increases in Kemp's ridley strandings seems to coincide with the implementation of the NOAA Fisheries TED regulations described above, and suggests that the population is increasing.

An analysis of the size of stranded Kemp's ridleys indicated that many more large immature individuals were stranded during the 1990s relative to the 1980s (Turtle Expert Working Group 2000). These results also suggest that juvenile mortality has decreased and that the population is increasing.

Onboard observation of offshore shrimp trawling by NOAA Fisheries in the southeast Atlantic indicated that over 2,800 Kemp's ridleys are captured in shrimp trawls annually. The number of Kemp's ridley mortalities attributable to this activity was estimated to be 767 turtles annually and most of these (65 percent) occurred in the western portion of the Gulf of Mexico (NMFS 1987). Magnuson et al. (1990) estimated the annual shrimp trawl bycatch mortality to be between 500 and 5,000 individuals. As discussed above, significant reductions in this source of mortality have been achieved as a result of the implementation of the TED regulations by the NOAA Fisheries in 1989 (Crouse et al. 1992). The reduction in shrimp-trawl-related mortality, as well as the efforts to protect nesting beaches, have probably resulted in the recent indications that the population is steadily increasing (Turtle Expert Working Group 1998; 2000).

Despite these improvements, the data suggest that this population remains at critically-low levels. This species was listed as endangered in 1970 and is considered the most endangered of all sea turtles (NMFS 1991a; Burke et al. 1994).

5.4 Atlantic Green Turtle (*Chelonia mydas*)

5.4.1 Description

The Atlantic green turtle is a medium-to-large sea turtle with a nearly oval carapace and a small, rounded head (Pritchard et al. 1983). Its carapace is smooth and olive brown in color with darker streaks and spots. Its plastron is yellow. Full-grown adult Atlantic greens normally weigh 100 to 150 kg (220 to 330 lb) and attain a SCL of 90 to 100 cm (35 to 40 in) (Pritchard et al. 1983; Hopkins and Richardson 1984; Witherington and Ehrhart 1989). Morphologically, this species can be distinguished from the other sea turtles by the following characteristics: 1) a relatively smooth shell with no overlapping scutes; 2) one pair of scutes on the front of the head; 3) four pairs of lateral scutes on the carapace; 4) plastron with four pairs of enlarged scutes connecting the carapace; 5) one claw on each flipper; and, 6) olive, dark brown mottled coloration (Nelson 1988; Pritchard et al. 1983; Carr 1952).

Hatchlings are about 25 grams (0.88 ounces) and 55 millimeters (2.2 in) long. They have a black carapace that is white on the ventral side.

5.4.2 Distribution

Atlantic green turtles are circumglobally distributed mainly in waters between the northern and southern 20 EC (68 EF) isotherms (Mager 1985). Preferred nesting grounds include sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands (NOAA Fisheries 2002).

In the western Atlantic, several major assemblages have been identified and studied (Parsons 1962; Pritchard 1966; Schulz 1975; 1982; Carr et al. 1978). In U.S. Atlantic waters, Atlantic green turtles are found around the U.S. Virgin Islands, Puerto Rico, and the continental United States from Texas to Massachusetts (NMFS, 1991b). Nesting grounds extend from Texas to North Carolina as well as in the U.S. Virgin Islands and Puerto Rico. Eastern Florida has some of the main nesting beaches; other important nesting beaches are found on St. Croix and Puerto Rico (NOAA Fisheries 2002). Critical habitat is designated in waters around Isla Culebra, Puerto Rico.

5.4.3 Food

Atlantic green turtles leave their pelagic habitat phase and enter benthic feeding grounds upon reaching a SCL of 20 to 25 cm (8-10 in). They are primarily herbivores eating sea grasses and algae (NMFS 1991b). Jellyfish, sponges, and other organisms living on sea grass blades and algae add to their diet (Mager 1985). Pelagic post-hatchlings are most likely omnivorous (NOAA Fisheries 2002).

5.4.4 Nesting

Atlantic green turtle nesting primarily occurs on the Atlantic coast of Florida from June to September (Hopkins and Richardson 1984). Other important nesting beaches include beaches in Yucatán and Tortuguero, Costa Rica. It is thought that nesting activity is increasing in Florida and Tortuguero; sparse data make it impossible to reliably estimate nesting trends in Yucatán (NOAA Fisheries 2002).

Although males mate annually, females only nest every two to four years (NOAA Fisheries 2002). Mature females may nest one to seven times per season at about 10-to-18-day intervals (Carr et al. 1978). Average clutch sizes vary between 100 and 200 eggs that usually hatch within 45 to 60 days (Hopkins and Richardson 1984). Hatchlings emerge, mostly at night, travel quickly to the water, and swim out to sea. At this point, they enter a period that is poorly understood but is likely spent pelagically in areas where currents concentrate debris and floating vegetation such as *Sargassum* spp. (Carr 1986).

5.4.5 Population Size

Elimination and deterioration of many nesting beaches and less-frequent encounters with green turtles provided inferential evidence of declining stocks in the early to mid 1980s (Mager 1985; Hopkins and Richardson 1984). The number of Atlantic green sea turtles that existed before commercial exploitation and the total number that now exists are not known. Records show drastic declines in the Florida catch during the 1800s, and similar declines occurred in other areas, such as Texas, where they were commercially harvested in the past (Hildebrand 1982; Hopkins and Richardson 1984). Although estimates are not available for the total population, it is estimated, while taking into account the two-year remigration interval, that the nesting population in the southeastern U.S. is recovering and has reached an approximate level of 1,000 nesting females (NOAA Fisheries 2002). Also, in Indian River Lagoon in Florida, a long-term study in juvenile foraging grounds found significant increases between the early and late 1980s in the population of juvenile green turtles (NOAA Fisheries 2002).

There are many ongoing threats to the Atlantic green turtle population. While TED regulations have helped reduce incidental take in trawl fisheries, incidental takes with fishing gear interactions continue to occur. Other threats at sea include pollution, foraging habitat loss through human-based direct destruction and secondary siltation, vessel strikes, and suction dredges. Nesting beaches are threatened by erosion control, artificial lighting, beach armoring, and disturbance. Finally, green turtle fibropapillomatosis disease, an often fatal tumor disease, is widespread and may be a contributor to population decline in Hawaii and Florida (NOAA Fisheries 2002). Outside the U.S., some areas continue direct takes of green turtles for their shells, eggs, and meat.

5.5 Leatherback Turtle (*Dermochelys coriacea*)

5.5.1 Description

The leatherback turtle is the largest sea turtle. It has an elongated, somewhat triangularly-shaped body with longitudinal ridges or keels. It has a leathery, blue-black shell composed of a thick layer of oily, vascularized, cartilaginous material, strengthened by a mosaic of thousands of small bones. This blue-black shell may also have variable white spotting (Pritchard et al. 1983). Its plastron is white. Leatherbacks normally weigh up to 300 kg (660 lb) and attain a SCL of 140 cm (55 in) (Pritchard et al. 1983; Hopkins and Richardson 1984). Specimens as large as 910 kg (2,000 lb) have been observed.

Morphologically, this species can be easily distinguished from the other sea turtles by the following characteristics: 1) its smooth unscaled carapace; 2) carapace with seven longitudinal ridges; 3) head and flippers covered with unscaled skin; and, 4) no claws on the flippers (Nelson 1988; Pritchard et al. 1983; Pritchard 1971; Carr 1952).

5.5.2 Distribution

Leatherbacks have a circumglobal distribution and occur in the Atlantic, Indian, and Pacific Oceans. They range as far north as Labrador and Alaska to as far south as Chile and the Cape of Good Hope. Their occurrence farther north than other sea turtle species is probably related to their ability to maintain a warmer body temperature over a longer period of time (NMFS 1985). Thompson (1984) reported that leatherbacks prefer water temperatures of about 20 EC (± 50) (68 EF) and were likely to be associated with cooler, more productive waters than the Gulf Stream.

Aerial surveys have shown leatherbacks to be present from April to November between North Carolina and Nova Scotia, but most likely to be observed from the Gulf of Maine south to Long Island during summer (Shoop et al. 1981).

5.5.3 Food

The diet of the leatherback consists primarily of soft-bodied animals such as jellyfish and tunicates, together with juvenile fishes, amphipods, and other organisms (Hopkins and Richardson 1984).

5.5.4 Nesting

Leatherback turtle nesting occurs on the mid-Atlantic coast of Florida from late February or March to September (Hopkins and Richardson 1984; NMFS 1992a). Mature females may nest one to nine times per season at about 9-to-17-day intervals. Average clutch sizes vary between 50 and 170 eggs that usually hatch within 50 to 75 days (Hopkins and Richardson 1984; Tucker 1988). Hatchlings emerge, mostly at night, travel quickly to the water, and swim out to sea. The life history of the leatherback is poorly understood since juvenile turtles are rarely observed.

5.5.5 Population Size

The world population estimates for the leatherback have been revised upward to over 100,000 females in recent years due to the discovery of nesting beaches in Mexico (Pritchard 1983).

5.6 Hawksbill Turtle (*Eretmochelys imbricata*)

5.6.1 Description

Hawksbills are small to medium turtles with elongated heads with pointy mouths. The hawksbill turtle is best known for its “tortoise shell” carapace, which is mostly brown, mottled with light and dark spots on the dorsal side. The ventral side is a light yellow or white, acting as a natural camouflage against predators. Identifying characteristics include overlapping costal scutes, serrated marginal scutes, two pairs of prefrontal scales, and two claws on each flipper. The hatchling and juvenile carapaces are heart-shaped and become elongated as the turtles mature.

5.6.2 Distribution

Posthatchlings are pelagic while juvenile, subadult, and adult hawksbills are found in coral reef environments or in bays and estuaries with mangroves when coral reefs are absent. Generally, hawksbills are found in tropical and subtropical waters, although they have been sighted as far north as Maine in Atlantic waters. Most sightings on the eastern coast of the U.S. have been reported from Florida and Texas.

5.6.3 Food

The hawksbill diet consists mostly of sponges found on coral reefs. Other common prey include mollusks, algae, sea anemones, squid, and other invertebrates. Hawksbills use their sharp beak-like mouth to forage for sponges in crevices of coral reefs (Pacific Whale Foundation 2003).

5.6.4 Nesting

Hawksbill turtles have solitary nesting behavior and are known to nest in the U.S. in Puerto Rico, U.S Virgin Islands, Florida, and Hawaii. Critical habitat is designated for nesting beaches in Puerto Rico. Individual nesting sites are often under vegetation. Females nest every two to three years, and lay up to six clutches per season with a 15-to-21-day interval; the average clutch size has 130 eggs (Pacific Whale Foundation 2003).

5.6.5 Population Size

Although there are little data about the hawksbill turtle, nesting populations are thought to be declining. An estimate based on data from the early to mid 1990s is approximately 34,000 nesting females (Caribbean Conservation Corporation 2003a). Critical habitat is designated for some nesting beaches in Puerto Rico, but Mexico probably has the biggest nesting population in the Atlantic and Caribbean. Most sightings off Texas and Florida are thought to be of populations from the Mexican nesting beaches.

5.7 Sea Turtles in Coastal Waters of New Jersey

Four species of sea turtle – loggerhead, Kemp’s ridley, green, and leatherback – are known to occur in the coastal marine and estuarine waters of New Jersey, based on the records of sea turtle strandings compiled by the Marine Mammal Stranding Center (MMSC) (Schoelkopf 1994; Schoelkopf 2000; Bailey 2004). The MMSC is a member of the Northeast Sea Turtle Salvage and Stranding Network supported by NOAA Fisheries. The records of the MMSC include strandings of sea turtles along the seaside beaches of New Jersey as well as New Jersey’s coastal embayments and estuaries such as Barnegat Bay and Delaware Bay.

The MMSC reported 1,254 sea turtle strandings in coastal New Jersey, from Delaware Bay to Sandy Hook, between 1977 and 2004 (Table 5-1). A total of 32 strandings (2.6 percent of total for New Jersey) occurred at the OCNGS during 1977-2004. The details of the strandings that occurred at the OCNGS are discussed in Section 6.0.

Loggerheads were the most commonly stranded turtle, comprising about two-thirds of the strandings in New Jersey between 1977 and 2004. Kemp’s ridleys and leatherbacks were less common (5.4 and 26 percent of the strandings, respectively). Less than two percent of the reported strandings were Atlantic green turtles (Schoelkopf 1994; Schoelkopf 2000; Bailey 2004). Similar to the trends observed at other locations along the Atlantic coast (Turtle Expert Working Group 2000; Boettcher 2002; STSSN 2004), the number of strandings in New Jersey has generally tended to increase since the late 1980s (Table 5-1).

The vast majority of the strandings in New Jersey have occurred between June and October (Table 5-2), coincident with the seasonal movements of juveniles and subadults along the Atlantic coast, although leatherbacks occur virtually all year in New Jersey.

Stomach content analyses from dead turtles have shown that primary food items for loggerheads are often blue crabs and horseshoe crabs. Blue crabs occur during most of the year in the OCNGS intake and discharge canals and adjacent areas of Barnegat Bay. Horseshoe crabs move into Barnegat Bay to lay eggs in the spring and summer, which coincides with the northward seasonal movement of loggerheads along the coast. Also, Kemp’s ridley stomachs that have been examined often contain primarily blue crab. From a functional, ecological viewpoint, loggerheads and Kemp’s ridleys would be secondary consumers. They are not likely to be an important link in the Barnegat Bay food web because of their apparently low abundance.

5.7.1 Sea Turtles in Barnegat Bay

Sea turtles are not commonly found in Barnegat Bay. From 1975 to 1985, GPU Nuclear Corporation (OCNGS owner prior to AmerGen) and its environmental consultants conducted a biological monitoring program designed to describe and quantify the marine biota of

Barneгат Bay. The program included sampling organisms impinged upon the CWS traveling screens and entrained in the cooling water flow of the condenser and dilution pump intakes at the OCNGS. In addition, thousands of trawl, seine, and gillnet samples were collected in Barneгат Bay, Forked River, and Oyster Creek (Danila et al. 1979; Ecological Analysts, Inc. 1981; EA Engineering, Science and Technology, Inc. 1986; EA Engineering, Science, and Technology, Inc. 1986a; Jersey Central Power and Light Company 1978; Tatham et al. 1977; Tatham et al. 1978).

Impingement and entrainment sampling involved the presence of two to four biologists at the intake structures during day and night sampling periods. No sea turtles were captured or observed during more than 20,000 hours of sampling.

Nearly 3,000 trawl samples were collected during day and night sampling periods. These samples consisted of five-minute hauls of a 4.9-meter (16 ft) semiballoon otter trawl. The trawl had a 3.8-cm (1.5-in) stretch-mesh body, a 3.2-cm (1.25-in) stretch-mesh cod end, and a 1.3-cm (0.5-in) stretch-mesh inner liner. No sea turtles were found in any of these samples. More than 2,000 seine samples were collected during day and night periods using 12.2-meter (40-ft) and 45.7-meter (150-ft) seines with 0.6-cm (0.25-in) and 1.3-cm (0.5-in) stretch mesh, respectively. No sea turtles were found in any of these samples.

Gillnet samples were collected using a 91.4-by-1.8-meter (300-by-6-ft) net consisting of three, 30.5-m (100-ft) panels of 38-, 70-, and 89-millimeter(mm) (1.5-, 2.75-, and 3.5-in) monofilament stretch mesh or a 61.0-m (200-ft) net, identical to that described above but without the 70-mm (2.75-in) mesh panel. Several hundred samples were collected during day and night periods, but no sea turtles were captured.

The New Jersey Department of Environmental Protection, Division of Fish, Game, and Wildlife has conducted periodic trawl and seine sampling in Barneгат Bay since 1971 (NJDEP 1973; Makai 1993; McLain 1993; Byrne 2004) and have reported no sea turtle captures. The scarcity of sea turtles in Barneгат Bay is not surprising considering the fact that the only direct access to the bay from the Atlantic Ocean is through a single, narrow inlet, approximately 300 m (1000 ft) wide. Similarly, Rutgers University reports that only one loggerhead turtle was captured during more than five years of periodic trawl sampling in Great Bay and Little Egg Harbor, estuaries located immediately south of Barneгат Bay (Able 1993).

The location of the generating station relative to the inlet from the ocean, as well as the rate and velocity of the cooling water flows, should be considered when considering incidental capture rates at OCNGS. A sea turtle entering Barneгат Bay must travel along several kilometers of narrow, relatively shallow navigation channels, characterized by very heavy boat traffic, and pass through the wooden support structures of three bridges to reach the OCNGS (Figure 5-6).

There were no changes in the design or the mode of operation of the OCNGS that could explain the occurrence of 32 sea turtles at the facility between 1992 and 2004, when none had been observed previously despite intensive sampling efforts. This phenomenon was most

likely attributable to changes in the accessibility of Barnegat Bay and increases in sea turtle population levels that occurred in approximately the same time frame. These same factors likely explain the recent increase in the number of incidental captures of Kemp's ridleys at the OCNGS.

The modifications to Barnegat Inlet that were completed in 1991 resulted in a significant increase in the depth of the inlet, and concomitant increase in the volume of water moving through the inlet during each tidal cycle. The average tidal prism following completion of the inlet modifications is approximately 2.5 times greater than during the 1980s prior to the modifications (Seabergh et al. 2003). In addition, the removal of shoals near the inlet entrance reduced the amount of turbulence associated with breaking surf. These changes may have made the Barnegat Inlet and Bay more accessible to sea turtles migrating along the Atlantic coast.

The nesting and stranding data discussed above indicate that both the loggerhead and the Kemp's ridley populations have been increasing since the early 1990s. These increases are probably attributable to the implementation of the NOAA Fisheries TED requirements in September of 1989 and the efforts to protect nesting beaches (Crouse et al. 1992; Turtle Expert Working Group 1998; Marquez et al. 1999; Turtle Expert Working Group 2000; Marquez et al. 2001; STSSN 2004). The use of TEDs has apparently resulted in a significant reduction in shrimp trawl bycatch mortality. According to NOAA Fisheries estimates (NMFS 1991a), prior to the use of TEDs shrimp trawls may have killed 5,000 to 50,000 loggerhead and more than 700 Kemp's ridleys each year. As a result of this significant reduction in sea turtle mortality and associated increases in population size, increasing numbers of juvenile and subadult sea turtles should be seasonally migrating along the Atlantic coast. This theory is supported by the observed increases in sea turtle strandings along the Atlantic coast (Table 5-1; Figures 5-2 and 5-5; Turtle Expert Working Group 2000; Boettcher 2002; STSSN 2004) and the recent increase in the number of incidental captures of Kemp's ridleys at the OCNGS (Figure 6-1).

