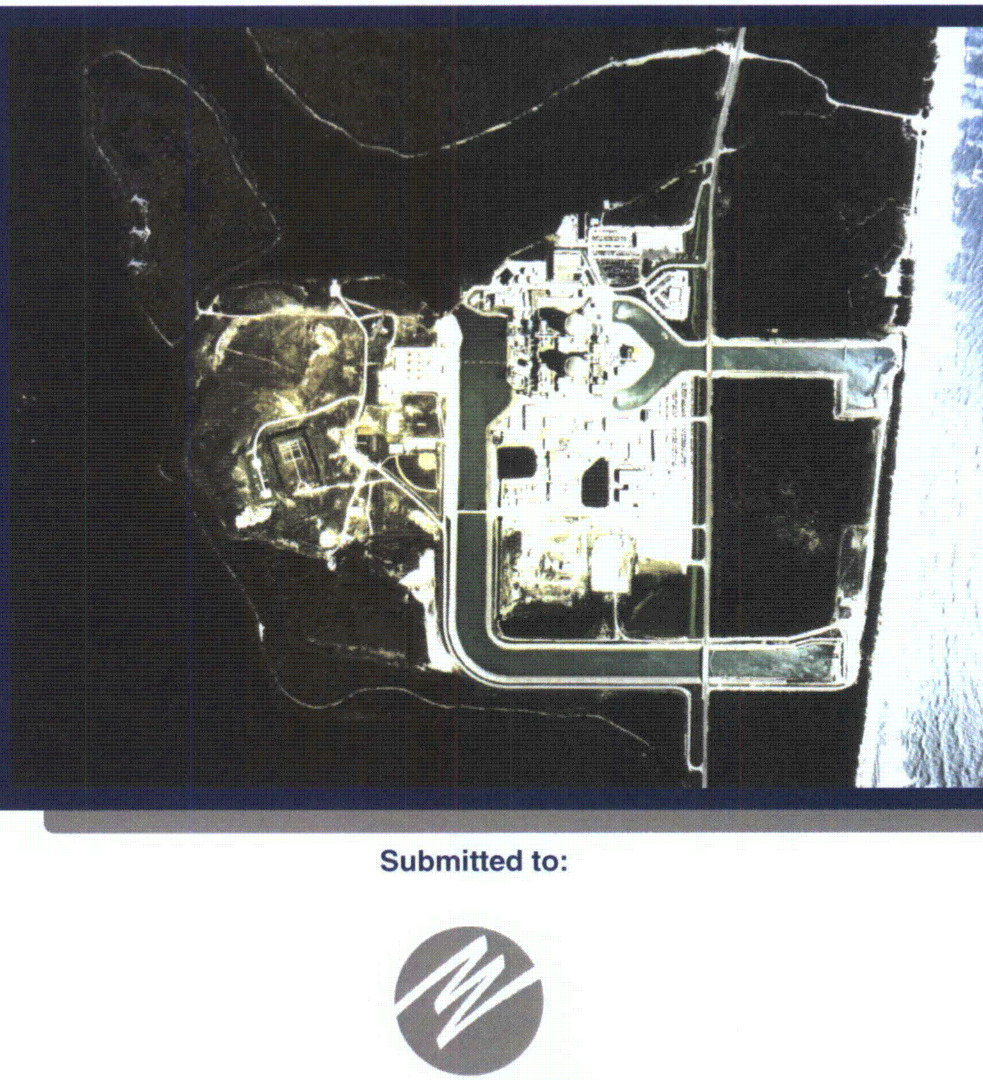
Clean Water Act Section 316(b) Biological Characterization Report for Florida Power & Light Company St. Lucie Nuclear Power Plant



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EXECUTIVE SUMMARY

The Florida Power & Light St. Lucie Nuclear Power Plant (Plant), National Pollutant Discharge Elimination System (NPDES) Permit No. FL 0002208, is located on a 1,132-acre site on Hutchinson Island in St. Lucie County, Florida. The Plant consists of two nuclear-fueled electric-generating units, with net generation capacity of 840 megawatts (MW) each, and a total generation capacity of 1,680 MW. Unit 1 received an operating license in March 1976 and Unit 2 in April 1983. In 2008 FPL submitted a Site Certification Application (SCA) to increase production at the Plant by about 11 percent. Net electrical generation per unit is expected to increase from about 840 MW to about 943 MW. The net increase will be approximately 103 MW per unit for a two-unit total of 206 MW. The uprated Plant is expected to operate within the existing permit limits, with one exception. FPL has submitted a request to modify the NPDES permit for the Plant, specifically to increase the maximum heated water temperature at the point of discharge for Outfall D-001. This modification was necessary as the result of an intake water temperature analysis performed. The power uprates at the St. Lucie Plant will be implemented in 2011 and 2012.

The Plant is located on the widest section of Hutchinson Island. The island is separated from the mainland on its western side by the Indian River Lagoon (IRL) and is bordered by the Atlantic Ocean to the east (see Figure 1-1). The source of cooling water for the Plant is the Atlantic Ocean.

Although the Atlantic Ocean is the source of cooling water for the Plant, the original Plant design called for the main cooling water intake structures (CWIS) to withdraw cooling water from the IRL through Big Mud Creek. The original plan to use the IRL as a source of cooling water was changed after studies demonstrated that this estuarine area was highly productive and a significant nursery area for many aquatic organisms important to the region. It was concluded at that time that the Plant would likely have an adverse environmental impact to the IRL. FPL's final decision was to move the CWIS to the Atlantic Ocean, though considerable expense was involved in this major design change. Currently, Big Mud Creek is an emergency water source to be used only for safe shutdown of the Plant under emergency conditions. The emergency intake system is tested at least four times a year; however, full-scale use has never occurred.

This report presents the results of sampling conducted to characterize the marine biological communities in the Atlantic Ocean in the vicinity of the CWIS. Sampling was also conducted in the IRL, the original design source for Plant cooling water. Data were collected from January 2006 through October 2007 for compliance with the Clean Water Act Section 316(b) Phase II Rule. In 2007, the Section 316(b) Phase II Rule was suspended.

This biological characterization study consists of the following three elements:

- Trawling in the Atlantic Ocean in the vicinity of the Plant intakes
- Atlantic Ocean plankton collections from intake water collected at the intake canal headwall
- Trawling and plankton collections in the IRL and Big Mud Creek in the vicinity of the original design intake for the Plant

In addition to characterizing aquatic communities in these two waterbodies, another important objective of the study was to demonstrate the significant reduction in impingement and entrainment attained by locating the intake structures offshore, at mid-depth, and utilizing velocity caps. An 80.9-percent reduction in impingeable-sized organism densities was observed when data from the Atlantic Ocean were compared to the IRL (Table ES-1). This calculation is based on data for all fish species and those invertebrates of commercial or recreational importance (shellfish) collected. Data were also evaluated separately for fish and shellfish; these reductions were 76.4-percent and 98.2-percent, respectively. Biomass percent reductions were also evaluated and showed an overall 97.1-percent reduction.

TABLE ES-1
PERCENT REDUCTION IN IMPINGEABLE-SIZED ORGANISMS WHEN COMPARING ATLANTIC OCEAN DENSITIES TO INDIAN RIVER LAGOON DENSITIES

	Percent Reduction	
	Density	Biomass
Fish and Shellfish	80.9	97.1*
Fish Only	76.4	97.0*
Shellfish Only	98.2	99.0**

* Biomass estimated using length-weight regressions for the most abundant species.

** No shellfish were present in the top 95-percent of species collected from the Atlantic Ocean in 2006.

A 91.5-percent reduction in entrainable-sized organism densities was observed when data from the Atlantic Ocean were compared to the IRL (Table ES-2). This determination was conducted using all fish and shellfish species collected. Data were also evaluated separately for fish and shellfish; reductions were 88.1-percent and 91.8-percent, respectively.

TABLE ES-2
PERCENT REDUCTION IN ENTRAINABLE-SIZED ORGANISM DENSITIES WHEN COMPARING ATLANTIC OCEAN DENSITIES TO INDIAN RIVER LAGOON DENSITIES

	Percent Reduction
	Density
Fish and Shellfish	91.5
Fish Only	88.1
Shellfish Only	91.8

The relocation of the intake structures from the IRL, as initially designed, to the Atlantic Ocean clearly has the result of drawing cooling water from a less biologically productive area and thus demonstrating a significant reduction. This study has demonstrated that densities of impingeable and entrainable organisms are more than 80-percent lower in the Atlantic Ocean than the IRL.

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1.0 INTRODUCTION

The Florida Power & Light St. Lucie Nuclear Power Plant (Plant), National Pollutant Discharge Elimination System (NPDES) Permit No. FL 0002208, is located on a 1,132-acre site on Hutchinson Island in St. Lucie County, Florida. The Plant consists of two nuclear-fueled electric-generating units, with net generation capacity of 840 megawatts (MW) each, and a total generation capacity of 1,680 MW. Unit 1 received an operating license in March 1976 and Unit 2 in April 1983. In 2008 FPL submitted a Site Certification Application (SCA) to increase production at the Plant by about 11 percent. Net electrical generation per unit is expected to increase from about 840 MW to about 943 MW. The net increase will be approximately 103 MW per unit for a two-unit total of 206 MW. The uprated Plant is expected to operate within the existing permit limits, with one exception. FPL has submitted a request to modify the NPDES permit for the Plant, specifically to increase the maximum heated water temperature at the point of discharge for Outfall D-001. This modification was necessary as the result of an intake water temperature analysis performed. The power uprates at the St. Lucie Plant will be implemented in 2011 and 2012.

The Plant is located on the widest section of Hutchinson Island. The island is separated from the mainland on its western side by the Indian River Lagoon (IRL) and is bordered by the Atlantic Ocean to the east (see Figure 1-1). The source of cooling water for the Plant is the Atlantic Ocean.

The data collected through this field sampling program was initially intended to demonstrate compliance with Clean Water Act (CWA) Section 316(b) Phase II requirements. In 2007, the Section 316(b) rule was suspended. The original compliance strategy was to demonstrate that the design, technology, and operational measures already implemented for the Plant, including relocation of the Plant cooling water intake structures (CWIS) from the IRL (Big Mud Creek), as proposed in the original Plant design, to the marine offshore environment (Atlantic Ocean), and the use of velocity caps at the three intakes, meet the national performance standards for Best Technology Available (BTA).

The relocation of the Plant's intake from a productive estuarine environment such as the IRL, to an offshore marine location (Atlantic Ocean), along with the significant reduction in cooling water flow that resulted by increasing the effluent delta-T (marine discharge), is expected to have significantly decreased the intake's impact to the aquatic environment. The use of velocity caps at all intakes has further reduced fish and shellfish impingement.

Fish and shellfish sampling was conducted to compare the aquatic ecosystem in the vicinity of the originally proposed intake in the IRL with the ecosystems near the current Atlantic Ocean offshore CWIS location. The field sampling program was a paired sampling plan that quantified and compared the fish and shellfish that were likely to have been impinged and entrained if the intake had been located in the IRL compared to fish and shellfish that are likely or currently impinged and entrained from the Atlantic Ocean. These data were used to compare densities, abundances, temporal trends, and determine percent reduction in aquatic organism densities when comparing the Atlantic Ocean in the vicinity of the Plant intakes to the IRL.

This biological study was initially designed as a BTA Verification Monitoring Study, as specified by Title 40, Part 125 of the Code of Federal Regulations (40 CFR 125), Section 95(b)(7), and was described in the Proposal for Information Collection (PIC) (Appendix A) submitted to the Florida Department of Environmental Protection (FDEP) in May of 2005. In 2007, the Section 316(b) Phase II Rule was suspended.

1.1 Source Water

The Atlantic Ocean is the source waterbody for the Plant and lies to the east of Hutchinson Island and the Plant. The bottom topography of the ocean gently slopes to a depth of 40 feet (ft), and then rises to approximately 21 ft at Pierce Shoal approximately 1 mile offshore. The coastal waters offshore of Hutchinson Island respond to a large field of motion including variations in the Florida Current. The currents are generally oriented parallel to the shoreline. Longshore currents predominantly run south at about 0.6 feet per second (fps); however, during periods of direction reversal, a northerly current flows at about 0.2 fps. Maximum south and north currents were previously recorded at 1.3 and 0.7 fps, respectively. Diving surveys indicate that the bottom sediment is coarse sand and contains shell fragments. The benthos is diverse, but does not include a significant number of commercially valuable species [U.S. Atomic Energy Commission (USAEC, 1974)].

The IRL is a back-up source of cooling water for emergency shutdown of the Plant. The IRL is a long, shallow, tidally-influenced lagoon. Its geographic location along the transition zone between warm-temperate and subtropical climates, combined with its length (156 miles) and diverse physical characteristics, make it an estuary of high biological productivity. Along the north side of the Plant site lies Big Mud Creek, an inlet off the IRL (Figure 1-1). Big Mud Creek, a naturally shallow embayment, receives surface and subsurface runoff resulting from precipitation on Hutchinson Island. During Plant construction, portions of the inlet were dredged to a maximum depth of 46 ft. Tidal exchange in the IRL in the vicinity of the Plant is minimal due to its considerable distance from the Ft. Pierce and St. Lucie Inlets and its shallow nature. The Plant site is approximately mid-way between the inlets at either end of the island and, therefore, in the region of least tidal exchange. Running north-south through the IRL is the Intracoastal Waterway, a navigation channel dredged to depths of 6 to 12 ft. No major streams enter the IRL in the vicinity of the Plant, and freshwater runoff is primarily associated with seasonal heavy rainfall. Thus, the salinity of the IRL can vary greatly over short periods of time. Tidal range in the IRL in the vicinity of the Plant is about 1 ft.

1.2 Cooling Water Intake Structures

The condenser cooling water system for the Plant is a once-through system with an intake and discharge in the Atlantic Ocean. Design intake flow is 1,032,600 gallons per minute (gpm) or 1,487 million gallons per day (MGD). The major components of the CWIS include:

1. Three ocean intake structures and associated velocity caps (Figures 1-2, 1-3, and 1-4)
2. Three submerged intake pipes to transport water from the intake structures to the intake canal (Figure 1-5)
3. An intake canal to convey water to each unit's intake well (Figure 1-2)
4. Individual unit trash racks (coarse bars) and traveling screens (Figure 1-6)

Prior to Plant operation, the U.S. Environmental Protection Agency (EPA), through deliberations with FPL and several government agencies, made a positive BTA determination for the Plant intake system. The BTA determination, based upon the requirements that were in effect at that time, is provided in the "St. Lucie Nuclear Plant, 316(b), Finding for Best Technology Available," dated August 15, 1981. On January 29, 1982, the BTA finding was supplemented and substantiated by EPA for the addition of the third cooling water pipeline. The BTA finding has been upheld with each subsequent issuance of the facility's water discharge permit.

Cooling water is withdrawn from the Atlantic Ocean through three submerged intake structures located 1,200 ft offshore at 27.347440N -80.233006W (Figure 1-2). Each structure consists of a concrete housing (including the velocity caps), a vertical shaft in the center, and large-diameter piping connected to the base of the structure for transporting water to the Plant (Figures 1-3 and 1-4). Two intake structures house 12-ft-inner-diameter intake pipes and a third intake structure houses a 16-ft-inner-diameter intake pipe. These intake structures supply cooling water for Units 1 and 2 through a common intake canal (Figure 1-2). The tops of the velocity caps are approximately 7 ft below the water surface at mean low tide [U.S. Nuclear Regulatory Commission (NRC), 2001] (Figure 1-4).

1.3 Velocity Caps

A velocity cap is a device that is placed over a vertical inlet at an offshore intake. The cap converts vertical flow into horizontal flow at the entrance to the intake. The device works on the premise that fish will avoid rapid changes in horizontal flow but are less able to detect and avoid vertical velocity vectors. Velocity caps have been installed at many offshore intakes and have usually been successful in minimizing impingement. The location of the velocity caps at mid-depth also helps reduce entrainment at the Plant, based on data demonstrating that plankton densities are much lower at mid-depth than at the ocean surface.

Each of the three Atlantic Ocean intake structures is fitted with a velocity cap, which consists of large flat plates positioned 6 to 7 ft above the vertical shaft of the intake structure. The horizontal intake velocity was calculated to be approximately 0.4 fps for the two 12-ft-diameter pipes and 1 fps for the 16-ft-diameter pipe (NRC, 1982). The velocity cap for the 16-ft-diameter pipe is 70 ft square, 5 ft thick, and has a vertical opening of 6.25 ft. The velocity cap for each of the two 12-ft-diameter pipes is 52 ft octagonal, 5 ft thick, and has a vertical opening of 6.5 ft (Figure 1-4).

1.4 Submerged Intake Pipes

Water passes under the velocity caps and into the submerged intake pipes, which are buried beneath the sea floor, beach, and dunes, and terminate at two headwalls located on the eastern end of an L-shaped common intake canal (Figure 1-5).

1.5 Intake Canal

The intake canal is 300 ft wide (Figure 1-2). The L-shaped intake canal, with a maximum depth of 25 ft, transports cooling water for approximately 5,000 ft to the Plant intake structure on the west side of Units 1 and 2.

A 5-inch mesh barrier net with support structures is located just downstream of the intake headwalls to reduce sea turtle residence times in the intake canal. The net is designed to confine turtles (i.e., small green turtles) with a carapace greater than 7 inches into the extreme eastern portion of the canal. The net was designed to withstand unusual events such as drift seaweed and algae, jellyfish, and siltation and, therefore, reduce the potential for sea turtle mortality.

A second barrier net is located near the A1A Bridge. This backup net also confines turtles to the easternmost section of the intake canal. This net is constructed of large-diameter polypropylene rope and has a mesh size of 8 inches x 8 inches. A cable and series of large floats are used to keep the top of the net above the water's surface, and the bottom is anchored by a series of concrete blocks. The net is inclined at a slope of 1:1, with the bottom positioned upstream of the surface cable. Improvements made to this barrier net in 1990 resulted in confinement of all turtles larger than 12.8 inches carapace length (11.3 inches carapace width) to the eastern end of the canal. A third net, which consists of a large barrier positioned perpendicular to the north-south arm of the canal, is also used to constrain turtles. This net has a mesh size of 9 inches x 9 inches (FPL, 2003). All sea turtles captured in the nets are released back to the Atlantic Ocean.

1.6 Emergency Water Intake

An emergency water intake structure, consisting of two 54-inch pipes/valves, allows water to flow into the intake canal from Big Mud Creek, a cove off the IRL (Figure 1-2). The emergency intake is designed to provide cooling water in the event that insufficient flow is available for emergency shutdown of the Plant. To assure that the emergency system is operational, the system is tested at least quarterly. The test consists of opening and closing each valve in each 54-inch diameter pipe for a period of less than

1 minute. Depending on the head differential between the intake canal and Big Mud Creek, approximately 100,000 gallons per valve per test flows from Big Mud Creek into the intake canal.

1.7 Trash Racks

Each unit has a separate intake structure consisting of four bays (intake wells) that are located at the far north end of the intake canal (Figure 1-2). Each bay contains trash racks (grizzlies) that are vertical bars, with approximately 3-inch spacing, to catch large objects. Trash rakes clean the trash racks, and debris collected from the trash racks empties into a debris trough (Figure 1-6).

1.8 Intake Traveling Screens

Traveling screens with a 3/8-inch mesh are installed upstream of the circulating water pumps that draw water from each of the eight bays, four per unit. The traveling screen spray wash removes debris and aquatic organisms from the rotating screens and discharges them through a trough into a debris collection area (Figure 1-6).

1.9 Circulating and Auxiliary Water Pumps

The Plant utilizes eight single-stage circulating water pumps (four per unit) which have a nominal total capacity of 974,600 gpm (1,404 MGD) to supply cooling water to Units 1 and 2 (Figure 1-6). In addition to once-through cooling, the Plant has an emergency water intake structure. This structure has two 54-inch pipe/valves available to be used in the event that insufficient flow is available for the shutdown of the nuclear power Plant. Six auxiliary pumps are capable of pumping 14,500 gpm each. With a normal configuration of two auxiliary pumps per unit in operation, the auxiliary pumps have a nominal flow capacity of 58,000 gpm (83 MGD) of cooling water through the auxiliary equipment.

A water balance line schematic including the once-through cooling water for the Plant is provided in Figure 1-7.

1.10 Plant Capacity Factors

The Plant Capacity Factors for the Plant's Units 1 and 2 are summarized in Table 1-2.

2.0 BIOLOGICAL CHARACTERIZATION STUDIES

All aspects of the field sampling program were completed on a bi-weekly schedule (every other week), as weather allowed. Forty-five field events were conducted and are summarized in this report. All sampling efforts were conducted once during the day and once during the night. Field work was conducted by Ecological Associates Inc. (EAI), a sub-consultant of Golder Associates Inc. (Golder), according to the Plant's PIC (Appendix A) and the FPL 316(b) Biological Sampling Program Quality Assurance Plan (Appendix B).

The following sections describe the paired sampling program for the Atlantic Ocean and the IRL, including trawling and plankton tows. Table 2-1 summarizes this sampling program and Figure 2-1 shows the sampling locations. Trawling was conducted to compare fish and shellfish that could be drawn into the originally proposed CWIS in the IRL with those in the Atlantic Ocean in the vicinity of the velocity caps. Entrainment was evaluated using plankton collections in the IRL and at the entrance to the Plant intake canal (near the headwall). As discussed below, the Atlantic Ocean required larger gear and longer tows due to the low density of organisms in the ocean environment; data are presented as densities [trawl data are presented as #/100 cubic meters (m^3) and plankton data as #/m^3], relative abundances, and biomass density (grams/m^3) for both waterbodies.

2.1 Atlantic Ocean Sampling Methods

Biological sampling included nearfield trawling at three stations in the Atlantic Ocean and plankton collections in the water withdrawn by the CWIS. Figure 2-1 shows the locations of the trawling stations and the sampling point for the plankton collection (cooling water as it enters the intake canal). Table 2-1 summarizes the Atlantic Ocean sampling plan.

2.1.1 Nearfield Trawling in the Atlantic Ocean

Trawling was conducted in the Atlantic Ocean in the vicinity of the velocity caps to evaluate species susceptible to impingement (Figure 2-1). Three shore-parallel transects were sampled: two near-shore [approximate depth of 3 to 4 meters (m) and 6 m]; and one offshore of the velocity caps (approximate depth of 10 m). Transect locations were selected such that the velocity caps were at the approximate mid-point of the trawl. Bottom trawls and mid-water trawls were conducted along each transect. Target trawl duration was 15 minutes, which resulted in trawl distances of approximately 1 kilometer (km) and a water volume sampled of approximately 3,000 to 6,000 m^3. Trawls in the Atlantic Ocean were conducted with a 4.9 × 0.9 m otter trawl. For mid-water tows, trawl doors were modified through the addition of planing boards; this caused the hydrodynamic force on the trawl doors to lift them in the water column as well as spread the mouth of the net.

From each trawl, up to 50 representative individuals of each fish species and commercially or recreationally important shellfish species were counted and measured to the nearest millimeter (mm) (total length; carapace width, post-orbital carapace length, mantle length, or other appropriate measure). After 50, remaining specimens were only counted. Specimens were identified to the lowest practical taxonomic level. The PIC stated that specimen weights would be measured in the field, but due to the difficulty of reliably and consistently collecting these data on the unstable platform of a rocking boat, weight data could not be routinely collected. Specimen weights were estimated using length-weight regressions. This technique is discussed in detail, along with the results, in Subsection 4.5.

2.1.2 Plankton Collection Near the Intake Headwalls

To evaluate the entrainable-sized organisms withdrawn into the Plant cooling water system, plankton samples were collected as the water entered the intake canal (Figure 2-1). The PIC stated that entrainment samples would be collected by pumping intake canal water through a plankton net. This was changed to the use of a plankton net lowered into the intake flow. This method was more direct and comparable to the IRL plankton tows.

The plankton net used for collections had a 1-m diameter mouth, 5:1 length-to-diameter ratio, and 300-micron mesh. The plankton net was suspended at mid-depth and fished for 5 minutes if both power generating units were running, or for 10 minutes if only one unit was running. On average, this method sampled approximately 130 to 200 m^3 of water (based on readings from a flow-meter mounted in the mouth of the net).

Plankton samples were preserved in the field and taken to the taxonomy laboratory for processing. Plankton samples were split, as necessary, to obtain an appropriate sub-sample size for taxonomic analysis. Samples were split using a Folsom or Motodo sample splitter. Fish and shellfish were identified to the lowest practical taxonomic level and their life stage determined.

2.2 Indian River Lagoon Sampling Methods

Trawl and plankton samples were collected at each of three locations in the IRL: in Big Mud Creek in front of the emergency intake structure (approximate depth of 3 to 4 m); in the IRL adjacent to the Big Mud Creek channel (approximate depth of 1 to 2 m); and east of, and parallel to, the Intracoastal Waterway (approximate depth of 2 to 3 m) (Figure 2-1). Sampling methods are summarized in Table 2-1. Trawl and plankton tow collections were treated in the same manner as described for the Atlantic Ocean sampling.

2.2.1 Nearfield Trawling in the Indian River Lagoon

The IRL is a relatively shallow aquatic system; therefore, only bottom trawls were collected. Target trawl duration was 5 minutes. Trawls were shortened as necessary to reduce drift algae loads in the nets. High loads of drift algae affect the capture efficiency of the trawl and increase the difficulty of recovering the gear (lifting the heavy net into the boat). Trawls in the IRL were conducted with a 3 × 0.9 m otter trawl. This method samples approximately 500 to 1,000 m^3 of water.

2.2.2 Plankton Collection in the IRL

IRL plankton samples were collected using paired 20-centimeter (cm) bongo plankton nets with 300-micron mesh. Bongo nets were deployed from a davit on the side of the sampling vessel and fished in mid-water. Samples from the two nets were composited after collection to yield a single sample. Tow duration was 5 minutes, which resulted in sampling approximately 13 to 26 m^3 of water.

2.3 Field Parameters Measured

2.3.1 Water Quality Data

Basic water quality parameters (temperature, salinity, dissolved oxygen, conductivity and pH) were measured during each sampling event. In water that was greater than 2 m deep, water quality was measured within 1 m of the bottom, mid-water, and within 1 m of the surface. In water less than 2 m deep, a single mid-water measurement was taken. The water entering the intake canal was considered to be from a single depth in the Atlantic Ocean and well-mixed, therefore, a single water quality sample was taken during each sampling event. During trawling operations in the Atlantic, due to the uniformity of the project area, water quality was only measured at the beginning and end of each day/night sampling effort. In the IRL, water quality was measured for each sample collected.

2.3.2 Other Field Data

Data were recorded for various environmental conditions, including air temperature, cloud cover, wind direction and speed, precipitation, tidal stage, and moon phase. The data were recorded on field data sheets for each sample during the 24-hour sampling event.

3.0 QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

All work was conducted under the direction of the Florida Power & Light Company 316(b) Biological Sampling Program Quality Assurance Plan (Appendix B) and Standard Operating Procedures for Section 316(b) Phase II Rule Impingement Mortality and Entrainment Study, St. Lucie Plant – St. Lucie County, Florida (Appendix C).

Golder's Senior Fisheries Group Manager worked with EAI personnel to initiate sampling efforts and provided guidance for the first 6 months of sampling. Golder also provided an Access database to EAI for data delivery; these data were delivered to Golder electronically once a month and incorporated into Golder's 316(b) Master Database. Golder staff conducted QA/QC of all data delivered. An audit of field activities was conducted in November 2006 by Golder personnel to evaluate field/lab operations and to provide feedback for the second year of sampling (initiated in January 2007).

Field personnel were experienced in taxonomic identification of fish and invertebrates. Any specimen collected in a trawl that could not be identified in the field was preserved on ice and returned to the laboratory or photographed for later identification. All field data sheets were completed and reviewed by the Field Team Leader (FTL) following field sampling. All database entries were verified for transcription errors. Plankton collections were sorted into three categories: meroplankton, ichthyoplankton, and fish eggs. Ten percent of the samples were evaluated for sorting efficiency. Once sorted, specimens were identified by trained taxonomists. Re-identification was conducted on 10 percent of the specimens. A summary of QA/QC results is provided in Appendix D.

4.0 RESULTS

Although some field events were re-scheduled due to inclement weather, all events planned for the first year were successfully completed. Sampling in year two ended approximately 3 months early (last sampling event was October 3, 2007) due to velocity cap maintenance requirements. In addition, nearfield trawls in the Atlantic Ocean were not conducted during three events (April 3 and 17 and October 3, 2007) due to other maintenance activities at the velocity caps. Nearfield trawl and plankton catches for each event were processed as densities of fish and shellfish (#/100 m^3 for trawls; #/m^3 for plankton), and paired densities are summarized. Relative abundance data are also summarized in figures for each type of data collection (e.g., shellfish in IRL plankton tows). All figures are included at the end of this section.

4.1 Trawl Data

A small green sea turtle was captured during the first event at Station 1 in the Atlantic Ocean (Figure 2-1). A stranding report was completed and submitted to the Florida Fish and Wildlife Conservation Commission (FFWCC), per EAI's Special Activities License (SAL).

Appendices E-1 and E-2 provide taxa lists for specimens collected using trawls in the IRL and the Atlantic Ocean, respectively. Figure 4-1 summarizes the paired fish densities (e.g., paired trawl data for both waterbodies) and Figures 4-2 and 4-3 illustrate the relative abundance of the most abundant fish species for each waterbody.

Fish densities in both the IRL and Atlantic Ocean were generally higher in summer months and were noticeably higher in 2006 than 2007 (Figure 4-1). As illustrated in this figure, fish densities in the IRL were much higher than in the Atlantic Ocean throughout the two years of sampling. IRL collections were dominated by pinfish (*Lagodon rhomboides*), which comprised 50 percent of the catch (Figure 4-2). The other dominant groups in the IRL were mojarras (Gerridae) and grunts (Haemulidae) at 16 and 13 percent respectively. Atlantic Ocean collections were dominated by anchovies (comprised primarily of *Anchoa hepsetus* and *A. lamproteania*) representing 89 percent of the catch, followed by herrings (Clupeidae) at 5 percent (Figure 4-3). A complete list of taxa collected is included as Appendix E.

Figure 4-4 summarizes the paired densities of shellfish and Figures 4-5 and 4-6 illustrate the relative abundance of the most abundant shellfish species for each waterbody. A relatively low number of total shellfish were collected in both the IRL and the Atlantic Ocean.

Shellfish densities were extremely low in the Atlantic Ocean throughout the 21 months of sampling (Figure 4-4). As illustrated in this figure, shellfish densities in the IRL were much higher throughout the year. IRL collections were dominated by commercial shrimp (Penaeidae) and blue crabs (*Callinectes sapidus* and congeners) representing 73 and 24 percent of the catch respectively (Figure 4-5). Atlantic

Ocean collections were dominated by commercial shrimp (Penaeidae) and swimming crabs (*Portunus* spp.) representing 70 and 16 percent of the catch (Figure 4-6).

4.2 Plankton Data

Appendices E-3 and E-4 summarize the fish species collected using plankton nets in the IRL and the Atlantic Ocean Plant intake (near the headwalls), respectively. Figure 4-7 summarizes paired fish plankton (eggs and larvae) densities for these waterbodies and Figures 4-8 and 4-9 illustrate the relative abundance of the most abundant species of larval fish for each waterbody.

Fish densities from plankton collections in both waterbodies generally peaked in the late Spring and late Summer (Figure 4-7). Intake canal densities remained relatively low throughout the sampling period. As illustrated in Figure 4-7, fish densities in the IRL plankton tows were substantially higher. IRL collections were dominated by anchovies (Engraulidae), which comprised approximately 50 percent of the catch (Figure 4-8). A portion (41.7 percent) of the plankton catch was not identified because they were undeveloped (20.5 percent), damaged (11.6 percent), or otherwise unidentifiable (9.6 percent). Following anchovies, gobies (Gobiidae) and herrings (Clupeidae) were the most abundant groups in the IRL, representing approximately 2 percent each of the catch.

Seventy-four point five percent of intake canal ichthyoplankton specimens were unidentifiable. This was because approximately 35 percent were undeveloped, 24 percent were damaged, and 15 percent were otherwise unidentifiable. Drums (Sciaenidae) were most abundant at 9.5 percent followed by drums and anchovies at 8.6 and 4 percent, respectively.

Appendix E also summarizes the shellfish species collected using plankton nets in the IRL and the Atlantic Ocean Plant intake (near the headwalls), respectively. Figure 4-10 summarizes paired shellfish plankton densities for these waterbodies and Figures 4-11 and 4-12 illustrate the relative abundance of the most abundant shellfish species for each waterbody.

Shellfish densities from plankton collections in the IRL peaked in Spring and then again in the late Summer (Figure 4-10). Plant intake densities remained relatively low throughout the sampling period. As illustrated in Figure 4-10, shellfish densities in the IRL plankton tows were consistently higher than in the water withdrawn from the Atlantic Ocean. IRL collections were dominated by brachyuran crabs (infraorder: Brachyura), which comprised 51 percent of the catch (Figure 4-11). The second most abundant shellfish group in the IRL was caridean shrimp (infraorder: Caridea), representing 21 percent of the catch. Intake canal plankton collections were also dominated by brachyuran crabs (Brachyura), representing 64 percent, followed by sergestid shrimp (superfamily: Sergestoidea) and caridean shrimp, representing 9 and 7 percent of the catch respectively (Figure 4-12). A complete list of shellfish species collected in the Intake plankton tows is included in Appendix E.

4.3 Data Comparisons within Waterbodies

Due to the non-parametric nature of the data, the non-parametric Kruskal-Wallis test was selected for evaluation of sampling station location, station depth (bottom vs. mid-water), and day/night effects. A critical alpha level of 0.05 was used in determining statistical significance. These statistical analyses were performed using Number Crunching Statistical Software (NCSS) 2007.

4.3.1 Trawls (Potential Impingement)

<u>Indian River Lagoon</u>

Trawl Fish Densities

In the IRL, station location was a significant factor ($p \leq 0.001$) affecting fish densities. Station 2, which is located on a shallow (~1 m) seagrass bed, had significantly higher densities of fish than either Station 1 or 3 (see Figure 2-1). Higher densities were also observed in night collections ($p \leq 0.001$) as compared to daytime. Only one depth (near bottom) was sampled in the IRL.

Trawl Shellfish Densities

Shellfish densities in the IRL were significantly different among stations ($p \leq 0.001$). Statistically significant differences exist among all three stations. Station 2 (shallow seagrass bed) had the highest densities and Station 1 (Big Mud Creek) had the lowest shellfish densities. There was a significant diurnal effect ($p \leq 0.001$), with higher densities of shellfish observed at night than during the day. Nocturnally active Penaeid shrimp and Callinectid crabs (Blue crabs and congeners) comprised the majority of the shellfish catch in the IRL.

<u>Atlantic Ocean</u>

Trawl Fish Densities

There was a significant station effect ($p \leq 0.001$) in the Atlantic Ocean. Station 3, the furthest off-shore and the only trawl transect off-shore of the intake structures, had significantly lower densities of fish than did either Station 1 or 2. Depth ($p=0.001$) was also significant, with higher catch rates near the bottom than in mid-water. Time of day ($p=0.003$) was a significant factor, with higher observed densities during the day.

Trawl Shellfish Densities

There was a significant station effect ($p=0.002$) in the Atlantic Ocean. Stations 1 and 3 were significantly lower than Station 2, but not significantly different than each other. Depth was a significant factor ($p \leq 0.001$), with higher densities of shellfish sampled near the bottom than in mid-water. The difference between day and night was also significant ($p \leq 0.001$), with higher densities sampled during the night. This may be due to the diurnal activity patterns of the species collected. The most abundant groups (Penaeid shrimp and swimming crabs) are generally more active at night.

4.3.2 *Plankton Collections*

Indian River Lagoon

Planktonic Fish (Ichthyoplankton) Densities

Ichthyoplankton densities in the IRL samples were statistically different ($p \leq 0.001$) among stations, with Station 1 (Big Mud Creek) showing higher densities than Station 2 or 3. There was a significant difference between daytime and nighttime samples ($p \leq 0.001$), with higher densities of fish eggs and larvae observed during the day. Only one depth (near bottom) was sampled in the IRL.

Planktonic Shellfish Densities

Planktonic shellfish densities were significantly different between stations ($p \leq 0.001$). Big Mud Creek (Station 1) had lower planktonic shellfish densities than Station 2 and 3. There was no significant difference ($p = 0.180$) between daytime and nighttime samples. Only one depth was sampled in the IRL.

Atlantic Ocean (Intake Headwall)

Planktonic Fish (Ichthyoplankton) Densities

Ichthyoplankton densities in the intake canal samples were significantly higher ($p \leq 0.001$) in nighttime collections than daytime collections. Only one station and one depth (mid-water) was sampled in the intake canal.

Planktonic Shellfish Densities

Planktonic shellfish densities in the intake canal samples did not show any statistical difference between daytime and nighttime collections ($p = 0.327$). Only one station and one depth (mid-water) were sampled in the intake canal.

4.4 Aquatic Organism Density Comparisons Between the IRL and the Atlantic Ocean Data (Percent Reduction)

Faunal densities were averaged across tows (trawl or plankton) within waterbodies for each event for comparisons between the Atlantic Ocean and the IRL aquatic organism densities. Event by event comparisons were previously discussed and are summarized in Figures 4-1, 4-4, 4-7, and 4-10.

4.4.1 *All Species (Fish and Shellfish)*

Tables 4-1 and 4-2 summarize the percent reduction in densities of impingeable- and entrainable-sized aquatic organisms when comparing the Atlantic Ocean to the IRL. When all species (fish and shellfish) of impingeable-sized organisms are considered collectively, densities in the Atlantic Ocean were 80.9 percent lower than those in the IRL (Table 4-1). When entrainable-sized organisms are considered collectively, densities in the Atlantic Ocean were 91.5 percent lower than those in the IRL (Table 4-2).

4.4.2 Impingeable Organisms

An overall reduction of 80.9 percent was observed for impingeable-sized organisms. Fish densities in the Atlantic Ocean in the vicinity of the Plant intakes were 76.4 percent lower than in the IRL. Shellfish densities exhibited an overall 98.2-percent reduction when comparing the Atlantic Ocean to IRL collections (Table 4-1).

4.4.3 Entrainable Organisms

An overall reduction of 91.5 percent was observed for entrainable-sized organisms. Ichthyoplankton densities were 88.1 percent lower in the water withdrawn from the Atlantic Ocean than in the IRL. Planktonic shellfish densities were 91.8 percent lower in the water withdrawn from the Atlantic Ocean than in the IRL (Table 4-2).

4.5 Biomass Estimation and Comparisons Between the Atlantic Ocean and the IRL

Biomass of fish and shellfish was another metric evaluated in the comparison of biological communities between the IRL and the Atlantic Ocean. As stated previously, the field team was unable to obtain reliable weight measurements of fish and shellfish on the unstable platform of a rocking boat; therefore, biomass was estimated.

Biomass was estimated through the use of individual length measurements. Length-weight regressions provide the average weight of an individual specimen of known length based on measurements of length and weight from the population. The form of the taxa-specific relationships, model parameters, and references are provided in Appendix F. There are several sources of potential error in applying this technique; however, all error is assumed to be random and non-directional for both waterbodies and should not affect a relative comparison. Due to the high diversity of species collected, and diminishing returns and difficulty in developing length-weight regressions for species occasionally observed, regressions were generated for those species comprising the top 95 percent, by density, of the collections from each waterbody in each year. In 2006 for the IRL, this included 20 of the 101 taxa observed, 14 of which were fish and 6 of which were shellfish. In the Atlantic Ocean in 2006, 8 taxa of the 108 observed comprised the top 95 percent, all of which were fish. In 2007 in the IRL, 27 of the 83 taxa observed comprised the top 95 percent (21 fish and 6 shellfish). In the Atlantic in 2007, the top 95 percent included 43 of the 79 taxa observed (32 fish and 11 shellfish). Data used for these regressions came primarily from other sampling efforts conducted by Golder; however, some data were drawn from the literature or early sampling efforts at the FPL St. Lucie Plant for species unique to the area.

Prior to the generation of regressions, length-weight data were examined for outliers and those data points were removed. Both a power function and an exponential function were fit to the data. The regression that best fit the data was selected for the generation of biomass estimates from lengths for the purpose of this analysis.

This approach estimated mean biomass density to be 55.3 grams (g)/100m^3 in the IRL and 1.6 g/100m^3 in the Atlantic Ocean.

Biomass density estimates were highest in the IRL from spring to fall. Estimates for the Atlantic Ocean were consistently low, with the exception of one event in July 2006 in which 15,000 anchovies were collected (Figure 4-13). A 97.1-percent reduction in biomass density (from 55.3 to 1.6 g/100m^3) was estimated when comparing the Atlantic Ocean to the IRL. When considering only fish species, there was a 97.0-percent reduction in estimated biomass between the Atlantic Ocean and the IRL. The shellfish reduction was 99.0 percent; however, no shellfish were included in the 2006 biomass estimates for the Atlantic Ocean, as no shellfish were within the top 95 percent of species by abundance (Table 4-3).

One of the shortcomings of using the most abundant species is that it accounts only for the most common, and generally smaller, species in each waterbody and fails to account for the less-frequently encountered species, which include the generally larger species that contribute more per individual to the total biomass. There are two justifications for this technique: the larger and less frequently-encountered species are likely more able to swim against intake currents and thus avoid impingement; and the smaller species, if rarely encountered would be a minor component of impingement. Generating or locating regressions for the complete list of species collected would be very labor intensive and hindered by a lack of published data and/or existing Golder data for the complete list of species.

4.6 Catch and Release of Fish Entrained into Intake Canal

FPL has an active and successful fish tag and release program that captures fish that have been entrained into the intake canal, retrieves them, tags them, and releases them back to the environment. FPL conducts the program under a FFWCC issued Special Activity License written specifically for fish removal and release from the intake canal. Passive and active capture techniques are required to target a diverse fish population entrained in the intake canal. The primary means of fish removal includes four fish traps along with hook and line capture. The fish tag and release program was initiated in 1992. To date, over 10,000 fish have been removed, tagged, and released from the intake canal. Recent efforts have focused on top predator fish through hook and line capture including margate, grouper, snapper, snook, and nurse sharks. The last 3 years of effort have resulted in an estimated removal and release of 7,500 pounds (lbs) of fish in 2008, 7,700 lbs of fish in 2009, and 2,500 lbs of fish through half of 2010. Based on the percent of fish tags returned, this capture and release program appears to have a good success rate. State and national aquariums also participate in this capture program and collect specimens for exhibits from the intake canal.

4.7 Water Quality

Average water quality parameters are presented in Appendix G. Water quality parameters were within the normal ranges expected for the Atlantic Ocean and IRL in the vicinity of the St. Lucie Nuclear Power Plant.

4.8 Data

All raw data are included in Appendix H (CD).

5.0 SUMMARY

Prior to construction, FPL modified the design of the St. Lucie Nuclear Power Plant to draw its cooling water from the Atlantic Ocean instead of the more biologically productive IRL. This change was made to reduce the impacts of impingement and entrainment mortality on the surrounding ecosystems. The biological communities potentially vulnerable to impingement and entrainment were characterized from January 2006 through October 2007. These studies included trawl and plankton sampling in the IRL, trawls in the Atlantic Ocean and plankton collections from Atlantic Ocean water as it enters the intake canal.

Based on the data summarized in Tables 4-1, 4-2 and 4-3, considerable reductions in impingeable-sized and entrainable-sized organisms were observed from January 2006 to October 2007 when comparing organism densities in the Atlantic Ocean to the IRL. These reductions ranged from 80.9 percent in impingeable-sized organism densities to 91.5 percent in entrainable-sized organism densities when comparing densities in the Atlantic Ocean with those in the IRL. The biomass density reduction estimate for impingeable-sized organisms was 97.1 percent (using the 95 percent most abundant species). This study also verified that an offshore intake located at mid-depth reduced impingement potential due to the significantly lower fish and shellfish densities at mid-depth as compared to the sea bottom. An offshore intake withdraws cooler water (when compared to an estuary such as the IRL) therefore reducing the volume of water required for cooling; this results in lower entrainment potential.

These data support the decision to reduce impingement and entrainment mortality by relocating the Plant's cooling water intake from the IRL to the Atlantic Ocean. These data continue to support the original BTA determination for the Plant ocean intake at mid-depth using velocity caps to reduce impingement.

6.0 REFERENCES

Florida Power & Light Company (FPL). 2003. St. Lucie Plant, Annual Environmental Operating Report, Sea Turtle Refuge.

U.S. Atomic Energy Commission (USAEC). 1974. Final Environmental Statement related to construction of St. Lucie Plant, Unit No. 2, Docket No. 50-389, Florida Power & Light Company. May 1974.

U.S. Nuclear Regulatory Commission (NRC). 1982. Final Environmental Statement related to the operation of St. Lucie Plant Unit No. 2, Docket No. 50-389 Florida Power & Light Company, April 1982.

U.S. Nuclear Regulatory Commission (NRC). 2001. Endangered Species Act – Section 7 Consultation. 2001. Biological Opinion, St. Lucie Plant, Units 1 and 2. May 18, 2001.

TABLES

TABLE 1-1
PUMPING CAPACITY OF CWIS BAYS

Pumps/Unit	Pump Capacity
Circulating Pumps	
Unit 1 (4)	4 bays @ 121,000 gpm
Unit 2 (4)	4 bays @ 122,650 gpm
Auxiliary Pumps (6)	58,000 gpm
Total Nominal Flow	**1,032,600 gpm (1,487 MGD)**

TABLE 1-2
PLANT CAPACITY FACTORS FOR
FPL'S ST. LUCIE NUCLEAR POWER PLANT

Year	Unit 1	Unit 2	St. Lucie Nuclear Power Plant
2000	102.0%	92.3%	97.2%
2001	91.3%	91.3%	91.3%
2002	94.2%	101.0%	97.6%
2003	102.1%	80.1%	91.1%
2004	85.8%	92.0%	88.9%
2005	82.8%	85.5%	84.2%
2006	101.0%	82.8%	91.9%
2007	84.8%	70.1%	77.5%
2008	90.6%	96.2%	93.4%
2009	101.5%	76.1%	88.8%

Source: FPL, 2010.

TABLE 2-1
SUMMARY OF BIOLOGICAL CHARACTERIZATION SAMPLING PLAN, FPL ST. LUCIE NUCLEAR POWER PLANT

Sample Type	Sampling Locations	Gear	Sample Frequency	Sample Summary
Nearfield	<u>Atlantic Ocean</u> • 3 transects • 2 depths (bottom and mid-depth) <u>IRL/Big Mud Creek</u> • 3 transects • bottom only	<u>Atlantic Ocean</u> • Otter trawl • Midwater trawl <u>IRL/Big Mud Creek</u> • Otter trawl	<u>Atlantic Ocean</u> • day and night • bi-weekly <u>IRL/Big Mud Creek</u> • day and night • bi-weekly	<u>Atlantic Ocean</u> • 12 samples/event • 42 events* <u>IRL/Big Mud Creek</u> • 6 samples/event • 45 events
Entrainment/ Plankton	<u>Intake canal headwalls</u> • 1 location (midwater) <u>IRL/Big Mud Creek</u> • 3 transects (midwater)	<u>Intake canal headwalls</u> • One-meter, 300-micron mesh plankton net <u>IRL/Big Mud Creek</u> • two 20-cm diameter, 300-micron mesh plankton nets	<u>Intake canal headwall</u> • 1 tow • day and night • bi-weekly <u>IRL/Big Mud Creek</u> • 1 tow • day and night • bi-weekly	<u>Intake canal headwall</u> • 2 samples/event • 45 events/year <u>IRL/Big Mud Creek</u> • 6 samples/event • 45 events/year

Note: IRL = Indian River Lagoon.

*Three sampling events were not conducted in the Atlantic Ocean due to maintenance activities at the velocity caps and the use of scuba divers for this work.

TABLE 4-1
PERCENT REDUCTION IN IMPINGEABLE-SIZED ORGANISMS WHEN COMPARING ATLANTIC OCEAN DENSITIES TO INDIAN RIVER LAGOON DENSITIES

	Percent Reduction
Fish and Shellfish	80.9
Fish Only	76.4
Shellfish Only	98.2

TABLE 4-2
PERCENT REDUCTION IN ENTRAINABLE-SIZED ORGANISM DENSITIES WHEN COMPARING ATLANTIC OCEAN DENSITIES TO INDIAN RIVER LAGOON DENSITIES

	Percent Reduction
Fish and Shellfish	91.5
Fish Only	88.1
Shellfish Only	91.8

TABLE 4-3
PERCENT REDUCTION IN IMPINGEABLE-SIZED ORGANISMS WHEN COMPARING ATLANTIC OCEAN BIOMASS DENSITIES TO INDIAN RIVER LAGOON BIOMASS DENSITIES

	Percent Reduction
Fish and Shellfish	97.1*
Fish Only	97.0*
Shellfish Only	99.0**

* Biomass estimated using length-weight regressions for the most abundant species.

** No shellfish were included in the top 95-percent of species collected from the Atlantic Ocean in 2006.

FIGURES

2,000 0 2,000 Feet

LEGEND

Property Boundary

NOTES

FPL Property does not include A1A or Walton Rocks Beach Road.

REFERENCES

1. Property Boundary, St. Lucie County Property Appraiser, October, 2007.

REV.	DATE	DES	REVISION DESCRIPTION	GIS	CHK	RVW

PROJECT

FPL ST. LUCIE POWER PLANT

TITLE

SITE LOCATION

Golder Associates
Gainesville, Florida

PROJECT No.		043-7645	FILE No.	0437645_A001
DESIGN	SJL	6/9/2010	SCALE: AS SHOWN	REV. 0
GIS	NRL	7/1/2010	**FIGURE 1-1**	
CHECK	SJL	7/1/2010		
REVIEW	ICJ	7/1/2010		

Map Document: G:\PROJECTS\2004\043-7645_FPL_StLucie\A_316B_Report\Rev_0\MapDocuments\0437645_A001_SiteLocation.mxd / Modified 7/1/2010 4:11:46 PM / Plotted 7/2/2010 3:36:34 PM by rlamar

REV.	DATE	DES	REVISION DESCRIPTION	GIS	CHK	RVW

PROJECT

FPL ST. LUCIE POWER PLANT

TITLE

FACILITY FEATURES

PROJECT No.		043-7645	FILE No. 0437645_A002	
DESIGN	SJL	7/1/2010	SCALE: AS SHOWN	REV. 0
GIS	NRL	7/2/2010	**FIGURE 1-2**	
CHECK	SJL	7/2/2010		
REVIEW	ICJ	7/2/2010		

Golder Associates
Gainesville, Florida

REFERENCES

1. Facility Features, FPL, 2010.

Map Document: G:\PROJECTS\2004\043-7645_FPL_StLucie\A_316B_Report\Rev_0\MapDocuments\0437645_A002_FacilityFeatures.mxd / Modified 7/2/2010 7:48:40 AM / Plotted 7/2/2010 7:53:06 AM by rlamar

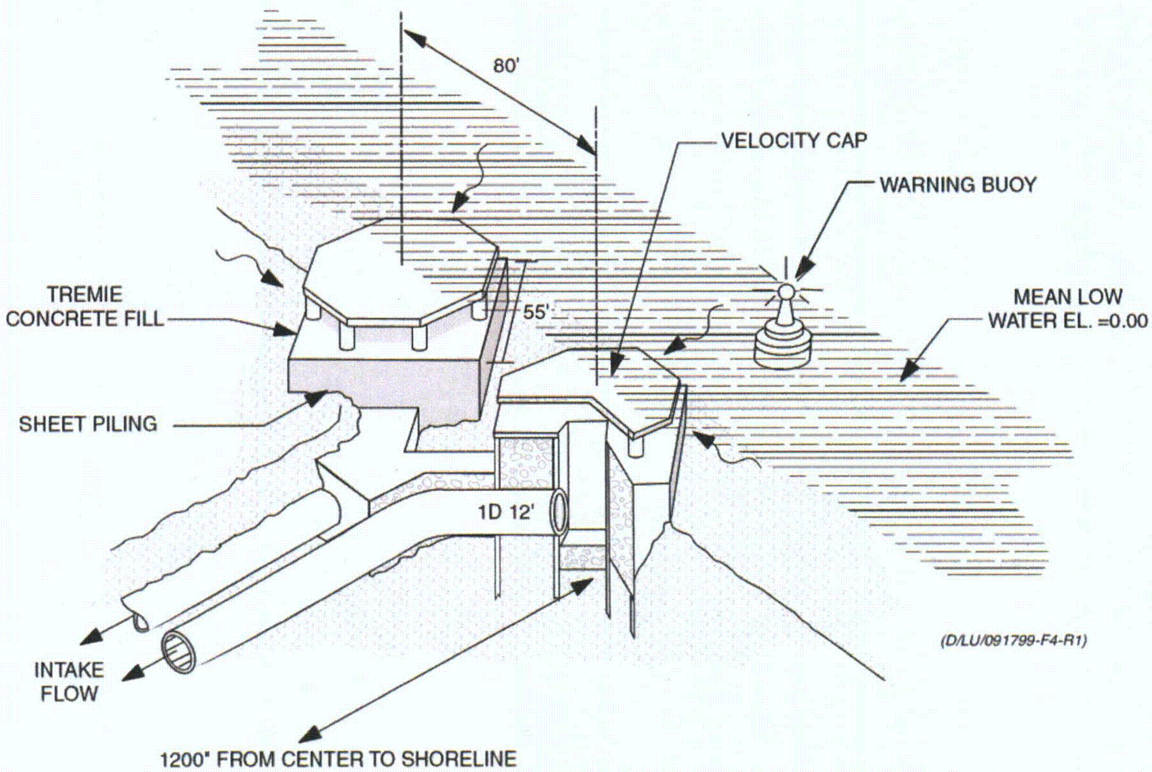


Figure 1-3. Configuration of the 12-ft diameter intake structures, FPL St. Lucie Nuclear Power Plant, Hutchinson Island, Florida

Source: Ecological Associates Inc., 2001

Golder Associates

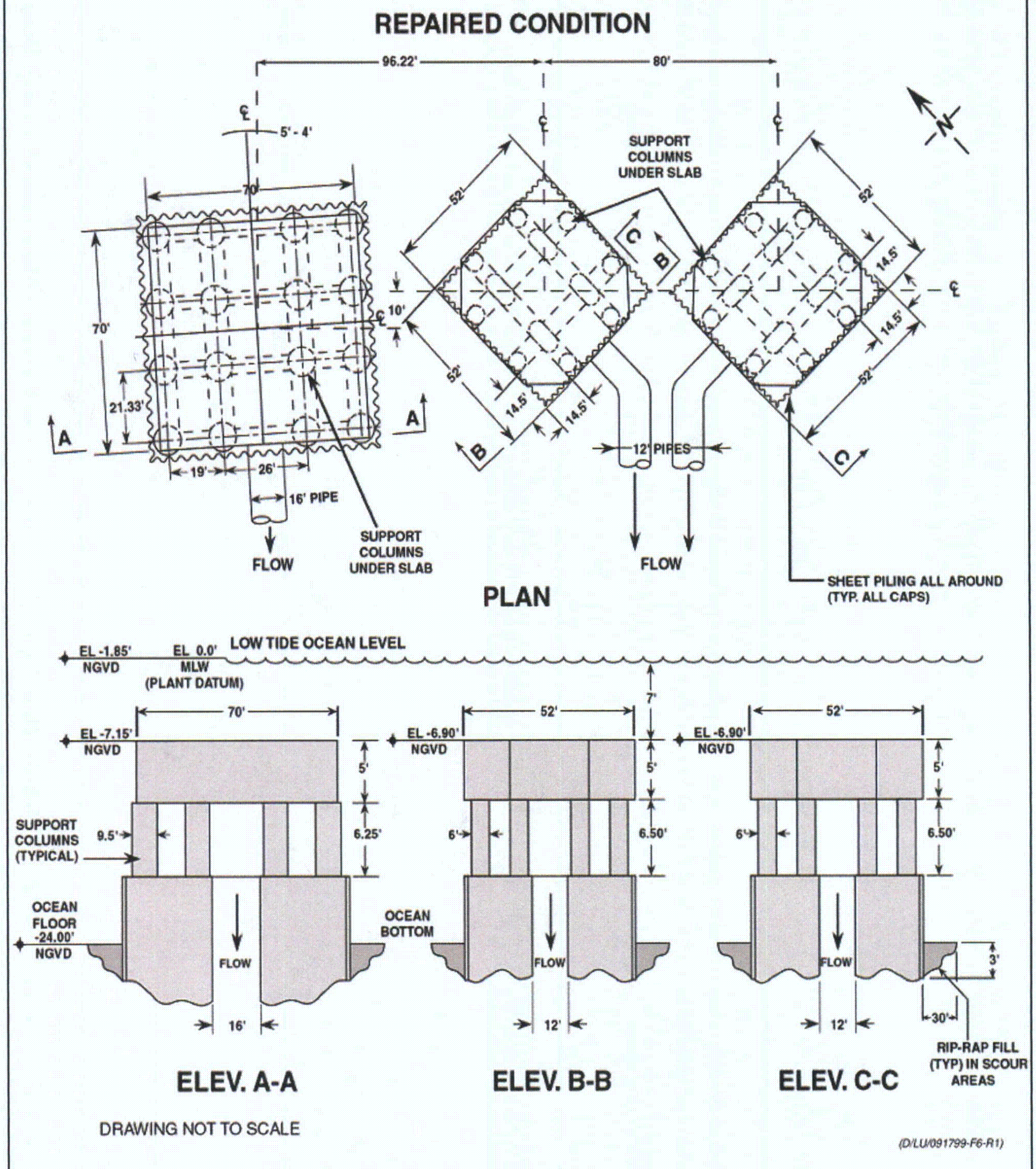


Figure 1-4. Diagram of the three intake structures located 1,200 feet offshore from the FPL St. Lucie Nuclear Power Plant, Hutchinson Island, Florida

Source: Ecological Associates Inc., 2001.

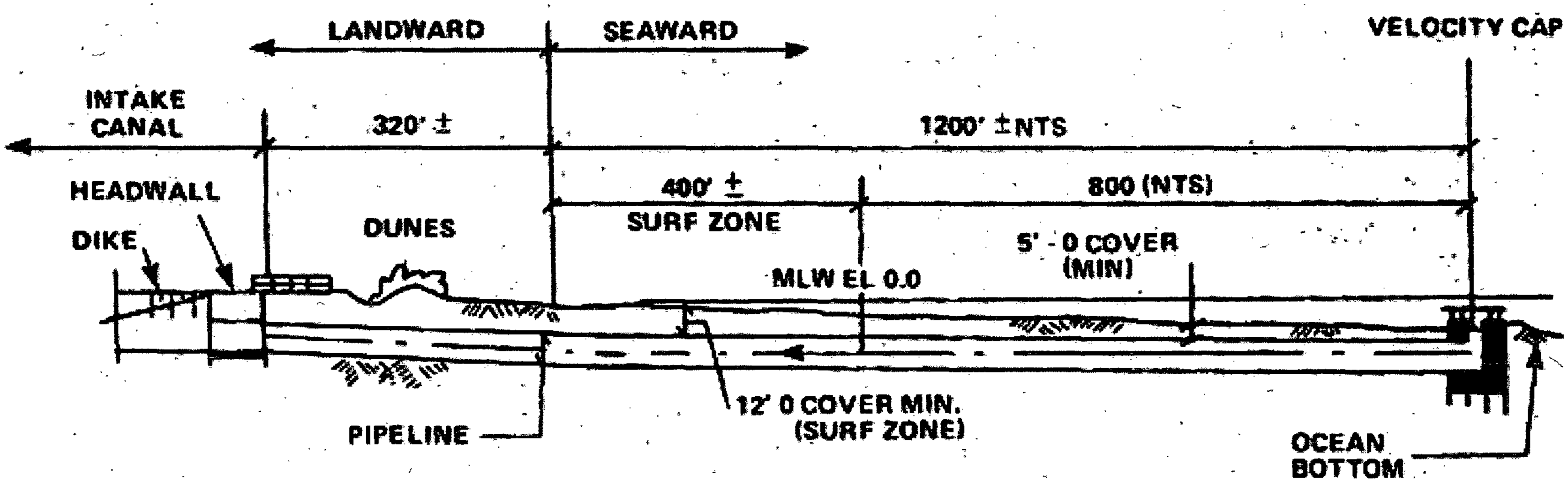


Figure 1-5. FPL St. Lucie Nuclear Power Plant Illustration of Intake Pipe

Source: U.S. Nuclear Regulatory Commission, 1982.

Golder Associates

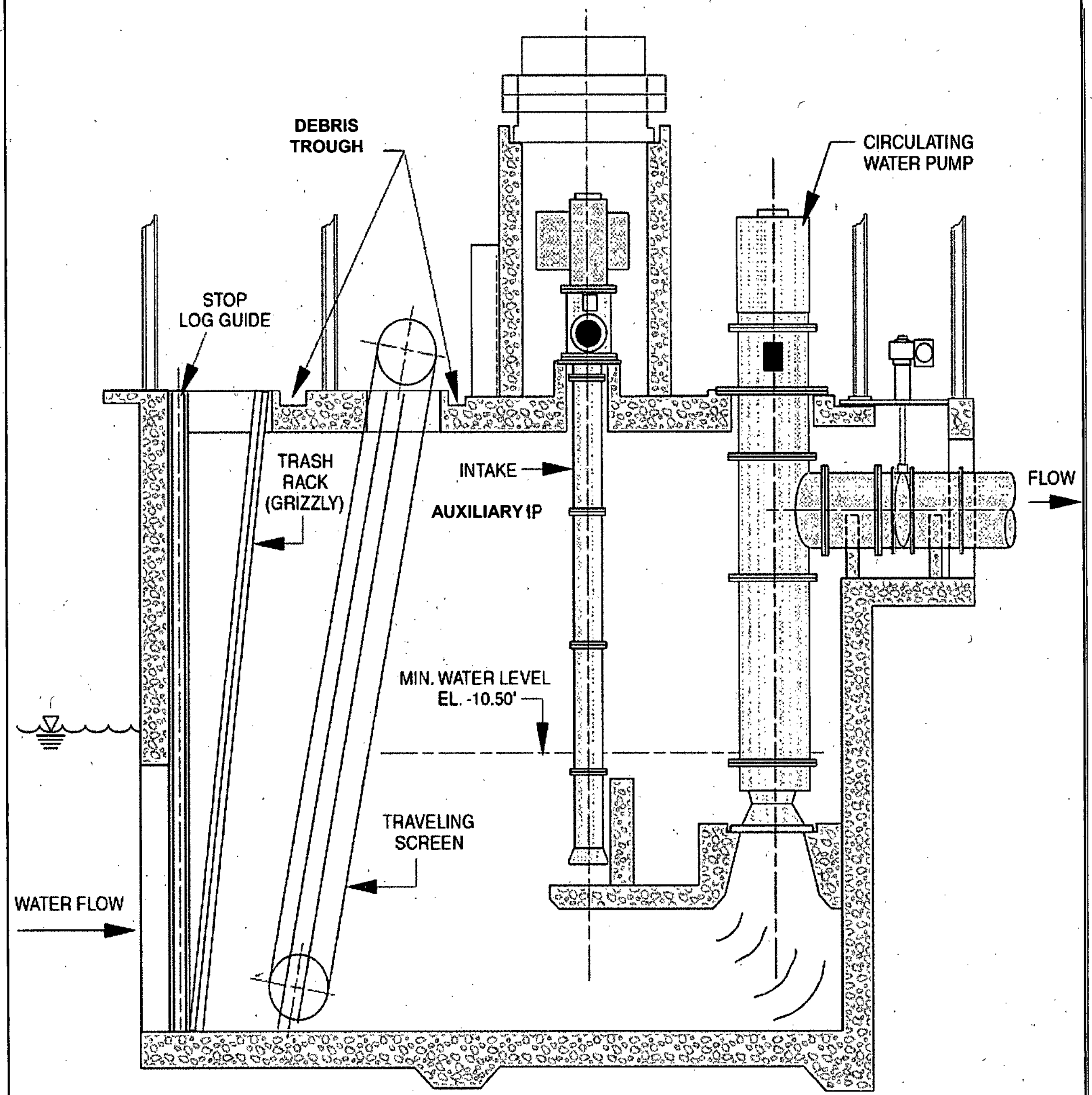
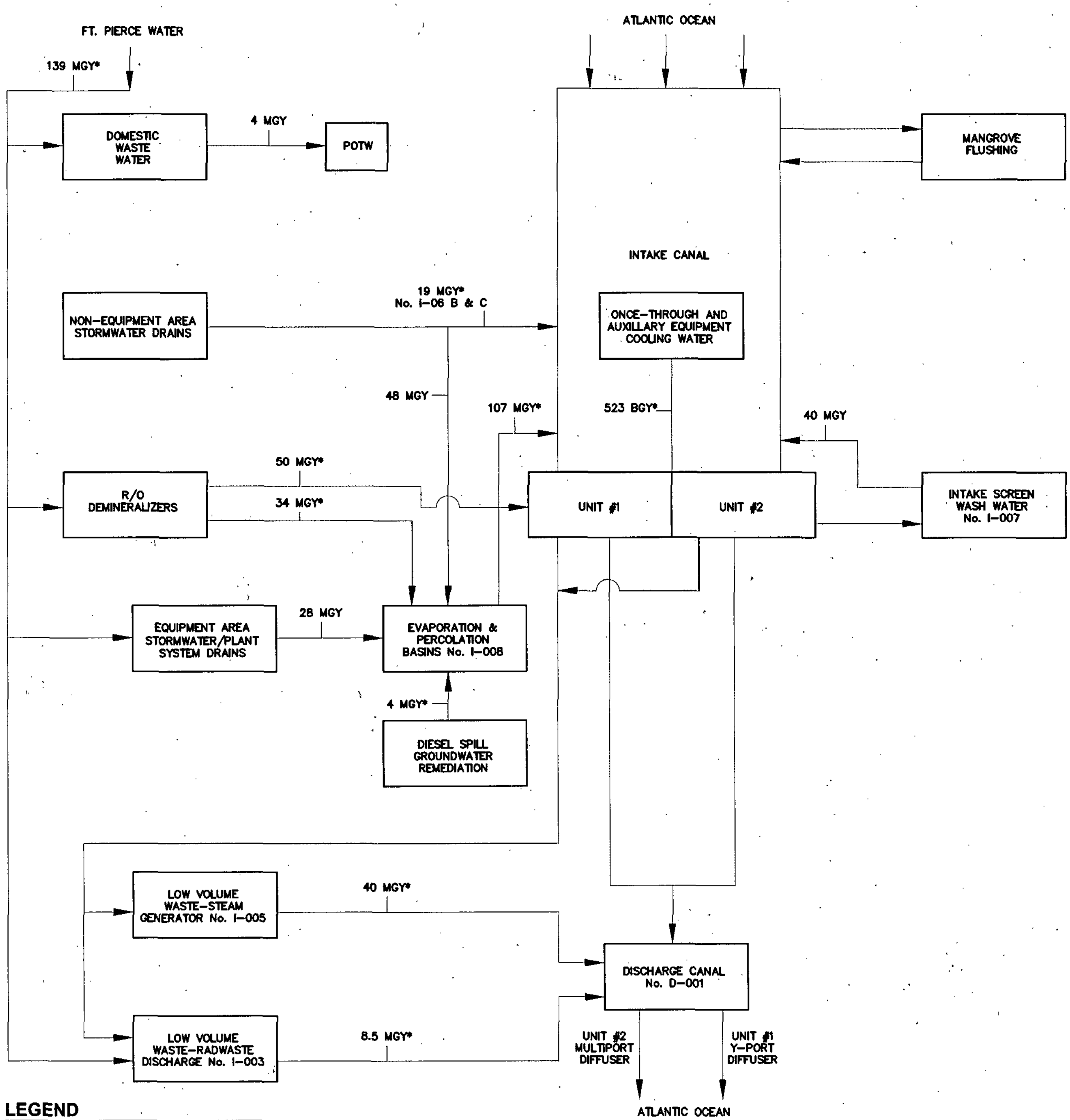


Figure 1-6. Diagram of an Intake Well at the FPL St. Lucie Nuclear Power Plant, Hutchinson Island, Florida.

Source: Ecological Associates Inc., 2001

Golder Associates



LEGEND

MGY: MILLION GALLONS PER YEAR

BBY: BILLION GALLONS PER YEAR

NOTE

2008 FIGURE FROM WHICH THIS FIGURE WAS DERIVED DID NOT HAVE "INFLOWS = OUTFLOWS".

* BASED ON 2008-2009 DATA. OTHER VALUES FROM 2003 DATA.

REFERENCES

1. FPL, 2010

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	07/12/10	JTD	UPDATE PROCESS FLOW DIAGRAM	NRL	JTD	JTD

PROJECT

FPL ST. LUCIE POWER PLANT

TITLE

INDUSTRIAL WATER PROCESS FLOW DIAGRAM

Golder Associates
Gainesville, Florida

PROJECT No.		043-7645	FILE No. 0437645_A003
DESIGN	JTD	06/02/10	SCALE AS SHOWN REV. 1
CADD	NRL	06/04/10	**FIGURE 1-7**
CHECK	ICJ	07/02/10	
REVIEW			

Drawing file: 0437645_A003_Rev1_FlowDiagram.dwg Jul 12, 2010 - 2:13pm

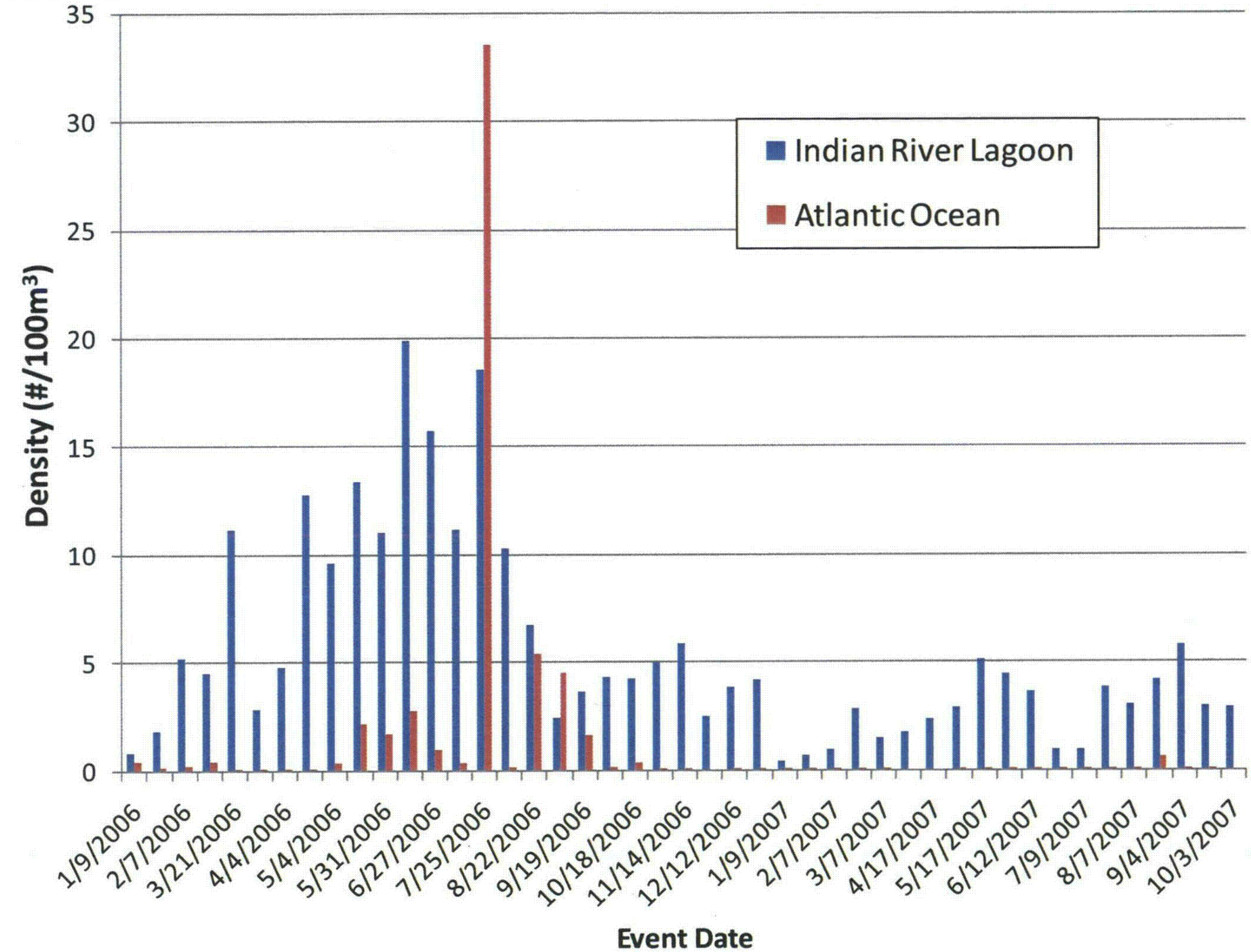


Figure 4-1
Density of Fish in Indian River Lagoon and Atlantic Ocean Trawls – January 2006 through October 2007

Source: Golder. 2010.

