Cross Florida Barge Canal and Withlacoochee River Survey and Monitoring Plan

Levy Nuclear Plant

Prepared for

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Prepared by

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Acronyms and Abbreviations

°F	degree Fahrenheit
AWS	abundance weighted salinity
CFBC	Cross Florida Barge Canal
COA	center of abundance
COC	Condition of Certification
COF	center of frequency
CREC	Crystal River Energy Complex
CRSMP	Cross Florida Barge Canal and Withlacoochee River Baseline Survey and Monitoring Plan
CWA	Clean Water Act
CWIS	cooling water intake structure
DO	dissolved oxygen
ES	estuarine indicator
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FIM	Fisheries Independent Monitoring
fps	feet per second
ft	foot
FW	freshwater indicator
FWC	Florida Fish and Wildlife Conservation Commission
FWRI	Fish and Wildlife Research Institute
FWS	frequency weighted salinity
HBMP	hydrobiological monitoring plan
km	kilometer
km^2	square kilometer
LNP	Levy Nuclear Plant Units 1 and 2
LNP 1	Levy Nuclear Plant Unit 1

Acronyms and Abbreviations, Continued

LNP 2	Levy Nuclear Plant Unit 2
m	meter
m^3	cubic meter
m/s	meter per second
mgd	million gallons per day
mi	mile
mi^2	square mile
µ	micron
NA	not applicable
NGM	nearshore Gulf of Mexico
NPDES	National Pollutant Discharge Elimination System
OWR	Old Withlacoochee River
PBS&J	PBS&J, Inc.
PEF	Progress Energy Florida, Inc.
psu	practical salinity unit
QA	quality assurance
QC	quality control
RIS	representative important species
SOP	standard operating procedure
SW	saltwater indicator
SWFWMD	Southwest Florida Water Management District
USACE	U.S. Army Corps of Engineers

1.0 Introduction

Progress Energy Florida, Inc. (PEF), is proposing to build and operate a nuclear power generating facility, consisting of two generating units, in Levy County, Florida. The proposed facility, known as Levy Nuclear Plant Units 1 and 2 (LNP), will be located east of U.S. Highway 19 and north of the Levy County and Citrus County border. The LNP will withdraw cooling water from the Cross Florida Barge Canal (CFBC), which extends west from the Inglis Lock to the Gulf of Mexico. PEF has proposed to route the LNP discharge to the existing Crystal River Energy Complex (CREC) discharge canal, located southwest of the proposed LNP site.

Section B.XXIXB.1 of the Conditions of Certification (COCs) adopted by the "Final Order on Certification for the Progress Energy Levy Nuclear Power Plant Units 1 and 2," dated August 26, 2009, requires the development of a CFBC and Withlacoochee River Baseline Survey and Monitoring Plan (CRSMP).

1.1 Regulatory Requirements

COC Section B.XXIXB.1 requires the submittal of a CRSMP to the Florida Department of Environmental Protection (FDEP) Siting Coordination Office and the Florida Fish and Wildlife Conservation Commission (FWC) for approval by FWC in consultation with FDEP and the Southwest Florida Water Management District (SWFWMD). The following requirements of COC Section B.XXIXB.1 are addressed in this CRSMP in the sections identified.

- Section B.XXIX.B.1. CFBC and Withlacoochee River Survey and Monitoring

  Described in Sections 3.1 and 5.1, Table 3-4, and Attachment A of this CRSMP:

  a. *Within 180 days following certification of the Levy County Nuclear Facility, the Licensee shall submit to the DEP Siting Office and FWC a Cross Florida Barge Canal and Withlacoochee River Baseline Survey and Monitoring Plan (CRSMP). Unless otherwise agreed to by the Licensee and FWC, in consultation with DEP, the CRSMP shall include, at a minimum, the following components and may include additional components as proposed by either the FWC or Licensee:*