Environmental factors, as well as population size and the accessibility of Barnegat Bay, probably played a role in the increase in the number of incidental captures of Kemp's ridleys at the OCNGS during 2004. One key environmental factor affecting the seasonal migrations of juvenile and subadult Kemp's ridley sea turtles is water temperature. Ocean water temperatures along the southern New Jersey coast during June-September 2004 were the third warmest since record keeping began more than 90 years ago in 1912 (National Weather Service 2004). The average ocean water temperature during the summer of 2004 was 1.4 EC (2.5 EF) above normal and 3 EC (5.4 EF) warmer than the previous year. These abnormally-high ocean water temperatures provided excellent conditions to entice juvenile and subadult Kemp's ridleys to migrate further up the Atlantic coast in search of foraging grounds during 2004.

In addition to favorable water temperatures, the New Jersey coast also offered rich feeding grounds for Kemp's ridleys migrating up the Atlantic Coast. According to MacKenzie (2003), New Jersey landings of blue crabs, a favorite food item for Kemp's ridley turtles, increased from less than one million pounds per year during the 1960s to nearly eight million pounds in 1993. Although landings declined somewhat after 1993, they remained in the four-to-seven million-pound range through 2002.

It is difficult to predict future trends in the occurrence of sea turtles at the OCNGS. Environmental factors, such as water temperature and food availability, probably play a role in determining the number of sea turtles that enter Barnegat Bay in a given year. These factors are difficult to predict, however, and their impact on the movements of sea turtles is difficult to quantify. If the number of individuals migrating up and down the Atlantic coast is the major determining factor, incidental captures may increase if the TED regulations are as effective as they seem to be after the first several years of experience. Also, the efforts to protect nesting beaches result in increased recruitment to the populations. If accessibility to Barnegat Bay is the most important factor, the frequency of incidental captures at the OCNGS may decline with time. Barnegat Inlet is notoriously dynamic. The position of the channel shifts frequently, and the volume of the tidal prism continuously decreases due to sedimentation (Table 3-1; Ashley 1987; Seabergh et al. 2003b). As a result, accessibility to the bay through the inlet was probably at its maximum following the completion of the inlet modifications in 1991 and subsequent dredging in 1993, and is likely to decrease with time.

Table 5-1
Sea Turtle Strandings in New Jersey Coastal and Estuarine Waters Reported by the
Marine Mammal Stranding Center

ANNUAL DISTRIBUTION					
YEAR	LOGGERHEAD	KEMP'S RIDLEY	LEATHERBACK	GREEN	UNKNOWN
1977	1	0	1	0	0
1978	4	0	2	0	0
1979	11	0	10	0	0
1980	9	0	2	0	0
1981	4	0	13	0	0
1982	2	0	13	0	0
1983	8	4	9	0	0
1984	8	0	2	0	0
1985	22	1	7	0	0
1986	15	0	2	0	0
1987	37	1	33	0	0
1988	13	0	6	0	0
1989	17	7	3	0	0
1990	26	0	9	1	0
1991	55	4	13	2	0
1992	39	5	5	1	0
1993	17	6	28	2	1
1994	33	4	9	1	1
1995	74	1	40	1	8
1996	51	2	5	0	0
1997	35	1	14	0	0
1998	47	1	4	0	1
1999	79	4	9	1	1
2000	40	5	9	3	5
2001	35	4	13	1	5

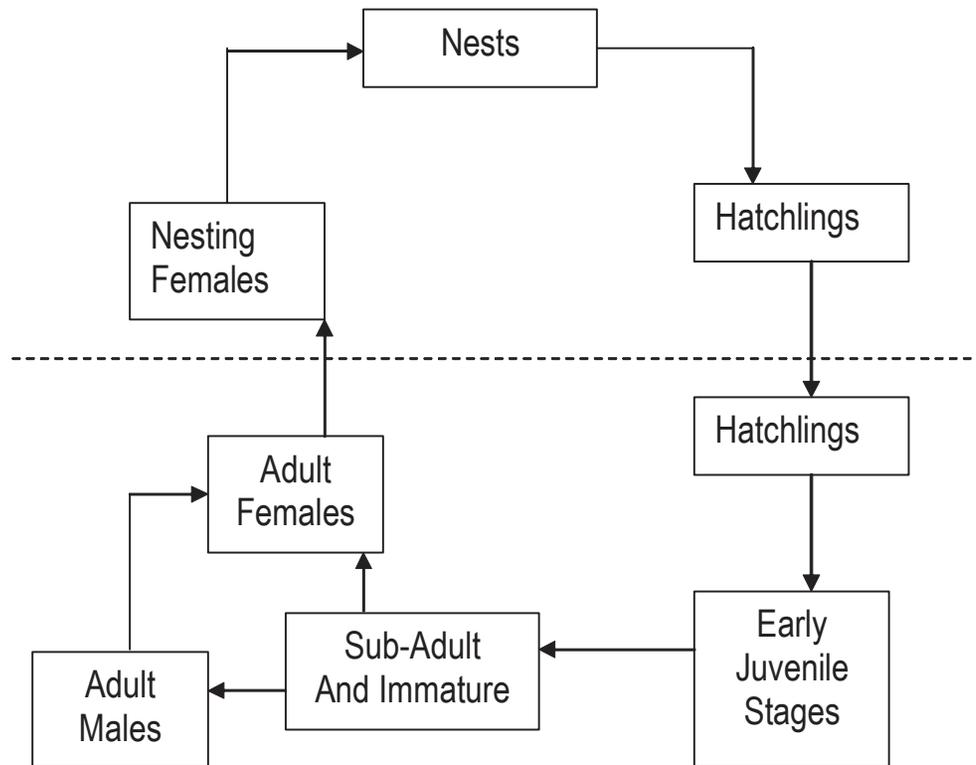
2002	44	6	19	0	5
2003	38	2	19	1	2
2004*	45	10	26	2	7
TOTAL	809	68	325	16	36

Notes: * 2004 data as of November 6, 2004.
 No hawksbill strandings have been reported in New Jersey.
 Sources: Schoelkopf 1993; Schoelkopf 2000; Bailey 2004.

Table 5-2
 Seasonal Occurrence of Sea Turtle Strandings in New Jersey Coastal and Estuarine Waters
 1980-2001

MONTHLY DISTRIBUTION (INCIDENTAL TAKES AT OCNCS)					
MONTH	LOGGERHEAD	KEMP'S RIDLEY	LEATHERBACK	GREEN	UNKNOWN
January	1(0)	1(0)	4(0)	0	0
February	0	1(0)	3(0)	0	0
March	0	0	0	0	1(0)
April	0	0	1(0)	0	0
May	0	0	2(0)	0	0
June	61(3)	1(1)	5(0)	0	3(0)
July	116(1)	12(9)	20(0)	1(1)	11(0)
August	150(1)	10(3)	44(0)	1(1)	7(0)
September	170(2)	11(6)	75(0)	2(0)	7(0)
October	80(0)	3(2)	54(0)	2(2)	0
November	8(0)	1(0)	18(0)	3(0)	1(0)
December	1(0)	1(0)	3(0)	0	0
TOTALS	587(7)	41(21)	229(0)	9(4)	30(0)
Note: No hawksbill strandings have been reported in New Jersey. Sources: NMFS 2000; STSSN 2004.					

TERRESTRIAL STAGES



PELAGIC STAGES

Figure 5-1
Generalized sea turtle life cycle (After PSE&G 1989).

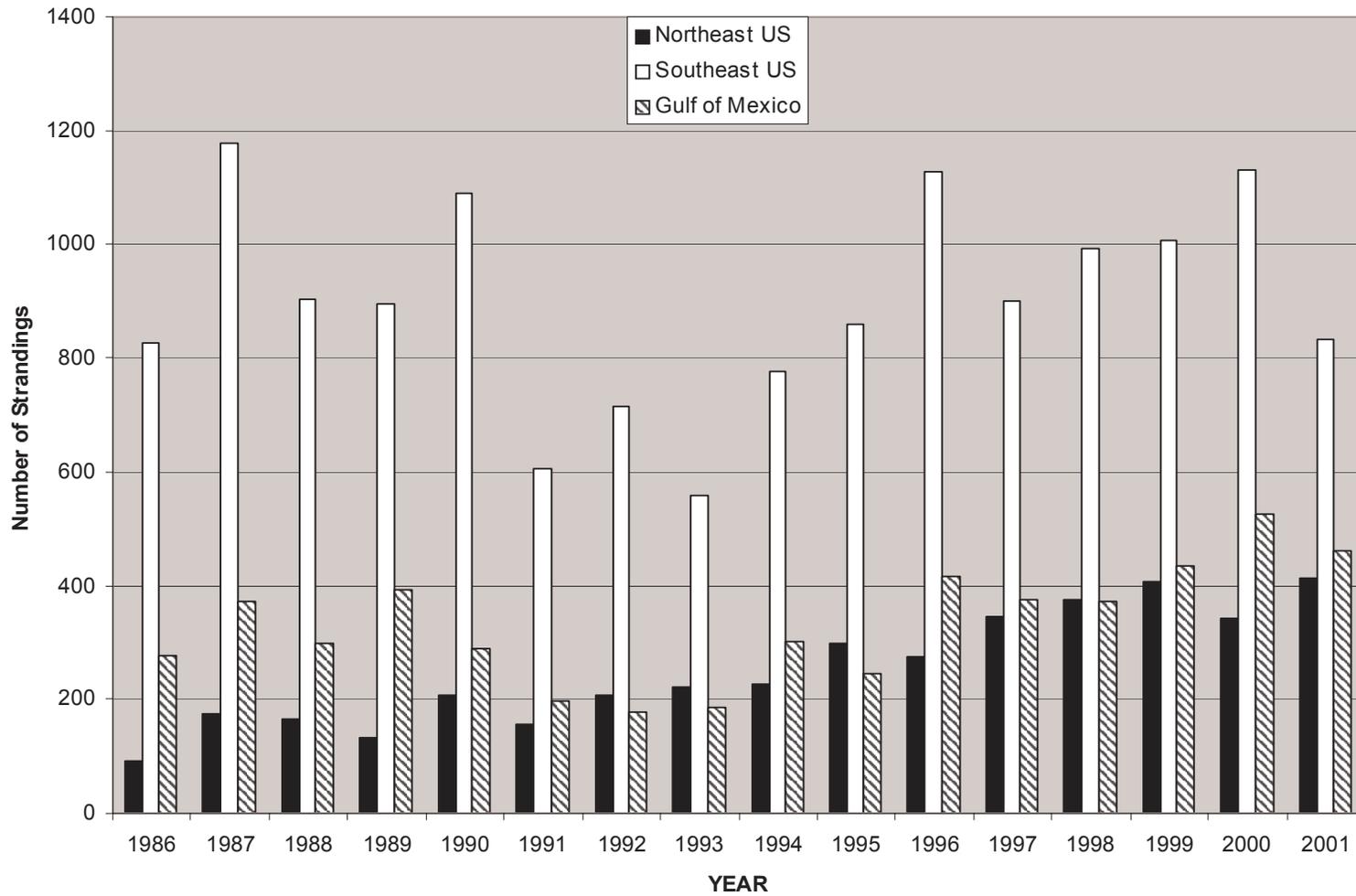


Figure 5-2
 Loggerhead sea turtle strandings by region, 1986-2001 (After Turtle Expert Working Group 2000 and STSSN 2004).

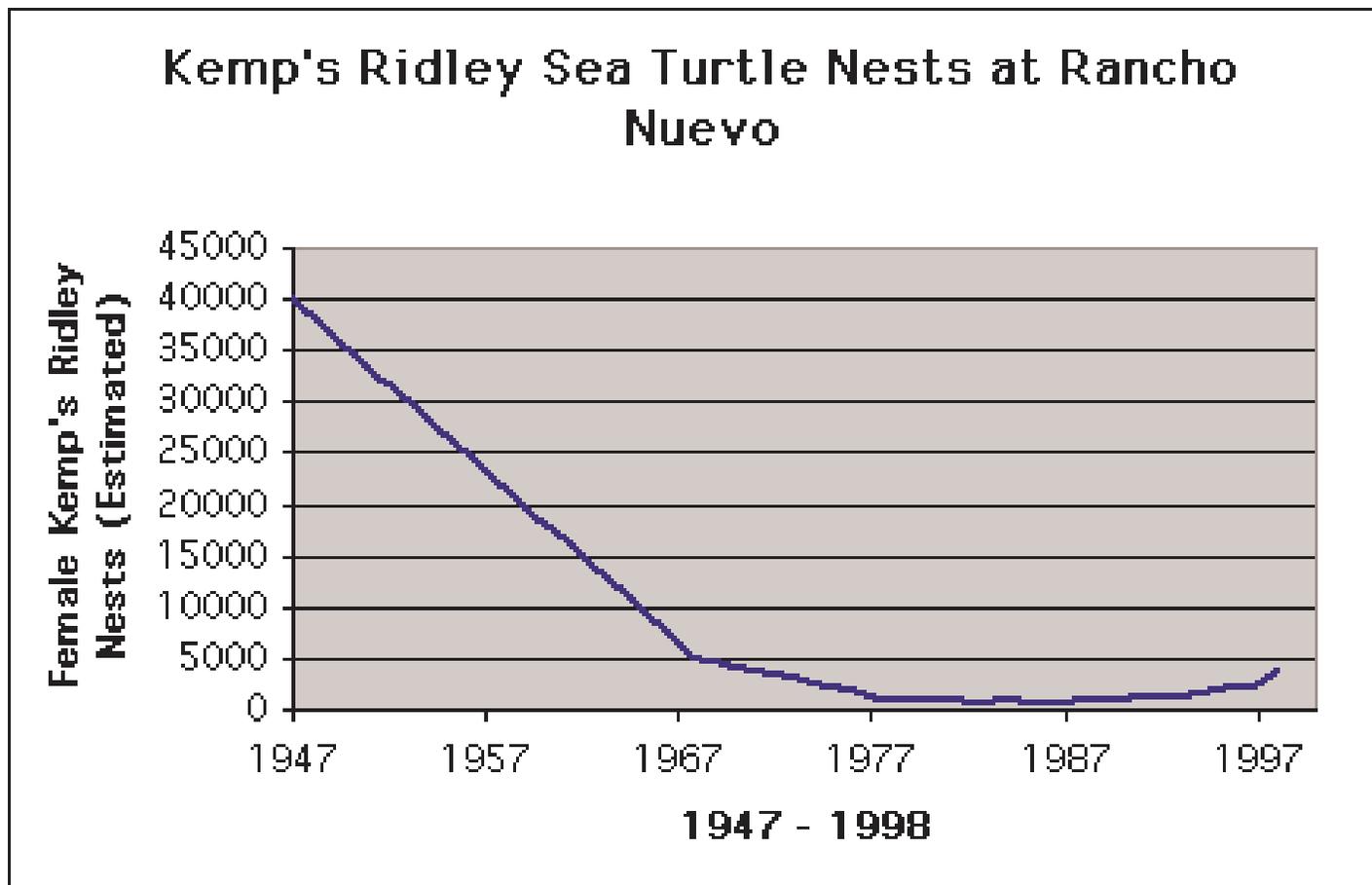


Figure 5-3
Estimated annual number of nesting female Kemp's Ridley sea turtles at Rancho Nuevo (HEART 1999).

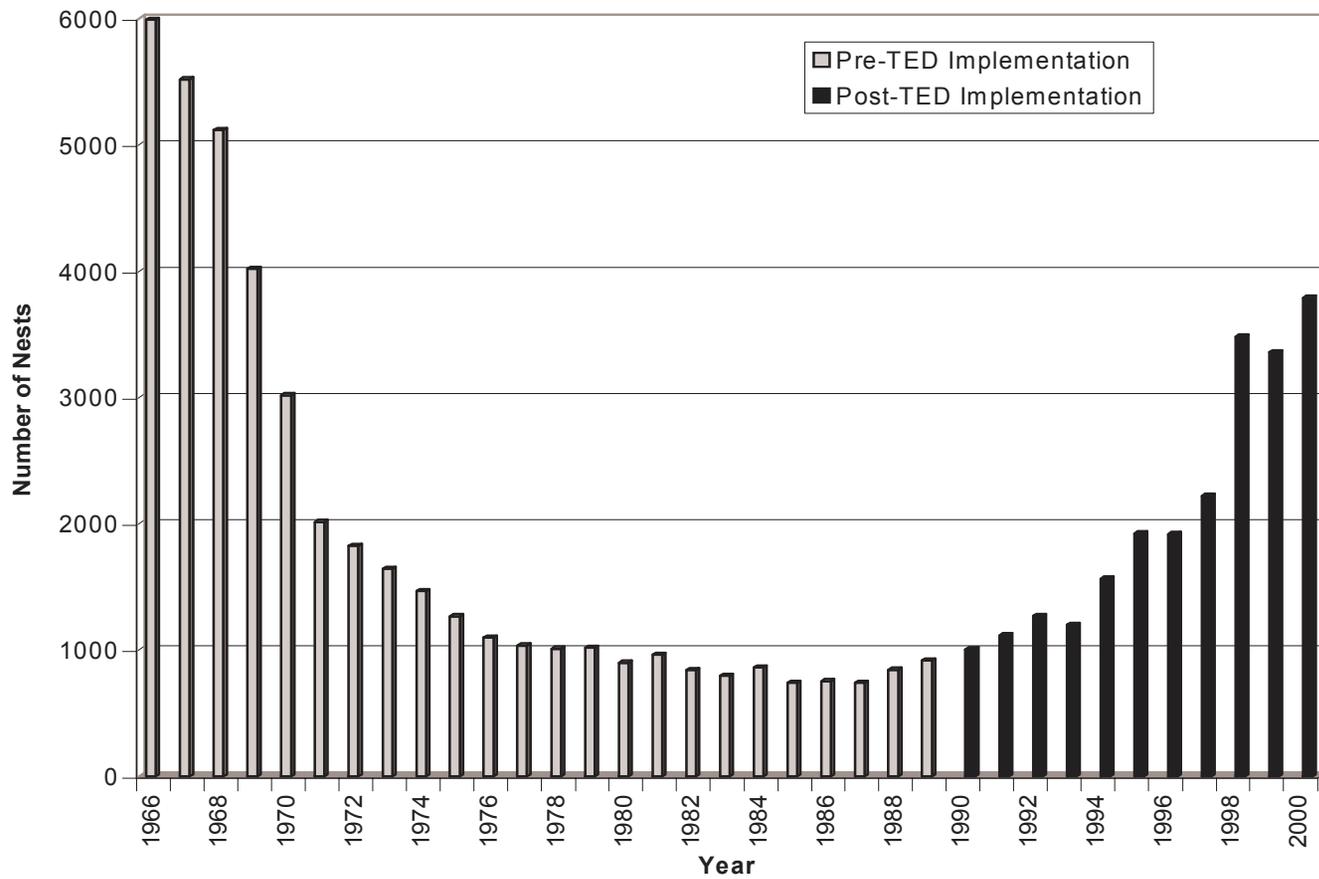


Figure 5-4
 Number of Kemp's ridley nests at Rancho Nuevo before and after implementation of the TED Regulations in 1989.
 (After Turtle Expert Working Group 2000 and Marquez et al. 2001)