Golder Associates

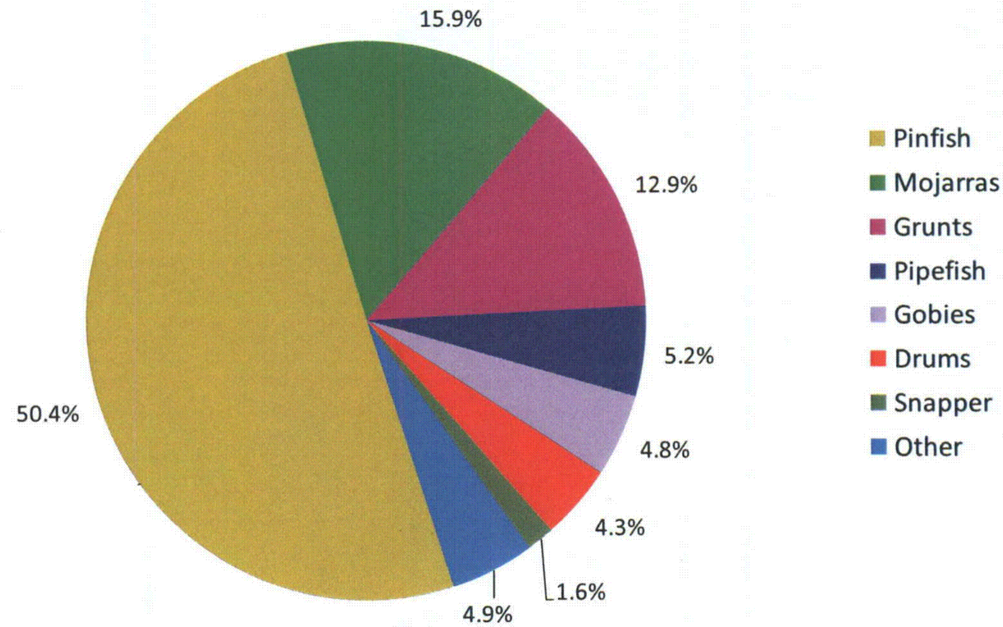


Figure 4-2

Relative Abundance of Fish in Indian River Lagoon Trawls – January 2006 through October 2007

Source: Golder, 2010.

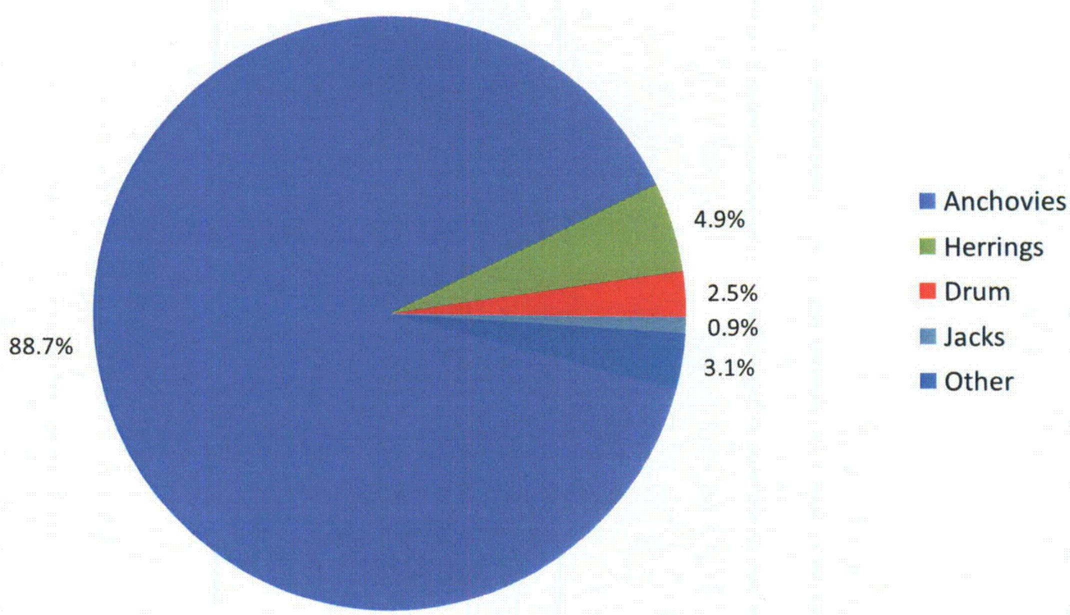


Figure 4-3

Relative Abundance of Fish in Atlantic Ocean Trawls – January 2006 through October 2007

Source: Golder, 2010.

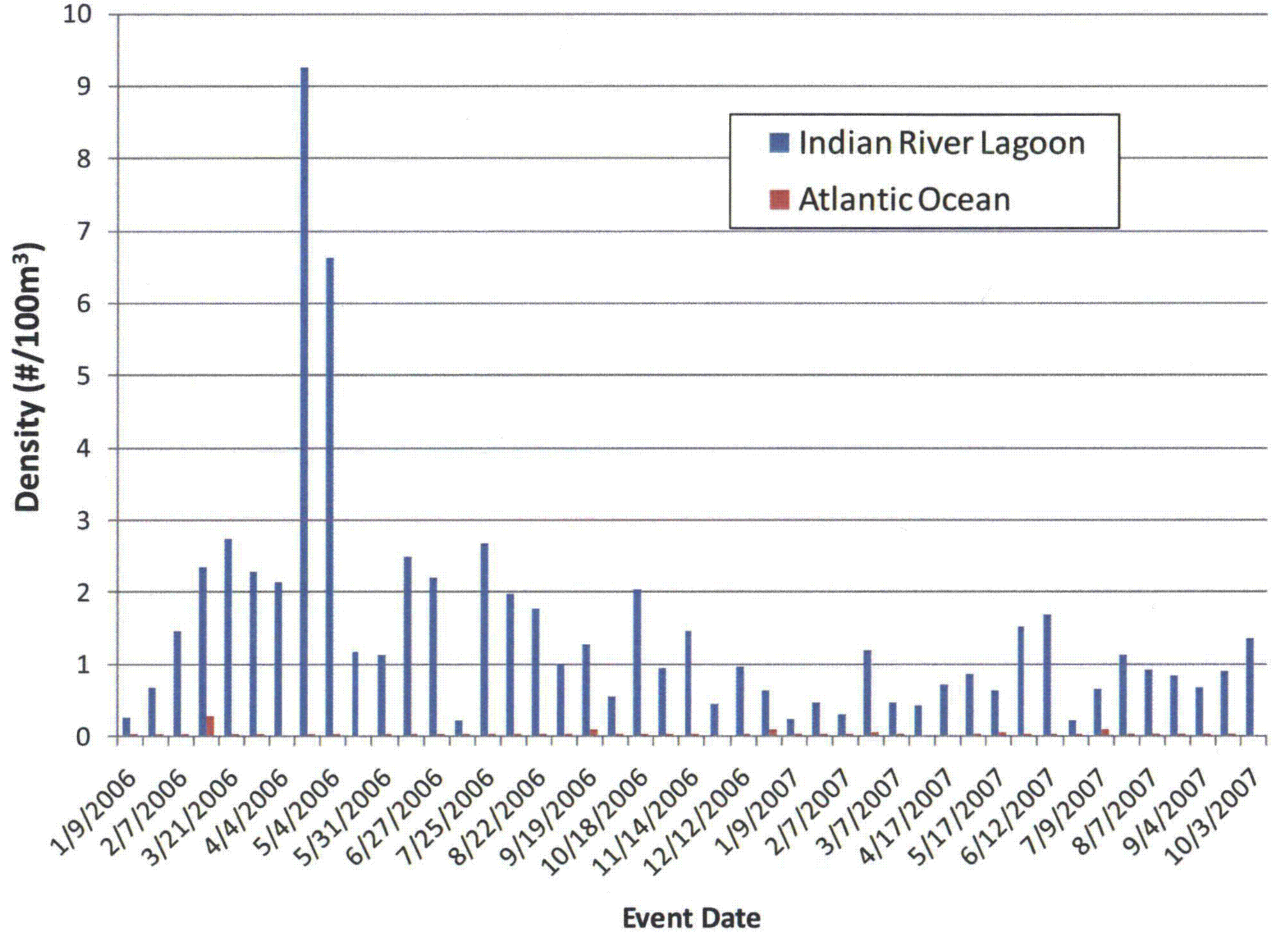


Figure 4-4
Densities of Shellfish in Indian River Lagoon and Atlantic Ocean Trawls –
January 2006 through October 2007

Source: Golder, 2010.

Golder Associates

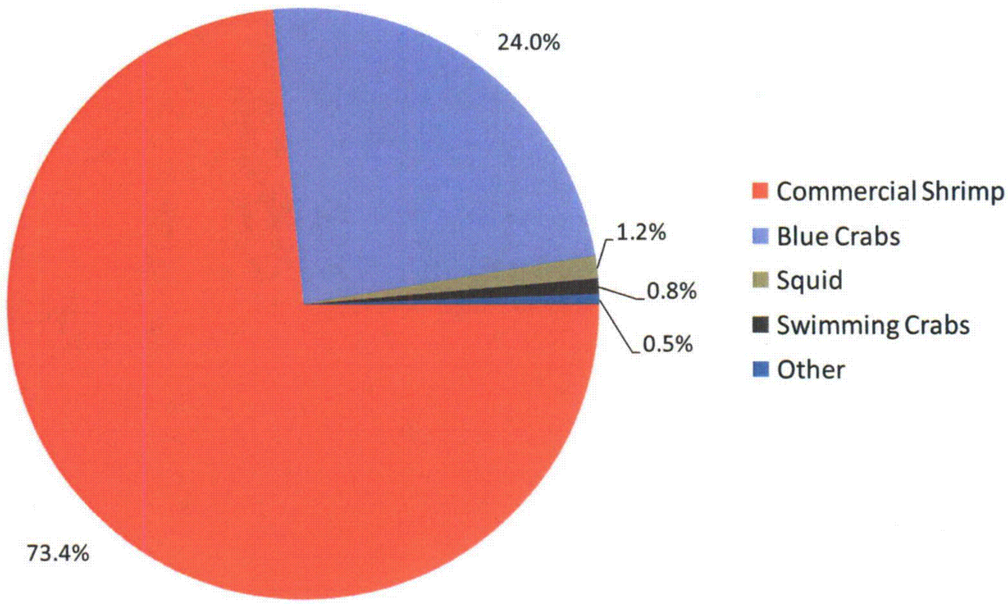


Figure 4-5

Relative Abundance of Shellfish in Indian River Lagoon Trawls – January 2006 through October 2007

Source: Golder, 2010.

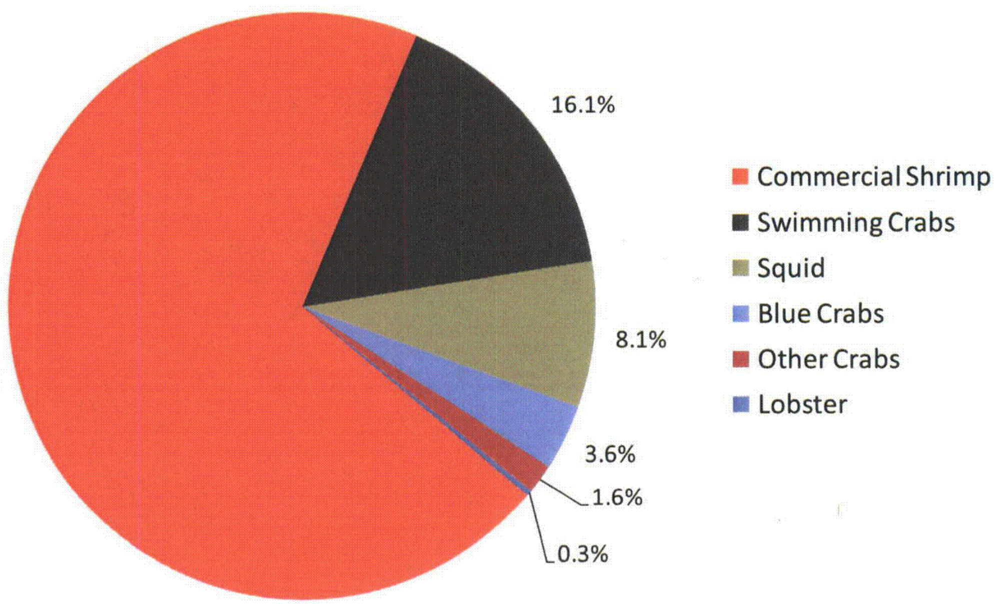


Figure 4-6

Relative Abundance of Shellfish in Atlantic Ocean Trawls – January 2006 through October 2007

Source: Golder 2010.

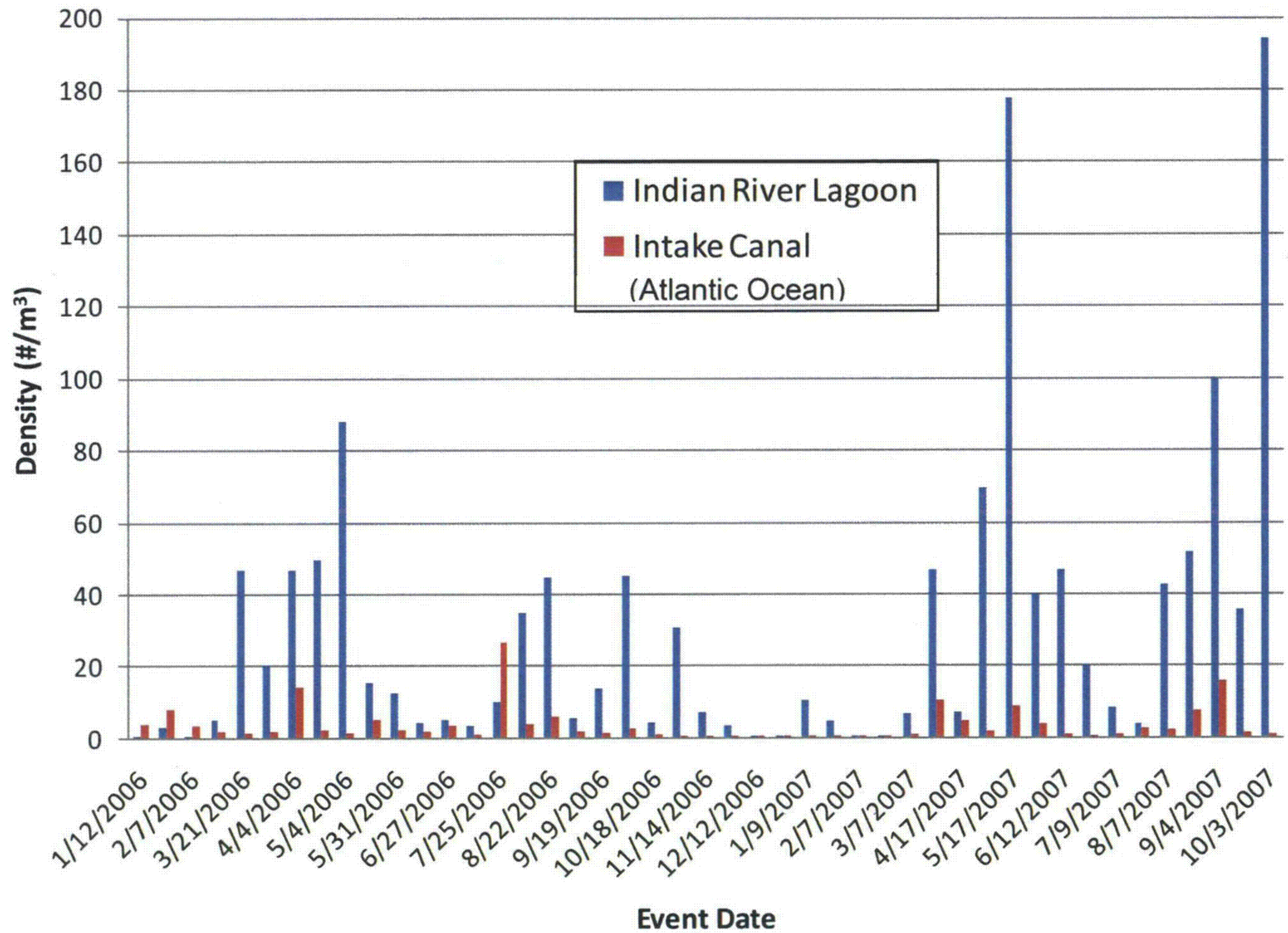


Figure 4-7

Densities of Fish Eggs and Larvae in Plankton Collections from the Indian River Lagoon and the FPL St. Lucie Intake Canal Headwall – January 2006 through October 2007
Source: Golder, 2010.

Golder Associates

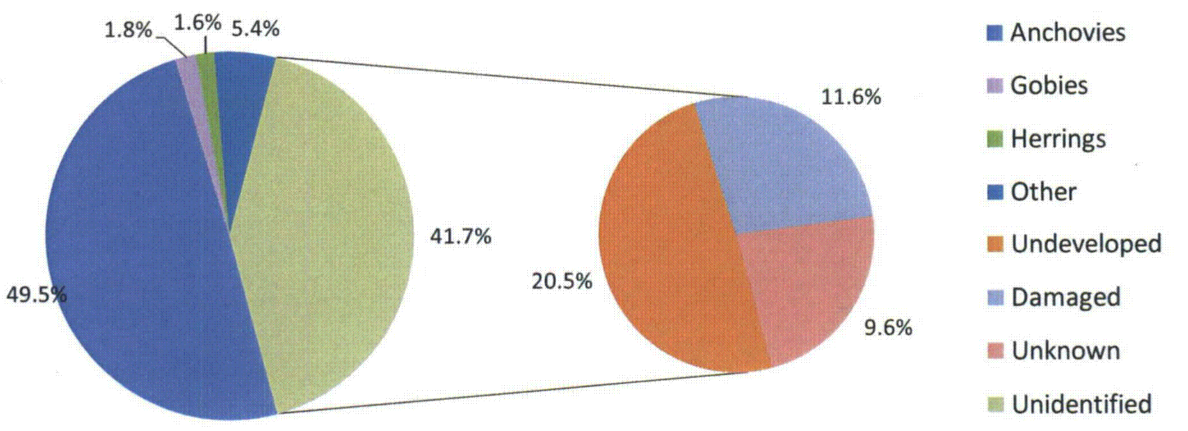


Figure 4-8

Relative Abundance of Fish Eggs and Larvae in Indian River Lagoon Plankton Samples – January 2006 through October 2007

Source: Golder 2010.

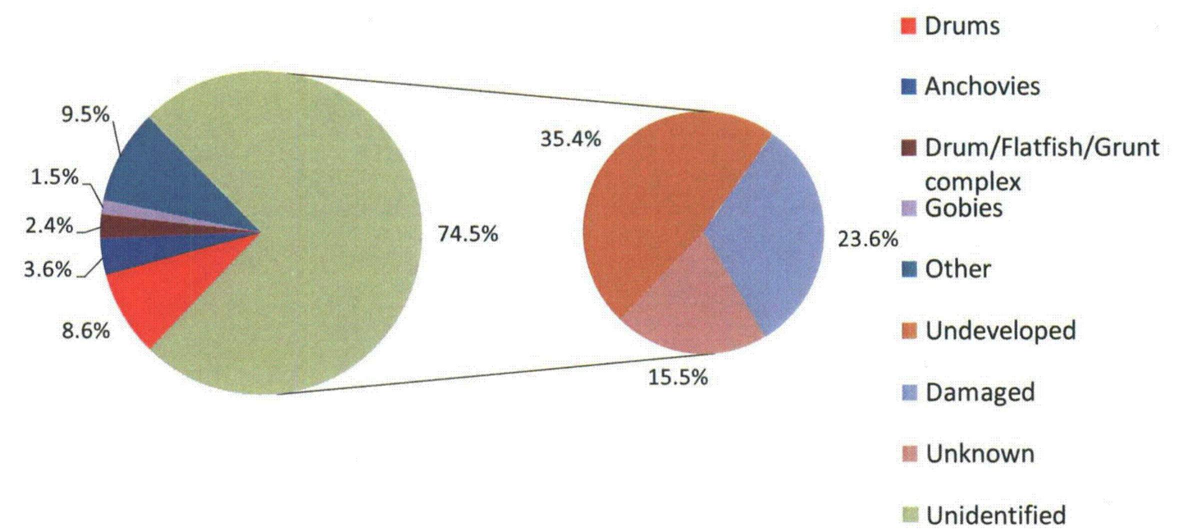


Figure 4-9

Relative Abundance of Fish Eggs and Larvae in the FPL St. Lucie Plant Intake Canal Headwall Plankton Samples – January 2006 through October 2007

Source: Golder 2010.

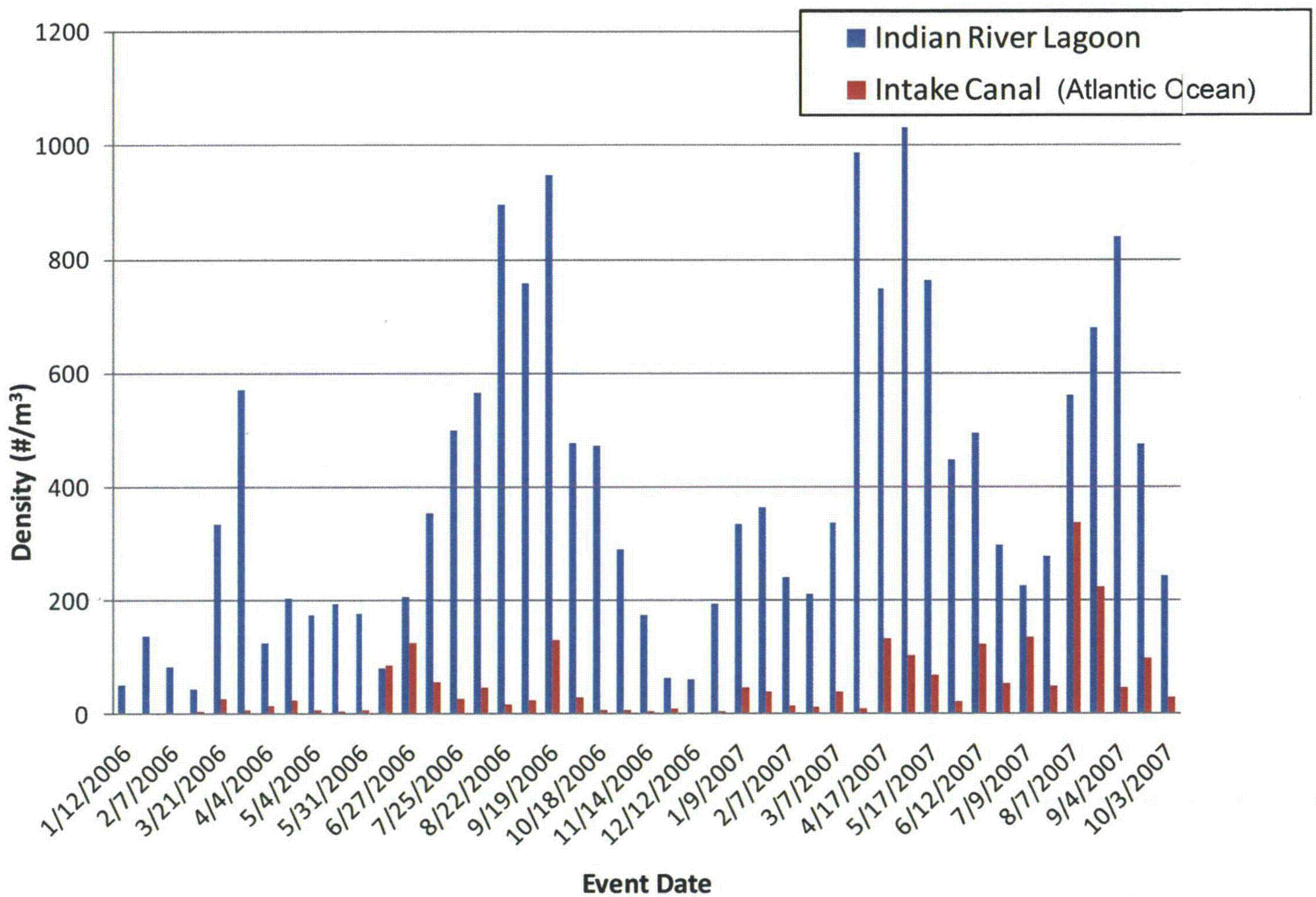


Figure 4-10
Densities of Shellfish in Plankton Samples from the Indian River Lagoon
and the FPL St. Lucie Intake Canal Headwall – January 2006 through October 2007

Source: Golder, 2010.

Golder Associates

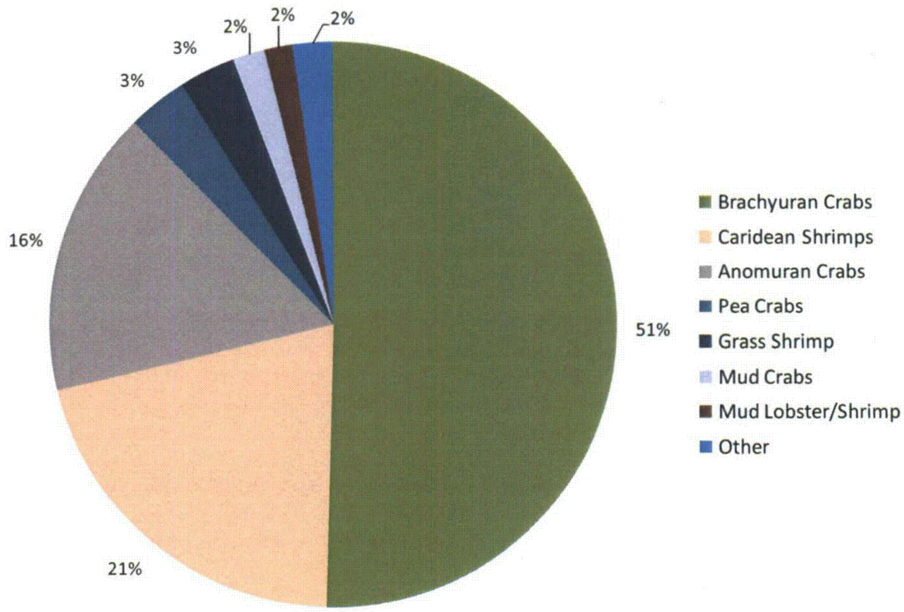


Figure 4-11

Relative Abundance of Shellfish in Indian River Lagoon Plankton Samples – January 2006 through October 2007

Source: Golder 2010.

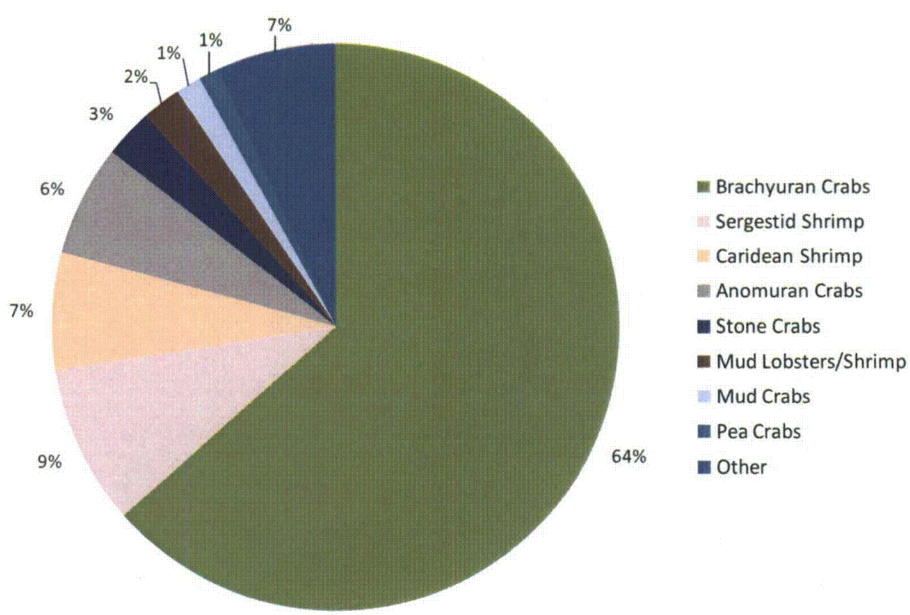


Figure 4-12

Relative Abundance of Shellfish in the FPL St. Lucie Intake Canal Headwall Plankton Samples – January 2006 through October 2007

Source: Golder, 2010.

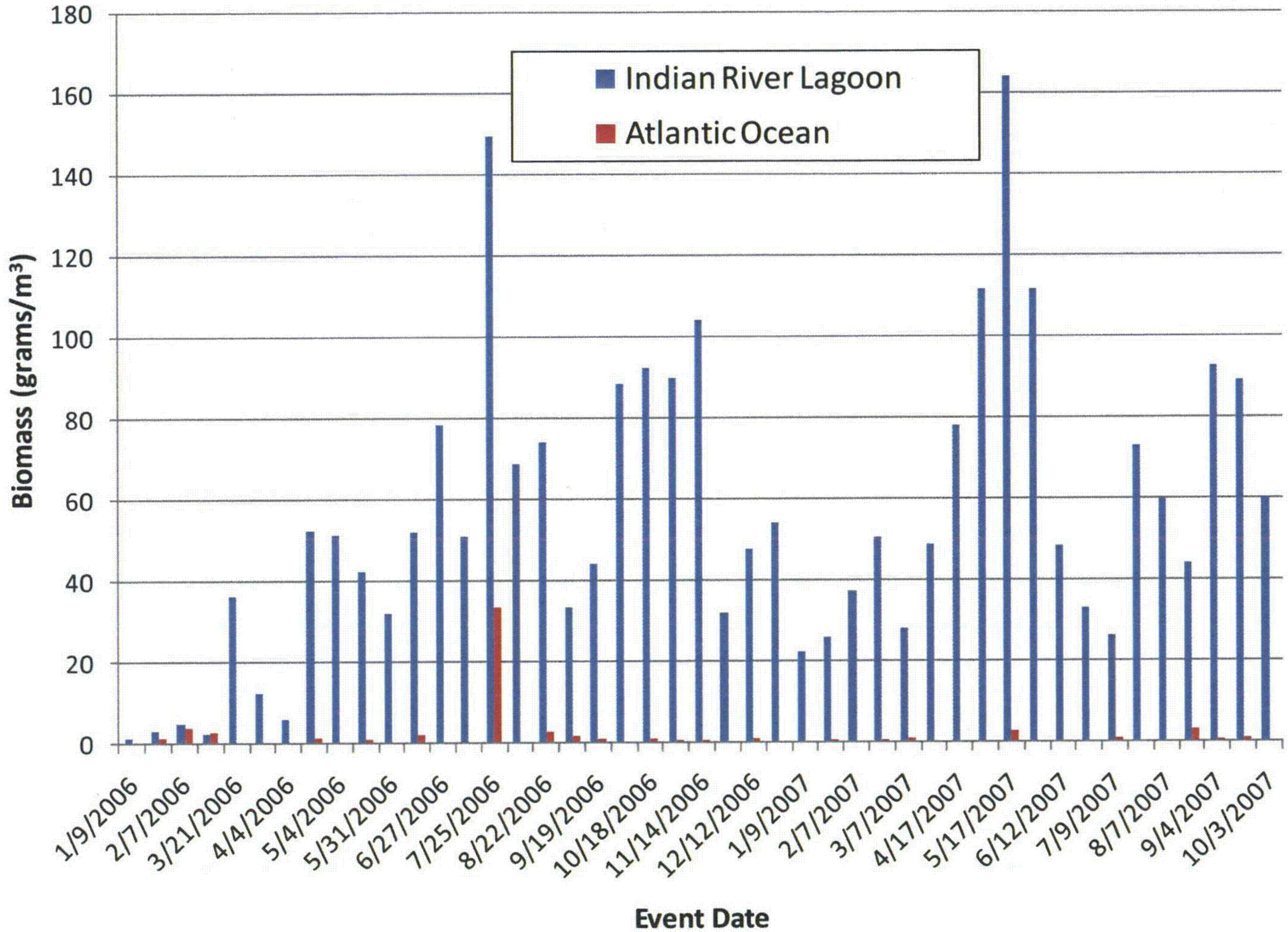


Figure 4-13
Biomass Density Estimates from Length-Weight Regressions for the Most Abundant Fish and Shellfish Species in Indian River Lagoon and Atlantic Ocean Trawls – January 2006 through October 2007

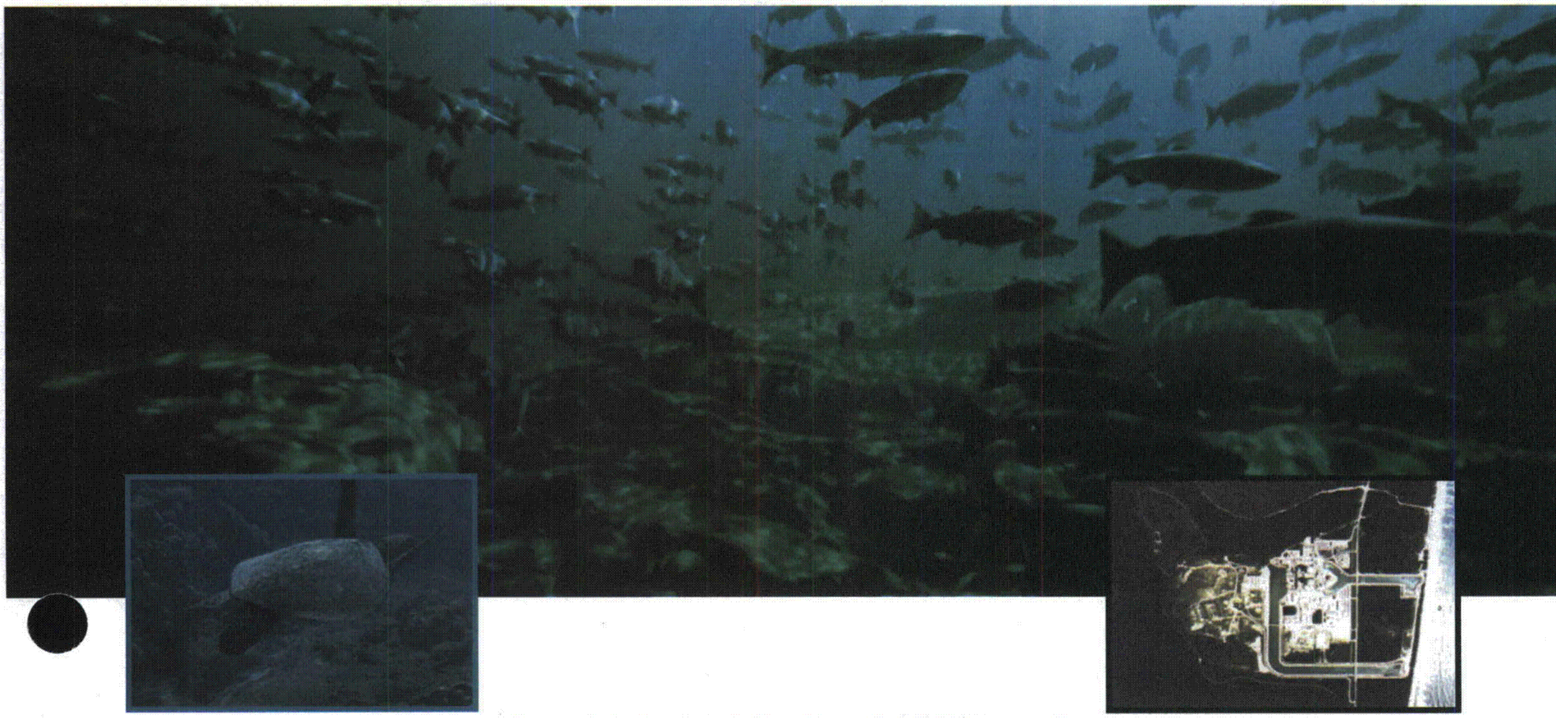
Source: Golder, 2010.

Golder Associates

APPENDICES

APPENDIX A

PROPOSAL FOR INFORMATION COLLECTION AND FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION COMMENTS AND FLORIDA POWER AND LIGHT RESPONSES



Clean Water Act Section 316(b) Phase II

Proposal for Information Collection

St. Lucie Nuclear Power Plant

FPL

Golder Associates

0437645
MAY 2005

PROPOSAL FOR INFORMATION COLLECTION FOR THE ST. LUCIE NUCLEAR POWER PLANT FLORIDA POWER & LIGHT COMPANY

Prepared For:

Florida Power & Light Company
700 Universe Boulevard
Juno Beach, Florida 33408

Prepared By:

Golder Associates Inc.
6241 NW 23rd Street, Suite 500
Gainesville, Florida 32653-1500

May 2005
0437645

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LIST OF ACRONYMS AND ABBREVIATIONS

Opinion	Biological Opinion
BTA	Best Technology Available
CDS	Comprehensive Demonstration Study
CERP	Comprehensive Everglades Restoration Plan
40 CFR	Title 40 of the Code of Federal Regulations
cfs	cubic feet per second
COE	U.S. Army Corp of Engineers
CWA	Clean Water Act
CWIS	cooling water intake structure(s)
DMS	St. Lucie 316(b) Data Management System
DCTP	Design and Construction Technology Plan
EAI	Ecological Associates, Inc.
eggs /m^3	eggs per cubic meter
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FDEP	Florida Department of Environmental Protection
FFWCC	Florida Fish and Wildlife Conservation Commission
FPL	Florida Power & Light Company
fps	foot per second
FR	Federal Register
ft	foot/feet
Golder	Golder Associates Inc.
gpm	gallons per minute
HZI	Hydraulic Zone of Influence
ICW	Intracoastal Waterway
IM & E Study	Impingement Mortality and Entrainment Characterization Study
IRL	Indian River Lagoon
kW	kilowatt
larvae/m^3	larvae per cubic meter
m	meter
MGD	million gallons per day
mm	millimeter
MW	megawatt

ND	not determined
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
PIC	Proposal for Information Collection
Plant	St. Lucie Nuclear Power Plant
ppt	parts per thousand
QA/QC	quality assurance/quality control
SCUBA	self-contained underwater breathing apparatus
STSSN	Sea Turtle Stranding and Salvage Network
TIOP	Technology Installation and Operation Plan
UIDS	underwater intrusion device system
USAEC	U.S. Atomic Energy Commission
USNRC	U.S. Nuclear Regulatory Commission
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

The Clean Water Act (CWA) Section 316(b) Phase II rule requires the submittal of a Proposal for Information Collection (PIC) and applicable portions of a Comprehensive Demonstration Study (CDS) for the Florida Power & Light Company (FPL) St. Lucie Nuclear Power Plant (St. Lucie Plant). The PIC must be submitted to the Florida Department of Environmental Protection (FDEP) prior to the start of information collection activities.

This PIC provides a description of the information that will be used to support the CDS for the St. Lucie Plant. Section 2.0 provides a brief overview of the Section 316(b) Phase II regulatory requirements associated with the PIC and CDS process. Section 3.0 of this PIC provides a description of the St. Lucie Plant, cooling water intake structure(s) (CWIS), source waterbody, hydraulic zone of influence, and CWIS operation. A description of the current technologies and operational measures is provided in Section 4.0. Section 5.0 is a description of historical studies that were conducted to characterize impingement and entrainment at the St. Lucie Plant and its vicinity. Section 6.0 provides a description of the historical and planned consultations with fish and wildlife agencies. Section 7.0 describes the proposed impingement mortality and entrainment Sampling Plan for the St. Lucie Plant. Section 8.0 outlines the proposed 316(b) implementation schedule, and Section 9.0 is a list of references that is applicable to the PIC and CDS.

2.0 SECTION 316(B) COMPLIANCE REQUIREMENTS

The U.S. Environmental Protection Agency (EPA) has promulgated regulations under Section 316(b) of the CWA (Section 316(b) Phase II rule) that apply to the location, design, construction, and capacity of CWIS at existing facilities to ensure that CWIS reflect the best technology available (BTA) for minimizing adverse environmental impacts to aquatic organisms.

40 CFR Part 125 (Subpart J) establishes performance standards for applicable electric-generating facilities based on the type of waterbody in which the intake structure is located, the volume of water withdrawn, and the facility's capacity utilization rate. Aquatic organisms that are drawn into the CWIS can be either impinged (pinned against screens) or entrained (drawn into and through the cooling system and thereby subjected to thermal, physical, and/or chemical stresses). Based on design features and cooling water source for a facility, the performance standards (40 CFR Part 125.94(b)) require reductions in impingement mortality by 80 to 95 percent and/or entrainment by 60 to 90 percent, from a calculation baseline. For the St. Lucie Plant, which has a capacity utilization rate above 15 percent and withdraws more than 50 million gallons per day (MGD) of cooling water from the ocean, both impingement mortality and entrainment reductions are required.

Impacted facilities may choose one of five options for meeting the BTA requirements (40 CFR Part 125.94). These options are:

1) Demonstration that the facility has reduced or will reduce flow commensurate with closed-cycle recirculating cooling, and/or reduced maximum design intake velocity (through-screen) to 0.5 foot per second (fps) or lower.
2) Demonstration that the facility's existing design and construction technology, operational measures, and/or restoration currently meet the performance standards.
3) Selection and implementation of design and construction technologies, operational measures, or restoration measures that will meet specified performance standards.
4) Demonstration that a facility has installed and properly operates and maintains an EPA approved technology.
5) Demonstration that a facility qualifies for a site-specific determination of BTA because the costs of compliance (i.e., new technology, operational measures, and/or restoration measures) are either significantly greater than those considered by the Agency during the development of the rule or the facility's cost of compliance would be significantly greater than the environmental benefits of compliance with the performance standards. The rule

also provides that facilities may use operational and/or restoration measures in combination with or in lieu of technology to meet performance standards or in establishing BTA on a site-specific basis.

Should compliance with 40 CFR Part 125 (Subpart J) result in a potential conflict with a safety requirement established by the U.S. Nuclear Regulatory Commission (NRC), FPL would need to demonstrate that, based on consultation with NRC, a site-specific determination of BTA is needed in order to resolve this conflict [40 CFR 125.94(f)].

The Section 316(b) Phase II rule requires the submittal of a PIC, applicable portions of a CDS, and related information, pursuant to 40 CFR 122.21(r)(1), (r)(2), (r)(3), (r)(5), and 40 CFR 125.95.

The CDS consists of the following components:

1. PIC;
2. Source Waterbody Flow Information (not applicable to an ocean intake);
3. Impingement Mortality and/or Entrainment Characterization Study (IM & E Study);
4. Technology and Compliance Assessment Information:
    a. Design and Construction Technology Plan (DCTP),
    b. Technology Installation and Operation Plan (TIOP);
5. Restoration Plan (if restoration is proposed);
6. Information to Support Site-Specific Determination of BTA (includes cost – cost test and/or cost-benefit analysis); and
7. Verification Monitoring Plan.

The purposes of the CDS are to characterize the impact of the CWIS on the aquatic environment and 1) provide a determination of whether the facility meets the performance standards, and/or 2) recommend a basis for determining BTA for minimizing adverse environmental impact. The information from the CDS is required to characterize impingement mortality and entrainment; describe the operation of CWIS; and to confirm that the technology(ies), operational measures, and/or restoration measures currently meet or will meet the applicable performance standards.

The PIC is the first part of the CDS and is also the first regulatory submittal required. The PIC provides a description of the information that will be collected and used to support the CDS. Prior to the collection of new data, the PIC must be submitted to the FDEP for review and comment. The

Section 316(b) rule allows facilities to initiate field activities prior to receiving comment from the permitting agency (FDEP).

The Section 316(b) rule states that the PIC must provide the following information:

a) A description of the proposed and/or implemented technologies, operational measures, and/or restoration measures to be evaluated in the CDS (Section 4.0).

b) A list and description of any historical studies characterizing impingement mortality and entrainment and/or the physical and biological conditions in the vicinity of the cooling water intake structures and their relevance to the CDS. If the permittee proposes to use existing data, the permittee shall demonstrate the extent to which the data are representative of current conditions and that the data were collected using appropriate quality assurance/quality control (QA/QC) procedures (Section 5.0).

c) A summary of any past or ongoing consultations with appropriate fish and wildlife agencies that are relevant to the proposed CDS, and a copy of written comments received as a result of such consultations Section 6.0).

d) A sampling plan of study for any new field studies proposed to be conducted in order to ensure that the permittee has sufficient data to develop a scientifically valid estimate of impingement mortality and entrainment at the site. The sampling plan must document all methods and QA/QC procedures for sampling and data analysis (Section 7.0).

For completeness, this PIC also includes a description of the Plant, area, source water, CWIS, and applicable regulatory requirements. It should be noted that the PIC is a "living document" and as such will be periodically revisited and revised as necessary to reflect new information regarding guidance from EPA/State or as information from the field sampling studies is obtained that may warrant a change in the scope and/or direction.

2.1 REGULATORY OVERSIGHT

In 1995, the FDEP received delegation of the National Pollutant Discharge Elimination System (NPDES) permitting program from EPA Region IV. The FDEP has oversight and authority to issue NPDES permits for point source discharges to waters of the United States (U.S.). Issues related to NPDES permitting, including Section 316(a) and (b) of the CWA and implementation of the applicable state water quality standards, are addressed by the FDEP, Bureau of Water Facilities Regulations and Industrial Wastewater Section, located in Tallahassee, Florida.

Biological consultation and/or issues related to fish and wildlife and/or threatened and endangered species are addressed by the U.S. Fish and Wildlife Service (USFWS), located in Jacksonville, Florida; the Florida Fish and Wildlife Conservation Commission (FFWCC), located in Tallahassee, Florida; the National Marine Fisheries Service (NMFS) located in St. Petersburg, Florida; the U.S. Army Corps of Engineers (COE) located in Palm Beach Gardens, Florida; and the NRC located in Washington, DC.

3.0 ST. LUCIE PLANT

3.1 PLANT DESCRIPTION

The St. Lucie Plant (NPDES Permit Number FL 0002208) is located on a 1,132-acre site on Hutchinson Island in St. Lucie County, Florida. The plant consists of two nuclear-fueled electric-generating units, 890 megawatt (MW) each, with a total generation capacity of 1,780 MW. Unit 1 received an operating license in March 1976 and Unit 2 during April 1983. The St. Lucie Plant is located on the widest section of Hutchinson Island. The island is separated from the mainland on its western side by the Indian River Lagoon (IRL) and borders the Atlantic Ocean on the east (Figure 3-1). Annual St. Lucie Plant capacity utilization for the past 5 years was 95.1 and 91.3 percent for Units 1 and 2, respectively (Figure 3-2 and Table 3-1).

3.2 AREA DESCRIPTION

The source water for the St. Lucie Plant is the Atlantic Ocean (Figures 3-3 and 3-4). At the location of the St. Lucie Plant on Hutchinson Island, the edge of the continental shelf is approximately 21 miles offshore. Hutchinson Island is a barrier island that extends 22.5 miles between inlets (Ft. Pierce and St. Lucie Inlets) and attains a maximum width of 1.2 miles at the St. Lucie Plant site. The Florida Current, northern extension of the Gulf Stream, flows north approximately parallel to the shelf margin, and a weak counter current is usually present near shore. During the summer, the Florida Current meanders over the inner shelf causing near shore water temperatures to decrease below those typical for the time of year. Tidal range in the vicinity of St. Lucie Plant is about 3 feet (ft). Near shore, in the vicinity of the St. Lucie Plant, mean water depths typically range from 23 to 32 ft [National Oceanic and Atmospheric Administration (NOAA) Chart, 11472] and gradually increase to the east.

3.3 SOURCE WATER DESCRIPTION

3.3.1 ATLANTIC OCEAN

The Atlantic Ocean is the source waterbody for the St. Lucie Plant and lies to the east of Hutchinson Island and the St. Lucie Plant. The bottom topography of the ocean gently slopes to a depth of 40 ft, and then rises to approximately 21 ft at Pierce Shoal approximately 1 mile offshore. The coastal waters offshore of Hutchinson Island respond to a large field of motion including variations in the Florida Current. The currents are generally oriented parallel to the shoreline. Longshore currents predominantly run south at about 0.6 fps; however, during periods of direction reversal, a northerly current flows at about 0.2 fps. Maximum south and north currents are 1.3 and 0.7 fps, respectively. Diving surveys indicate the bottom sediment is coarse sand and contains shell fragments. No outcroppings, reefs, or grasses were reported within 6 miles of the St. Lucie Plant site. The benthos is diverse, but does not include a significant number of commercially valuable species [U.S. Atomic Energy Commission (USAEC, 1974)].

3.3.2 INDIAN RIVER LAGOON

Hutchinson Island is separated from the mainland by the IRL, a long shallow, tidally influenced lagoon. Its geographic location along the transition zone between warm-temperate and subtropical climates combined with its large size (156 miles) and diverse physical characteristics make it an estuary of high biological productivity. Along the north side of the St. Lucie Plant site lays Big Mud Creek, an inlet off the IRL (Figures 3-3 and 3-4). Big Mud Creek, a backwater cove, is shallow (less than 3 ft deep) and receives surface and subsurface runoff resulting from precipitation on Hutchinson Island. During plant construction, portions of the cove were dredged to a maximum depth of 46 ft. Tidal exchange in the IRL in the vicinity of the Plant is minimal due to its considerable distance from the Ft. Pierce and St. Lucie Inlets, the constricted entrances to the river, as well as its shallow nature (Ecological Associates, Inc., 2001). Running north-south through the IRL is the Intracoastal Waterway, a navigation channel dredged to a depth of 6 to 12 ft. The Plant site and Big Mud Creek are approximately mid-way between the inlets at either end of the island and, therefore, in the region of least tidal exchange. No major streams enter the IRL in the area, and freshwater runoff is primarily associated with seasonal heavy rainfall. Thus, the salinity of the IRL can vary greatly over short periods of time. Tidal range in the IRL in the vicinity of the St. Lucie Plant is about 1 ft.

Although the St. Lucie Plant ultimately selected the Atlantic Ocean as its source for cooling water, the original plant design called for the main CWIS to withdraw its cooling water from the IRL through Big Mud Creek. The original plan to use the IRL as a source of cooling water was eliminated after studies indicated that the area was highly productive and a significant nursery area for many species important to the area. FPL's final decision was to move the intake to the Atlantic Ocean even though considerable expense was involved in this major design change. Today, Big Mud Creek is an emergency water source to be used only for safe shutdown of the St. Lucie Plant under emergency conditions. The emergency intake system is tested at least four times a year; however, full-scale use has never occurred.

3.4 CWIS CONFIGURATION

The condenser cooling water system for the St. Lucie Plant is a once-through system with an intake and discharge in the Atlantic Ocean. Design intake flow is 1,026,000 gallons per minute (gpm) or 1,477 MGD. The major components of the CWIS include:

1. Three ocean intake structures and associated velocity caps (Figures 3-3 and 3-4);
2. Three submerged intake pipes to transport water from the intake structures to the intake canal;
3. An intake canal to convey water to each unit's intake well; and
4. Individual unit trash racks (coarse bars) and traveling screens (Figure 3-5).

Prior to Plant operation, the EPA, through deliberations with FPL and several government agencies, made a positive BTA determination for the St. Lucie Plant intake system. The BTA determination, based upon the requirements that were in effect at that time, is provided in a St. Lucie Nuclear Plant, 316(b), Finding for Best Technology Available, dated August 15, 1981. On January 29, 1982, the BTA finding was supplemented and substantiated by EPA for the addition of the third cooling water pipeline. The BTA finding has been upheld with each subsequent issuance of the facility's water discharge permit.

3.4.1 OCEAN INTAKE STRUCTURES

Cooling water is withdrawn from the Atlantic Ocean through three submerged intake structures located 1,200 ft offshore (Figures 3-3 and 3-4). Each structure consists of a concrete housing (including the velocity caps), a vertical shaft in the center, and large-diameter piping connected to the base of the structure for transporting water to the Plant (Figures 3-6, 3-7, and 3-8). Two intake structures house 12-ft-inner-diameter intake pipes and a third intake structure houses a 16-ft-inner-diameter intake pipe. These intake structures supply cooling water for Units 1 and 2 through a common Intake Canal. The tops of the velocity caps are approximately 7 ft below the water surface at mean low tide (NRC, 2001) (Figure 3-7).

3.4.2 VELOCITY CAPS

A velocity cap is a device that is placed over a vertical inlet at an offshore intake. The cap converts vertical flow into horizontal flow at the entrance to the intake. The device works on the premise that fish will avoid rapid changes in horizontal flow but are less able to detect and avoid vertical velocity vectors. Velocity caps have been installed at many offshore intakes and have usually been successful in minimizing impingement. The location of the velocity caps at mid-depth also help reduce entrainment at the St. Lucie Plant, based on data demonstrating that ichthyoplankton densities are much lower at mid-depth than at the ocean surface.

Each of the three Atlantic Ocean intake structures is fitted with a velocity cap, which consists of large flat plates positioned 6 to 7 ft above the vertical shaft of the intake structure. The horizontal intake velocity was calculated to be approximately 0.4 fps for the two 12-ft-diameter pipes and 1 fps for the 16-ft-diameter pipe (NRC, 1982). The velocity cap for the 16-ft-diameter pipe is 70 ft square, 5 ft thick, and has a vertical opening of 6.25 ft. The velocity cap for each of the two 12-ft-diameter pipes is 52 ft octagonal, 5 ft thick, and has a vertical opening of 6.5 ft (Figure 3-7).

3.4.3 SUBMERGED INTAKE PIPES

Each intake pipeline is buried for the entire length and equipped with a velocity cap to minimize fish impingement and entrapment (Figure 3-8). Water passes under the velocity caps and into the submerged pipes, which are beneath the sea floor, beach, and dunes, and terminate at two headwalls located on the eastern end of an L-shaped common intake canal (Figures 3-3, 3-4, 3-6, and 3-8).

3.4.4 INTAKE CANAL

The intake canal is 300 ft wide with two intake headwalls (Figures 3-3 and 3-4). The L-shaped intake canal, with a maximum depth of 25 ft, transports cooling water for approximately 5,000 ft to the Plant intake structure on the west side of Units 1 and 2.

A 5-inch mesh barrier net with support structures is located just downstream of the intake headwalls to reduce sea turtle residence times in the intake canal. The net is designed to confine turtles (i.e., small green turtles) with a carapace greater than 7 inches into the extreme eastern portion of the canal. The net was designed to withstand unusual events such as drift seaweed and algae, jellyfish, and siltation and, therefore, reduce the potential for sea turtle mortality.

A second barrier net is located near the A1A Bridge. This backup net, will also confine turtles to the easternmost section of the intake canal for capture and release. This net is constructed of large-diameter polypropylene rope and has a mesh size of 8 inches x 8 inches. A cable and series of large floats are used to keep the top of the net above the water's surface, and the bottom is anchored by a series of concrete blocks. The net is inclined at a slope of 1:1, with the bottom positioned upstream of the surface cable. Improvements made to the A1A barrier net in 1990 resulted in confinement of all turtles larger than 12.8 inches carapace length (11.3 inches carapace width) to the eastern end of the canal. Another net, which consists of a large barrier positioned perpendicular to the north-south arm of the canal, is also in place and will assist in constraining turtles if they pass through the A1A barrier net. This net has a mesh size of 9 inches x 9 inches (FPL, 2003).

3.4.5 EMERGENCY WATER INTAKE

An emergency water intake structure that consists of two 54-inch pipes/valves allows water to flow into the intake canal from Big Mud Creek, a cove off the IRL (Figures 3-3 and 3-4). The emergency intake is required in the event that insufficient flow is available for the shutdown of the St. Lucie Plant. To assure that the emergency system is operational, the system is tested at least quarterly. The test consists of opening and closing each valve in each 54-inch diameter pipe for a period of less than 1 minute. Depending on the head differential between the intake canal and Big Mud Creek, approximately 100,000 gallons per valve per test flows from Big Mud Creek into the intake canal.

3.4.6 TRASH RACKS

Each unit has a separate intake structure consisting of four bays (intake wells) that are located at the far end of the intake canal (Figure 3-3). Each bay contains trash racks (grizzlies) that are vertical bars, with approximately 3-inch spacing, to catch large objects. Trash rakes clean the trash racks, and debris collected from the trash racks empties into a debris trough (Figure 3-5).

3.4.7 INTAKE TRAVELING SCREENS

Traveling screens with a 3/8-inch mesh are installed upstream of the circulating water pumps that take suction from each of the eight bays, four per unit (Figure 3-5). The traveling screen spray wash removes debris and aquatic organisms from the rotating screens and discharges them through a trough into a debris collection area.

3.4.8 CIRCULATING AND AUXILIARY WATER PUMPS

The plant utilizes eight single-stage circulating water pumps (four per unit) which have a nominal total capacity of 968,000 gpm (1,394 MGD) to supply cooling water to Units 1 and 2 (Figure 3-5). In addition to once-through cooling, the Plant has an emergency water intake structure. This structure has two 54-inch pipe/valves available to be used in the event that insufficient flow is available for the shutdown of the nuclear power plant. Six auxiliary pumps are capable of pumping 14,500 gpm each. With a normal configuration of two auxiliary pumps per unit in operation, the auxiliary pumps have a nominal flow capacity of 58,000 gpm (83 MGD) of cooling water through the auxiliary equipment. Figure 3-9 is the 2004 annual flow diagram for the St. Lucie Plant.

Pumps/Unit	Pump Capacity
Circulating Pumps	
Unit 1 (4)	4 bays @ 121,000 gpm
Unit 2 (4)	4 bays @ 121,000 gpm
Auxiliary Pumps (6)	58,000 gpm
Total Nominal Flow	**1,026,000 gpm (1,477 MGD)**

3.4.9 AREA OF INFLUENCE

The Hydraulic Zone of Influence (HZI), sometimes called the "area of influence" [40 CFR 122.21(r)(2)(ii)], the "zone of potential involvement" (EPA, 1977), or simply the "zone of influence," is that portion of the source water body that is hydraulically affected by the withdrawal of water by the CWIS. The HZI defines the source area for small, weakly motile or planktonic organisms that are easily entrained. This area of influence has little or no implication for larger fish that can swim away from the CWIS-induced flow. Conceptually, the HZI line is the dividing line between water that is influenced primarily by ambient wind-induced and tidal currents and water that is primarily influenced by flow to the intake. The HZI model provides an estimate of the approximate distance to the point where the ambient tide and wind-induced currents can be expected to dominate the flow patterns. Inside the line of the HZI, the probability of hydraulically influencing weakly motile or planktonic organisms is high; outside the HZI, the probability is lower.

The radial distance of the HZI line within the Atlantic Ocean is determined by continuity, using the formulas provided in Appendix A. The maximum radial distance to the stagnation point limit or dividing line of the HZI within the Atlantic Ocean (i.e., the "R_{HZI}" dimension in Table 3-2, Figure 3-10, and the Appendix A definition sketch) is determined using potential flow theory by equating the mean ambient source water velocity to the velocity that would be induced by the intake in still water. Appendix A provides a description of how the HZI is calculated in an open body of water and provides a definition sketch showing the relationship of the variables involved in each calculation.

The St. Lucie Plant HZI within the Atlantic Ocean has been calculated using the input values described below:

1. Design intake flow conditions:
   a) Maximum design intake flow for CWIS 12A = 392 MGD or 606.5 cubic feet per second (cfs),
   b) Maximum design intake flow for CWIS 12B = 392 MGD or 606.5 cfs, and
   c) Maximum design intake flow for CWIS 16A = 695 MGD or 1,075.3 cfs.
2. A mean depth within the HZI of the Atlantic Ocean at $\boldsymbol{R_{HZI}}$ is 24 ft.
3. Two ambient mean velocity conditions, which generate two HZI scenarios:

   $V_{ma} = 0.1$ fps (scenario 1), and

   $V_{ma} = 0.3$ fps (scenario 2).

The location of the HZI line within the Atlantic Ocean will change slightly with varying withdrawal amounts, tide levels, and velocities and, therefore, will vary with time (Figure 3-10). Because the total depth of water at the intake structure is relatively deep (24 ft) compared to the magnitude of tidal fluctuations, tide levels will have relatively small effects on the HZI line. The maximum radial distance, $\boldsymbol{R_{HZI}}$, values associated with 1) maximum design intake flows of 392 MGD (606.5 cfs) for CWIS 12A and CWIS 12B and 695 MGD (1,075.3 cfs) for CWIS 16A, 2) a mean depth of 24 ft, and 3) a mean ambient wind-/tidal-induced velocity of 0.1 fps, are 40 ft for CWIS 12A and 12B, and 71 ft for CWIS 16A. Consequently, outside the HZI line defined by these conditions, the probability of hydraulically influencing non-motile organisms remains low most of the time (Figure 3-10 and Table 3-2). The minimum radial distance, R_{HZI}, values associated with 1) maximum design intake flows for CWIS 12A, CWIS 12B, and CWIS 16A; 2) a mean depth of 24 ft; and 3) a mean ambient wind/tidal-induced velocity of 0.3 fps are 13 ft for CWIS 12A and 12B, and 24 ft for CWIS 16A. Consequently, inside the HZI line defined by these conditions, the probability of hydraulically influencing non-motile organisms remains high most of the time. Between these extremes, the probability of hydraulically influencing non-motile organisms is moderate and variable depending primarily on tidal conditions.

An IRL/Big Mud Creek HZI was also estimated (Figure 3-11 and Table 3-3). The St. Lucie Plant HZI within the IRL/Big Mud Creek has been calculated using the input values described below:

1. Design intake flow conditions - maximum current design intake flow of 2,288.3 cfs;
2. A mean depth within the HZI in the IRL/Big Mud Creek at $\boldsymbol{R_{HZI}}$ is 4 ft; and
3. Two ambient mean velocity conditions, which generate two HZI scenarios:

   $V_{ma} = 0.1$ fps (scenario 1), and

   $V_{ma} = 0.3$ fps (scenario 2).

Figure 3-11 illustrates the HZI estimated for an intake in Big Mud Creek. The location of the HZI line within the IRL would have changed slightly with varying withdrawal amounts, tide levels, and velocities, and therefore, would have varied with time (Figure 3-11). Because the magnitude of tidal fluctuations in IRL is relatively small it is not expected to significantly affect the HZI line. The maximum radial distance, R_{HZI}, value associated with 1) maximum design intake flow of 1,477 MGD (2,288.3 cfs), 2) a mean depth of 4 ft, and 3) a mean ambient wind-/tidal-induced velocity of 0.1 fps, is 1,818 ft. Consequently, outside the HZI line defined by these conditions, the probability of hydraulically influencing non-motile organisms remains low most of the time (Table 3-3 and Figure 3-11). The minimum radial distance, R_{HZI}, values associated with 1) maximum design intake flow of 1,477 MGD (2,288.3 cfs), 2) a mean depth of 4 ft, and 3) a mean ambient wind/tidal-induced velocity of 0.3 fps, is 606 ft. Consequently, inside the HZI line defined by these conditions, the probability of hydraulically influencing non-motile organisms remains high most of the time. Between these extremes, the probability of hydraulically influencing non-motile organisms is moderate and variable depending primarily on tidal conditions.

It should be noted that this calculation was made using the existing station intake flow rate; however, the flow rate for the calculation baseline would be larger (see Subsection 4.2.5).

3.5 COOLING WATER SYSTEM DATA

The once-through cooling water leaves the condensers through a buried pipeline for 500 ft to the discharge canal. Flow from both Units is combined in the discharge canal (Figures 3-3 and 3-4). The canal is 200 ft wide and extends approximately 1,735 ft to a point 400 ft west of the shoreline. The discharged water is carried in two concrete pipes buried under the beach and ocean floor out to the ocean discharge structures, located 1,200 ft out from the shoreline.

3.6 REGULATORY REQUIREMENTS AND PERFORMANCE STANDARDS

NPDES Permit Number FL0002208 authorizes the operation of a "once-through cooling water system" at the St. Lucie Plant. Under the laws and regulations that have been in effect, the CWIS at St. Lucie have been found by the EPA to be BTA and this determination has been upheld for each issuance of the water discharge permit. However, as an existing facility under the new 316(b) Phase II rule and since the St. Lucie Plant withdraws water for cooling purposes from the Atlantic Ocean, it is required to meet the new numerical performance standards for both impingement mortality and entrainment.

4.0 EXISTING AND PROPOSED TECHNOLOGY, OPERATIONAL, AND/OR RESTORATION MEASURES

4.1 APPLICABLE PERFORMANCE STANDARDS

The St. Lucie Plant is required to demonstrate that it has or will reduce impingement mortality by 80 to 95 percent and entrainment by 60 to 90 percent from the calculation baseline. The definition of calculation baseline "means an estimate of impingement mortality and entrainment that would occur at your site assuming that the cooling system has been designed as a once-through system..." In the preamble to the final rule [Federal Register (FR) Vol. 69, No. 131, page 41595, July 9, 2004), EPA states that the definition of the calculation baseline "recognizes and provides credit for any structural or operational controls, including flow or velocity reductions, a facility has adopted that reduce impingement mortality or entrainment."

The calculation baseline location for the St. Lucie Plant has been selected based upon the original design to locate the CWIS on the IRL (at Big Mud Creek). As provided in *The Final Environmental Statement for St. Lucie Plant Unit No. 1* (USAEC, 1973), "Indian River (Big Mud Creek) could be used as a source of cooling water for the Plant with discharge to the Atlantic Ocean. The Plant was originally designed for such a system (see Figure XI-1 of USACE, 1973). However, the plan was altered prior to issuance of a construction permit because of possible adverse effects on the ecological balance in the Indian River."

4.2 EXISTING TECHNOLOGY, OPERATIONAL, AND/OR RESTORATION MEASURES

The St. Lucie Plant is subject to the CWA, Section 316(b) impingement mortality and entrainment reduction performance standards. The regulations require that the location, design, construction (technology and configuration) and capacity of the CWIS reflect BTA for minimizing impacts to aquatic organisms. These measures have been considered by FPL in the past and have been incorporated in the design of the St. Lucie Plant. Consequently, FPL believes that it has already implemented the measures necessary to comply with the new 316(b) BTA performance standards [40 CFR 125.94(a)(2)].

4.2.1 TECHNOLOGY AND OPERATIONAL MEASURES

The implemented technologies and operational measures that will be documented in the CDS are as follows:

- Final design location of the CWIS in a lower impact area than the original design (calculation baseline) location:
  - CWIS placement 1,200 ft offshore in the Atlantic Ocean; and
  - CWIS with mid-depth water withdrawal.
- Use of velocity caps.
- Reduction in source water capacity (intake flow volumes).
- Barrier nets:
  - Fish capture and release program, and
  - Turtle capture and release program.
- Protection and restoration.

4.2.2 LOCATION OF CWIS INTAKE

One of the most effective methods for reducing both impingement and entrainment is to locate the Plant CWIS intake in an area with low source aquatic organism density. This has been done at the St. Lucie Plant by locating the Plant's intakes in the Atlantic Ocean instead of Big Mud Creek/IRL (USAEC, 1973). The Plant intakes are located 1,200 ft offshore and at mid-depth within the water column. This location minimizes the entrainment of aquatic organisms, as the mid-depth offshore regions have limited ichthyoplankton densities (Applied Biology, Inc., 1982). Additionally, each intake structure has a velocity cap, and this technology has been demonstrated to significantly reduce impingement/entrainment of larger aquatic organisms into the CWIS and, thus, further reduces potential impingement on the Plant screens.

The St. Lucie Plant (Unit 1) was originally designed to have its CWIS located off the IRL in Big Mud Creek. The USAEC (1973) Final Environmental Statement stated that although locating the CWIS in Big Mud Creek had some postulated environmental benefits, such as increased water circulation in the IRL due to the probability of having substantially more entrainment and impingement of aquatic organisms in the IRL, FPL selected a higher cost alternative and relocated the Plant's primary CWIS to an offshore location in the Atlantic Ocean. The CWIS pipelines were constructed below the ocean floor with intakes at a location 1,200 ft offshore. These ocean intakes were designed with velocity caps to further minimize fish entrainment and impingement.

The Final Environmental Statement for St. Lucie Plant Unit No. 1 (USAEC, 1973) documents the fact that once-through cooling with an intake in the IRL (Big Mud Creek) was the originally planned location and configuration. This document also discusses the fact that the decision to move the intake to the Atlantic Ocean was made to reduce entrainment and damage to organisms (impingement), and not for economic advantage (Section XI.A.4.f of USAEC, 1973).

Section 125.94(a)(2) of the final Section 316(b) Phase II rule provides an alternative for establishing BTA for minimizing adverse environmental impact. This section of the rule clearly demonstrates what EPA intended, and the rule is designed to give credit for the existing design and construction technologies that facilities may have implemented prior to promulgation of the final rule.

> "You may demonstrate to the Director that your existing design and construction technologies, operational measures, and/or restoration measures meet the performance standards specified in paragraph (b) of this section and/or the restoration requirements in paragraph (c) of this section."