     i. *Nekton pre-operational survey and post-operational monitoring should be based on a stratified-random sampling design, with a minimum of 12 samples per month in the Cross Florida Barge Canal, a minimum of 6 samples per month in the Withlacoochee River downstream of Lake Rousseau, and a minimum of 6 samples per month in the area just off the entrance to the Cross Florida Barge Canal. Ideally the sampling effort would be divided between bag seines and otter trawls, with a ratio of two seine hauls to one trawl haul. This study design will allow comparison between monitoring results of nekton communities, and possible changes in these communities, in the CFBC and Withlacoochee River with systems north and south of the CFBC. Ideally the number of samples necessary per month would be based on preliminary sampling and subsequent power analysis (to determine*

power to detect change. If additional gear is deemed more appropriate, these should be provided in the nekton monitoring study design.

Described in Sections 3.1 and 5.2, Table 3-4, and Attachment A and B of this CRSMP:

ii. *Plankton (ichthyoplankton and meroplankton) preoperational survey and post-operational monitoring should be based on a stratified random sampling design, with a minimum of 12 samples per month in the Cross Florida Barge Canal, a minimum of 6 samples per month in the area just off the entrance to the Cross Florida Barge Canal, and in the Withlacoochee River. The surveys should employ standard plankton sampling gear. Ideally the number of samples necessary per month would be based on preliminary sampling and subsequent power analysis (to determine power to detect change). The plankton monitoring should, at a minimum, include sampling at night.*

Described in Section 3.2, Table 3-5, and Figure 3-4, and Attachment C of this CRSMP:

iii. *Additional hydrographic survey sites may be needed, depending on the data available from previous studies, to characterize circulation and flow from the Withlacoochee River south to the Barge Canal, across and into the Barge Canal, and south towards the Crystal River Energy Complex. Specific survey and monitoring locations, sampling frequencies and methods, and specific parameters to be surveyed and monitored shall be approved by the FWC, in consultation with DEP and SWFWMD.*

Described in Sections 3.1, 3.2, 3.3, and 3.4, and Attachment A of this CRSMP:

iv. *Pre-operational surveys and monitoring shall be conducted for a period of time to be determined by statistical analysis in coordination between the FWC and the Licensee in order to establish seasonal/climatological baseline, biological and water quality conditions. This timeframe will not exceed the period of time that is available prior to operation of the facility.*

Described in Sections 3.1, 3.2, 3.3, and 3.4, and Attachment A of this CRSMP:

v. *Pre-operational survey and post-operational monitoring shall be conducted for a period of time to be determined by statistical analysis in coordination between the FWC, in consultation with DEP, and the Licensee, utilizing the same pre-operational survey methodologies in order to identify and characterize biological and water quality impacts associated with the project for any needed mitigation purposes.*

Described in Sections 3.3, 5.3, and 5.4 of this CRSMP:

vi. *In accordance with federal regulations related to the project's intake structure, an impingement and entrainment study shall be developed and implemented for use during operations to validate the assumptions of limited or no impingement and entrainment of organisms.*

Described in Section 3.4 of this CRSMP:

vii. *An adaptive management approach shall be applied during pre-operational surveying and post-operational monitoring plan development in order to accommodate for less expensive data collection methodologies that may become available.*

Described in Section 6.0 of this CRSMP:

b. *The Licensee will prepare yearly progress reports, including all data and statistical analyses resulting from the survey and monitoring requirements, hydrographic analysis documenting*

the flow and circulation patterns in the nearshore areas, and a summary report at the end of the baseline period. These reports shall be submitted to the FWC, and DEP Siting Office for review. If the FWC, in consultation with DEP and SWFWMD, in their review of the yearly progress reports, determines inadequacies or the need to modify the CRSMP, FWC will notify DEP and the Licensee and a joint meeting will be held to discuss the findings. At the end of the baseline monitoring period, the Licensee will hold a joint meeting with the DEP and EWC [sic]to discuss the results. At that time, the FWC, in consultation with DEP and SWFWMD, and the Licensee will determine what, if any, modifications need to be made to the CRSMP for monitoring once the Plant begins operations. The FWC will transmit its findings to the DEP-Siting Office for coordination and transmittal to the licensee.