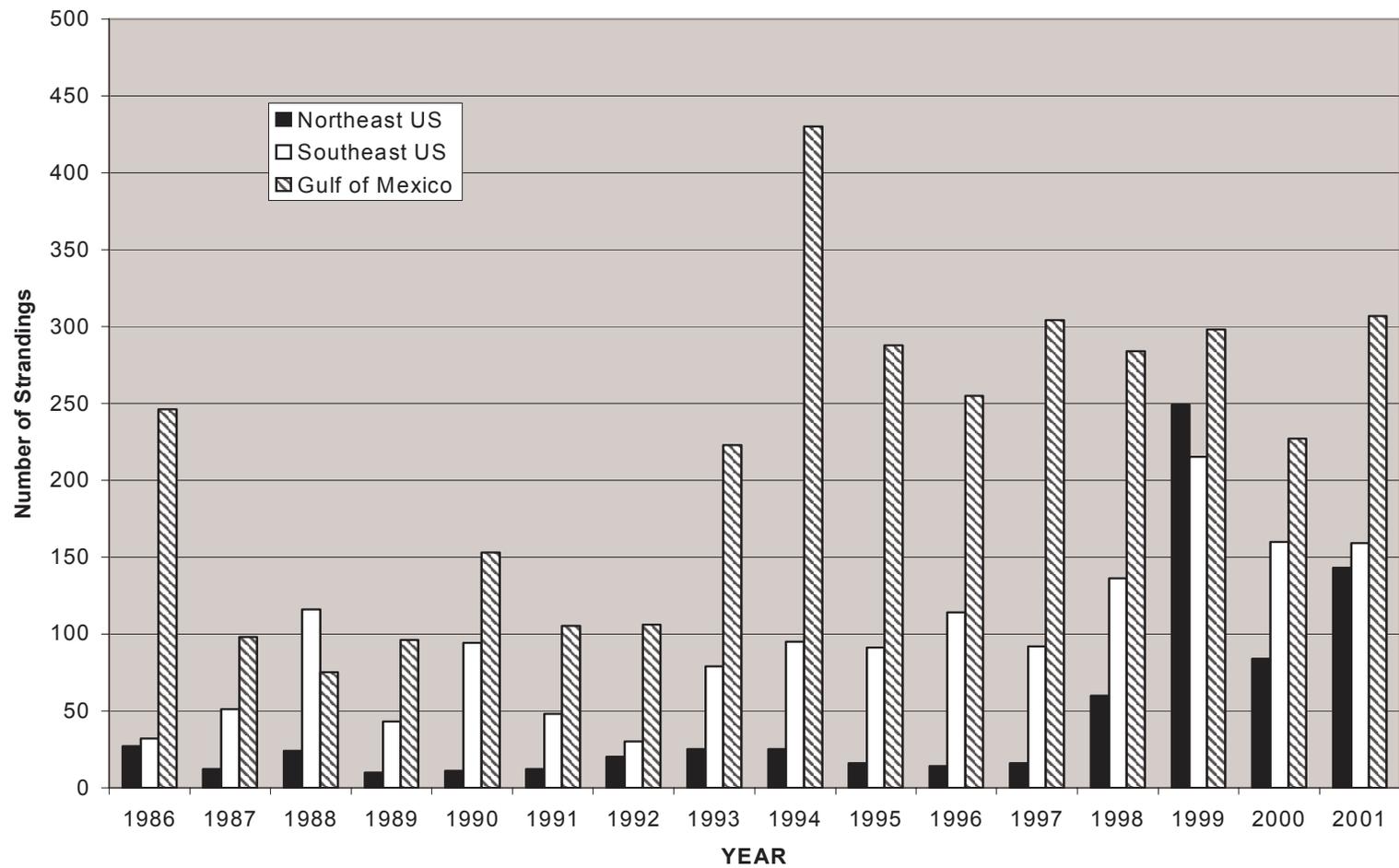


Figure 5-5
 Kemp's ridley sea turtle strandings by region, 1986-2001.
 (After Turtle Expert Working Group 2000 and STSSN 2004)

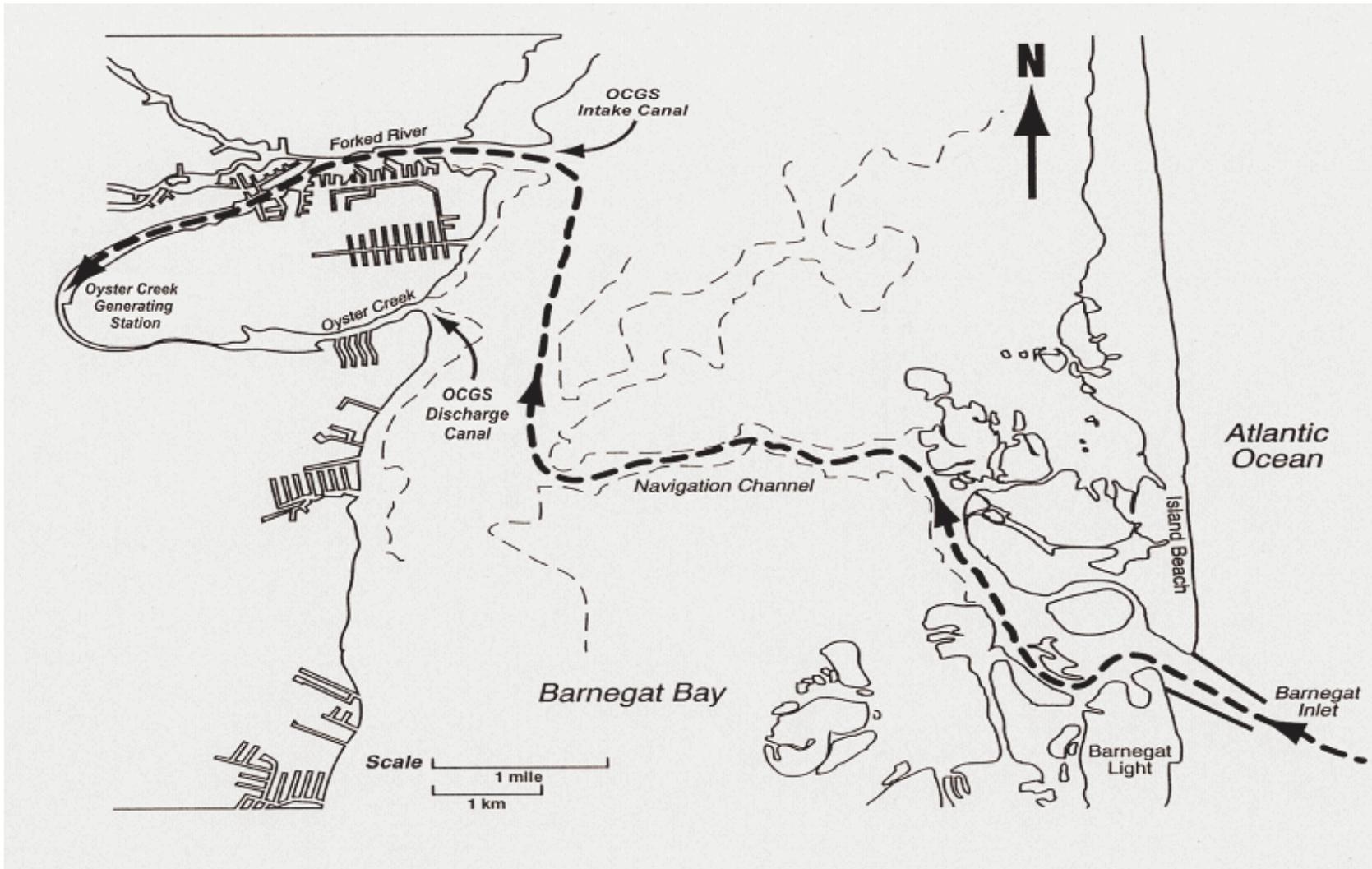


Figure 5-6
 Probable pathway of sea turtles moving from the Atlantic Ocean to the OCGS via Barnegat Inlet.

6.0 Onsite Information

6.1 Occurrence of Sea Turtles at the Oyster Creek Nuclear Generating Station

As discussed in Section 5.0, despite intensive sampling efforts, no sea turtles were observed during the first 22 years of OCNGS operation (prior to 1992); 32 sea turtles have been captured since 1992 (Tables 5-2 and 6-1; Figure 6-1). Three sea turtles were taken in 1992: a dead loggerhead (*Caretta caretta*) with deep boat propeller wounds drifted into the dilution water intake on June 25, 1992; a live loggerhead taken twice in September 1992; and a live Kemp's ridley turtle (*Lepidochelys kempii*) was taken October 26, 1992.

During 1993, the only sea turtle observed at the OCNGS was a dead juvenile Kemp's ridley turtle taken on October 17, 1993.

Four sea turtles were taken in 1994: a live juvenile loggerhead in June, a dead loggerhead subadult in July (and for which the necropsy showed that death due to infections and boat propeller wounds had occurred prior to capture at the OCNGS), and two dead Kemp's ridley juveniles in July (Table 6-1).

No sea turtles were observed or taken at the OCNGS during the three-year period from August 1994 to August 1997.

One sea turtle was taken each year in 1997 and 1998: a dead Kemp's ridley subadult taken during September 1997, and a live loggerhead subadult taken during August 1998 and was transported to Florida and subsequently released into the Atlantic Ocean.

Two sea turtles were taken in 1999: a live Kemp's ridley subadult taken during September 1999 and was transported to Virginia and subsequently released into the Atlantic Ocean, and a dead juvenile Atlantic green turtle (*Chelonia mydas*) taken during October 1999.

Five sea turtles were taken in 2000: a live loggerhead juvenile was taken during June 2000 and was transported to the Marine Mammal Stranding Center (MMSC) in Brigantine, NJ, and subsequently released into the Atlantic Ocean in New Jersey; a dead juvenile Kemp's ridley was taken during early July 2000; a live Atlantic green sea turtle juvenile and a live Kemp's ridley juvenile were taken during August and a live loggerhead subadult was taken during September of 2000. The latter three sea turtles were taken to the MMSC and subsequently released into the Atlantic Ocean in North Carolina.

Three sea turtles were taken in 2001: a live Atlantic green turtle was taken in July, delivered to the MMSC, and subsequently released into the Atlantic Ocean in New Jersey; two dead Kemp's ridley juveniles were taken during July and August of 2001. The Kemp's ridley taken during July exhibited wounds possibly attributable to an encounter with a boat propeller.

Two sea turtles were taken in 2002. Live Kemp's ridley juveniles were taken during late June and early July; both individuals were taken to the MMSC and subsequently released into the Atlantic Ocean.

Two sea turtles were taken in 2003: a live Kemp's ridley juvenile taken in September was delivered to the MMSC and later released into the Atlantic Ocean in New Jersey; a live Atlantic green turtle juvenile

taken during the latter part of October was transferred to the MMSC where arrangements were made to have it released into the Atlantic Ocean in Virginia, to eliminate the possibility of post-release cold shock.

Eight sea turtles were taken in 2004: all sea turtles taken during 2004 were Kemp's ridley juveniles – five were captured alive, and the remaining three were dead. The live individuals taken during July and August were delivered to the MMSC and subsequently released into the Atlantic Ocean in New Jersey; the live sea turtles captured in September were also taken to the MMSC where arrangements were made to have them released into the Atlantic Ocean in Virginia, to eliminate the possibility of post-release cold shock.

6.1.1 Details of Incidental Captures at the OCNGS

Descriptions of the circumstances surrounding each incidental capture at the OCNGS based on available information are provided in Sections 6.1.1.1 through 6.1.1.32. This information is also summarized in Table 6-1. In some cases, observations or inferences about the turtles' behaviors or orientations could be made. However, when turtles were removed from more than about 1 m (3 ft) below the surface, or if they were obscured by debris near the surface, detailed information on their exact location and orientation was not always available. The OCNGS Sea Turtle Observation/Capture Report Form, an attachment to the Sea Turtle Surveillance, Handling, and Reporting Instructions (Appendix A), was implemented in June 1995 to standardize data collection related to incidental captures.

6.1.1.1 Incidental Capture of June 25, 1992

A dead sea turtle was removed from the DWS intake trash bars at approximately 12:50 PM on June 25, 1992. Members of the OCNGS Environmental Affairs Department identified it as a juvenile loggerhead measuring 35.5 cm (14 in) in SCL and noted that this turtle had several deep gashes on its side that appeared to be boat propeller wounds. The MMSC of Brigantine, NJ was notified and requested to perform a necropsy. MMSC confirmed that the specimen was a juvenile loggerhead. The MMSC necropsy determined that the cause of death was from boat propeller wounds and that the specimen had died prior to becoming impinged on OCNGS trash bars.

6.1.1.2 Incidental Captures of September 9 and 11, 1992

During the early evening (approximately 6:00 PM) of September 9, 1992 a live sea turtle was noticed by OCNGS Operations personnel during a routine inspection of the CWS intake trash bars. The turtle was removed by several plant personnel, tentatively identified as a juvenile loggerhead, and released alive into the OCNGS discharge canal. Although this individual was alive and healthy when released, it was noted that it had a small wound surrounded by scar tissue just behind its head. The turtle's SCL was 46.7 cm (18.4 in).

During a mid-afternoon (approximately 2:00 PM) tour of the CWS intake structure on September 11, 1992, an OCNGS security officer noticed a live sea turtle impinged on the CWS trash bars. When the turtle was removed from the intake structure, it was identified as a juvenile loggerhead with a neck wound identical to that noted on the loggerhead released at OCNGS on September 9, 1992. The MMSC was notified, and the turtle was released in healthy condition to MMSC personnel who took it their Brigantine facility for examination, holding, tagging, and subsequent release. MMSC personnel

confirmed the turtle to be a juvenile loggerhead and observed that it had a small (0.6-cm [0.25-in]) wound with scar tissue on the dorsal midline just behind the head. MMSC Director Robert Schoelkopf stated that he believed it to be the same juvenile loggerhead that was collected and released at the OCNGS on September 9, 1992. The turtle was tagged by MMSC personnel and released in the Atlantic Ocean near Brigantine in healthy condition.

6.1.1.3 Incidental Capture of October 26, 1992

During an early morning routine inspection of the CWS intake, an OCNGS Operations department representative noticed a live sea turtle impinged against the trash bars. The turtle was initially found at about 3:00 AM with its head out of the water and pointing upward. The turtle was retrieved and found to be in good condition. Environmental Affairs department personnel who took custody of the turtle identified it as a Kemp's ridley subadult and made arrangements for its immediate transfer to the MMSC. Although it was impossible to say precisely how long the turtle had been on the intake structure prior to removal, it may have been there between three and eight hours.

MMSC personnel who examined the turtle found that it was very healthy, swam freely, and required no direct care. However, two scars from slash-like wounds were apparent on the plastron, indicating that the turtle had been wounded at some time prior to its incidental capture at the OCNGS. The turtle measured 32 cm (12.6 in) in SCL.

The water temperature in the OCNGS intake canal at the time of the impingement was 11.1 EC (52 EF). Because of concerns that the turtle might be subject to cold stunning if released into New Jersey coastal waters, MMSC personnel made arrangements for the turtle to be transported to North Carolina prior to being released to ensure that cold stunning would not occur. The turtle was tagged and released on October 31, 1992 at Kure Beach, North Carolina.

6.1.1.4 Incidental Capture of October 17, 1993

OCNGS Operations department personnel conducting a routine morning (approximately 12 noon) inspection of the DWS intake on October 17, 1993 noticed a sea turtle impinged against the trash bars. The turtle was found to be limp, immobile, and with no apparent breathing when retrieved. OCNGS Environmental Affairs personnel who examined the turtle identified it as a juvenile Kemp's ridley. No tags, prominent scars, or slash-like propeller wounds were apparent on the turtle. Minor scrape marks that were observed on the plastron may have occurred during removal of the turtle from the dilution intake area. The turtle measured 26 cm (10.3 in) in SCL.

The water temperature in the intake canal at the time of the impingement was approximately 14.4 EC (58 EF). Although it was impossible to say precisely how long the turtle had been on the intake structure prior to removal, it may have been between four and eight hours. Within three to four hours after its capture, the turtle was placed in a freezer for temporary storage at an on-site OCNGS biological laboratory. At the suggestion of the National Marine Fisheries Service, arrangements were made to have a necropsy of the turtle performed by sea turtle expert Dr. Steven Morreale of Cornell University and his associates at the New York State College of Veterinary Medicine. The following is an excerpt from Dr. Morreale's necropsy:

"... The overall condition of this turtle was one of an otherwise healthy young Kemp's ridley, typical of the many that I have examined in northeastern waters. The

lack of food in the gut is typical of the sea turtles that I have seen at this time of year and is indicative of a behavioral change prior to migrating southward. The lack of any obvious trauma would tend to implicate drowning as the cause of death to this animal. The lack of fluid in the lungs is not necessarily contradictory to this conclusion. It is my opinion that sea turtles suffocate underwater rather than inhaling water. The superficial scrapes on the plastron and neck were very fresh and probably occurred on the intake (trash racks). However, I could not tell whether these occurred prior to or after death. The only potentially contradictory evidence of this turtle having died as a result of impingement was the condition of the specimen. From the information given to me about the timing of death, the water temperature, and the subsequent handling of the carcass, I expected to observe slightly less decomposition. The moderate levels of decomposition of liver and gonad tissues are usually more representative of a turtle that has been dead for one to two days at those temperatures."