The intake location in the Atlantic Ocean is an integral part of the existing design and construction technology that was used by FPL to achieve BTA by reducing adverse environmental impact. It is clear from the above discussion that FPL's St. Lucie Plant should receive credit for the previous environmentally beneficial decision to locate and construct the existing cooling water intakes in the Atlantic Ocean, and not in the IRL, as originally proposed.

In the context of the final 316(b) Phase II rule, the potential "credit" for the location of the CWIS offshore in the Atlantic Ocean will be determined through the field sampling program by using the IRL as the source waterbody for the "calculation baseline" for the impingement and entrainment reduction calculations. This is consistent with the approach EPA used in developing the Phase II rule.

The CDS will provide a matched set of source water data for the IRL and for the Atlantic Ocean in the vicinity of the St. Lucie Plant. The data sets will quantify aquatic resources within the IRL and Atlantic Ocean waterbodies and will be concurrent, with the same sampling frequency, similar replication, similar field sampling methodologies (if possible), and similar levels of quality assurance/quality control (QA/QC) in order to provide an accurate data set from which to calculate entrainment and impingement reduction credits. Entrainment and impingement reduction calculations will be estimated by comparing the IRL and Atlantic Ocean densities and composition.

Section 7.0 of this PIC presents a detailed sampling plan for Big Mud Creek/IRL and the Atlantic Ocean in the vicinity of the Plant intakes. The IRL in the vicinity of the Plant would have been influenced by Plant operations if the intake had been located in Big Mud Creek, this potential area of influence was described in Section 3.0 and Figure 3-11. Concurrently, the area in the vicinity of the offshore intakes in the Atlantic Ocean that is hydraulically influenced by the Plant will also be sampled.

4.2.3 MID-DEPTH OFFSHORE INTAKES

An additional benefit of the current technology is the location of the intakes at mid-depth and offshore, as opposed to near the surface and near the shore. Fish and shellfish eggs and larvae have been shown to concentrate near the ocean surface, with lower densities at the depth of the CWIS (Applied Biology, Inc., 1983). Therefore, it is anticipated that because of the current configuration, there is a reduced level of entrainment at mid-depth compared to an intake near the surface.

4.2.4 VELOCITY CAP

Concurrent with the field biological sampling, a literature review of the efficacy of velocity caps in reducing impingement will be evaluated using published literature and information from other plants that employ this technology. It is expected that the reduced flow velocity and the change in flow direction (from vertical to horizontal) caused by the velocity caps reduce the number of fish and shellfish drawn into the intake structure. A body of literature exists for velocity caps documenting their success in reducing impingement, and this literature will be discussed thoroughly in the CDS as part of the BTA discussion.

4.2.5 INTAKE FLOW REDUCTION AND TEMPERATURE CONSIDERATIONS

The decision to locate the intake of the St. Lucie Plant in the Atlantic Ocean, in lieu of Big Mud Creek/IRL, provides for the use of the cooler Atlantic Ocean waters as the Plant's source water. This allows the Plant to operate at a higher discharge delta-T with less cooling water use (reduced flow) than would have been required if surface water was withdrawn from the warmer waters of Big Mud Creek. This will also be evaluated further in the CDS to determine the potential reduction in impingement and entrainment that has occurred because of the reduced volume of water currently used, relative to the volume of water that would have been required if Big Mud Creek was the source water.

4.2.6 BARRIER NETS

Barrier nets are currently used in the intake canal as a mitigation device for the sea turtle return program.

4.2.7 ENTRAPMENT IN THE INTAKE CANAL

FPL has implemented an ongoing fish tagging, capture, and release program in the intake canal as an operational measure. This information will be used to evaluate the numbers and/or biomass of fish and shellfish returned to the marine environment by current Plant operations. Based on initial review of data from this capture and release program, it appears to have a good success rate as demonstrated by the percentage of fish tags returned.

4.3 SUMMARY

Figure 4-1 illustrates the compliance flow path for the FPL St. Lucie Plant. The objective of the field biological program described in this PIC will be to demonstrate that the previous actions/decisions that reflected BTA when the Plant was constructed, including the additional Unit (Unit 2) technologies (offshore intake and velocity caps), still meet BTA under the current Section 316(b) rule language. In other words, the biological sampling program proposed is a Verification Monitoring Program.

If verification monitoring does not show that the plant is meeting the performance standards applicable to the Plant, then this PIC can be revised to reflect the additional technologies/operational measures and/or restoration measures that will be considered. The revised PIC would describe how these measures will be evaluated and discuss the alternative(s) that will be used in the CDS.

4.4 EPA MODEL TECHNOLOGY

The EPA identified the applicable performance standard and what it considered "as the most appropriate compliance technology" for meeting the applicable performance standards for several facilities in Appendix A of the final Section 316(b) rule. The EPA also provided cost data for what it considered "as the most appropriate compliance technology" for meeting the applicable performance standards for several facilities in Appendix A of the final rule. In the same appendix, some facilities were identified with "N/A" in the assumed design intake flow column. For these facilities, the EPA projected that they "would already meet otherwise applicable performance standards based on existing technologies and measures" (FR, Volume 69, No. 131, July 9, 2004, Page 41646). EPA projected zero compliance costs for these facilities. Consequently, these facilities should use $0 as their value for the costs considered by EPA for a like facility in establishing the applicable performance standards" (*ibid*). For the St. Lucie Plant, the EPA projected "N/A" for the model technology and "$0" for the compliance cost. Therefore, it is presumed that the EPA projected that the St. Lucie Plant "meets the applicable performance standards based on existing technologies and measures."

5.0 ECOLOGICAL STUDIES AND HISTORICAL IMPINGEMENT MORTALITY AND ENTRAINMENT STUDIES

This section presents regional information for the IRL as well as studies conducted in the Atlantic Ocean and intake canal of the St. Lucie Plant.

5.1 INDIAN RIVER LAGOON SYSTEM

The IRL system is part of the longest barrier island complex in the United States, occupying over 30 percent of Florida's east coast. The IRL system is a narrow, tidally influenced estuarine lagoon system extending approximately 156 miles from the Ponce de Leon Inlet in Volusia County to the Jupiter Inlet in Palm Beach County. The IRL system actually consists of three lagoons: the Mosquito Lagoon, the Banana River, and the IRL.

The width of the IRL varies from a few meters at New Smyrna Beach to over 5 miles north of Titusville. The average depth of the IRL is approximately 5 ft, but dredged areas of the Intracoastal Waterway (ICW) may range from 6 to 12 ft. Several low-gradient rivers, creeks, and canals discharge into the IRL. The rivers and canals generally have locks that are opened or closed depending on inland conditions. The salinity in the IRL varies, depending on rainfall, discharge from the freshwater systems, ocean exchange, and evaporation. The average mean annual salinity in the IRL is about 27 parts per thousand (ppt) (Gilmore *et al.*, 1981). Hyper-saline conditions (up to 40 ppt) can occur in open waters of the lagoon during the dry season. Major freshwater sources may lower salinities considerably during the wet season at the location of entry into the IRL. For example, salinity levels have been observed to drop markedly (from 23 to 0.2 ppt) when the St. Lucie Canal locks are opened (Gilmore *et al.*, 1981). Water temperature within the lagoon is generally controlled by air temperature. Water temperature affects fish distribution within the lagoon, with subtropical and tropical fishes being found toward the southern end of the system. Coquina, or "worm rock," formations are found on the shore of the IRL and on the ocean side of the barrier islands and provide habitat for a variety of species.

5.2 RECENT STUDIES IN THE VICINITY OF THE ST. LUCIE PLANT

Several institutions and agencies are currently conducting, or have conducted, ecological studies in the vicinity of the St. Lucie Plant. The FFWCC's Fisheries-Independent Monitoring Program has sampled numerous sites along the lagoon shoreline in the vicinity of the St. Lucie Plant (Figure 5-1).

The Fisheries Independent Monitoring Program was initiated in 1985 to monitor the relative abundance of fishery resources in Florida's major estuarine, coastal, and reef systems. Sampling began in the southern IRL, from Vero Beach south to Jupiter Inlet in 1997. Shoreline locations are sampled using a 183-meter (m) center-bag haul seine with 37.5-millimeter (mm) stretch mesh. Large fish are the target of this study and generally only fish that are 100 mm or greater standard length are captured. In 2003, the Fisheries Independent Monitoring Program captured 32,089 fish and invertebrates. One hundred and seven (107) fish taxa and 4 invertebrate taxa were represented in the 192 samples collected. The most dominant species in the 2003 southern IRL collections were pinfish, Irish pompano, white mullet, and Atlantic thread herring.

The Harbor Branch Oceanographic Institution (Harbor Branch) and the Smithsonian Marine Station are both located in Ft. Pierce and have completed extensive research in the IRL. The Smithsonian Marine Station specializes in studying the marine biodiversity and ecosystems of Florida, with a focus on the IRL and offshore environments. The Smithsonian Marine Station has created an IRL Species Inventory and a Field Guide to the IRL. From 1971 to 1981, Harbor Branch (co-funded by FPL) conducted over 2,000 collections in the IRL, its freshwater tributaries, and nearshore reefs in an effort to qualitatively asses the estuarine and faunal diversity. The results of these collections were summarized in *Fishes of the Indian River Lagoon and Adjacent Waters* (Gilmore *et al*., 1981). These studies were primarily carried out to develop a list of fishes in IRL habitats, and this study provided regional descriptions and checklists of fishes in this region. The status of the fish populations or the quality of the fish habitats in the IRL was not addressed.

5.3 SUMMARY OF HISTORICAL ECOLOGICAL STUDIES

Operational monitoring for Unit 1 and pre-operational monitoring for Unit 2 was designed to assess aquatic impacts associated with the operation of the St. Lucie Plant, and was required by the Plant's NRC Environmental Protection Plan and the EPA NPDES permit. The objective of the regulatory requirements, and of the studies, was to assess the effects of Plant construction and operation on the major biotic communities in the nearshore marine environment. These studies included water quality, phytoplankton, zooplankton, aquatic macrophytes, periphyton, macroinvertebrates (shellfish), fish, and sea turtles. Monitoring commenced in 1976 coincident with Unit 1 startup; and monitoring was no longer required after 1983, as it was demonstrated that Unit 1 operations were not having a substantial, persistent, or widespread effect on aquatic resources (Applied Biology, Inc., 1984). Most studies were conducted prior to Unit 2 becoming operational. Presented below are brief summaries of the studies conducted from 1977 to 1983, and an evaluation of their relevance to the calculation baseline.

5.3.1 COMMERCIAL SHELLFISH IN THE NEARFIELD OF THE PLANT

Commercial shellfish populations were assessed using gill nets, trawls, and beach seines in the Atlantic Ocean. Offshore stations were positioned near the CWIS (velocity caps). Very small numbers of shellfish were collected, and no spatial pattern could be discerned. Thus, it was concluded that the nearshore area in the vicinity of the St. Lucie Plant does not appear to provide suitable or preferred habitat for these shellfish species.

5.3.2 ASSESSMENT OF FISH THAT ARE POTENTIALLY IMPINGEABLE

Studies of regional fishes and fish eggs/larvae were conducted as part of the operational monitoring at the St. Lucie Plant to assess potential impacts on recreational and commercial fisheries and to evaluate potential mortality in local and migratory fish populations through entrainment and impingement of eggs and larvae. Compilation of fish records for the IRL and adjacent waters were developed and published (Gilmore *et al.*, 1981).

Operational studies for Unit 1 began in March 1976 and ended in 1983. The purpose of these fish studies were to:

1. Sample the intake screens;
2. Sample the intake canal for juvenile and adult fish;
3. Sample the intake canal and offshore habitats for fish eggs and larvae; and
4. Sample at the beach and offshore locations for juvenile and adult fish.

Paired plankton nets (Bongo nets) were used to collect ichthyoplankton; gill nets were used in the intake canal; and ocean stations were sampled using beach seines, gill nets, and trawls. Samples were collected in the intake canal and from offshore stations (additional samples were taken in the vicinity of the discharge, and are not discussed or relevant to this PIC). Canal gill netting was conducted to assess fish entrapment in the intake canal. Catch records by gear and station showed considerable year-to-year variation in the number of fish inhabiting nearshore waters adjacent to the St. Lucie Plant. An overall analysis of the data showed no significant variations that could be attributable to the Plant (Applied Biology, Inc., 1983). Notable species in the offshore catches included Atlantic bumper, Spanish and king mackerels, bluefish, Atlantic croaker, spot, cobia, weakfish, sheepshead, snook, pigfish, pompano, jacks, menhaden, sardines, anchovies, and herring.

Intake Screens Impingement Studies

Fish impingement studies were conducted from 1976 to 1978 twice weekly, over a 24-hour period divided into 8-hour samples.

In 1977, the predominant fishes collected were members of the grunt family and anchovy. The grunt family comprised 50.3 percent of the total fish collected and 21.1 percent of the biomass. Jacks accounted for 4.7 percent of the total fish impinged and 40.9 percent of the biomass. Anchovies comprised 28 percent of the total number of fish collected and 3.1 percent of the biomass. Fish other than the above occurred in relatively low numbers. Based on the sample size in 1977, the extrapolated total fish impinged were 74,754 individuals and would have been 80,612 individuals if the Plant was on-line for 365 days.

A total of 7,202 commercially important shellfish were impinged in 1977. Shrimp comprised 88.7 percent of the total number collected and 42.1 percent of the biomass. Blue crabs accounted for 10.1 percent of the total number of shellfish impinged and 54.9 percent of the biomass. Based on the sample size in 1977, the extrapolated total shrimp impinged was 22,110 and would have been 23,840 if the Plant was on-line for 365 days.

The results of the 1978 impingement study showed the predominant fishes were anchovies, jacks, croaker, and mojarras. Anchovies made up to 18.2 percent of the total number of fishes collected and 1.7 percent of the total biomass. Jacks accounted for 15 percent of the total number of fishes collected and 20.7 percent of the biomass. Croakers (drum) made up 14.5 percent of the total fishes and 5 percent of the biomass and mojarras accounted for 12.5 percent. In 1978, the extrapolated total fish impinged were 27,385 individuals and would have been 33,696 individuals if the Plant was on-line for 365 days.

A total of 8,539 shellfish of commercial importance were impinged during 1978. Shrimp made up 84.1 percent of the catch and 53.3 percent of the biomass, blue crabs made up 15.6 percent and stone crab and spiny lobster made up 0.3 percent of the total numbers impinged. Extrapolated shrimp impingement was 4,702 while the Plant was in operation and would have been 31,200 individuals if the Plant was on-line for 365 days. Blue crab impingement was 4,702 when the Plant was operating and would have been 6,790 individuals if the Plant was on-line for 365 days.

Canal Gill Nets

Monthly gill net collections were taken at two stations in the intake canal to evaluate fish entrapped in the intake canal. Both stations were located between A1A and the plant intake screens. The gill nets were 61 m long by 3 m deep, and were constructed of 76-mm stretch mesh. At each station, a net was set on the bottom, completely spanning the canal. Sampling was conducted over a continuous 24-hour period. After each 24-hour period, the specimens were removed from the nets and identified by species, counted, measured, and weighed.

According to Applied Biology, Inc. (1983), the intake canal gill netting data showed that fish were not accumulating there. The average catch rate over the 8-year program ranged from 3.5 to 12.5 fish per 30 m of net per day (Figure 5-2). For all fishes collected during the 8 years combined, grunts accounted for about 20 percent of the gill net catch; followed by snapper, jacks, porgies, and drum at 12 to 13 percent; and catfish, mullet, and searobin at 4 to 6 percent (Figure 5-3). These fish are all common in the nearshore habitats off of Hutchinson Island. In contrast to the number of fish collected during the ocean studies in the vicinity of the intakes, the number of fish entrapped in the intake canal was low.

This low entrapment was attributed primarily to the velocity caps at the ocean intakes. These appeared to be effective in enabling fish to avoid being drawn into the intake pipes. Several of the fishes collected in the intake canal, such as snappers, sheepshead, drum, and mullet, were species of sport and commercial importance. However, the loss of these fishes to sport or commercial interests was negligible considering the low numbers encountered. It is particularly noteworthy that the important migratory fishes usually avoid entrapment; only 15 mackerel and 37 bluefish were collected in the intake canal during the 8-year study (Applied Biology, Inc., 1983).

Ocean Gill Nets

Six ocean gill net stations were located near the offshore intake and discharge (Stations 0 through 5 in Figure 5-4; Station 0 was the control). An additional station 2 kilometers (km) offshore was also sampled. Ocean gill net sampling was conducted once per month from April to September, and twice per month from October through March. The increased sampling frequency in the late fall and winter months coincided with the expected increased abundance of the important migratory fishes in the area. The ocean gill net was 183 m long by 3.7 m deep, and had 5 mesh sizes sewn end to end (64, 74, 84, 97, and 117 mm). The net was set on the bottom of the water column, perpendicular to shore, and fished for 30 minutes at each station. The specimens were removed from the nets and identified as to species, counted, measured, and weighed.

According to Applied Biology, Inc. (1983) the number of fish collected during ocean gill netting varied considerably over the 8-year study period. The catch per unit effort ranged from 8 to 94 fish per net set at the two stations sampled during all study years. The combined number of fish collected per year in the offshore gill nets ranged from 874 to 1,610 fish per year (1977 to 1981); larger numbers were collected in 1982 and 1983 (4,152 and 5,598) as the number of net sets almost doubled based on a scope of work change. These data include all the stations near the offshore intake and discharge. Migratory fish species of sport and commercial value found during the ocean gill netting were Spanish mackerel, king mackerel, and bluefish. In 1983, bluefish and Spanish mackerel were abundant species collected in the ocean gill nets, but were not collected in the intake canal gill nets.

Differences among years are attributable to natural annual variations in fish abundance and to the chance occurrence of the highly motile, often migratory, fish encountered. The taxa of fish making up the catch each year also has fluctuated over the years. These variations are also attributed to chance occurrence and natural fluctuations. These studies concluded that fish remained in the area for only part of the year. This had particularly important implications for migratory species such as Spanish mackerel, because it showed that the Plant structures are not important attractants to these species, they are not entrapped in significant numbers, and their natural migratory movements do not appear to be affected (Applied Biology, Inc., 1983).

Ocean Trawls

Monthly trawl samples were taken at six stations (Stations 0 through 5, Figure 5-5) through May 1982 (this regulatory requirement was discontinued at that time). One 15-minute tow was made at each station with a 4.9-m semi-balloon trawl of 12.7-mm stretch mesh in the bag, and 6.4-mm stretch mesh in the cod end. Towing speed was 2 to 3 knots. To reduce net avoidance by the fish, all trawling was conducted at night. Fish collected by trawling were analyzed in the same manner as the gill net samples. Macroinvertebrates were also collected in the trawls and treated similarly (Applied Biology, Inc., 1982).

The number of fish collected by trawling at the different stations varied considerably over the 7 years of monitoring. However, for the 7 years combined, the most fish were collected near the Plant discharge. The percentage composition, or relative abundance, of taxa collected during trawling varied between the baseline studies and subsequent environmental monitoring, including variation within each study year. These differences were attributed to natural yearly variations in fish population composition, the chance occurrence of schooling fishes, and variations in the total sample sizes. No consistent trend was apparent for any particular taxon over the years.

Beach Seines

Beach seining was conducted monthly at three stations (Stations 6 through 8, Figure 5-5) through May 1982 (this regulatory requirement was discontinued at that time). These stations were located at the shoreline near the intake, discharge, and north of the discharge. The seine was 30.5 m long by 1.8 m deep with a stretch mesh size of 25 mm. It was heavily weighted at the bottom and had extra flotation along the top to maintain a hanging position under surf conditions. The net was carried out to a depth of approximately 1.2 m, deployed parallel to the shore, and pulled onto the beach with the ends perpendicular to the shore. Three replicate seine hauls were made at each station during each sampling period. Fish collected by seining were analyzed by the same methods described for gill nets (Applied Biology, Inc., 1982).

Ichthyoplankton

Ichthyoplankton was sampled twice a month during the daytime at six ocean stations corresponding with the ocean trawl stations (Stations 0 through 5), and at one additional ocean station near the offshore ocean intake (not shown in Figure 5-5). One station in the intake canal (Station 11) and one station in the discharge canal (Station 12) were also sampled (Figure 5-5). Ichthyoplankton sampling was discontinued after May 1982. Samples were collected twice a month during the daytime using paired 20-centimeter (cm), 505-micron (μ) bongo nets. At Stations 0 through 5, nets were towed just below the surface at 3.5 and 4.0 knots for 15 minutes. Mid-depth samples were taken at the station next to the offshore intake in the same manner in order to sample ichthyoplankton being entrained into the CWIS. At the intake and discharge canal stations, 15-minute step-oblique tows were taken to sample the canal ichthyoplankton populations drawn in from the ocean waters, and circulated through the plant.

Ichthyoplankton retained in the cod-end collecting bucket were washed into jars, preserved in 5-percent formalin, and sent to the lab for taxonomic analysis. Eggs were counted and their diameters measured. Eggs were not identified to taxon due to lack of taxonomic keys. Larval fish were identified to the lowest practicable taxon, counted, and their total length measured to the nearest tenth of a millimeter. Ichthyoplankton densities were expressed as the number of eggs or fish larvae per cubic meter.

Ocean Stations

Fish eggs and larvae were found year-round during each study year, and maximum densities typically occurred during the spring and summer. Most of the larvae were herring and anchovies. Thus, most of the eggs were likely the same species. Blennies, gobies, mojarras, drums, and jacks were also common fish species. Mackerel larvae were found occasionally, while bluefish larvae were not found. The 8-year study concluded that the composition of larval populations in the vicinity of the St. Lucie Plant have not changed appreciably over the period sampled. Differences in ichthyoplankton densities among ocean stations were attributed to station locations relative to the distance from the shore and natural year-to-year and seasonal variations. The ichthyoplankton data collected suggested cyclic variations in the offshore ichthyoplankton populations (Applied Biology, Inc., 1982).

Intake Stations

In general, eggs and larval densities were lower in the discharge canal than in the intake canal from 1977 to 1981, reflecting egg and larval mortality from passage through the condensers. Mean densities of eggs and larvae in the intake canal were lower than the mean densities found in the ocean during 1977 to 1981. The Applied Biology, Inc. (1982) report stated that two factors may explain the lower concentration of eggs and larvae in the intake canal as compared to surface densities found at ocean stations. First, the intake pipe draws cooling water from a lower depth where eggs and larvae are not as abundant as in surface areas; and, secondly, mortality may be occurring from mechanical damage or predation during passage through the pipe or intake canal.

Statistical analysis showed that the mid-depth ocean intake station (closest to the velocity caps) had lower ichthyoplankton densities than near the ocean surface; and it was also documented that most of the larval fish collected from the intake canal were damaged. The amount of ichthyoplankton entrained was calculated to be a very small portion of the ichthyoplankton population occurring near the St. Lucie Plant and, therefore, not considered of significant environmental concern. The ichthyoplankton sampling requirement was discontinued in 1982.

5.3.3 SUMMARY

In summary, these studies concluded that fish and shellfish were not accumulating in the intake canal, the number entrapped in the intake canal was low (relative to ocean densities), and very few sport or commercial fish were entrapped. The 8 years of biological study also concluded that the St. Lucie Plant was not affecting ichthyoplankton numbers in the vicinity of the Plant, and the number entrained into the intake canal was a very small portion of the population occurring in the offshore environment near the Plant. Impingement sampling at the screens and entrainment behind the screens has not been conducted at the Plant.

5.4 APPLICABILITY TO THE CALCULATION BASELINE

The regional and historical information will be used to the greatest extent possible to provide information regarding trends and populations in the vicinity of the Plant. This information has been considered in the development of the biological field sampling plan included in this PIC.

Based upon the above information the applicability of the historical data for use in calculating the baseline is limited. The data was collected when only Unit 1 was in operation and does not reflect current operating conditions. New data will be required to determine the calculation baseline for the Plant and to verify compliance with the applicable performance standards.

5.5 SEA TURTLE PROGRAM

The FPL St. Lucie Plant conducts sea turtle protection activities in order to remain in compliance with state and federal laws and permits (FPL, 2003). These activities include nesting surveys, intake canal monitoring and turtle relocation, participation in the Sea Turtle Stranding and Salvage Network (STSSN), and conducting public service turtle walks during the nesting season.

FPL began conducting nesting surveys in 1971. Surveys were conducted in odd years between 1971 and 1979, and annually after 1979. Loggerhead, leatherback, and green sea turtles are known to nest on Hutchinson Island. Data indicates that plant operation, exclusive of nighttime intake/discharge construction, has not had an apparent effect on nesting levels. Likewise, there is no indication that the plant has affected temporal nesting patterns. Nesting usually begins on Hutchinson Island between mid-April and early May and ends by mid-September; however, data indicates that temperature affects temporal nesting patterns. There is a general trend toward an increase in the number of nesting females since 1971.

Several devices have been installed at the Plant that limit the passage of turtles through the intake canal. In 1978, a barrier net was erected in the intake canal east of A1A to confine entrapped turtles to the easternmost section of the canal where capture techniques are the most effective. Another net was completed in 1986. This net constrains turtles not confined by the A1A barrier net. A small mesh barrier net was erected east of the A1A barrier net in 1996 in an effort to better constrain the large numbers of small green turtles encountered in the intake canal. The intake canal was dredged to reduce velocities and a new barrier net was erected in 2002. The new net was designed with stronger mesh and more reinforcements so that it can withstand the events that caused the design failure of the old barrier net. The new barrier net is considered effective, since 99.6 percent of all turtles entrapped in the canal in 2003 were captured east of the A1A bridge.

Sea turtles entrapped in the intake canal are removed using tangle nets (daytime only), dip nets, and diver-assisted hand capture. All sea turtles removed from the canal are identified, weighed, tagged, photographed, and checked for condition. Healthy sea turtles are returned to the ocean the same day of capture. Sick or injured sea turtles may be held for observation or transported to an approved rehabilitation facility. The FFWCC is contacted and provides disposition instructions to FPL for all dead sea turtles.

During the years of 1976 through 2003, 5,372 loggerheads, 3,975 green, 28 leatherbacks, 38 Kemp's ridleys, and 39 hawksbills were captured at the St. Lucie plant. Of these, 1,556 were recaptures. Annual capture totals range from 33 in 1976 (a partial year of operation and monitoring) to 944 in 2003. Approximately 97 percent of all sea turtles entrapped in the canal were captured alive and returned to the ocean. Mortality rates for captured turtles have declined since 1976. The mortality rate has been less than 1 percent since 1990.

Historically, loggerheads are the most abundant sea turtle species in the intake canal. Recent data show a trend of increase in capture for loggerheads and green sea turtles. This increase has been attributed to the natural variations on the occurrence of sea turtles in the vicinity of the Plant.

In 1999, FPL exceeded the anticipated annual incidental take limit set by the National Marine Fisheries Service (NMFS) in the 1997 Biological Opinion (NRC, 1997). Reinitiation of consultation under the Endangered Species Act (ESA) was required. A new Biological Opinion was issued in 2001 (NRC, 2001) that stated FPL will exceed their take limits for a calendar year if:

- More than 1,000 sea turtles are captured; or

- More than 1 percent of the total number of loggerhead and green sea turtles captured are injured or killed causal to plant operations; or
- More than two Kemp's ridley sea turtles are injured or killed causal to plant operations; or
- Any hawksbill or leatherback sea turtles are injured or killed causal to plant operations.

Reinitiation of the ESA Section 7 consultation will be required if any of these events, or the event cited below, occur:

- In rare instances where dredging may be required east of the 5-inch barrier net, FPL will contact NMFS and initiate a consultation on the particular project, in conjunction with the NRC or COE.

6.0 AGENCY CONSULTATIONS

6.1 NATIONAL MARINE FISHERIES SERVICE CONSULTATIONS

6.1.1 FEBRUARY 7, 1997 BIOLOGICAL OPINION

The National Marine Fisheries Service (NMFS) previously issued a Biological Opinion on February 7, 1997 on the St. Lucie Plant Units 1 and 2. NMFS concluded that the continued operation of the St. Lucie Plant Units 1 and 2 was not likely to jeopardize the continued existence of species listed in the opinion under their jurisdiction. However, the Opinion concluded that operation of the St. Lucie Plant Units 1 and 2 may adversely affect these species. Therefore, NMFS developed an Incidental Take Statement, which includes terms and conditions necessary to monitor and minimize the lethal take of sea turtles at the St. Lucie Plant. In order for the NRC to fulfill its responsibility under Section 7 of the ESA, as detailed in 50 CFR Part 402, NMFS requested that FPL propose appropriate changes to the Environmental Protection Plan (EPP), within 60 days of the receipt of the Opinion. The changes to the EPP needed to reference the Incidental Take Statement included in the Biological Opinion and provide reasonable and prudent measures as detailed in the Incidental Take Statement.

The following listed species were under the jurisdiction of NMFS, and were expected to occur in the nearshore or inshore waters of Florida's Atlantic Coast, and may be affected by the Plant activities.

Endangered

Northern right whale	*Eubalaena glacialis*
Leatherback sea turtle	*Dermochelys coriacea*
Kemp's ridley sea turtle	*Lepidochelys kempii*
Green sea turtle	*Chelonia mydas*
Hawksbill sea turtle	*Eretmochelys imbricate*

Threatened

Loggerhead sea turtle	*Caretta caretta*

Threatened, Proposed

Johnson's seagrass	*Halophila johnsonii*

Species Not Likely to Be Affected

It was stated in the Opinion that right whales and Johnson's seagrass were not likely to be adversely affected by the continued operation of the CWIS at the St. Lucie Plant.

Assessment of Impact

Between 1976 and 1995, 4,132 sea turtles have become entrapped at the St. Lucie intake canal; 178 died, for a total mortality rate of 4.3 percent. Loggerheads were the species most involved over this period, although green turtles have been the dominant species since 1993. Low rates of sea turtle drowning in capture nets were reported by FPL for the St. Lucie Plant capture and release program during the 1976 to 1995 period. Since the capture and release program began, mortality rates of 0.3 percent for loggerheads and 1.1 percent for green turtles were recorded. NMFS stated that the installation of the new barrier net with a 5-inch-square mesh was expected to reduce the impacts of entrapment in the intake canal. This mesh size was selected based on the observed carapace widths of green turtles removed from the canal during the first half of 1995. NMFS concluded that intake mortalities should approach zero with the new barrier net installed. NMFS stated that the mortality rate of entrapped turtles had decreased from 1990 to 1995 due to the incremental improvements in the turtle program executed at FPL, including the construction of barrier nets, improved monitoring, and fine-tuning of capture methods.

FPL also addressed the possible impact of Taprogge condenser cleaning system sponge balls by instituting an operational procedure to prevent sponge ball release into the aquatic environment. NMFS concluded that no impacts from the Taprogge system were anticipated. Regarding sea turtles entrapment, NMFS concluded that future lethal impacts to green and loggerhead turtles are not expected to exceed greatly the 1-percent mortality rate observed since 1990. It also stated that no leatherback, Kemp's ridley, or hawksbill mortalities had occurred in the previous 6 years at the St. Lucie Plant. Therefore, a very low level of impact not likely to exceed 1 individual per year was possible for this species.

Conclusion

NMFS concluded that continued operation of the circulating water system at the St. Lucie Plant was likely to result in adverse effects on loggerhead, green, and to a lesser extent, Kemp's ridley, hawksbill, and leatherback turtles. However, NMFS believes that the level of impact is not likely to jeopardize the continued existence of any sea turtle species.

Reinitiation of Consultation

NMFS stated that reinitiation of formal consultation would be required if:

1. The amount or extent of taking specified in the Incidental Take Statement is exceeded;
2. New information reveals effects of the action that may affect listed species or critical habitat (when designated) in a manner or to an extent not previously considered;
3. The identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not previously considered in the Biological Opinion; or
4. A new species is listed or critical habitat designated that may be affected by the identified action.

This consultation correspondence, Biological Opinion, and Incidental Take Statement are included as Appendix B.

6.1.2 MAY 4, 2001 BIOLOGICAL OPINION

This Biological Opinion was a reinitiation of consultation subsequent to the February 7, 1997 Opinion. The NRC formally requested reinitiation on November 30, 1999, after the St. Lucie Plant exceeded the NMFS' anticipated incidental take of three green turtles per year established in the Incidental Take Statement of the 1997 Opinion. The 2001 Opinion considered new information about turtle interactions with the plant submitted by FPL in a March 2000 report entitled "Physical and Ecological Factors Influencing Sea Turtle Entrainment Levels at the St. Lucie Nuclear Power Plant: 1976 – 1998" (Ecological Associates, Inc., 2000). The May 4, 2001 Opinion states NMFS' belief that the continued operation of the circulating seawater cooling system at the St. Lucie Plant is not likely to jeopardize the continued existence of the five species of sea turtle found at St. Lucie. However, it revises the Incidental Take Statement and modifies some of the Terms and Conditions of the previous Opinion.

The complete Biological Opinion and new Incidental Take Statement are included in Appendix B. The following is a summary of the major change.

Amount or Extent of Anticipated Take

NMFS stated that the lethal take levels are based on historical observed lethal takes, but provide for increased total numbers of lethal takings as entrapment levels increase.

Based on stranding records and historical data, five species of sea turtles are known to occur in the vicinity of the St. Lucie Plant. Available information, at the time of the Biological Opinion, on the relationship between sea turtle capture and mortality and the St. Lucie Plant's circulating seawater cooling system indicated that injury or death of sea turtles is likely to occur from entrapment in the system's intake canal. In recent years (prior to 2001) turtle entrapment increased, especially green sea turtles, and it was considered likely that it would continue to increase, as the green turtle population, and other species' populations continue to increase and recover. Therefore, pursuant to Section 7(b) of the ESA, NMFS anticipated an annual incidental capture of up to 1,000 turtles, in any combination of the five species found near the St. Lucie Plant. NMFS anticipated 1 percent of the total number of green and loggerhead turtles (combined) captured will be injured or killed each year over the next 10 years as the result of incidental capture. NMFS also anticipated two Kemp's ridley turtles would be killed each year and one hawksbill or leatherback will be injured or killed every 2 years for the next 10 years also as a result of this incidental capture.

If the actual incidental captures, injuries, or mortalities meet or exceed this level, NRC must immediately request reinitiation of formal consultation.

FPL's Sea Turtle Refuge Annual Operating Report (2003) was summarized in Section 3.0 of this report.

6.1.3 FEBRUARY 17, 2005 CONSULTATION

This consultation was in response to a February 11, 2005 email to the NMFS regarding the proposed dredging activities at the St. Lucie Plant intake canal. This request is pursuant to Section 7(a)(2) of the ESA on the proposed dredging activities east of the 5-inch barrier net, which were necessitated due to sediment build up caused by the multiple hurricanes in 2004. FPL provided documentation on the project and its potential effects via email on January 12, and February 8 and 11, 2005. The consultation received from NMFS on February 17, 2005, states that NMFS concluded that sea turtles entering the canal east of the 5-inch barrier net would be unlikely to be entrained in the cutter head that was modified with a 6-inch rebar-caged grid around it. This consultation required a full-time permitted biologist acting as a turtle observer monitoring the dredging operations to ensure that turtles were not in the vicinity of the dredge head. As the result of this consultation, the COE issued a permit modification on February 21, 2005, requiring the following;

1. "The permittee shall modify the cutterhead to protect sea turtles while performing all maintenance dredging east of the 5-inch mesh turtle barrier net in the intake canal.

Specifically, the permittee shall cage the cutterhead by welding rebar over the head to prevent any object larger than 6 inches wide from entering the suction pipe. The cutterhead will be slowly lowered into the water, and the cutterhead rotation and suction will not be turned on until the dredge head is in the sediment, and then it will be turned on at idle speed.

2. A permitted sea turtle biologist shall be present during all dredging east of the 5-inch mesh barrier net in order to serve as a lookout to ensure the procedures in special condition number 1 above are followed."

6.2 AGENCY CONTACTS

FPL is not currently involved in any other consultations with federal, state, or other agencies; however, the following agencies will be contacted in order to coordinate sampling and field activities and acquire the referenced permits and licenses (as needed) to support the field sampling effort:

- *Florida Fish and Wildlife Conservation Commission (FFWCC)*
  The scientific, educational, and exhibitional collection of marine species is authorized by the FFWCC under a Scientific Research Special Activity License (SRSAL). The FFWCC has the authority to regulate freshwater and marine species within the waters of the State of Florida.
- *United States Fish and Wildlife Service (USFWS)*
  The USFWS issues the Native Endangered and Threatened Species Scientific Purposes Permit which allows for the "take" of threatened and/or endangered species.
- *National Marine Fisheries Service (NMFS)*
  The NMFS issues a Scientific Purpose Permit for scientific research purposes or to enhance the propagation or survival of species listed as threatened or endangered species. The NMFS regulatory authority extends only to threatened and endangered marine and anadromous fish species.

7.0 IMPINGEMENT AND ENTRAINMENT VERIFICATION SAMPLING PLAN

The objective of this field sampling plan is to demonstrate that the design, technology, and operational measures already implemented for the St. Lucie Plant, including relocation of the St. Lucie Plant CWIS from the IRL (Big Mud Creek), as proposed in the original Plant design, to the marine offshore environment (Atlantic Ocean), and the use of velocity caps at the three intakes, currently meet the national performance standards (for BTA) as specified in 40 CFR 125.94(b). Based on the data developed through the execution of this field sampling plan, compliance with Section 316(b) performance standards will be determined. The relocation of the Plant's intake from a productive estuarine environment such as the IRL, to an offshore marine location, along with the significant reduction in cooling water flow that resulted by increasing the delta-T, is expected to have significantly decreased the intake's impact to the estuarine environment (Applied Biology, Inc.; 1982, 1983). Furthermore, the use of velocity caps at all intakes should further reduce fish impingement. Velocity caps convert vertical water flow into horizontal flow at the entrance to the intakes. Velocity cap technology works on the premise that fish can avoid rapid changes in horizontal water flow, but are less able to detect and avoid vertical velocity vectors. Velocity caps have been installed at many offshore intakes and have been successful in minimizing impingement. The mid-depth location of the intakes (velocity caps) have reduced entrainment at the Plant due to the documented lower ichthyoplankton densities at mid-depth as compared to the ocean surface.

This field sampling plan has been developed to verify compliance with the Section 316(b) rule performance standards for impingement and entrainment. Fish, shellfish, and ichthyoplankton sampling will be conducted in these two aquatic ecosystems to compare a surface shoreline intake in the IRL (calculation baseline) and the current Atlantic Ocean offshore CWIS location at mid-depth using velocity caps. The field sampling program will quantify the fish and shellfish that were likely to be impinged and entrained if the intake had been located in the IRL and compare these data to fish and shellfish that are likely or currently impinged and entrained from the marine environment by the St. Lucie Plant. Collected data will be used to evaluate abundance, temporal trends, and potential susceptibility to impingement and entrainment. As data is collected and analyzed, the field sampling plan may be revisited and revised to continue to meet the study objectives.

To the extent that this field sampling plan demonstrates, in accordance with 40 CFR 125.94(a)(2), that the St. Lucie Plant is already in compliance with the national performance standards specified in

40 CFR 125. 94(b), the biological results will be applied to the Verification Monitoring Plan specified by 40 CFR 125.95(b)(7).

7.1 FIELD SAMPLING PLAN

The sampling plan is required for any new field studies that are proposed to be conducted for compliance with Section 316(b) to ensure that there is sufficient data to develop a scientifically valid estimate of impingement mortality and entrainment. The sampling plan is a required component of the PIC. The sampling plan must document all methods and QA/QC procedures for sampling and data analysis. The sampling and data analysis methods proposed must be appropriate for a quantitative survey and include consideration of the methods used in other studies performed in the source waterbody. The sampling plan must include a description of the study area, including the area of influence of the CWIS and taxonomic identification of the sampled or evaluated biological assemblages (including all life stages of fish and shellfish).

The 316(b) rule allows the use of various metrics [i.e., representative species (RS) or all species, and total count for fish and shellfish or total biomass] to characterize impingement mortality and entrainment and measure success in meeting the performance standards. The metric to be applied to the data collected through this sampling program will remain undefined in order to provide maximum flexibility during the preliminary data collection effort (i.e., data will be collected to allow the use of the most appropriate metric). The metric(s) that will ultimately be used to characterize impingement mortality and entrainment will be the one(s) that provides the least data variability and uncertainty, and will be used to demonstrate compliance with the performance standards. This will be particularly important when comparing the calculation baseline data to the verification monitoring data to demonstrate compliance with the performance standards.

Based on previous studies at the St. Lucie Plant, fish most likely to be susceptible to impingement are grunts, snapper, porgies, jacks, and drums (Applied Biology, Inc., 1983). Bottom and mid-depth trawling will be conducted to evaluate fish and shellfish that could be drawn into the CWIS both in the IRL and the Atlantic Ocean. The fish most likely to be susceptible to entrainment were herring and anchovies. Entrainment will be evaluated using plankton tows in the IRL and collection of entrained organisms at the entrance to the intake canal (at the headwall).

Currently, sampling at the intake screens for either impingement or entrainment is not planned because the residence time of organisms in the intake canal can be variable depending on many factors including species, life stage, organisms' condition, and Plant operations. It would be difficult to correlate the levels of impingement and entrainment at the screens to the source waters and it probably has little value since the primary objective is to compare the IRL as the calculation baseline and the Atlantic Ocean for current operating conditions.

Prior to the initiation of the field biological sampling described in this section, a field reconnaissance sampling event will be conducted to determine the final station locations and most appropriate field gear to most effectively sample target populations given specific local conditions.

7.2 IMPINGEMENT SAMPLING PLAN

The typical objective of screen impingement sampling is to estimate the number, taxonomic composition, and biomass of fish and shellfish impinged on the intake screens. Due to the CWIS configuration, with offshore intakes, an intake canal, the large size of the intake canal, and the relatively long residence time of larger fish and shellfish in the intake canal, the numbers of many fish species found impinged at the screens are not representative of what is being pulled into the CWIS. Therefore, nearfield studies will be conducted in the Atlantic Ocean in the vicinity of the velocity caps, to quantify the types and number of fish that could be susceptible to the CWIS. Furthermore, similar sampling will be conducted in the IRL to compare the offshore data to the "calculation baseline."

7.2.1 NEARFIELD TRAWL SAMPLING PLAN

To understand biological variability as it relates to Plant impingement, nearfield studies will be conducted in the IRL/Big Mud Creek (Figure 7-1) and in the vicinity of the velocity caps (Atlantic Ocean) (Figure 7-2). Nearfield sampling will be conducted every other week to characterize impingeable size fish and shellfish. Sampling is currently expected to begin in 2005.

7.2.2 SAMPLING FREQUENCY AND METHODOLOGY

Three stations in the IRL/Big Mud Creek and three stations in the Atlantic Ocean will be sampled every other week during the day and at night (Table 7-1). Trawl sampling will be conducted using a trawl of the appropriate dimension, such as a 4.9-m semi-balloon otter trawl with 12.7-mm mesh in the bag and 6.4-mm mesh in the cod-end. The trawling gear will be equipped with a flow meter to measure the volume filtered during each sample. For ocean sampling, the trawl will be released from a moving boat and one sample will be collected as the trawl is dragged along the bottom, and a second sample will be collected at mid-depth. For IRL sampling, the trawl will be dragged at the bottom only, due to the shallow nature of the estuary. During the reconnaissance study, mid-depth sampling in the deeper areas of Big Mud Creek will be evaluated. One trawl pull will be conducted per ocean station depth; and one trawl pull will be conducted per IRL station. Sampling will be conducted during the day and at night.

In summary, sampling will be conducted:

- At three stations in the IRL and at three stations in the Atlantic Ocean;
- During the day and at night;
- Bottom and mid-depth trawls will be collected at each ocean station;
- Bottom trawls will be collected at each IRL station and mid-depth trawls will be evaluated during the reconnaissance trip;
- Six trawl samples will be collected from the IRL and 12 trawl samples from the Atlantic Ocean during each sampling event (Table 7-1); and
- The sampling events will be conducted every other week.

The proposed station locations in the IRL and in the Atlantic Ocean are shown in Figures 7-1 and 7-2 and are described in Table 7-1. Exact locations will be determined during the field reconnaissance effort. All locations will be identified using Geographical Positioning System (GPS).

In the field, fish and shellfish will be identified to the lowest practicable taxonomic level, sorted (typically by species), and enumerated. If there are distinct size groups of a particular species, then each size group will be treated as a separate age class. The batch weight (gram or kilogram, depending on the number) will be obtained for each species (or size group). Up to 50 organisms per species or size group will be individually measured for length (total length, mm) and weight. For sample sizes greater than 50, up to 50 organisms of each species that are representative of the size distribution in the sample will be selected for measurement. At times of the year when samples contain excessive numbers of organisms, a random splitter (such as a 2-cell Motoda Box splitter) will be used to obtain an appropriate subsample that can be analyzed within a 1- to 2-hour period.

All data will be recorded on the field data sheets. Fish and shellfish that could not be identified in the field will be placed in a sample jar, preserved with 10-percent formalin, and taken to the laboratory for identification. If necessary, fish and shellfish specimens will be sent to a recognized expert for identification confirmation. A voucher collection of each species collected will be maintained for identification confirmation.

For each trawl sample collected, the following information will be obtained, recorded on field data sheets, and transferred to the St. Lucie 316(b)-Data Management System (DMS):

- Fish and shellfish taxonomic identifications, numbers, measurements and observations;
- Date and time at initiation and completion of the sampling event;
- Speed, duration, start and end location, and distance traveled;
- Field equipment used;
- Tidal stage;
- Names of field staff; and
- Water temperature, dissolved oxygen, salinity, conductivity, and pH will be measured and recorded at the beginning and end of each sampling period.

7.2.3 TREATMENT OF DATA

The primary use of the trawl catch data will be to describe the spatial and temporal trends in abundance (general community characterization) and to identify the fish (and shellfish) that may enter the CWIS.

7.2.4 IMPINGEMENT SAMPLING PLAN MODIFICATIONS

Should a determination be made that sampling for impingement at the screens or elsewhere within the intake cooling canal is warranted and appropriate, FPL will discuss the sampling changes and the basis for such changes with FDEP prior to incorporating them into the impingement sampling plan.

7.3 ENTRAINMENT SAMPLING PLAN

The objective of the entrainment sampling program is to identify and quantify the meroplankton organisms including shellfish and ichthyoplankton in the intake water that pass through the velocity caps and enter the intake canal during normal plant operations. Meroplankton will also be sampled in the IRL/Big Mud Creek at the same stations identified for the fish and shellfish in the nearfield sampling (Section 7.2). Fauna vulnerable to entrainment is related to their size, but generally includes fish eggs, larvae, small juveniles, and small macroinvertebrates (planktonic organisms). Data collected within this sampling program will be used to identify temporal trends in entrainment abundance at the Plant and to calculate the baseline based on the IRL/Big Mud Creek sampling results. Entrainment sampling is currently expected to begin in 2005.

7.3.1 SAMPLING FREQUENCY AND METHODOLOGY

Plant Entrainment

Entrainment sampling at the Plant will take place in the intake canal at the headwall and will occur over a 24-hour period with entrainment samples being collected during the day and at night; biweekly sampling is proposed (Table 7-1). Length of the sampling period will depend on the amount of material and condition of ichthyoplankton being collected. The sampling methods to be evaluated for entrainment sampling at the Plant are as follows: a PVC pipe connected to an on-shore pump will be lowered in front of the opening of the intake pipes as water enters the intake canal; the water collected will be discharged into a large tank through a fine mesh net (505-micron or smaller mesh size will be used depending on the field conditions) to collect meroplankton. Alternatively, plankton tows may also be used for entrainment sampling.

At the conclusion of each sample collection, the contents of the plankton mesh net will be rinsed down with source water from the outside of the net and carefully transferred to sample jars. The samples will be preserved in a 10-percent buffered formalin solution, labeled, and sent to the taxonomy laboratory for identification. If more than one jar is required per sample, the contents of the jars will be composited in the laboratory for analysis.

IRL/Big Mud Creek

"Calculation Baseline" Entrainment

Entrainment samples for fish and shellfish (meroplankton) will be collected in the IRL both in Big Mud Creek in the vicinity of the originally proposed CWIS and in the IRL, at the same stations as the trawl sampling. Sampling will be conducted on a biweekly basis during the trawling sampling trips. Entrainment plankton samples will be collected using two 20-cm-diameter bongo nets (or other plankton net appropriate for this location). One tow will be collected both at night and during the day at each station (Table 7-1). The plankton net will be equipped with a calibrated flow meter to measure the volume of water filtered during each sample. The net mesh will be 505 micron, or smaller, depending on the field conditions.

The contents of the plankton net will be rinsed from the outside with source water and transferred to sample jars. The plankton samples will be preserved with a 10-percent buffered formalin solution, labeled, and sent to the taxonomic laboratory for identification. If more than one jar is required per sample, the contents of the jars will be composited in the laboratory for analysis.

7.3.2 SAMPLE ANALYSIS

In the laboratory, shellfish meroplankton and ichthyoplankton will be separated from detritus (sorted), identified to the lowest practical taxon and lifestage (e.g., egg, yolk-sac larvae, post-yolk-sac larvae, or juvenile for fish; lifestage for shellfish), and counted. The total weight of the entrained sample will be recorded. For QA purposes, 5 percent of the samples will be split as a replicate and treated as a separate sample. Staining may be necessary to distinguish specimens.

Total length (TL to the nearest millimeter) will be determined for up to 50 larval fish of each species and shellfish lifestage in each sample. In the event that a sample contains a large number of organisms of various lifestages (e.g., >500), subsampling will be conducted and the analyzed portion of the sample will be extrapolated to the full sample catch. A Folsom plankton splitter, or other method, can be used to equally divide the contents retained in the sample jars into sub-samples. The division of organisms among the resulting sub-samples will be random. Sorting, identification, and enumeration of invertebrate plankton will be limited to those taxa of commercial value in later lifestages. Taxonomic identification of fish eggs and larvae and shellfish lifestages will be made through the use of standard literature sources and the taxonomic reference collection of the taxonomic laboratory used.

Total entrainment wet sample weight will be obtained. Total sample weight can be estimated by filtering a subsample and measuring the weight gain of the filter per unit volume filtered. All laboratory sorting, identification, and length measurements will be subject to QA/QC procedures for sampling and data analysis.

For each sample collected, the following information will be obtained and recorded on field data sheets and transferred to the DMS:

- Volume of water filtered;
- Air temperature;
- Identification of the circulating water pumps in operation at the start and end of the sampling event;
- Volume of circulating water or flow rate (based on the number of circulating water pumps in operation and the pumping rates);

- Equipment used;
- Station location;
- Date and time of day at initiation and completion of the sampling event;
- Tidal stage;
- Intake water temperature, dissolved oxygen, salinity, conductivity and pH will be collected in front of the intake and recorded at the beginning and end of each sampling effort; and
- Name of field staff.

7.3.3 TREATMENT OF DATA

The primary use of the entrainment data will be to describe the spatial and temporal trends in abundance (general community characterization) and what becomes entrained in the CWIS. This requires that the raw data be appropriately summarized and transformed to allow relative comparisons between species, months, and years.

7.3.4 CALCULATION OF BASE DENSITIES

Base densities will be calculated for the most abundant organisms. The raw data are to be adjusted to account for:

- Lifestage; and
- Sample volumes.

To normalize the abundance data to account for differences in sample volumes, the densities of the collected meroplankton will be calculated. Sample densities (presented as # per 100 m^3) will be calculated by dividing the number of shellfish and ichthyoplankton collected in each sample by the volume of water filtered during the collection of that sample.

Linear interpolation will be used to obtain entrainment densities for the unsampled days. These values will be multiplied by the daily flow(s) to obtain estimates for each unsampled day. The daily entrainment estimates will be summed over the week to obtain the weekly entrainment estimates and over the month to give the monthly entrainment estimates. Likewise, the daily entrainment estimates will be summed over the year to determine the annual entrainment estimates.

7.4 QA/QC PLAN

The goal of the QA/QC Plan is to provide work performance and work products of the highest quality in a cost-effective, scientifically defensible, and timely manner. All deliverables are subject to QA/QC guidelines, checks, and reviews. A QA manual outlining specific procedures will be prepared prior to initiation of the field work. Highlights of the QA program are listed below.

The main functions of the QA/QC Plan include:

- Establish and maintain a system of appropriate QA documentation and QC records;
- Maintain this system by routine project QA audits;
- Ensure that the technical staff assigned to each task are qualified and appropriately trained;
- Establish regular equipment calibration and maintenance procedures;
- Require at least 5 percent of samples are re-sorted;
- Require at least 5 percent of final taxonomic identification are re-checked;
- Require taxonomic confirmation obtained from specialist;
- Ensure adequate and appropriate technical and peer review of scopes of work and deliverables; and
- Investigate quality problems and recommend corrective actions, as necessary.

Effective project QA requires appropriate documentation and that QC records are maintained. QC records and documentary information may include the following:

- Computer models and programs – properly tested, documented, and dated;
- Taxonomic identification QA/QC;
- Records of critical calculations or assessment checks;
- Project Deliverable Review Sheet – properly completed and signed for each submittal of a major deliverable;
- Letters of transmittal; and
- Project files, including project reports, memoranda, and correspondence.

The objective of the QA/QC Plan is to assure all methods used both in the field and laboratory will have written standard operating procedures (SOPs) to assure consistency in sampling and data analysis. SOPs will be prepared prior to commencement of field studies. In addition to QA/QC procedures for sampling, documentation of sample collection, instrument calibration, chain of custody, and provisions for entering data into a database will be developed.

Field and laboratory taxonomic identification will be standardized. Field data will be recorded on field sheets at the time of sample collection and analysis, and later entered into electronic spreadsheets/database (DMS). The data will be subject to multiple rounds of QA/QC validation procedures. For example, initial proofs will be conducted for review for completeness and reasonableness of the data entries. Additional checks will be made to ensure that the records entered in electronic files for the sampling programs match data recorded in the field and laboratory and documented on hard copy data sheets. Data validation procedures will be completed at the conclusion of each year of study. Upon discovery of discrepancies or anomalies, the electronic data should be compared to the hard copy data sheets and adjusted as appropriate. A final data validation will be completed after all study data has been entered into the database.

8.0 SCHEDULE

The FPL St. Lucie Plant is required to submit a CDS by January 7, 2008. Therefore, this PIC is being submitted for review by FDEP in time for the field biological studies to start in 2005.

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TABLES

Table 3-1. Annual Capacity Utilization for FPL's St. Lucie Nuclear Power Plant.

FPL ST. LUCIE NUCLEAR POWER PLANT
NET CAPACITY FACTOR

	2000	2001	2002	2003	2004	5-YEAR AVERAGE
Unit 1	102.0%	91.3%	94.2%	102.1%	85.8%	95.1%
Unit 2	92.3%	91.3%	101.0%	80.1%	92.0%	91.3%
St. Lucie Power Plant	**97.2%**	**91.3%**	**97.6%**	**91.1%**	**88.9%**	**93.2%**

Table 3-2
Hydraulic Zone of Influence Calculation
St. Lucie Nuclear Power Plant
Atlantic Ocean

Hydraulic Zone of Influence								
Atlantic Ocean								
			Scenarios					
			1			2		
	Variable	Units	CWIS12A	CWIS12B	CWIS16A	CWIS12A	CWIS12B	CWIS16
Design Intake Flow	Q_i	cfs	606.50	606.50	1075.30	606.50	606.50	1075.30
Mean Depth at Radius R_{HZI}	d_r	ft	24.00	24.00	24.00	24.00	24.00	24.00
Arc Angle	θ	deg	360	360	360	360	360	360
Ambient Mean Velocity in Atlantic Ocean	V_{ma}	ft/s	0.10	0.10	0.10	0.30	0.30	0.30
HZI Radius from Intake	R_{HZI}	ft	40	40	71	13	13	24

Note: See Appendix A for HZI Methodology

Maximum Day Average Design Intake Flow for CWIS 12A = 392 MGD (606.5 cfs)
Maximum Day Average Design Intake Flow for CWIS 12B = 392 MGD (606.5 cfs)
Maximum Day Average Design Intake Flow for CWIS 16A = 695 MGD (1,075.3 cfs)
Mean depth at R_{HZI} = 24 feet (Final Environmental Statement, 1974)

Scenario 1 - Ambient Mean Velocity (V_{ma}) = 0.1 ft/s
Scenario 2 - Ambient Mean Velocity (V_{ma}) = 0.3 ft/s

Table 3-3
Hydraulic Zone of Influence Calculation
Indian River Lagoon/Big Mud Creek

Hydraulic Zone of Influence				
Indian River Lagoon/Big Mud Creek				
			Scenario 1	Scenario 2
Design Intake Flow	Q_i	cfs	2288.30	2288.30
Mean Depth at Radius RHZI	d_r	ft	4.00	4.00
Arc Angle	θ	deg	180	180
Ambient Mean Velocity in Indian River (Estuary)	V_{ma}	ft/s	0.10	0.30
HZI Radius from Intake	R_{HZI}	ft	**1818**	**606**

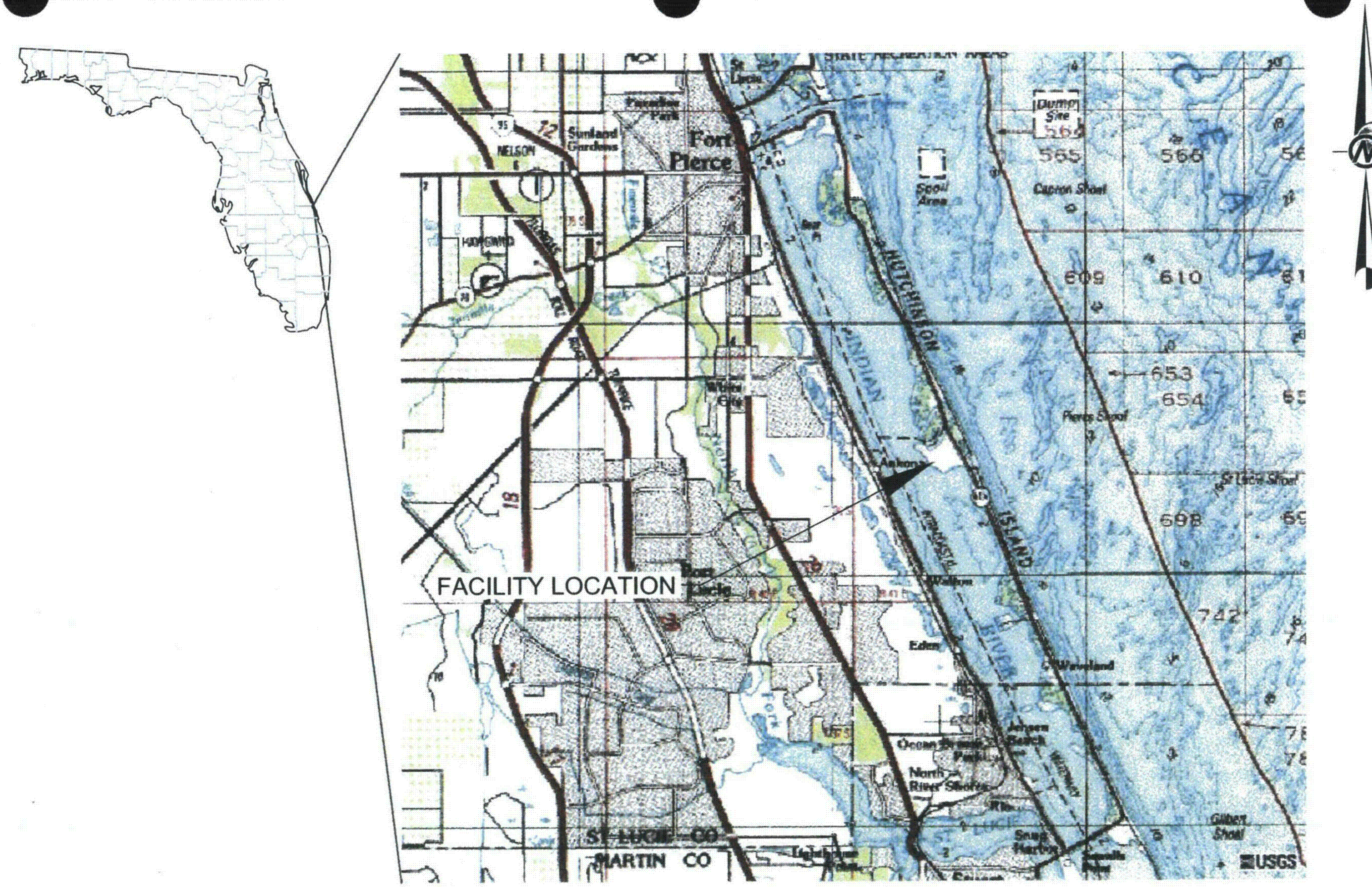
Note: See Appendix A for HZI Methodology

Maximum Day Average Design Intake Flow for CWIS 12A = 392 MGD (606.5 cfs)
Maximum Day Average Design Intake Flow for CWIS 12B = 392 MGD (606.5 cfs)
Maximum Day Average Design Intake Flow for CWIS 16A = 695 MGD (1,075.3 cfs)
Mean depth at R_{HZI} = 4 feet (NOAA Nautical Chart, 11472, 2003)

Table 7-1. Summary of Proposed Sampling Plan, FPL St. Lucie Nuclear Power Plant

Sample Type	Sampling Locations	Gear	Sample Frequency	Sample Summary
Nearfield	Atlantic Ocean • 3 locations • 2 depths (bottom and mid-depth)	Atlantic Ocean • Otter trawl	Atlantic Ocean • 2 depths • day and night • bi-weekly	Atlantic Ocean • 12 samples/event • 26 events
	IRL/Big Mud Creek • 3 locations • bottom only (mid-depth to be evaluated)	IRL/Big Mud Creek • Otter trawl	IRL/Big Mud Creek • 1 depth • day and night • bi-weekly	IRL/Big Mud Creek • 6 samples/event • 26 events
Entrainment	Intake canal headwalls • 1 location	Intake canal headwalls • 505 microns, or smaller, plankton mesh, pump fitted with a flow meter	Intake canal headwall • day and night • bi-weekly	Intake canal headwall • 2 samples/event • 26 events/year
	IRL/Big Mud Creek • 3 stations (same as nearfield trawls)	IRL/Big Mud Creek • two 20-cm diameter, 505 microns, or smaller, mesh bongo nets	IRL/Big Mud Creek • 1 tow • day and night • bi-weekly	IRL/Big Mud Creek • 6 samples/event • 26 events/year

FIGURES

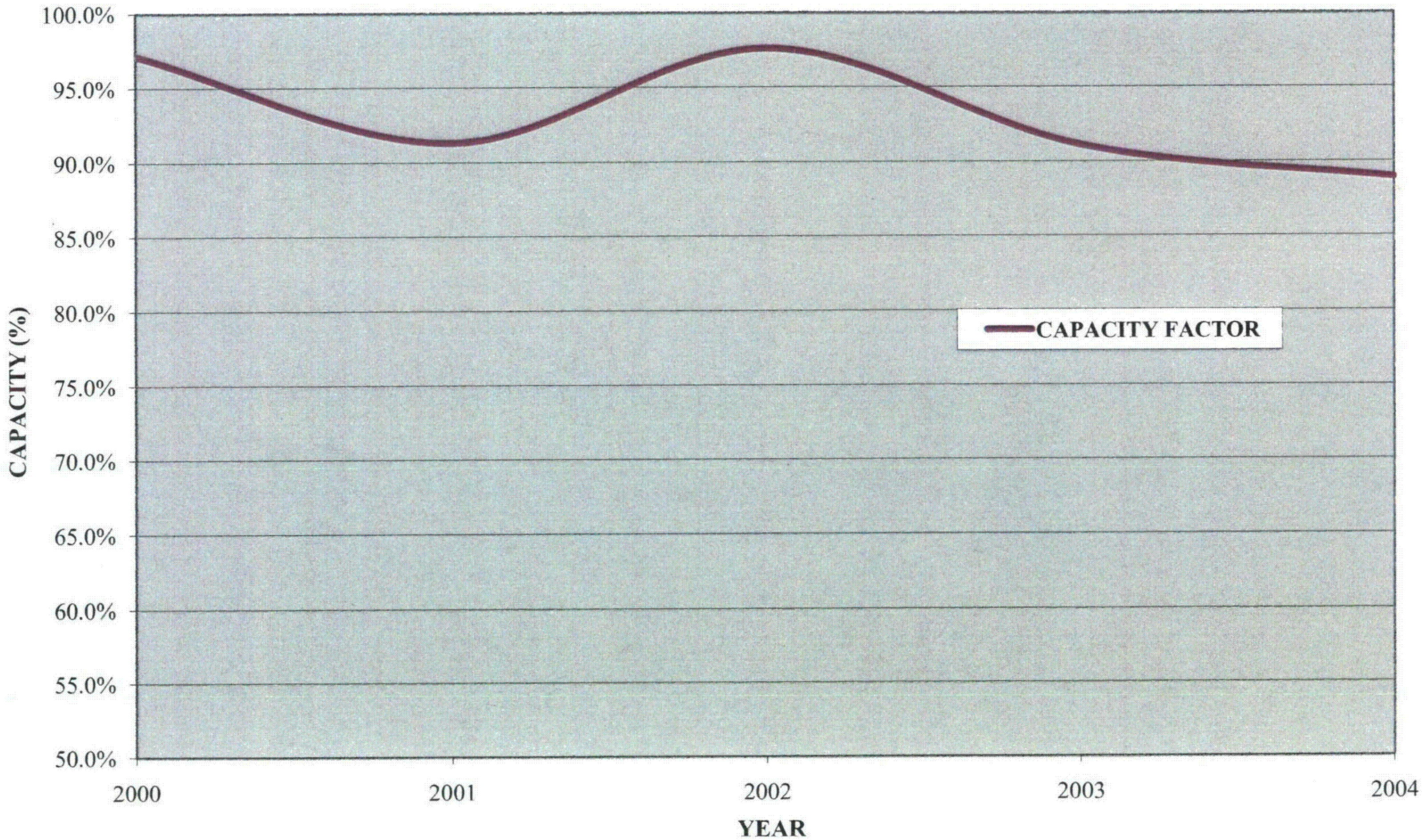


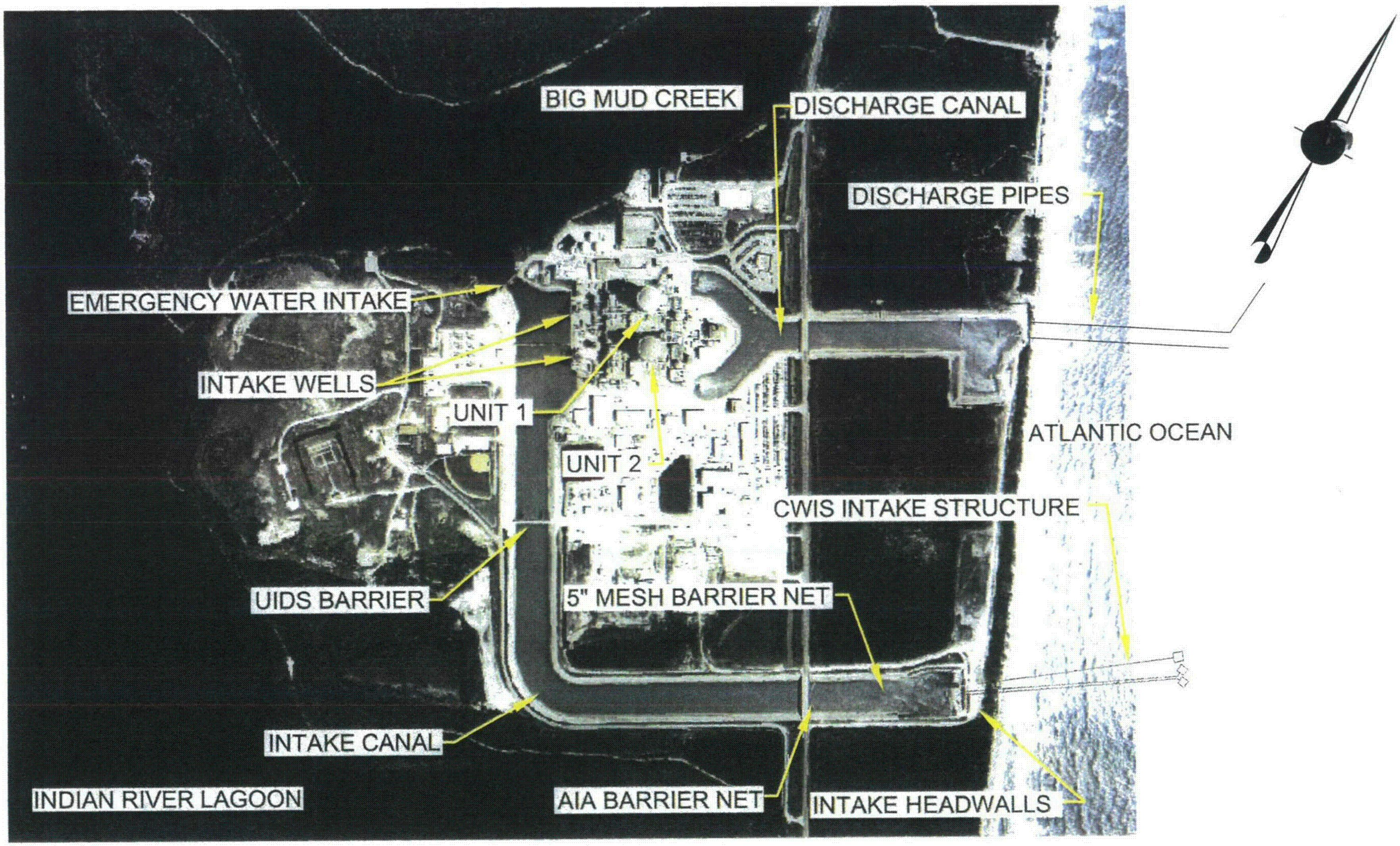
APPROXIMATE SCALE IN MILES

SOURCE: USGS 7.5 MIN QUADRANGLE MAP: ST. LUCIE, FLORIDA, PHOTOREVISED, 1985.