Described in Section 5.0 of this CRSMP:

d. *The Licensee will submit, after initiation of operations at the Levy Plant, an annual report, including all data and statistical analyses resulting from the monitoring requirements and an analysis comparing the current data to the preoperational survey (baseline) data to the FWC and the Siting Office. If the FWC, in consultation with DEP and SWFWMD, determines that the pre-operational survey and post-operational monitoring data indicate harm or potential harm to the ecological resources of the waters of the State and/or indicate exceedance of State water quality standards, or if these data are insufficient to evaluate changes, then additional measures shall be required to evaluate or to abate such impacts. Additional measures include but are not limited to: (i) Enhanced monitoring and/or modeling, and mitigative measures; (ii) Operational changes in the cooling water intake system to reduce any such impacts; (iii) Other measures to abate impacts as may be described in the Canal and River Monitoring Plan.*

Described in Section 6.0 of this CRSMP:

e. *The Licensee will submit a summary report, including all data and statistical analyses from the baseline monitoring and an analysis comparing the current data to the baseline data, to the FWC and the DEP Siting Office. The summary report should be submitted a minimum of 6 months before renewal of the* [National Pollutant Discharge Elimination System] *NPDES permit.*

2.0 Background and Site Description

This section provides relevant background information on the LNP and the study area.

2.1 LNP Cooling Water Intake and Discharge

The LNP will consist of two nominal 1,100-megawatt nuclear electrical generating units and will use a closed-cycle cooling water system that will withdraw cooling tower makeup water from the CFBC. The cooling water intake structure (CWIS) will be constructed on the canal bank at a location south of the LNP site and west of the Inglis Lock, approximately 6.9 miles (mi) inland from the Gulf of Mexico. Cooling water will be withdrawn at a flow rate of approximately 122 million gallons per day (mgd) through six intake bays. The CWIS will include 3/8-inch mesh dual-flow traveling water screens with a through-screen velocity of less than 0.5 foot per second (fps). The CWIS conforms to Clean Water Act (CWA) 316(b) design criteria to reduce the impingement and entrainment of aquatic life.

The LNP will have a combined wastewater discharge comprised of several wastewater streams, including approximately 98 percent blowdown cooling water. The combined blowdown of approximately 88 mgd will be piped to the CREC and discharged into the existing CREC discharge canal.

2.2 Aquatic Study Area Descriptions

COC Section B.XXIX.B.1 requires a survey and monitoring plan for nekton, plankton, hydrographic characteristics, and impingement and entrainment within areas potentially influenced by the operation of the LNP CWIS. The study areas included in this monitoring plan are the CFBC, Old Withlacoochee River (between the Inglis Dam and the CFBC), and the nearshore Gulf of Mexico (NGM) located between the Withlacoochee River and CREC (see Figure 2-1).

2.2.1 Cross Florida Barge Canal

The CFBC is a man-made canal that, in the project vicinity, extends between Lake Rousseau and the Gulf of Mexico. Lake Rousseau is a 3,400-acre impoundment formed by the construction of Inglis Dam in the Withlacoochee River. In the 1960s, the U.S. Army Corps of Engineers (USACE) built a portion of the CFBC, which bisects the Withlacoochee River below Lake Rousseau. Water released through the main spillway at Inglis Dam flows through the Old Withlacoochee River and then enters the CFBC en route to the Gulf of Mexico. USACE constructed the Inglis Lock bypass channel and spillway to control freshwater discharges from Lake Rousseau into the lower Withlacoochee River segment, thereby maintaining the connection between the upper and lower portions of the river. The Inglis Dam and the bypass channel spillway collectively control the water level in Lake Rousseau. The CFBC between Inglis Lock and the Gulf of Mexico is 7.4 mi long and approximately 12 feet deep with a surface width of approximately 200 feet, and side slopes over much of its length approximating the 3:1 (horizontal: vertical) canal design.