6.1.1.5 Incidental Capture of June 19, 1994

During the early afternoon (approximately 1:30 PM) of June 19, 1994, OCNGS Operations personnel conducting a routine inspection of the CWS intake area observed a sea turtle in the #4 CWS intake bay (CWS and DWS intake bays are sequentially numbered from 1 through 6, north to south). The turtle was swimming freely a few feet upstream of the face of the CWS intake trash bars. The turtle was removed and found to be active, healthy and with no apparent wounds. OCNGS Environmental Affairs department personnel identified it as a juvenile loggerhead turtle and immediately notified the MMSC of the capture. The turtle measured 36.8 cm (14.5 in) in SCL.

Although it was impossible to determine precisely how long the turtle had been near the intake structure prior to retrieval, it is believed to have been in the vicinity for a relatively short period of time. Within three to four hours of the time of its capture, the turtle was taken to MMSC. Personnel at MMSC examined and tagged it, and subsequently released it offshore of Brigantine, NJ.

6.1.1.6 Incidental Capture of July 1, 1994

During a routine mid-morning (approximately 10:00 AM) cleaning of the DWS intake trash bars on July 1, 1994, a dead sea turtle was retrieved from the trash bars in front of DWS bay #5. The turtle was removed quickly by OCNGS Operations personnel. It was found to be inactive and exhibited a strong odor of decomposition. Environmental Affairs personnel identified it as a juvenile Kemp's ridley turtle and tried unsuccessfully to resuscitate it. The turtle measured 27.7 cm (10.9 in) in SCL.

Although it was impossible to say precisely how long the turtle had been at the intake structure prior to removal, it is known that the intake bay in which the turtle was found had been cleaned during the previous afternoon. No prominent scars or slash-like propeller wounds were apparent on the turtle. The turtle was sent to marine turtle experts at the Center for the Environment, Cornell University for necropsy. However, no record of the necropsy was received despite several requests.

6.1.1.7 Incidental Capture of July 6, 1994

At approximately 6:15 AM on July 6, 1994, OCNGS Operations personnel conducting routine cleaning of the DWS intake area removed a sea turtle from the DWS trash bars in bay #4. OCNGS Environmental Affairs personnel who took custody of the turtle identified it as a subadult loggerhead

(SCL of 61.4 cm [24.5 in]) and tried unsuccessfully to resuscitate it. Although it was impossible to say precisely how long the turtle had been at the intake structure prior to removal, the trash bars at the DWS intake had previously been cleaned 6-8 hours earlier.

At least three deep scars or slash-like propeller wounds were apparent on the turtle. These scars were not fresh because blue mussels were attached and growing within the scars.

Several hours after its capture, the turtle was taken to the MMSC in Brigantine, NJ. MMSC Director Robert Schoelkopf performed a necropsy of the carcass. Mr. Schoelkopf reported that the turtle did not die at the intake nor did it suffocate. The lungs were found to be in good condition. The turtle was believed to have died one to two days prior to arriving at the OCNGS, probably due to a long-term illness. Decomposition of all four appendages, as well as a large notch along the turtle's marginal scutes, were attributed by Schoelkopf to bacterial or fungal infections.

6.1.1.8 Incidental Capture of July 12, 1994

At approximately 10:40 PM on July 12, 1994, OCNGS Operations personnel conducting routine cleaning of the DWS intakes removed a sea turtle from the trash bars at bay #4. The turtle was found to be inactive, but had no apparent wounds. OCNGS Environmental Affairs personnel who took custody of the turtle identified it as a juvenile Kemp's ridley turtle (26.7 cm or 10.5 in SCL) and tried unsuccessfully to resuscitate it.

Although it was impossible to say precisely how long the turtle had been at the intake structure prior to removal, it may have been there for up to several hours. No prominent scars or slash-like propeller wounds were evident on the turtle.

This turtle was sent to marine turtle experts at the Center for the Environment, Cornell University for necropsy. However, no record of the necropsy was received despite several requests.

6.1.1.9 Incidental Capture of September 4, 1997

During the early morning (approximately 3:18 AM) of September 4, 1997, Operations personnel conducting routine cleaning of the DWS intakes noticed a sea turtle among the eelgrass on the trash bars at bay #6 of the DWS. The turtle, which was removed quickly, was limp, immobile, and had no apparent breathing. OCNGS Environmental Affairs personnel who took custody of the turtle identified it as a subadult Kemp's ridley turtle (48.8 cm [19 in] in SCL) and tried unsuccessfully to resuscitate it.

Although it was impossible to say precisely how long the turtle had been at the intake structure prior to removal, it may have been there for up to several hours. No prominent scars or slash-like propeller wounds were evident on the turtle. Damage to two dorsal scutes, which may have occurred either during removal of the turtle from the DWS or prior to its capture, was noted. Because this turtle was collected immediately after the Labor Day weekend, which is one of the periods of busiest Barnegat Bay boat traffic, the damage to the turtle may have resulted from a collision with a boat.

6.1.1.10 Incidental Capture of August 18, 1998

During the morning (approximately 9:59 AM) of August 18, 1998, OCNGS Operations personnel conducting a routine inspection of the CWS intake area observed a sea turtle in the #4 CWS intake bay. The turtle was swimming freely a few feet upstream of the face of the CWS intake trash bars. The turtle was removed using a sea turtle dip net and found to be alive and moving about actively. However, a 3.7-m (12-ft) length of 0.6-cm- (0.25-in-) diameter polypropylene rope with a bucket attached to one end was tightly wrapped around the base of the right front flipper of the turtle, causing restricted circulation and movement of that limb. It was apparent from the atrophied and partially-decayed condition of the right front flipper that the turtle had been injured by becoming entangled in the rope long before its incidental capture. OCNGS Environmental Affairs department personnel identified it as a subadult loggerhead turtle and notified the MMSC of the capture.

The water temperature at the time of the incidental capture was 26.9 EC (80.5 EF) and the OCNGS was in operation at full power with four circulating water pumps and two dilution pumps in operation. The turtle measured 50.8 cm (20.0 in) in SCL and weighed 24.4 kg (53.9 lb).

After the turtle was examined by Environmental Affairs personnel, it was transferred to the MMSC in Brigantine, NJ. MMSC personnel attempted to locate a facility where the turtle could receive appropriate medical treatment and rehabilitation prior to releasing it. The turtle was transported to Sea World in Orlando, FL, which provided specialized surgery and rehabilitation and eventually released the turtle in the ocean.

6.1.1.11 Incidental Capture of September 23, 1999

During an early morning routine inspection of the CWS intake, an OCNGS Operations department representative noticed a live sea turtle impinged against the trash bars. The turtle was initially found at about 3:10 AM. The turtle was retrieved and found to be in good condition. The turtle was identified as a subadult Kemp's ridley and made arrangements for its immediate transfer to the MMSC. The turtle measured 26.4 cm (10.3 in) in SCL and weighed 2.9 kg (6.3 lb).

The water temperature at the time of the capture was approximately 19.6 EC (67.2 EF) and the OCNGS was in operation at full power with four circulating water pumps and two dilution pumps operating.

After the turtle was examined by the licensee's Environmental Affairs personnel, it was transferred to the MMSC in Brigantine, NJ. MMSC personnel attempted to locate a facility in a warmer climate where the turtle could be transferred for eventual release in the ocean. The turtle was transported to the Virginia State Aquarium, which tagged and eventually released the turtle in the ocean off of Virginia Beach, VA.

6.1.1.12 Incidental Capture of October 23, 1999

During an early morning routine inspection of the DWS intake, an OCNGS Operations department representative noticed a sea turtle among materials removed from the trash bars in DWS bay #4. The turtle was initially found to be either dead or comatose at about 2:00 AM. Attempts were made to resuscitate the turtle for several hours after the incidental capture, but the attempts were unsuccessful. Environmental Affairs department personnel who took custody of the turtle identified it as a juvenile Atlantic green turtle. The turtle measured 27.0 cm (10.6 in) in SCL and weighed 2.8 kg (6.1 lb).

The water temperature at the time of the capture was approximately 17.1 EC (62.8 EF) and the OCNGS was in operation at full power with four circulating water pumps and two dilution pumps operating. Although it was impossible to say precisely how long the turtle had been near the intake structure prior to removal, the intake trash bars had been mechanically cleaned the previous day.

The cause of death was not immediately apparent. There were no obvious boat propeller wounds and no open wounds that would have been life threatening. After the turtle was examined by Environmental Affairs personnel, arrangements were made for it to be examined further by Dr. Steven Morreale, a Cornell University sea turtle expert who has conducted numerous necropsies on sea turtles in the past. However, no record of the necropsy was received despite several requests.

6.1.1.13 Incidental Capture of June 23, 2000

During an early morning routine inspection of the DWS intake, an OCNGS Operations department representative noticed a sea turtle in front of the trash bars in DWS bay #1. The turtle was dip-netted from the trash bars and found to be very active and with no visible wounds or signs of injury. OCNGS Environmental Affairs personnel who took custody of the turtle confirmed it to be a juvenile loggerhead. The turtle measured 47.8 cm (18.8 in) in SCL and weighed approximately 17.2 kg (38 lb). The water temperature at the time of the incidental capture was approximately 25.3 EC (77.5 EF), and the OCNGS was in operation at full power with four circulating water pumps and two dilution pumps operating.

After the turtle was examined by Environmental Affairs personnel, arrangements were made for it to be transferred to the MMSC. At the MMSC, the turtle was examined, fed, and eventually released in the Atlantic Ocean off Brigantine, NJ.

6.1.1.14 Incidental Capture of July 2, 2000

During the afternoon (approximately 3:00 PM) of July 2, 2000, Operations personnel conducting routine cleaning of the DWS intakes noticed a sea turtle approach the trash bars at bay #1 of the DWS. The turtle, which was removed and found to be limp, immobile, and had no apparent breathing. OCNGS Environmental Affairs personnel who took custody of the turtle identified it as a juvenile Kemp's ridley turtle (27.3 cm [10.8 in] in SCL) and tried unsuccessfully to resuscitate it.

Although it was impossible to say precisely how long the turtle had been at the intake structure prior to removal, it may have been there for up to several hours. No prominent scars or slash-like propeller wounds were evident on the turtle. Minor scrapes to two dorsal scutes, which may have occurred either during removal of the turtle from the DWS or prior to its capture, were noted. Because this turtle was collected during the Independence Day weekend, which is one of the periods of busiest Barnegat Bay boat traffic, the damage to the turtle may have resulted from a collision with a boat.

6.1.1.15 Incidental Capture of August 3, 2000

At approximately 3:25 PM on Thursday, August 3, 2000, an OCNGS operator performing a routine inspection of the dilution trash racks noticed a live sea turtle in bay # 4 of the DWS intake structure. The turtle was removed and found to be alive, moving about normally and with no apparent injury. OCNGS Environmental Affairs personnel who took custody of the turtle confirmed it to be a juvenile Atlantic green turtle. The water temperature at the time of the incidental capture was approximately 28.8°C (83.9°F), and the OCNGS was in operation at full power with four circulating water pumps and

two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the intake structure prior to removal, the dilution trash racks had been mechanically cleaned earlier the same day.

The turtle measured 29.2 cm (11.5 in) in SCL and weighed 3.4 kg (7.6 lb). Sex was not determined. No tags were present on the turtle when captured. The majority of the dorsal surface of the turtle was heavily encrusted with barnacles. Several marginal scutes on the posterior dorsal surface had a dull, grayish coloration, which may be an indication of a fungal infection.

The turtle was transferred to the MMSC in Brigantine, NJ on August 3, 2000, where it was examined and given initial care. It was transferred on September 7, 2000 to the Karen Beasley Sea Turtle Rescue and Rehabilitation Center in Topsail Island, NC for final care before release. It was released October 12, 2000 in the Atlantic Ocean off Topsail Beach, NC.

6.1.1.16 Incidental Capture of August 28, 2000

At approximately 1:12 AM on Monday August 28, 2000, an OCNGS operator performing a routine inspection of the DWS trash racks noticed a live sea turtle in bay # 1 of the dilution intake structure. The turtle was removed and found to be alive, moving about normally and with no apparent injury. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley sea turtle. The water temperature at the time of the incidental capture was approximately 26.5 EC (79.8 EF), and the OCNGS was in operation at 72 percent power with four circulating water pumps and two dilution pumps in operation. The turtle measured 26.2 cm (10.3 in) in SCL and weighed 2.9 kg (6.5 lb). Sex was not determined. No tags were present on the turtle when captured. Although it is impossible to say precisely how long the turtle had been on the intake structure prior to removal, the dilution trash racks had been mechanically cleaned the previous day and inspected earlier the same night that the turtle was captured.

The turtle was taken to the MMSC in Brigantine, NJ. At the MMSC, the turtle was examined, fed, tagged, and given initial care. The turtle was transferred on September 7, 2000 to the Karen Beasley Sea Turtle Rescue and Rehabilitation Center in Topsail Island, NC, where it received final care prior to being released in offshore Atlantic Ocean waters.

6.1.1.17 Incidental Capture of September 18, 2000

At approximately 1:10 PM on Monday September 18, 2000, an OCNGS operator performing a routine inspection of the trash racks noticed a live sea turtle in bay # 4 of the CWS intake structure. The turtle was removed and found to be alive, moving about normally and with no apparent injury. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a subadult loggerhead sea turtle. The water temperature at the time of the incidental capture was approximately 20.4 EC (68.8 EF), and the OCNGS was in operation at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the intake structure prior to removal, the circulating water trash racks had been cleaned the previous afternoon.

The turtle measured 57.2 cm (22.5 in) in SCL and weighed 26.5 kg (58.5 lb). Sex was not determined. No tags were present on the turtle when captured. The majority of the dorsal surface of the turtle was heavily encrusted with barnacles. A few of the scutes on the posterior dorsal surface had partially peeled, which may have occurred when some barnacles scraped off of the turtle.

The turtle was taken to the MMSC in Brigantine, NJ. At the MMSC, the turtle was examined, fed, and tagged. The turtle was taken during late September to a more southerly location in Nags Head, NC (where cold-stunning was less likely) and released into the Atlantic Ocean.

6.1.1.18 Incidental Capture of July 8, 2001

At approximately 2:30 PM on Sunday, July 8, 2001, an (OCNGS) operator performing a routine inspection of the trash racks noticed a live sea turtle swimming freely in bay # 4 of the circulating water intake structure. The turtle was removed and found to be alive, moving about normally, and with no apparent injury. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Atlantic green turtle. The water temperature at the time of the incidental capture was approximately 26.7 EC (80.1 EF) and the OCNGS was in operation at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been in the vicinity of the intake structure prior to removal, the circulating water trash racks had been cleaned the previous afternoon.

The turtle measured 26.7 cm (10.5 in) in SCL and weighed 2.3 kg (5.1 lb). Sex was not determined. No tags were present on the turtle when captured. The dorsal surface of the turtle was encrusted with several barnacles.

The turtle was taken on the date of capture to the MMSC in Brigantine, NJ. At the MMSC, the turtle was examined, fed, and tagged. After determining that the turtle was healthy and capable of swimming and feeding normally, MMSC personnel released it into the Atlantic Ocean near Brigantine, NJ.

6.1.1.19 Incidental Capture of July 22, 2001

At approximately 5:44 PM on Sunday, July 22, 2001, an OCNGS operator performing a routine inspection and cleaning of the trash racks noticed a dead sea turtle being removed from bay # 5 of the dilution water intake structure by the trash rake. The turtle was found to have a deep slice wound between its head and carapace on the left side of its neck. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 26.9 EC (80.4 EF), and the OCNGS was in operation at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the trash bars prior to removal, the dilution water trash racks had been cleaned earlier the same day at 3:30 AM.

The turtle measured 26.0 cm (10.3 in) in SCL and weighed 2.9 kg (6.3 lb). Sex was not determined. No tags were present on the turtle when captured. The turtle was frozen and sent to Cornell University for necropsy; however, no results were obtained. Therefore, it cannot be determined if the death was related to OCNGS operations.

6.1.1.20 Incidental Capture of August 14, 2001

At approximately 3:34 AM on Tuesday, August 14, 2001, OCNGS Operations personnel removed a dead juvenile Kemp's ridley turtle from bay #6 of the DWS intake structure. The temperature of the intake canal at the time of capture was 27.8 EC (82.0 EF), and the OCNGS was operating at full power with four circulating water pumps and two dilution pumps in operation.

The turtle measured 22.8 cm (8.9 in) in SCL and weighed 1.8 kg (4.0 lbs). No tags were observed on the turtle, which appeared fresh dead and had some minor scrapes along its dorsal surface and near the posterior notch. There was no evidence of boat propeller damage.

The turtle was transferred to MMSC personnel who indicated that a necropsy would likely be performed by the University of Pennsylvania. However, the University of Pennsylvania advised MMSC that the turtle could not be necropsied because it had been frozen. Subsequently, all dead turtles have been kept unfrozen until transferred to MMSC.

6.1.1.21 Incidental Capture of June 29, 2002

At approximately 2:00 AM on Saturday, June 29, 2002, an OCNGS Operator performing a routine inspection of the trash racks noticed a sea turtle swimming freely in bay #5 and bay #6 of the CWS intake structure. The turtle was dip-netted from bay #6 and found to be apparently healthy and moving about normally. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 26.2 EC (79.2 EF), and the OCNGS was operating at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been in the vicinity of the intake structure, the circulating water trash racks had been cleaned at 10:00 PM on June 28, approximately four hours prior to the turtle's capture. The turtle was not observed during that trash rack cleaning process.

The turtle measured 25.4 cm (10.0 in) in SCL and weighed 2.6 kg (5.7 lbs). Sex was not determined. A scar was observed on the right side of the carapace; no tags were observed on the animal.

The turtle was taken to the MMSC at approximately 4:55 AM on June 29 where it was examined and fed. The wound on the carapace was determined not to be a significant concern. The turtle was held at the MMSC for a few days before it was tagged and released into the Atlantic Ocean near Brigantine, NJ.

6.1.1.22 Incidental Capture of July 3, 2002

At approximately 7:55 AM on Wednesday, July 3, 2002, an OCNGS operator performing a routine inspection of the trash racks noticed a sea turtle swimming freely in bay # 5 of the DWS intake structure. The turtle was dip-netted from bay #5 and found to be apparently healthy and moving about normally. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 28.2 EC (82.8 EF) and OCNGS was operating at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the trash bars prior to removal, the dilution water trash racks had been cleaned earlier the same day at 5:00 AM. The turtle was not observed during that trash rack inspection and cleaning.