Golder Associates	SCALE: AS SHOWN	TITLE	
	DATE: 12/02/04	**FPL ST. LUCIE NUCLEAR POWER PLANT LOCATION MAP**	
	DESIGN		
	CADD: MAH		
FILE No. 043-7645 001.dwg	CHECK	**Proposal for Information Collection**	FIGURE **3-1**
PROJECT No. 043-7645 REV. 0	REVIEW		

Figure 3-2. FPL ST. LUCIE NUCLEAR POWER PLANT CAPACITY SUMMARY





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APPROXIMATE SCALE IN FEET

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REV.	0

TITLE

FPL ST. LUCIE NUCLEAR POWER PLANT AERIAL PHOTO

Proposal for Information Collection

FIGURE **3-3**

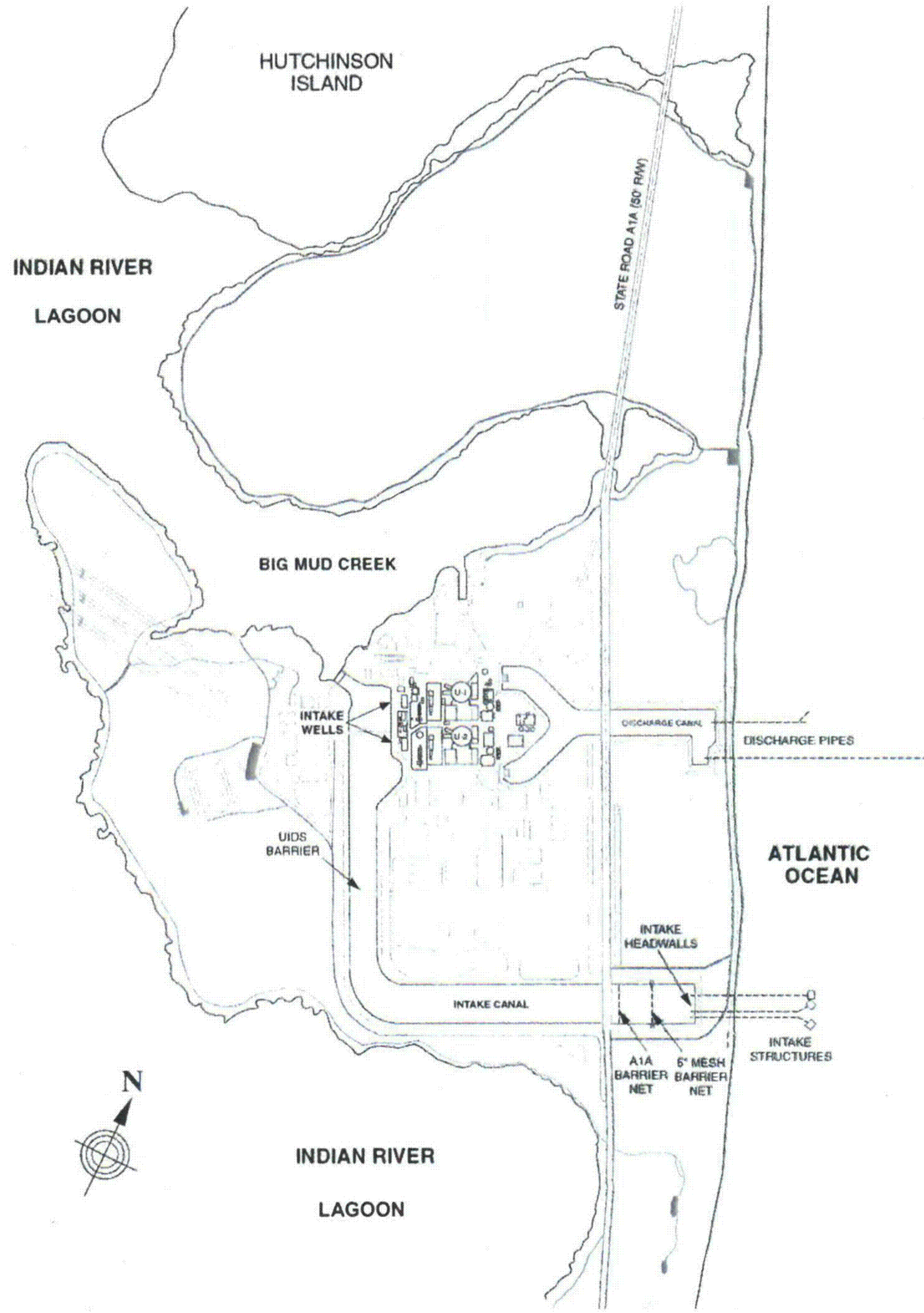


Figure 3-4. FPL St. Lucie Nuclear Power Plant facility layout showing cooling water intake and discharge system.

Source: Ecological Associates Inc., 2001

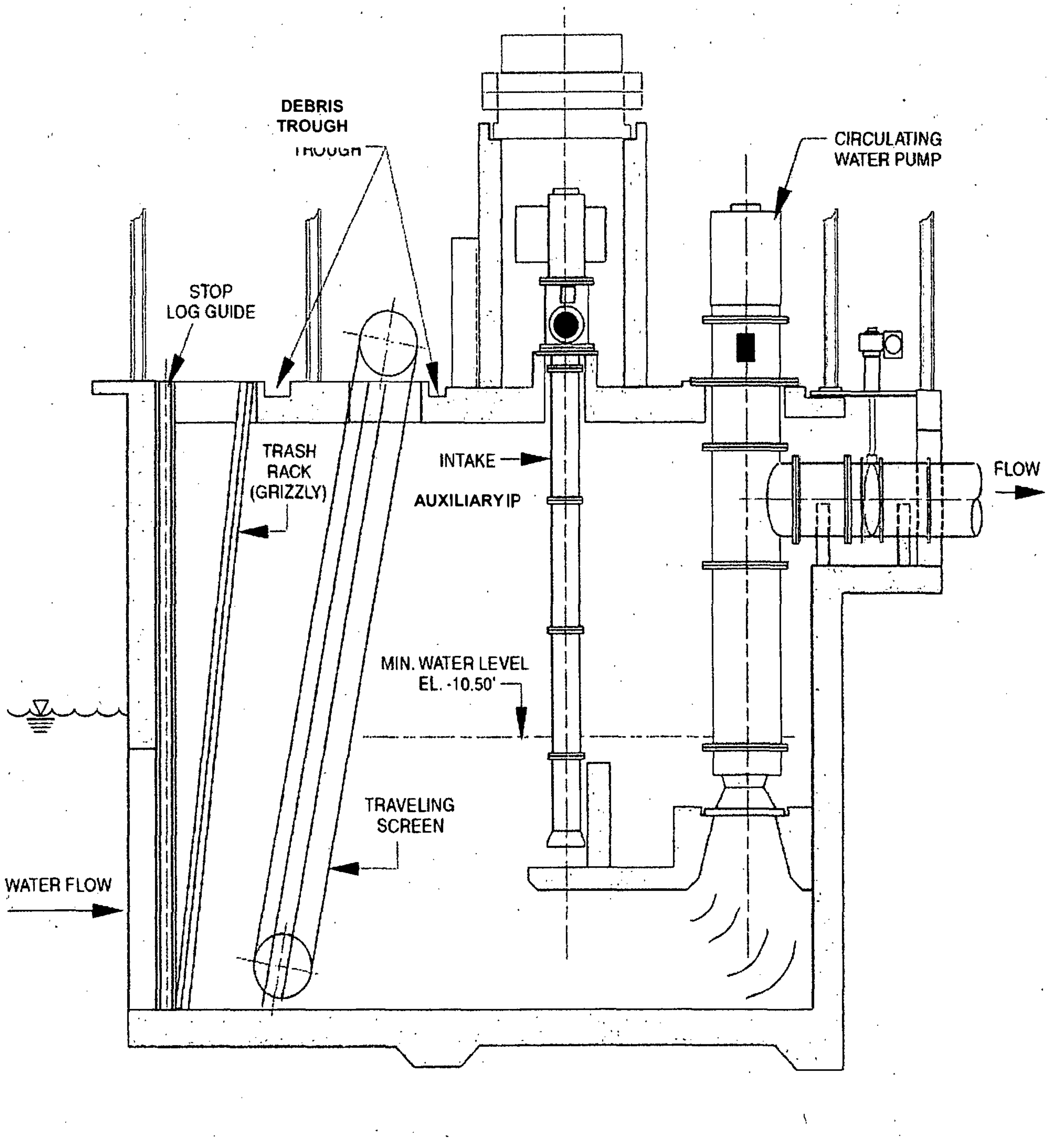


Figure 3-5 Diagram of an intake well at the FPL St. Lucie Nuclear Power Plant, Hutchinson Island, Florida.

Source: Ecological Associates Inc., 2001

Golder Associates

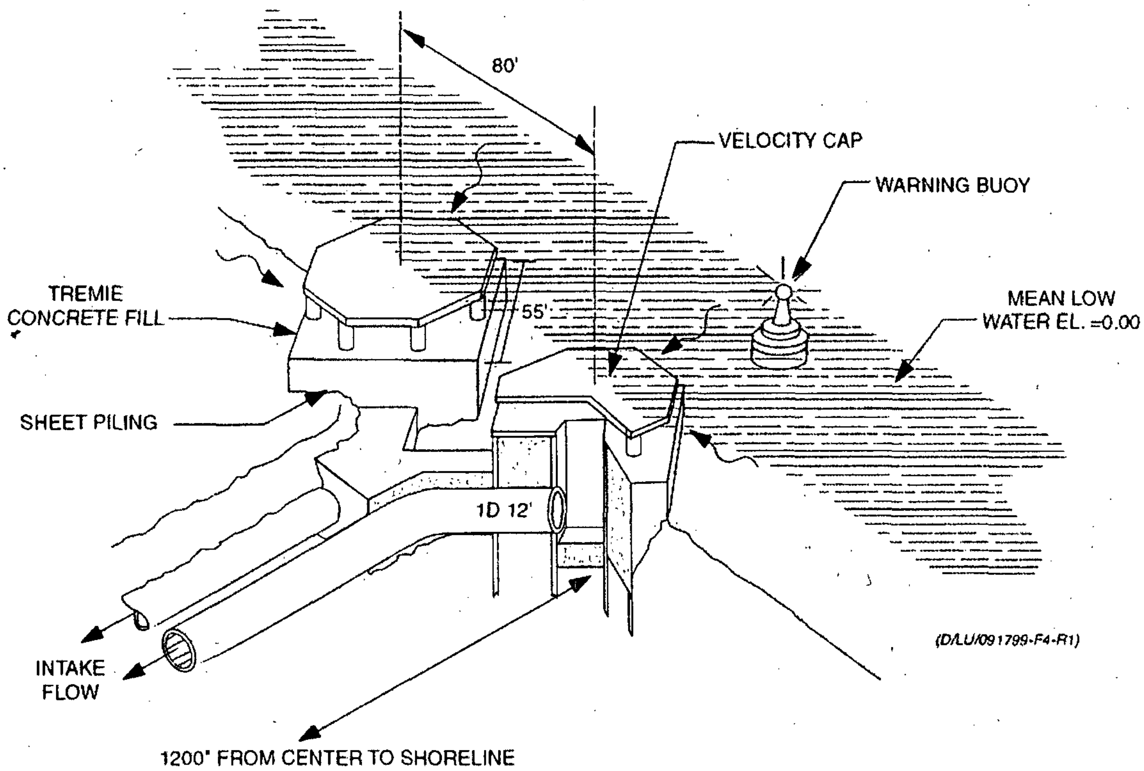


Figure 3-6. Configuration of the 12-ft diameter intake structures, FPL St. Lucie Nuclear Power Plant, Hutchinson Island, Florida

Source: Ecological Associates Inc., 2001

Golder Associates

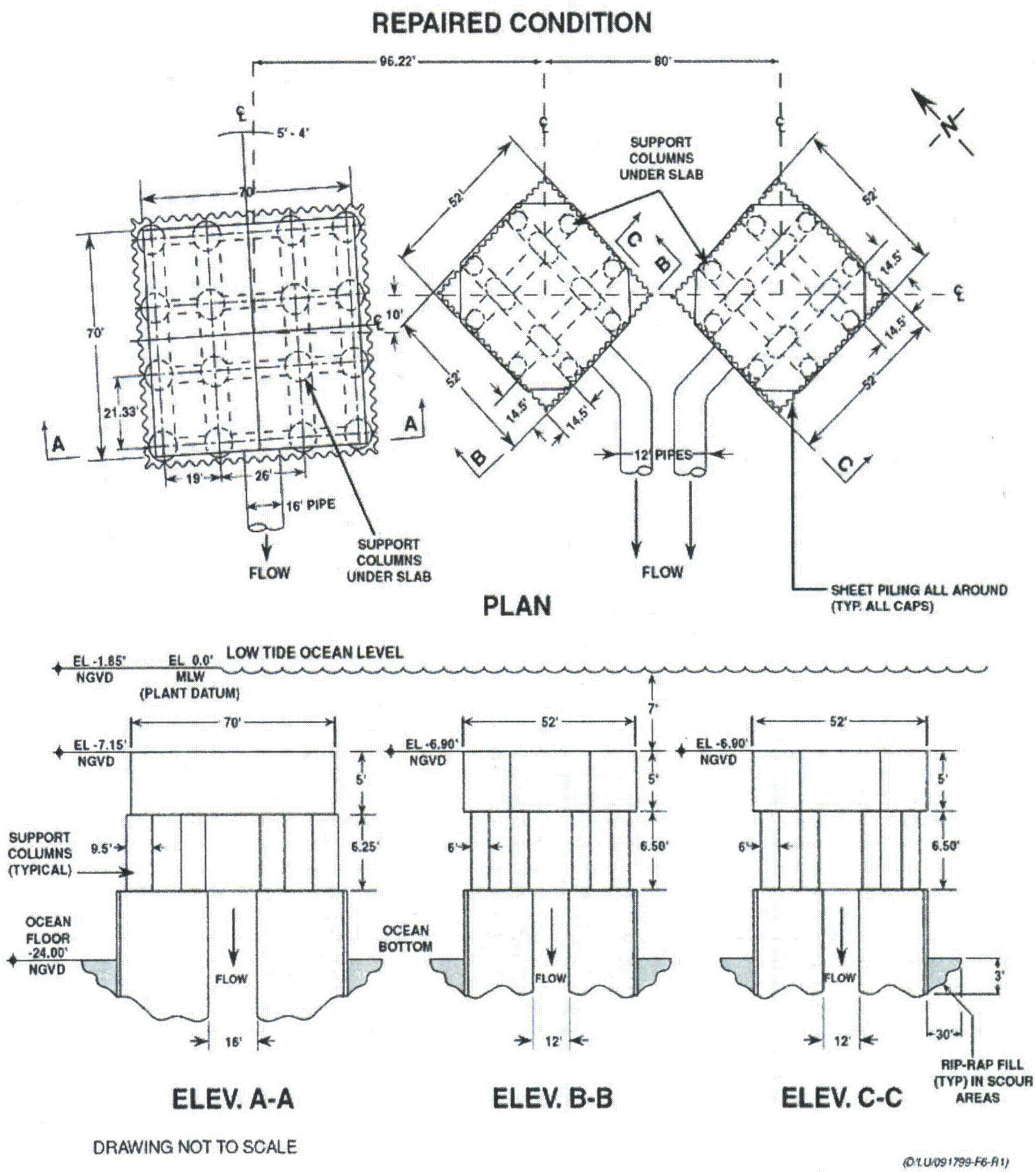


Figure 3-7. Diagram of the three intake structures located 1,200 feet offshore from the FPL St. Lucie Nuclear Power Plant, Hutchinson Island, Florida.

Source: Ecological Associates Inc., 2001.

Golder Associates

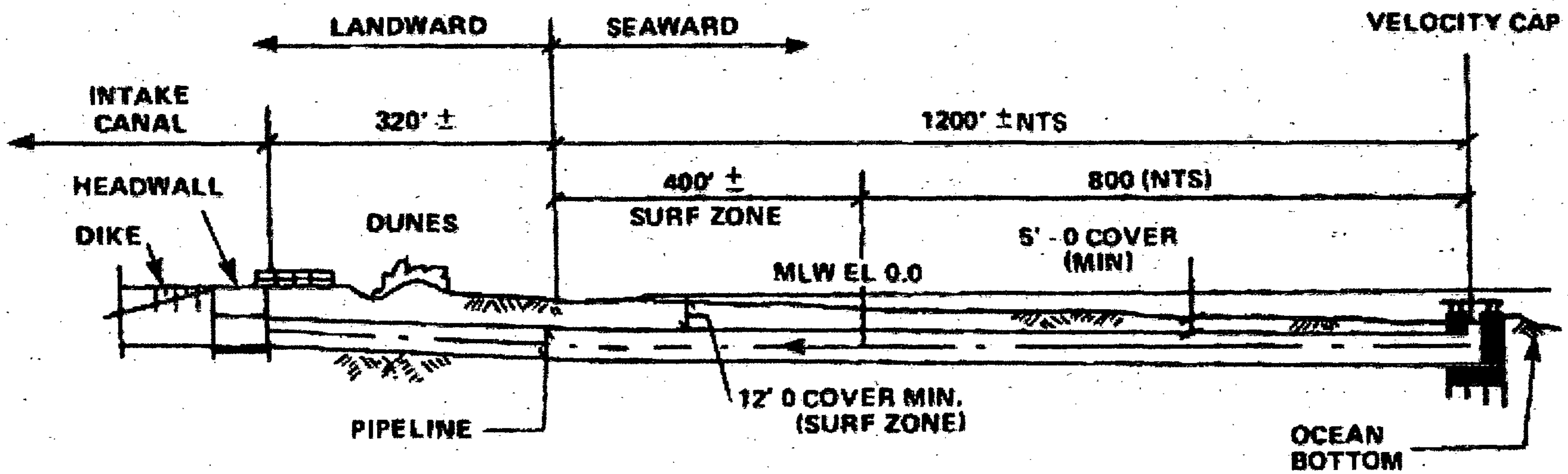
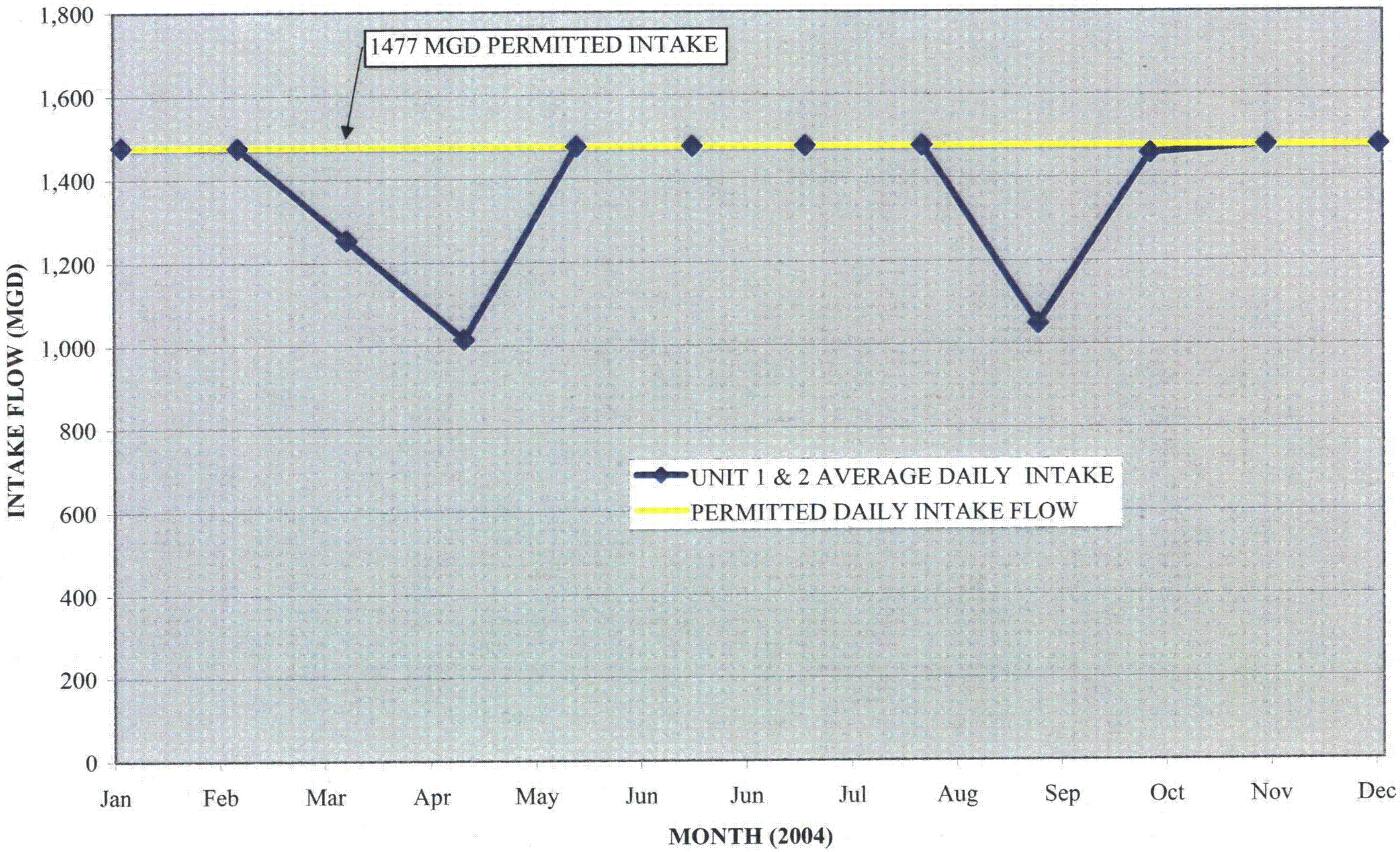


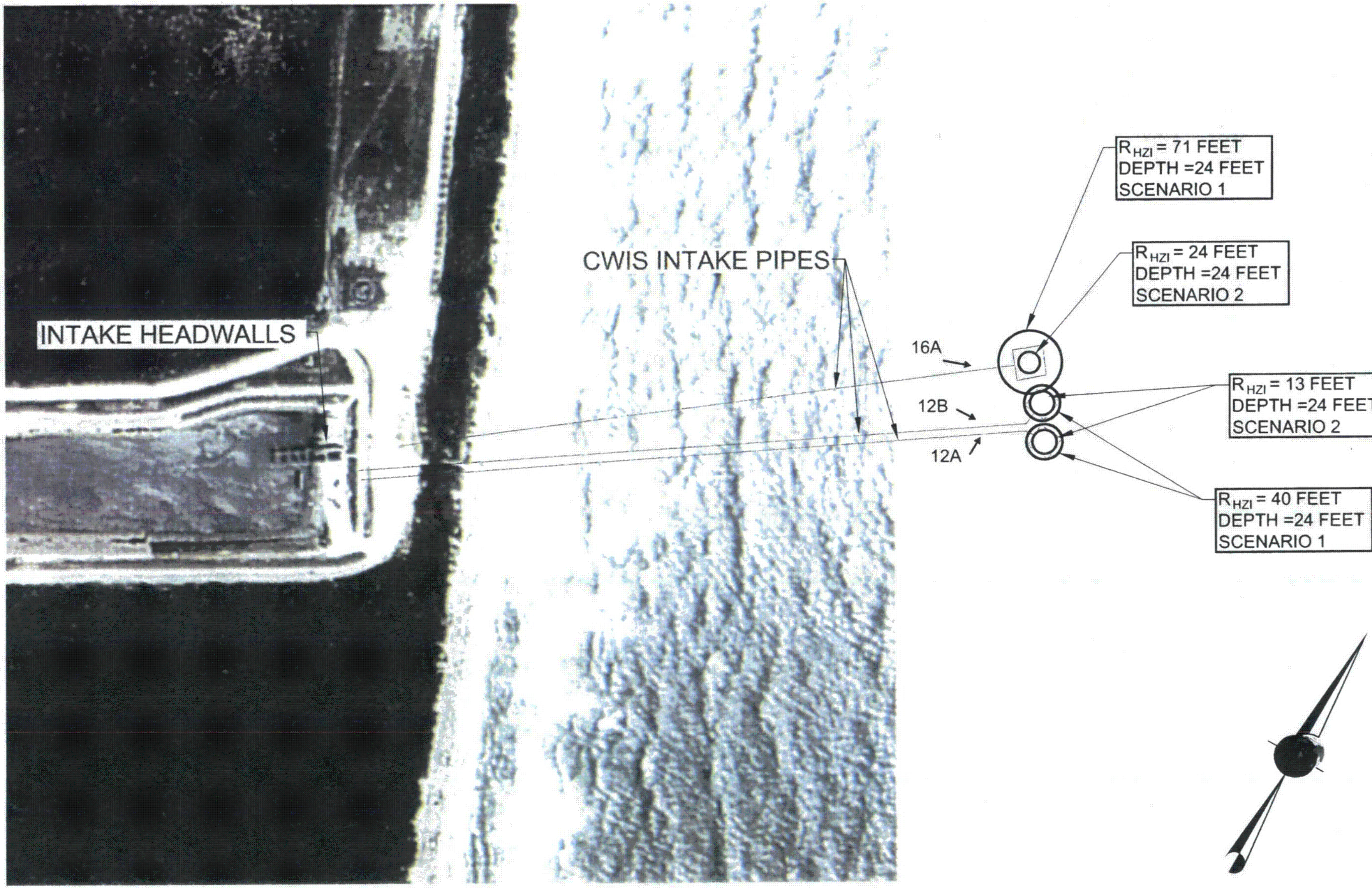
Figure 3-8 FPL St. Lucie Nuclear Power Plant Illustration of Intake Pipe.

Source: U.S. Nuclear Regulatory Commission, 1982.

Golder Associates

Figure 3-9. FPL - ST LUCIE NUCLEAR POWER PLANT
2004 MONTHLY AVERAGE DAILY INTAKE FLOW





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APPROXIMATE SCALE IN FEET

Golder Associates

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DATE	12/02/04		
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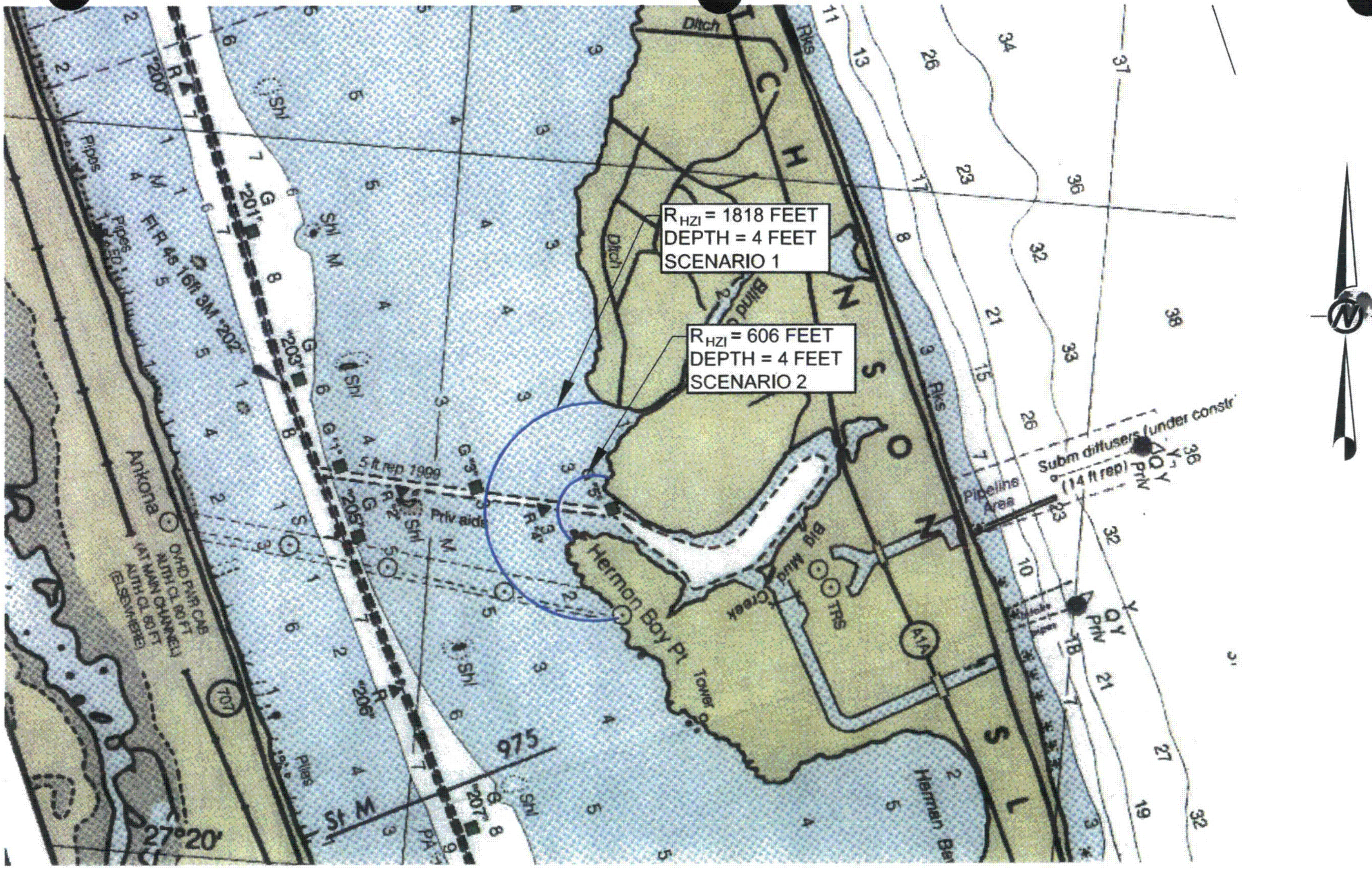
REVIEW		FIGURE	3-10

FILE No. 043-7645 001.dwg

PROJECT No. 043-7645 REV. 0



SOURCE: NOAA, NAUTICAL CHART 11472, 2003

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DESIGN			
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FILE No.	043-7645 001.dwg	CHECK	
PROJECT No.	043-7645	REV. 0	REVIEW

TITLE

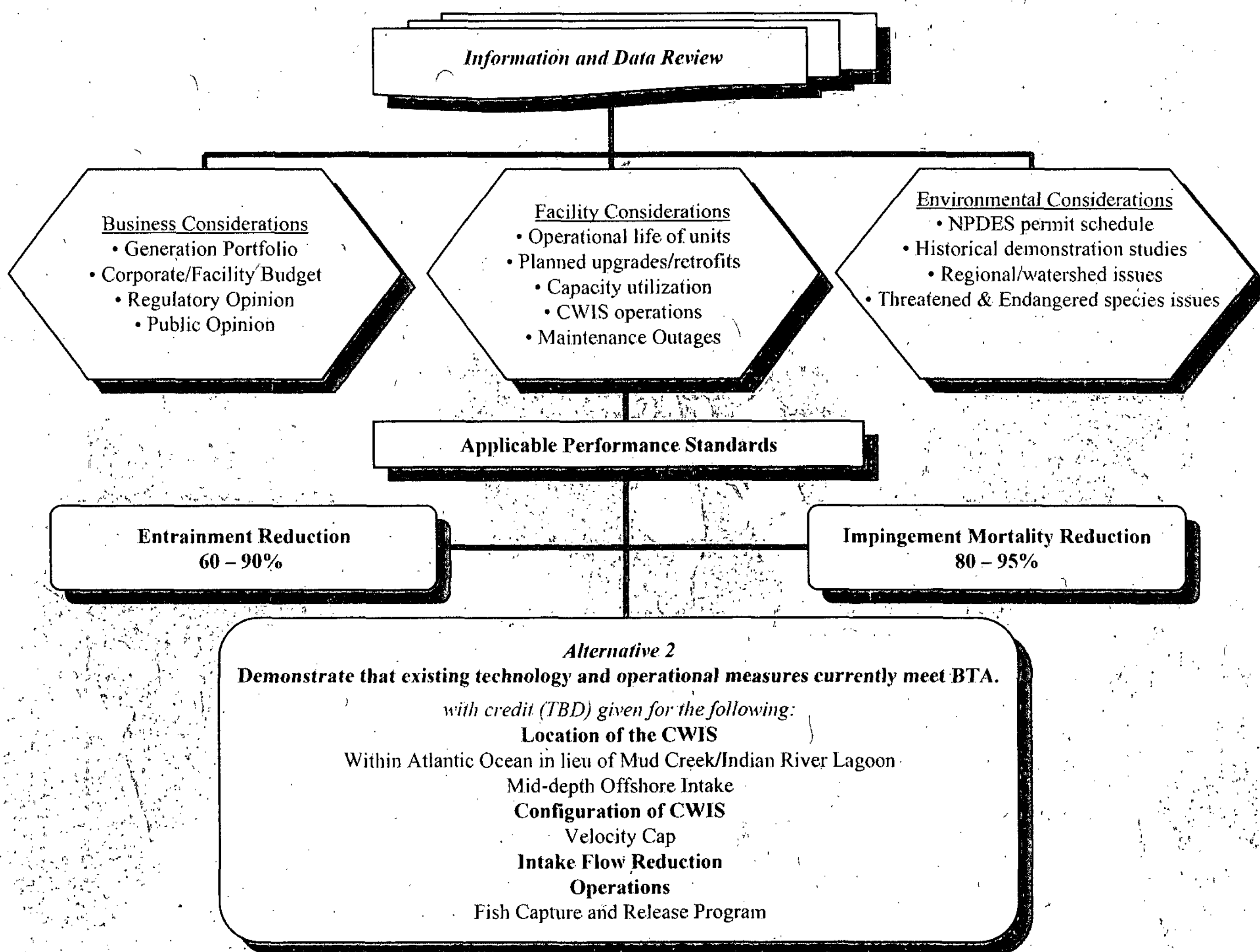
FPL ST. LUCIE NUCLEAR POWER PLANT
HYDRAULIC ZONE OF INFLUENCE
INDIAN RIVER LAGOON/BIG MUD CREEK

Proposal for Information Collection

FIGURE **3-11**

Figure 4-1
316(b) Compliance Flow Path

St. Lucie Nuclear Power Plant



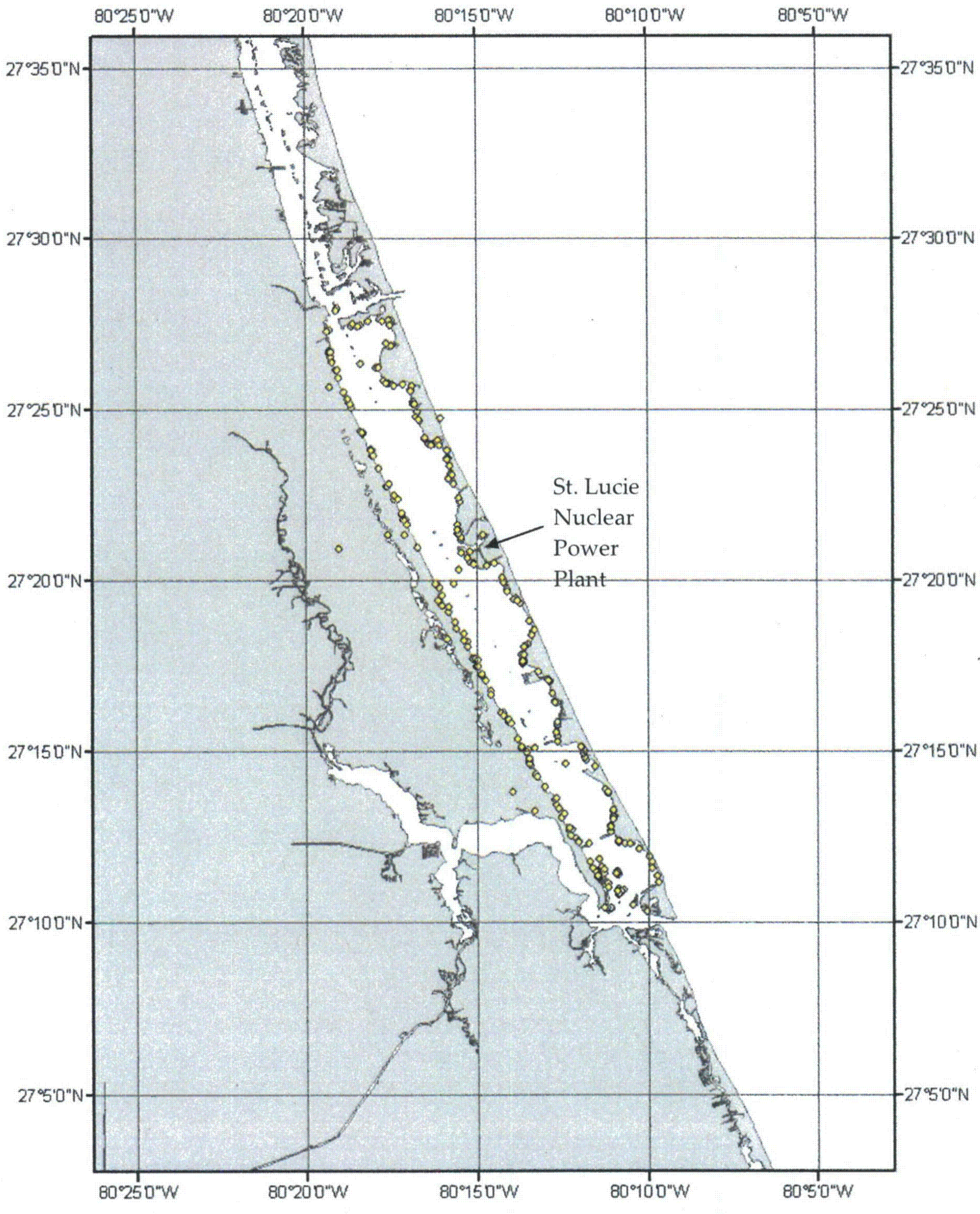


Figure 5-1. Location of sites sampled during 1997-2003 in the Indian River Lagoon by the Florida Fish and Wildlife Conservation Commission (FFWCC) as part of their Fisheries Independent Monitoring Program.

Source: Florida Fish and Wildlife Conservation Commission, 2004.

Golder Associates

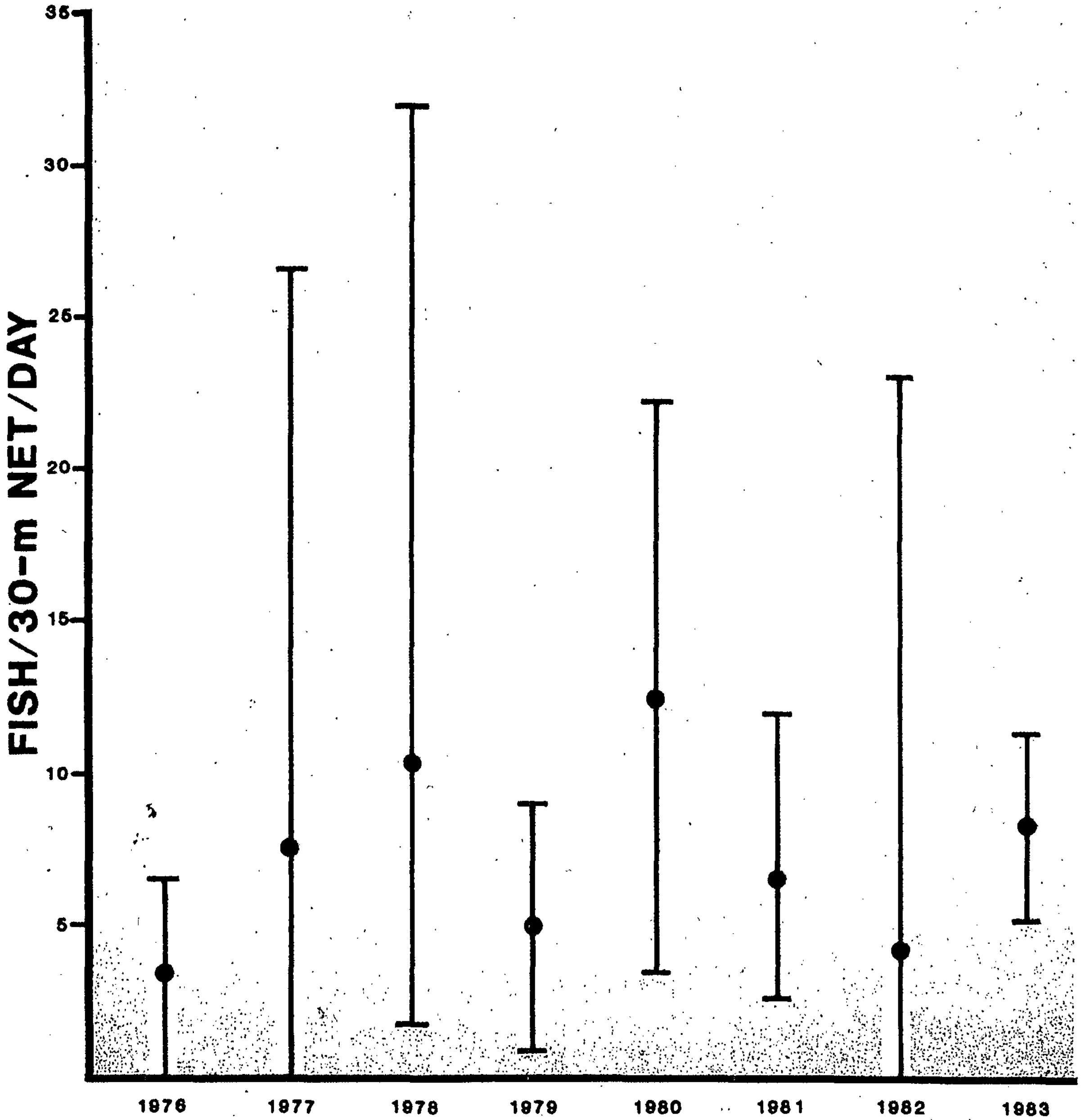


Figure 5-2. Range and mean number of fish collected per 30 m of gill net per day in the intake canal, FPL St. Lucie Nuclear Power Plant, 1976-1983.

Source: Applied Biology Inc., 1983.

Golder Associates

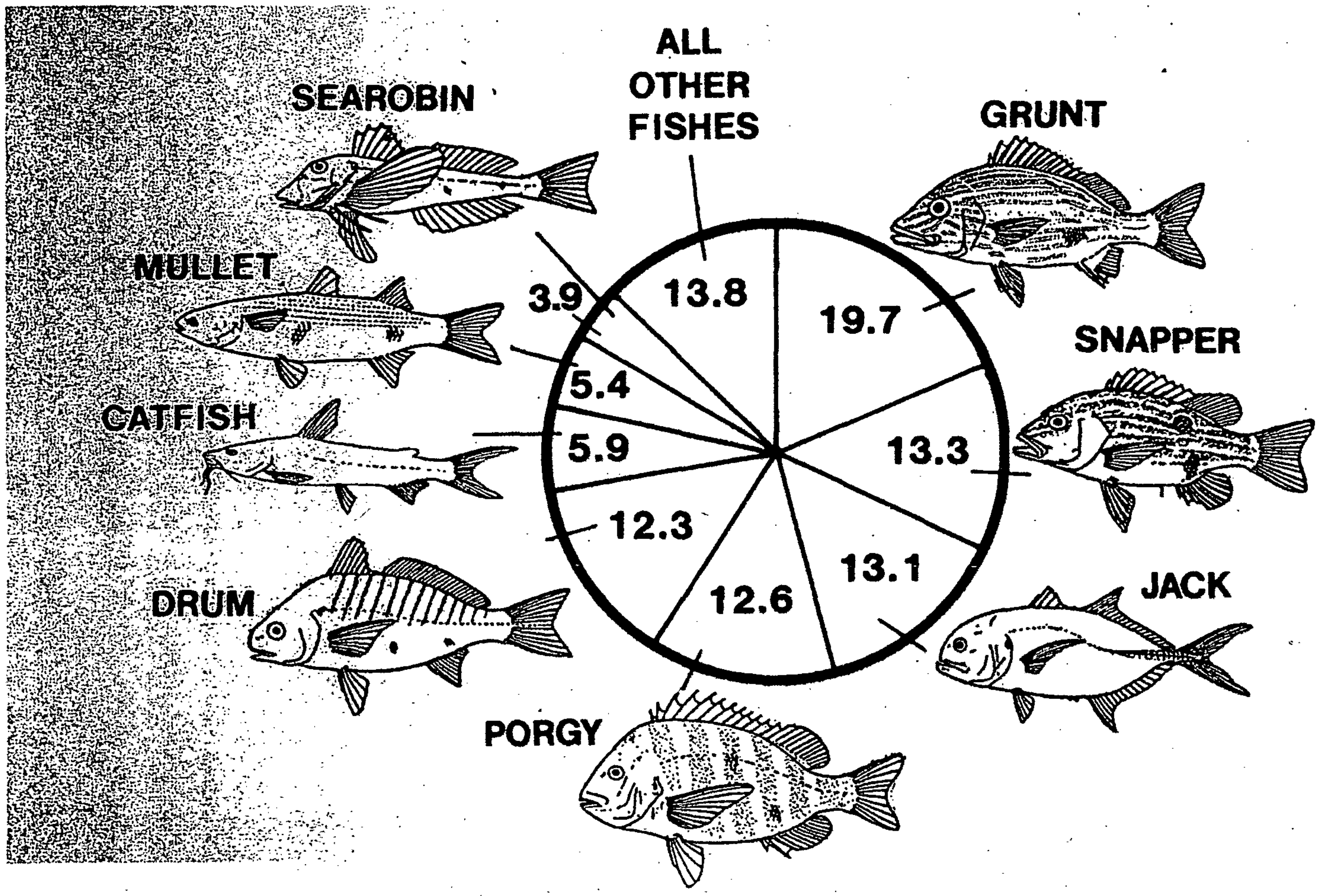


Figure 5-3. Percentage composition by number of fishes collected by gill nets in the intake canal, FPL St. Lucie Nuclear Power Plant, 1976-1983.

Source: Applied Biology Inc., 1983.

Golder Associates

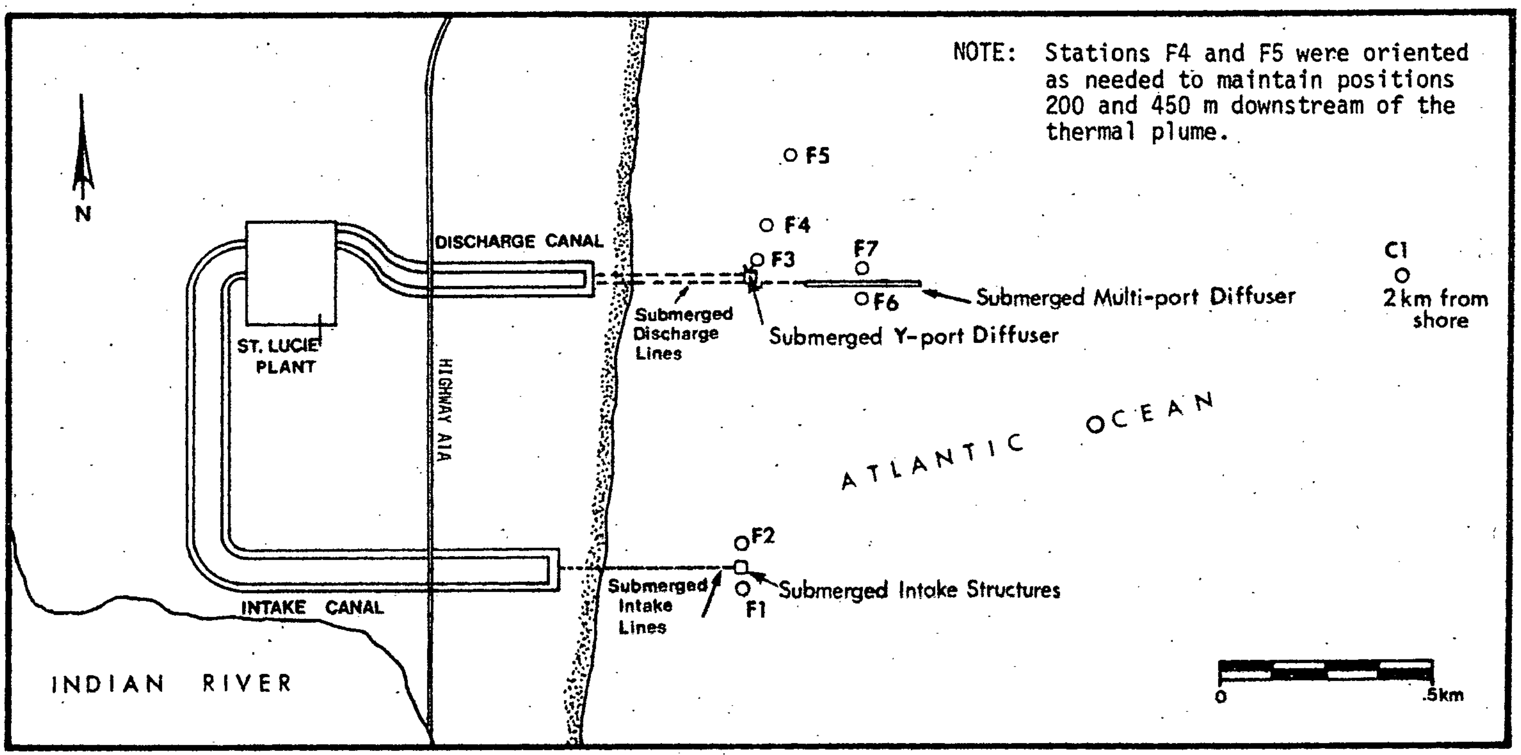


Figure 5-4. Gill net fish sampling station designations and locations, FPL St. Lucie Nuclear Power Plant non-radiological environmental monitoring.

Source: Applied Biology Inc., 1982.

Golder Associates

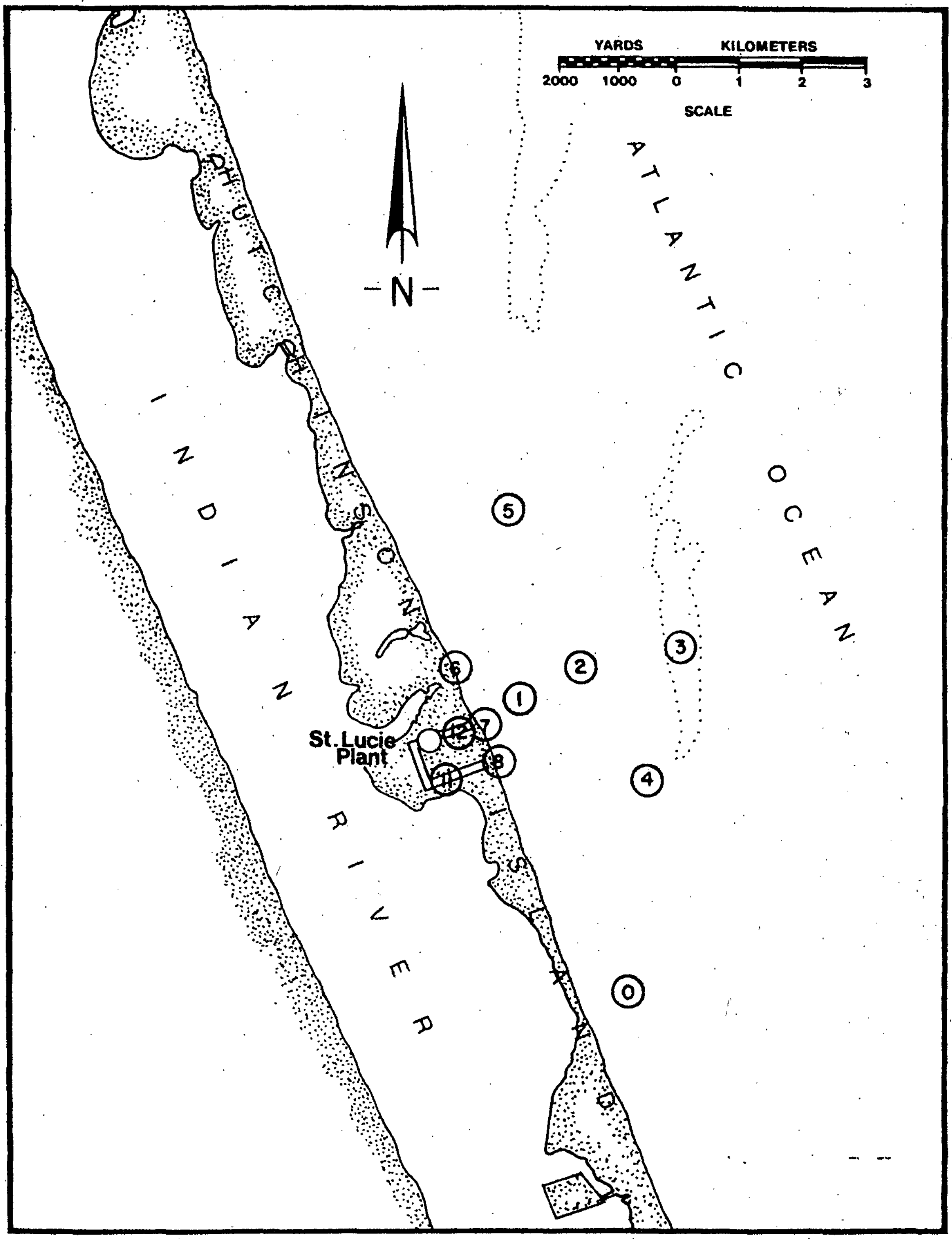
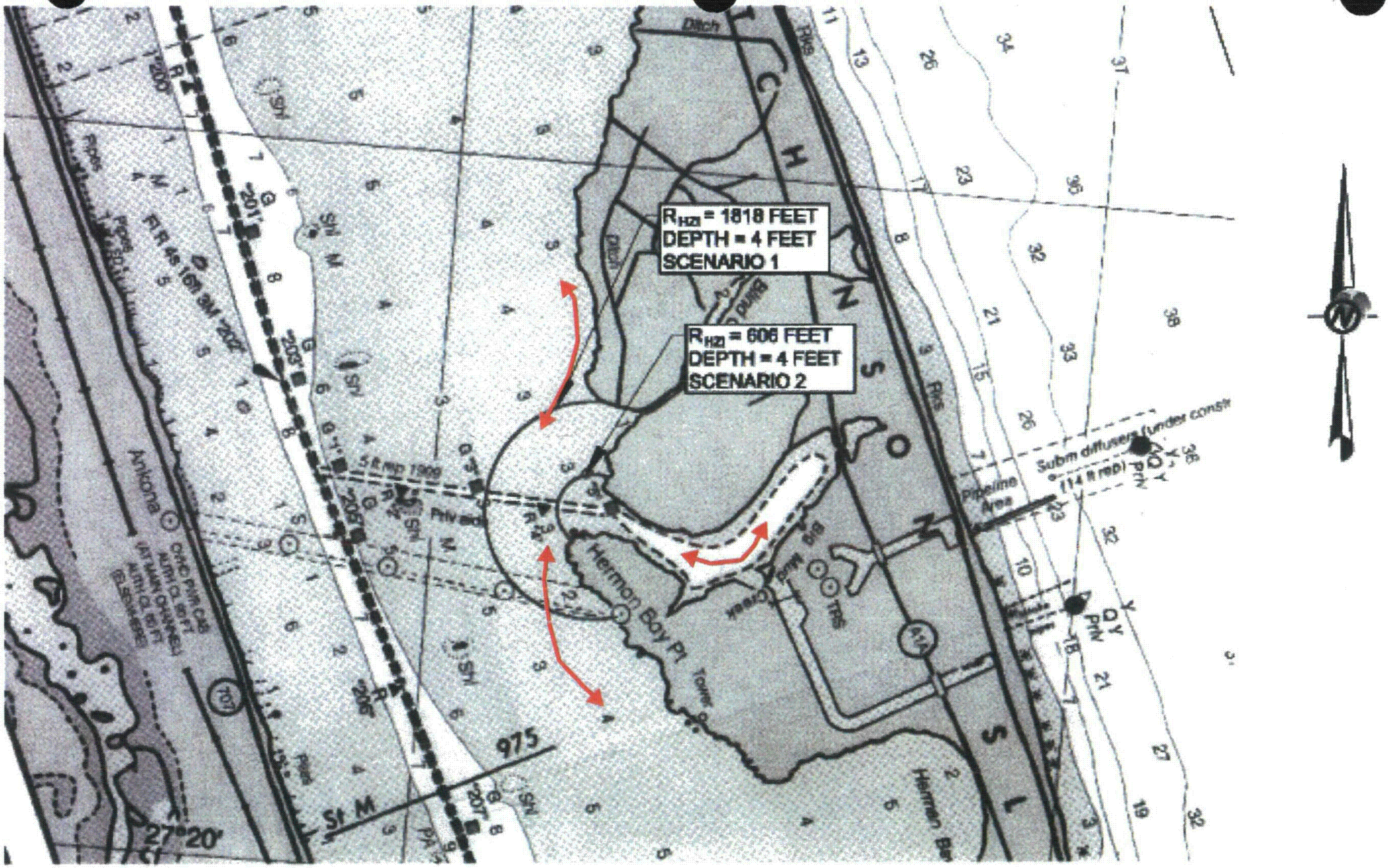


Figure 5-5. Ocean trawls, beach seine, and ichthyoplankton sampling station designations and locations, FPL St. Lucie Nuclear Power Plant non-radiological environmental monitoring, March 1976 – May 1982.

Source: Applied Biology Inc., 1982.

Golder Associates



SOURCE: NOAA, NAUTICAL CHART 11472, 2003

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SCALE FEET

Golder Associates

SCALE	AS SHOWN	TITLE	FPL ST. LUCIE NUCLEAR POWER PLANT INDIAN RIVER LAGOON/BIG MUD CREEK PROPOSED BIOLOGICAL SAMPLING STATIONS
DATE	12/02/04		
DESIGN			
CADD	MAH		
FILE No. 043-7845 001.dwg		CHECK	
PROJECT No. 043-7845	REV. 0	REVIEW	Proposal for Information Collection — FIGURE 7-1

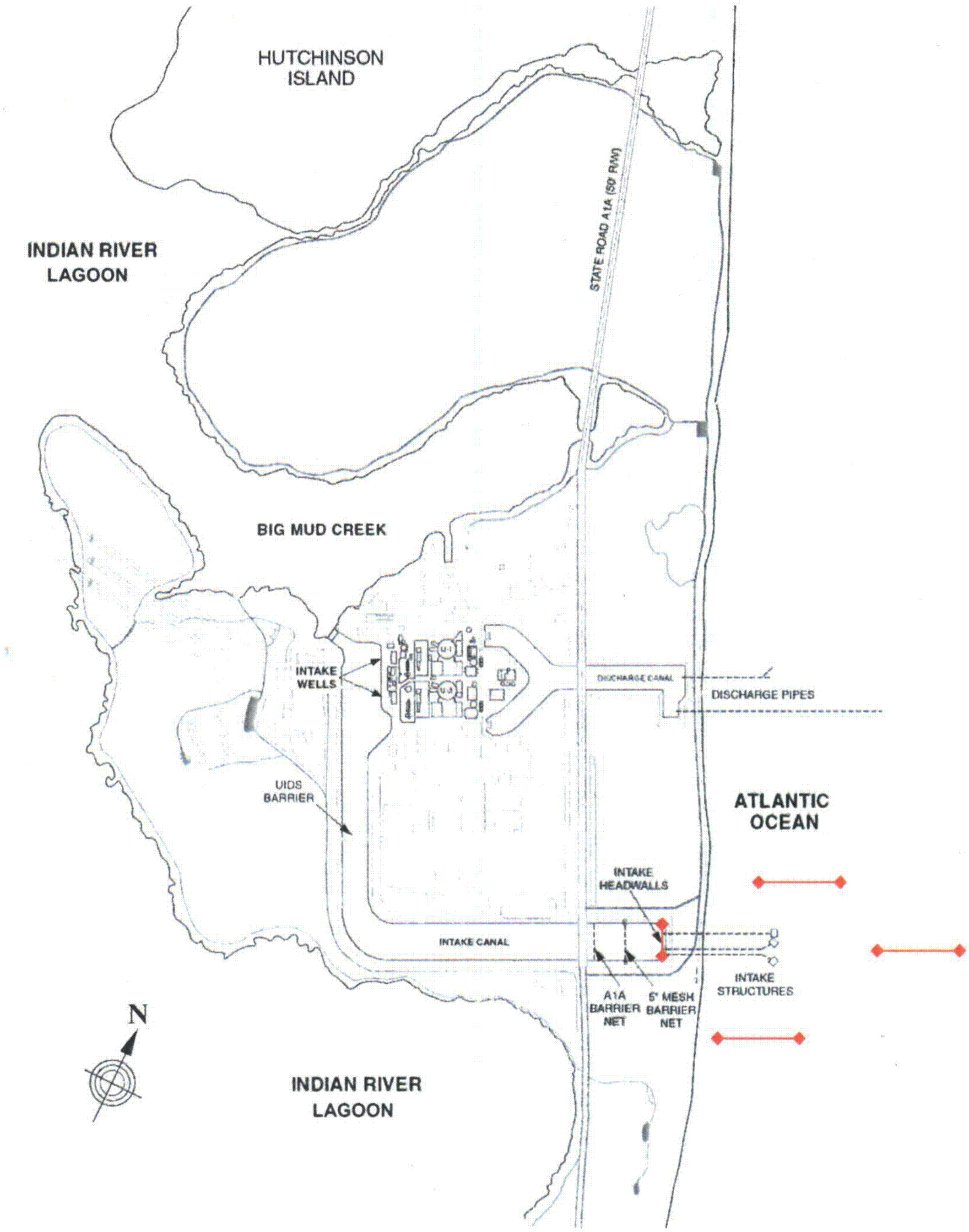

Figure 7-2. FPL St. Lucie Nuclear Power Plant Atlantic Ocean and Intake Headwalls Proposed Biological Sampling Stations

Golder Associates

Source: Ecological Associates Inc., 2001

APPENDIX A

HYDRAULIC ZONE OF INFLUENCE IN AN OPEN BODY OF WATER

APPENDIX A

HYDRAULIC ZONE OF INFLUENCE IN AN OPEN BODY OF WATER

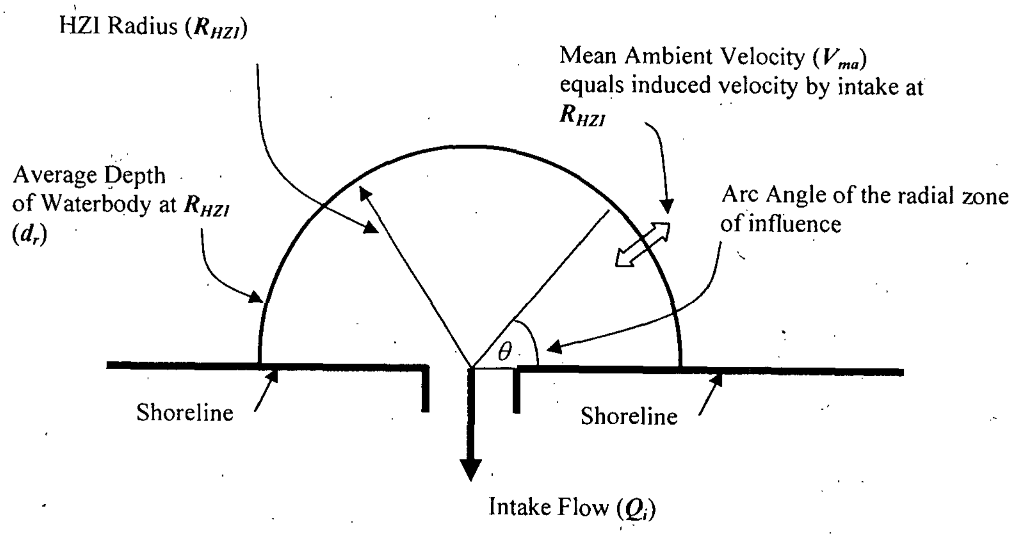

Figure 1: Hydraulic Zone of Influence Definition Sketch

In this scenario, the HZI is defined as the location where the mean ambient wind-induced velocity (V_{ma}) in the source waterbody is equal to the velocity induced by the intake. Beyond this point, the wind-induced currents will dominate the flow patterns. The radial distance from the intake structure at the shoreline to the dividing line that defines the boundary of the Hydraulic Zone of Influence in an open body of water, R_{HZI} (see definition sketch above), can be estimated from continuity using the following formulas:

$$Q_i = (180/\theta) \times \pi \times R_{HZI} \times d_r \times V_{ma} \quad (1)$$

Rearranging terms in equation (1) gives:

$$R_{HZI} = (Qi) \times (\theta/180)/(\pi \times d_r \times V_{ma}) \quad (2)$$

Wind induced surface drift velocities are typically 2 to 3 percent of the average wind speed (Wiegel, 1964). Therefore, under conditions of a gentle breeze (average wind speed of 8 - 12 miles per hour) the surface drift velocity would be 0.2 ft/s to 0.5 ft/s. The mean ambient velocity (i.e., the velocity averaged over the depth of the water column) will be less than the surface drift velocity. The relationship will depend on many factors including the speed and duration of the wind, and the depth of the water. In coastal waters, the mean velocity is typically 40 to 60 percent of the surface drift current. Therefore, 0.1 ft/s to 0.3 ft/s represent reasonable estimates of V_{ma} for wind induce currents. These values are also typical of net tidal induced currents (peak flood and ebb tide currents are often much greater). In other words, at a location where the intake induced velocity is less than 0.1 ft/s to 0.3 ft/s, the ambient wind-induced currents and/or tidal drift currents likely will dominate the flow patterns and the "hydraulic influence" of the intake will no longer be significant.

APPENDIX B

BIOLOGICAL OPINIONS FROM THE U.S. NUCLEAR REGULATORY COMMISSION

OPINION DATED MAY 30, 1997

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 30, 1997

RECEIVED
JUN - 4 1997
Nuclear Licensing

Mr. Thomas F. Plunkett
President, Nuclear Division
Florida Power and Light Company
Post Office Box 14000
Juno Beach, Florida 33408-0420

SUBJECT: SECTION 7 BIOLOGICAL CONSULTATION, BIOLOGICAL OPINION
ST. LUCIE PlANT, UNITS 1 AND 2 (TAC NOS. M92014 AND M92015)

Dear Mr. Plunkett:

Enclosed is the Biological Opinion issued by the National Marine Fisheries Service (NMFS) of the Department of Commerce on February 7, 1997. NMFS has concluded that the continued operation of St. Lucie Units 1 and 2 is not likely to jeopardize the continued existence of species listed in the opinion under their jurisdiction. However, NMFS has also concluded that operation of St. Lucie Units 1 and 2 may adversely affect these species. Therefore, NMFS has developed an Incidental Take Statement, which is included with the Biological Opinion, which includes terms and conditions necessary to monitor and minimize the lethal take of sea turtles at St. Lucie. An exploratory meeting was held at the St. Lucie site on May 7, 1997, to discuss the Biological Opinion and Incidental Take Statement.

In order for the Nuclear Regulatory Commission to fulfill its responsibility under Section 7 of the Endangered Species Act, as detailed in 50 CFR Part 402, it is requested that Florida Power and Light Company propose appropriate changes to the Environmental Protection Plan, Appendices B of the St. Lucie, Units 1 and 2, licenses, within 60 days of receipt of this letter. These proposed changes should reference the Incidental Take Statement included in the enclosed Biological Opinion and provide that reasonable and prudent measures, as detailed in items 1) through 10) of the Incidental Take Statement, will be taken.

Sincerely,

L. A. Wiens, Senior Project Manager
Project Directorate II-3
Division of Reactor Projects-I/II
Office of Nuclear Reactor Regulation

Docket No. 50-335
and 50-389

Enclosure: Biological Opinion

cc w/enclosure: See next page

Hildebrand, H. 1982. A historical review of the status of sea turtle populations in the western Gulf of Mexico, pp. 447-453 in Bjorndal, K., (ed.), Biology and Conservation of Sea Turtles. Proc. World Conf. of Sea Turtle Conserv. Smithsonian Inst. Press. Washington, D.C.

Hirth, H.F. 1971. Synopsis of biological data on the green turtle *Chelonia mydas* (Linnaeus) 1758. FAO Fisheries Synopsis. 85:1-77.

Lazell, J.D. 1980. New England waters: critical habitat for marine turtles. Copeia 1980 (2):290-295.

Mendonca, M.T. and L.M. Ehrhart. 1982. Activity, population size and structure of immature *Chelonia mydas* and *Caretta caretta* in Mosquito Lagoon, Florida. Copeia. (1):161-167.

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NMFS and USFWS. 1992. Recovery Plan for leatherback turtles in the U.S. Caribbean, Atlantic and Gulf of Mexico. NMFS, Washington, D.C.

Paladino, F.V., M.P. O'Connor, and J.R. Spotila. 1990. Metabolism of leatherback turtles, gigantothermy and thermoregulation of dinosaurs. Nature 344:858-860.

Parsons, J.J. 1962. The green turtle and man. Gainesville, University of Florida Press.

Peters, J.A. 1954. The amphibians and reptiles of the coast and coastal sierra of Michoacan, Mexico. Occ. Pap. Mus. Zool. 554:1-37.

Mr. T. F. Plunkett
Florida Power and Light Company

ST. LUCIE PLANT

cc:

Senior Resident Inspector
St. Lucie Plant
U.S. Nuclear Regulatory Commission
7585 S. Hwy A1A
Jensen Beach, Florida 34957

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Division of Emergency Preparedness
Department of Community Affairs
2740 Centerview Drive
Tallahassee, Florida 32399-2100

M. S. Ross, Attorney
Florida Power & Light Company
P.O. Box 14000
Juno Beach, FL 33408-0420

John T. Butler, Esquire
Steel, Hector and Davis
4000 Southeast Financial Center
Miami, Florida 33131-2398

Mr. Thomas R.L. Kindred
County Administrator
St. Lucie County
2300 Virginia Avenue
Fort Pierce, Florida 34982

Mr. Bill Passetti
Office of Radiation Control
Department of Health and
Rehabilitative Services
1317 Winewood Blvd.
Tallahassee, Florida 32399-0700

Patricia A. Mantanio
Acting Director
Office of Protection Resources
Natinal Marine Fisheries Service
Silver Spring, MD 20910

Regional Administrator
Region II
U.S. Nuclear Regulatory Commission
61 Forsyth Street, SW., Suite 23T8
Atlanta, GA 30303-3415

H. N. Paduano, Manager
Licensing & Special Programs
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J. A. Stall, Site Vice President
St. Lucie Nuclear Plant
6351 South Ocean Drive
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Mr. J. Scarola
Plant General Manager
St. Lucie Nuclear Plant
6351 South Ocean Drive
Jensen Beach, Florida 34957

Mr. Kerry Landis
U.S. Nuclear Regulatory Commission
61 Forsyth Street, SW., Suite 23T8
Atlanta, GA 30303-3415

E. J. Weinkam
Licensing Manager
St. Lucie Nuclear Plant
6351 South Ocean Drive
Jensen Beach, Florida 34957

BIOLOGICAL OPINION

ENCLOSURE

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, Maryland 20910

FEB 7 1997

Mr. Dennis M. Crutchfield
Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Dear Mr. Crutchfield:

Enclosed is the Biological Opinion (Opinion) in response to the Nuclear Regulatory Commission's (NRC) request for reinitiation of consultation under Section 7 of the Endangered Species Act (ESA) regarding the continued operation of the St. Lucie Nuclear Generating Plant (Plant).

A series of meetings and discussions were held in May 1995, between the NRC, Florida Power & Light (FPL), Florida Department of Environmental Protection (FLDEP) and the National Marine Fisheries Service (NMFS) due to a large increase in the frequency of small green turtles taken incidentally and occasionally killed by entrapment in the Plant's cooling water intake structure. This opinion considers the effects on listed species of the continued operation of the circulating seawater cooling system at the Plant, the capture-release program for sea turtles entrapped in the Plant's intake canal, the associated sea turtle conservation and monitoring programs, and the assessment submitted by the NRC. FPL's installation of a modified barrier net, completed in January 1996 as a requirement identified during early consultation to reduce the passage of sea turtles into the intake structure was also evaluated. The enclosed opinion is based on the best available information and concludes that the continued operation of the Plant may adversely affect, but is not likely to jeopardize, the continued existence of listed species under NMFS jurisdiction.