The turtle measured 35.6 cm (14.0 in) in SCL and weighed 6.0 kg (13.3 lb). Sex was not determined. A small scrape less than 1 cm (0.4 in) long was observed on one of the dorsal scutes of the carapace. No tags were present on the turtle when captured.

The turtle was taken to the MMSC in Brigantine, NJ at approximately 10:15 AM on July 3. At the MMSC, the turtle was examined and fed. The scrape on the carapace was determined not to be a

significant concern. The turtle was held at the MMSC for a few days before it was tagged and released into near-shore waters around Brigantine, NJ.

6.1.1.23 Incidental Capture of September 24, 2003

At approximately 2:55 PM on Wednesday September 24, 2003, an OCNGS operator performing a routine cleaning of the trash racks noticed a sea turtle among the vegetation and debris removed from bay # 6 of the DWS intake structure. The turtle was found to be apparently healthy and moving about normally. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 22.8 EC (73.0 EF), and the OCNGS was operating at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the trash bars prior to removal, the dilution water trash racks had been cleaned earlier the prior day at 1:45 PM. The turtle was not observed during that trash rack inspection and cleaning.

The turtle measured 31.1 cm (12.2 in) in SCL and weighed 5.2 kg (11.5 lb). Sex was not determined. Some small scrapes were observed on the dorsal and ventral surfaces of the carapace. No tags were present on the turtle when captured.

The turtle was taken to the MMSC in Brigantine, NJ at approximately 5:45 PM on September 24, 2003. At the MMSC, the turtle was examined and fed. The scrapes on the carapace were determined not to be a significant concern. The turtle was held at the MMSC for less than a day before it was tagged and released into near-shore Atlantic Ocean waters around Brigantine, NJ.

6.1.1.24 Incidental Capture of October 24, 2003

At approximately 8:50 AM on Friday, October 24, 2003, an OCNGS operator performing a routine cleaning of the trash racks noticed a sea turtle against bay #4 of the CWS intake structure. The turtle was found to be apparently healthy and moving about normally. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Atlantic green turtle. The water temperature at the time of the incidental capture was approximately 11.7 EC (53.1 EF), and the OCNGS was operating at 98-percent power with three circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the trash bars prior to removal, the circulating water trash racks had been inspected earlier the same morning at 5:00 AM. The turtle was not observed during that trash rack inspection.

The turtle measured 36.2 cm (14.2 in) in SCL and weighed 6.9 kg (15.3 lb). Sex was not determined. Some small scrapes and chips were observed on the dorsal and lateral surfaces of the carapace. No tags were present on the turtle when captured.

The turtle was taken to the MMSC in Brigantine, NJ at approximately 10:30 AM on October 24, 2003. At the MMSC, the turtle was examined and fed. The scrapes on the carapace were determined not to be a significant concern. The turtle was held at the MMSC until arrangements were made to transfer it to the Virginia Marine Science Museum (VMSM). VMSM is a more southerly location where the turtle could be observed, fed, and eventually released without fear of it dying due to cold shock.

6.1.1.25 Incidental Capture of July 4, 2004

At approximately 12:15 PM on Sunday, July 4, 2004, an OCNGS Operator performing a routine cleaning of the trash racks noticed a sea turtle among the vegetation and debris removed from bay # 4 of the dilution water intake structure. The turtle appeared to be either comatose or dead. In accordance with OCNGS procedures, operators initiated resuscitation of the sea turtle but were unable to revive it. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 25.6 EC (78.1 EF) and the OCNGS was operating at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the trash bars prior to removal, the dilution water trash racks had been inspected earlier the same day at 8:00 AM. The turtle was not observed during that trash rack inspection.

The turtle measured 26.5 cm (10.4 in) in SCL and weighed 5.4 kg (11.9 lb). Some small scrapes were observed on the ventral surface of the carapace. It was not possible to determine definitively whether the turtle had died prior to arriving at OCNGS or as a result of interaction with the OCNGS intake. No tags were present on the turtle when captured.

The turtle was taken to the MMSC in Brigantine, NJ at approximately 3:00 PM on July 4, 2004. At the MMSC, the turtle was examined and measured, and a necropsy was performed. MMSC personnel indicated that the necropsy indicated that the lungs were compressed, but that the cause of death was indeterminate. The turtle was buried by MMSC personnel at Brigantine, NJ.

6.1.1.26 Incidental Capture of July 11, 2004

At approximately 2:22 PM on Sunday, July 11, 2004, an OCNGS operator preparing to perform a routine cleaning of the trash racks noticed a sea turtle swimming in the water immediately upstream of the trash racks in bay # 5 of the DWS intake structure. The turtle appeared briefly at the water surface before diving out of sight. In accordance with OCNGS procedures, operators immediately initiated efforts to retrieve the turtle. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 27.5 EC (81.5 EF) and OCNGS was operating at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been swimming in the area of the trash bars prior to removal, the dilution water trash racks had been inspected earlier the same day at 1:15 PM. The turtle was not observed during that trash rack inspection.

The turtle measured 22.3 cm (8.8 in) in SCL and weighed 1.8 kg (4.0 lb). Some very minor scrapes were observed on the ventral surface of the carapace. No external tags were present on the turtle when captured.

The turtle was taken to the MMSC in Brigantine, NJ at approximately 4:23 PM on July 11, 2004. At the MMSC, the turtle was examined and held to ensure it was feeding well. The turtle was released two days later off Brigantine, NJ.

6.1.1.27 Incidental Capture of July 16, 2004

At approximately 11:00 AM on Friday, July 16, 2004, an OCNGS Operator performing a routine cleaning of the trash racks noticed a sea turtle among the vegetation and debris removed from bay # 5 of the DWS intake structure. The turtle appeared to be alive and in good condition when captured. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 24.4 EC (76.0 EF) and the OCNGS was operating at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the trash bars prior to removal, the dilution water trash racks had been inspected earlier the same day at 9:00 AM. The turtle was not observed during that trash rack inspection.

The turtle measured 28.0 cm (11.0 in) in SCL and weighed 3.1 kg (6.9 lb). Some small scrapes were observed on the plastron (undersurface of the carapace). No tags were present on the turtle when captured.

The turtle was taken to the MMSC in Brigantine, NJ at approximately 1:00 PM on July 16, 2004. At the MMSC, the turtle was examined, fed, and observed. The turtle was released by MMSC personnel to a safe location off Brigantine, NJ.

6.1.1.28 Incidental Capture of July 20, 2004

At approximately 12:13 PM on Tuesday, July 20, 2004, an OCNGS operator performing a routine cleaning of the trash racks noticed a sea turtle among the vegetation and debris removed from bay # 1 of the CWS intake structure. The turtle appeared to be either comatose or dead. In accordance with OCNGS procedures, operators initiated resuscitation of the sea turtle but were unable to revive it. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 26.5 EC (79.7 EF) and the OCNGS was operating at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the trash bars prior to removal, the circulating water trash racks had been inspected at 9:15 PM the previous evening. The turtle was not observed during that trash rack inspection.

The turtle measured only 18.3 cm (7.2 in) in SCL and weighed just 0.8 kg (1.8 lb). A small puncture wound about 1.3 cm (0.5 in) in diameter was observed on the left rear surface of the carapace, and internal organs were exposed. The cause of death was not obvious so it was not possible to determine definitively whether the turtle had died prior to arriving at OCNGS or as a result of interaction with the OCNGS intake. No tags were present on the turtle when captured.

The turtle was taken to the MMSC in Brigantine, NJ at approximately 10:00 AM on July 21, 2004. At the MMSC, the turtle was examined and measured, and a necropsy was performed. MMSC personnel included the results of the necropsy on the STSSN form, and the turtle was buried by MMSC personnel at Brigantine, NJ.

6.1.1.29 Incidental Capture of August 7, 2004

At approximately 9:00 AM on Saturday, August 7, 2004, an OCNGS Operator performing a routine cleaning of the trash racks noticed a sea turtle among the vegetation and debris removed from bay #5

of the dilution water intake structure. The turtle appeared to be alive, healthy, and moving about normally. OCNGS personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 22.7 EC (72.8 EF) and the OCNGS was operating at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the trash bars prior to removal, the dilution water trash racks had been inspected at 5:15 AM the same morning. The turtle was not observed during that trash rack inspection.

The turtle measured 27.0 cm (10.6 in) in SCL and weighed 3.2 kg (7.0 lb). A small bruise on the plastron was noted. Also, a healed scar from a previous injury (i.e., not related to interaction with the OCNGS) was noted on the left side of the turtle's head, immediately in front of its left eye. No tags were present on the turtle when captured.

The turtle was taken to the MMSC in Brigantine, NJ during the morning of August 7, 2004. At the MMSC, the turtle was examined, measured, observed, tagged, and subsequently released in the ocean off Brigantine, NJ.

6.1.1.30 Incidental Capture of September 11, 2004

At approximately 10:10 AM on Saturday, September 11, 2004, an OCNGS operator performing a routine cleaning of the trash racks noticed a sea turtle among the vegetation and debris removed from bay # 4 of the DWS intake structure. The turtle appeared to be either comatose or dead. In accordance with OCNGS procedures, operators initiated resuscitation of the sea turtle but were unable to revive it. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 24.3 EC (75.8 EF), and the OCNGS was operating at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the trash bars prior to removal, the dilution water trash racks had been inspected and cleaned the previous morning. The turtle was not observed during that trash rack inspection and cleaning.

The turtle measured 22.3 cm (8.8 in) in SCL and weighed 2.2 kg (4.8 lb). A small puncture wound was observed on the underside of the neck. No tags were present on the turtle when captured.

The turtle was taken to the MMSC in Brigantine, NJ at approximately 12:30 PM on September 11, 2004. At the MMSC, the turtle was examined and measured. The turtle was transferred to the New Bolton Center of the University of Pennsylvania School of Veterinary Medicine, where a necropsy was performed. It was not possible to determine definitively whether the turtle had died prior to arriving at OCNGS or as a result of interaction with the OCNGS intake.

6.1.1.31 Incidental Capture of September 12, 2004

At approximately 11:29 PM on Sunday, September 12, 2004, an OCNGS operator performing a routine cleaning of the trash racks noticed a sea turtle among the vegetation and debris removed from bay # 5 of the CWS intake structure. The turtle appeared to be healthy, alert, and moving about normally. OCNGS Environmental personnel confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 24.9 EC (76.8 EF), and the OCNGS was operating at 40-percent power with four circulating water pumps and two dilution pumps in

operation. Although it is impossible to say precisely how long the turtle had been on the trash bars prior to removal, the circulating water trash racks had been inspected at 8:00 PM the same evening. The turtle was not observed during that trash rack inspection.

The turtle measured 21.0 cm (8.3 in) in SCL and weighed 1.4 kg (3.1 lb). The left front flipper was nearly entirely missing due to a previous injury that had completely healed. No tags or scarring from tags were present on the turtle when captured.

The turtle was taken to the MMSC in Brigantine, NJ at approximately 7:00 AM on September 13, 2004. At the MMSC, the turtle was examined, measured, fed, and held for subsequent release. The turtle was transported to the VMSM during the week of September 27, 2004 for tagging and release to the Atlantic Ocean. The release of the turtle from a more southerly locale eliminated the possibility of autumn cold stunning effects that could have occurred if the turtle had been released from a New Jersey location at that time of year.

6.1.1.32 Incidental Capture of September 23, 2004

At approximately 9:45 PM on Thursday, September 23, 2004, an OCNGS operator performing a routine cleaning of the trash racks noticed a sea turtle among the vegetation and debris removed from bay #3 of the CWS intake structure. The turtle appeared to be alert and responsive. OCNGS Environmental personnel who took custody of the turtle confirmed it to be a juvenile Kemp's ridley turtle. The water temperature at the time of the incidental capture was approximately 21.9 EC (71.4 EF) and OCNGS was operating at full power with four circulating water pumps and two dilution pumps in operation. Although it is impossible to say precisely how long the turtle had been on the trash bars prior to removal, the circulating water trash racks had been inspected earlier the same day. The turtle was not observed during that trash rack inspection.

The turtle measured 24.2 cm (9.5 in) in SCL and weighed 1.9 kg (4.2 lb). Small abrasions on the underside of the carapace of the turtle were observed. No tags or scarring from previous tags were present on the turtle when captured.

The turtle was taken to the MMSC in Brigantine, NJ at approximately 6:00 AM on September 24, 2004. At the MMSC, the turtle was examined, measured, fed, and held for observation prior to release. The turtle was transported to the VMSM during the week of September 27, 2004 for tagging and release to the Atlantic Ocean. The release of the turtle from a more southerly locale eliminated the possibility of autumn cold stunning effects that could have occurred if the turtle had been released from a New Jersey location at that time of year.

6.1.2 Annual Comparison

During any particular year the number of sea turtles collected at the OCNGS CWS and DWS intakes ranged from zero (in all years from 1970 to 1991, as well as 1995 and 1996) to eight during 2004 (Table 6-2 and Figure 6-1). The number of loggerheads incidentally captured at the OCNGS ranged from zero to two animals annually. The number of Kemp's ridleys incidentally captured ranged from zero to eight animals annually. The number of Atlantic green turtles incidentally captured ranged from zero to one animal annually.

There have been no changes in the design or the mode of operation of the OCNGS that could explain the incidental take of eight Kemp's ridley turtles at the facility during 2004, when the previous annual maximum had been two individuals (Figure 6-1). This increase was probably ascribable to the combined effects of the rapidly-increasing population and the unusually-warm ocean water temperatures along the New Jersey coast during the summer of 2004.

As described above in Section 5.3.5, the size of the Kemp's ridley population has been rapidly increasing in recent years (Crouse et al. 1992; Turtle Expert Working Group 1998; Marquez et al. 1999; Turtle Expert Working Group 2000; Marquez et al. 2001). The 3,788 nests observed at Rancho Nuevo, Mexico in 2000 was the highest on record since 1969 and three to four times higher than the annual nest counts during the 1980s (Marquez et al. 2001). According to the Turtle Expert Working Group (1998; 2000), the Kemp's ridley population, as measured by the above-described nesting activity, is increasing exponentially. This contention is supported by observations from along the Atlantic coast where increasing numbers of Kemp's ridleys have been observed. A dramatic increase in strandings of this species has been observed, for example, along the North Carolina coast since 1993 (Boettcher 2000). Prior to 1993, 20 or fewer Kemp's ridley strandings were reported annually. The number of stranded individuals has steadily increased since 1993 to a maximum of 122 in 1999. A similar, although less dramatic, trend has been observed in New Jersey stranding data reported by the MMSC (Table 5-1). It has been suggested that this apparent increase in population size reflects the reduction in shrimp-trawl-related mortality realized since the implementation of the NOAA Fisheries TED regulations in September 1989 (Crouse et al. 1992; Turtle Expert Working Group 2000). The increase is also likely to be attributable in part to an increase in recruitment to the population as a result of beach and nest protection efforts at Rancho Nuevo (Marquez et al. 1999; Turtle Expert Working Group 2000). Given the evidence for the recent expansion of the Kemp's ridley population, it should not be surprising to see increasing numbers of this species in New Jersey waters, particularly if environmental conditions are favorable.

A key environmental factor affecting the seasonal migrations of juvenile and subadult Kemp's ridley turtles is water temperature. Ocean water temperatures along the southern New Jersey coast during June-September 2004 were the third warmest since record keeping began more than 90 years ago in 1912 (National Weather Service 2004). The average ocean water temperature during the summer of 2004 was 1.4 EC (2.5 EF) above normal and 3 EC (5.4 EF) warmer than the previous year. These abnormally-high ocean water temperatures provided excellent conditions to attract juvenile and subadult Kemp's ridleys migrating up the Atlantic coast in search of productive foraging grounds during 2004.

In addition to favorable water temperatures, the New Jersey coast also offers rich feeding grounds for Kemp's ridleys migrating up the Atlantic coast. According to MacKenzie (2003), New Jersey landings of the blue crab, a favorite food item for Kemp's ridley sea turtles, increased from less than one million pounds per year during the 1960s to nearly eight million pounds in 1993. Although landings declined somewhat after 1993, they remained in the four-to-seven-million-pound range through 2002.

Given the relatively small number of sea turtles captured at the OCNGS and the fact that they have only occurred during some of the years between 1992 and 2004, it is difficult to predict how many may be captured in the future. However, based on the levels of incidental capture observed at the OCNGS to date, it is estimated that zero to three loggerheads, zero to nine Kemp's ridleys, and zero to two Atlantic green turtles could be expected to be taken from the OCNGS intake during any given year.

6.1.3 Species Composition and Size

Seven loggerhead turtles, 21 Kemp's ridley turtles, and four Atlantic green turtles have been captured at the circulating and dilution water intakes of the OCNGS between 1992 and 2004 (Figure 6-1).

The loggerheads were all juveniles or subadults. SCLs ranged from 35.5 to 61.4 cm (14 to 24 in) with a mean of 48.0 cm (18.9 in) (Figure 6-2). The Kemp's ridleys were also juveniles or subadults. Their SCLs ranged from 18.3 to 48.8 cm (7.2 to 19.2 in) with a mean of 27.2 cm (10.7 in) (Figure 6-2). The four Atlantic green turtles were all juveniles. Their SCLs ranged from 27.0 to 36.2 cm (10.6 to 14.3 in), with an average length of 29.8 cm (11.7 in).

6.1.4 Seasonal Distribution of Occurrences

Four out of 32 sea turtle strandings at the OCNGS were reported during June, 11 during July, five during August, eight during September, and four during October. No sea turtles were collected during the late fall to winter (November-February) or spring (March-May) (Table 6-3).

The timing of sea turtle occurrences at the OCNGS corresponds well with the available information on the seasonal movements of these animals. Based on aerial surveys of pelagic turtles (Shoop et al. 1981), sea turtles migrate up the coast from the southeast in the spring and summer months. They move into the bays and coastal waters as water temperatures reach suitable levels and forage on crabs and other preferred foods (Keinath et al. 1987; Morreale and Standora 1989; Seney et al. 2002). As water temperatures in the bays and coastal waters start to decline, these animals move southward to the warmer waters of the southeast Atlantic Coast. Recapture information from tagged animals provides evidence for such movements in loggerheads and Kemp's ridleys (Shoop et al. 1981; Henwood 1987; PSE&G 1989).

6.1.5 Location of Incidental Captures at the OCNGS

The incidental captures of loggerhead and Atlantic green turtles at the OCNGS were equally divided between the CWS and DWS intake structures. Four loggerheads were captured at the CWS, compared with three at the DWS. Two Atlantic green turtles were taken at the CWS intake and two at the DWS intake.

Seventy-one percent (15 out of 21) of the Kemp's ridley turtles incidentally captured at the OCNGS were taken at the DWS intake structure. The water velocity is about four times greater at the DWS intake than at the CWS intake; therefore, it is much harder for turtles to fight the current at the DWS intake. During normal operation, the DWS employs two dilution pumps that withdraw 1,968 m³/min (520,000 gpm) producing a flow velocity of 73 cm/sec (2.4 ft/sec) in front of the DWS trash bars. Also during normal operation, the CWS employs four circulating pumps that withdraw 1,740 m³/min (460,000 gpm) producing a flow velocity of 17-20 cm/sec (0.56-0.66 ft/sec) in front of the CWS trash bars. Additionally, the floating debris/ice barrier described in Section 4.1.2.1.2 is designed to divert floating debris away from the CWS and towards the DWS intake. This passive device may also divert sea turtles toward the DWS intake, however, the barrier only extends about 60 cm (2 ft) below the surface and it is unclear why only Kemp's ridleys would be affected in this manner.

The size and associated swimming ability of the sea turtles may also be a factor. The average SCL of the Kemp's ridleys taken at the OCNGS was 27.2 cm (10.7 in), compared with average lengths of

29.8 cm (11.7 in) for Atlantic green turtles and 48.0 cm (18.9 in) for loggerheads. The loggerhead and Atlantic green turtles may be stronger swimmers than the smaller Kemp's ridleys, and may be able to avoid the higher flow area near the DWS intake selectively moving towards the lower flow area near the CWS intake.

6.1.6 Conditions of Turtles Captured at the Intake Structures

Nearly 60 percent (19 of 32) of all sea turtles captured at the OCNGS intakes were alive at the time of capture and subsequently released (Tables 6-1 and 6-2). The remaining 40 percent (13 of 32) were dead at the time of capture. The survival rate of the most commonly encountered species, the Kemp's ridley, averaged 51 percent during the ten years that they were captured at the OCNGS (Figure 6-3). The Kemp's ridley survival rate during 2004, the year that the highest number of individuals was taken (8 individuals compared to a maximum of 2 in prior years), was 63 percent, exceeding the mean survival rate by 12 percent (Figure 6-3). Detailed descriptions of each incidental capture at the OCNGS are provided in Section 6.1.1. The following paragraphs summarize the condition of the sea turtles captured during the 1992-2004 period.

**Table 6-1
Sea turtle incidental captures at the Oyster Creek Nuclear Generating Station 1969-20**

DATE OF CAPTURE	TIME OF CAPTURE	SPECIES AND LIFE STAGE	SCL (cm) AND WEIGHT (kg)	CAPTURED AT CWS OR DWS (# PUMPS OPERATING)	INTAKE TEMPERATURE EF (EC)	ALIVE?	FRESH DEAD?
6/25/1992	12:50 pm	Loggerhead juvenile	35.5 cm 9.6 kg	DWS 2 pumps	70.8 (21.6)	no	no
9/9/1992	6:00 pm	Loggerhead juvenile	46.7 cm 19.1 kg	CWS 4 pumps	78.2 (25.6)	yes	N/A
9/11/1992*	2:00 pm	Loggerhead juvenile	46.7 cm 19.1 kg	CWS 4 pumps	79.2 (26.2)	yes	N/A
10/26/1992	3:00 am	Kemp's ridley adult	32.0 cm 5.7 kg	CWS 4 pumps	52.0 (11.1)	yes	N/A
10/17/1993	12:00 noon	Kemp's ridley juvenile	26.0 cm 3.0 kg	DWS 2 pumps	58.0 (14.4)	no	yes
6/19/1994	1:30 pm	Loggerhead juvenile	36.8 cm 9.8 kg	CWS 4 pumps	81.1 (27.3)	yes	N/A
7/1/1994	10:00 am	Kemp's ridley juvenile	27.7 cm 3.6 kg	DWS 2 pumps	78.3 (25.7)	no	no
7/6/1994	6:40 am	Loggerhead subadult	61.4 cm 40.4 kg	DWS 2 pumps	80.5 (26.9)	no	no
7/12/1994	10:40 pm	Kemp's ridley juvenile	26.7 cm 3.3 kg	DWS 2 pumps	83.2 (28.4)	no	yes
9/4/1997	3:18 am	Kemp's ridley subadult	48.8 cm 18.1 kg	DWS 2 pumps	73.2 (22.9)	no	yes
8/18/1998	9:59 am	Loggerhead subadult	50.8 cm 24.4 kg	CWS 4 pumps	80.5 (26.9)	yes	N/A
9/23/1999	3:10 am	Kemp's ridley subadult	26.4 cm 2.9 kg	CWS 4 pumps	67.2 (19.6)	yes	N/A
10/23/1999	2:00 am	Green juvenile	27.0 cm 2.8 kg	DWS 2 pumps	62.8 (17.1)	no	**
6/23/2000	1:00 am	Loggerhead juvenile	47.8 cm 17.2 kg	DWS 2 pumps	77.5 (25.3)	yes	N/A

**Table 6-1
Sea turtle incidental captures at the Oyster Creek Nuclear Generating Station 1969-2004.**

DATE OF CAPTURE	TIME OF CAPTURE	SPECIES AND LIFE STAGE	SCL (cm) AND WEIGHT (kg)	CAPTURED AT CWS OR DWS (# PUMPS OPERATING)	INTAKE TEMPERATURE EF (EC)	ALIVE?	FRESH DEAD?	BOAT WOUNDS?	RELEASE SITE
7/2/2000	3:00 pm	Kemp's ridley juvenile	27.3 cm 3.2 kg	DWS 2 pumps	78.1 (25.6)	no	**	no	N/A
8/3/2000	3:25 pm	Green juvenile	29.2 cm 3.4 kg	DWS 2 pumps	83.9 (28.8)	yes	N/A	no	NC
8/28/2000	1:12 am	Kemp's ridley juvenile	26.2 cm 2.9 kg	DWS 2 pumps	79.8 (26.5)	yes	N/A	no	NC
9/18/2000	1:10 pm	Loggerhead subadult	57.2 cm 26.5 kg	CWS 4 pumps	68.6 (20.4)	yes	N/A	no	NC
7/8/2001	2:30 pm	Green juvenile	26.7 cm 2.3 kg	CWS 4 pumps	80.1 (26.7)	yes	N/A	no	NJ
7/22/2001	5:44 pm	Kemp's ridley juvenile	26.0 cm 2.9 kg	DWS 2 pumps	80.4 (26.9)	no	**	possible	N/A
8/14/2001	3:34 am	Kemp's ridley juvenile	22.8 cm 1.8 kg	DWS 2 pumps	82.0 (27.8)	no	**	no	N/A
6/29/2002	2:00 am	Kemp's ridley juvenile	25.4 cm 2.6 kg	CWS 4 pumps	79.2 (26.2)	yes	N/A	possible	NJ
7/3/2002	7:55 am	Kemp's ridley juvenile	35.6 cm 6.0 kg	DWS 2 pumps	82.8 (28.2)	yes	N/A	no	NJ

Table 6-1
Sea turtle incidental captures at the Oyster Creek Nuclear Generating Station 1969-2004.

DATE OF CAPTURE	TIME OF CAPTURE	SPECIES AND LIFE STAGE	SCL (cm) AND WEIGHT (kg)	CAPTURED AT CWS OR DWS (# PUMPS OPERATING)	INTAKE TEMPERATURE EF (EC)	ALIVE?	FRESH DEAD?	BOAT WOUNDS?	RELEASE SITE
9/24/2003	2:55 pm	Kemp's ridley juvenile	31.1 cm 5.2 kg	DWS 2 pumps	73.0 (22.8)	yes	N/A	no	NJ
10/24/2003	8:50 am	Green juvenile	36.2 cm 6.9 kg	CWS 3 pumps	53.0 (11.7)	yes	N/A	no	VA
7/4/2004	12:15 pm	Kemp's ridley juvenile	26.5 cm 5.4 kg	DWS 2 pumps	78.0 (25.6)	no	yes	no	N/A
7/11/2004	2:22 pm	Kemp's ridley juvenile	22.3 cm 1.8 kg	DWS 2 pumps	81.5 (27.5)	yes	N/A	no	NJ
7/16/2004	11:00 am	Kemp's ridley juvenile	28.0 cm 3.1 kg	DWS 2 pumps	76.0 (24.4)	yes	N/A	no	NJ
7/20/2004	12:13 am	Kemp's ridley juvenile	18.3 cm 0.8 kg	CWS 4 pumps	79.7 (26.5)	no	yes	no	N/A
8/7/2004	9:00 am	Kemp's ridley juvenile	27.0 cm 3.2 kg	DWS 2 pumps	72.8 (22.7)	yes	N/A	no	NJ
9/11/2004	10:10 am	Kemp's ridley juvenile	22.3 cm 2.2 kg	DWS 2 pumps	75.8 (24.3)	no	yes	yes (healed)	N/A
9/12/2004	11:29 pm	Kemp's ridley juvenile	21.0 cm 1.4 kg	CWS 4 pumps	76.8 (24.9)	yes	N/A	no	VA

**Table 6-1
Sea turtle incidental captures at the Oyster Creek Nuclear Generating Station 1969-2004.**

DATE OF CAPTURE	TIME OF CAPTURE	SPECIES AND LIFE STAGE	SCL (cm) AND WEIGHT (kg)	CAPTURED AT CWS OR DWS (# PUMPS OPERATING)	INTAKE TEMPERATURE EF (EC)	ALIVE?	FRESH DEAD?	BOAT WOUNDS?	RELEASE SITE
9/23/2004	9:45 pm	Kemp's ridley juvenile	24.2 cm 1.9 kg	CWS 4 pumps	71.4 (21.9)	yes	N/A	no	VA

Note: No sea turtles were captured during the first 22 years of OCN GS operation, 1969-1991.

* Loggerhead captured on 9/11/1992 was the same individual that was captured on 9/9/1992.

** Necropsy report was unavailable; therefore, whether the turtle was fresh dead could not be determined.

TABLE 6-2
MORTALITY OF SEA TURTLES CAPTURED FROM INTAKE TRASH BARS AT
THE OYSTER CREEK NUCLEAR GENERATING STATION 1969-2004 (LIVE/DEAD).

YEAR	LOGGERHEAD	KEMP'S RIDLEY	GREEN	TOTALS
1969	0/0	0/0	0/0	0/0
1970	0/0	0/0	0/0	0/0
1971	0/0	0/0	0/0	0/0
1972	0/0	0/0	0/0	0/0
1973	0/0	0/0	0/0	0/0
1974	0/0	0/0	0/0	0/0
1975	0/0	0/0	0/0	0/0
1976	0/0	0/0	0/0	0/0
1977	0/0	0/0	0/0	0/0
1978	0/0	0/0	0/0	0/0
1979	0/0	0/0	0/0	0/0
1980	0/0	0/0	0/0	0/0
1981	0/0	0/0	0/0	0/0
1982	0/0	0/0	0/0	0/0
1983	0/0	0/0	0/0	0/0
1984	0/0	0/0	0/0	0/0
1985	0/0	0/0	0/0	0/0
1986	0/0	0/0	0/0	0/0
1987	0/0	0/0	0/0	0/0
1988	0/0	0/0	0/0	0/0
1989	0/0	0/0	0/0	0/0
1990	0/0	0/0	0/0	0/0
1991	0/0	0/0	0/0	0/0
1992	1/1	1/0	0/0	2/1
1993	0/0	0/1	0/0	0/1
1994	1/1	0/2	0/0	1/3
1995	0/0	0/0	0/0	0/0
1996	0/0	0/0	0/0	0/0
1997	0/0	0/1	0/0	0/1
1998	1/0	0/0	0/0	1/0
1999	0/0	1/0	0/1	1/1
2000	2/0	1/1	1/0	4/1
2001	0/0	0/2	1/0	1/2
2002	0/0	2/0	0/0	2/0
2003	0/0	1/0	1/0	2/0
2004	0/0	5/3	0/0	5/3
TOTALS	5/2	11/10	3/1	19/13

TABLE 6-3
 SEASONAL OCCURRENCE OF SEA TURTLES AT THE OYSTER CREEK
 NUCLEAR GENERATING STATION INTAKES 1969-2004

MONTH	LOGGERHEAD	KEMP'S RIDLEY	GREEN	TOTALS
JANUARY	0	0	0	0
FEBRUARY	0	0	0	0
MARCH	0	0	0	0
APRIL	0	0	0	0
MAY	0	0	0	0
JUNE	3	1	0	4
JULY	1	9	1	11
AUGUST	1	3	1	5
SEPTEMBER	2	6	0	8
OCTOBER	0	2	2	4
NOVEMBER	0	0	0	0
DECEMBER	0	0	0	0
TOTALS	7	21	4	32

**NUMBER OF SEA TURTLE INCIDENTAL CAPTURES AT THE
OYSTER CREEK NUCLEAR GENERATING STATION 1992-2004**

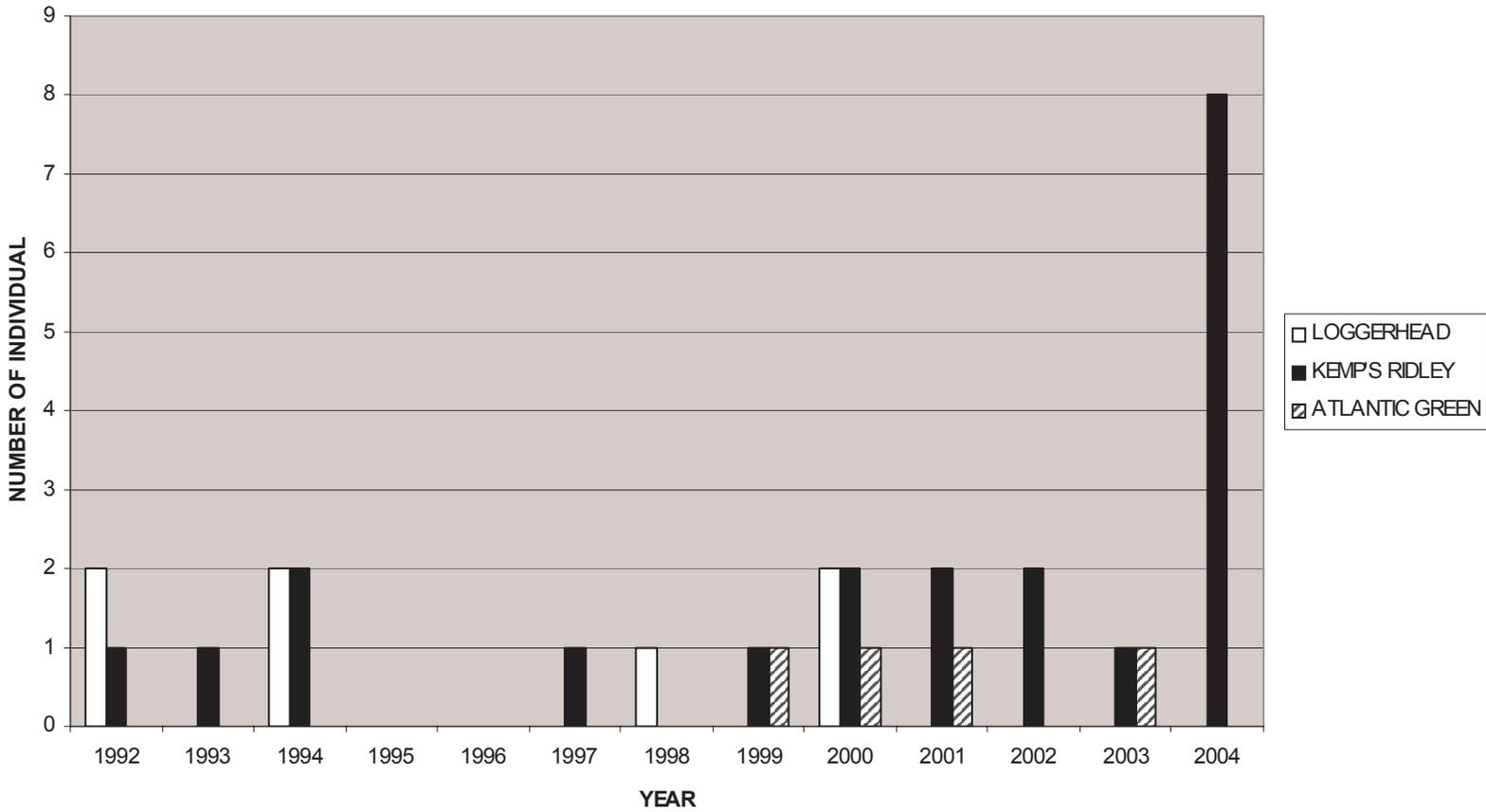
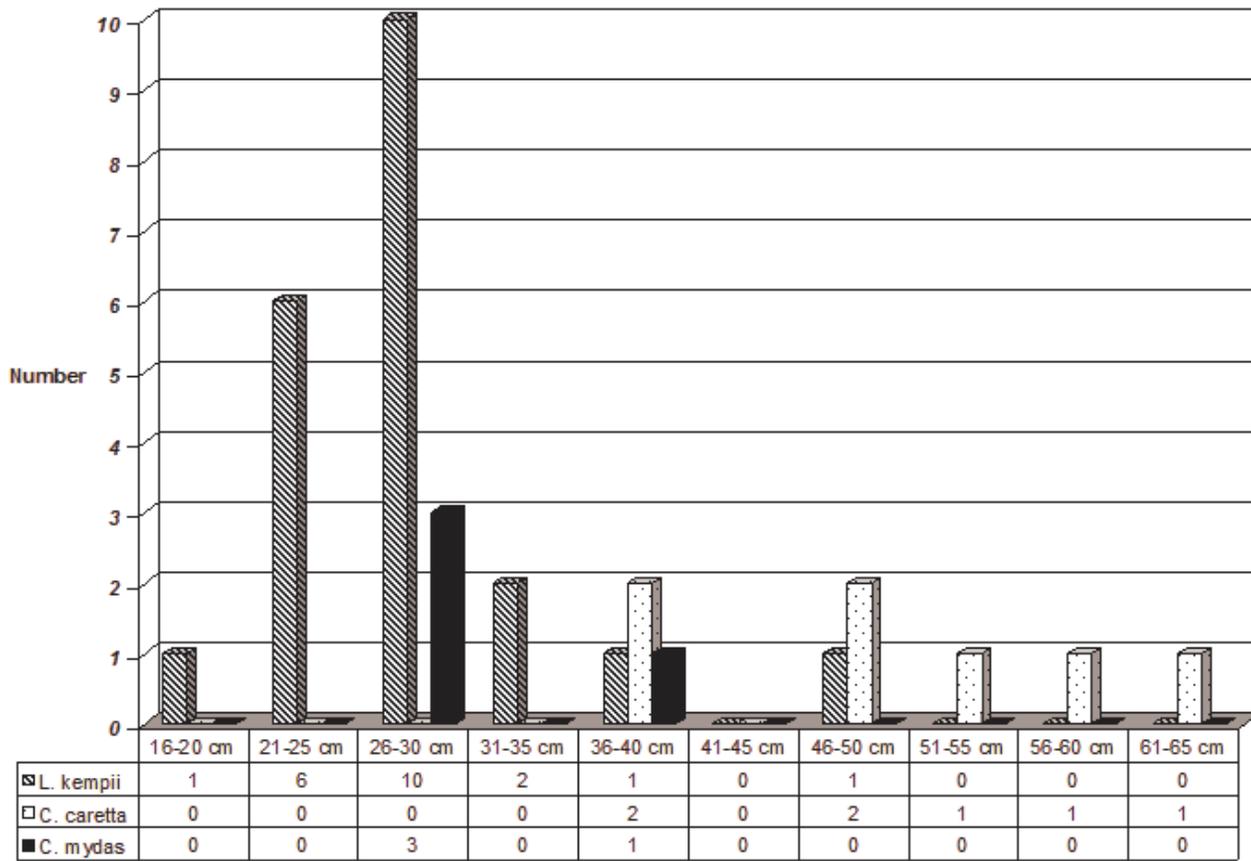


Figure 6-1

Number of sea turtle incidental captures at the OCNGS, 1992-2004.