An Incidental Take Statement is included with this opinion. Variability in the rate of turtle entrapment at the Plant is considered to be primarily a function of the local abundance of turtles, since the operational characteristics of the intake structures have remained constant over the years. In recent years, green turtle entrapment has increased at a dramatic and unpredicted rate and may continue to increase. Therefore, no maximum level will be specified for non-lethal takes through entrapment, capture, and release of any species of turtle. NMFS will continue to monitor the level of turtle entrapment reported by FPL and relate the capture rates to other indices of turtle abundance. However, lethal take levels have been established based on historical numbers of observed lethal takes.

Two lethal take levels are specified; a fixed level of the number of turtles of each species entrapped during the calendar year, and a percentage of the number of turtles of each species entrapped during the calendar year. The allowable lethal take level will be the greater of the two numbers, considering the prevailing entrapment rates. These levels provide for increased total numbers of lethal takings as entrapment levels increase, but restrict the proportion of lethal takes based on historical averages. The following annual incidental lethal take levels are established:

1. 2 loggerheads or 1.5 percent of the total number of loggerheads entrapped at the intake canal, whichever is greater;
2. 3 greens or 1.5 percent of the total number of greens entrapped at the intake canal, whichever is greater;
3. 1 Kemp's ridley or 1.5 percent of the total number of Kemp's ridleys entrapped at the intake canal, whichever is greater;
4. 1 hawksbill or 1.5 percent of the total number of hawksbills entrapped at the intake canal, whichever is greater;
5. 1 leatherback or 1.5 percent of the total number of leatherbacks entrapped at the intake canal, whichever is greater.

The Incidental Take Statement includes terms and conditions necessary to monitor and minimize the lethal take of sea turtles at the Plant. These terms and conditions, with one exception, are generally consistent with current practices at the Plant, but are nonetheless specified as requirements to ensure against degradation of the sea turtle monitoring program in the face of other cutbacks in FPL's environmental programs. [redacted] conditions are implemented. Therefore, it is recommended that NRC include these terms and conditions as part of any permit issued to FPL.

This concludes consultation responsibilities under Section 7 of the ESA. Reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in the incidental take statement is exceeded, (2) new information reveals effects of the action that may affect listed species or critical habitat (when designated) in a manner or to an extent not previously considered, (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the opinion, or (4) a new species is listed or critical habitat designated that may be affected by the identified action. However, if take levels are approached, NRC, in conjunction with FPL, should contact NMFS to re-evaluate impacts and to discuss whether reinitiation of consultation is necessary in order to avoid unlawful takes.

Please call David Bernhart, Protected Species Branch, Southeast Region, at (813) 570-5312, if you have questions regarding any information discussed above or enclosed in the opinion.

Sincerely,

Patricia A. Montanio
Acting Director,
Office of Protected Resources

Enclosure

cc: Gary L. Bouska - St. Lucie Power Plant

ENDANGERED SPECIES ACT

SECTION 7 CONSULTATION

BIOLOGICAL OPINION

Agency:	U.S. Nuclear Regulatory Commission
Activity:	Reinitiation of Consultation in accordance with Section 7(a) of the Endangered Species Act regarding the continued operation of the Circulating Water System of the St. Lucie Nuclear Generating Plant
Consultation Conducted by:	National Marine Fisheries Service Southeast Regional Office
Date Issued:	FEB 7 1997

Background

The St. Lucie Nuclear Power Plant is located on South Hutchinson Island, Florida between the Atlantic Ocean and the Indian River. Florida Power & Light Company (FPL) operates the St. Lucie Plant while the U.S. Nuclear Regulatory Commission (NRC) maintains Federal regulatory authority. The plant consists of two 839 megawatt electrical, nuclear-fueled, Pressurized Water Reactors, Units 1 and 2, beginning commercial operation in February 1977 and August 1983, respectively.

The Atlantic Ocean provides cooling waters for and receives discharge waters from the condensers and auxiliary cooling systems of the plant via piping systems that run beneath the ocean beach. Sea water is drawn through three separate intake structures and pipes into a 5000 ft long cooling water canal. At the end of the canal, water is drawn into each unit of the plant at the intake wells. Sea turtles encountering the ocean intake structures can be drawn through the intake pipes with the cooling water and become entrapped or impinged and must be removed through a capture-release program run by FPL. Entrapment occurs when an organism enters a confined area and cannot escape, therefore, turtles entering the intake canal cannot escape and are considered to be entrapped. Impingement occurs when an organism is carried by currents and pinned to a water intake structure or barrier, and in the case of a power plant, the trash racks and/or the traveling screens system in the intake wells are the points of impingement.

All five species of sea turtles occurring in the southeastern United States have been documented in the intake canal, and fatalities from various causes have resulted or been observed for three of those five species. In the original evaluation of the environmental impact of St. Lucie Unit 1, sea turtle entrapment and impingement were not evaluated (U. S. Atomic Energy Commission, 1974), and the turtle entrapment and impingement experienced when St. Lucie Unit 1 began commercial operation in 1977 was unexpected. To facilitate the capture of entrapped turtles and to prevent turtles from moving down the canal system toward the plant, a large mesh barrier net was erected in 1978. A mesh size of 8 in. (20.3 cm) by 8 in. was chosen to exclude 95 percent of the turtles, based on the size frequency of turtles captured in the canal before March 1978. A Biological Assessment and a Section 7 consultation were completed in 1982 for St. Lucie Unit 2, which resulted in a no-jeopardy opinion but which made no provisions for mortality. This assessment was based on the entrapment history of the plant from 1976 through 1981 which had been approximately 150 turtles per year. As part of this evaluation, the 8 in. (20.3 cm) square mesh barrier net was determined appropriate to exclude turtles from the plant's intake wells. Also a research program to investigate methods to physically or behaviorally exclude turtles from the offshore intake structures was conducted as part of the Environmental Protection Plan of Unit 2 and concluded that there was no practical method to accomplish this goal (Florida Power & Light, 1985).

Since 1993, FPL has documented significant increases in the numbers of entrapped turtles. A principal component of this increase was juvenile green turtles with carapace widths less than 12 in. (30 cm). In 1995, 673 green turtles, mostly juveniles, were captured. Before 1993, the maximum number of green turtles captured annually at the St. Lucie Plant was 69. This is a marked increase over the record 1994 levels of 193 green turtles. With the increase in the number of turtles handled and the decrease in the average size of the turtles, more green turtles have been able to penetrate the 8 in. (20.3 cm) mesh barrier net and pass down the canal to be entrained in the intake structures of the plant. The entrainment level peaked in 1995, when 97 turtles (14 percent of the turtles captured) were removed from the intake wells of the plant.

Based on the increasing number of sea turtles captured at the St. Lucie Plant, the NRC determined that reinitiation of formal Section 7 consultation with NMFS was required and informed the NMFS Southeast Regional Office of this determination in a May 11, 1995 letter. The NRC submitted a Biological Assessment to NMFS on February 7, 1996. In addition, FPL has installed a new barrier net with 5 in. (12.7 cm) bar length webbing to prevent the passage of small turtles through the existing 8 in. net to the intake wells of the plant. Installation of the new barrier net was identified as a mitigation measure early in the consultation process, when methods to reduce entrainment were first discussed. FPL implemented this requirement before completion of the Section 7 consultation.

Proposed action

The proposed actions considered in this Biological Opinion are the continued operation of the circulating seawater cooling system at the St. Lucie Nuclear Power Plant licensed by NRC, the capture-release program for sea turtles which become entrapped in the plant's intake canal, and the associated sea turtle conservation and monitoring programs. A description of these activities follows.

Circulating Water System

The Atlantic Ocean provides cooling and receiving waters for each unit's condenser and auxiliary cooling systems. These systems share common intake and discharge canals with ocean piping.

Major components of these canals and ocean piping systems are: 1) three ocean intake structures and associated velocity caps located approximately 1200 ft (365 m) from the shore line; 2) three buried intake pipelines to transport water from the intake structure to the intake canal (one pipeline is 16 ft (4.9 m) in diameter, and two are 12 ft (3.65 m) in diameter); 3) a common intake canal to convey sea water to each unit's intake structure; 4) individual unit intake structures; 5) discharge structures for each unit; 6) a common discharge canal; 7) one discharge pipeline to convey water offshore to a "Y" diffuser (12 ft [3.65 m] diameter pipeline) approximately 1200 ft (365 m) offshore and another pipeline to convey water offshore to a multiport diffuser (16 ft (4.9 m) diameter pipeline; solid pipeline from shoreline to approximately 1200 ft (365 m) offshore and then the multiport diffuser segment from approximately 1200 to 2400 ft (365-730 m) offshore.

The design unit flow for Units 1 and 2 is 1150 cubic ft per second (32.6 m^3/sec) with maximum and normal temperature rise across the condensers of 31 °F and 25 °F (17°-13° C), respectively (Bellmund *et al.*, 1982).

<u>Intake Structures and Velocity Caps</u>

In 1991-1992, all three velocity caps were rebuilt due to the failure of several panels comprising the caps. The intake structures are located approximately 1200 ft (365 m) offshore and about 2400 ft (731 m) south of the discharge structures. The intake structures have a vertical section to minimize sand intake and a velocity cap to minimize fish entrapment, but no screens or grates are used to deny organisms access to the intake pipes. The tops of the intake structures are approximately 7 ft (2.1 m) below the surface at mean low water. The velocity cap for the 16 ft (4.9 m) diameter pipe is 70 ft (6.5 m) square, 5 ft (1.5) thick, and has a vertical opening of 6.25 ft (1.9 m). The velocity cap for the two 12 ft (3.65) diameter pipes is 52 ft (4.8 m) square, 5 ft (1.5 m) thick, and has a vertical opening of 6.5 ft (2.0 m).

The flow velocities at various locations of the velocity cap and intake structures have been calculated under various levels of biological fouling. The minimum and maximum horizontal intake velocities at the face of the ocean intake structures for the 12 ft (3.65 m) diameter pipe is calculated at 0.37-0.41 ft/sec

(11.2-12.6 cm/sec) and for the 16 ft (4.9 m) diameter pipe is calculated at 0.92-1.0 ft per second (28.3-30.5 cm/sec). As the water passes under the velocity cap, flow becomes vertical and the velocity increases to approximately 1.3 ft/sec (40.2 cm/sec) for the 12 ft (3.65 m) diameter pipe and 6.8 ft/sec (206 cm/sec) for the 16 ft (4.9 m) diameter pipe (Bellmund *et al.*, 1982).

Intake Pipes
From the ocean intake structures, water flows through the three buried pipelines of approximately 1200 ft (365 m) in length, which empty into the open intake canal behind the dune line. The flow through these pipelines varies from 4.2-6.8 ft/sec (127-206 cm/sec) depending on the pipeline and the degree of fouling. Transit time for an object to travel the distance through the pipeline is approximately 180-285 seconds (3 to 4.75 minutes).

Due to the differences in the diameter of the pipelines and friction of the pipeline walls, the calculated volume through the two 12 ft (3.65 m) diameter lines is approximately 20 percent each and approximately 60 percent for the 16 ft (4.9 m) diameter pipeline (Bellmund *et al.*, 1982).

Headwalls and Canal System
Approximately 450 ft (138 m) behind the primary dune line the intake pipes discharge their water at two head wall structures into the intake canal. The headwall structure for the two 12 ft (3.65 m) diameter pipes is a common vertical concrete wall. The head wall for the 16 ft (4.9 m) diameter pipe is more elaborate and consists of a guillotine gate in a concrete box open at the other end. A series of pillars parallel to the flow support a walkway above the discharge area.

The 300 ft (91 m) wide intake canal, whose maximum depth is approximately 25 ft (7.6 m), carries the cooling water 5000 ft (1525 m) to the intake structures. The flow rate in the canal varies from 0.9-1.1 ft/sec (27-32 cm/sec), depending on tidal stage.

Highway Bridge and Underwater Intrusion System
The intake canal is crossed by two permanent structures. One is a bridge owned by the Florida Department of Transportation and is part of U.S. Highway A1A. The roadway is supported by a series of concrete pilings driven into the bottom of the intake canal.

The other barrier is the underwater intrusion detection system (UIDS), which is required for security reasons and has a net with a 9- ft. (23 cm) square mesh to prevent human intrusion into the secure area of the plant.

Intake Wells, Trash Racks, and Traveling Screens

Each unit has a separate intake structure consisting of four bays. Each bay contains trash racks ("grizzlies") that are vertical bars with approximately 3 in. (7.6 cm) spacings to catch large objects, such as flotsam, traveling screens with a 3/8 in. (1 cm) mesh to remove smaller debris, and circulating water pumps. Approach velocities to each bay are calculated to be less than 1 ft/sec (30.5 cm/sec), but increase to approximately 5 ft/sec (150 cm/sec) at the trash racks.

The trash racks are periodically cleaned by a rake that is lowered to the bottom of the rack. The rake's teeth fit into the 3 in. (7.6 cm) vertical openings of the structure. This rake is pulled vertically up and collects any debris that may have accumulated on the structures. This debris is emptied into a trough at the top of the intake bay for subsequent disposal. Any debris that is collected on the traveling screens is washed from the screen by a series of spay jets and is then also emptied into a trough at the top of the intake bay for disposal.

Condensers

After the water has passed through the trash racks, the traveling screens, and the circulating water pump, it travels through the condenser, which contains thousands of 3/8 in. (1 cm) diameter tubes. Condenser water heat is transferred to this water, which is then expelled into the discharge canal.

On Unit 2 FPL has installed a "Taprogge" cleaning system to maintain condenser cleanliness and is in the process of installing the same system on Unit 1. The Unit 2 system has been in operation since January 23, 1996. The Taprogge system works by passing hundreds of sponge balls less than an inch in diameter through the condenser tubes to remove biological fouling and scale. This mechanical cleaning system reduces the need for chemical treatments. The sponge balls are strained and returned to the head of the condenser for re-use. Four separate water boxes and sponge circulating systems are installed on the condenser. Each water box is normally charged with 1800 sponge balls. The sponge ball strainers periodically require backflushing to clean debris from the strainer grid. When the grids are opened, the possibility exists for sponge balls to be released into the discharge waters. FPL has developed "best management practices" to prevent sponge ball loss.

Discharge Systems

Each unit discharges its condenser cooling water into the discharge canal that is approximately 300 ft (91 m) wide and 2200 ft (670 m) long. The canal terminates at two headwall structures approximately 450 ft (137 m) behind the primary dune line. One structure supports a 12 ft (3.65 m) diameter pipeline that is buried under the ocean floor and runs approximately 1500 ft (460 m) offshore where it terminates into a two-port "Y" nozzle. The other structure supports a 16 ft (4.9 m) diameter pipeline that is buried under the ocean floor and runs approximately 3375 ft (1030 m) offshore. The last 1400 ft (425 m) of this pipeline contain a multiport diffuser segment with 58 discharge ports. To minimize plume interference, the ports are oriented in an offshore direction on alternating sides of the pipeline. The velocity of the water inside this pipeline averages about 5.7 ft/sec (174 cm/sec) and the jet velocity of the discharge water at each port averages approximately 13 ft/sec (400 cm/sec) to ensure quick dissipation of the thermal load (Bellmund *et al.*, 1982).

Thermal Plume

FPL had the thermal plume modeled for two-unit operation. The results indicated that the maximum surface temperatures are strongly dependent on ambient ocean conditions. The maximum surface horizontal temperature difference is predicted to be less than 4.9 °F (2.7 °C) and the resulting +2 °F (+1.1 °C) surface isotherm is estimated to encompass 963 acres (390 ha) (Bellmund *et al.*, 1982).

Sea Turtle Capture and Removal Program

The goal of the sea turtle capture program at the St. Lucie Plant is to remove entrapped turtles from the intake canal system quickly once they have entered the system. FPL, in conjunction with Applied Biology, Inc., and Quantum Resources, Inc., former and current contractors for sea turtle conservation and monitoring activities at St. Lucie Plant, have developed procedures and methods for handling marine turtles entrapped or impinged (Applied Biology, 1993; Quantum, 1994).

FPL hypothesizes that the intake structures and velocity caps serve as an artificial reef, since the structures are the only significant physical feature in this inshore environment. Turtles may encounter these structures in their normal range of activities and feed on the fouling organisms growing on the structures, or seek the structures for shelter. Based on the intake velocities of the intake structures, once a turtle passes the vertical plane of the velocity cap, it can be quickly sucked into the intake pipeline and, after a 3-5 minute ride through the pipeline, be discharged into the intake canal.

From 1976 through 1994, all five species of turtles present in the inshore waters of Florida have been entrapped, and a total of 3199 turtles have been removed from the intake canal of the St. Lucie Plant. Loggerheads are the dominant turtle in numbers (n = 2394), greens are next (n = 751), followed by Kemp's ridleys (n = 24), leatherbacks (n = 17), and hawksbills (n = 13). During 1995, turtle entrapment rates have increased sharply. Through June 30, 1995, a total of 609 turtles have been handled and 414 of those have been green turtles.

Barrier Nets-Past Configuration

To facilitate the capture of entrapped turtles and to reduce the likelihood of turtles moving down the intake canal toward the plant to be impinged, a large mesh barrier net (8 in. (20.3 cm) square mesh) was erected at the A1A bridge in 1978. The net was suspended across the canal and was anchored at the bottom with weights and supported at the top by cables and floats. The net was hung so that it had a 1:1 slope, with the bottom anchors being positioned upstream of the surface floats. This configuration was designed to prevent bowing of the net in the center, minimizing the risk of an injured or lethargic turtle being pinned against the net and drowning. By confining most turtles to the canal area east of the A1A bridge, the net capture of turtles in this part of the canal was facilitated. Additionally, any turtle with a carapace width of 11.3 in. (28.7 cm) or greater was excluded from passing through the net and moving down the canal and becoming impinged.

The net has been rehung several times (e.g., 1985, 1988, 1990) to maintain its 1:1 slope and blockage of the canal. The net is inspected approximately quarterly to ensure its integrity throughout the water column, its sides, and its bottom. Repairs are made as necessary, and sediment is removed by an air lift if the foot of the net is buried by a build-up of material. Because of deterioration of this net over time, a new net with the same 8 in. (20.3 cm) mesh was installed in 1987. In 1990, the headcable of the net was given more support by attaching a series of floatation rafts, which would keep the top of the net at or above the surface of the water under varying water levels that result from tides or operational changes of the generating units (e.g., if a unit is not operating, the water level in the canal rises about 4 ft (1.2 m)). This reconfiguration would also keep turtles from swimming over the top of the net.

Barrier Net-New Configuration

Due to observed increases in the entrapment rate in 1993 and 1994 (Quantum, 1994) for greens and loggerheads, the continuing upward trend in 1995, and the increases in impingement rates and subsequent mortality at the intake wells of the plant, construction of a new, smaller mesh barrier net east of the present barrier net was identified early in the consultation process as a necessary mitigation measure t reduce lethal takes. Specific details of the net configuration were discussed during early consultation activities, which included FPL's solicitation of ideas from their engineers, Florida Department of Environmental Protection (FLDEP) turtle specialists, and NMFS personnel. FPL completed construction of the new barrier net, a 5 in. (12.7 cm) square mesh with a deployed diagonal measurement of 7 in. (18 cm) in January 1996. FPL selected the 5 in. mesh size based on the size distribution of turtles seen in the first half of 1995. None of the 414 green turtles entrapped in the intake canal during the first half of 1995 had a straight carapace width measurement smaller than 18 cm. FPL predicts that all turtles encountering the 5 in. barrier net will be prevented from moving down the canal toward the plant, if future turtle size distributions match those of 1995. The net is located approximately halfway between the old 8 in. barrier net and the intake headwalls, thus entrapped sea turtles will be confined in a much smaller area. The new net is anchored along the bottom of the canal and is held up by an aerial wire that is strung between tensioning towers on the sides of the canal. The net is designed to remain partially out of the water at varying water levels. Due to potential fouling situations from jellyfish or seaweed, the top of the net can be quickly released from the tensioning towers so that it can drop to the bottom of the canal. The net will be inspected quarterly to ensure its integrity and to provide necessary cleaning and maintenance as required. The old 8- ft. (20.3 cm) mesh barrier net will also be maintained in its existing place to serve as a backup in case there is a failure of the 5- ft. (12.7 cm) mesh net or the new net needs to be lowered because of fouling from jellyfish, seaweed, or flotsam.

Underwater Intrusion Detection System (UIDS)
In 1986, the UIDS was installed to prevent human entry into the plant via the canal system and to provide further security for the plant. This system also provides an additional barrier for turtles that penetrate the old 8 in. barrier net. The barrier is on the north-south arm of the canal and consists of a rigid net with a 9 in. (22.9 cm) mesh. The net is hung at approximately a 0.9:1 slope with the bottom of the net downstream of the top. This net is inspected periodically by security personnel and several turtles, both live and dead, have been removed from this area in 1994 and 1995.

Intake Well Inspection and Removal
In December 1994 and through 1995, FPL has provided inspection of the intake wells by at least once every three hours over a 24-hour period. This increase in surveillance was necessary due to increased turtle presence and mortality in the intake wells.

Any plant or security personnel who see any turtle that is impinged or swimming in the intake well area are required to notify a plant turtle biologist through a beeper system. Sea turtle biologists are constantly on call and response time is within an hour. The responding biologist then captures the turtle with a long-handle dip net and places it in a padded box for holding and transport.

Netting Program
Sea turtles are removed from the intake canal by means of large-mesh entanglement net fished between the intake headwall and the barrier net at the A1A bridge. From 1976 through the present, this netting program has been constantly evaluated and continuously improved to minimize trauma to turtles and to

maximize capture efficiency. Nets presently used are from 100-120 ft (30-37 m) long, 9-12 ft (2.7-3.7 m) deep, and composed of 16 in. (41 cm) stretch-mesh multifilament nylon. Large floats are attached to the top of the net to provide buoyancy and the bottom of the net is unweighted. Prior to April 1990, turtle nets were deployed on Monday mornings and retrieved on Friday afternoons. During periods of deployment, the nets were inspected for captures at least twice daily (e.g., mornings and afternoons). Additionally, plant and security personnel checked the net periodically, and notified biologists immediately if a capture had occurred. Sea turtle biologists were on call 24 hours/day to retrieve turtles entangled in capture nets

Beginning in April 1990, after consultation with NMFS, net deployment was scaled back to daylight hours only. Concurrently, surveillance of the intake canal and the nets was increased to the hours the nets were being fished. This measure decreased response time for removal of entangled turtles from the nets and decreased mortalities from accidental drowning. The presence of a biologist also provided a daily assessment of turtle numbers in the canal and an indication of when a given turtle was first sighted. Biologists were then able to estimate the residence time of the turtle from the first observation to capture and release.

Hand Capture and Dip Netting

In addition to the use of entanglement nets to capture turtles, dip nets and hand captures by snorkel and SCUBA divers are used. Long-handle dip nets used from small boats and from the canal banks and headwalls are effective in capturing turtles with carapace lengths of 12 in. (30.5 cm) or less. Hand nets have also been used to remove dead and floating small green turtles from various areas in the canal system and this factor accounts for the high mortality level associated with this recovery system (4 out of 20 green turtles captured with this method in the first half of 1995 were mortalities).

Under good water visibility conditions, divers have proven to be very effective in capturing turtles of all sizes, particularly inactive turtles partially buried in the sediment near the barrier net or sleeping individuals throughout the canal. FPL believes that hand captures have had a significant impact in reducing residence times for turtles in the canal.

Tagging and Health Assessment Activities

All turtles removed from the St. Lucie Plant intake canal system are identified to species, measured, weighed, tagged, and examined for overall condition (wounds, abnormalities, parasites, missing appendages). Healthy turtles are released into the ocean on the day of capture.

Since July 1, 1994, all turtles captured are photographed dorsally and ventrally prior to release, and the photographs are retained for future reference. Inconel tags supplied by NMFS are applied to the proximal edge of the foreflippers. The tag numbers, the species, and morphometrics of each turtle are reported monthly to FLDEP.

If a turtle has been previously tagged either at the St. Lucie facility or elsewhere, that fact is noted in a monthly data sheet and reported. These data are forwarded by FLDEP to NMFS for inclusion in their data base. From 1976-1994, 177 recaptures (150 loggerhead and 27 green turtles) have occurred and a number of turtles have been recaptured more than once (Quantum, 1994). One loggerhead in particular has been recaptured 11 times. Several other turtles with tag scars have also been recovered, suggesting that the actual number of recaptures may be higher. Occasionally, turtles are captured that have been tagged by other researchers. One such capture occurred in 1994, and was a female leatherback with tags from French Guiana.

Necropsy and Rehabilitation Activities

Resuscitation techniques are used on turtles that appear to be comatose. Lethargic or slightly injured turtles are treated and occasionally held for observation prior to release. If further treatment is warranted, FLDEP is notified and a decision is made about which facility would provide additional veterinarian treatment. Beginning in 1982, necropsies were conducted on dead turtles found in fresh conditions. Three necropsies were performed in 1994.

Sea Turtle Conservation and Monitoring Program

FPL has been conducting nesting studies as part of the St. Lucie Unit 1 and Unit 2 reporting requirements for the U.S. Fish and Wildlife Service (FWS). In addition, FWS and FLDEP have started a long-term nesting index survey, and the data generated by FPL since 1971 are an integral part of this program. Nesting reports are summarized on a yearly basis (Applied Biology, 1976-1994; Quantum, 1994). Nesting surveys run from April 15-September 15. Biologists used small off-road motorcycles to survey the island early morning, generally completing the survey before 10 A.M. New nests, non-nesting emergences (false crawls), and nests destroyed by predators are recorded for each of the 0.62-mile (1 km) survey areas on Hutchinson Island. In addition to nesting data, data from stranded turtles found during beach nesting surveys are logged. These data are routinely provided to FLDEP and NMFS through the Sea Turtle Stranding and Salvage Network (STSSN). NMFS uses the STSSN database to monitor impacts to sea turtles from natural and human sources of mortality, as well as to infer turtle population characteristics. Also FPL has been conducting turtle walk programs at the St. Lucie Plant since 1982 as a public service. These walks are permitted by FLDEP and have become quite popular.

Listed Species Likely to Occur in the Action Area

Listed species under the jurisdiction of NMFS that occur in the nearshore or inshore waters of Florida's Atlantic Coast and may be affected by the proposed activities include:

Endangered

Northern right whale	*Eubalaena glacialis*
Leatherback sea turtle	*Dermochelys coriacea*
Kemp's ridley sea turtle	*Lepidochelys kempii*
Green sea turtle*	*Chelonia mydas*
Hawksbill sea turtle	*Eretmochelys imbricata*

*Green turtles in U.S. waters are listed as threatened except the Florida breeding population which is listed as endangered. Due to the inability to distinguish between these populations away from the nesting beach, green turtles are considered endangered wherever they occur in U.S. waters.

Threatened

Loggerhead sea turtle	*Caretta caretta*

Threatened, proposed

Johnson's seagrass *Halophila johnsonii*

Species Not Likely to be Affected

The best available information indicates that right whales and Johnson's seagrass are not likely to be adversely affected by the continued operation of the circulating cooling water system at St. Lucie Plant.

Biology and Distribution

Sea Turtles:

Precise data regarding the total number of sea turtles in waters of the southeastern U.S. Atlantic are not available. Trends in turtle populations are identified through monitoring of their most accessible life stages on the nesting beaches, where hatchling production and the number of nesting females can be directly measured. NMFS selected an Expert Working Group (EWG) consisting of population biologists, sea turtle biologists and state and federal managers to consider the best available information to formulate population estimates for sea turtles affected by the shrimp fishery. The EWG focused on determining population estimates for Kemp's ridley and loggerhead sea turtles, the species of greatest concern. Preliminary information generated by the EWG in November 1995 was considered in the June 11 and June 27, 1996 sea turtle conservation regulations BOs. Completed reports by the Group, entitled "Kemp's ridley (*Lepidochelys kempii*) Sea Turtle Status Report," dated June 28, 1996, and the "Status of the Loggerhead Turtle Population (*Caretta caretta*) in the Western North Atlantic", dated July 1, 1996, were submitted in early July. These reports are incorporated by reference.

Kemp's ridley sea turtle (*Lepidochelys kempi*)

The EWG report, "Kemp's ridley (*Lepidochelys kempii*) Sea Turtle Status Report", dated June 28, 1996, provides a summary of Kemp's ridley habitat use, life history parameters and estimates of the number of adults in the populations, as well as current and projected population trends. Additionally, updated information regarding Kemp's ridley nesting for 1996 is considered in this

BO. Figure 1 illustrates Kemp's ridley nesting data from Rancho Nuevo and, since 1990, adjacent beaches in Mexico. Although data are still preliminary for the 1996 nesting season, 1,957 nests were protected in corrals; 37 were placed in styrofoam boxes for incubation; and 13 nests were left *in situ* for a total of 2,007 nests. (Burchfield, 1996b). Unusual nesting behavior, such as two weeks of night-time nesting, was observed and attributed to the odd climatic conditions this summer (Burchfield, 1996a). The EWG identified an average Kemp's ridley population growth rate of 13 percent per year since 1991, however, this rate of growth did not continue in 1996. Annual fluctuations due in part to irregular internesting periods are normal for sea turtle populations.

Figure 1 shows the upward trend in Kemp's ridleys nests since the late 1980s, although the increase is not dramatic at the Rancho Nuevo camp. The area surveyed for ridley nests was expanded in 1990 due to destruction of the primary nesting beach by Hurricane Gilbert. The EWG assumed that the increased nesting observed particularly since 1990 was a true increase, rather than the result of expanded beach coverage. Because systematic surveys of the adjacent beaches were not conducted prior to 1990, there is no way to determine what proportion of the nesting increase documented since that time is due to the increased survey effort rather than an expanding ridley nesting range. As noted by the EWG, trends in Kemp's ridley nesting suggest that recovery of this population has begun, but continued caution is necessary to ensure recovery and to meet the goals identified in the Kemp's ridley Recovery Plan.

Leatherback turtle (*Dermochelys coriacea*)

The Recovery Plan for Leatherback Turtles (*Dermochelys coriacea*) contains a description of the natural history and taxonomy of this species (NMFS and USFWS, 1992). Leatherbacks are widely distributed throughout the oceans of the world, and are found throughout waters of the Atlantic, Pacific, Caribbean, and the Gulf of Mexico (Ernst and Barbour, 1972). Leatherbacks are predominantly distributed pelagically, feeding primarily on jellyfish such as *Stomolophus*, *Chryaora*, and *Aurelia* (Rebel, 1974). However, their distribution over nearshore waters does not vary significantly from loggerheads (Shoop and Kenney, 1992), and they likely come into shallow waters if there is an abundance of jellyfish nearshore.

Leatherbacks were observed most commonly during summer and fall months, and showed a more pelagic and northerly distribution than loggerheads. Aerial surveys conducted over coastal waters from North Carolina south identified the greatest abundance of leatherbacks within the Southeast Region during summer months off the northern east coast of Florida, adjacent to leatherback nesting beaches (Thompson and Huang, 1993).

Trends in the leatherback population are the most difficult to assess since major nesting beaches occur over broad areas within tropical waters outside the United States. In the eastern Caribbean, nesting occurs primarily in the Dominican Republic, the Virgin Islands, and on islands near Puerto Rico. Sandy Point, on the western edge of St. Croix, Virgin Islands, has been designated by the FWS as critical habitat for nesting leatherback turtles. Nesting also occurs the Atlantic Coast of Florida on a smaller scale. The primary leatherback nesting beaches in the western Atlantic occur in French Guiana, Suriname, and Mexico. Although increased observer effort on some nesting beaches has resulted in increased reports of leatherback nesting, declines in nest abundance have been reported in the beaches of greatest nesting densities. At Mexiquillo, Michoacan, Mexico, between 1986 and 1987, 4796 nests were laid on 4.5 km of beach. During the 1990-1991 season, only an estimated 1200 nests were reported. Another large western Atlantic nesting beach is located at Yalimapo-Les Hattes, French Guiana, where Fretey and Girondot estimated the total number of adult females at 14,700 to 15,300 in the late 1980s. Beach erosion has pushed nesting into Suriname, confounding efforts to monitor trends from this colony. Anecdotal information suggests nesting has declined at Caribbean beaches over the last several decades (Eckert, 1993).

Leatherbacks are the largest of sea turtles and are able to maintain body temperatures several degrees above ambient temperatures, likely by virtue of their size, insulating subdermal fat, and an arrangement of blood vessels in the skin and flippers that enables retention of heat generated during swimming (Paladino *et al.*, 1990).

In the northwest Atlantic, leatherbacks have been reported in New England and as far north as Nova Scotia and Newfoundland from April to November (CeTAP, 1982). Although their tolerance of low temperatures is greater than for other sea turtles, leatherbacks are generally absent from northern waters in winter and spring. In Cape Cod Bay, sightings peak in August and September (Prescott, 1988). Adult leatherbacks stranded in the western Atlantic identify impressive migrations between temperate and tropical waters. For example, leatherbacks tagged on nesting beaches in French Guiana and Suriname have stranded on New York beaches (Morreale, pers comm), and other leatherbacks tagged while nesting in the Caribbean have stranded on New England Beaches (NMFS and USFWS). Shoop and Kenney (1992) observed leatherbacks during summer months scattered along the continental shelf from Cape Hatteras to Nova Scotia. Relative concentrations of leatherbacks were seen off the south shore of Long Island and off New Jersey during summer and fall months. Leatherbacks in these waters are thought to be following their preferred jellyfish prey, including *Cyanea* sp. (Lazell, 1980; Shoop and Kenney, 1992). Researchers in the Chesapeake have observed leatherbacks in the mouth of the Bay during summer months (Byles, 1988).

Hawksbill turtle (*Eretmochelys imbricata*)

The hawksbill turtle is relatively uncommon in the waters of the continental United States. Hawksbills prefer coral reefs, such as those found in the Caribbean and Central America. However, there are accounts of hawksbills in south Florida and a surprising number are encountered in Texas. Most of the Texas records are small turtles, probably in the 1-2 year class range. Many of these captures or strandings are of individuals in an unhealthy or injured condition (Hildebrand, 1982). The lack of sponge-covered reefs and the cold winters in the northern Gulf of Mexico probably prevent hawksbills from establishing a viable population in this area.

Hawksbills feed primarily on a wide variety of sponges but also consume bryozoans, coelenterates, and mollusks. The Culebra Archipelago of Puerto Rico contains especially important foraging habitat for hawksbills. Nesting areas in the western North Atlantic include Puerto Rico and the Virgin Islands.

Green turtle (*Chelonia mydas*)

Green turtles are distributed circumglobally, mainly in waters between the northern and southern 20°C isotherms (Hirth, 1971). In the western Atlantic, several major nesting assemblages have been identified and studied (Peters, 1954; Carr and Ogren, 1960; Parsons, 1962; Pritchard, 1969; Carr *et al.*, 1978). Most green turtle nesting in the continental United States occurs on the Atlantic Coast of Florida (Ehrhart, 1979). Recently, limited nesting has been documented along the southeast and panhandle coasts of Florida (Schroeder, pers. comm.). The Florida Department of Environmental Protection established an index nesting beach survey program in 1989 to standardize data collection methods and effort on key nesting beaches. The pattern of green turtle nesting on index beaches shows biennial peaks in abundance, with a generally positive trend during the eight years of regular monitoring since the index beaches were established.

While nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging grounds. Some of the principal feeding pastures in the western Atlantic Ocean include Florida, the northwestern coast of the Yucatan Peninsula, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth, 1971). The preferred food sources in these areas are *Cymodocea, Thalassia, Zostera, Sagittaria, and Vallisneria* (Babcock 1937; Underwood, 1951; Carr, 1952; 1954; Mexico, 1966).

In Florida, important foraging grounds include the shallow, protected waters of the Indian River Lagoon, the Florida Keys, Florida Bay, Homosassa, Crystal River and Cedar Key. Additionally, the nearshore waters along Florida's east coast from Cape Canaveral south through Broward County also provide important foraging habitat. Evidence provided by Mendonca and Ehrhart (1982) indicates that immature green turtles utilize estuarine systems during periods of their lives. These authors identified a population of young green turtles (carapace length 29.5-75.4 cm) resident in Mosquito Lagoon, Florida. The Indian River system, of which Mosquito Lagoon is a part, supported a green turtle fishery during the late 1800s (Ehrhart, 1983), and these turtles may be remnants of this historical colony.

Additional juvenile green turtles occur north to Long Island Sound, presumably foraging in coastal embayments. In North Carolina, green turtles are known from estuarine and oceanic waters and occasional nests are documented as far north as Cape Hatteras National Seashore.

Loggerhead turtle (*Caretta caretta*)

The EWG report, "Status of the loggerhead turtle population (*Caretta caretta*) in the Western North", dated July 1, 1996, provides a summary of loggerhead habitat use, life history parameters and population trends and estimates. This report is incorporated by reference. The EWG report identified four nesting subpopulations of loggerheads in the western North Atlantic based on mitochondrial DNA evidence. These include: (1) the Northern Subpopulation producing approximately 6,200 nests/year from North Carolina to Northeast Florida; (2) the South Florida Subpopulation occurring from just north of Cape Canaveral on the east coast of Florida and extending south to the Florida Keys and continuing north to Naples on the west coast and producing approximately 64,000 nests/year; (3) the Florida Panhandle Subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City and producing approximately 450 nests/year; and (4) the Yucatan Subpopulation occurring on the northern and eastern Yucatan Peninsula in Mexico and producing approximately 1,500 - 2,000 nests/year.

The EWG believed that the Northern subpopulation appears to be stable after a period of decline; the South Florida Subpopulation appears to have shown significant increases over the last 25 years suggesting the population is recovering, although the trend could not be detected over the most recent 7 years of nesting. An increase in the numbers of adult loggerheads has been reported in recent years in Florida waters without a concomitant increase in benthic immatures. Since loggerheads take approximately 20-30 years to mature, the effects of decline in immature loggerheads might not be apparent on nesting beaches for decades. Therefore, the EWG cautions against over-interpreting upward trends in nesting. In addition, these subpopulations cannot be managed separately because the in-water distribution of each is unknown, and research suggests that at least two of the subpopulations intermingle on the foraging grounds of the U.S. Atlantic coast.

Assessment of Impacts

Four thousand one hundred thirty-two sea turtles have become entrapped at the St. Lucie intake canal between 1976 and 1995. One hundred seventy-eight of those have died, for a total mortality rate of 4.3 percent. Loggerheads have been the species most involved over this period, although green turtles have been the dominant species encountered since 1993.

Entrapment at the St. Lucie intake canal can result in direct negative impacts on turtles in a number of ways: drowning in the intake pipes, injury sustained in the pipes and the canal, injury sustained during canal dredging, loss of condition due to long entrapment, exposure to predators in the intake canal, injury and stress sustained during capture, entanglement and drowning in fish gillnets and turtle capture nets, and impingement and drowning on barrier nets and in the intake wells.

Drowning and injury in the intake pipes are unlikely to be major direct impacts. With both generating units operating, the transit time through the intake pipes (5 minutes through the 12 ft pipes and 3 minutes through the 16 ft pipes) is likely too short to drown a sea turtle, and there are no known instances of turtle mortalities from forced submergence in the intake pipes. Some captured turtles have shown recent superficial scrapes, usually to the anterior carapace or plastron, which may have resulted from contact with encrusting organisms in the pipeline. From July 1, 1994 to June 30, 1995, 14 of 361 turtles captured had significant injuries, most of which were old and well-healed (Quantum, 1994). One loggerhead captured in 1994 had a fresh penetrating crack in the carapace which may have been sustained in the intake pipes or before entrapment, possibly by boat collision.

NMFS has conducted several formal consultations with the U.S. Army Corps of Engineers (COE) on the effects of channel maintenance dredging on sea turtles, which have generally concluded that the operation of hopper dredges, but not hydraulic or clamshell dredges, adversely affect sea turtles. This conclusion does not apply, however, to dredging conducted in the narrow confines of the St. Lucie intake canal where turtles have limited ability to evade a dredge. All types of dredging may affect sea turtles there. In fact, from 1976 to 1990, 7 loggerheads were killed during maintenance dredging in the St. Lucie intake canal. In 1994, however, hydraulic dredging was accomplished without any sea turtle mortality by isolating the dredging area with a temporary 4 in. square barrier net. FPL engineers expect that future maintenance dredging in the intake canal will generally only be necessary west of the newly installed 5 in. barrier net. Impacts to sea turtles from dredging west of the new barrier net are considered unlikely. In the rare instances where dredging may be required to the east of the 5 in. barrier net, FPL will contact NMFS and initiate consultation on the particular project, in conjunction with NRC or COE. Dredging associated with the construction of the 5 in. barrier net was the subject of a separate, informal consultation with NMFS (concluded October 26, 1995), and the work was accomplished without any impacts to turtles.

The extent of impacts resulting from loss of condition and exposure to predation is largely dependent on the species and the total residence time of individual animals in the intake canal. Green turtles in particular would not have access to their normal food sources of sea grasses or algae in the canal. Loggerheads may be able to find some of their prey species that have also become entrapped in the canal. In 1994, FPL reported residence times based on visual observations for turtles entrapped east of the Highway A1A barrier net. Average residence times were 1.47 days for loggerheads and 2.00 days for green turtles, and 100 percent of the loggerheads and 97 percent of the greens were captured within one week of first sighting. Loss of condition from lack of adequate food sources should not have serious negative impacts on turtles over these relatively short periods of time. Predatory fish, including barracuda, sharks, and jewfish, occur in the intake canal and may pose a threat to the smaller turtles in the canal. The level of predation on turtles entrapped in the intake canal has not been quantified, but can be mitigated by minimizing the residence time for individuals entrapped at the St. Lucie Plant. The contribution of predation to the overall turtle mortality rate at the St. Lucie Plant is probably small.

Drowning in capture nets has occurred occasionally throughout the history of the St. Lucie Plant's capture program during the period 1976-June 1995. Since the capture-release program began, 7 loggerheads (7 mortalities out of 2583 captures or 0.3

percent) and 13 green turtles (13 mortalities out of 1165 captures or 1.1 percent) have drowned in capture nets. Turtles can drown when they become tightly entangled, when the net becomes fouled on the bottom, or when a small turtle becomes tangled with a large turtle and is held underwater. Since April 1990, the nets have been set only during daylight hours and constantly tended resulting in 3 greens drowned in capture nets, but no loggerheads.

Injuries sustained during capture are all reported to be superficial. Typically they involve small cuts from net strands and abrasions sustained during handling. Efforts can be made to reduce effects from stress by minimizing handling time (reported to be generally under one-half hour to obtain biological information and to tag the animal) and by keeping turtles cool and shaded prior to release.

Impingement of turtles on the barrier nets has been implicated in only one mortality since improvements to the 8 in. barrier net were completed in 1990. Since then, one loggerhead has become entangled in the 8 in. barrier net and drowned. Six other loggerheads and 5 green turtles have been recovered dead at the barrier net, but their cause of death is unknown and the carcasses would naturally accumulate at the barrier net. The UIDS barrier is believed by FPL to pose a greater threat to turtles than the other barrier nets because of its downward slope relative to the current flow, and 1 UIDS-associated mortality has been reported since 1990. Generally, however, small turtles capable of penetrating the A1A barrier net can presumably penetrate the UIDS barrier without impingement and end up in the intake wells. The large number of small turtles removed from the intake wells in recent years bears this out. With the recent installation of the 5 in. barrier net, any turtles which penetrate that net will likely be of such a small size that they will easily pass through the UIDS barrier.

Since 1992, the number of small green turtles entrapped in the St. Lucie intake canal has been rising rapidly. Correspondingly, more small turtles are penetrating the barrier nets and eventually reaching the intake wells. In 1995, 673 green turtles were entrapped in the St. Lucie intake canal, and 97 of those had to be removed from the intake wells, where 7 died. Since 1990, a total of 16 green turtles have been recovered dead from the intake wells. FPL has reported that 3 of the 16 died as the result of injury inflicted by the mechanical debris-removing rakes. The other 13 are reported by FPL as dying of unknown causes. These small turtles possibly died from exhaustion and drowning after swimming against the currents in the intake well. Certainly other factors may contribute to a weakened state of health in some small individuals that reach the intake wells, but it is clear that entrapment in the intake wells poses a mortality threat to these small turtles. In 1995, green turtles reaching the intake wells experienced a mortality rate approximately five times higher than those green turtles that were captured elsewhere in the canal. Kemp's ridley turtles, due to their small size, are also at risk to penetrate the 8 in. barrier net and to become exposed to the intake wells. Kemp's ridleys become entrapped at St. Lucie much less frequently than green turtles, however, and no ridley mortalities have occurred at St. Lucie since 1988.

In addition to the impacts to sea turtles already discussed, entrapment at the St. Lucie intake canal can have several other negative effects on sea turtles, through interruption of migration, loss of mating opportunities, and loss of nesting opportunities. Leatherbacks are probably more sensitive to interruption of migration than the other species of sea turtle because their spring migrations seem to be closely synchronized with the presence of prey species. The problem of loss of mating opportunities is impossible to quantify but would affect adults prior to and during the nesting season. Loss of nesting opportunities is a documented problem, with several instances of females nesting on the canal bank reported by FPL. The severity of any of these impacts can be reduced by minimizing residence time of individual turtles in the canal.

The recent installation of a new barrier net with a 5 in. square mesh should reduce many of the current impacts of entrapment in the intake canal. The new mesh size was selected based on the observed carapace widths of green turtles removed from the canal during the first half of 1995 when no green turtles were observed with a carapace width smaller than the maximum diagonal opening in the mesh of the proposed barrier net. Smaller turtles have been encountered historically, but the 5 in. mesh net would prevent virtually all of the turtles encountering it from penetrating the barrier, so long as the net is properly maintained. Intake well mortalities should therefore approach zero with the new barrier net in place. The new barrier net has been erected to the east of the existing large mesh net, which will continue to be maintained. The area of the canal in which turtles will be entrapped has been reduced by about 40 percent, and capture activities are reported to have become more efficient (J. Gorham, pers. comm.), which may reduce residence times in the canal.

Since reporting of sea turtle entrapment and mortality at St. Lucie Plant began in 1976, two general trends in the impacts on sea turtles are clear. The total number of turtles entrapped has increased, particularly in the last five years, and the mortality rate of the entrapped turtles has decreased. With the exception of the activation of Unit 2 in 1982, the operating characteristics of the circulating water system have not changed over time. The increased number of entrapments are most likely the result of increased local abundances of turtles, especially juvenile green turtles. The decreasing mortality rates are due to incremental improvements in the turtle program executed at FPL, including the construction of barrier nets, improved monitoring, and fine-tuning capture methods. Since 1990, turtle mortalities have resulted from drowning in the capture or barrier nets, entrapment in the intake wells, and unknown, presumably natural, causes. Small green turtles from the intake wells constitute half of these mortalities.

A new trend may also be emerging. In 1995, only 14 of the 673 green turtles (2.1 percent) captured were visibly afflicted with fibropapilloma tumors. From January 1 through May 31, 1996, 37 out of 276 green turtles (13.4 percent) captured have been afflicted. Whether this increase in fibropapilloma rates will continue is uncertain. If it does, however, mortality rates of entrapped green turtles may increase beyond the rates observed historically. Afflicted animals may suffer a general loss of fitness and be more likely to succumb to natural sources of stress, as well as any stress due to entrapment at the intake canal.

Possible impacts of the Taprogge condenser cleaning system have been examined. Release of the system's sponge balls in the plant's discharge waters would introduce persistent marine debris offshore of the plant. The cleaning balls, made of vulcanized natural rubber, could be mistaken for prey items by turtles and consumed, with unknown health effects. To address this and other concerns relating to the Taprogge system's operation, FPL instituted operational procedures for the system to prevent sponge ball release into the environment. FPL has been making operational reports to FLDEP since March 1996 on the Taprogge system. Through April, sponge ball loss was quite low, maximally estimated at 3 balls/day. These sponge balls would most likely have been lost as a result of deterioration to a small enough size to pass through the strainer grid. In May, however, the loss of 1200 out of the 1800 balls in one of the water boxes was detected. This loss was not associated with a backflush, but probably resulted from accidental opening of the strainer grid. Although a survey of the beach along Hutchinson Island did not result in the finding of any of the discharged sponge balls, it is important to note that the size and coloring of the balls would make them extremely difficult to observe on a sandy beach. FPL subsequently has increased controls on sponge ball inventories and has added key lock controls on the ball strainers. The sponge ball loss rate that was reported, prior to the large loss event, was quite low, and probably consisted of very small sponge parts. No impacts to sea turtles are expected from this normal operational loss rate. Single, large losses of sponge balls should be preventable through proper management controls, which FPL appears to be implementing. No impacts from the Taprogge system are anticipated as long as effective operational and management measures are maintained. FPL should continue to generate the monthly reports on the operation of the Taprogge system which have been required by the FLDEP Bureau of Protected Species Management, and a copy should also be provided to the NMFS Southeast Regional Office to allow NMFS to evaluate whether impacts from sponge ball loss are greater than presently anticipated.

Future levels of impacts to marine turtles at the St. Lucie Plant are difficult to assess in absolute terms, since the continuation of the recent increases in entrapment is likely but unpredictable. However, an estimate of future mortality rates can be derived from recent observations. Under the turtle capture and release program that has been in place since 1990, no hawksbill, leatherback, or Kemp's ridley mortalities have occurred, and entrapped greens and loggerheads have experienced mortality rates of 2.6 percent and less than 1 percent, respectively. The new barrier net should greatly reduce or even eliminate intake well turtle mortalities, even though the overall green turtle mortality rate since 1990, excluding intake well mortalities, has been less than 1 percent. Future lethal impacts to greens and loggerheads are not expected to exceed greatly the current 1 percent rates. Although no leatherback, Kemp's ridley, or hawksbill mortalities have occurred in the last six years at St. Lucie Plant, a very low level of impact not likely to exceed 1 individual per year is possible for these species.

Conclusion

Continued operation of the circulating water system at the St. Lucie Plant is likely to result in adverse effects on loggerhead, green, and to a lesser extent, Kemp's ridley, hawksbill and leatherback sea turtles, however, NMFS believes that the level of impact is not likely to jeopardize the continued existence of any sea turtle species.

Cumulative Effects

Cumulative effects are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation. State regulated fishing activities, including trawl and seine fisheries, in nearshore Atlantic waters probably take endangered species. These takes are not regulated or reported. It is expected that States will continue to license/permit large vessel and thrill-craft operations which do not fall under the purview of a Federal agency and may issue regulations which will affect fishery activities. Increased recreational vessel activity in inshore and nearshore waters of the Atlantic will likely increase the number of turtles taken by injury or mortality in vessel collisions. Recreational hook-and-line fisheries have also been known to lethally take sea turtles. Although pathological effects of oil spills have been documented in laboratory studies of marine mammals, as well as sea turtles (Vargo *et al.*, 1986), the impacts of other anthropogenic toxins have not been investigated.

Reinitiation of Consultation

Reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in the incidental take statement is exceeded, (2) new information reveals effects of the action that may affect listed species or critical habitat (when designated) in a manner or to an extent not previously considered, (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the Biological Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

Conservation Recommendations

Pursuant to section 7(a)(1) of the ESA, the following conservation [redacted] are [redacted]o further reduce or mitigate adverse impacts from the continued operation of the cooling sea water system at St. Lucie Nuclear Generating Plant on loggerhead, leatherback, green, Kemp's ridley and hawksbill turtles:

(1) FPL should continue to carry out or assist in research to determine the subsequent dispersal of captured and released

turtles through its tagging program and through cooperation with properly permitted scientists.

(2) Current procedures for determining turtle residence times in the intake canal tend to underestimate actual residence times. FPL should continue efforts to improve residence time estimates. These efforts may include directed studies of residence time, so long as research permits are obtained from the proper authority.

Incidental Take Statement

Section 7(b)(4) of the ESA requires that when an agency action is found to comply with Section 7(a)(2), NMFS will issue a statement specifying the impact of any incidental taking, providing reasonable and prudent measures necessary to minimize impacts, and setting forth terms and conditions that [redacted] Only incidental taking by the Federal agency or applicant that complies with the specified terms and conditions is authorized. Specifically, reasonable and prudent measures described below are non-discretionary, and must be implemented by the agency so that they become binding conditions of any permit issued to applicants, as appropriate, in order for the exemption in section 7 (o)(2) to apply. Under the terms of Section 7 (b)(4) and 7 (o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Based on historical records of sea turtle capture and mortality at the St. Lucie Plant cooling water intake canal, NMFS anticipates that continued operation of the circulating water system at St. Lucie Nuclear Generating Plant may result in the capture and mortality of loggerhead, leatherback, Kemp's ridley, green and hawksbill turtles. Therefore, an incidental take level, and terms and conditions necessary to minimize and monitor takes, is established. Variability in the rate of turtle entrapment at the St. Lucie Plant is considered to be primarily a function of the local abundance of turtles, since the operational characteristics of the intake structures have remained constant over the years. In recent years, green turtle entrapment has increased at a dramatic and unpredicted rate and may continue to increase. Therefore, no take level will be specified for entrapment, capture, and release of any species of turtle.

The lethal take levels below are based on the historical observed lethal takes, but provide for increased total numbers of lethal takings as entrapment levels increase. Consequently, two lethal take levels are specified: one is a fixed level of the number of turtles of each species entrapped during the calendar year, while the other is a percentage of the number of turtles of each species entrapped during the calendar year. The allowable take level will be the greater of the two numbers, considering the prevailing entrapment rates. The following annual incidental lethal take levels are established:

1. 2 loggerheads, *Caretta caretta*, or 1.5 percent of the total number of loggerheads entrapped at the intake canal, whichever is greater;
2. 3 greens, *Chelonia mydas*, or 1.5 percent of the total number of greens entrapped at the intake canal, whichever is greater;
3. 1 Kemp's ridley, *Lepidochelys kempi*, or 1.5 percent of the total number of Kemp's ridleys entrapped at the intake canal, whichever is greater;
4. 1 hawksbill, *Eretmochelys imbricata*, or 1.5 percent of the total number of hawksbills entrapped at the intake canal, whichever is greater;
5. 1 leatherback, *Dermochelys coriacea*, or 1.5 percent of the total number of leatherbacks entrapped at the intake canal, whichever is greater;

The following terms and conditions are established to monitor the level of take and to minimize the adverse impacts of entrapment and the possibility of lethal takes:

1) Install and maintain a 5in (12.7cm) bar mesh barrier net across the intake canal, east of the existing 8in mesh barrier net. The new net must receive regular inspection, maintenance, and repair on at least a quarterly basis. The regular maintenance schedule notwithstanding, any holes or damage to the net that are discovered must be promptly repaired to prevent the passage of turtles through the barrier net.

2) The existing 8in mesh barrier net must be retained to serve as a backup to the new 5 in. mesh barrier net, which may be lowered occasionally because of fouling and water flow problems. The 8in mesh net must receive regular inspection, maintenance, and repair on at least a quarterly basis. The regular maintenance schedule notwithstanding, any holes or damage to the net that are discovered must be promptly repaired to prevent the passage of turtles through the barrier net.

3) FPL must continue its current program to capture and release turtles from the intake canals. The handling of

captured turtles, treatment and rehabilitation of sick and injured turtles, and disposition of dead turtle carcasses shall be in accordance with permits granted through the FLDEP.

4) Capture netting in the intake canal shall be conducted with a surface floating tangle net with an unweighted lead line. The net must be closely and thoroughly inspected via boat at least once per hour. Netting shall be conducted whenever sea turtles are present in the intake canal according to the following schedule:

a) 8 hours per day, 5 days per week, under normal circumstances;
b) 12 hours per day or during daylight hours, whichever is less, 7 days per week, under any of the following circumstances:
   i) an adult turtle occurs in the canal during mating or nesting season (March 1 through September 30),
   ii) an individual turtle has remained in the canal for 7 days or more,
   iii) a leatherback turtle occurs in the canal,
   iv) an apparently sick or injured turtle occurs in the canal.

Reasonable deviations from this schedule due to human safety considerations (i.e., severe weather) are expected.

5) If a turtle is observed in the intake canal west of the 8 in. barrier net, directed capture efforts shall be undertaken to capture the turtle and to prevent it from entering the intake wells.

6) The gratings at each of the intake wells shall be visually checked for turtles at least 8 times each 24-hour period. If a turtle is sighted in an intake well, dip nets or other non-injurious methods should be used to remove the turtle.

7) Considering the recent increases in turtle entrapment at the St. Lucie Plant intake canal and the possibility of future increases, operation of the current turtle capture and removal program may become increasingly expensive and

result in unacceptable take levels. Although some engineering solutions to prevent or reduce turtle entrainment at the intake structures have already been investigated, increasing burdens on the turtle capture and removal program warrant the investigation of other possible alternatives. Little or no information has been provided on the factors that attract turtles to the intake structures and the specific behaviors of turtles in the immediate vicinity of the intake structures. Without such information, it is unlikely that solutions or mitigative measures can be developed to decrease the current take levels. [redacted] information on [redacted]ructures. This may be accomplished by remote vid[redacted] or similarly designed methodology that will not interfere with turtle behavior. FPL shall provide NMFS with the proposed plan for collecting these data by June 30, 1997. Once the plan is approved and the study is initiated, FPL must report quarterly on progress in this regard and shall provide a final report by December 31, 1998.

8) FPL must continue to participate in the STSSN, under proper permits and authority, in order to assess any possible delayed lethal impacts of capture as well as to provide background data on the mortality sources and health of local sea turtles. As a point of clarification, stranded sea turtles will generally not be counted against the authorized level of lethal incidental take in this incidental take statement, but information from strandings may be the basis for the determination that unanticipated impacts or levels of impacts are occurring.

9) FPL should continue to conduct, under proper permits and authority, the ongoing sea turtle nesting programs and public service turtle walks.

10) Monthly reports covering sea turtle entrapment, capture efforts, turtle mortalities, available information on barrier net inspections and maintenance, and the Taprogge cleaning system operation and any sponge ball loss at St. Lucie Plant shall be furnished to NMFS. In addition, an annual report discussing these same topics shall be furnished to NMFS. Also, a meeting shall be convened

between FPL, NRC, and NMFS to discuss endangered and threatened species information and developments at [redacted]

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Expert Working Group (Byles, Richard, C. Caillouet, D. Crouse, L. Crowder, S. Epperly, W. Gabriel, B. Gallaway, M.Harris, T. Henwood, S. Heppell, R.Marquez-M, S. Murphy, W. Teas, N. Thompson, and B. Witherington) 1996. Kemp's ridley sea turtle (*Lepidochelys kempii*) status report. Submitted to NMFS June 28, 1996.

Expert Working Group (Byles, Richard, C. Caillouet, D. Crouse, L. Crowder, S. Epperly, W. Gabriel, B. Gallaway, M.Harris, T. Henwood, S. Heppell, R.Marquez-M, S. Murphy, W. Teas, N. Thompson, and B. Witherington) 1996. Status of the loggerhead turtle population (*Caretta caretta*) in the Western North Atlantic. Submitted to NMFS on July 1, 1996.

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OPINION DATED MAY 18, 2001

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 18, 2001

Mr. Thomas F. Plunkett
President, Nuclear Division
Florida Power and Light Company
Post Office Box 14000
Juno Beach, Florida 33408-0420

SUBJECT: BIOLOGICAL OPINION, ST. LUCIE PLANT, UNITS 1 AND 2 (TAC NOS. MA6374 AND MA6375)

Dear Mr. Plunkett:

Enclosed is a copy of the National Marine Fisheries Service's (NMFS) Biological Opinion, which was issued May 4, 2001. This Opinion is a reinitiation of consultation subsequent to the February 7, 1997, Opinion.

The U.S. Nuclear Regulatory Commission formally requested reinitiation on November 30, 1999, after the St. Lucie Plant exceeded NMFS' anticipated incidental take of three green turtles per year established in the Incidental Take Statement of the 1997 Opinion. The current Opinion considered new information about turtle interactions with the plant submitted by Florida Power and Light in a March 2000 report entitled "Physical and Ecological Factors Influencing Sea Turtle Entrainment Levels at the St. Lucie Nuclear Power Plant: 1976-1998."

The May 4, 2001, Opinion states NMFS' belief that the continued operation of the circulating seawater cooling system at the St. Lucie Plant is not likely to jeopardize the continued existence of the five species of sea turtles found at St. Lucie. However, it revises the Incidental Take Statement and modifies some of the Terms and Conditions of the previous Opinion. These should be evaluated for the potential need to revise the St. Lucie Plant Technical Specifications and plant procedures.

If you have any questions following review of the document, please contact me at (301) 415-3974.

Sincerely,

Brendan T. Moroney, Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-335, 50-389

Enclosure: NMFS Biological Opinion

cc w/enclosure: R. Hoffman, NMFS
See next page

Mr. T. F. Plunkett
Florida Power and Light Company

ST. LUCIE PLANT

cc:
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MAY - 4 2001

F/SER3:BH:mdh

Mr. Kahtan N. Jabbour
Senior Project Manager, Section 2
Project Directorate
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U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Mr. Jabbour:

This document transmits the National Marine Fisheries Service's (NMFS) biological opinion (Opinion) based on our review of the document prepared by the Florida Power and Light Company (FP&L) titled "Physical and Ecological Factors Influencing Sea Turtle Entrainment Levels at the St. Lucie Nuclear Power Plant: 1976-1998" and a site visit and meeting held on November 10, 1999, among the plant, Nuclear Regulatory Commission (NRC), state of Florida, and NMFS personnel. The FP&L document was written to satisfy the terms and conditions set in the 1997 Opinion for the continued operation of the circulating seawater cooling system at the plant. The NRC's May 9, 2000, request for formal consultation was received on May 12, 2000. The NMFS consultation number for this action is F/SER/2000/01394. If you have any questions about this consultation, please refer to this number.

This Opinion is a reinitiation of consultation subsequent to the 1997 Opinion. Reinitiation is necessitated by two factors: 1) in 1999 the plant exceeded NMFS' anticipated incidental take of 3 green turtles per year established in the incidental take statement of the 1997 Opinion, and 2) the FP&L document referenced above represents new information about turtle interactions with the plant. This Opinion will analyze the plant's circulating seawater cooling system and its effects on loggerhead, Kemp's ridley, green, leatherback, and hawksbill sea turtles in accordance with section 7 of the Endangered Species Act of 1973 as amended.

The Opinion states NMFS' belief that the continued operation of the circulating seawater cooling system at the St. Lucie Nuclear Power Plant is not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, green, leatherback, or hawksbill sea turtles. However, NMFS anticipates incidental take of these species and has issued an Incidental Take Statement (ITS) pursuant to section 7 of the ESA. This ITS contains reasonable and prudent measures with implementing terms and conditions to help minimize this take. A complete administrative record of this consultation is on file at NMFS, Southeast Regional Office.

We look forward to further cooperation with you on other NRC projects to ensure the conservation and recovery of our threatened and endangered marine species.

Sincerely,

Joseph E. Powers, Ph.D.
Acting Regional Administrator

Enclosure

cc: F/PR3

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Endangered Species Act - Section 7 Consultation

Agency: United States Nuclear Regulatory Commission

Activity: Continued Operation of the St. Lucie Nuclear Power Plant's Circulating Seawater Cooling System, Jensen Beach, Hutchinson Island, Florida (F/SER/2000/01394)

Consultation Conducted By: National Marine Fisheries Service, Southeast Region

Date Issued: May 4, 2001

Approved By:

Joseph E. Powers, Ph.D.
Acting Regional Administrator

This document represents the National Marine Fisheries Service's (NMFS) biological opinion (Opinion) based on our review of the continued operation of the St. Lucie Nuclear Power Plant's circulating seawater cooling system and its effects on loggerhead turtles (*Caretta caretta*), Kemp's ridley turtles (*Lepidochelys kempii*), green turtles (*Chelonia mydas*), leatherback turtles (*Dermochelys coriacea*), and hawksbill turtles (*Eretmochelys imbricata*) in accordance with section 7 of the Endangered Species Act (ESA) of 1973 as amended. The Nuclear Regulatory Commission's (NRC) May 9, 2000, request for formal consultation was received on May 12, 2000.

This Opinion is a reinitiation of consultation which resulted in NMFS' January 1997 Opinion and is based on information provided in the document prepared by the Florida Power and Light Company (FP&L) titled "Physical and Ecological Factors Influencing Sea Turtle Entrainment Levels at the St. Lucie Nuclear Power Plant: 1976-1998" and a site visit and meeting held on November 10, 1999, among the plant, NRC, state of Florida, and NMFS personnel. A complete administrative record of this consultation is on file at the NMFS Southeast Regional Office in St. Petersburg, Florida.

Consultation History

In the original evaluation of the environmental impact of St. Lucie Unit 1, sea turtle entrapment and impingement were not evaluated (U.S. Atomic Energy Commission 1974). Nevertheless, sea turtles were entrapped and impinged when St. Lucie Unit 1 began commercial operation in 1977. To facilitate the capture of entrapped turtles and to prevent turtles from moving down the canal system toward the plant, a large mesh barrier net was erected in 1978. A mesh size of 8 in (20.3 cm) by 8 in was chosen to exclude 95% of the turtles based on the size frequency of turtles captured in the canal before March 1978.

A biological assessment was completed in 1982 for the operation of St. Lucie Unit 2. This assessment was based on the entrapment history of the plant from 1976 through 1981, approximately 150 turtles per year. As part of this evaluation, the 8-in (20.3 cm) square mesh barrier net was considered adequate to exclude turtles from the plant's intake wells. Also, a research program to investigate methods to physically or behaviorally exclude turtles from the offshore intake structures was conducted as part of the Environmental Protection Plan of Unit 2 and concluded that there was no practical method to accomplish this goal (Florida Power & Light 1985). In its 1982 biological opinion on the operation of St. Lucie Unit 2, NMFS concluded that the project was not likely to jeopardize the continued existence of listed species under its jurisdiction but made no provisions for sea turtle mortality.

Since 1993, FP&L has documented significant increases in the numbers of entrapped turtles. A principal component of this increase was juvenile green turtles with carapace widths less than 12 in (30 cm). Before 1993, the maximum number of green turtles captured annually at the St. Lucie Plant was 69. In 1994, a record high of 193 green turtles was captured. In 1995, 673 green turtles were captured, mostly juveniles. With the increase in the number of turtles handled and the decrease in the average size of the turtles, significantly more green turtles have been able to penetrate the 8-in (20.3 cm) mesh barrier net and pass down the canal to be entrained in the intake structures of the plant. The entrainment level peaked in 1995, when 97 turtles (14% of the turtles captured) were removed from the intake wells of the plant.

Based on the increasing number of sea turtles captured and killed at the St. Lucie Plant, the NRC determined that reinitiation of formal section 7 consultation with NMFS was required (also in part because the 1982 Opinion did not make provisions for sea turtles) and informed the NMFS Southeast Regional Office of this determination in a May 11, 1995 letter. The NRC submitted a biological assessment to NMFS on February 7, 1996. In addition, FP&L had installed a new barrier net with 5-in (12.7 cm) bar length webbing to prevent the passage of small turtles through the existing 8-in net and into the intake wells of the plant. Installation of the new barrier net was identified as a mitigation measure early in the consultation process, when methods to reduce entrainment were first discussed. FP&L implemented this requirement before completion of the section 7 consultation.

That consultation was completed with the issuance of a biological opinion in January 1997 which concluded that the project was not likely to jeopardize the continued existence of listed species under NMFS jurisdiction. The 1997 Opinion anticipated an annual incidental lethal take of 2 loggerhead sea turtles or 1.5% of the total number of loggerheads entrapped at the intake canal, whichever was greater; 3 green sea turtles or 1.5% of the total number of greens entrapped at the intake canal, whichever was greater; 1 Kemp's ridley sea turtle or 1.5% of the total number of Kemp's ridleys entrapped at the intake canal, whichever was greater; 1 hawksbill sea turtle or 1.5% percent of the total number of hawksbills entrapped at the intake canal, whichever was greater; and 1 leatherback sea turtle or 1.5% of the total number of leatherbacks entrapped at the intake canal, whichever was greater.

On November 10, 1999, NMFS attended a meeting to discuss the reinitiation of section 7 consultation because in 1999 the plant exceeded the anticipated incidental take level of green turtles set by the 1997 Opinion. At the meeting, FP&L informed NMFS that the study report on turtle interactions with the plant (required by the terms and conditions of the 1997 Opinion) would be completed by March 2000. NMFS advised the NRC and FP&L that NMFS would wait until the report was completed and would partly base the new consultation on that report. NMFS received the report on April 19, 2000, and the NRC's letter requesting reinitiation of section 7 consultation on May 12, 2000. The document and letter contained new information about turtle interactions with the plant. NMFS consided the consultation package complete as of receipt of the May 12, 2000, letter.

This Opinion analyzes the plant's circulating seawater cooling system and its effects on loggerhead, Kemp's ridley, green, leatherback, and hawksbill sea turtles in accordance with section 7 of the ESA.

BIOLOGICAL OPINION

I. Description of Proposed Action

The NRC is the licensing and regulating authority for all nuclear power plants in the United States. The proposed action considered in this Opinion is the NRC's continued licensing of the St. Lucie Nuclear Power Plant and the plant's continued operation of the circulating seawater cooling system, including the capture-release program for sea turtles which are entrapped in the plant's intake canal, and the associated sea turtle conservation and monitoring programs conducted under that license. A description of these activities follows:

Circulating Water System

The Atlantic Ocean provides cooling and receiving waters for both units' condensers and auxiliary cooling systems. These systems share common intake and discharge canals with ocean piping. The major components of these canals and ocean piping systems are: 1) three ocean intake structures and associated velocity caps located approximately 1,200 ft (365 m) from the shore line; 2) three buried intake pipelines to transport water from the intake structure to the intake canal (one pipeline is 16 ft (4.9 m) in diameter, and two are 12 ft (3.65 m) in diameter); 3) a common intake canal to convey sea water to each unit's intake structure; 4) individual unit intake structures; 5) discharge structures for each unit; 6) a common discharge canal; 7) one discharge pipeline to convey water offshore to a "Y" diffuser (12 ft [3.65 m] diameter pipeline) approximately 1,200 ft (365 m) offshore and another pipeline to convey water offshore to a multiport diffuser 16-ft (4.9 m) diameter pipeline; solid pipeline from shoreline to approximately 1,200 ft (365 m) offshore and then the multiport diffuser segment from approximately 1,200 to 2,400 ft (365-730 m) offshore.

The design unit flow for Units 1 and 2 is 1,150 cu ft per second (32.6 m^3/sec) with maximum and normal temperature rise across the condensers of 31°F and 25°F (17°-13°C), respectively (Bellmund *et al.* 1982).