Note: No sea turtles were captured during the first 22 years of OCNGS operation, 1969-1991.

**OYSTER CREEK NUCLEAR GENERATING STATION
SEA TURTLE LENGTH FREQUENCY DISTRIBUTION 1969-2004
Standard Carapace Length (cm)**



Fig

ure 6-2

Frequency distribution of SCLs for Kemp's ridley, loggerhead, and green turtles captured from intake structures at the OCNBS from 1969 through 2004.

**SURVIVAL RATE OF KEMP'S RIDLEY SEA TURTLES CAPTURED AT THE
OYSTER CREEK NUCLEAR GENERATING STATION**

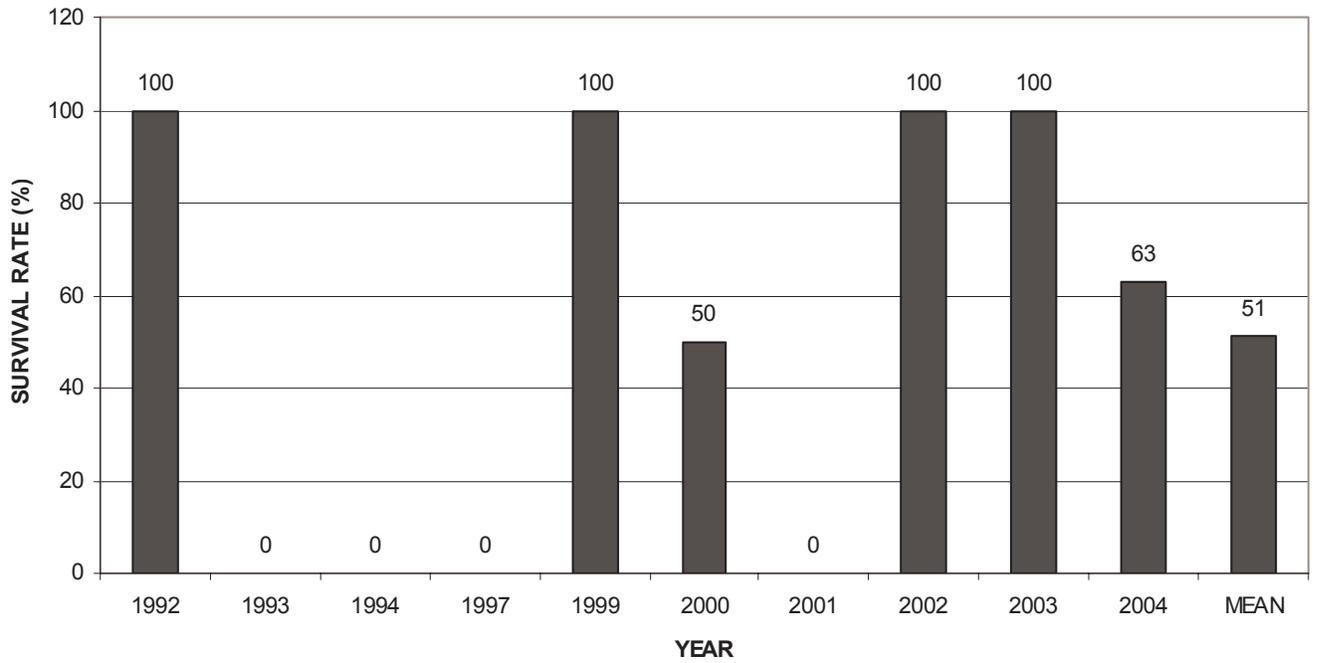


Figure 6-3

Survival rate of Kemp's ridley turtles captured at the OCNGS.

Note: No Kemp's ridleys were taken during 1995, 1996, and 1998;
no sea turtles were captured during the first 22 years of OCNGS operation, 1969-1991.

7.0 Assessment of Present Operations

The primary concern with sea turtles at the OCNGS is whether or not any station related losses of these endangered or threatened sea turtle species "jeopardizes their continued existence." Federal regulation (50 CFR 402) defines "jeopardizes the continued existence" as "engaging in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of that species." Therefore, the question relative to the OCNGS is: Do the activities associated with the operation of the OCNGS "appreciably reduce" the reproduction, numbers, or distribution of the loggerhead, Kemp's ridley, or Atlantic green turtles?

7.1 Impacts of Continued Operation of Oyster Creek Nuclear Generating Station on Sea Turtle Populations

7.1.1 Impacts due to Incidental Capture (Impingement) of Turtles on CWS and DWS Intake Trash Racks

Thirty-two sea turtles have been retrieved from either the CWS or DWS intake at the OCNGS during the period from 1969 to 2004. Nineteen turtles were alive and returned to the Atlantic Ocean. Typically, the live sea turtles were delivered to the Marine Mammal Stranding Center (MMSC) in Brigantine, New Jersey and subsequently released into nearby ocean waters by MMSC personnel. However, five Kemp's ridleys, two Atlantic greens, and two loggerheads were transported by MMSC personnel to warmer Atlantic Ocean waters for release in North Carolina, Virginia, and Florida due to the cold and falling ocean water temperatures in New Jersey at the time they were captured at the OCNGS (Table 6-1).

Thirteen turtles removed from the OCNGS intake were dead at the time of capture. Of these, two loggerheads exhibited severe boat prop wounds and were moderately decomposed indicating that death occurred prior to encountering the intake. The intake trash bars routinely capture floating debris during normal operation; dead and injured turtles, buoyed by the gases of decomposition, would be expected to be part of the debris load in the intake canal removed by the station. One dead sea turtle was a juvenile green turtle captured during late October 1999. This individual

exhibited no significant wounds, but given the time of year, its death may have been related to cold stunning. The remaining ten sea turtles found dead at the OCNGS intake structures were all Kemp's ridleys. The condition of four dead Kemp's ridleys at the time of capture suggests that the causes of death were indeterminate regarding interaction with the OCNGS intake (Section 6.1.1). One of the two dead Kemp's ridleys taken in 1994 exhibited a strong odor of decomposition, suggesting that it may have died prior to becoming impinged on the DWS intake. It also could have drowned after being impinged on the trash bars at a depth beyond the range of visibility from the surface decomposing over time. A Kemp's ridley taken in July 2001 had a deep slice wound on its neck that could have also been caused by an encounter with a boat. Two of the three dead Kemp's ridleys taken during 2004 had puncture wounds on the carapace or neck that could have resulted from collisions with boats or could have been caused by the tines of the trash rakes, although the tines have a diameter slightly greater than that of the puncture wounds. The most likely cause of death of one individual taken in 1993 was determined by necropsy to be drowning at the DWS intake. The deaths of the remaining five Kemp's ridleys may also be attributable to drowning at either the DWS or CWS intake, although the causes of death were not definitively determined. Therefore, there have been a maximum of eleven, and as few as six, dead turtles removed from the intake during the 35 years since the OCNGS began operation in 1969 whose cause of death may have been attributable to station operations.

Based on these levels of incidental capture at the OCNGS intake, it is estimated that zero to three loggerheads, zero to nine Kemp's ridleys, and zero to two greens would be expected to be taken from the intake during any given year.

7.1.1.1 Assessment of Impacts on Loggerhead Turtle Populations

The annual number of loggerheads incidentally captured at the OCNGS has ranged from zero to two turtles. Five of the seven loggerheads captured were alive and released back into the wild. The two dead loggerheads taken were moderately decomposed when collected, suggesting death prior to involvement with the station. Carapace wounds suggested that the damage from boat propellers caused the death of one, and the effects of a variety of diseases had resulted in the death of the other. Therefore, if live and long-dead animals are removed from the assessment of impact, the OCNGS has had no impact on loggerhead turtle populations to date.

To determine if any future losses attributable to the OCNGS "appreciably reduce" the reproduction, numbers, or distribution of loggerheads, it is necessary to compare on-site information with breeding information, population estimates, and distribution information for this species.

Although three loggerhead nests were reported from New Jersey in the 1980s and 1990s (Schoelkopf 1994), loggerhead nesting in the U.S. primarily occurs along coastal beaches in Florida, Georgia, South Carolina, and North Carolina. Also, all loggerheads incidentally captured at the CWS and DWS intakes were juveniles or subadults, which are more prevalent along the mid-Atlantic coast than adults (Van Buskirk and Crowder, 1994).

Therefore, based on the immaturity of the specimens captured and the fact that loggerhead nesting does not typically occur in New Jersey, the only loss to loggerhead reproduction would be from production foregone due to the loss of juvenile/subadult animals, which could have been recruited into the breeding female population at some time in the future.

The observed worst-case incidental catch level for loggerheads at the OCNCS has been two turtles during any given year, with no mortality attributable to the OCNCS. If we compare this with the estimated adult female population size of 44,780 animals (Turtle Expert Working Group 2000), this mortality would represent 0.004 percent of the adult female population in the Atlantic. The worst-case estimate of losses attributable to the OCNCS is overestimated. Mortality at this level would not "appreciably reduce," or for that matter measurably reduce, the distribution or numbers of loggerhead turtles along the Atlantic coast of the U.S.

7.1.1.2 Assessment of Impacts on Kemp's Ridley Turtle Populations

The number of Kemp's ridleys incidentally captured at the OCNCS has ranged from zero to eight per year during the 1969-2004 period. Eleven of the 21 Kemp's ridleys captured at the OCNCS were alive and were successfully released back into the wild. Six of the ten Kemp's ridleys found dead at the OCNCS appeared to have died recently and exhibited no significant wounds. The remaining four had significant wounds or a strong odor of decomposition, suggesting that their deaths could have been attributable to factors other than interaction with the OCNCS intake. The observed worst-case incidental catch level was in 2004 when five live and three dead Kemp's ridleys were taken at the OCNCS CWS and DWS intakes.

To determine if the OCNCS "appreciably reduces" the reproduction, numbers, or distribution of Kemp's ridley turtles, it is necessary to compare on-site information with breeding information, population estimates, and distribution information for this species. The adult Kemp's ridley turtle population was estimated to be approximately 2,200 turtles in 1989 (Márquez 1989), based on breeding females observed in Mexico. Since, with a few minor exceptions, this breeding colony is the only known colony in the world, this estimate essentially represents the worldwide breeding population for Kemp's ridleys. All specimens captured at the OCNCS were juveniles or subadults, not yet capable of reproducing (Van Buskirk and Crowder, 1994). Therefore, based on the immaturity of the specimens captured and the fact that Kemp's ridley nesting does not occur in New Jersey, the only loss to Kemp's ridley reproduction would be from production foregone due to the mortality of juvenile/subadult animals, which could have been recruited into the breeding female population at some time in the future.

If we assume a worst-case incidental mortality rate at the OCNCS of three Kemp's ridley turtles during any given year and compare it with the estimated population size of 2,200, they would represent 0.14 percent of the population. This population estimate does not include juveniles and subadults. Also, studies of Kemp's ridley nesting activity have shown that the population has been increasing rapidly since the population estimate was developed in 1989 (Turtle Expert Working Group 1998; Turtle Expert Working Group 2000; Márquez et al. 2001). Therefore, this is a significant underestimate of the actual population size. It is unlikely that losses at this level would "appreciably reduce," or for that matter measurably reduce, the distribution or numbers of Kemp's ridley turtles along the Atlantic coast of the U.S.

7.1.1.3 Assessment of Impacts on Atlantic Green Turtle Populations

Only four Atlantic green turtles were incidentally captured at the OCNCS during the 1969-2004 period, with one individual taken each year in 1999, 2000, 2001, and 2003. Three turtles were alive at the time of capture and released back into the wild. The only dead specimen was taken in late October 1999, and its death could have been attributable to cold stunning. All Atlantic green turtles

taken at the OCNGS were juveniles.

To determine if the OCNGS "appreciably reduces" the reproduction, numbers, or distribution of Atlantic green turtles, it is necessary to compare on-site information with breeding information, population estimates, and distribution information for this species. Although the green turtle occurs worldwide in tropical and semitropical waters, they are found in U.S. Atlantic waters around the Virgin Islands, Puerto Rico, and the continental U.S. from Texas to Massachusetts (NMFS and USFWS, 1991b). In U.S. Atlantic waters, green turtles nest in small numbers in the U.S. Virgin Islands and Puerto Rico, and in larger numbers along the eastern coast of Florida. As many as 477 Atlantic green turtle nests per year have been documented to occur along a 21-km (13-mi) stretch of beach in Melbourne Beach, Florida. The Florida Department of Natural Resources (FDNR) has found up to 2,288 clutches of Atlantic green turtle eggs per year in nests on Florida beaches (FDNR, unpublished data). However, more information is needed before detailed maps or estimates of population number and structure can be made for green turtle populations in U.S. territorial waters (NMFS and USFWS, 1991b).

Based on the immaturity of the Atlantic green turtles captured at the OCNGS and the fact that nesting of Atlantic green turtles is not known to occur as far north as New Jersey, the only loss to green turtle reproduction would be from production foregone due to the mortality of juvenile/subadult animals, which could have been recruited into the breeding female population at some time in the future.

If we assume a worst-case incidental mortality rate at the OCNGS of one Atlantic green turtle during any given year and compare it with an assumed population size of several thousand, this loss would represent only a very small fraction of one percent of the population. It is unlikely that losses at this level would "appreciably reduce," or for that matter measurably reduce, the distribution or numbers of Atlantic green turtles along the Atlantic coast of the U.S.

7.2 Other Potential Station Impacts on Turtles

7.2.1 Acute Thermal Effects

The discharges from OCNGS's CWS and DWS are located 45 and 105 m (150 and 450 ft) west of the reactor building, respectively (Figure 4-2). As discussed in Section 4.0, the temperature rise of the CWS discharge is typically about 11 EC (20 EF) above ambient intake canal temperatures. Because of the relatively high discharge velocities (65-95 cm/sec [2.1-3.1 ft/sec]), a sea turtle is not likely to remain in the immediate vicinity of the condenser discharge for any length of time. Furthermore, turtles in the area would easily be able to avoid entrainment in the thermal discharge flow by swimming away. Downstream of the condenser discharge, complete mixing with ambient temperature water from the DWS occurs, reducing the discharge canal water temperatures by approximately 5.6 EC (10 EF) when two dilution pumps are operating. The resulting water temperature of approximately 5.6 EC (10 EF) above ambient should not be stressful for any sea turtle species. Therefore, it is concluded that no adverse, acute, thermally-related impacts would be sustained by any sea turtle species.

7.2.2 Chronic Thermal Effects

The thermal discharge from OCNGS would not adversely impact the reproduction or migratory behavior of sea turtles inhabiting Barnegat Bay or coastal oceanic waters in the vicinity of the OCNGS.

Because the vast majority of reproduction occurs in the southeastern U.S. or other distant locations in the case of the loggerhead and green turtles, and Mexico in the case of the Kemp's ridley, no reproductive impacts are expected.

The New Jersey Department of Environmental Protection evaluation of the impact of the OCNGS thermal plume on Barnegat Bay concluded that the effects on fish distribution and abundance were small and localized with few or no regional consequences (Summers et al. 1989). Similarly, due to the shallow nature of the plume, the relatively small area affected, and the small temperature increases within Barnegat Bay, the movements of sea turtles in the bay are not expected to be adversely impacted. The extent of the thermal plume, as measured by the 1.1 EC (34 EF) excess temperature isotherm, depends upon prevailing wind conditions and tidal stage but has been estimated to be less than 1.6 km (5,300 ft) in an east-west direction by 5.6 km (18,500 ft) in a north-south direction, under all conditions (Starosta et al. 1979, JCP&L 1986). More importantly, as discussed in Section 4.1.3, outside of the immediate vicinity of the mouth of Oyster Creek, the plume is primarily a surface phenomenon. As such, it is easily avoidable by sea turtles that move freely about in the water column, spending a large portion of their time foraging on the bottom.

7.2.3 Cold Shock

Cold shock mortalities of fishes have occurred at the OCNGS in the past. These events occurred when migratory species, attracted to the heated condenser discharge, remained in the discharge canal after they normally would have migrated out of Barnegat Bay in response to falling autumn water temperatures. Subsequent station outages, after ambient water temperatures had fallen below 10 EC (50 EF), resulted in cold-shock fish kills. The number and severity of these events has been reduced as a result of the operation of two dilution pumps in the fall, when ambient water temperatures began to drop, to decrease the attractiveness of the discharge canal as overwintering habitat (Summers et al. 1989).