Intake Structures and Velocity Caps

In 1991-1992, all three velocity caps were rebuilt due to the failure of several panels comprising the caps. The intake structures are located approximately 1,200 ft (365 m) offshore and about 2,400 ft (731 m) south of the discharge structures. The intake structures have a vertical section to minimize sand intake and a velocity cap to minimize fish entrapment, but no screens or grates are used to deny organisms access to the intake pipes. The tops of the intake structures are approximately 7 ft (2.1 m) below the surface at mean low water. The velocity cap for the 16-ft (4.9 m) diameter pipe is 70 ft (6.5 m) square, 5 ft (1.5) thick, and has a vertical opening of 6.25 ft (1.9 m). The velocity cap for the two 12-ft (3.65 m) diameter pipes is 52 ft (4.8 m) square, 5 ft (1.5 m) thick, and has a vertical opening of 6.5 ft (2.0 m).

The flow velocities at various locations of the velocity cap and intake structures have been calculated under various levels of biological fouling. The minimum and maximum horizontal intake velocities at the face of the ocean intake structures for the 12-ft (3.65 m) diameter pipe is calculated at 0.37-0.41 ft/sec (11.2-12.6 cm/sec) and for the 16-ft (4.9 m) diameter pipe is calculated at 0.92-1.0 ft/sec (28.3-30.5 cm/sec). As the water passes under the velocity cap, flow becomes vertical and the velocity increases to approximately 1.3 ft/sec (40.2 cm/sec) for the 12-ft (3.65 m) diameter pipe and 6.8 ft/sec (206 cm/sec) for the 16-ft (4.9 m) diameter pipe (Bellmund *et al.* 1982).

Intake Pipes

From the ocean intake structures, water flows through the three buried pipelines for approximately 1,200 ft (365 m) and empties into the open intake canal behind the dune line. The flow through these pipelines varies from 4.2-6.8 ft/sec (127-206 cm/sec), depending on the pipeline and the degree of fouling. Transit time for an object to travel the distance through the pipeline is approximately 180-285 sec (3 to 4.75 min).

Due to the differences in the diameter of the pipelines and friction of the pipeline walls, the calculated volume through the two 12-ft (3.65 m) diameter lines is approximately 20% each and approximately 60% for the 16-ft (4.9 m) diameter pipeline (Bellmund *et al.* 1982).

Head Walls and Canal System

Approximately 450 ft (138 m) behind the primary dune line, the intake pipes discharge their water at two head wall structures into the intake canal. The head wall structure for the two 12-ft (3.65 m) diameter pipes is a common vertical concrete wall. The head wall for the 16-ft (4.9 m) diameter pipe is more elaborate and consists of a guillotine gate in a concrete box open at the other end. A series of pillars parallel to the flow support a walkway above the discharge area.

The 300-ft (91 m) wide intake canal, whose maximum depth is approximately 25 ft (7.6 m), carries the cooling water 5,000 ft (1,525 m) to the intake structures. The flow rate in the canal varies from 0.9-1.1 ft/sec (27-32 cm/sec), depending on tidal stage.

Highway Bridge and Underwater Intrusion System

The intake canal is crossed by two permanent structures. One is a bridge owned by the Florida Department of Transportation and is part of U.S. Highway A1A. The roadway is supported by a series of concrete pilings driven into the bottom of the intake canal. The other barrier is the underwater intrusion detection system (UIDS), which is required for security reasons and has a net with a 9-ft (23-m) square mesh to prevent human intrusion into the secure area of the plant.

Intake Wells, Trash Racks, and Traveling Screens

Each unit has a separate intake structure consisting of four bays. Each bay contains trash racks ("grizzlies") that are vertical bars with approximately 3-in (7.6-cm) spacings to catch large objects, such as flotsam, traveling screens with a 3/8-in (1-cm) mesh to remove smaller debris, and circulating water pumps. Approach velocities to each bay are calculated to be less than 1 ft/sec (30.5 cm/sec), but increase to approximately 5 ft/sec (150 cm/sec) at the trash racks.

The trash racks are periodically cleaned by a rake that is lowered to the bottom of the rack. The rake's teeth fit into the 3 in (7.6 cm) vertical openings of the structure. This rake is pulled vertically up and collects any debris that may have accumulated on the structures. This debris is emptied into a trough at the top of the intake bay for subsequent disposal. Any debris that is collected on the traveling screens is washed from the screen by a series of spay jets and is then also emptied into a trough at the top of the intake bay for disposal.

Condensers

After the water has passed through the trash racks, the traveling screens, and the circulating water pump, it travels through the condenser, which contains thousands of 3/8-in (1-cm) diameter tubes. Condenser water heat is transferred to this water, which is then expelled into the discharge canal.

On Unit 2, FP&L has installed a "Taprogge" cleaning system to maintain condenser cleanliness, and is in the process of installing the same system on Unit 1. The Unit 2 system has been in operation since January 23, 1996. The Taprogge system works by passing hundreds of sponge balls less than an inch in diameter through the condenser tubes to remove biological fouling and scale. This mechanical cleaning system reduces the need for chemical treatments. The sponge balls are strained and returned to the head of the condenser for re-use. Four separate water boxes and sponge circulating systems are installed on the condenser. Each water box is normally charged with 1,800 sponge balls. The sponge ball strainers periodically require backflushing to clean debris from the strainer grid. When the grids are opened, the possibility exists for sponge balls to be released into the discharge waters. FP&L has developed "best management practices" to prevent sponge ball loss.

Discharge Systems

Each unit discharges its condenser cooling water into the discharge canal that is approximately

300 ft (91 m) wide and 2,200 ft (670 m) long. The canal terminates at two headwall structures approximately 450 ft (137 m) behind the primary dune line. One structure supports a 12-ft (3.65-m) diameter pipeline that is buried under the ocean floor and runs approximately 1,500 ft (460 m) offshore where it terminates into a two-port "Y" nozzle. The other structure supports a 16-ft (4.9-m) diameter pipeline that is buried under the ocean floor and runs approximately 3,375 ft (1,030 m) offshore. The last 1,400 ft (425 m) of this pipeline contain a multiport diffuser segment with 58 discharge ports. To minimize plume interference, the ports are oriented in an offshore direction on alternating sides of the pipeline. The velocity of the water inside this pipeline averages about 5.7 ft/sec (174 cm/sec), and the jet velocity of the discharge water at each port averages approximately 13 ft/sec (400 cm/sec) to ensure quick dissipation of the thermal load (Bellmund *et al.* 1982).

Thermal Plume

FP&L had the thermal plume modeled for the two-unit operation. The results indicated that the maximum surface temperatures are strongly dependent on ambient ocean conditions. The maximum surface horizontal temperature difference is predicted to be less than 4.9°F (2.7°C) and the resulting +2°F (+1.1°C) surface isotherm is estimated to encompass 963 acres (390 ha) (Bellmund *et al.* 1982).

Sea Turtle Capture and Removal Program

The goal of the sea turtle capture program at the St. Lucie Plant is to remove entrapped turtles from the intake canal system quickly once they have entered the system. FP&L, in conjunction with Applied Biology, Inc., and Quantum Resources, Inc., former and current contractors for sea turtle conservation and monitoring activities at St. Lucie Plant, has developed procedures and methods for handling marine turtles entrapped or impinged (Applied Biology 1993; Quantum 1994).

FP&L hypothesizes that the intake structures and velocity caps serve as an artificial reef, since the structures are the only significant physical feature in this inshore environment. Turtles may encounter these structures in their normal range of activities and feed on the fouling organisms growing on the structures, or seek the structures for shelter. Based on the intake velocities of the intake structures, once a turtle passes the vertical plane of the velocity cap, it can be quickly sucked into the intake pipeline and, after a 3-5 minute ride through the pipeline, be discharged into the intake canal.

From 1976 through 1999, all five species of turtles present in the inshore waters of Florida have been entrapped. A total of 6,576 turtles have been removed from the intake canal of the St. Lucie Plant since 1976. Loggerheads are the dominant turtle in numbers, greens are next, followed by Kemp's ridleys, leatherbacks, and hawksbills.

Barrier Nets–Past Configuration

To facilitate the capture of entrapped turtles and to reduce the likelihood of turtles moving down the intake canal toward the plant to be impinged, a large mesh barrier net (8-in [20.3 cm] square mesh) was erected at the A1A bridge in 1978. The net was suspended across the canal and was anchored at the bottom with weights and supported at the top by cables and floats. The net was hung so that it had a 1:1 slope, with the bottom anchors being positioned upstream of the surface floats. This configuration was designed to prevent bowing of the net in the center, minimizing the risk of an injured or lethargic turtle being pinned against the net and drowning. By confining most turtles to the canal area east of the A1A bridge, the net capture of turtles in this part of the canal was facilitated. Additionally, any turtle with a carapace width of 11.3 in (28.7 cm) or greater was excluded from passing through the net and moving down the canal and becoming impinged.

The net has been rehung several times (e.g., 1985, 1988, 1990) to maintain its 1:1 slope and blockage of the canal. The net is inspected approximately quarterly to ensure its integrity throughout the water column, its sides, and its bottom. Repairs are made as necessary, and sediment is removed by an air lift if the foot of the net is buried by a build-up of material. Because of deterioration over time, a new net with the same 8-in (20.3 cm) mesh was installed in 1987. In 1990, the headcable of the net was given more support by attaching a series of flotation rafts, which would keep the top of the net at or above the surface of the water under varying water levels that result from tides or operational changes of the generating units (e.g., if a unit is not operating, the water level in the canal rises about 4 ft ([1.2 m]). This reconfiguration would also keep turtles from swimming over the top of the net.

<u>Barrier Net–New Configuration</u>

Due to observed increases in the entrapment rate in 1993 and 1994 (Quantum 1994) for greens and loggerheads, the continuing upward trend in 1995, and the increases in impingement rates and subsequent mortality at the intake wells of the plant, construction of a new, smaller mesh barrier net east of the present barrier net was identified early in the consultation process as a necessary mitigation measure to reduce lethal takes. Specific details of the net configuration were discussed during early consultation activities, which included FP&L's solicitation of ideas from their engineers, Florida Fish and Wildlife Conservation Commission (FFWCC, formerly Department of Environmental Protection) turtle specialists, and NMFS personnel. FP&L completed construction of the new barrier net, a 5-in (12.7 cm) square mesh with a deployed diagonal measurement of 7 in (18 cm) in January 1996. FP&L selected the 5-in mesh size based on the size distribution of turtles seen in the first half of 1995. None of the 414 green turtles entrapped in the intake canal during the first half of 1995 had a straight carapace width measurement smaller than 7 in (18 cm). FP&L predicts that all turtles encountering the 5-in barrier net will be prevented from moving down the canal toward the plant if future turtle size distributions match those of 1995. The net is located approximately halfway between the old 8-in barrier net and the intake headwalls, thus entrapped sea turtles will be confined in a much smaller area. The 5-in net is anchored along the bottom of the canal and is held up by an aerial wire that is strung between tensioning towers on the sides of the canal. The net is designed to remain partially out of the water at varying water levels. Due to potential fouling situations from jellyfish or seaweed, the top of the net can be quickly released from the tensioning towers so that it can drop to the bottom of the canal. The net is inspected quarterly to ensure its integrity and to provide necessary cleaning and maintenance as required. The old 8-in (20.3-cm) mesh barrier net will also be maintained in its existing place to serve as a backup in case there is a failure of the 5-in (12.7-cm) mesh net or the new net needs to be lowered because of fouling from jellyfish, seaweed, or flotsam.

Underwater Intruder Detection System (UIDS)

In 1986, the UIDS was installed to prevent human entry into the plant via the canal system and to provide further security for the plant. This system also provides an additional barrier for turtles that penetrate the old 8-in barrier net. The barrier is on the north-south arm of the canal and consists of a rigid net with a 9-in (22.9-cm) mesh. The net is hung at approximately a 0.9:1 slope with the bottom of the net downstream of the top. This net is inspected periodically by security personnel; and several turtles, both live and dead (the exact numbers and species were not recorded), were removed from this area in 1994 and 1995, prior to the installation of the 5-inch barrier net.

Intake Well Inspection and Removal

Since December 1994, FP&L has provided inspection of the intake wells at least once every three hours over a 24-hour period. This increase in surveillance was necessary due to increased turtle presence and mortality in the intake wells.

Plant or security personnel who see any turtle impinged or swimming in the intake well area are required to notify a plant turtle biologist through a beeper system. Sea turtle biologists are constantly on call and response time is within an hour. The responding biologist then captures the turtle with a long-handle dip net and places it in a padded box for holding and transport.

Netting Program

Sea turtles are removed from the intake canal by means of large-mesh entanglement nets fished between the intake head wall and the barrier net at the A1A bridge. From 1976 through the present, this netting program has been constantly evaluated and continuously improved to minimize trauma to turtles and to maximize capture efficiency. Nets presently used are from 100-120 ft (30-37 m) long, 9-12 ft (2.7-3.7 m) deep, and composed of 16-in (41-cm) stretch-mesh multifilament nylon. Large floats are attached to the top of the net to provide buoyancy and the bottom of the net is unweighted. Prior to April 1990, turtle nets were deployed on Monday mornings and retrieved on Friday afternoons. During periods of deployment, the nets were inspected for captures at least twice daily (e.g., mornings and afternoons). Additionally, plant and security personnel checked the net periodically, and notified biologists immediately if a capture had occurred. Sea turtle biologists were on call 24 hours/day to retrieve turtles entangled in capture nets.

Beginning in April 1990, after consultation with NMFS, net deployment was scaled back to daylight hours only. Concurrently, surveillance of the intake canal and the nets was increased to the hours the nets were being fished. This measure decreased response time for removal of entangled turtles from the nets and decreased mortalities from accidental drowning. The presence of a biologist also provided a daily assessment of turtle numbers in the canal and an indication of when a given turtle was first sighted. Biologists were then able to estimate the residence time of the turtle from the first observation to capture and release.

Hand Capture and Dip Netting
In addition to the use of entanglement nets to capture turtles, dip nets and hand captures by snorkel and SCUBA divers are used. Long-handle dip nets used from small boats and from the canal banks and head walls are effective in capturing turtles with carapace lengths of 12 in (30.5 cm) or less. Hand nets have also been used to remove dead and floating small green turtles from various areas in the canal system.

Under good water visibility conditions, divers have proven to be very effective in capturing turtles of all sizes, particularly inactive turtles partially buried in the sediment near the barrier net or sleeping individuals throughout the canal. FP&L believes that hand captures have had a significant impact in reducing residence times for turtles in the canal.

Tagging and Health Assessment Activities
All turtles removed from the St. Lucie Plant intake canal system are identified as to species, measured, weighed, tagged, and examined for overall condition (wounds, abnormalities, parasites, missing appendages). Healthy turtles are released into the ocean on the day of capture.

Since July 1, 1994, all turtles captured are photographed dorsally and ventrally prior to release, and the photographs are retained for future reference. Inconel tags supplied by NMFS are applied to the proximal edge of the foreflippers. The tag numbers, species, and morphometrics of each turtle are reported monthly to FFWCC.

If a turtle has been previously tagged either at the St. Lucie facility or elsewhere, that fact is noted in a monthly data sheet and reported. These data are forwarded by FFWCC to NMFS for inclusion in their data base. From 1990 through 1999, recaptures of green turtles have gone from less than 1% in 1990 to 43% in 1997 and back down to 35% in 1999. Loggerhead recaptures were 10% in 1990, staying between 5% and 11% until 1999 where they reached 15% (Quantum 1999). Several other turtles with tag scars have also been recovered, suggesting that the actual number of recaptures may be higher. Occasionally, turtles are captured that have been tagged by other researchers. One such capture occurred in 1994: a female leatherback with tags from French Guiana.

Necropsy and Rehabilitation Activities
Resuscitation techniques are used on turtles that appear to be comatose. Lethargic or slightly injured turtles are treated and occasionally held for observation prior to release. If further treatment is warranted, FFWCC is notified and a decision is made about which facility would provide additional veterinarian treatment. Beginning in 1982, necropsies were conducted on dead turtles found in fresh conditions.

Sea Turtle Conservation and Monitoring Program

FP&L has been conducting nesting studies as part of the St. Lucie Unit 1 and Unit 2 reporting requirements for the U.S. Fish and Wildlife Service (FWS). In addition, FWS and FFWCC have started a long-term nesting index survey, and the data generated by FP&L since 1971 are an integral part of this program. Nesting reports are summarized on a yearly basis (Applied Biology 1976-1994; Quantum 1994). Nesting surveys run from April 15 through September 15. Biologists use small off-road motorcycles to survey the island early morning, generally completing the survey before 10 a.m. New nests, non-nesting emergences (false crawls), and nests destroyed by predators are recorded for each of the 0.62-mile (1-km) survey areas on Hutchinson Island. In addition to nesting data, data from stranded turtles found during beach nesting surveys are logged. These data are routinely provided to FFWCC and NMFS through the Sea Turtle Stranding and Salvage Network (STSSN). NMFS uses the STSSN database to monitor impacts to sea turtles from natural and human sources of mortality, as well as to infer turtle population characteristics. Also FP&L has been conducting turtle walk programs at the St. Lucie Plant since 1982 as a public service. These walks are permitted by FFWCC and have become quite popular.

Action Area

The action area consists of St. Lucie Nuclear Power Plant, Units 1 and 2, located on a 437-hectare site on Hutchinson Island, Florida, and the piping, canals, and equipment, described above, that make up the circulating seawater cooling system. The Island is bound by the Atlantic Ocean on the east side, the Indian River Lagoon on the west side, the Ft. Pierce Inlet on the north side and the St. Lucie Inlet on the south side. The plant is located approximately midway between the two inlets.

II. Status of Listed Species and Critical Habitat

The following listed species under the jurisdiction of NMFS are known to occur in the action area and may be affected by the proposed action:

Endangered

Blue whale	*Balaenoptera musculus*
Humpback whale	*Megaptera novaeangliae*
Fin whale	*Balaenoptera physalus*
Northern right whale	*Eubalaena glacialis*
Sei whale	*Balaenoptera borealis*
Sperm whale	*Physeter macrocephalus*
Leatherback sea turtle	*Dermochelys coriacea*
Hawksbill sea turtle	*Eretmochelys imbricata*
Kemp's ridley sea turtle	*Lepidochelys kempii*

Green sea turtle *Chelonia mydas**

*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, green turtles are considered endangered wherever they occur in U.S. waters.

Threatened

Loggerhead sea turtle	*Caretta caretta*
Johnson's seagrass	*Halophila johnsonii*

Species of large whales protected by the ESA are not likely to be affected by the proposed action. Species of large whales will not be affected by the intake structures and cannot be trapped in the intake canal. Therefore, species of large whales will not be discussed further in this Opinion.

The proposed action does not include any construction or dredging activities that will cause increased sedimentation or turbidity in Johnson's seagrass habitat. The intake and discharge structures are situated above the sea floor and do not affect the bottom sediments. Therefore, Johnson's seagrass and its critical habitat are not expected to be affected. Johnson's seagrass will not be discussed further in this Opinion.

Critical Habitat Designations

Johnson's seagrass *Halophila johnsonii*

Loggerhead turtle (*Caretta caretta*)

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans and are the most abundant species of sea turtle occurring in U.S. waters. Loggerhead sea turtles concentrate their nesting in the north and south temperate zones and subtropics, but generally avoid nesting in tropical areas of Central America, northern South America, and the Old World (Magnuson *et al.* 1990). The largest known nesting aggregation of loggerhead sea turtles occurs on Masirah and Kuria Muria Islands in Oman (Ross and Barwani 1982). In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. The best scientific and commercial data available on the genetics of loggerhead sea turtles suggests there are four major subpopulations of loggerhead sea turtles in the northwest Atlantic: (1) a northern nesting subpopulation that occurs from North Carolina to northeast Florida, about 29° N; (2) a south Florida nesting subpopulation, occurring from 29°N on the east coast to Sarasota on the west coast; (3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida; and (4) a Yucatan nesting subpopulation, occurring on the eastern Yucatan Peninsula, Mexico (Márquez 1990). This biological opinion will focus on the northwest Atlantic subpopulations of loggerhead sea turtles, which occur in the action area.

Although NMFS has not completed the administrative processes necessary to formally recognize populations or subpopulations of loggerhead sea turtles, these sea turtles are generally grouped by their nesting locations. Based on the most recent reviews of the best scientific and commercial data on the population genetics of loggerhead sea turtles and analyses of their population trends (TEWG 1998; TEWG in prep.), NMFS treats these loggerhead turtle nesting aggregations as distinct sub-populations whose survival and recovery is critical to the survival and recovery of the species. Further, any action that appreciably reduced the likelihood that one or more of these nesting aggregations would survive and recover would appreciably reduce the species' likelihood of survival and recovery in the wild. Consequently, this biological opinion will focus on the four nesting aggregations of loggerhead sea turtles identified in the preceding paragraph (which occur in the action area) and treat them as subpopulations for the purposes of this analysis. Natal homing to the nesting beach provides the genetic barrier between these subpopulations, preventing recolonization from turtles from other nesting beaches. The importance of maintaining these subpopulations in the wild is shown by the many examples of extirpated nesting assemblages in the world.

The loggerhead sea turtles in the action area are likely to represent differing proportions of the four western Atlantic subpopulations. Although the northern nesting subpopulation produces about 9 percent of the loggerhead nests, they comprise more of the loggerhead sea turtles found in foraging areas from the northeastern United States to Georgia: between 25% and 59% of the loggerhead sea turtles in this area are from the northern subpopulation (Bass *et al.* 1998; Norrgard 1995; Rankin-Baransky 1997; Sears 1994, Sears *et al.* 1995). In North Carolina, the northern subpopulation is estimated to make up from 28% to 32% of the loggerheads (NMFS, unpublished data; Bass *et al.* 1998). About 10% of the loggerhead sea turtles in foraging areas off the Atlantic coast of central Florida are from the northern subpopulation (Witzell *et al.* in prep.). In the Gulf of Mexico, most of the loggerhead sea turtles in foraging areas will be from the South Florida subpopulation, although the northern subpopulation may represent about 10% of the loggerhead sea turtles in the gulf (Bass pers. comm.). In the Mediterranean Sea, about 45%-47% of the pelagic loggerheads are from the South Florida subpopulation and about 2% are from the northern subpopulation, while about 51% originated from Mediterranean nesting beaches (Laurent *et al.* 1998). In the vicinity of the Azores and Madeira Archipelagoes, about 19% of the pelagic loggerheads are from the northern subpopulation, about 71% are from the South Florida subpopulation, and about 11% are from the Yucatan subpopulation (Bolten *et al.* 1998).

Loggerhead sea turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years. Turtles in this life history stage are called "pelagic immatures" and are best known from the eastern Atlantic near the Azores and Madeira and have been reported from the Mediterranean as well as the eastern Caribbean (Bjorndal *et al.* in press). Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm SCL they recruit to coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico.

Benthic immatures have been found from Cape Cod, Massachusetts, to southern Texas, and occasionally strand on beaches in northeastern Mexico (R. Márquez-M. pers. comm.). Large benthic immature loggerheads (70-91 cm) represent a larger proportion of the strandings and in-water captures (Schroeder *et al.* 1998) along the southern and western coasts of Florida as compared with the rest of the coast, but it is not known whether the larger animals actually are more abundant in these areas or just more abundant within the area relative to the smaller turtles. Benthic immature loggerheads foraging in northeastern U.S. waters are known to migrate southward in the fall as water temperatures cool (Epperly *et al.* 1995; Keinath 1993; Morreale and Standora 1999; Shoop and Kenney 1992), and migrate northward in spring. Given an estimated age at maturity of 21-35 years (Frazer and Ehrhart 1985; Frazer and Limpus 1998), the benthic immature stage must be at least 10-25 years long.

Adult loggerhead sea turtles have been reported throughout the range of this species in the United States and throughout the Caribbean Sea. As discussed in the beginning of this section, they nest primarily from North Carolina southward to Florida with additional nesting assemblages in the Florida Panhandle and on the Yucatán Peninsula. Non-nesting, adult female loggerheads are reported throughout the United States and Caribbean Sea; however, little is known about the distribution of adult males who are seasonally abundant near nesting beaches during the nesting season. Aerial surveys suggest that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following proportions: 54% in the southeast U.S. Atlantic, 29% in the northeast U.S. Atlantic, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico (TEWG 1998).

There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size. Nesting data collected on index nesting beaches in the United States from 1989-1998 represent the best dataset available to index the population size of loggerhead sea turtles. Between 1989 and 1998, the total number of nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,016-89,034 annually, representing, on average, an adult female population of 44,780 [(nests/4.1) * 2.5]. On average, 90.7% of the nests were from the South Florida subpopulation, 8.5% were from the northern subpopulation, and 0.8% were from the Florida Panhandle subpopulation. There is limited nesting throughout the Gulf of Mexico west of Florida, but it is not known to what subpopulation they belong. There are an estimated 3,700 nesting females in the northern loggerhead subpopulation, and the status of this population has been classified as stable at best (TEWG in prep.).

From a global perspective, the southeastern U.S. nesting aggregation is critical to the survival of this species: it is second in size only to the nesting aggregations in the Arabian Sea off Oman and represents about 35% and 40% of the nests of this species. The status of the Oman nesting beaches has not been evaluated recently, but they are located in a part of the world that is vulnerable to extremely disruptive events (*e.g.*, political upheavals, wars, and catastrophic oil spills), the resulting risk facing this nesting aggregation and these nesting beaches is cause for considerable concern (Meylan *et al.* 1995).

Loggerhead sea turtles face a number of threats in the marine environment, including oil and gas exploration, development, and transportation; marine pollution; trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries; underwater explosions; dredging, offshore artificial lighting; power plant entrapment; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; and poaching. On their nesting beaches in the United States, loggerhead sea turtles are threatened with beach erosion, armoring, and nourishment; artificial lighting; beach cleaning; increased human presence; poaching; recreational beach equipment; exotic dune and beach vegetation; predation by exotic species such as fire ants, raccoons (*Procyon lotor*), armadillos (*Dasypus novemcinctus*), and opossums (*Didelphus virginiana*).

Large numbers of loggerhead sea turtles from the four subpopulations that occur in the action area are captured, injured, or killed in a wide variety of fisheries. Virtually all of the pelagic immature loggerheads taken in the Portuguese longline fleet in the vicinity of the Azores and Madeira are from western North Atlantic nesting subpopulations (Bolten *et al.* 1994, 1998) and about half of those taken in both the eastern and western basins of the Mediterranean Sea are from the western North Atlantic subpopulations (Bowen *et al.* 1993; Laurent *et al.* 1998). Aguilar *et al.* (1995) estimated that the Spanish swordfish longline fleet, which is only one of the many fleets operating in the region, alone captures more than 20,000 juvenile loggerheads annually, killing as many as 10,700. Estimated bycatch of marine turtles by the U.S. Atlantic tuna and swordfish longline fisheries, based on observer data, was significantly greater than reported in logbooks through 1997 (Johnson *et al.* 1999; Witzell 1999), but was comparable by 1998 (Yeung 1999). Observer records indicate that an estimated 6,544 loggerheads were captured by the U.S. fleet between 1992-1998, of which an estimated 43 were dead (Yeung *et al.* in prep.). For 1998 an estimated 510 loggerheads (225-1250) were captured and, based on serious injury criteria developed for marine mammals (which may be inappropriate for sea turtles), all were presumed dead or were expected to die subsequent to being captured. Logbooks and observer records indicated that loggerheads readily ingest hooks (Witzell 1999). Aguilar *et al.* (1995) reported that hooks were removed from only 171 of 1,098 loggerheads captured in the Spanish longline fishery, describing that removal was possible only when the hook was found in the mouth, the tongue or, in a few cases, externally (flippers, *etc.*); the presumption is that all others had ingested the hook.

Loggerhead sea turtles also face numerous threats from natural causes. For example, there is a significant overlap between hurricane seasons in the Caribbean Sea and northwest Atlantic Ocean (June to November) and loggerhead sea turtle nesting season (March to November); hurricanes can have potentially disastrous effects on the survival of eggs in sea turtle nests. In 1992, Hurricane Andrew affected turtle nests over a 90-mile length of coastal Florida; all of the eggs were destroyed by storm surges on beaches that were closest to the eye of this hurricane (Milton *et al.* 1992). On Fisher Island near Miami, Florida, 69% of the eggs did not hatch after

Hurricane Andrew, probably because they were drowned by the storm surge. Nests from the northern subpopulation were destroyed by hurricanes which made landfall in North Carolina in the mid to late 1990s. Sand accretion and rainfall that result from these storms can appreciably reduce hatchling success. These natural phenomena probably have significant, adverse effects on the size of specific year classes; particularly given the increasing frequency and intensity of hurricanes in the Caribbean Sea and northwest Atlantic Ocean.

Status and trend of loggerhead sea turtles

Several published reports have presented the problems facing long-lived species that delay sexual maturity in a world replete with threats from a modern, human population (Congdon *et al.* 1993, Congdon and Dunham 1994, Crowder *et al.* 1994). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high, annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes. This general rule applies to sea turtles, particularly loggerhead sea turtles, because the rule originated in studies of sea turtles (Crouse *et al.* 1987, Crowder *et al.* 1994, Crouse 1999). Heppell *et al.* (in prep.) specifically showed that the growth of the loggerhead sea turtle population was particularly sensitive to changes in the annual survival of both juvenile and adult sea turtles and that the adverse effects of the pelagic longline fishery on loggerheads from the pelagic immature phase appeared critical to the survival and recovery of the species. Crouse (1999) concluded that relatively small changes in annual survival rates of both juvenile and adult loggerhead sea turtles will adversely affect large segments of the total loggerhead sea turtle population.

The four major subpopulations of loggerhead sea turtles in the northwest Atlantic—northern, south Florida, Florida Panhandle, and Yucatan—are all subject to fluctuations in the number of young produced annually because of natural phenomena like hurricanes as well as human-related activities. Although sea turtle nesting beaches are protected along large expanses of the northwest Atlantic coast (in areas like Merritt Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection and probably cause fluctuations in sea turtle nesting success. Volusia County, Florida, for example, allows motor vehicles to drive on sea turtle nesting beaches (the County has filed suit against the USFWS to retain this right) and sea turtle nesting in Indian River, Martin, West Palm, and Broward Counties of Florida can be affected by beach armoring, beach renourishment, beach cleaning, artificial lighting, predation, and poaching.

As discussed previously, the survival of juvenile loggerhead sea turtles is threatened by a completely different set of threats from human activity once they migrate to the ocean. Pelagic immature loggerhead sea turtles from these four subpopulations circumnavigate the North Atlantic over several years (Carr 1987, Bjorndal 1994). During that period, they are exposed to a series of longline fisheries that include an Azorean longline fleet, a Spanish longline fleet, and various fleets in the Mediterranean Sea (Aguilar *et al.* 1995, Bolten *et al.* 1994, Crouse 1999). Based on their proportional distribution, the capture of immature loggerhead sea turtles in longline fleets in the Azores and Madeira Archipelagoes and the Mediterranean Sea will have a significant, adverse effect on the annual survival rates of juvenile loggerhead sea turtles from the western Atlantic subpopulations, with a disproportionately large effect on the northern subpopulation that may be significant at the population level.

In waters off the coastal United States, the survival of juvenile loggerhead sea turtles is threatened by a suite of fisheries in Federal and State waters. Loggerhead turtles are captured, injured, or killed in shrimp fisheries off the Atlantic coast; along the southeastern Atlantic coast, loggerhead turtle populations were declining where shrimp fishing is intense off the nesting beaches, before the required use of TEDs (Magnuson *et al.* 1990). Conversely, these nesting populations did not appear to be declining where nearshore shrimping effort is low or absent. The management of shrimp harvest in the Gulf of Mexico demonstrates the correlation between shrimp trawling and impacts to sea turtles. Waters out to 200 nm are closed to shrimp fishing off Texas each year for approximately a 3-month period (mid-May through mid-July) to allow shrimp to migrate out of estuarine waters; sea turtle strandings decline dramatically during this period (NMFS, STSSN unpublished data). Loggerhead sea turtles are captured in fixed pound net gear in the Long Island Sound, in pound net gear and trawls in summer flounder and other finfish fisheries in the mid-Atlantic and Chesapeake Bay, in gill net fisheries in the mid-Atlantic and elsewhere, in fisheries for monkfish and for spiny dogfish, and in northeast sink gill net fisheries (see further discussion in the *Environmental Baseline* of this Opinion). Witzell (1999) compiled data on capture rates of loggerhead and leatherback turtles in U.S. longline fisheries in the Caribbean and northwest Atlantic; the cumulative takes of these fisheries approach those of the U.S. shrimp fishing fleet (Crouse 1999, Magnuson *et al.* 1990).

Leatherback turtle (*Dermochelys coriacea*)

The Recovery Plan for Leatherback Turtles (*Dermochelys coriacea*) contains a description of the natural history and taxonomy of this species (USFWS and NMFS 1992). Leatherbacks are widely distributed throughout the oceans of the world, and are found throughout waters of the Atlantic, Pacific, Caribbean, and the GOM (Ernst and Barbour 1972). They are predominantly distributed pelagically, feeding primarily on jellyfish such as *Stomolophus*, *Chryaora*, and *Aurelia* (Rebel 1974). Leatherbacks are deep divers, with recorded dives to depths in excess of 1000 m (Eckert *et al.* 1989), but they may come into shallow waters if there is an abundance of jellyfish nearshore. Leary (1957) reported a large group of up to 100 leatherbacks just offshore of Port Aransas, Texas, associated with a dense aggregation of *Stomolophus*. They also occur annually in places such as Cape Cod and Narragansett Bays during certain times of the year, particularly the fall.

The leatherback is the largest living turtle and it ranges farther than any other sea turtle species, exhibiting broad thermal tolerances (NMFS and USFWS 1995). Leatherback turtles feed primarily on cnidarians (medusae, siphonophores) and tunicates (salps, pyrosomas) and are often found in association with jellyfish. TDR data recorded by Eckert *et al.* (1989) indicate that leatherbacks are night feeders. Of the Atlantic turtle species, leatherback turtles seem to be the most susceptible to entanglement in lobster gear and, along with loggerheads, to longline gear. This susceptibility may be the result of attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, and perhaps to the lightsticks used to attract target species in the longline fishery.

Although leatherbacks are a long lived species (>30 years), they are somewhat faster to mature than loggerheads, with an estimated age at sexual maturity reported as about13-14 years for females, and an estimated minimum age at sexual maturity of 5-6 years, with 9 years reported as a likely minimum (Zug 1996).

Compared to the current knowledge regarding loggerhead populations, the genetic distinctness of leatherback populations is less clear. However, genetic analyses of leatherbacks to date indicate that within the Atlantic basin significant genetic differences occur between St. Croix, U.S.V.I., and mainland Caribbean populations (Florida, Costa Rica, Suriname and French Guiana) and between Trinidad and the same mainland populations (Dutton *et al.* 1999), leading to the conclusion that there are at least three separate subpopulations of leatherbacks in the Atlantic. Much of the genetic diversity is contained in the relatively small insular subpopulations. To date, no studies have been published on the genetic make-up of pelagic or benthic foraging leatherbacks in the Atlantic and thus it is not known what populations are being impacted by particular actions.

Although populations or subpopulations of leatherback sea turtles have not been formally recognized, based on the most recent reviews of the analysis of population trends of leatherback sea turtles, and due to our limited understanding of the genetic structure of the entire species, the most conservative approach would be to treat leatherback nesting populations as distinct populations whose survival and recovery is critical to the survival and recovery of the species. Further, any action that appreciably reduced the likelihood for one or more of these nesting populations to survive and recover in the wild would appreciably reduce the species' likelihood of survival and recovery in the wild.

Nest counts are currently the only reliable indicator of population status available for leatherback turtles. Recent declines have been seen in the number of leatherbacks nesting worldwide (NMFS and USFWS 1995). The status of the leatherback population in the Atlantic is difficult to assess since major nesting beaches occur over broad areas within tropical waters outside the United States. The nesting population within U.S. jurisdiction is presumed to be stable. Numbers at some nesting beaches (*e.g.*, St. Croix, Florida, Puerto Rico) are increasing (P. Dutton pers. comm.), although some nesting beaches in the U.S. Virgin Islands have been extirpated including nesting assemblages in other areas of the Caribbean such as St. John and St. Thomas. The nesting beach at Sandy Point, St. Croix, which has witnessed an increase in the population, has been subject to intensive conservation management efforts since 1981. However, it is not known whether the observed increase is due to improved adult survival or recruitment of new nesters, since flipper tag loss is so high in this species. Better data collection methods implemented since the late 1980s may soon help to answer these questions. Based on an expected inter-nesting interval of one to five years, Dutton *et al.* (in press) estimate a 19–49% mortality rate for re-migrating females at Sandy Point. Researchers are currently unable to explain the underlying mechanisms which somehow are resulting simultaneously in such high mortality levels to nesting age females, and yet exponential growth in the nesting population.

In the western Atlantic, the primary nesting beaches occur in French Guiana, Suriname, and Costa Rica. The nesting population of leatherback sea turtles in the Suriname-French Guiana trans-boundary region has been declining since 1992 (Chevalier and Girondot 1998). The current status of nesting populations in French Guiana and Suriname is difficult to interpret because these beaches are so dynamic geologically. Chevalier (pers. comm.), in a talk at the recent Annual Sea Turtle Symposium on March 2, 2000, entitled "Driftnet Fishing in the Marconi Estuary: the Major Reason for the Leatherback Turtle's Decline in the Guianas," stated that since the mid 1970s leatherback nesting has declined (1987-1992 mean = 40,950 nests and 1993-1998 mean = 18,100 nests). He states that there is very little shifting in nesting from French Guiana and Suriname to other Caribbean sites (there has only been one tag recapture elsewhere). Chevalier claims that there is no human-induced mortality on the beach in French Guiana, and natural mortality of adults should be low. There has been very low hatchling success on beaches used for the last 25 years. Chevalier believes that threats to the population include fishing (longlines, driftnets, and trawling), pollution (plastic bags and chemicals), and boat propellers. Around 90% of the nests are laid within 25 km from the Maroni estuary. Strandings in 1997, 1998, and 1999 in the estuary were 70, 60, and 100, which Chevalier considers underestimates. He questioned the fishermen and actually observed a 1 km gill net with seven dead leatherbacks. This observation, coupled with the strandings, led him to conclude that there were large numbers captured incidentally in large mesh nets. There are protected areas nearshore in French Guiana; offshore, driftnets are set. There are no such protected areas off Suriname, and fishing occurs at the beach. Offshore nets soak overnight in Suriname; many boats fish overnight. According to Chevalier, the French Guiana government is starting up a working group to deal with accidental capture and to enforce the legislation. They will work towards the management of the fishery activity and collaborate with Suriname. They plan to study the accidental capture by the fishermen, satellite track turtles, and study strandings. The main problem appears to be the close proximity of the driftnet fishery to the nesting areas.

Swinkels (pers. comm.) also gave a presentation at the symposium on March 3, 2000, entitled "The Leatherback on the Move? Promising News from Suriname." Swinkels stated that from 1995-1999 there was a large increase in leatherback nesting in Suriname. There is a nature reserve in two parts: one in Suriname and one in adjacent French Guiana. There were increasing trends observed on three beaches but poaching was 80%. Samsambo is a very dynamic beach which has been newly created (by natural events) and now is a nesting beach. In 1999, there were >4000 nests of which about 50% were poached. In 1995 very few were poached (very little poaching effort was concentrated there because at the time there wasn't much beach or nesting). Swinkels indicated that since that time, however, poaching has been increasing. The beach has naturally been renourished over this period. Swinkels' null hypothesis was that there had been a shift in nesting activity (from other nesting areas). His alternate hypothesis was that the new nesting represented new recruitment to the population.

The status of leatherbacks in the Pacific appears more dire than the Atlantic. The East Pacific leatherback population was estimated to be over 91,000 adults in 1980 (Spotila 1996). Declines in nest abundance have been reported from primary nesting beaches. At Mexiquillo, Michoacan, Mexico, Sarti *et al.* (1996) reported an average annual decline in nesting of about 23% between 1984 and 1996. The total number of females nesting on the Pacific coast of Mexico during the 1995-1996 season was estimated at fewer than 1,000. Less than 700 females are estimated for Central America (Spotila *et al.* 2000). In the western Pacific, the decline is equally severe. Current nestings at Terengganu, Malaysia, represent 1% of the levels recorded in the 1950s (Chan and Liew 1996).

Globally, leatherback populations have been decimated worldwide. The population was estimated to number approximately 115,000 adult females in 1980 (Pritchard 1982) and only 34,500 by 1995 (Spotila *et al.* 1996). The decline can be attributed to many factors including fisheries as well as intense exploitation of the eggs (Ross 1979). On some beaches, nearly 100% of the eggs laid have been harvested (Sarti *et al.* 1996). Sarti (1996) and Spotila *et al.* (1996) record that adult mortality has also increased significantly, particularly as a result of driftnet and longline fisheries. The Pacific population appears to be in a critical state of decline, now estimated to number less than 3,000 total adult and subadult animals (Spotila 2000). The status of the Atlantic population is less clear. In 1996, it was reported to be stable, at best (Spotila 1996), but numbers in the western Atlantic at that writing were reported to be on the order of 18,800 nesting females. According to Spotila (pers. comm.), the western Atlantic population currently numbers about 15,000 nesting females, whereas current estimates for the Caribbean (4,000) and the eastern Atlantic (*i.e.*, off Africa, numbering ~ 4,700) have remained consistent with numbers reported by Spotila *et al.* in 1996. Between 1989 and 1995, marked leatherback returns to the nesting beach at St. Croix averaged only 48.5%, but that the overall nesting population grew (McDonald *et al.* 1993). This is in contrast to a Pacific nesting beach at Playa Grande, Costa Rica, where only 11.9% of turtles tagged in 1993-94 and 19.0% of turtles tagged in 1994-95 returned to nest over the next five years. Characterizations of this population suggest that it has a very low likelihood of survival and recovery in the wild under current conditions.

Spotila *et al.* (2000) states that a conservative estimate of annual leatherback fishery-related mortality (from longlines, trawls, and gill nets) in the Pacific during the 1990s is 1,500 animals. He estimates that this represented about a 23% mortality rate (or 33% if most mortality was focused on the East Pacific population). Spotila *et al.* (2000) asserts that most of the mortality associated with the Playa Grande nesting site was fishery related. As noted above, leatherbacks normally live at least 30 years, usually maturing at about 12-13 years. Such long-lived species cannot withstand such high rates of anthropogenic mortality.

Spotila *et al.* (1996) describe a hypothetical life table model based on estimated ages of sexual maturity at both ends of the species' natural range (5 and 15 years). The model concluded that leatherbacks maturing in 5 years would exhibit much greater population fluctuations in response to external factors than would turtles that mature in 15 years. Furthermore, the simulations indicated that leatherbacks could maintain a stable population only if both juvenile and adult survivorship remained high and if other life history stages (*i.e.*, egg, hatchling, and juvenile) remained static, "stable leatherback populations could not withstand an increase in adult mortality above natural background levels without decreasing . . . Even the Atlantic populations are being exploited at a rate that cannot be sustained." Model simulations indicated that an increase in adult mortality of more than 1% above background levels in a stable population was unsustainable. Spotila *et al.* (1996) recommended not only reducing mortalities resulting from fishery interaction, but also advocated protection of eggs during the incubation period and of hatchlings during their first day, and indicated that such practices could potentially double the chance for survival and help counteract population effects resulting from adult mortality. They conclude "the Atlantic population is the most robust, but it is being exploited at a rate that cannot be sustained and if this rate of mortality continues, these populations will also decline. Leatherbacks are on the road to extinction."

Zug (1996) point out that the combination of the loss of long-lived adults in fishery related mortality and the lack of recruitment stemming from elimination of annual influxes of hatchlings because of intense egg harvesting has caused the sharp decline in leatherback populations. The authors state that "the relatively short maturation time of leatherbacks offers some hope for their survival if we can greatly reduce the harvest of their eggs and the accidental and intentional capture and killing of large juveniles and adults."

Summary

The conflicting information regarding the status of Atlantic leatherbacks makes it difficult to conclude whether or not the population is currently in decline. Numbers at some nesting sites are up, while at others they are down. At one site (St. Croix), population growth has been documented despite large apparent mortality of nesting females; where data are available, population numbers are down in the western Atlantic, but stable in the Caribbean and eastern Atlantic. It does appear, however, that the western Atlantic portion of the population is being subjected to mortality beyond sustainable levels, resulting in a continued decline in numbers of nesting females.

In the absence of any other population models, the western Atlantic population cannot withstand more than a 1% human-related mortality level which translates to 150 nesting females (Spotila *et al.* 1996; Spotila pers. comm.). As noted above, there are many anthropogenic sources of mortality to leatherbacks; a tally of all leatherback takes anticipated annually under current biological opinions yields a potential for up to 1,166 leatherback takes, although this sum includes many takes expected to be nonlethal and takes of males, juveniles, and possibly leatherbacks from the Caribbean and West African nesting assemblages. In combination with other threatening factors, such as the continued harvest of eggs and adult turtles for meat in some Caribbean and Latin nations, the effects of ocean pollution, and natural disturbances such as hurricanes (which may wipe out nesting beaches), it is clear that the endangered leatherback populations of the Atlantic require significant conservation efforts to ensure their long-term survival and recovery in the wild.

Green turtle (*Chelonia mydas*)

Green turtles are globally distributed, mainly in waters between the northern and southern 20°C isotherms (Hirth 1971). Green turtles were traditionally (and are still) highly prized for their flesh, fat, eggs, and shell, and fisheries in the United States and throughout the Caribbean are largely to blame for the decline of the species.

In the western Atlantic, several major nesting assemblages have been identified and studied (Peters 1954, Carr and Ogren 1960, Parsons 1962, Pritchard 1969, Carr *et al.* 1978). The largest, at Tortuguero, Costa Rica, has shown a long-term increasing trend since monitoring began in 1971. The increase is from an annual fitted-estimated number of emergences of under 20,000 in 1971 to over 40,000 in 1996. Over 100,000 emergences occurred in 1995 (Bjorndal *et al.* 1999b). In the continental United States, green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979). Occasional nesting has been documented along the Gulf coast of Florida, at southwest Florida beaches, as well as the beaches on the Florida Panhandle (Meylan *et al.* 1995). Most documented green turtle nesting activity occurs on Florida index beaches, which were established to standardize data collection methods and effort on key nesting beaches. The pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the ten years of regular monitoring since establishment of the index beaches in 1989, perhaps due to increased protective legislation throughout the Caribbean (Meylan *et al.* 1995). A long-term in-water monitoring study in the Indian River Lagoon of Florida has tracked the populations of juvenile green turtles in a foraging environment and noted significant increases in catch per unit effort (more than doubling) between the years 1983-85 and 1988-90. An extreme, short-term increase in CPUE of ~300% was seen between 1995 and 1996 (Ehrhart *et al.* 1996).

While nesting activity is obviously important in identifying population trends and distribution, the majority portion of a green turtle's life is spent on the foraging grounds. Green turtles are herbivores, and appear to prefer marine grasses and algae in shallow bays, lagoons, and reefs (Rebel 1974). Some of the principal feeding pastures in the Gulf of Mexico include inshore south Texas waters, the upper west coast of Florida and the northwestern coast of the Yucatan Peninsula. Additional important foraging areas in the western Atlantic include the Indian River Lagoon System in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito coast of Nicaragua, the Caribbean coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1971). The preferred food sources in these areas are *Cymodocea, Thalassia, Zostera, Sagittaria,* and *Vallisneria* (Babcock 1937, Underwood 1951, Carr 1952, 1954).

Green turtles were once abundant enough in the shallow bays and lagoons of the Gulf to support a commercial fishery, which landed over one million pounds of green turtles in 1890 (Doughty 1984). Doughty reported the decline in the turtle fishery throughout the Gulf of Mexico by 1902.

Currently, green turtles are uncommon in offshore waters of the northern Gulf, but abundant in some inshore embayments. Shaver (1994) live-captured a number of green turtles in channels entering into Laguna Madre, in South Texas. She noted the abundance of green turtle strandings in Laguna Madre inshore waters and opined that the turtles may establish residency in the inshore foraging habitats as juveniles. Algae along the jetties at entrances to the inshore waters of South Texas was thought to be important to green turtles associated with a radio-telemetry project (Renaud *et al.* 1995). Transmitter-equipped turtles remained near jetties for most of the tracking period. This project was restricted to late summer months, and therefore may reflect seasonal influences. Coyne (1994) observed increased movements of green turtles during warm water months.

Hawksbill turtle (*Eretmochelys imbricata*)

The hawksbill turtle is relatively uncommon in the waters of the continental United States, preferring coral reefs, such as those found in the Caribbean and Central America. Hawksbills feed primarily on a wide variety of sponges but also consume bryozoans, coelenterates, and mollusks. Nesting areas in the western North Atlantic include Puerto Rico and the Virgin Islands. NMFS has designated the coastal waters surrounding Mona and Monito Islands, off the west coast of Puerto Rico, as critical habitat for hawksbills. Mona Island supports the largest population of nesting hawksbills in the U.S. Caribbean. In the northern Gulf of Mexico, a surprising number of small hawksbills are encountered in Texas. Most of the Texas records are probably in the 1-2 year class range. Many of the individuals captured or stranded are unhealthy or injured (Hildebrand 1983). The lack of sponge covered reefs and the cold winters in the northern Gulf of Mexico probably prevent hawksbills from establishing a strong presence in that area. Of the 65 geopolitical units worldwide, where estimates of relative hawksbill nesting density exist, 38 of them have hawksbill populations that are suspected or known to be in decline and an additional 18 have experienced "well-substantiated declines" (NMFS and USFWS 1995).

Kemp's ridley turtle (*Lepidochelys kempii*)

Of the seven extant species of sea turtles of the world, the Kemp's ridley has declined to the lowest population level. The Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) (USFWS and NMFS 1992b) contains a description of the natural history, taxonomy, and distribution of the Kemp's ridley turtle. Kemp's ridleys nest in daytime aggregations known as arribadas, primarily at Rancho Nuevo, a stretch of beach in Mexico. Most of the population of adult females nest in this single locality (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the early 1970s, the world population estimate of mature female Kemp's ridleys had been reduced to 2,500-5,000 individuals. The population declined further through the mid-1980s. Recent observations of increased nesting suggest that the decline in the ridley population has stopped and there is cautious optimism that the population is now increasing.

The nearshore waters of the Gulf of Mexico are believed to provide important developmental habitat for juvenile Kemp's ridley and loggerhead sea turtles. Ogren (1988) suggests that the Gulf coast, from Port Aransas, Texas, through Cedar Key, Florida, represents the primary habitat for subadult ridleys in the northern Gulf of Mexico. Stomach contents of Kemp's ridleys along the lower Texas coast consisted of a predominance of nearshore crabs and mollusks, as well as fish, shrimp, and other foods considered to be shrimp fishery discards (Shaver 1991). Analyses of stomach contents from sea turtles stranded on upper Texas beaches apparently suggest similar nearshore foraging behavior (Plotkin pers. comm.).

Research being conducted by Texas A&M University has resulted in the intentional live-capture of hundreds of Kemp's ridleys at Sabine Pass and the entrance to Galveston Bay. Between 1989 and 1993, 50 of the Kemp's ridleys captured were tracked (using satellite and radio telemetry) by biologists with the NMFS Galveston Laboratory. The tracking study was designed to characterize sea turtle habitat and to identify small and large scale migration patterns. Preliminary analysis of the data collected during these studies suggests that subadult Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud pers. comm.).

In recent years, unprecedented numbers of Kemp's ridley carcasses have been reported from Texas and Louisiana beaches during periods of high levels of shrimping effort. NMFS established a team of population biologists, sea turtle scientists, and managers, known as the Turtle Expert Working Group (TEWG), to conduct a status assessment of sea turtle populations. Analyses conducted by the group have indicated that the Kemp's ridley population is in the early stages of recovery; however, strandings in some years have increased at rates higher than the rate of increase in the Kemp's population (TEWG 1998). While many of the stranded turtles observed in recent years in Texas and Louisiana are believed to have been incidentally taken in the shrimp fishery, other sources of mortality exist in these waters. These stranding events illustrate the vulnerability of Kemp's ridley and loggerhead turtles to the impacts of human activities in nearshore Gulf of Mexico waters.

The TEWG (1998) developed a population model to evaluate trends in the Kemp's ridley population through the application of empirical data and life history parameter estimates chosen by the TEWG. Model results identified three trends in benthic immature Kemp's ridleys. Benthic immatures are those turtles that are not yet reproductively mature but have recruited to feed in the nearshore benthic environment, where they are available to nearshore mortality sources that often result in strandings. Benthic immature ridleys are estimated to be 2-9 years of age and 20-60 cm in length. Increased production of hatchlings from the nesting beach beginning in 1966 resulted in an increase in benthic ridleys that leveled off in the late 1970s. A second period of increase followed by leveling occurred between 1978 and 1989 as hatchling production was further enhanced by the cooperative program between the U.S. Fish and Wildlife Service and Mexico's Instituto Nacional de Pesca to increase the nest protection and relocation program in 1978. A third period of steady increase, which has not leveled off to date, has occurred since 1990 and appears to be due to the greatly increased hatchling production and an apparent increase in survival rates of immature turtles beginning in 1990 due, in part, to the introduction of turtle excluder devices (TEDs). Adult ridley numbers have now grown from a low of approximately 1,050 adults producing 702 nests in 1985, to greater than 3,000 adults producing 1,940 nests in 1995, to greater than 9,000 adults producing about 5,700 nests in 2000.

The TEWG (1998) was unable to estimate the total population size and current mortality rates for the Kemp's ridley population; however, the TEWG listed a number of preliminary conclusions. The TEWG indicated that the Kemp's ridley population appears to be in the early stage of exponential expansion. Over the period 1987 to 1995, the rate of increase in the annual number of nests accelerated in a trend that would continue with enhanced hatchling production and the use of TEDs. Nesting data indicated that the number of adults declined from a population that produced 6,000 nests in 1966 to a population that produced 924 nests in 1978 and a low of 702 nests in 1985. Thus, the trajectory of adult abundance tracks trends in nest abundance from an estimate of 9,600 in 1966 to 1,050 in 1985. The TEWG estimated that in 1995 there were 3,000 adult ridleys. The increased recruitment of new adults is illustrated in the proportion of neophyte, or first time nesters, which has increased from 6% to 28% from 1981 to 1989 and from 23% to 41% from 1990 to 1994. The population model in the TEWG projected that Kemp's ridleys could reach the intermediate recovery goal identified in the Recovery Plan, of 10,000 nesters by the year 2020, if the assumptions of age to sexual maturity and age specific survivorship rates plugged into their model are correct. It determined that the data reviewed suggested that adult Kemp's ridley turtles were restricted somewhat to the Gulf of Mexico in shallow nearshore waters, and benthic immature turtles of 20-60 cm straight line carapace length are found in nearshore coastal waters including estuaries of the Gulf of Mexico and the Atlantic.

The TEWG (1998) identified an average Kemp's ridley population growth rate of 13% per year between 1991 and 1995. Total nest numbers have continued to increase. However, the 1996 and 1997 nest numbers reflected a slower rate of growth, while the increase in the 1998 nesting level was much higher, then decreased in 1999, and increased again strongly in 2000. The population growth rate does not appear as steady as originally forecasted by the TEWG, but annual fluctuations, due in part to irregular internesting periods, are normal for other sea turtle populations. Also, as populations increase and expand, nesting activity would be expected to be more variable.

The area surveyed for ridley nests in Mexico was expanded in 1990 due to destruction of the primary nesting beach by Hurricane Gilbert. The TEWG (1998) assumed that the increased nesting observed particularly since 1990 was a true increase, rather than the result of expanded beach coverage. Because systematic surveys of the adjacent beaches were not conducted prior to 1990, there is no way to determine what proportion of the nesting increase documented since that time is due to the increased survey effort rather than an expanding ridley nesting range. As noted by TEWG, trends in Kemp's ridley nesting even on the Rancho Nuevo beaches alone suggest that recovery of this population has begun but continued caution is necessary to ensure recovery and to meet the goals identified in the Kemp's Ridley Recovery Plan.

III. Species Likely to Be Affected

Of the above-listed species occurring in the Atlantic Ocean offshore of the southeastern United States, NMFS believes that the five sea turtle species are vulnerable to capture, injury, and death from some of the activities associated with the proposed action. However, based on stranding records and records from the plant, hawksbill and leatherback turtles are rare in this area; therefore, NMFS believes that although there is a chance that a hawksbill or leatherback sea turtle could be affected by the proposed action the chances of one of these species being affected is remote.

IV. Environmental Baseline

This section contains an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, their habitat, and ecosystem, within the action area. The environmental baseline is a snapshot of a species' health at a specified point in time and includes state, tribal, local, and private actions already affecting the species, or that will occur contemporaneously with the consultation in progress. Unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultation are also part of the environmental baseline, as are Federal and other actions within the action area that may benefit listed species or critical habitat.

The environmental baseline for this biological opinion includes the effects of several activities that affect the survival and recovery of threatened and endangered species in the action area. The activities that shape the environmental baseline in the action area of this consultation are primarily fisheries and recovery activities associated with reducing fisheries impacts. Other environmental impacts include effects of discharges, dredging, military activities, oil and gas development activities, and industrial cooling water intake.

Status of the Species Within the Action Area

The five species of sea turtles that occur in the action area are all highly migratory. NMFS believes that no individual members of any of the species are likely to be year-round residents of the action area. Individual animals will make migrations into near shore waters as well as other areas of the North Atlantic Ocean, Gulf of Mexico, and the Caribbean Sea. Therefore, the range-wide status of the five species of sea turtles, given in section II above, most accurately reflects the species' status within the action area. Likewise, while the following discussion of factors affecting species reflects conditions both inside and outside of the immediate action area, this discussion most accurately reflects those factors acting on sea turtles which may occur within the action area seasonally or transiently.

Factors Affecting Species within the Action Area

Federal Actions

In recent years, NMFS has undertaken several ESA section 7 consultations to address the effects of Federally-permitted fisheries and other Federal actions on threatened and endangered species in the action area. Each of those consultations sought to develop ways of reducing the probability of adverse effects of the action on sea turtles. Similarly, recovery actions NMFS has undertaken under both the MMPA and the ESA are addressing the problem of take of sea turtles in the fishing and shipping industries. Incidental take levels anticipated under the incidental take statements associated with these existing biological opinions are summarized in Table 1 below, followed by a brief discussion of each action consulted on. The following summary of anticipated incidental take of turtles includes only those Federal actions which have undergone formal section 7 consultation.

Table 1. Summary of annual incidental take levels anticipated under the incidental take statements associated with NMFS' existing biological opinions in the U.S. Atlantic and Gulf of Mexico.

Federal Action	Annual Anticipated Incidental Take Level (lethal)[1]				
	Loggerhead	Leatherback	Green	Kemp's	Hawksbill
Coast Guard Vessel Operation	1(1)[2]	1(1)[2]	1(1)[2]	1(1)[2]	1(1)[2]
Navy - SE Ops Area[3]	91(91)	17(17)[2]	16(16)[2]	16(16)[2]	4(4)[2]
Navy-NE Ops Area	10(10)	0	1(1)[2]	1(1)[2]	0
Shipshock - Seawolf/Winston Churchill[4]	276(58)[2]	276(58)[2]	276(58)[2]	276(58)[2]	276(58)[2]
COE Dredging-NE Atlantic	27(27)	1(1)	6(6)[2]	5(5)[2]	0
COE Dredging - S Atlantic	35(35)	0	7(7)	7(7)	2(2)
COE Dredging - N & W Gulf of Mexico	30(30)	0	8(8)	14(14)	2(2)
COE Dredging - E Gulf of Mexico	8 (8) [5]	5(5)[5]	5(5)[5]	5(5)[5]	5(5)[5]
COE Rig Removal, Gulf of Mexico	1(1)[2]	1(1)[2]	1(1)[2]	1(1)[2]	1(1)[2]
MMS Destin Dome Lease Sales	1(1)[2;6]	1(1)[2;6]	1(1)[2;6]	1(1)[2;6]	1(1)[2;6]
MMS Rig Removal, Gulf of Mexico	10(10)[7]	5(5)[2;7]	5(5)[2;7]	5(5)[2;7]	5(5)[2;7]
NE Multispecies Sink Gillnet Fishery	10(10)	4(4)	4(4)	2(2)	0
ASMFC Lobster Plan	10(10)	4(4)	0	0	0
Bluefish	6(3)	0	0	6(6)	
Herring	6(3)	1(1)	1(1)	1(1)	0
Mackerel, Squid, Butterfish	6(3)	1(1)	2(2)	2(2)	0
Monkfish Fishery[7]	6(3)	1(1)	1(1)	1(1)	0
Dogfish Fishery	6(3)	1(1)	1(1)	1(1)	0
Sargassum	30(30)[8]	1(1)[2]	1(1)[2]	1(1)[2]	1(1)[2]

Summer Flounder, Scup & Black Sea Bass	15(5)	3(3)[2]	3(3)[2]	3(3)[2]	3(3)[2]
Shrimp Fishery	3450(3450)[9]	650(650)[9]	3450(3450)[9]	3450(3450)[9]	3450(3450)[9]
Weakfish	20(20)	0	0	2(2)	0
HMS - Pelagic Longline Fishery [10]	468(7)	358(6)	46(2)	23(1)	46(2)
HMS - Shark gillnet Fishery [11]	20(20)	2(2)	2(2)	2(2)	2(2)
HMS - Bottom Longline Fishery [11]	12(12)	2(2)	2(2)	2(2)	2(2)
NRC - St. Lucie, FL [12]	unlimited(2)	unlimited(1)	unlimited(3)	unlimited(1)	unlimited(1)
NRC - Brunswick, NC	50 (6)[2]	50[2]	50 (3)[2]	50 (2)[2]	50[2]
NRC - Crystal River, FL	55 (1)[2]	55 (1)[2]	55 (1)[2]	55 (1)[2]	55 (1)[2]
Total [13]	**4,660(3,860)**	**1,440(767)**	**3,945(3,587)**	**3,933(3,592)**	**3,907(3,541)**

[1]Anticipated Take level represents '**observed**' unless otherwise noted. Number in parenthesis represents lethal take and is a subset of the total anticipated take; numbers less than whole are rounded up.
[2] The anticipated take level may represent any combination of species and thus is tallied under each column (note: in most cases, it is expected that takes of turtle species other than loggerheads will be minimal).
[3] Includes Navy Operations along the Atlantic coast and Gulf of Mexico, Mine Warfare Center, Eglin AFB, Moody AFB.
[4] Total **estimated** take includes acoustic harassment.
[5]Up to 8 turtles total, of which, no more than 5 may be leatherbacks, greens, Kemp's or hawksbill, in combination.
[6]Total anticipated take is 3 turtles of any combination over a 30-year period.
[7] Not to exceed 25 turtles, in total.
[8] Anticipated take for post-hatchlings for total period June 21, 1999 through January 2001.
[9]Represents **estimated** take; however, the Incidental take statement cites observed take (5 loggerheads, 2 leatherbacks, or 3 Kemp's ridleys or greens or hawksbills in any combination) as a representative of the estimated take. The estimated take represents any combination of species other than the leatherback.
[10]Represents **estimated** total take and **observed** lethal take in parentheses.
[11] Represents **estimated** total and lethal take.
[12]Take levels for nonlethal were not identified because entrainment is a function of turtle abundance & environmental conditions; lethal take is also expressed as 1.5% of the total number entrained in the plant, whichever is greater.
[12] Represents a minimum number of turtles taken annually because the majority of the take is observed take and is not an estimate of true numbers that are taken; the 'unlimited' lethal take for St.Lucie Power Plant is not incorporated in the total. [13]
[13] The numbers for each species are not additive because the total anticipated take, in many cases, represents a combination of species.

Vessel Operations

Potential adverse effects from Federal vessel operations in the action area of this consultation include operations of the Navy (USN) and Coast Guard (USCG), which maintain the largest Federal vessel fleets, the Environmental Protection Agency, the National Oceanic and Atmospheric Administration (NOAA), and the Army Corps of Engineers (COE). NMFS has conducted formal consultations with the USCG, the USN (described below) and is currently in early phases of consultation with the other Federal agencies on their vessel operations. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species. At the present time, however, they represent potential for some level of interaction. Refer to the biological opinions for the USCG (NMFS 1995, 1996a, and 1998b) and the USN

(NMFS 1997b) for detail on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures. Since the USN consultation only covered operations out of Mayport, Florida, potential still remains for USN vessels to adversely affect sea turtles when they are operating in other areas within the range of these species. Similarly, operations of vessels by other Federal agencies within the action area (NOAA, EPA, COE) may adversely affect sea turtles. However, the in-water activities of those agencies are limited in scope, as they operate a limited number of vessels or are engaged in research/operational activities that are unlikely to contribute a large amount of risk.

Additional military activities, including vessel operations and ordnance detonation, also affect sea turtles. U.S. Navy aerial bombing training in the ocean off the southeast U.S. coast, involving drops of live ordnance (500- and 1,000-lb bombs) is estimated to have the potential to injure or kill, annually, 84 loggerheads, 12 leatherbacks, and 12 greens or Kemp's ridley, in combination (NMFS 1997a). The USN will also conduct ship-shock testing for the new SEAWOLF submarine and the DDG-81 WINSTON S. CHURCHILL guided missile destroyer off the Atlantic coast of Florida, using 5 submerged detonations, each of 10,000-lb explosive charge. This testing is estimated to injure or kill 50 loggerheads, 6 leatherbacks, and 4 hawksbills, greens, or Kemp's ridleys, for the SEAWOLF and 8 sea turtles in any combination of the five species found in the action area for the Winston Churchill (NMFS 1996b; NMFS 2000). The USN Mine Warfare Center in Corpus Christi, Texas, may take, annually, up to 5 loggerheads and 2 leatherbacks, hawksbills, greens, or Kemp's ridleys, in combination, during training activities in the western Gulf of Mexico. U.S. Air Force operations in the Eglin Gulf Test Range in the eastern Gulf of Mexico may also kill or injure sea turtles. Air-to-surface gunnery testing is estimated to kill a maximum of 3 loggerheads, 2 leatherbacks, and 1 green, hawksbill or Kemp's ridley. Search and rescue training operations are expected to have a low level of impacts, taking 2 turtles over a 20-year period. Operation of the USCG's boats and cutters in the U.S. Atlantic, meanwhile, is estimated to take no more than one individual turtle—of any species—per year (NMFS 1995). Formal consultation on overall USCG or USN activities in the Gulf of Mexico has not been conducted.

The construction and maintenance of Federal navigation channels has also been identified as a source of turtle mortality. Hopper dredges, which are frequently used in ocean bar channels and sometimes in harbor channels and offshore borrow areas, move relatively rapidly (compared to sea turtle swimming speeds) and can entrain and kill sea turtles, presumably as the drag arm of the moving dredge overtakes the slower moving turtle. Along the Atlantic coast of the southeastern United States, NMFS estimates that annual, observed injury or mortality of sea turtles from hopper dredging may reach 35 loggerheads, 7 greens, 7 Kemp's ridleys, and 2 hawksbills (NMFS 1997c). A combination of hopper dredging and the use of explosives is expected to take 18 sea turtles (all species) during the deepening and widening of Wilmington Harbor, North Carolina. Along the north and west coasts of the Gulf of Mexico, channel maintenance dredging using a hopper dredge may injure or kill 30 loggerhead, 8 green, 14 Kemp's ridley, and 2 hawksbill sea turtles annually (NMFS 1997d). Additional incidental take statements for dredging of Charlotte Harbor and Tampa Bay, Florida, anticipate these projects may incidentally take, by injury or mortality, 2 loggerheads or 1 Kemp's ridley or 1 green or 1 hawksbill sea turtle for Charlotte Harbor and 8 sea turtles, including no more than 5 documented Kemp's ridley, hawksbill, leatherback, or green turtles, in any combination, for Tampa Bay.

The COE and Minerals Management Service (MMS) (the latter is nonmilitary) rig removal activities also adversely affect sea turtles. For the COE activities, an incidental take (by injury or mortality) of one documented Kemp's ridley, green, hawksbill, leatherback, or loggerhead turtle is anticipated under a rig removal consultation for the New Orleans District (NMFS 1998c). MMS activities are anticipated to result in annual incidental take (by injury or mortality) of 25 sea turtles, including no more than 5 Kemp's ridley, green, hawksbill, or leatherback turtles and no more than 10 loggerhead turtles, due to MMS' OCS oil and gas exploration, development, production, and abandonment activities.

Federal Fishery Operations
Adverse effects on threatened and endangered species from several types of fishing gear occur in the action area. Efforts to reduce the adverse effects of commercial fisheries are addressed through the ESA section 7 process. Gill net, longline, trawl gear, and pot fisheries have all been documented as interacting with sea turtles. For all fisheries for which there is a Federal fishery management plan (FMP) or for which any Federal action is taken to manage that fishery, impacts have been evaluated under section 7.

Several formal consultations have been conducted on the following fisheries that NMFS has determined are likely to adversely affect threatened and endangered species: American Lobster, Monkfish, Dogfish, Southeastern Shrimp Trawl Fishery, Northeast Multispecies, Atlantic Pelagic Swordfish/Tuna/Shark, and Summer Flounder/Scup/ Black Sea Bass fisheries. These consultations are summarized below; for more detailed information, refer to the respective biological opinions.

The *Northeast Multispecies Sink Gill Net Fishery* is one of the other major fisheries that is known to take sea turtles. This fishery has historically occurred from the periphery of the Gulf of Maine to Rhode Island in water to 60 fathoms. In recent years, more of the effort in this fishery has occurred in offshore waters and into the Mid-Atlantic. Participation in this fishery declined from 399 to 341 permit holders in 1993 and is expected to continue to decline as further groundfish conservation measures are implemented. The fishery operates throughout the year with peaks in the spring and from October through February. Data indicate that gear used in this fishery has seriously injured loggerhead and leatherback sea turtles. It is often difficult to assess gear found on stranded animals or observed at sea and assign it to a specific fishery. Only a fraction of the takes are observed, and the catch rate represented by the majority of takes, which are reported opportunistically, *i.e.*, not as part of a random sampling program, is unknown. Consequently, the total level of interaction cannot be determined through extrapolation. The incidental take level established for this fishery in the July 5, 1989, BO estimated that 10 documented Kemp's ridley, 10 green, 10 hawksbill, 10 leatherback, and 100 loggerhead sea turtles would be killed or injured by the fishery annually.

The monkfish and dogfish fisheries are prosecuted with multispecies-type gear, and therefore have potential to interact with sea turtles. After reviewing the best available information on the status of endangered and threatened species under NMFS jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, NMFS concluded in a biological opinion issued December 21, 1998, that conduct of the monkfish fishery, with modification to reduce impacts of entanglement through the whale and porpoise TRPs, may adversely affect but is not likely to jeopardize the continued existence of endangered and threatened species under NMFS jurisdiction.

The *Monkfish Fishery Management Plan* was recently completed by the New England and Mid-Atlantic Fishery Management Councils. This fishery uses several gear types which may entangle protected species, and takes of shortnose sturgeon and sea turtles have been recorded from monkfish trips. NMFS completed a formal consultation on the Monkfish FMP on December 21, 1998, which concluded that the fishery, with modification under the take reduction plans, is not likely to jeopardize listed species or adversely modify critical habitat. The ITS provided under this Opinion anticipates up to 6 incidental takes of loggerhead turtles (no more than 3 lethal), 1 lethal or nonlethal take of a green sea turtle, 1 lethal or nonlethal take of a Kemp's ridley, and 1 lethal or nonlethal take of a leatherback. However, the implication of this fishery in the recent pulse of sea turtle strandings in North Carolina noted elsewhere in this Opinion necessitate reinitiation of consultation and likely the current incidental take levels will be revised in a new incidental take statement.

A consultation was recently concluded for *the Spiny Dogfish Fishery*. This fishery is similar to the monkfish fishery, but uses somewhat smaller mesh gear. The recent biological opinion prepared for the FMP for this fishery anticipates 6 takes (no more than 3 lethal) of loggerheads, and 1 take (lethal or nonlethal) each for Kemp's ridley, leatherbacks, and, green sea turtles.

The *Summer Flounder, Scup and Black Sea Bass fisheries* are known to interact with sea turtles. Significant measures have been developed to reduce the take of sea turtles in summer flounder trawls and trawls that meet the definition of a summer flounder trawl (which would include fisheries for other species like scup and black sea bass) by requiring TEDs in nets in the area of greatest bycatch off the North Carolina and southern Virginia coast. NMFS is considering a more geographically inclusive regulation to require TEDs in trawl fisheries that overlap with sea turtle distribution to reduce the impact from this fishery. Developmental work is also ongoing for a TED that will work in the flynets used in the weakfish fishery. The anticipated observed annual take rates for turtles in this multispecies fishery is 15 loggerheads and 3 leatherbacks, hawksbills, greens, or Kemp's ridleys, in combination annually (NMFS 1997a).

The *Atlantic Pelagic Fisheries for Swordfish, Tuna, Shark, and Billfish* are known to incidentally capture large numbers of turtles, particularly in the pelagic longline component (NMFS 2000). Take levels from hooking or entanglement in longline gear are estimated for 2000 at 468 loggerheads, 358 leatherbacks, 46 greens, 23 Kemp's ridleys, and 46 hawksbills, with a resulting mortality rate of approximately 30%. The interactions resulting from the shark gillnet, shark bottom longline, and other gears used in this fishery are lower. The shark gillnet component is estimated, based on limited observer data, to injure or kill 20 loggerheads, 2 leatherbacks, 2 Kemp's ridleys, 2 greens, and 2 hawksbills annually. The shark bottom longline component is similarly estimated, based on limited observer data, to injure or kill 12 loggerheads, 2 leatherbacks, 2 Kemp's ridleys, 2 greens, and 2 hawksbills annually. The other gears are anticipated to result in documented takes of no more than 3 turtles, in total, of any species.

The *Southeast U.S. Shrimp Fishery* is known to incidentally take high numbers of sea turtles. Shrimp trawlers in the southeastern United States are required to use TEDs, which reduce a trawler's capture rate by 97%. Even so, NMFS estimated that 4,100 turtles may be captured annually by shrimp trawling, including 650 leatherbacks that cannot be released through TEDs, 1,700 turtles taken in try nets, and 1,750 turtles that fail to escape through the TED (NMFS 1998d), including large loggerheads. Henwood and Stuntz (1987) reported that the mortality rate for trawl-caught turtles ranged between 21% and 38%, although Magnuson *et al.* (1990) suggested Henwood and Stuntz's estimates were very conservative and likely an underestimate of the true mortality rate.

Other Federal Actions
Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of electrical generating plants. At the St. Lucie Nuclear Power Plant at Hutchinson Island, Florida, large numbers of green and loggerhead turtles have been captured in the seawater intake canal in the past several years. Annual capture levels from 1994-1997 have ranged from almost 200 to almost 700 green turtles and from about 150 to over 350 loggerheads. Almost all of the turtles are caught and released alive; NMFS estimates the survival rate at 98.5% or greater (see NMFS 1997f). A biological opinion completed in January 2000 estimates that the operations at the Brunswick Steam Electric Plant in Brunswick, North Carolina, may take 50 sea turtles in any combination annually, that are released alive. NMFS also estimated the total lethal take of turtles at this plant may reach 6 loggerhead, 2 Kemp's ridley or 3 green turtles annually. A biological opinion completed in June 1999 on the operations at the Crystal River Energy Complex in Crystal River, Florida, estimated the level of take of sea turtles in the plant's intake canal may reach 55 sea turtles with an estimated 50 being released alive biennially.

Environmental Contaminants
An extensive review of environmental contaminants in turtles has been conducted by Meyers-Schöne and Walton (1994); however, most available information relates to freshwater species. High concentrations of chlorobiphenyls and organochlorine pesticides in the eggs of the freshwater snapping turtle, *Chelydra serpentina*, have been correlated with population effects such as decreased hatching success, increased hatchling deformities and disorientation (Bishop *et al.* 1991, 1994). Very little is known about baseline levels and physiological effects of environmental contaminants on marine turtle populations (Witkowski and Frazier 1982; Bishop *et al.* 1991). There are a few isolated studies on organic contaminants and trace metal accumulation in green and leatherback sea turtles (Davenport and Wrench 1990; Aguirre *et al.* 1994). Mckenzie *et al.* (1999) measured concentrations of chlorobiphenyls and organochlorine

pesticides in marine turtles tissues collected from the Mediterranean (Cyprus, Greece) and European Atlantic waters (Scotland) between 1994 and 1996. Omnivorous loggerhead turtles had the highest organochlorine contaminant concentrations in all the tissues sampled, including those from green and leatherback turtles. It is thought that dietary preferences were likely to be the main differentiating factor among species. Decreasing lipid contaminant burdens with turtle size were observed in green turtles, most likely attributable to a change in diet with age. Sakai *et al.* (1995) found the presence of metal residues occurring in loggerhead turtle organs and eggs. More recently, Storelli *et al.* (1998) analyzed tissues from twelve loggerhead sea turtles stranded along the Adriatic Sea (Italy) and found that characteristically, mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals and porpoises by Law *et al.* (1991). Research is needed on the short- and long-term health and fecundity effects of chlorobiphenyl, organochlorine, and heavy metal accumulation in sea turtles.

State or Private Actions

Private and commercial vessels
Commercial traffic and recreational pursuits can have an adverse effect on sea turtles through prop and boat strike damage. Private vessels participate in high speed marine events concentrated in the southeastern United States and are a particular threat to sea turtles, and occasionally to marine mammals as well. The magnitude of these marine events is not currently known. NMFS and the USCG are in early consultation on these events, but a thorough analysis has not been completed. The Sea Turtle Stranding and Salvage Network (STSSN) also reports many records of vessel interaction (propeller injury) with sea turtles off coastal states such as New Jersey and Florida, where there are high levels of vessel traffic.

State fishery operations.
A biological opinion on the NMFS/ASMFC interjurisdictional FMP for weakfish was conducted in June 1997. Weakfish are caught in the summer flounder fishery and are also fished with fly nets. Analyses of the NMFS' observer data showed 36 incidental captures of sea turtles for trawl and gill net vessels operating south of Cape May, New Jersey, from April 1994 through December 1996. Of those turtles taken, 28 loggerheads were taken in trawls that also caught weakfish, and resulted in two deaths. Most of the sea turtle takes occurred in late fall. In all cases, weakfish landings were second in poundage behind Atlantic croaker and summer flounder (NEFSC unpub. data).

The North Carolina observer program documented 33 fly net trips from November through April of 1991-1994 and recorded no turtles caught in 218 hours of trawl effort. However, a NMFS observed vessel fished for summer flounder for 27 tows with an otter trawl equipped with a TED and then fished for weakfish and Atlantic croaker with a fly net that was not equipped with a TED. They caught one loggerhead in 27 TED equipped tows and seven loggerheads in nine fly net tows without TEDs. In addition, the same vessel using the fly net in a previous trip took 12 loggerheads in 11 out of 13 observed tows targeting Atlantic croaker. Weakfish landings from these fly net tows were second in poundage (NEFSC unpub.data).

Georgia and South Carolina prohibit gill nets for all but the shad fishery. This fishery was observed in South Carolina for one season by the NMFS Southeast Fisheries Science Center (McFee *et al.* 1996). No takes of protected species were observed. Florida has banned all but very small nets in state waters, as has the state of Texas. Louisiana, Mississippi, and Alabama have also placed restrictions on gill net fisheries within state waters such that very little commercial gillnetting takes place in southeast waters, with the exception of North Carolina. Most pot fisheries in the southeast are prosecuted in areas frequented by sea turtles.

Pulses of greatly elevated sea turtle strandings occur with regularity in the mid-Atlantic area, particularly along North Carolina through southern Virginia in the late fall/early spring, coincident with their migrations. For example, in the last weeks of April through early May 2000, approximately 300 turtles, mostly loggerheads, stranded north of Oregon Inlet, North Carolina. Gill nets were found with four of the carcasses. These strandings are likely caused by state fisheries as well as Federal fisheries, although not any one fishery has been identified as the major cause. Fishing effort data indicate that fisheries targeting monkfish, dogfish, and bluefish were operating in the area of the strandings. Strandings in this area represent at best, 7%-13% of the actual nearshore mortality (Epperly *et al.* 1996). Studies by Bass *et al.* (1998), Norrgard (1995), and Rankin-Baransky (1997) indicate that the percentage of northern loggerheads in this area is highly over-represented in the strandings when compared to the approximately 9% representation from this subpopulation in the overall U.S. sea turtle nesting populations. Specifically, the genetic composition of sea turtles in this area is 25%-54% from the northern subpopulation, 46%-64% from the South Florida subpopulation, and 3%-16% from the Yucatan subpopulation. The cumulative removal of these turtles on an annual basis would severely impact the recovery of this species.

Conservation and Recovery Actions Shaping the Environmental Baseline

NMFS implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial fisheries. In particular, NMFS has required the use of TEDs in southeast U.S. shrimp trawls since 1989 and in summer flounder trawls in the mid-Atlantic area (south of Cape Charles, Virginia) since 1992. It has been estimated that TEDs exclude 97% of the turtles caught in such trawls. These regulations have been refined over the years to ensure that TED effectiveness is maximized through proper placement and installation, configuration (*e.g.*, width of bar spacing), floatation, and more widespread use. Recent analyses by Epperly and Teas (1999) indicate that the minimum requirements for the escape opening dimensions are too small, and that as much as 47% of the loggerheads stranding annually along the Atlantic seaboard and Gulf of Mexico were too large to fit through existing openings. On April 5, 2000, NMFS published an Announcement of Proposed Rulemaking to require larger escape openings (65 FR 17852).

In 1993 (with a final rule implemented 1995), NMFS established a Leatherback Conservation

Zone to restrict shrimp trawl activities from off the coast of Cape Canaveral, Florida, to the North Carolina/Virginia border. This provides for short-term closures when high concentrations of normally pelagically distributed leatherbacks are recorded in more coastal waters where the shrimp fleet operates. This measure is necessary because, due to their size, adult leatherbacks are larger than the escape openings of most NMFS-approved TEDs. This rule was originally established because of coastal concentrations of leatherbacks which sometimes appear during their spring northward migration, but the rule was also recently implemented in the fall of 1999 off the coast of northern Florida due to unseasonable concentrations there, and leatherback TEDs were also required off the coast of Texas in the spring of 2000 due to unusual numbers of leatherback strandings there.

NMFS is also working to develop a TED which can be effectively used in a type of trawl known as a fly net, which is sometimes used in the mid-Atlantic and northeast fisheries to target sciaenids and bluefish. Limited observer data indicate that takes can be quite high in this fishery. A prototype design has been developed, but testing under commercial conditions is still necessary.

In addition, NMFS has been active in public outreach efforts to educate fishermen regarding sea turtle handling and resuscitation techniques. As well as making this information widely available to all fishermen, NMFS recently conducted a number of workshops with longline fishermen to discuss bycatch issues including protected species, and to educate them regarding handling and release guidelines. NMFS intends to continue these outreach efforts and hopes to reach all fishermen participating in the pelagic longline fishery over the next 1 to 2 years.

Sea Turtle Stranding and Salvage Network Activities
There is an extensive network of sea turtle stranding and salvage network (STSSN) participants along the Atlantic and Gulf of Mexico which not only collects data on dead sea turtles, but also rescues and rehabilitates any live stranded turtles. In most states, the STSSN is coordinated by state wildlife agency staff, although some state stranding coordinators are associated with academic institutions. Data collected by the STSSN are used to monitor stranding levels and compare them with fishing activity in order to determine whether additional restrictions on fishing activities are needed. These data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All of the states that participate in the STSSN are collecting tissue for and/or conducting genetic and ageing studies to better understand the population dynamics of the small subpopulation of northern nesting loggerheads. These states also tag turtles as live ones are encountered (either via the stranding network through incidental takes or in-water studies). Tagging studies help provide an understanding of sea turtle movements, longevity, reproductive patterns, *etc.*

Other Potential Sources of Impacts in the Environmental Baseline

A number of activities that may indirectly affect listed species include discharges from wastewater systems, dredging, ocean dumping and disposal, and aquaculture. The impacts from these activities are difficult to measure. Where possible, however, conservation actions are being implemented to monitor or study impacts from these elusive sources. For example, extensive monitoring is being required for a major discharge in Massachusetts Bay (Massachusetts Water Resources Authority) in order to detect any changes in habitat parameters associated with this discharge. Close coordination is occurring through the section 7 process on both dredging and disposal sites to develop monitoring programs and ensure that vessel operators do not contribute to vessel-related impacts.

NMFS and the U.S. Navy have been working cooperatively to establish a policy for monitoring and managing acoustic impacts from anthropogenic sound sources in the marine environment. Acoustic impacts can include temporary or permanent injury, habitat exclusion, habituation, and disruption of other normal behavior patterns. It is expected that the policy on managing anthropogenic sound in the oceans will provide guidance for programs such as the use of acoustic deterrent devices in reducing marine mammal-fishery interactions and review of Federal activities and permits for research involving acoustic activities. The Office of Naval Research hosted a meeting in March 1997 to develop scientific and technical background for use in policy preparation. NMFS hosted a workshop in September 1998 to gather technical information which will support development of new acoustic criteria.

Summary and Synthesis of the Status of Species and Environmental Baseline

In summary, the potential for dredging, military activities, fisheries, *etc.*, to adversely affect sea turtles exists for the sea turtles considered in this consultation. However, recovery actions have been undertaken as described and continue to evolve. Those actions have started to produce positive changes in the nesting numbers of Kemp's ridley and loggerhead turtles (south Florida subpopulation) that are expected to continue. The other listed species are not likely to have benefitted to the same degree from the recovery actions taken: *e.g.*, green, leatherback, and hawksbill turtle nesting is mostly outside the United States and Mexico and likely has received less beachside protection efforts, and loggerheads and Kemp's ridleys are the major shrimp bycatch species that have benefitted the most from TED use. Still, those actions are expected to benefit the listed species in the foreseeable future. These actions should not only improve the conditions of sea turtles, but are expected to reduce sources of human-induced mortality as well.

However, factors in the existing baseline for loggerhead sea turtles and leatherback sea turtles leave cause for considerable concern regarding the status of these populations and the current impacts upon these populations:

a. The leatherback sea turtle is declining worldwide. Overall sources of mortality, including the NMFS HMS fisheries, incurred by this population exceed the 1% sustainable level proposed by Spotila *et al.* (1996).

b. The nesting numbers for the northern subpopulation of loggerhead sea turtles are stable or declining, and the nesting females currently number only about 3,700. The percent of northern loggerheads represented in sea turtle strandings in northern U.S. Atlantic states is over-representative of their total numbers in the overall loggerhead population. Current take levels from other sources, particularly fisheries (especially longline, trawl, and gill net fisheries), are high.

IV. Effects of the Action

Summary of FP&L's Report on the Physical and Ecological Factors Influencing Sea Turtle Entrainment at the St. Lucie Nuclear Power Plant

The terms and conditions of the incidental take statement of NMFS' January 1997 Opinion required FP&L to conduct a study of the physical and ecological factors influencing sea turtle interactions with the plant. This report was completed in March 2000 and the results are summarized below. For further information please refer to the report titled "Physical and Ecological Factors Influencing Sea Turtle Entrainment Levels at the St. Lucie Nuclear Power Plant: 1976-1998" (Florida Power and Light, 2000).

Immature loggerhead and green turtles apparently use the near shore ocean environment in the vicinity of the St. Lucie Plant as developmental/foraging habitat. This appears to be related to the water depth in the area, the presence of hard bottom substrates and worm reefs, and the occurrence of preferred food items. Based on recapture data, it appears that some turtles reside in the area throughout the year, while others transmigrate seasonally. The area is apparently also used as internesting habitat by large numbers of female loggerhead turtles that nest on Hutchinson Island every year.

Turtles migrating along the coast and/or utilizing hard bottom substrates and worm reefs in the vicinity of the plant would be brought into close proximity with the plant's intake structures. Turtles may enter the intake structures to rest or avoid attack from predators and/or competition from other turtles. Green and loggerhead turtles may also be attracted to the intakes for the purpose of foraging, since the structures resemble reefs, important foraging habitat for both species.

The majority of the loggerhead and green turtles entrained into the St. Lucie Plant intake canal between 1977 and 1998 were juveniles. However, loggerhead captures included a higher proportion of subadults and adults than green turtle captures. This probably reflects the fact that the loggerhead nesting population is considerably larger than the green turtle nesting population in the Hutchinson Island area.

There were significant increases in the numbers of juvenile and adult loggerhead captures and juvenile green turtle captures at the St. Lucie Plant from 1977 through 1998. The increase in adult loggerhead captures was more or less continuous and was significantly correlated with increases in nesting on Hutchinson Island. The upward trends in juvenile loggerhead and green turtle captures were primarily due to increases that occurred in the 1990s.

On average, more turtles were captured each year after Unit 2 was placed on line than before, suggesting that the addition of a second unit affected capture rates to some extent. However, this change could not account for the dramatic increases in capture rates of juvenile loggerhead and green turtles that only occurred after Unit 2 had been operating for ten years.

Changes in the physical appearance of the intake structure velocity caps following their repair coincided with substantial increases in juvenile green turtle captures at the plant. However, the extent to which the two are causally related is unclear.

Power plant outages over the life of the plant, at times, appeared to affect short term trends in juvenile loggerhead and green turtle captures. However, plant outages could not explain the substantial increases in captures of either species that occurred during the 1990s. Flow rates from 1988 through 1998 appeared to have a weak but significant effect on short-term juvenile loggerhead entrainment rates. Again, however, flow rates were not responsible for the long-term increases in juvenile loggerhead captures occurring during this period. Flow rates had no effect on either short- or long-term captures of juvenile green turtles.

Changes in the nearshore environment near the St. Lucie Plant might be expected to affect long-term trends in the turtle entrainment. Unfortunately, data relating to the relative size and relief of nearby worm reefs and hard bottom or to changes in the abundance of food items in the area were lacking. One environmental factor that was shown to be significantly correlated with monthly captures of juvenile green and loggerhead turtles was water temperature. However, no relationship between local water temperatures and long-term trends in capture rates could be demonstrated. The frequency of high, wave producing winds also did not appear to affect entrainment of turtles. Seasonal increases in the number of juvenile loggerhead and green turtles in the vicinity of the plant may be more closely related to the migration patterns of turtles from more northern areas than to local conditions.

There is evidence (mainly from nesting beach surveys) that the adult populations of both green and loggerhead turtles that provide juveniles to the Hutchinson Island area increased during the study period. It would logically follow that the juvenile component of those populations also increased. The number of juvenile green turtles captured at the St. Lucie Plant increased dramatically in the 1990s. A similar increase was documented in the central Indian River Lagoon in an area well beyond the influence of the St. Lucie Plant. Unfortunately, there are relatively few other study sites for which long-term quantitative data are available for juvenile loggerheads. However, the strong correlation between adult loggerhead captures at the St. Lucie Plant and nesting on Hutchinson Island elucidates the relationship between canal rates and the relative numbers of individuals in the nearshore environment.

Even though changes in physical plant design and operating characteristics have occurred over the life of the plant, these changes do not appear to be responsible for the long-term increases in the numbers of juvenile and adult loggerhead and juvenile green turtles captured at the St. Lucie Plant. The most logical explanation for these increases is that there are more individuals of these life history stages present in the vicinity of the plant.

Direct Effects

At least 6,576 sea turtles have become entrapped at the St. Lucie intake canal between 1976 through 1999. One hundred ninety-seven of those have died, for a total mortality rate of 3.0%. Loggerheads have been the species most frequently taken over this period, although green turtles have been the dominant species encountered since 1993.

Entrapment at the St. Lucie intake canal can result in direct negative impacts on turtles in a number of ways: drowning in the intake pipes, injury sustained in the pipes and the canal, injury sustained during canal dredging, debilitation of condition due to long entrapment, exposure to predators in the intake canal, injury and stress sustained during capture, entanglement and drowning in fish gillnets and turtle capture nets, and impingement and drowning on barrier nets and in the intake wells. The Taprogge condenser cleaning system may also have an effect on sea turtles if discharged sponge balls are ingested.

Drowning and injury in the intake pipes are unlikely to be a major direct impact. With both generating units operating, the transit time through the intake pipes (5 minutes through the 12-ft pipes and 3 minutes through the 16-ft pipes) is likely too short to drown a sea turtle, and there are no known instances of turtle mortalities from forced submergence in the intake pipes. Some captured turtles have shown recent superficial scrapes, usually to the anterior carapace or plastron, which may have resulted from contact with encrusting organisms in the pipeline.

NMFS has conducted several formal consultations with the COE on the effects of channel maintenance dredging on sea turtles, generally concluding that the operation of hopper dredges may adversely affect sea turtles, but not hydraulic or clam shell dredges. This latter conclusion does not apply, however, to dredging conducted in the narrow confines of the St. Lucie intake canal where turtles have limited ability to evade a dredge. All types of dredging may affect sea turtles there. In fact, from 1976 to 1990, 7 loggerheads were killed during maintenance dredging in the St. Lucie intake canal. In 1994, however, hydraulic dredging was accomplished without any sea turtle mortality by isolating the dredging area with a temporary 4-in square barrier net. FP&L engineers expect that future maintenance dredging in the intake canal will generally only be necessary west of the 5-in barrier net. Impacts to sea turtles from dredging west of the barrier net are considered unlikely. In the rare instances where dredging may be required to the east of the 5-in barrier net, FP&L will contact NMFS and initiate consultation on the particular project, in conjunction with NRC or COE. Dredging associated with the construction of the 5-in barrier net was the subject of a separate informal consultation with NMFS (concluded October 26, 1995); and the work was accomplished without any impacts to turtles.

The extent of impacts resulting from loss of condition and exposure to predation is largely dependent on the species and the total residence time of individual animals in the intake canal. Green turtles, in particular, would not have access to their normal food sources of sea grasses or algae in the canal. Loggerheads may be able to find some of their prey species that have also become entrapped in the canal. In 1994, FP&L reported residence times based on visual observations for turtles entrapped east of the Highway A1A barrier net. Average residence times were 1.5 days for loggerheads and 2 days for green turtles, and 100% percent of the loggerheads and 97% percent of the greens were captured within one week of first sighting. Loss of condition from lack of adequate food sources should not have serious negative impacts on turtles over these relatively short periods of time. Predatory fish, including barracuda, sharks, and jewfish, occur in the intake canal and may pose a threat to the smaller turtles in the canal. The level of predation on turtles entrapped in the intake canal has not been quantified, but can be mitigated by minimizing the residence time for individuals entrapped at the St. Lucie Plant. The contribution of predation to the overall turtle mortality rate at the St. Lucie Plant is probably small.

Drowning in capture nets has occurred occasionally throughout the history of the St. Lucie Plant's capture program during the period from 1976 through 1999. Since the capture-release program began, 7 loggerheads and 13 green turtles have drowned in capture nets (0.3% of the total number of turtles captured). Turtles can drown when they become tightly entangled, when the net becomes fouled on the bottom, or when a small turtle becomes tangled with a large turtle and is held underwater. Since April 1990, the nets have been set only during daylight hours and constantly tended, resulting in 4 greens drowned in capture nets but no loggerheads. The last green turtle to drown in a capture net was on February 7, 1999.

Injuries sustained during capture are all reported to be superficial. Typically they involve small cuts from net strands and abrasions sustained during handling. Efforts can be made to reduce effects from stress by minimizing handling time (reported to be generally under one-half hour to obtain biological information and to tag the animal) and by keeping turtles cool and shaded prior to release.

Impingement of turtles on the barrier nets has been implicated in only one mortality since improvements to the 8-in barrier net were completed in 1990. Since then, one loggerhead has become entangled in the 8-in barrier net and drowned. Six other loggerheads and 5 green turtles have been recovered dead at the barrier net, but their cause of death is unknown and the carcasses would naturally accumulate at the barrier net. The UIDS barrier is believed by FP&L to pose a greater threat to turtles than the other barrier nets because of its downward slope relative to the current flow. One UIDS-associated mortality has been reported since 1990. Generally, however, small turtles capable of penetrating the 8-in barrier net can presumably penetrate the UIDS barrier without impingement and end up in the intake wells. The large number of small turtles removed from the intake wells between 1990 and 1995 bears this out. However, with the installation of the 5-in barrier net in 1996, fewer turtles have been getting through to the intake wells.

Since 1992, the number of small green turtles entrapped in the St. Lucie intake canal has been rising. Correspondingly, until the installation of the 5-in barrier net, more small turtles were penetrating the barrier nets and eventually reaching the intake wells. In 1995, 673 green turtles were entrapped in the St. Lucie intake canal, and 97 of those had to be removed from the intake wells, where 7 died. Since 1990, a total of 16 green turtles have been recovered dead from the intake wells. FP&L has reported that 3 of the 16 died as the result of injury inflicted by the mechanical debris-removing rakes. The other 13 are reported by FP&L as dying of unknown causes. However, as stated previously, turtles reaching the intake wells have decreased due to the installation of the 5-in barrier net in 1996, with only 55 turtles making it through to the intake wells from 1996 through 2000 and only 3 of these being found dead. This has helped to decrease total turtle mortalities at the plant.

Possible impacts of the Taprogge condenser cleaning system have been examined. Release of the system's sponge balls in the plant's discharge waters would introduce persistent marine debris offshore of the plant. The cleaning balls, made of vulcanized natural rubber, could be mistaken for prey items by turtles and consumed, with unknown health effects. To address this and other concerns relating to the Taprogge system's operation, FP&L instituted operational procedures for the system to prevent sponge ball release into the environment. FP&L has been making operational reports to FFWCC since March 1996 on the Taprogge system. Based on these reports, sponge ball loss is quite low, with the maximum estimated at three balls/day. These sponge balls would most likely have been lost as a result of deterioration to a small enough size to pass through the strainer grid. FP&L has increased controls on sponge ball inventories and has added key lock controls on the ball strainers. The sponge ball loss rate is quite low, and probably consists of very small sponge parts. No impacts to sea turtles are expected from this normal operational loss rate. Single, large losses of sponge balls should be preventable through proper management controls, which FP&L has implemented. No impacts from the Taprogge system are anticipated as long as effective operational and management measures are maintained. FP&L should continue to generate the yearly reports on the operation of the Taprogge system, which have been required by the FFWCC Bureau of Protected Species Management, and a copy should also be provided to the NMFS Southeast Regional Office to allow NMFS to evaluate whether impacts from sponge ball loss are greater than presently anticipated.

In addition to the impacts to sea turtles already discussed, entrapment at the St. Lucie intake canal can have several other negative effects on sea turtles, through interruption of migration, loss of mating opportunities, and loss of nesting opportunities. Leatherbacks are probably more sensitive to interruption of migration than the other species of sea turtle because their spring migrations seem to be closely synchronized with the presence of prey species. The problem of loss of mating opportunities is impossible to quantify but would affect adults prior to and during the nesting season. Loss of nesting opportunities is a documented problem, with several instances of females nesting on the canal bank reported by FP&L. The severity of any of these impacts can be reduced by minimizing residence time of individual turtles in the canal.

Since reporting of sea turtle entrapment and mortality at St. Lucie Plant began in 1976, two general trends in the impacts on sea turtles are clear. The total number of turtles entrapped has increased, particularly in the last five years, and the mortality rate of the entrapped turtles has decreased. With the exception of the activation of Unit 2 in 1982, the operating characteristics of the circulating water system have not changed over time. From 1976 through 1994, there was an average of 181 turtles entrapped per year. From 1995 through 1999, the average has gone up to 676 turtles entrapped per year. From 1976 to 1990, an average of 11 turtles per year were found dead in some part of the circulating seawater cooling system. This number has decreased from 1991 through 1999 to 4.8 turtles per year.

The TEWG (1998) found that loggerhead nesting on Hutchinson Island was a good predictor of nesting trends on other Florida index beaches and may well reflect nesting trends for the total South Florida loggerhead nesting population. FP&L (2000) found that loggerhead nesting on Hutchinson Island has increased significantly from 1981 through 1998. If trends on Hutchinson Island do accurately reflect nesting trends for the whole South Florida loggerhead nesting population, then nesting for this population also has increased from 1981 through 1998. Based on results of genetic testing by Bass (1999) the majority of loggerheads captured at the plant are from the South Florida nesting population. Provancha (1997, 1998) found green turtle catch per unit effort (CPUE) in nearby Mosquito Lagoon to be greater than the CPUE's recorded for the same area for the years 1977 through 1979. Therefore, the increased number of entrapments of turtles could be a result of increased local abundances. The decreasing mortality rates are due to incremental improvements in the turtle program executed at FP&L, including the construction of barrier nets, improved monitoring, and fine-tuning capture methods. Since 1990, turtle mortalities have resulted from drowning in the capture or barrier nets, entrapment in the intake wells, and unknown, presumably natural, causes. Small green turtles from the intake wells constitute half of these mortalities.

From 1976 to 1990, an average of 11 turtles per year were found dead out of an average of 183 total turtles captured in some part of the circulating seawater cooling system. Due to improvements in the turtle detection and capture methods, discussed above, the number of dead turtles has decreased from 1991 through 1999 to 4.8 turtles per year even though the total number of turtles captured has increased to a average of 487 turtles per year during that time period. Future levels of impacts to marine turtles at the St. Lucie Plant are difficult to assess in absolute terms due to fluctuating capture rates. If the years 1995 through 1999 are broken out from the averages above, those years give an average of 722 turtles captured per year with a high of 933 in 1995 and a low of 382 in 1997. Therefore, NMFS believes that there is a possibility that 1,000 turtles, in any combination of the five species found in the action area, could be captured during any given year at the plant. The majority of these turtles will be green turtles, followed by loggerhead turtles, and to a much lesser extent Kemp's ridley, leatherback, and hawksbill sea turtles. Based on this and past mortality information NMFS, believes that 10 or 1% of the total number of green and loggerhead turtles (combined) captured (which ever is less) in any combination of green and loggerhead turtles may be incidentally taken by injury or mortality, per year, as a result of the proposed action. NMFS believes that one Kemp's ridley turtle, per year, and one hawksbill or leatherback turtle, every two years, may be incidentally taken by injury or mortality, per year, as a result of the proposed action.

V. Cumulative Effects

Cumulative effects are the effects of future state, local, or private activities that are reasonably certain to occur within the action area considered in this biological opinion. Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Within the action area, major future changes are not anticipated in the ongoing human activities described in the environmental baseline. The present, major human uses of the action area -- commercial and recreational fishing and recreational beach use and boating -- are expected to continue at the present levels of intensity in the near future. As discussed in Section III, however, listed species of turtles and whales migrate throughout the Atlantic Ocean and Gulf of Mexico and may be affected during their life cycles by non-Federal activities outside the action area.

Beachfront development, lighting, and beach erosion control all are ongoing activities along the Atlantic and Gulf coasts. These activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Nocturnal human activities along nesting beaches may also discourage sea turtles from nesting sites. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. However, more and more coastal counties are adopting more stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting. Some of these measures are being drafted in response to ongoing law suits brought against the counties by concerned citizens who charged the counties with failing to uphold the ESA by allowing unregulated beach lighting which resulted in takes of hatchlings.

State-regulated commercial and recreational fishing activities in the Gulf of Mexico waters currently result in the incidental take of threatened and endangered species. Other recreational activities, such as whale watch cruises, have also resulted in the incidental take of endangered whales. It is expected that states will continue to license/permit large vessel and thrill-craft operations which do not fall under the purview of a Federal agency and regulations that will affect fishery activities. Any increase in recreational vessel activity in inshore and offshore waters of the Gulf of Mexico and Atlantic Ocean will likely increase the number of turtles and whales taken by injury or mortality in vessel collisions. Recreational hook-and-line fisheries have been known to lethally take sea turtles. Future cooperation between NMFS and the states on these issues should help decrease take of sea turtles and whales caused by recreational activities. NMFS will continue to work with coastal states to develop and refine ESA section 6 agreements and section 10 permits to enhance programs to quantify and mitigate these takes.

VI. Conclusion

After reviewing the current status of the endangered green, leatherback, hawksbill, and Kemp's ridley sea turtles and the threatened loggerhead sea turtle in the action area, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is NMFS' biological opinion that the continued use of St. Lucie Nuclear Power Plant's circulating seawater cooling system is not likely to jeopardize the continued existence of the endangered green, leatherback, hawksbill, and Kemp's ridley sea turtles, or the threatened loggerhead sea turtle. No critical habitat has been designated for these species in the action area; therefore, none will be affected.

VII. Incidental Take Statement

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or to attempt to engage in any such conduct. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary and must be undertaken by the NRC so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. NRC has a continuing duty to regulate the activity covered by this incidental take statement. If NRC fails to assume and implement the terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, NRC must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement.

Amount or Extent of Anticipated Take

The lethal take levels below are based on the historical observed lethal takes, but provide for increased total numbers of lethal takings as entrapment levels increase.

Based on stranding records and historical data, five species of sea turtles are known to occur in the action area. Currently available information on the relationship between sea turtle capture and mortality and the St. Lucie Nuclear Power Plant's circulating seawater cooling system indicates that injury and/or death of sea turtles is likely to occur from entrapment in the system's intake canal associated with the proposed action. In recent years turtle entrapment has increased, especially green turtles, and will likely continue to increase, as the green turtle population, and other species' populations, continue to increase and recover. Therefore, pursuant to section 7(b)(4) of the ESA, NMFS anticipates an **annual incidental capture of up to 1,000 turtles, in any combination of the five species found in the action area. NMFS anticipates 1% of the total number of green and loggerhead turtles (combined) captured** (i.e., if there are 900 total green and loggerhead turtles captured in one year, then 9 turtles in any combination of greens and loggerheads are expected to be injured or killed as a result. In cases where 1% of the total is not a whole number, then the total allowable incidental take due to injury or death will be rounded to the next higher whole number) **will be injured or killed each year over the next 10 years** as a result of this incidental capture. **NMFS also anticipates two Kemp's ridley turtles will be**

killed each year and one hawksbill or leatherback turtle will be injured or killed every 2 years for the next 10 years also as a result of this incidental capture. NMFS anticipates that the turtles most likely to be entrapped and taken will be green turtles, followed by loggerhead turtles, and to a much lesser extent, Kemp's ridley, leatherback, and hawksbill sea turtles. If the actual incidental captures, injuries or mortalities meets or exceeds this level, NRC must immediately request reinitiation of formal consultation. NMFS Southeast Region will cooperate with NRC in the review of the incident.

Effect of the Take

NMFS believes that the aforementioned level of anticipated take (lethal, injury or non-lethal) over the next 10 years is not likely to appreciably reduce either the survival or recovery of Kemp's ridley, green, loggerhead, leatherback, and hawksbill sea turtles in the wild by reducing their reproduction, numbers, or distribution. In particular, NMFS determined that it does not expect activities associated with the St. Lucie Nuclear Power Plant's circulating seawater cooling system, when added to ongoing activities affecting these species in the action area and cumulative effects, to affect sea turtles in a way that reduces the number of animals born in a particular year (i.e., a specific age-class), the reproductive success of adult sea turtles, or the number of young sea turtles that annually recruit into the adult breeding population.

Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the Kemp's ridley, green, loggerhead, leatherback, and hawksbill sea turtles.

1. FP&L shall have a program in place to monitor, protect, and capture turtles entrapped in the intake canal.

2. FP&L shall report all turtle captures and subsequent mortalities per permit conditions.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, NRC must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting and monitoring requirements. These terms and conditions are nondiscretionary.

1) FP&L shall maintain a 5-in bar mesh barrier net across the intake canal, east of the existing 8-in mesh barrier net. The 5-in net must receive regular inspection, maintenance, and repair on at least a quarterly basis. The regular maintenance schedule notwithstanding, any holes or damage to the net that are discovered must be promptly repaired to prevent the passage of turtles through the barrier net.

2) The existing 8-in mesh barrier net must be retained to serve as a backup to the 5-in mesh barrier net, which may be lowered occasionally because of fouling and water flow problems. The 8-in mesh net must receive regular inspection, maintenance, and repair on at least a quarterly basis. The regular maintenance schedule notwithstanding, any holes or damage to the net that are discovered must be promptly repaired to prevent the passage of turtles through the barrier net.

3) FP&L shall continue its current program to capture and release turtles from the intake canals.

a) Turtles that have been flipper tagged by the plant have experienced a 19% loss rate of the tags and some turtles have experienced severe flipper scaring (Gorhan *et al.* 1998). Therefore all turtles released shall be PIT tagged. However, in order to continue to gain data on flipper tag loss rates turtles not exhibiting flipper scaring and damage shall also be flipper tagged. The handling and tagging of captured turtles, treatment, and rehabilitation of sick and injured turtles, and disposition of dead turtle carcasses shall be in accordance with permits granted through the state of Florida. FP&L biologists shall immediately (within 30 minutes) notify the Florida STSSN staff of any sick or injured turtle so the turtle can receive proper attention at the earliest possible time. The Florida STSSN beeper number is: 1-800-241-4653, the ID number is: 274-4867.

4) Capture netting in the intake canal shall be conducted with a surface floating tangle net with an unweighted lead line. The net must be closely and thoroughly inspected via boat at least once per hour. Netting shall be conducted whenever sea turtles are present in the intake canal according to the following schedule:

a) 8 hours per day, 5 days per week, under normal circumstances;
b) 12 hours per day or during daylight hours, whichever is less, 7 days per week, under any of the following circumstances:
i) an adult turtle occurs in the canal during mating or nesting season (March 1 through September 30),
ii) an individual turtle has remained in the canal for 7 days or more,
iii) a leatherback turtle occurs in the canal,
iv) an apparently sick or injured turtle occurs in the canal.

Reasonable deviations from this schedule due to human safety considerations (i.e., severe weather) are expected.

5) If a turtle is observed in the intake canal west of the 8-in barrier net, directed capture efforts shall be undertaken to capture the turtle and to prevent it from entering the intake wells.

6) The gratings at each of the intake wells shall be visually checked for turtles at least eight times each 24-hour period. If a turtle is sighted in an intake well, dip nets, or other non-injurious methods should be used to remove the turtle.

7) FP&L shall continue to participate in the STSSN, under proper permits and authority, in order to assess any possible delayed lethal impacts of capture as well as to provide background data on the mortality sources and health of local sea turtles. As a point of clarification, stranded sea turtles will generally not be counted against the authorized level of lethal incidental take in this incidental take statement, but information from strandings may be the basis for the determination that unanticipated impacts or levels of impacts are occurring.

8) FP&L should continue to conduct, under proper permits and authority, the ongoing sea turtle nesting programs and public service turtle walks.

9) Monthly reports covering sea turtle entrapment, capture efforts, turtle mortalities, available information on barrier net inspections and maintenance shall be furnished to NMFS. In addition, an annual report discussing these same topics and the Taprogge cleaning system operation, and any sponge ball loss at St. Lucie Plant shall be furnished to NMFS. All reports shall be sent to the National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, 9721 Executive Center Drive North, St. Petersburg, Florida 33702.

NMFS anticipates that no more than 1% of the total number of green and loggerhead turtles and two Kemp's ridleys entrapped in the canal will be taken by injury or mortality annually for each of the next 10 years of the proposed action. NMFS also anticipates that no more than one hawksbill or leatherback turtle entrapped in the canal will be taken by injury or mortality every two years for the next 10 years. These reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. NRC must immediately request initiation of formal consultation, provide an explanation of the causes of the taking, and review with NMFS the need for possible modification of the reasonable and prudent measures.

IX. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authority to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat to help implement recovery plans or to develop information.

(1) The NRC should promote FP&L's continued research to determine the subsequent dispersal of captured and released turtles through its tagging program and through cooperation with properly permitted scientists.

(2) Current procedures for determining turtle residence times in the intake canal tend to underestimate actual residence times. The NRC should direct FP&L to continue efforts to improve residence time estimates. These efforts may include directed studies of residence time, so long as research permits are obtained from the proper authority.

(3) NRC should encourage FP&L to gain the proper permits to conduct tissue sampling to determine the genetic identity of turtles interacting with the plant's cooling water intake system.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

X. Reinitiation of Consultation

This concludes formal consultation on the actions outlined in NRC's letter dated May 9, 2000. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if (1) the amount or extent of taking specified in the incidental take statement is met or exceeded, (2) new information reveals effects of the action that may affect listed species or critical habitat (when designated) in a manner or to an extent not previously considered, (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinion, or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, NRC must immediately request reinitiation of formal consultation.

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OPINION DATED FEBRUARY 17, 2005

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Dr. N.
St. Petersburg, FL 33702
(727) 570-5317, FAX 570-5317
http://sero.nmfs.noaa.gov

FEB 17 2005 F SER3:E

Ms. Tori White
Palm Beach Gardens Regulatory Office
U.S. Army Corps of Engineers
4400 PGA Boulevard, Suite 500
Palm Beach Gardens, FL 33410

Dear Ms. White:

This responds to your February 11, 2005, e-mail to NOAA's National Marine Fisheries Service (NMFS) regarding proposed dredging by Florida Power and Light (FP&L) of approximately 130,000 cubic yards (cu yds) of sediment at the St. Lucie Power Plant intake canal in St. Lucie County, Florida. You have requested consultation pursuant to section 7(a)(2) of the Endangered Species Act (ESA) on the proposed dredging activity. FP&L provided documentation on the project and its potential effects via e-mails dated January 12, and February 8 and 11, 2005.

The proposed work would be done by hydraulic cutterhead suction dredge, with a modified draghead to protect sea turtles, to remove sediments that accumulated during the 2004 hurricane season. Due to unexpected excessive intake canal shoaling as a direct result of the unusually high number and strength of hurricanes that affected Florida's East Coast in 2004, extraordinary dredging measures are now required. Limited cooling water flow into the plant's turbines could limit the plant's power output and also adversely affect the turbines themselves. Thus FP&L has stated that it is essential that dredging be accomplished as quickly as possible. Dredging of hurricane-deposited sediments in areas both east and west of the 5-in mesh barrier net is required.

The intake canal has two permanent barrier nets installed to prevent sea turtles from being swept into the cooling water intake structures of the plant's energy-generating turbines. The 8-in mesh barrier net is closest to the turbine intake structure (i.e., is the most landward net). The 5-in mesh net is located seaward of the 8-in mesh barrier net, and is the first barrier entrained turtles would encounter. Dredging is scheduled to commence in February 2005 and will be conducted both east (seaward) of the 5-in mesh barrier net and between the two barrier nets. These barrier nets are permanently in place and regularly monitored (see Enclosure 1) to prevent sea turtles entrained in the offshore cooling-water intake structures from being carried all the way through the cooling water intake canal and being sucked into the power plant's turbines.

The dredging company, L.W. Matteson, Inc., has estimated that it will take approximately six days to complete the work east of the 5-in barrier net, six days to complete the work between the

5-in and 8-in barrier nets, and 37 days to complete the rest of the work (S. Foster e-mai to E. Hawk, February 11, 2005).

Similar to the proposed action, in 2002 the intake canal at St. Lucie was dredged east o the 5-in barrier net. Approximately 34,000 cu yds of sediment were removed, and there were n incidents involving sea turtles (S. Foster, e-mail to E. Hawk, January 12, 2004). Nor w re there any sea turtle takes during the previous (1995) dredging. FP&L is proposing to modify the dredge cutterhead in the same manner as it did in 2002 to protect sea turtles. The mod ications include caging the cutterhead by welding rebar over the head to prevent any object larg r than 6 inches wide from entering the suction pipe. The cutterhead will be slowly lowered into the water, and cutterhead rotation and suction will not be turned on until the dredge head i in the sediment. Then, it will be turned on at idle speed. The dredge has variable speeds and the cutterhead will be deep in the sediment while running. In addition, there will be a perr itted sea turtle biologist present during all dredging east of the 5-in mesh barrier net to serve as lookout and ensure that these procedures are followed (S. Foster, e-mails to E. Hawk, January 2, 2005 and February 11, 2005). These conservation measures are in addition to those non-dis retionary reasonable and prudent (conservation) measures which are already permanently in place, as required by NMFS' May 4, 2001, biological opinion to the Nuclear Regulatory Commission (NRC) on FP&L operations at the St. Lucie Power Plant. These conditions are included with this consultation as Enclosure 1. That opinion is still in effect.

Analysis

Existing biological opinions to the U.S. Army Corps of Engineers (COE) on hopper dredging in U.S. South Atlantic and Gulf of Mexico waters have established that non-hopper type dredging methods such as the type proposed for the above-described proposed activity have discountable effects on, or are not likely to adversely affect, currently-listed ESA-listed species (Au ust 29, 1997, biological opinion to the COE's South Atlantic Division). Cutterhead dredges have not been implicated in strandings of sea turtles or other federally-listed threatened or enda gered species, probably because they advance at such a slow pace and are noisy, giving mob e sea turtles and sturgeon time to get out of the way of the rotating cutterhead.[1] The tempor ry turbidity effects associated with dredging are also not expected to adversely affect fed ally-listed species. However, those consultations envisioned dredging in unconfined areas. The St. Lucie Power Plant intake canal is a confined space so turtles are less likely to be able to get out of the way of dredging equipment.

The May 4, 2001, opinion to the NRC on FP&L power plant operations at St. Lucie noted the following: "NMFS has conducted several formal consultations with the COE on the e ects of

[1] With the exception of a recent occurrence in the shallow waters of the Laguna Madre, Texas, where a old-stunning event (temperatures dropped over 19 degrees Fahrenheit in less than 72 hours) during late-December 2004 resulted in the stranding of 20 juvenile green turtles. In all likelihood, the green turtle entrained by the cutterhead dredge operating in the Brazos Santiago Pass area at the time of the cold-stunning event was already lethargic or moribund, and thus unable to avoid the suction draghead, when it was entrained. No such weather impacts are exp cted at the St. Lucie intake canal; furthermore, an endangered species observer will be present during all dredging operations (there was no observer during the Laguna Madre dredging).

channel maintenance dredging on sea turtles, generally concluding that the operation of hopper dredges may adversely affect sea turtles, but not hydraulic or clam shell dredges. This latter conclusion does not apply, however, to dredging conducted in the narrow confines of the St Lucie intake canal where turtles have limited ability to evade a dredge. All types of dredging may affect sea turtles there. In fact, from 1976 to 1990, 7 loggerheads were killed during maintenance dredging in the St. Lucie intake canal. In 1994, however, hydraulic dredging was accomplished without any sea turtle mortality by isolating the dredging area with a temporary 4-in square barrier net. FP&L engineers expect that future maintenance dredging in the intake canal will generally only be necessary west of the 5-in barrier net. Impacts to sea turtles from dredging west of the barrier net are considered unlikely. In the rare instances where dredging may be required to the east of the 5-in barrier net, FP&L will contact NMFS and initiate consultation on the particular project, in conjunction with NRC or COE."

Conclusions
NMFS has no reasons or new information that would change the basis of the 2001 opinion's conclusion that impacts to sea turtles from dredging west of the 5-in mesh barrier net are considered unlikely. Turtles are unlikely to make it past the 5-in barrier net, so they are unlikely to be affected by dredging activity taking place inshore of the barrier net. Furthermore, additional precautions to ensure sea turtle safety during dredging have been taken since then, i.e., in 2002 (and in the proposed action) by modifying the cutterhead with a 6-inch rebar grid to prevent accidental entrainment in the suction draghead, and the posting of a full-time sea turtle observer.

East of the 5-in mesh barrier net, entrainment in the suction draghead is more likely, since no deflector/barrier nets will have impeded their presence. FP&L has also submitted size-frequency graphs showing the sizes of turtles captured in the intake canal in 2003 (see Enclosure 2). From these graphs it can be deduced that it is unlikely that green sea turtles, the smallest species typically captured in the intake canal, would be able to pass through the 6-inch rebar grid cage surrounding the cutterhead. Loggerheads, typically larger than greens, would be even less likely to pass through the rebar grid. Thus, NMFS concludes that sea turtles entering the intake canal east of the 5-in barrier net would still be unlikely to be entrained, because their size is typically too large to allow them to get through the 6-inch rebar grid cage around the cutterhead. In addition, the presence of a full-time turtle observer monitoring the dredging operation should ensure that any turtle in the draghead vicinity will be spotted in time to shut down the dredging operation to prevent its accidental entrainment.

In summary, based on your description of the proposed activity, required conservation measures and commitment to protect federally-listed species, we concur with your determination that the proposed activity may affect but is not likely to adversely affect endangered and threatened species under the purview of NMFS. There is no critical habitat in the action area; therefore, none will be affected. This concludes your consultation responsibilities under section 7 of the ESA. A new consultation should be initiated if there is a take, if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent that was not previously considered; if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not previously considered; or if a new species is listed or critical habitat designated that may be affected by the identified action.

If you have any questions, please contact Mr. Eric Hawk at the number listed above or by e-mail at Eric.Hawk@noaa.gov.

Sincerely,

James E. Weaver

for Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosures

Cc: F/PR3
File: 1514-22.f.1 FL
Ref: I/SER/2005/00170

Enclosure 1: Reasonable and Prudent Measures (from May 21, 2001, Biological Opinion to NRC)

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of the Kemp's ridley, green, loggerhead, leatherback, and hawksbill sea turtles.

1. FP&L shall have a program in place to monitor, protect, and capture turtles entrapped in the intake canal.

2. FP&L shall report all turtle captures and subsequent mortalities per permit conditions.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, NRC must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting and monitoring requirements. These terms and conditions are nondiscretionary.

1) FP&L shall maintain a 5-in bar mesh barrier net across the intake canal, east of the existing 8-in mesh barrier net. The 5-in net must receive regular inspection, maintenance, and repair on at least a quarterly basis. The regular maintenance schedule notwithstanding, any holes or damage to the net that are discovered must be promptly repaired to prevent the passage of turtles through the barrier net.

2) The existing 8-in mesh barrier net must be retained to serve as a backup to the 5-in mesh barrier net, which may be lowered occasionally because of fouling and water flow problems. The 8-in mesh net must receive regular inspection, maintenance, and repair on at least a quarterly basis. The regular maintenance schedule notwithstanding, any holes or damage to the net that are discovered must be promptly repaired to prevent the passage of turtles through the barrier net.

3) FP&L shall continue its current program to capture and release turtles from the intake canals.

a) Turtles that have been flipper tagged by the plant have experienced a ?% loss rate of the tags and some turtles have experienced severe flipper scarring (Gorham et al. 1998). Therefore all turtles released shall be tagged with Passive Integrated Transponder (PIT) internal tags. However, in order to continue to gain data on flipper tag loss rates turtles not exhibiting flipper scarring and damage shall also be flipper tagged. The handling and tagging of captured turtles, treatment, and rehabilitation of sick and injured turtles, and disposition of dead turtle carcasses shall be in accordance with permits granted through the state of Florida. FP&L

biologists shall immediately (within 30 minutes) notify the Florida Sea Turtle Stranding and Salvage Network (STSSN) staff of any sick or injured turtle so the turtle can receive proper attention at the earliest possible time. The Florida STSSN beeper number is: 1-800-241-4653, the ID number is: 274-4867.

4) Capture netting in the intake canal shall be conducted with a surface floating tangle net with an unweighted lead line. The net must be closely and thoroughly inspected via boat at least once per hour. Netting shall be conducted whenever sea turtles are present in the intake canal according to the following schedule:

a) 8 hours per day, 5 days per week, under normal circumstances;
b) 12 hours per day or during daylight hours, whichever is less, 7 days per week under any of the following circumstances:
i) an adult turtle occurs in the canal during mating or nesting season (March 1 through September 30),
ii) an individual turtle has remained in the canal for 7 days or more,
iii) a leatherback turtle occurs in the canal,
iv) an apparently sick or injured turtle occurs in the canal.

Reasonable deviations from this schedule due to human safety considerations (i.e., severe weather) are expected.

5) If a turtle is observed in the intake canal west of the 8-in barrier net, directed capture efforts shall be undertaken to capture the turtle and to prevent it from entering the intake wells.

6) The gratings at each of the intake wells shall be visually checked for turtles at least eight times each 24-hour period. If a turtle is sighted in an intake well, dip nets or other non-injurious methods should be used to remove the turtle.

7) FP&L shall continue to participate in the STSSN, under proper permits and authority, in order to assess any possible delayed lethal impacts of capture as well as to provide background data on the mortality sources and health of local sea turtles. As a point of clarification, stranded sea turtles will generally not be counted against the authorized level of lethal incidental take in this incidental take statement, but information from strandings may be the basis for the determination that unanticipated impacts or levels of impacts are occurring.

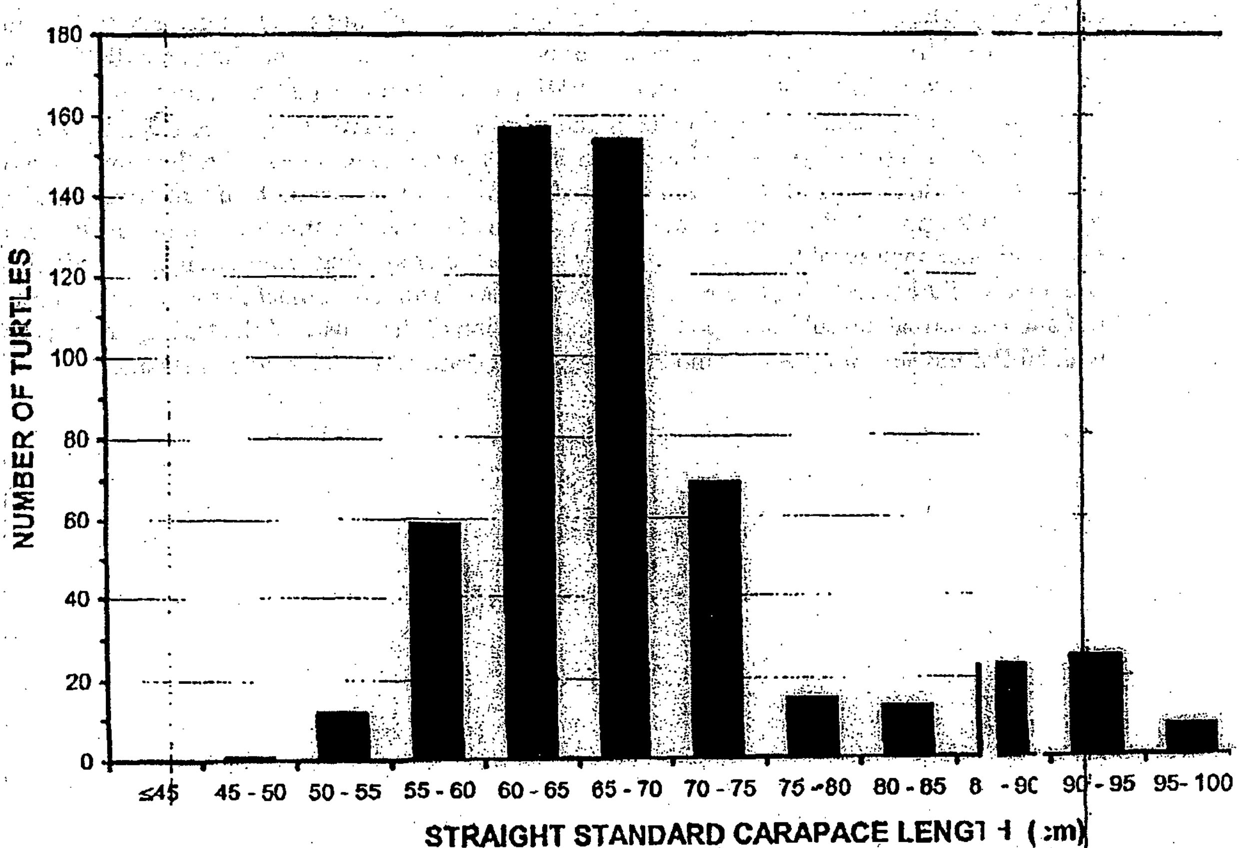
8) FP&L should continue to conduct, under proper permits and authority, the ongoing sea turtle nesting programs and public service turtle walks.

9) Monthly reports covering sea turtle entrapment, capture efforts, turtle mortalities, available information on barrier net inspections and maintenance shall be furnished to

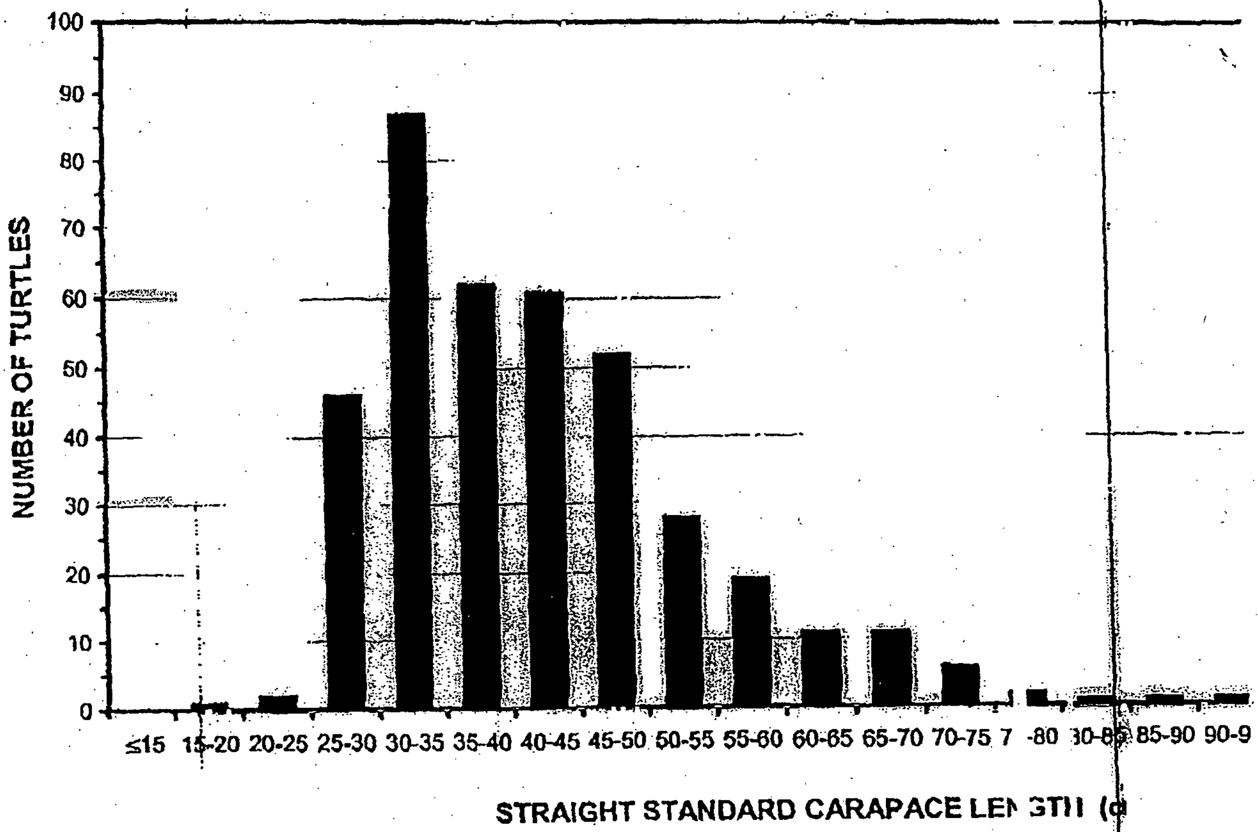
NMFS. In addition, an annual report discussing these same topics and the Taprogge cleaning system operation, and any sponge ball loss at St. Lucie Plant shall be furnished to NMFS. All reports shall be sent to the National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, 9721 Executive Center Drive North St. Petersburg, Florida 33702.

NMFS anticipates that no more than 1% of the total number of green and loggerhead turtles and two Kemp's ridleys entrapped in the canal will be taken by injury or mortality annually for each of the next 10 years of the proposed action. NMFS also anticipates that no more than one hawksbill or leatherback turtle entrapped in the canal will be taken by injury or mortality every two years for the next 10 years. These reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. NRC must immediately request initiation of formal consultation, provide an explanation of the causes of the taking, and review with NMFS the need for possible modification of the reasonable and prudent measures.

Enclosure 2: Size Distributions of Loggerhead and Green Sea Turtles Entering the St Lucie Power Plant Intake Canal in 2003



Size distribution (SSCL) of loggerhead turtles (n = 538) removed from the intake cana St. Lucie Plant, 2003.



Size distribution (SSCL) of green turtles (n = 394) removed from the intake canal, St. L cie Plant, 2003.

APPENDIX C

FNAI DATA REPORT

FLORIDA
Natural Areas
INVENTORY

1018 Thomasville Road
Suite 200-C
Tallahassee, FL 32303
850-224-8207
fax 850-681-9364
www.fnai.org

December 15, 2004

Colleen M. Cunningham
Golder & Associates, Inc.
6241 NW 23rd Street, Suite 500
Gainesville, FL 32653-1500

Dear Ms. Cunningham:

Thank you for your request for information from the Florida Natural Areas Inventory (FNAI). We have compiled the following information for your project area.

Project: Florida Power & Light Hutchinson Island Nuclear Power Plant

Date Received: December 6, 2004

Location: St. Lucie County

Based on the information available, this site appears to be located on or very near a significant region of scrub habitat, a natural community in decline that provides important habitat for several rare species within a small area. Additional consideration should be given to avoid and/or mitigate impacts to these natural resources, and to design land uses that are compatible with these resources.

Element Occurrences

A search of our maps and database indicates that currently we have several Element Occurrences mapped within the vicinity of the study area (see enclosed map and table). Please be advised that a lack of element occurrences in the FNAI database is not a sufficient indication of the absence of rare or endangered species on a site.

The Element Occurrences data layer includes occurrences of rare species and natural communities. The map legend indicates the precision of the element occurrence location, defined as second (within about 300 feet of the point), minute (within about one mile), or general (within about 5 miles). For animals and plants, Element Occurrences generally refer to more than a casual sighting; they usually indicate a viable population of the species. Note that some element occurrences represent historically documented observations that may no longer be extant.

Several of the species and natural communities tracked by the Inventory are considered **data sensitive**. Occurrence records for these elements contain information that we consider sensitive due to collection pressures, extreme rarity, or at the request of the source of the information. The Element Occurrence Record has been labeled "Data Sensitive." We request that you not publish or release specific locational data about these species or communities without consent from the Inventory. If you have any questions concerning this please do not hesitate to call.

Florida State University 1851

Florida Resources and Environmental Analysis Center

Institute of Science and Public Affairs

The Florida State University

Potential Natural Areas

Portions of the site appear to be located on or near Potential Natural Areas (PNA). These PNA are priority 4 and may include the following community types: maritime hammock, coastal strand, estuarine tidal swamp or beach dune.

Potential Natural Areas are lands that appear to be relatively intact areas of natural vegetation based on aerial photography, as determined by FNAI scientists. Please see the enclosed explanation sheet for more information. PNAs are not a regulatory designation; they are intended for conservation planning purposes. The maps show a revised version of the PNAs, based on 1995 land use land cover data from the water management districts.

Potential Habitat for Rare Species

Portions of the site appear to be located on or near Potential Habitat for Rare Species. This potential habitat is associated with a known occurrence in the vicinity of: bald eagle (*Haliaeetus leucocephalus*), Florida sandhill crane (*Grus canadensis pratensis*), Florida scrub-jay (*Aphelocoma coerulescens*), fragrant prickly apple (*Harrisia fragrans*), green turtle (*Chelonia mydas*), Johnson's seagrass (*Halophila johnsonii*), large-flowered rosemary (*Conradina grandiflora*), leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), sand-dune spurge (*Chamaesyce cumulicola*), snail kite (*Rostrhamus sociabilis plumbeus*) and southeastern beach mouse (*Peromyscus polionotus niveiventris*).

FNAI Potential Habitat for Rare Species indicates areas, which based on landcover type, offer suitable habitat for one or more rare species that is known to occur in the vicinity. Potential habitat layers have been developed for approximately 250 of the most rare species tracked by the Inventory, including all federally listed species.

Potential Habitat is not a regulatory designation, and should not be confused with "critical habitat", which is an official designation made by the U.S. Fish and Wildlife Service. Information on critical habitats can be found in the Code of Federal Regulations, 50 CFR 17.95, which lists all critical habitats that have been designated. The Code of Federal Regulations can be accessed through the following website: "www.access.gpo.gov/nara/cfr/cfr-table-search.html".

The Inventory always recommends that professionals familiar with Florida's flora and fauna should conduct a site-specific survey to determine the current presence or absence of rare, threatened, or endangered species.

Please visit www.fnai.org/data.cfm for county or statewide element occurrence distributions and links to more element information.

The database maintained by the Florida Natural Areas Inventory is the single most comprehensive source of information available on the locations of rare species and other significant ecological resources. However, the data are not always based on comprehensive or site-specific field surveys. Therefore, this information should not be regarded as a final statement on the biological resources of the site being considered, nor should it be substituted for on-site surveys. Inventory data are designed for the purposes of conservation planning and scientific research, and are not intended for use as the primary criteria for regulatory decisions.

Information provided by this database may not be published without prior written notification to the Florida Natural Areas Inventory, and the Inventory must be credited as an information source in these publications. FNAI data may not be resold for profit.

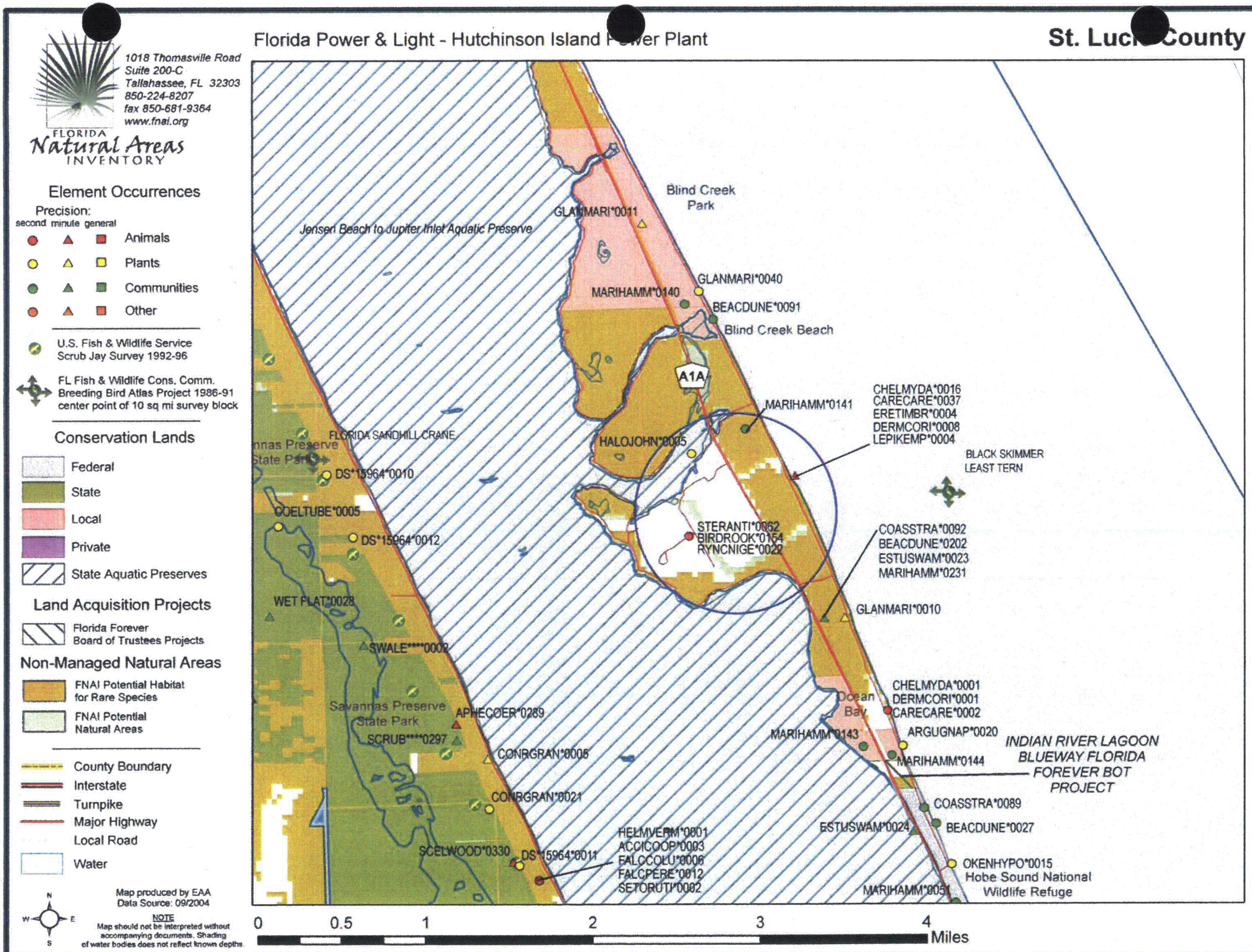
Thank you for your use of FNAI services. If I can be of further assistance, please give me a call at (850) 224-8207.