Cold stunning, which is a possible cause of death for some turtles that were taken at OCNGS, differs from cold shock. Cold stunning occurs when a turtle or other migratory animal fails to migrate in advance of declining temperatures and becomes trapped and unable to escape from water becoming progressively colder. The declining temperature results in reduced mobility and ultimately death. Basically, the animal suffers from exposure to the cold because the animal did not migrate soon or fast enough toward the tropics. Cold shock occurs in conjunction with station outages during the winter. Typically, an animal that suffers cold shock has taken up temporary residence in or near the warm-water discharge and did not migrate toward the tropics per usual migratory patterns. When a winter outage occurs, an animal near the warm-water discharge is shocked when the ambient temperatures quickly drop to levels below the animal's tolerance.

Cold-shock mortality of sea turtles has not been observed and is not expected to occur at the OCNGS for a number of reasons. The area where sea turtles could overwinter is extremely limited, including only the immediate vicinity of the condenser discharge, prior to any mixing with the DWS flow. Winter water temperatures in the discharge canal, downstream of the area where CWS and DWS flows mix, routinely fall below 7.2 EC (45 EF).

The small area where winter water temperatures would be suitable for overwintering sea turtles is characterized by a relatively high discharge velocity of 65-95 cm/sec (2.1-3.1 ft/sec). This would require continuous swimming activity, 24 hours per day, for a sea turtle to maintain its position in the heated discharge flow.

Food availability in the potential overwintering area would be extremely limited and probably insufficient to support the amount of swimming activity required to maintain a turtle in the heated discharge flow throughout the winter. Their preferred food, blue crabs and horseshoe crabs, would not be found in this area during the winter months. In addition, the canal bottom has a very hard substrate in the vicinity of the condenser discharge, and does not support a wide variety of benthic organisms that might support sea turtle diets.

7.2.4 Biocides

Low-level, intermittent chlorination is used to control biofouling in the OCNCS service water system and CWS. New Jersey Pollutant Discharge Elimination System (NJPDES) permit conditions limit chlorine discharge levels to a maximum daily concentration of 0.2 mg/l (2.7×10^{-5} ounces per gallon) or a maximum daily chlorine usage of 41.7 kg/day (91.9 lbs/day). The main condenser cooling water is chlorinated for approximately two hours per day. The chlorine demand in the main condenser discharge consumes almost all remaining free chlorine and results in essentially no chlorine being released to the discharge canal.

Given the very small quantities of chlorine applied, the short duration of the application periods, the fact that residual chlorine levels in the condenser discharge are at or near zero, and the fact that the condenser discharge is combined with unchlorinated DWS flow, the use of this biocide would not have any impact on sea turtles that may occur in the discharge canal or Barnegat Bay.

7.3 Mitigating Measures

To minimize the potential impact of station operations on threatened or endangered sea turtles, a variety of mitigating measures have been instituted at the OCNCS. These measures include all of the "reasonable and prudent measures necessary to minimize the impact on listed species" specified in the ITS dated July 18, 2001, and are described in this section.

7.3.1 Sea Turtle Surveillance and Handling

The surveillance and handling requirements necessary to minimize the impact of OCNCS operations on sea turtles are defined in the Sea Turtle Surveillance, Handling, and Reporting Instructions (Appendix A) for operations personnel and associated Operations Department tour sheets. These instructions apply to all Operations Department personnel responsible for conducting surveillances of the intake structures, cleaning trash bars, and making notifications.

7.3.1.1 Surveillance of CWS and DWS Intakes

The CWS and DWS intake trash bars, and the area immediately upstream of the trash bars, are inspected for the presence of sea turtles at least twice per eight-hour shift from June 1 to October 31. This represents a doubling of the frequency of intake structure inspections specified prior to the incidental capture of two Kemp's ridley turtles during July of 1994. Prior to 1994, only two individuals

of this species had been observed at the OCNCS, both during October. In response to the incidental takes of 1994, the frequency of intake structure inspections was increased to the current level. The first inspection is normally conducted one to two hours into the workshift; the second inspection is normally performed five to six hours into the workshift. Although emergencies or other responsibilities may periodically prohibit strict adherence to this schedule, the intent of the schedule is to prevent the individual inspections from being clustered together in a relatively short time period. The time that each inspection is completed is recorded on intake area tour sheets.

Because the sea turtle season typically coincides with the period of greatest debris loading at the intakes, additional inspections of the intakes are often made during this period to ensure they are sufficiently clean of debris. Cleaning all CWS and DWS intake trash bars may take several hours when debris levels are high. These additional activities at the intake structures provide further opportunities for plant personnel to observe sea turtles.

The Sea Turtle Surveillance, Handling, and Reporting Instructions (Appendix A) provides guidance on how to distinguish sea turtles from Diamondback Terrapins. In addition, large color posters which illustrate the distinguishing features of sea turtles have been placed in prominent locations at both CWS and DWS intake structures (Figure 7-1). This information is also published in the OCNCS employee newspaper each spring to increase the level of awareness of station personnel just prior to the period when sea turtles are likely to occur in the vicinity of the station.

Station personnel conducting sea turtle surveillances use portable spotlights during night inspections. It should be noted, however, that visibility is still limited to approximately 1 m (3 ft) below the water's surface.

7.3.1.2 Special Precautions during Trash Rack Cleaning

Personnel cleaning the CWS and DWS intake trash racks during the June 1 - October 31 period observe the trash rake while cleaning operations are underway so that the rake may be stopped if a sea turtle is sighted. The debris gathered from the trash racks is hand raked into the trash car hopper. Personnel performing this task are instructed to look for sea turtles and to take particular care to ensure sea turtles are not mistaken for horseshoe crabs. The floodlights attached to the trash rake unit (Figures 4-5 and 4-8) are utilized during the evening hours to aid station personnel in spotting sea turtles. Note, however, that organisms are only visible in the upper few feet of water at the intakes because water transparency is typically about 1 m (3 ft).

7.3.1.3 Actions Taken if a Sea Turtle is Observed

Sea turtles observed on the trash racks or in the vicinity of the intake structures are recovered as soon as possible, taking care to prevent injury to the animal. The method of recovery depends upon the size and location of the turtle. A rescue sling suitable for larger turtles (in excess of 18 kg [40 lbs]) is kept at the CWS intake structure. This device consists of large-mesh netting on a rigid metal frame with ropes attached to each corner (Figure 4-10). Long-handled dip nets have also been fabricated for the smaller turtles most commonly encountered (Figure 4-11). These dip nets are stored within easy reach, attached to fences, railings, or buildings at the CWS and DWS intake structures during the sea turtle season (June 1 – October 31).

Both the rescue sling and the long-handled dip nets are adequate for retrieving turtles from the

surface to about 1 m (3 ft) below the surface. The use of either device requires that the sea turtles be visible from the surface. The retrieval of sea turtles from the trash bars, more than 1 m (3 ft) below the water's surface requires the use of the trash rake alone or in combination with the dip nets or rescue sling.

7.3.1.4 Sea Turtle Handling and Resuscitation

In accordance with the Sea Turtle Surveillance, Handling, and Reporting Instructions (Appendix A), sea turtles removed from the intake structures, regardless of their condition, are kept moist and out of direct sunlight. Fiberglass tubs suitable for holding sea turtles are stored at the CWS intake structure. Station personnel are cautioned not to assume that an inactive turtle is dead and that they should attempt to revive inactive animals immediately after they are retrieved. Specific guidance on handling and resuscitation is provided in the written instructions and on large color posters placed in prominent locations at both the CWS and DWS intake structures (Figure 7-2). NOAA Fisheries has sent updated procedures for resuscitating sea turtles, and new posters will be at the intake structures before the 2005 sea turtle season begins (expected to be posted in March 2005). Special instructions are also provided for cold-stunned turtles (Appendix A). Also, OCNCS provides appropriate personnel with training and guidance on handling sea turtles found at the CWS and DWS intake structures.

Live sea turtles are delivered to the local affiliate of the Sea Turtle Salvage and Stranding Network (Marine Mammal Stranding Center in Brigantine, New Jersey) for examination and subsequent release into the ocean. Dead sea turtles have been sent to Cornell University and the University of Pennsylvania for necropsy.

7.4 Notification and Reporting of Incidental Captures

OCNCS Procedure OP-OC-106-101 "Significant Event Notification and Reporting" and LS-MA-1253 "Exelon Reportability Reference Manual, Reportable Event Plant Specific, OC-08", direct station personnel to report all sightings or captures of sea turtles to the NRC and the NOAA Fisheries within 24 hours of the event. The Sea Turtle Surveillance, Handling, and Reporting Instructions (Appendix A) call for the OCNCS Control Room to be notified immediately of any sea turtle observations or captures. The OCNCS Shift Manager or designee is required to complete the Sea Turtle Observation/Capture Report form (an attachment to Appendix A). In addition, a written report is prepared by OCNCS Chemistry/Environmental personnel and submitted to the NRC and NOAA Fisheries within 30 days of the event. The written report provides the details of the capture or sighting including the time and place of capture; the length, weight and condition of the turtle; the disposition of the turtle; and any other pertinent information. Annual reports of sea turtle captures have been provided as part of the Annual Environmental Operating Report for the OCNCS.

7.5 Discussion of General Impacts on Sea Turtle Populations

Five factors have been listed by the Federal government as factors contributing to the decline in sea turtle populations (43 FR 146:32800-32811):

1. Destruction or modification of habitat;
2. Overutilization for commercial, scientific or educational purposes;

3. Inadequate regulatory mechanisms;
4. Disease and/or predation; and
5. Other natural or man-made sources.

The destruction and/or modification of habitat from coastal development and losses due to incidental capture during commercial fishing are likely the two major factors impacting sea turtle populations along the Atlantic coast of the U.S. The continued development of beachfront and estuarine shoreline areas is likely to be impacting foraging and nesting grounds for several sea turtle species. Incidental capture (take) is defined as the capture of species other than those towards which a particular fishery is directed. As implied by this definition, the commercial fishing industry has been implicated in many of the turtle carcass strandings on southeastern U.S. beaches. The annual bycatch of sea turtles by shrimp trawlers in the southeast alone has been estimated by Henwood and Stuntz (1987) to be nearly 48,000 turtles (primarily loggerheads), resulting in over 11,000 turtle deaths per year. In a study conducted for Congress, the National Academy of Sciences concluded that incidental drowning in shrimp trawls "kills more sea turtles than all other human activities combined..." and may result in as many as 55,000 sea turtle drownings annually in U.S. waters (Magnuson et al. 1990).

The drowning of sea turtles in commercial fishing nets is not the only anthropogenic source of mortality. Other human-related causes include injuries from encounters with boats, plastic ingestion, and entanglement in trash. In New Jersey and New York, boat-related damage is a commonly-observed injury in stranded turtles. The loggerhead, because it is the most abundant sea turtle in U.S. coastal waters, is the species most frequently encountered by fishermen and other boat operators. More research needs to be conducted to identify all sources of sea turtle mortality and to develop mitigation methods.

The unintentional entrapment of sea turtles during non-fishery-related industrial processes, such as the generation of electricity, is another source of incidental capture and mortality. We have documented the capture of 32 sea turtles at the OCNCS during more than 35 years of operation. A maximum of 11 and as few as 6 of these turtles may have died as a result of their encounter with the station's intakes. Relative to losses from other sources, such as commercial fishery bycatch, this loss is extremely small. According to the Turtle Expert Working Group (2000), the cumulative effect of all power plant related sea turtle mortality is considered to be relatively small. Even though any loss of any individual of an endangered or threatened species is important, the magnitude of the potential losses of loggerhead, Kemp's ridley, and Atlantic green turtles associated with the operation of the OCNCS would not be expected to significantly impact the U.S. Atlantic coast populations of these sea turtle species.

7.6 Recommendations for a Revised Incidental Take Statement for Sea Turtles at Oyster Creek Nuclear Generating Station

Due to the variable distribution of opportunistic feeding aggregations of sea turtles, the apparent recent increase in population size of the three species of sea turtles collected from the intake canal, and the other habitat related changes in Barnegat Bay and the Atlantic Ocean, it is impossible to predict with any certainty the sea turtle take at the OCNCS. The trend of gradual increase in incidental takes is expected to continue. Any numerical limits established based on past takes are

likely to be exceeded. Therefore, it is recommended that no annual limit on live takes be established for the OCNGS. The licensee has demonstrated competency in collecting, processing, and returning captured individuals. A record will be made, and data collected for all live captures at the station. Limits would be retained, however, for causally-related mortalities, which is the appropriate focus of the staff's concern. The current limits for causally-related mortalities per calendar year are two lethal takes for loggerhead turtles, three lethal takes for Kemp's ridley turtles, and one lethal take for green turtles. The staff recommends retaining these limits. Justification for the determination that a moribund turtle collected from the DWS or the CWS is not causally related to plant operation would have to be provided. To assist in the determination of causally- or non-causally-related mortality the NRC staff is recommending that OCNGS staff be able to perform a gross necropsy near the time of discovery of a moribund turtle and preserve the necessary tissue samples during that preliminary examination so they could be sent off for a full evaluation. At the time of initial collection, the licensee would make the determination, subject to change upon completion of a full necropsy, whether the mortality is causally related to plant operation. If the necropsy and other data obtained at the time the specimen was taken prove inconclusive as to the cause of death, the mortality would likely be causally related.

As part of the Sea Turtle Surveillance, Handling, and Reporting Instructions (Appendix A), OCNGS personnel will continue to investigate and document the circumstances surrounding any sea turtle mortalities observed at the OCNGS.

Therefore, the NRC staff suggests that the incidental take statement be amended to eliminate the numerical limit on live and non-causally-related mortalities and impose only an annual lethal take limit per calendar year of two loggerheads, three Kemp's ridleys, and one green causally related to plant operations. The staff also recommends standardizing the following terms and conditions:

1. Implementation of the OCNGS Sea Turtle Surveillance, Handling, and Reporting Instructions (see Appendix A), which specifies surveillance, reporting requirements, rescue, care, and disposal/release of sea turtles.
2. That the licensee develop the capability to perform gross necropsies on moribund turtles, and that these examinations be performed close to the time of discovery of the expired turtle.
3. All sea turtle takes shall be recorded by species, size, date and time collected, location collected, individual condition, length, weight, disposal/release, and other pertinent information as appropriate. Details on the information to be collected and recorded shall be specified in the OCNGS Sea Turtle Surveillance, Handling, and Reporting Instructions (Appendix A). Data collected shall be tabulated and submitted to the NRC annually as part of the Annual Environmental Operating Report for the OCNGS. Copies will be forwarded to the NRC. Results of any completed necropsies from turtles collected in the previous year shall be included in the annual report.
4. Causally-related mortalities of any listed species shall be reported in writing to NMFS with copies to the NRC and the State within thirty days of the date of recovery. The report shall include a discussion of the circumstances surrounding the mortality, including but not limited to plant operating conditions at the time of recovery, location and circumstances of recovery, condition and description of the specimen, and disposition of the specimen as well as speculation as to the cause of death or injuries leading to death. The preliminary results of

the necropsy should be included if available.

5. If the causally related mortality limit for any species is reached or exceeded, the licensee shall notify the NMFS within two business days, and the NRC promptly. The licensee shall make a preliminary assessment of the likely cause of death, subject to change upon completion of a detailed necropsy. Any subsequent causally-related mortalities exceeding the take limit would be reported in a similar manner.

Additionally, there is a number of site-specific requirements listed in the terms and conditions of the 2001 BO such as inspection frequency, lighting requirements, on-hand rescue equipment, disposal and release of recovered turtles, and other requirements. It is the staff's understanding that these requirements, as modified by the letter dated August 29, 2001, would be included in a new BO.

HOW TO DISTINGUISH SEA TURTLES FROM TERRAPINS

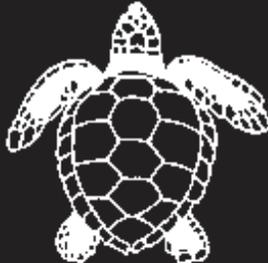
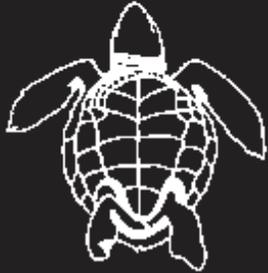
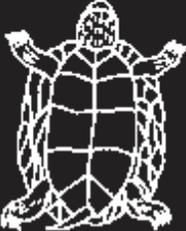
Distinguishing Features	Sea Turtles	Terrapins
Limbs	Has swimming fins or flippers.	Lacks flippers, but has walking feet with 4 or 5 claws at the end.
Head	Unable to fully withdraw head inside of shell.	Can withdraw head inside of shell.
Maximum Size	Adult can grow to over three feet in length.	Does not exceed 10 inches in length.
Top View		
Bottom View		
	Sea Turtles	Terrapins

Figure 7-1
Sea Turtle Identification Poster placed at OCNGS intake structures.

SEA TURTLE RESUSCITATION

1

**PLACE THE TURTLE ON
ITS BREASTPLATE AND
RAISE THE HIND
FLIPPERS SLIGHTLY
ABOVE THE FRONT
FLIPPERS.**

2

**KEEP THE TURTLE
SHADED AND MOIST AND
OBSERVE FOR 24 HOURS.**

3

**PERIODICALLY, ROCK THE
TURTLE SLIGHTLY FROM
SIDE TO SIDE AND GENTLY
PINCH TAIL TO CHECK FOR
RESPONSE.**

Figure 7-2

Sea Turtle Resuscitation Poster placed at OCNGS intake structures.

8.0 References

50 CFR 17.11, Endangered and Threatened Wildlife.

50 CFR 222.23(a), Endangered Fish or Wildlife Permits (under National Marine Fisheries Service jurisdiction).

50 CFR 227.4(b), Threatened Fish and Wildlife, Enumeration of Threatened Species.

50 CFR 402; Interagency cooperation - Endangered Species Act of 1973, as amended (Joint regulations of U.S. Fish and Wildlife Service and National Marine Fisheries Service).

43 FR 146:32800-32811; Proposed rulemaking listing loggerhead, Ridley and green turtles as threatened or endangered species (Joint regulations of U.S. Fish and Wildlife Service and National Marine Fisheries Service).

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Appendix A

SEA TURTLE SURVEILLANCE, HANDLING, AND REPORTING INSTRUCTIONS