Sincerely,

Edwin A. Abbey

Edwin A. Abbey
Environmental Reviewer

encl


Florida Power & Light - Hutchinson Island Power Plant
St. Lucie County
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Suite 200-C
Tallahassee, FL 32303
850-224-8207
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www.fnai.org
FLORIDA Natural Areas INVENTORY
Element Occurrences
Precision:
second minute general
Animals
Plants
Communities
Other
U.S. Fish & Wildlife Service Scrub Jay Survey 1992-96
FL Fish & Wildlife Cons. Comm. Breeding Bird Atlas Project 1986-91 center point of 10 sq mi survey block
Conservation Lands
Federal
State
Local
Private
State Aquatic Preserves
Land Acquisition Projects
Florida Forever Board of Trustees Projects
Non-Managed Natural Areas
FNAI Potential Habitat for Rare Species
FNAI Potential Natural Areas
County Boundary
Interstate
Turnpike
Major Highway
Local Road
Water
Map produced by EAA
Data Source: 09/2004
NOTE
Map should not be interpreted without accompanying documents. Shading of water bodies does not reflect known depths.
N
W
E
S
Blind Creek Park
Jensen Beach to Jupiter Inlet Aquatic Preserve
GLANMARI*0011
GLANMARI*0040
MARIHAMM*0140
BEACDUNE*0091
Blind Creek Beach
A1A
MARIHAMM*0141
CHELMYDA*0016
CARECARE*0037
ERETIMBR*0004
DERMCORI*0008
LEPIKEMP*0004
HALOJOHN*0005
FLORIDA SANDHILL CRANE
BLACK SKIMMER
LEAST TERN
DS*15964*0010
COELTUBE*0005
DS*15964*0012
STERANTI*0062
BIRDROOK*0154
RYNCNIGE*0022
COASSTRA*0092
BEACDUNE*0202
ESTUSWAM*0023
MARIHAMM*0231
WET FLAT*0028
GLANMARI*0010
SWALE****0002
Savannas Preserve State Park
APHECOER*0289
SCRUB****0297
CONRGRAN*0005
CONRGRAN*0021
CHELMYDA*0001
DERMCORI*0001
CARECARE*0002
Ocean Bay
ARGUGNAP*0020
MARIHAMM*0143
MARIHAMM*0144
INDIAN RIVER LAGOON BLUEWAY FLORIDA FOREVER BOT PROJECT
COASSTRA*0089
BEACDUNE*0027
ESTUSWAM*0024
HELMVERM*0001
ACCICOOP*0003
FALCCOLU*0006
FALCPERE*0012
SETORUTI*0002
SCELWOOD*0330
DS*15964*0011
OKENHYPO*0015
Hobe Sound National Wildlife Refuge
MARIHAMM*0051
0
0.5
1
2
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4
Miles

1018 Thomasville Road
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Tallahassee, FL 32303
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850-681-9364 fax
www.fnai.org

FLORIDA Natural Areas INVENTORY

Florida Natural Areas Inventory

ELEMENT OCCURRENCES MAPPED ON OR NEAR PROJECT SITE

Map Label	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Listing	Observation Date	Description	EO Comments
GLANMARI*0011	Glandularia maritima	Coastal Vervain	G3	S3	N	LE	1969-12-13	ON FORE DUNE.	1969-12-13:COROLLAS DEEP LAVENDER, FLOWERING.
LEPIKEMP*0004	Lepidochelys kempii	Kemp's Ridley	G1	S1	LE	LE	1988-11	ATLANTIC OCEAN 365 M OFFSHORE, APPROX. 7 M DEPTH.	DEVELOPMENTAL/FORAGING HABITAT. BETWEEN MAR 1976 AND NOV 1988, OF 1,918 TURTLES CAPTURED, 15 WERE RIDLEYS.
DERMCORI*0008	Dermochelys coriacea	Leatherback	G2	S2	LE	LE	1988-11	ATLANTIC OCEAN 365 M OFFSHORE, APPROX. 7 M DEPTH.	DEVELOPMENTAL/FORAGING HABITAT. BTWN. 3/76-11/88, OF 1,918 TURTLES CAPTURED - 8 WERE LEATHERBACKS. SEE 2708032/3 FOR NESTING BEACH DATA.
SCRUB****0297	Scrub		G2	S2	N	N	1981-05-11	SAND PINE SCRUB, SOME AREAS WITHOUT PINES.	No EO data given
MARIHAMM*0231	Maritime hammock		G3	S2	N	N	1990	No general description given	HAMMOCK IS PATCHY AND VARIABLE. PARTS HAVE BEEN OBLITERATED BY AUSTRALIAN PINE AND BRAZILIAN PEPPER. SOME AREAS ARE VERY TROPICAL, WHEREAS OTHERS ARE DOMINATED BY TEMPERATE SPECIES. THERE ARE SEVERAL GOOD HAMMOCK AREAS WITHIN THE S. HUTCHINSON ISLAND SIT
COASSTRA*0092	Coastal strand		G3	S2	N	N	1990	No general description given	HEAVY AUSTRALIAN PINE INVASION HAS ELIMINATED MOST OF THE COASTAL STRAND AND OBSCURED THE GRADIATION BETWEEN THE STRAND AND DUNE COMMUNITIES. WHERE PATCHES OF STRAND REMAIN, COMMON SPECIES INCLUDE COCCOLOBA UVIFERA, SERENOA REPENS, ARDISIA ESCALLONIOIDES
ESTUSWAM*0023	Estuarine tidal swamp		G5	S4	N	N	1990	No general description given	THE WATER TABLE IS AT OR NEAR THE SURFACE IN THE MANGROVE AREAS WHICH HAVE PRACTICALLY ALL BEEN DITCHES AND DIKED.
CARECARE*0037	Caretta caretta	Loggerhead	G3	S3	LT	LT	1988-11	ATLANTIC OCEAN 365 M OFFSHORE, APPROX. 7 M DEPTH.	DEVELOPMENTAL/FORAGING HABITAT. BTWN. 3/76-11/88, 1918 TURTLES CAPTURED-84.6% LOGGERHEADS. PREDOMINANTLY JUVENILES (65.8 CM MEAN) WITH GENERAL PAUCITY OF LARGE JUVENILES (> 70.0 CM), AND NO JUVENILES <40 CM. SECONDARY ACCUMULATION OF ADULTS. ADULTS (>/=

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FLORIDA Natural Areas INVENTORY

Florida Natural Areas Inventory

ELEMENT OCCURRENCES MAPPED ON OR NEAR PROJECT SITE

Map Label	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Listing	Observation Date	Description	EO Comments
WET FLAT*0028	Wet flatwoods		G4	S4	N	N	ZZ	No general description given	NO EO DATA GIVEN BY DUEVER.
ESTUSWAM*0024	Estuarine tidal swamp		G5	S4	N	N	1990	No general description given	NO EO DATA IN DUEVER.
APHECOER*0289	Aphelocoma coerulescens	Florida Scrub-jay	G3	S2	LT	LT	1981-05-11	SAND PINE SCRUB, SOME AREAS WITHOUT PINES.	1981-05-11: 10 SCRUB JAYS.
SCELWOOD*0330	Sceloporus woodi	Florida Scrub Lizard	G3	S3	N	N	1986-08-03	Coastal scrub	1986-08-03: K.E. Enge, GFC, observation. See Enge et al (1986; Coop Unit Tech Rep No 26).
CHELMYDA*0016	Chelonia mydas	Green Turtle	G3	S2	LE, LT	LE	1988-11	ATLANTIC OCEAN 365 M OFFSHORE, APPROX. 7 M DEPTH.	DEVELOPMENTAL/FORAGING HABITAT. BTWN. 3/76-11/88 1,918 TURTLES CAPTURED - GREEN TURTLES 13.9%. PREDOMINATELY JUVENILES (35.6 CM=MEAN MSCL), 80% <40 CM. 50% OF CAPTURES IN JAN. & FEB. SEE 2708032/2 FOR NESTING BEACH DATA.
CONRGRAN*0005	Conradina grandiflora	Large-flowered Rosemary	G3	S3	N	LT	1965-08-08	SCRUB	LOW, STRAGGLY SHRUB-- STERILE ON 1965-08-08
ERETIMBR*0004	Eretmochelys imbricata	Hawksbill	G3	S1	LE	LE	1988-11	ATLANTIC OCEAN 365 M OFFSHORE, APPROX. 7 M DEPTH.	DEVELOPMENTAL/FORAGING HABITAT. BETWEEN MARCH 1976 AND NOVEMEBER 1988 OF 1,918 TURTLES CAPTURED, 6 WERE HAWKSBILLS.
GLANMARI*0010	Glandularia maritima	Coastal Vervain	G3	S3	N	LE	1969-01-19	ALONG FIRST DUNE.	1969-01-19: FLOWERING-PINKISH LAVENDER FLOWERS.
SWALE****0002	Swale		G3	S3	N	N	ZZ	No general description given	SERENOA REPENS CLUMPS OCCUPY THE HIGHEST GROUND. ILEX CASSINE, ILEX GLABRA AND BLECHNUM SERRULATUM ARE TYPICALLY SCATTERED THROUGH THE PALMETTOS.
BEACDUNE*0202	Beach dune		G3	S2	N	N	1990	No general description given	THE HUTCHINSON ISLANDS BEACH DUNES ARE COMPOSED OF PALM BEACH FINE SAND. THEY ARE GENERALLY A RAGGED, NARROW STRIP WITH PATCHES OF UNIOLA PANICULATA, ALTERNANTHERA MARITIMA, IVA IMBRICATA, HELIANTHUS DEBILIS, AND PASPALUM VAGINATUM. SURIANA MARITIMA MAY
CONRGRAN*0021	Conradina grandiflora	Large-flowered Rosemary	G3	S3	N	LT	1987-08-28	No general description given	FREQUENT IN UNDERSTORY OF DENSE SAND PINE WITH MYRTLE OAK, RED BAY, FLORIDA HICKORY

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FLORIDA Natural Areas INVENTORY

Florida Natural Areas Inventory

ELEMENT OCCURRENCES MAPPED ON OR NEAR PROJECT SITE

Map Label	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Listing	Observation Date	Description	EO Comments
GLANMARI*0040	Glandularia maritima	Coastal Vervain	G3	S3	N	LE	1990-04-20	PLANTS ALONG PATH W FROM BEACH N OF MOUTH OF BLIND CREEK.	SEVERAL PROSTRATE PLANTS IN FLOWER.
OKENHYPO*0015	Okenia hypogaea	Burrowing Four-o'clock	G3?	S2	N	LE	1983	PLANTS ON SANDY BEACH.	6 PLANTS IN 0.5 MILE STRETCH
COELTUBE*0005	Coelorachis tuberculosa	Piedmont Jointgrass	G3	S3	N	LT	1989-12-10	GRASSY SHALLOW MARSHES.	PLANTS RARE AMONG STAND OF RHYNCHOSPORA INUNDATA.
ARGUGNAP*0020	Argusia gnaphalodes	Sea Lavender	G4	S3	N	LE	1983	STRAND/BEACH INTERFACE AND LANDWARD SIDE OF STRAND	ONE SHRUB (ANOTHER COLONY OF APPROX. 20 S. OF HERMAN BAY PARK) COLONY SHOWS SIGNS OF STRESS; MANY STEMS NEARLY LEAFLESS.
HALOJOHN*0005	Halophila johnsonii	Johnson's Seagrass	G2	S2	LT	N	1975-04-09	No general description given	LAT/LONGS GIVEN DON'T FIT FOR BIG MUD CREEK BY MY RECKONING.
FALCCOLU*0006	Falco columbarius	Merlin	G5	S2	N	N	1987-	SANDHILL RIDGE WITH WET PRAIRIE TO W. AND ESTUARY (INDIAN RIVER LAGOON) TO E.	MIGRATION/STOP-OVER AREA: 1987 - 104 COUNTED FROM BANDING STATION, 11 TRAPPED, BANDED AND RELEASED DURING FALL. ASSUME FORAGING OCCURS IN NEARBY SAVANNAH STATE RESERVE AS WELL.
BIRDROOK*0154	Bird rookery		GNR	SNR	N	N	1987	Gravel berm along discharge canal and no data on other site.	1987: SEVERAL DOZEN STERNA ANTILLARUM AND 8-10 PAIRS RYNCHOPS NIGER NESTING IN 1987 west of the intake canal (U97GFC02FLUS and U87QUI01FLUS). Nesting in 1982-83 and 1985 along the gravel berm on the discharge canal; no nesting in 1984 and 1986-87 (U97GFC
CHELMYDA*0001	Chelonia mydas	Green Turtle	G3	S2	LE, LT	LE	1980	36.3 KM STRETCH OF ATLANTIC COASTAL BARRIER ISLAND BEACH.	NESTING BEACH. 1980: 14 NESTS IN 11 KM (1.3/KM); 1979: 15 NESTS (0.4/KM); 1978: 61 NESTS (1.7/KM); 1977: 5 NESTS (0.1/KM); 1976: 10 NESTS (0.3/KM); 1975:37 NESTS (1.0/KM); 1975-1979 DATA FOR FULL 36.3 KM. A76WOR01; OBSERVED 24 NESTS IN 1971 AND 26 IN 197
COASSTRA*0089	Coastal strand		G3	S2	N	N	1990-04-20	SEA GRAPE/SERENOA BAND BEHIND BARE SAND DUNE (NO SEA OATS).	COCCOLOBA UVIFERA (X), SERENOA REPENS, YUCCA ALOIFOLIA.
BEACDUNE*0091	Beach dune		G3	S2	N	N	1990-04-20	NARROW BEACH BACKED BY CASUARINA. NATIVE HAMMOCK PARALLELS DITCH N OF BLIND CREEK, DOMINATED BY CABBAGE PALMS.	PATCHES OF PLANTS IN FRONT OF CASUARINA STAND: COCCOLOBA UVIFERA (X), ALTERNANTHERA MARITIMA, SURIANA MARITIMA (X) - NOT RESPROUTING, HELIANTHUS DEBILIS, RANDIA ACULEATA.

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MARIHAMM*0140	Maritime hammock		G3	S2	N	N	1990-04-20	NARROW BEACH BACKED BY CASUARINA. NATIVE HAMMOCK PARALLELS DITCH N OF BLIND CREEK. DOMINATED BY CABBAGE PALMS.	CANOPY TREES: SABAL PALMETTO, COCCOLOBA UVIFERA, BURSERA SIMAROUBA, MASTICHODENDRON FOETIDISSIMUM, FICUS AUREA, CELTIS LAEVIGATA, PERSEA BORBONIA. UNDERSTORY TREES: COCCOLOBA DIVERSIFOLIA, ARDISIA ESCALLONIOIDES, EUGENIA FOETIDA, TOXICODENDRON RADICANS.
FALCPERE*0012	Falco peregrinus	Peregrine Falcon	G4	S2	N	LE	1987-11-06	SANDHILL RIDGE WITH WET PRAIRIE TO W. AND ESTUARY (INDIAN RIVER LAGOON) TO E.	MIGRATION/STOP-OVER AREA: 1987 - 56 FALCO PEREGRINUS COUNTED FROM BANDING STATION, 6 TRAPPED AND RELEASED (1 BANDED IN GREELAND); ASSUME FORAGING/ROOSTING AT ADJACENT SAVANNAHS STATE RESERVE AS WELL.
CARECARE*0002	Caretta caretta	Loggerhead	G3	S3	LT	LT	1980	36.3 KM STRETCH OF ATLANTIC COASTAL BARRIER ISLAND BEACH.	NESTING BEACH. 1980: 5.0 KM MONITORED BY FL DNR, 528 NESTS (105.6/KM): 1979: EST. 4676 NESTS (128.8/KM); 1977: EST. 3001 NESTS (82.7/KM); 1975: EST. 4808 NESTS (132.5/KM). A76WOR01 COUNTED 1412 NESTS IN 11.25 KM., AND EST. 6067 NESTS FOR WHOLE ISLAND IN
SETORUTI*0002	Setophaga ruticilla	American Redstart	G5	S2	N	N	1987-10-06	SANDHILL RIDGE WITH WET PRAIRIE TO W. AND ESTUARY (INDIAN RIVER LAGOON) TO E.	MIGRATION/STOP-OVER AREA: 1987 - 57 SETOPHAGA BANDED AND RELEASED DURING SPRING (APR.-MAY) AND FALL (AUG.-OCT.). ASSUME FORAGING/ROOSTING IN ADJACENT SAVANNAHS STATE RESERVE.
MARIHAMM*0143	Maritime hammock		G3	S2	N	N	1990-04-20	LARGE TREES OF REDBAY, OAK, FIG AND GUMBO LIMBO ON NARROW RIDGE PARALLEL TO SHORE. ACCESSIBLE VIA REGULAR SURVEY CUTS EXTENDING W FROM A1A. TWO SEPARATE PARCELS.	PERSEA BORBONIA (2' DIAM.), SABAL PALMETTO, QUERCUS VIRGINIANA, BURSERA SIMAROUBA (18" DIAM.), FICUS AUREA, EXOTHEA PANICULATA, MASTICHODENDRON FOETIDISSIMUM. UNDERSTORY: SERENOA REPENS, EUGENIA AXILLARIS (X).
ACCICOOP*0003	Accipiter cooperii	Cooper's Hawk	G5	S3	N	N	1987-	SANDHILL RIDGE WITH WET PRAIRIE TO W. AND ESTUARY (INDIAN RIVER LAGOON) TO E.	MIGRATION/STOP-OVER AREA: 1987 - 72 COUNTED FROM BANDING STATION, 7 WERE TRAPPED AND RELEASED IN SPRING(MAR.) AND FALL (OCT.-NOV.). ASSUME FORAGING/ROOSTINGIN ADJACENT SAVANNAHS STATE RESERVE.

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BEACDUNE*0027	Beach dune		G3	S2	N	N	ZZ	AREA MAY BE NARROWING FROM BECH EROSION: "EXCELLENT" CONDITION	BEACH DUNE ZONE BEGINS ABRUPTLY WITH FEW PIONEERS EXTENDING INTO BEACH AREA. UNIOLA DANICULATA, IVA IMBRICATA, PASPALUM VAGINATUM ABUNDANT; OKENIA HYPOGAEA PRESENT.
HELMVERM*0001	Helmitheros vermivorus	Worm-eating Warbler	G5	S1	N	N	1987-08-29	SANDHILL RIDGE WITH WET PRAIRIE TO W. AND ESTUARY (INDIAN RIVER LAGOON) TO E.	MIGRATION/STOP-OVER AREA: 1987 - 1 BANDED 29 AUG., 4 BANDED IN APR. ASSUME FORAGING/ROOSTING IN ADJACENT SAVANNAH RESERVE AS WELL.
RYNCNIGE*0022	Rynchops niger	Black Skimmer	G5	S3	N	LS	1987	NO DATA	8-10 PAIRS NESTING IN 1987.
MARIHAMM*0051	Maritime hammock		G3	S2	N	N	1990-04-20	OCCURS PATCHILY; CANOPY IS LOWER IN CENTRAL AREA WHERE IT MERGES WITH COASTAL STRAND COMMUNITY-1983. 20-30 FT. HAMMOCK WITH MIXTURE OF TEMPERATE/TROPICAL TREES IN CANOPY. SOME PEPPER ALONG A1A-1990.	CANOPY LAYER DOMINATED BY COCCOLOBA UVIFERA, BURSERA SIMAROUBA, AND SABAL PALMETTO. UNDERSTORY TREES INCLUDE ARDISIA ESCALLIONOIDES AND EUGENIA FOETIDA. OTHER SPP. INCLUDE CHIOCOCCA ALBA, FICUS AUREA, RIVINAHUMILIS, VITUS, QUERCUS VIRGINIANA, ZANTHOXYLUM
DERMCORI*0001	Dermochelys coriacea	Leatherback	G2	S2	LE	LE	1980	36.3 KM STRETCH OF ATLANTIC COASTAL BARRIER ISLAND BEACH.	NESTING BEACH. USED ANNUALLY. 1980: 4 NESTS IN 11.3 KM SURVEY (FL DNR); 1979: 7 NESTS; 1977: 2 NESTS; 1975: 1NEST. DATA FOR 1975,1977,1979 FROM APPLIED BIOLOGY. 36.3 KM SURVEYS. A76WOR01; OBSERVED 6 NESTS IN 1971, 2 IN 1973 OVER AN AREA OF 11.25 KM. SEE
STERANTI*0062	Sterna antillarum	Least Tern	G4	S3	N	LT	1987	Gravel berm along discharge canal at one site. No data on other site.	1987: SEVERAL DOZEN TERNS NESTING IN 1987 WEST OF THE INTAKE CANAL (U87QUI01FLUS and U97GFC02FLUS). Along the discharge canal's gravel berm, birds nested in 1983-83 and 1985; they did not nest in 1984, 1986-87 (U97GFC02FLUS).
MARIHAMM*0141	Maritime hammock		G3	S2	N	N	1990-04-20	TROPICAL HAMMOCK ON RIDGE SURROUNDED BY MANGROVES. SOME CASUARINA AND SCHINUS INVASION.	CANOPY TREES: FICUS AUREA, BURSERA SIMAROUBA (X), MASTICHODENDRON FOETIDISSIMUM (X), COCCOLOBA DIVERSIFOLIA (X), METOPIUM TOXIFERUM (X), EXOTHEA PANICULATA (X), SIMAROUBA GLAUCA. UNDERSTORY: ARDISIA ESCALLONIOIDES, EUGENIA FOETIDA, ZANTHOXYLUM FAGARA.

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MARIHAMM*0144	Maritime hammock		G3	S2	N	N	1990-04-20	TEMPERATE/TROPICAL CANOPY (OAK/CABBAGE PALM/STRANGLER FIG/ GUMBO LIMBO). TWO SEPARATE PARCELS.	CASUARINA EQUISETIFOLIA, SABAL PALMETTO, FICUS AUREA, BURSERA SIMAROUBA, ZANTHOXYLUM CLAVA-HERCULIS. UNDERSTORY: ARDISIA ESCALLONIOIDES, EUGENIA FOETIDA, ZANTHOXYLUM FAGARA.
DS*15964*0010	DATA SENSITIVE	DATA SENSITIVE	G1	S1	LE	LE	2002-11		
DS*15964*0011	DATA SENSITIVE	DATA SENSITIVE	G1	S1	LE	LE	2002-11		
DS*15964*0012	DATA SENSITIVE	DATA SENSITIVE	G1	S1	LE	LE	2002-11		

Florida Natural Areas Inventory
Potential Natural Areas (PNA) Data Layer

POTENTIAL NATURAL AREAS (PNA)

The Potential Natural Areas data layer indicates, throughout the State of Florida, lands that are in private ownership and are not managed or listed for conservation purposes that are possible examples of good quality natural communities. These areas were determined from FNAI's scientific staff vegetative interpretation of 1988-1993 FDOT aerial photographs and from input received during Regional Ecological Workshops held for each regional planning council. These workshops were attended by experts familiar with natural areas in the region. Element occurrences in the FNAI database may or may not be present on these sites. In order to be classified as a Potential Natural Area (with the exception of internal rank PNA-5) the natural communities identified through aerial photographs must meet the following criteria:

1. Must be a minimum of 500 acres. *Exceptions*: sandhill, min. 320 acres; scrub, min. 80 acres; pine rockland, min. 20 acres; dry prairie, min. 320 acres; *or* any example of coastal rock barren, upland glade, coastal dune lake, spring-run stream or terrestrial cave.
2. Must contain at least one of the following:
   a. One or more high quality examples of FNAI state ranked S3 or above natural communities.
   b. An outstanding example of any FNAI tracked natural community.

Potential Natural Areas have been assigned ranks of PNA-1 through PNA-4 mostly based on size and perceived quality and type of natural community present. The areas included in internal rank PNA-5 (former ACI Category C) are exceptions to the above criteria. These areas were identified through the same process of aerial photographic interpretation and regional workshops as the PNA 1 through 4 ranked sites, but do not meet the standard criteria. These PNA 5 areas are considered lower priority for conservation than areas ranked PNA 1- 4, but nonetheless are believed to be ecologically viable tracts of land representative of Florida's natural ecosystems.

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Florida Resources and Environmental Analysis Center
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Tracking Florida's Biodiversity

FLORIDA NATURAL AREAS INVENTORY

Florida Scrub-Jay Survey and Breeding Bird Atlas Data Layers

In addition to our element occurrence database of rare species and natural community locations, the Inventory has additional data layers that have been provided by state and federal agencies.

Florida Scrub-Jay Survey - U.S. Fish and Wildlife Service

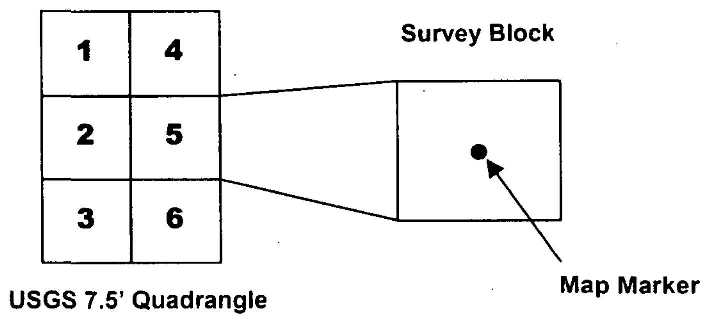
This survey was conducted by staff and associates of the Archbold Biological Station from 1992 to 1996. An attempt was made to record all scrub-jay (*Aphelocoma coerulescens*) groups, although most federal lands were not officially surveyed.

Each map point represents one or more groups.

Florida Breeding Bird Atlas Project - Florida Game and Fresh Water Fish Commission (now Florida Fish and Wildlife Conservation Commission)

This study was conducted from 1986 to 1991, (final report, *An Atlas of Florida's Breeding Birds* by Kale, Pranty, Stith, and Biggs, Nongame Wildlife Program, Florida Game and Fresh Water Fish Commission). The study divided the state into "blocks", with each block representing one-sixth of a U.S. Geological Survey 7.5 minute topographic quadrangle map. Several categories of breeding activity were recorded by observers.

Each map point is located at the center of a block, and represents species listed as Possible or Probable Breeders within the surrounding block (approximately 10 square miles in area).



Species identified by Marker may occur anywhere within block.

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GLOBAL AND STATE RANKS

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Florida Natural Areas Inventory (FNAI) defines an **element** as any rare or exemplary component of the natural environment, such as a species, natural community, bird rookery, spring, sinkhole, cave, or other ecological feature. FNAI assigns two ranks to each element found in Florida: the **global rank**, which is based on an element's worldwide status, and the **state rank**, which is based on the status of the element within Florida. Element ranks are based on many factors, including estimated number of occurrences, estimated abundance (for species and populations) or area (for natural communities), estimated number of adequately protected occurrences, range, threats, and ecological fragility.

GLOBAL RANK DEFINITIONS

G1	Critically imperiled globally because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or human factor.
G2	Imperiled globally because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or human factor.
G3	Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals), or found locally in a restricted range, or vulnerable to extinction from other factors.
G4	Apparently secure globally (may be rare in parts of range).
G5	Demonstrably secure globally.
GH	Occurred historically throughout its range, but has not been observed for many years.
GX	Believed to be extinct throughout range.
GXC	Extirpated from the wild but still known from captivity or cultivation.
G#?	Rank uncertain (e.g., G2?).
G#G#	Range of rank; insufficient data to assign specific global rank (e.g., G2G3)
G#T#	Rank of a taxonomic subgroup such as a subspecies or variety; the G portion of the rank refers to the entire species, and the T portion refers to the subgroup; T# has same definition as G#.
G#Q	Ranked as species but there is some question as to whether it is a valid species.
G#T#Q	Same as above, but validity as subspecies or variety is questioned.
GU	Global rank unknown; due to lack of information, no rank or range can be assigned.
G?	Temporarily not ranked.

STATE RANK DEFINITIONS

State ranks (S#) follow the same system and have the same definitions as global ranks, except they apply only to Florida, with the following additions:

SA	Accidental in Florida and not part of the established biota.
SE	Exotic species established in Florida (may be native elsewhere in North America).
SX	Believed to be extirpated from state.

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FEDERAL AND STATE LEGAL STATUSES

Provided by FNAI for information only.
For official definitions and lists of protected species, consult the relevant state or federal agency.

FEDERAL LEGAL STATUS

Definitions derived from U.S. Endangered Species Act of 1973, Sec. 3. Note that the federal status given by FNAI refers only to Florida populations and that federal status may differ elsewhere.

LE	Endangered: species in danger of extinction throughout all or a significant portion of its range.
LT	Threatened: species likely to become Endangered within the foreseeable future throughout all or a significant portion of its range.
E(S/A)	Endangered due to similarity of appearance to a species which is federally listed such that enforcement personnel have difficulty in attempting to differentiate between the listed and unlisted species.
T(S/A)	Threatened due to similarity of appearance (see above).
PE	Proposed for listing as Endangered species..
PT	Proposed for listing as Threatened species.
C	Candidate species for which federal listing agencies have sufficient information on biological vulnerability and threats to support proposing to list the species as Endangered or Threatened.
XN	Non-essential experimental population.
MC	Not currently listed, but of management concern to USFWS.
N	Not currently listed, nor currently being considered for listing as Endangered or Threatened.

FLORIDA LEGAL STATUSES

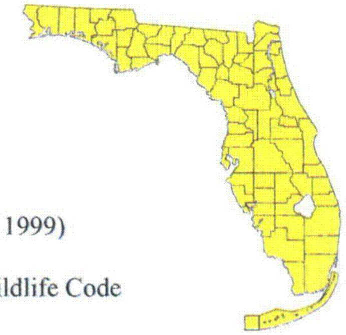
Animals: Definitions derived from "Florida's Endangered Species and Species of Special Concern, Official Lists" published by Florida Fish and Wildlife Conservation Commission, 1 August 1997, and subsequent updates.

LE	Endangered: species, subspecies, or isolated population so few or depleted in number or so restricted in range that it is in imminent danger of extinction.
LT	Threatened: species, subspecies, or isolated population facing a very high risk of extinction in the future.
LS	Species of Special Concern is a species, subspecies, or isolated population which is facing a moderate risk of extinction in the future.
PE	Proposed for listing as Endangered.
PT	Proposed for listing as Threatened.
PS	Proposed for listing as Species of Special Concern.
N	Not currently listed, nor currently being considered for listing.

Plants: Definitions derived from Sections 581.011 and 581.185(2), Florida Statutes, and the Preservation of Native Flora of Florida Act, 5B-40.001. FNAI does not track all state-regulated plant species; for a complete list of state-regulated plant species, call Florida Division of Plant Industry, 352-372-3505.

LE	Endangered: species of plants native to Florida that are in imminent danger of extinction within the state, the survival of which is unlikely if the causes of a decline in the number of plants continue; includes all species determined to be endangered or threatened pursuant to the U.S. Endangered Species Act.
LT	Threatened: species native to the state that are in rapid decline in the number of plants within the state, but which have not so decreased in number as to cause them to be Endangered.
PE	Proposed for listing as Endangered.
PT	Proposed for listing as Threatened.
N	Not currently listed, nor currently being considered for listing.

BALD EAGLE
Haliaeetus leucocephalus



Order: Falconiformes
Family: Accipitridae
FNAI Ranks: G4/S3
U.S. Status: Threatened
(proposed for delisting in 1999)
FL Status: Threatened
U.S. Migratory Bird Treaty Act and state Wildlife Code prohibit take of birds, nests, or eggs.

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immature
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Description: Adult has white head, white tail,and large, bright yellow bill; other plumage is dark. Immatures dark with variable amounts of light splotching on body, wings, and tail; head and bill are dark. In flight wings are broad and wide and held horizontally, presenting a flat profile when soaring and gliding. Flies with slow, powerful wing-beats.

Similar Species: At a distance, in flight, eagle's size and lack of white in wings should help differentiate it from the crested caracara (*Caracara cheriway*; see species account), which also has a white head. Flattened aspect of the eagle's wings is unlike the teetering, V-shaped flight of the turkey vulture (*Cathartes aura*).

Habitat: Most commonly includes areas close to coastal areas, bays, rivers, lakes, or other bodies of water that provide concentrations of food sources, including fish, waterfowl, and wading birds. Usually nests in tall trees (mostly live pines) that provide clear views of surrounding area. In Florida Bay, where there are few predators and few tall emergent trees, eagles nest in crowns of mangroves and even on the ground.

BALD EAGLE *Haliaeetus leucocephalus*

Seasonal Occurrence: In extreme southern Florida, most adults are resident, but most birds in northern and central Florida migrate north out of state after breeding season (late May - July). Juveniles and younger birds mostly migrate north in summer and may range as far as Canada. Also, in winter, some birds from northern populations migrate to northern Florida.

Florida Distribution: Florida has largest breeding population of any state outside Alaska. Breeds throughout most of peninsular Florida and Keys, mainly along coast in eastern panhandle, and is rare in western panhandle. Greatest concentrations of nesting eagles occur around Lake Kissimmee in Polk and Osceola counties, around Lake George in Putnam, Volusia, and Lake counties, lakes Jessup, Monroe, and Harney in Seminole and Volusia counties, along Gulf coast north of Tampa, and Florida Bay and southwest peninsula area.

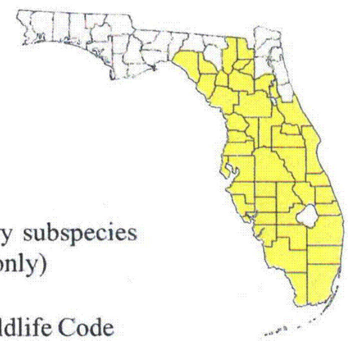
Range-wide Distribution: North America. Breeding range extends from Alaska, across Canada, south to Baja California, the Gulf coast and Florida Keys, although very local in the Great Basin and prairie and plains regions in interior U.S., where range has expanded to include Nebraska and Kansas. Non-breeding range is generally throughout breeding range except in far north, most commonly from southern Alaska and southern Canada southward.

Conservation Status: Original population in Florida could be found throughout state and likely numbered well over 1,000 pairs. Population declined sharply after late 1940s, reaching a low of 120 active nests in 1973, and by 1978 was considered rare as a breeder. Use of pesticide DDT and related compounds and development of coastal habitat are probably chief causes of decline. Numbers have steadily increased, especially since 1989. In 1993, 667 active territories were reported, and in 1999, 996 active nests were recorded. Major threats include habitat loss because of development and commercial timber harvest; pollutants and decreasing food supply are also of concern.

Protection and Management: Monitored annually by Fish and Wildlife Conservation Commission (FFWCC). Continue acquisition of breeding territories and protection of foraging and roosting sites. Incorporate information known about buffer zones around nesting areas into state and local development regulations to help mitigate losses as Florida's human population continues to expand. Monitor pesticides and other environmental contaminants that affect reproduction and food supply.

Selected References: FFWCC 2001, Kale (ed.) 1978, Poole and Gill (eds.) 2000, Robertson and Woolfenden 1992, Rodgers et. al. (eds.) 1996, Stevenson and Anderson 1994.

FLORIDA SANDHILL CRANE
Grus canadensis pratensis



Order: Gruiformes
Family: Gruidae
FNAI Ranks: G5T2T3/S2S3
U.S. Status: Endangered (nonmigratory subspecies in Cuba and Mississippi only)
FL Status: Threatened
U.S. Migratory Bird Treaty Act and state Wildlife Code prohibit take of birds, nests, or eggs.

Description: A tall, long-necked, long-legged bird with a clump of feathers that droops over the rump. Adult is gray overall, with a whitish chin, cheek, and upper throat, and dull red skin on the crown and lores (lacking in immatures); feathers may have brownish-red staining resulting from preening with muddy bill. Immature has pale to tawny feathers on head and neck and a gray body with brownish-red mottling. Flies with neck extended. Their distinctive rolling call can be heard from far away.

Similar Species: Indistinguishable from greater sandhill crane (*Grus canadensis tabida*), which winters in Florida. Greater sandhill crane generally arrives in Florida in October and leaves in March, so the date observed or definite evidence of reproduction may be used to differentiate the two. Great blue heron (*Ardea herodias*) is sometimes mistakenly identified as a crane. This heron lacks the bald, red crown of the sandhill and flies with its neck tucked in, typical of herons and egrets. Whooping crane (*G. americana*) is white.

Habitat: Prairies, freshwater marshes, and pasture lands. Avoids forests and deep marshes but uses transition zones and edges between these and prairies or pasture lands. Will frequent agricultural areas like feed lots and crop fields, and also golf courses and other open lawns, especially in winter and early spring. Nest is a mound of herbaceous plant material in shallow water or on the ground in marshy areas. Favors wetlands dominated by pickerelweed and maidencane.

Seasonal Occurrence: Nonmigratory. Very sedentary, although may forage widely. Large influx of northern migratory subspecies in winter (October - March).

Florida Distribution: Most of peninsular Florida within appropriate habitat, though not as common south of Lake Okeechobee. Rarely reported west of Taylor County.

Range-wide Distribution: Florida range plus extreme southeastern Georgia (Okefenokee Swamp).

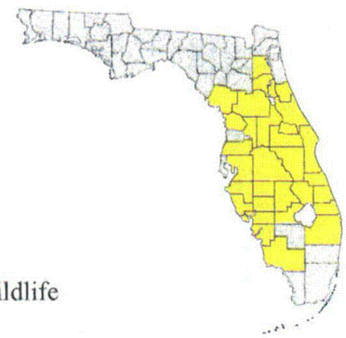
Conservation Status: Population estimate in 1975 of approximately 4,000 birds (25 percent are nonbreeding subadults) is still considered accurate. Habitat availability will become more and more of concern as Florida continues to lose open rangeland and native prairie to development and more intensive agricultural uses (e.g., citrus, row crops). Nesting success in human-altered areas is well below that of native areas. Shallow wetlands used by cranes are easily affected by drainage of adjacent uplands even if they are not directly disturbed. Florida sandhill cranes are found on federal and state lands and on local government lands (e.g., wellfields).

Protection and Management: Because of large home-range requirements, public lands do not protect large populations of cranes. Aquire land, through fee-simple acquisition and conservation easements on suitable ranchlands, in areas that bolster existing protected populations. Periodic fire important to retard invasion of woody vegetation in crane habitat. Filling drainage ditches to restore natural hydrological conditions important in some areas.

Selected References: Poole and Gill (eds.) 1992, Robertson and Woolfenden 1992, Rodgers et al. (eds.) 1996, Stevenson and Anderson 1994, Toland 1999a.

FLORIDA SCRUB-JAY

Aphelocoma coerulescens



Order: Passeriformes
Family: Corvidae
FNAI Ranks: G3/S3
U.S. Status: Threatened
FL Status: Threatened
U.S. Migratory Bird Treaty Act and state Wildlife Code prohibit take of birds, nests, or eggs.

© Tom Vezo

Description: Similar in size and shape to the familiar blue jay (*Cyanocitta cristata*). Crestless head, nape, wings, and tail are pale blue, and the back and belly pale gray. Juveniles have fluffy brown heads.

Similar Species: The scrub-jay lacks the crest and white spotting on wings and tail that are characteristic of the blue jay.

Habitat: Inhabits fire-dominated, low-growing, oak scrub habitat found on well-drained sandy soils. May persist in areas with sparser oaks or scrub areas that are overgrown, but at much lower densities and with reduced survivorship.

Seasonal Occurrence: Extremely sedentary.

Florida Distribution: Restricted to peninsular Florida, with largest populations occurring in Brevard, Highlands, Polk, and Marion counties.

FLORIDA SCRUB-JAY *Aphelocoma coerulescens*

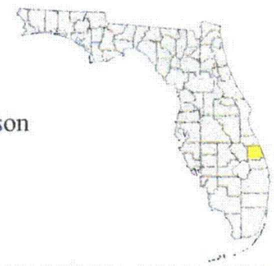
Range-wide Distribution: Same as Florida distribution.

Conservation Status: Recognized in 1995 as a distinct species from the scrub-jays in the western U.S., making it the only bird species whose entire range is restricted to Florida. Continuing loss, fragmentation, and degradation of scrub habitat has resulted in a decline of greater than 90 percent of the original pre-settlement population of Florida scrub-jays. Precipitous decline since the 1980s. A 1992 range-wide estimate gives an overall population of approximately 10,000 birds. Largest populations are found on federal lands (Merritt Island National Wildlife Refuge and Ocala National Forest), but are declining. Land management practices on these lands are of concern. Smaller populations are found scattered along Lake Wales Ridge in Polk and Highlands counties, with a major protected population at Archbold Biological Station. Cars and cats take toll on scrub-jays in developed areas. Scrub-jays are susceptible to population crashes because of catastrophic fires or disease, so protection of additional secure populations is essential.

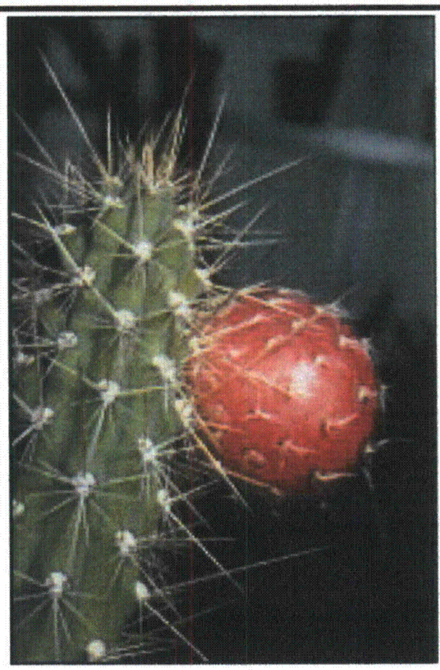
Protection and Management: Acquire suitable xeric habitat in strategic locations among existing scrub-jay preserves to help mitigate the extensive fragmentation of this habitat. Continued existence of this species will depend on preservation and long-term management of suitable scrub habitat. Prescribed fire every 8 - 15 years that burns patchily, where few territories are burned completely, is optimal. Mechanical treatments, at least initially, may be required where fire cannot be used, although the long-term effects of this management practice are unknown.

Selected References: Fitzpatrick et al. 1991, Poole and Gill (eds.) 1996, Robertson and Woolfenden 1992, Rodgers et al. (eds.) 1996, Stevenson and Anderson 1994, Thaxton and Hingtgen 1996.

FRAGRANT PRICKLY APPLE



Harrisia fragrans Small ex Britton & Rose
Synonym: *Cereus eriophorus* Pfeiff. & Otto var. *fragrans* (Small ex Britton & Rose) L.D. Benson
Family: Cactaceae (cactus)
FNAI Ranks: G1/S1
Legal Status: US–Endangered FL–Endangered
Wetland Status: US–UPL FL–UPL



Billy B. Boothe

Field Description: Erect tree cactus, with slender, cylindrical, spiny **stems** 3 - 16 feet tall, with 10 or more ridges, sometimes branched or leaning. **Spines** gray with yellow tips, 9 - 13 per cluster, 1 - 1.5 inches long, one spine longer than the others. **Flowers** showy, solitary, 5 - 8 inches long, with a long, scaly floral tube; **petals** numerous, long and narrow, fragrant, white when flowers open at night and turning pink the next morning; inner petals without teeth at the tip. **Fruits** usually one per plant, red, round, 2 inches across, with wooly spines.

Related Rare Species: Simpson's prickly apple (*Harrisia simpsonii*), found on FL's east coast in mangroves and in coastal thickets and strands, is quite similar to fragrant prickly apple but lacks the single, conspicuous, long spine; spines 7 - 14 per cluster, yellow with dark tips, 0.5 - 1 inch long; inner petals toothed at apex; fruits red. Aboriginal prickly apple (*Harrisia aboriginum*) occurs on FL's SW coast on shell mounds; spines 7 - 9 per cluster, less than 0.5 inch long, inner petals toothed; fruits yellow.

Fragrant prickly apple *Harrisia fragrans*

Habitat: Scrubby flatwoods and xeric hammocks on the Atlantic Coastal Ridge, with sand live oak, myrtle oak, cabbage palm, and prickly pear.

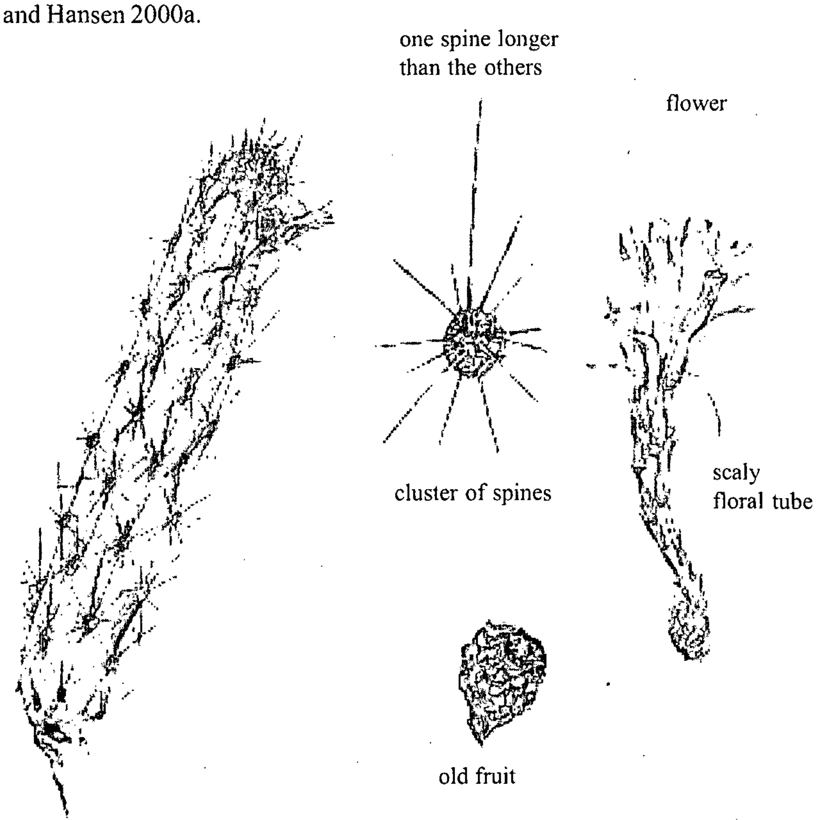
Best Survey Season: Flowers April–May and September–October; fruits July–October.

Range-wide Distribution: Endemic to FL; this species now occurs only in St. Lucie County. Historically it was reported from as far north as Brevard County and also in Monroe County Keys and mainland.

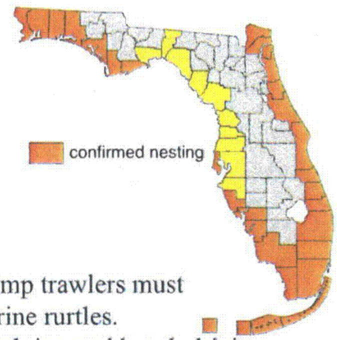
Conservation Status: Fragrant prickly apple occurs in 1 preserve.

Protection & Management: Preserve upland coastal habitats; monitor known populations; protect plants from off-road-vehicles and plant poachers with fences; remove exotic species; avoid use of herbicides in right-of-way maintenance; effect of fire is unknown.

References: Austin 1984a, Benson 1982, Coile 2000, IRC 1999, Rae 1995, Small 1920, Small 1935, USFWS 1998, Ward 1979, Wunderlin 1998, Wunderlin and Hansen 2000a.

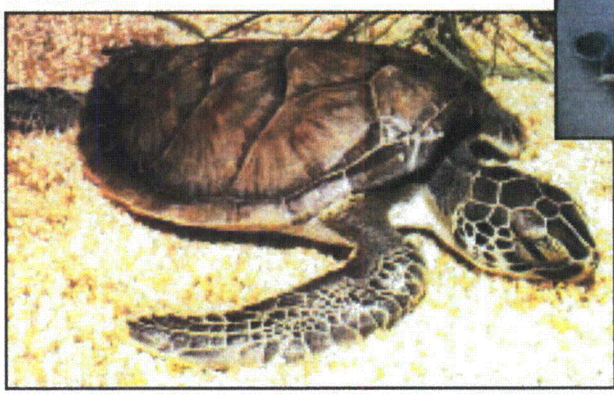


GREEN TURTLE
Chelonia mydas



Order: Testudines
Family: Cheloniidae
FNAI Ranks: G3/S2
U.S. Status: Endangered
FL Status: Endangered
Status applies to eggs as well as turtles. Shrimp trawlers must be fitted with excluder devices to release marine rurtles. Some local ordinances regulate beachfront lighting and beach driving.

© Robert S. Simmons



hatchling
© Blair Witherington

Description: A large sea turtle that is dark above, light below, and which bears only a single pair of elongate scales (prefrontals) between eyes; front limbs modified as flippers. Upper shell (carapace) of adult: olive with dark spots; juvenile: brown to olive with radiating lines. Carapace without central keel except in young, and with only four large, non-overlapping scales (costal scutes) on each side, the first one not in contact with nuchal scute (small scale over neck). Lower shell (plastron) cream to yellow. Adults reach 35 - 48 in. (88 - 122 cm) shell length and 220 - 450 lbs. (104 - 204 kg). Hatchlings 1.6 - 2.4 in. (41 - 61 mm) shell length, black to dark gray above, white ventrally and along rear margins of flippers, with a low keel on back and two keels on plastron.

Similar Species: Hawksbill (*Eretmochelys imbricata*; see species account) is smaller as adult, has mid-dorsal keel throughout life, and pointed beak and overlapping carapacial scales except in old turtles. Loggerhead and Kemp's ridley (*Caretta caretta* and *Lepidochelys kempii*; see species accounts) have five or more costal scutes, the first touching the nuchal. Loggerhead is distinctively reddish-brown; much smaller Kemp's ridley has nearly circular, grayish to olive-green shell. All three have two pairs of prefrontal scales between eyes. Hawksbill and loggerhead hatchlings are darker below and have pronounced keels on back.

Habitat: Estuarine and marine coastal and oceanic waters; nests on coastal sand beaches, often near dune line, sufficiently high to avoid tidal inundation. Large juveniles and adults feed on seagrasses and algae. Hatchlings use offshore floating sargassum mats; juveniles frequent coastal bays, inlets, lagoons, and offshore worm reefs.

Seasonal Occurrence: Present in Florida waters year-round, but more commonly observed during warmer months. Nests late May - September; hatchlings emerge and head toward sea August - November.

Florida Distribution: Coastal waters statewide. Nests mostly along Atlantic coast, especially from Volusia to Miami-Dade County, with a few nests in Keys and on southwestern and western panhandle coasts. Areas known to be especially important to young green turtles include Gulf coast of Citrus and Levy counties, Indian River Lagoon, shallow hard bottom along southeastern coast, and Florida Bay.

Range-wide Distribution: Tropical and subtropical marine waters worldwide. In the eastern U.S., largely restricted to Florida, although may wander as far north as Massachusetts.

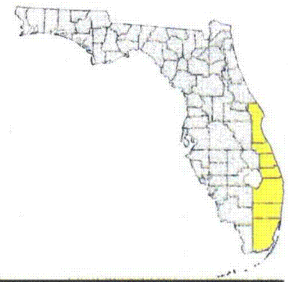
Conservation Status: Some nesting beaches are on military, state, federal, and private conservation lands on both Atlantic and Gulf coasts. State-designated aquatic preserves partially protect some feeding and developmental habitat.

Protection and Management: Protect beaches and adjacent uplands statewide from development and coastal armoring. Protect estuaries and coastal waters from pollution, dumping of entangling debris, dredging, over-use by boats and ships, and other disturbance. Focus extreme attention on Brevard and Indian River counties. While Turtle Excluder Devices (TEDs) have reduced mortality in shrimp nets, greater regulation of long-line and gill-net fisheries is needed to prevent hooking mortality and incidental drowning. Enact or strengthen beach lighting ordinances in all counties that support nesting to reduce deaths of newly emerged hatchlings that become distracted by artificial lights.

Selected References: Ashton and Ashton 1991, Bartlett and Bartlett 1999, Conant and Collins 1991, Ernst et al. 1994, Hirth 1971, Moler (ed.) 1992.

JOHNSON'S SEAGRASS

Halophila johnsonii Eiseman
Synonyms: none
Family: Hydrocharitaceae (frog's-bit)
FNAI Ranks: G2/S2
Legal Status: US–Threatened FL–none
Wetland Status: US–OBL FL–none



Gary Knight

Field Description: Submerged **sea grass** with long, delicate stems embedded in coastal sediments; a pair of leaves and a single root are borne on the stem at 0.5 - 2 inch intervals. **Leaves** 0.8 - 2 inches long (including leaf stalk), linear, hairless, with brown midrib and veins, and entire margins; two small scale leaves occur at the base of each leaf stalk. Vase-shaped **female flowers and fruits** at nodes, with 3 long, curving styles; male flowers have never been observed.

Similar Species: Caribbean seagrass or paddle-grass (*Halophila decipiens*) has oval or oblong leaves with toothed margins and microscopic prickle hairs on one or both leaf surfaces. Engelmann's seagrass (*Halophila engelmannii*) has 4 - 8 leaves at the ends of branches, with leaves up to 4 inches long.

Related Rare Species: None in FL.

Johnson's seagrass *Halophila johnsonii*

Habitat: Tidal deltas inside inlets, sandy shoals, and mouths of canals; at water depths from shallow intertidal to 9 feet deep.

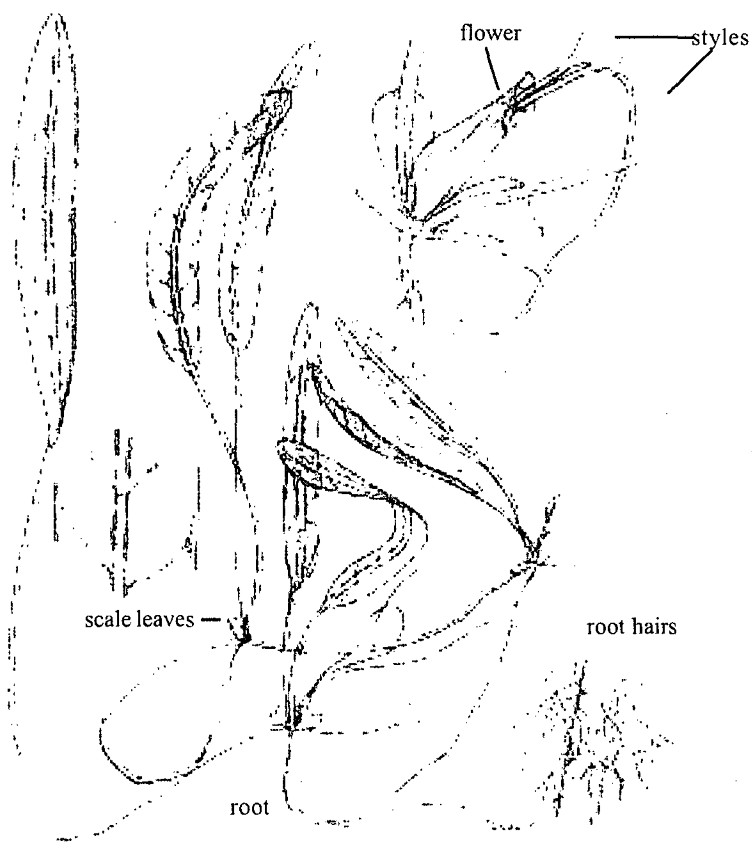
Best Survey Season: All year.

Range-wide Distribution: Endemic to 120 miles of SE FL coastline from Sebastian Inlet in Brevard County to north Biscayne Bay in Dade County.

Conservation Status: Although federal and state laws aim to protect seagrass beds, there is continuing serious loss of these habitats. Because of small size and lack of sexual reproduction, Johnson's seagrass is especially vulnerable to disturbance. Only two populations occur on managed areas.

Protection & Management: Protect coastal waters and sediments from pollution, dredging, siltation, propellor disturbance, and shading by docks and jetties.

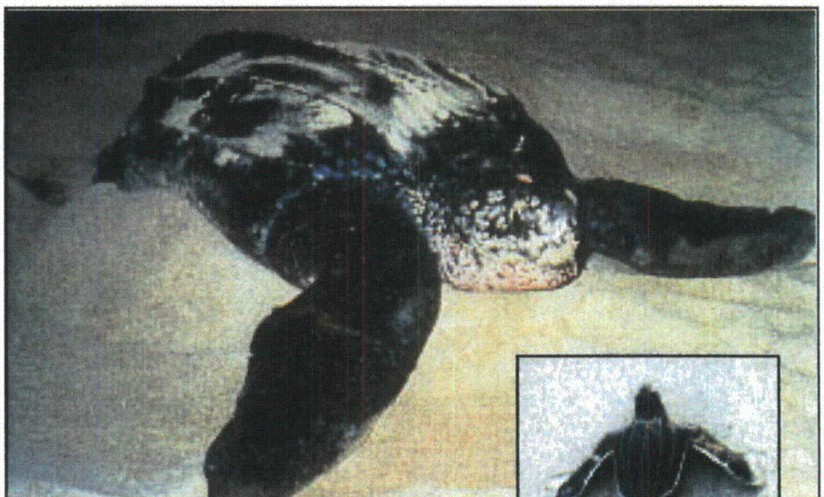
References: Bolen 1997, Durako and Wettstein 1994, Eiseman and McMillan 1980, Federal Register 2000, IRC 1999, NMFS 2000, Virnstein et al. 1997, Wunderlin 1998, Wunderlin and Hansen 2000a.



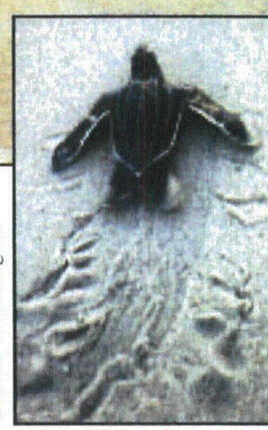
Florida Natural Areas Inventory, 2000

LEATHERBACK
Dermochelys coriacea

Order: Testudines
Family: Dermochelyidae
FNAI Ranks: G3/S2
U.S. Status: Endangered
FL Status: Endangered
Status applies to eggs as well as turtles. Shrimp trawlers must be fitted with excluder devices to release marine turtles. Some local ordinances regulate beachfront lighting and beach driving.



© courtesy of Caribbean Conservation Corporation



hatchling
© Blair Witherington

Description: A huge sea turtle with a dark gray to black body covered by leathery skin and bearing seven prominent longitudinal ridges; five similar ridges occur on the mostly white lowe shell (plastron). Front limbs modified as flippers. Adults typically reach 53 - 70 in. (135 - 178 cm) shell length and 650 - 1300 lbs. (295 - 590 kg). Young are black dorsally with white ridges and are covered by small beady scales; hatchlings measure 2.4 - 3 in. (61 - 76 mm).

LEATHERBACK *Dermochelys coriacea*

Similar Species: None. The shells of all other sea turtles are covered with a series of hard plates (scutes).

Habitat: Oceanic waters; nests on coastal sand beaches. Leatherbacks are rarely seen in coastal waters except as hatchlings dispersing from nesting beaches and as adult females approaching the beach to nest.

Seasonal Occurrence: Present in Florida waters year-round, though concentrations of adults are known to occur from Nassau through Brevard counties from fall through early spring. Nests from early spring through early summer, with hatchlings emerging and heading toward sea in late spring and summer.

Florida Distribution: Entire coast of Florida, with nesting known from every Atlantic coastal county and in panhandle. Approximately half of Florida nests are in Palm Beach County.

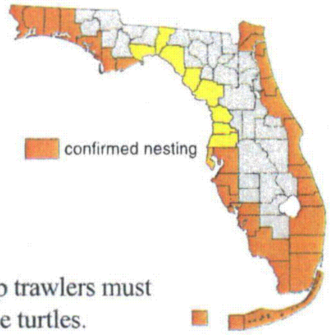
Range-wide Distribution: Tropical and temperate marine waters worldwide, but venturing farther into cooler waters than other sea turtles. Nesting in U.S. confined principally to Florida and St. Croix, Virgin Islands, with a few nests in southern Georgia.

Conservation Status: Believed to be in severe decline worldwide. Some Florida nesting beaches are on state, federal (including military), and private conservation lands on both coasts.

Protection and Management: Protect beaches and adjacent uplands statewide from development and coastal armoring. Protect coastal and oceanic waters from pollution, dumping of plastic debris which leatherbacks mistake for their jellyfish prey, dredging, overuse by boats and ships, and other disturbance. While Turtle Excluder Devices (TEDs) have reduced general sea turtle mortality in shrimp nets, their openings must be enlarged to allow leatherbacks to escape as well. Enact or strengthen beach lighting ordinances in all counties that support nesting to reduce deaths of newly emerged hatchlings that become distracted by artificial lights.

Selected References: Ashton and Ashton 1991, Bartlett and Bartlett 1999, Conant and Collins 1991, Ernst et al. 1994, Moler (ed.) 1992, Spotila et al. 1996.

LOGGERHEAD
Caretta caretta



Order: Testudines
Family: Cheloniidae
FNAI Ranks: G3/S3
U.S. Status: Threatened
FL Status: Threatened
Status applies to eggs as well as turtles. Shrimp trawlers must be fitted with excluder devices to release marine turtles. Some local ordinances regulate beachfront lighting and beach driving.

© courtesy of Caribbean Conservation Corporation

hatchling © Blair Witherington

Description: A large sea turtle with a reddish brown carapace (upper shell) and large, blunt head with yellow cheeks; front limbs reddish brown and modified as flippers. Carapace with five or more large scales (costal scutes) on each side, the first one touching the nuchal scute (small scale over neck). Lower shell (plastron) yellow and usually without a single small scale at its posterior tip. Bridge usually with three large scales, occasionally four, and these lack pores. Two pairs of scales (prefrontals) between eyes. Adults 28 - 49 in. (70 - 125 cm) carapace length, 170 - 350 lbs. (77 - 159 kg). Hatchlings 1.6- 1.9 in. (41 - 48 mm) shell length, with three lengthwise ridges (keels) on upper shell, and two on lower; brown, tan, or light to dark gray above and often lighter below.

Similar Species: The reddish brown coloration is distinctive among sea turtles. Hawksbill and green turtles (*Eretmochelys imbricata* and *Chelonia mydas*; see species accounts) lack contact between first costal and nuchal scutes . Adult Kemp's ridley (*Lepidochelys kempii*; see species account) is smaller, has a gray to olive-green, nearly circular shell with four large scales (each with a posterior pore) on the bridge, usually a single small scale at rear edge of plastron, and a cusped, parrot-like beak.

Habitat: Marine coastal and oceanic waters; nest on coastal sand beaches, often near the dune line, sufficiently high to avoid tidal inundation. Hatchlings use offshore floating sargassum mats; juveniles frequent coastal bays, inlets, and lagoons.

Seasonal Occurrence: Present in Florida waters year-round, but more commonly observed during warmer months when turtles are more active. Nesting occurs late April - early September; hatchlings emerge from nests and head toward the sea July - November.

Florida Distribution: Coastal waters statewide. Nesting occurs along the entire Atlantic coast, in the Keys, and along the Gulf coast from Pinellas County south and Franklin County west, with the greatest numbers from Brevard to Broward counties.

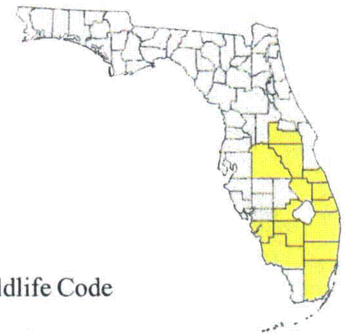
Range-wide Distribution: Temperate and subtropical marine waters worldwide. Nesting in the eastern U.S. is principally confined to Florida, Georgia, and South Carolina, with smaller numbers from North Carolina to Virginia.

Conservation Status: Some nesting beaches are on military lands and state, federal, and private conservation lands on both Atlantic and Gulf coasts. State-designated aquatic preserves partially protect some feeding and developmental habitat.

Protection and Management: Protect beaches and adjacent uplands statewide from development and coastal armoring. Protect estuaries and coastal waters from pollution, dumping of entangling debris, dredging, over-use by boats and ships, and other disturbance. Focus extreme attention on Brevard and Indian River counties. While Turtle Excluder Devices (TEDs) have reduced mortality in shrimp nets, greater regulation of long-line and gill-net fisheries is needed to prevent hooking mortality and incidental drowning. Enact or strengthen beach lighting ordinances in all counties that support nesting to reduce deaths of newly emerged hatchlings that become distracted by artificial lights.

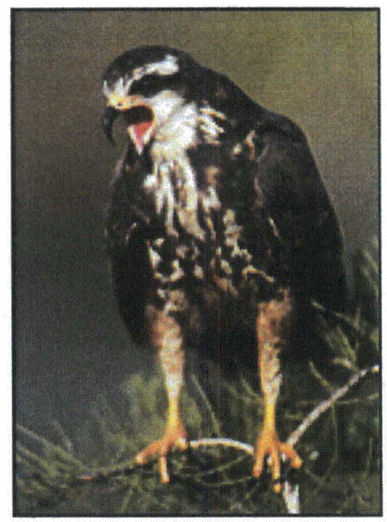
Selected References: Ashton and Ashton 1991, Bartlett and Bartlett 1999, Conant and Collins 1991, Dodd 1988, Ernst et al. 1994, Moler (ed.) 1992.

SNAIL KITE
Rostrhamus sociabilis plumbeus



Order: Falconiformes
Family: Accipitridae
FNAI Ranks: G4G5T2/S2
U.S. Status: Endangered
FL Status: Endangered
U.S. Migratory Bird Treaty Act and state Wildlife Code prohibit take of birds, nests, or eggs.

male © Robert Bennetts



female © Robert Bennetts

Description: Medium-sized raptor. Adult male is dark slate gray to black; tail is white with a broad, dark band and pale terminal band; long, hooked bill. Breeding birds have orange-red legs and reddish eyes and facial skin. Adult females are brown with streaking on head, throat, and underparts; soft part colors like males. Juveniles and subadults similar to adult females.

Similar Species: Northern harrier (*Circus cyaneus*) has white on rump and not on tail and has a gliding flight, tilting side to side, unlike the floppy flight of the snail kite.

Habitat: Large open freshwater marshes and lakes with shallow water, < 4 ft. (1.2 m) deep, and a low density of emergent vegetation are preferred foraging habitat. Dependent upon apple snails (*Pomacea paludosa*) caught at water surface. Nests usually over water in a low tree or shrub (commonly willow, wax myrtle, pond apple, or buttonbush, but also in non-woody vegetation like cattail or sawgrass).

Seasonal Occurrence: Nonmigratory. Nomadic dispersal in response to habitat changes (e.g., water level, food availability, hydroperiod).

Florida Distribution: Formerly in freshwater marshes throughout peninsular Florida. Now, depending on water conditions and food availability, restricted to St. Johns River headwaters, Kissimmee Valley, Lake Okeechobee, Loxahatchee National Wildlife Refuge, and Holey Land Wildlife Management Area; Water Conservation Areas 2A, 2B, 3A, 3B in Palm Beach, Broward and Dade counties; and parts of Everglades National Park and Big Cypress National Preserve. Also smaller wetlands in above counties plus St. Lucie, Martin, Hendry, and Lee counties. May disperse widely in drought years.

Range-wide Distribution: Subspecies *plumbeus* is restricted to Florida, Cuba, Isle of Pines, and northwest Honduras. Other subspecies occur in the neotropics.

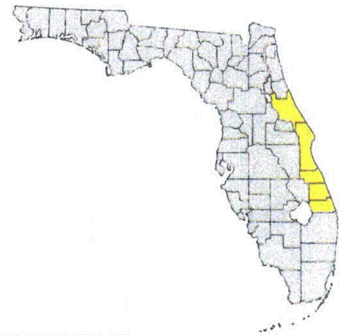
Conservation Status: Much of range lies within conservation areas, although these lands are not necessarily managed for kites. Greatly affected by water management, especially in south Florida. Population fluctuates considerably, declining in drought years. Wetland drainage and conversion and introduction of exotic plants (which prevent foraging success) are major threats. Agricultural runoff has caused pollution, eutrophication, and snail die-offs. Concomitant increase in plant growth has led to continued use of herbicides, which contributes to nest collapse in non-woody nesting substrates.

Protection and Management: Continue mid-winter surveys to monitor population and identify areas used during droughts. Preserve extensive freshwater wetlands, including suitable refuges for kites during droughts; management should allow for the requirements of kites. Coordination among water managers is necessary to prevent drawdowns of lakes in central Florida at the same time drought conditions exist in south Florida.

Selected References: Poole and Gill (eds.) 1995, Robertson and Woolfenden 1992, Rodgers et al. (eds.) 1996, Stevenson and Anderson 1994.

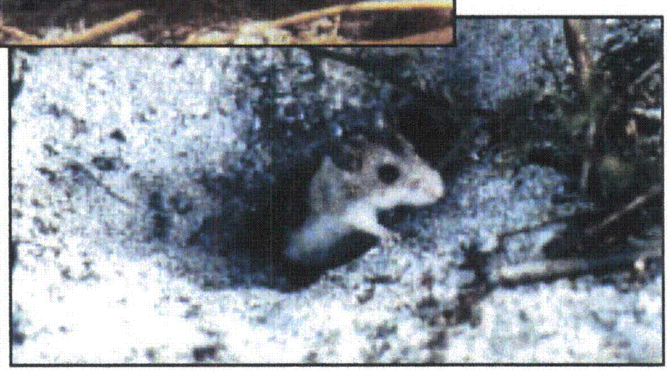
SOUTHEASTERN BEACH MOUSE

Peromyscus polionotus niveiventris



Order: Rodentia
Family: Cricetidae
FNAI Ranks: G5T1/S1
U.S. Status: Threatened
FL Status: Threatened

© Jack Stout



© Donna Oddy

Description: A small, light-colored mouse. Adult males average 5.3 in. (134 mm); adult females average 5.5 in. (139 mm). Average tail length in males and females is 2. in. (53 mm) and 2.2 in. (55 mm), respectively. Hairs of the dorsal fur are buff-tipped with gray bases. Hairs on the forehead and snout are buff to the base. Flanks, feet, cheeks, and underside are white. Tail is bicolored buff or gray above and white below.

SOUTHEASTERN BEACH MOUSE — *Peromyscus polionotus niveiventris*

Similar Species: Other subspecies of beach mouse (oldfield mouse) are similar in appearance, but do not overlap in range. Cotton mouse (*Peromyscus gossypinus*) is larger (5.6 - 8.1 in. = 142 - 206 mm), has a relatively longer tail (2.7 - 4.5 in. = 71 - 116 mm), and is chestnut-brown and gray. Florida mouse (*Podomys floridanus*) is also larger (7.3 - 8.0 in. = 179 - 203 mm) and similar in color to cotton mouse; hind feet generally have five large pads (plantar tubercles) versus six to seven (rarely five) small pads of beach mice and other *Peromyscus* species. House mouse (*Mus musculus*) is gray above with a slightly lighter gray underside and has a hairless, nearly unicolor (gray-pink) tail that is generally longer than 2.5 in. (63 mm).

Habitat: Primary, secondary, and occasionally tertiary sand dunes with a moderate cover of grasses and forbs, including sea oats (*Uniola paniculata*), bitter panicum (*Panicum amarum*), and beach dropseed (*Sporobolus virginicus*). Adjacent coastal palmetto flats (coastal strand) and scrub are important during and following hurricanes.

Seasonal Occurrence: Less active when the moon is bright.

Florida Distribution: Historically occurred from New Smyrna Beach possibly as far south as Miami Beach. Now known from a few isolated locations from southern Volusia County to Martin County.

Range-wide Distribution: Same as Florida distribution. Southeastern beach mouse is a subspecies of oldfield mouse, which is common throughout Alabama, Georgia, southern South Carolina, and most of Florida.

Conservation Status: The extensive habitat at Cape Canaveral Air Station and Canaveral National Seashore provide a stronghold for the southeastern beach mouse. Small tracts of suitable habitat exist south of Brevard County; however, long-term survival at these sites is unlikely without population augmentation.

Protection and Management: Prevent damage to dune habitat: construct boardwalks over dunes; prevent off-road-vehicle (ORV) use on dunes; restore breaks in the primary dune to prevent erosion and flooding during high tides and surges. Remove feral cats, which are thought to cause high mortality.

Selected References: Brown 1997, Humphrey (ed.) 1992, Whitaker 1996.