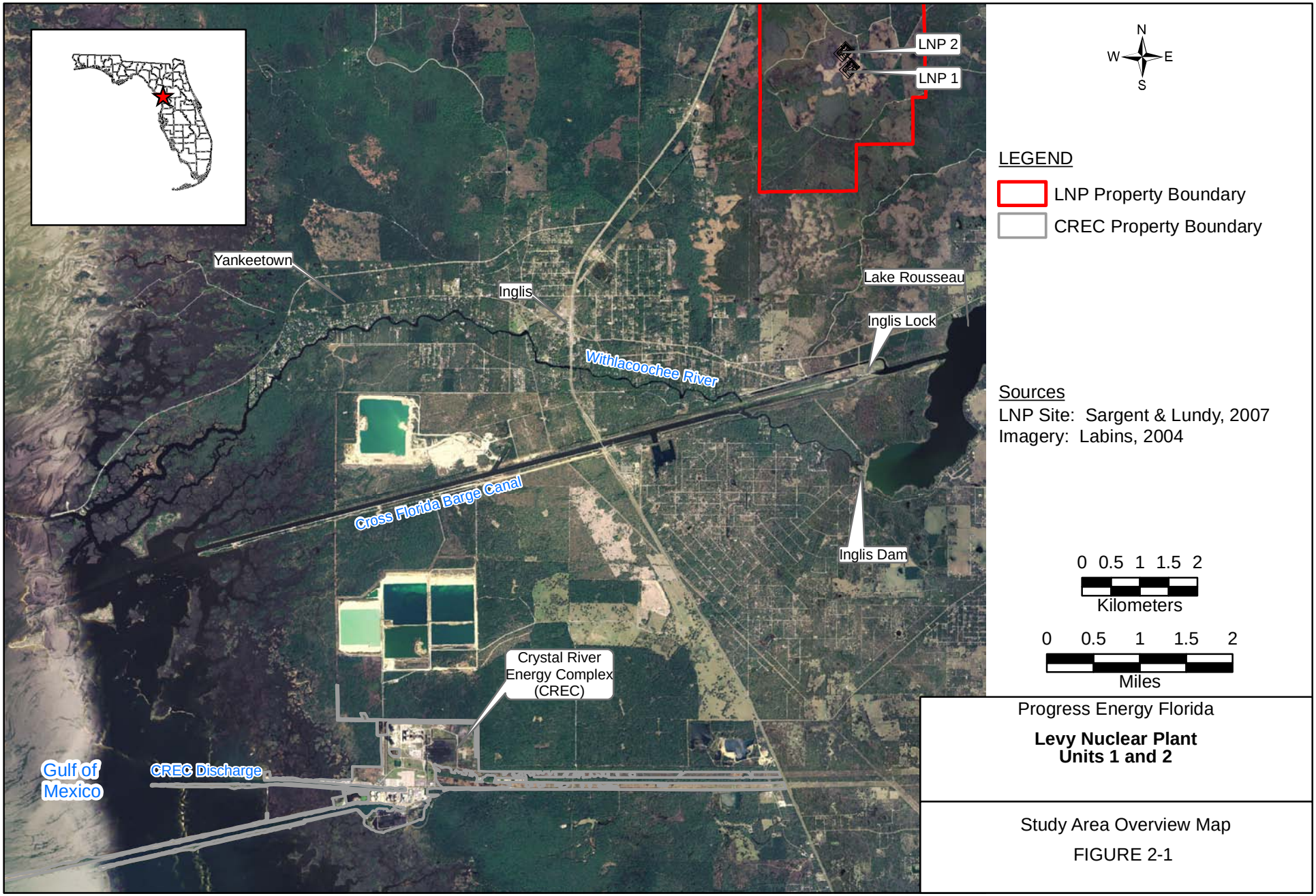
2.2.2 Old Withlacoochee River

The isolated segment of the Withlacoochee River, which runs 1.5 mi from the Inglis Dam to the CFBC, is referred to as the Old Withlacoochee River (OWR). The OWR is meandering and approximately 65 to 100 feet wide with variable depths ranging from 4 to 10 feet. Water flow is regulated at the Inglis Dam, and both flow and velocity within the OWR are highly variable, reflecting episodic releases from the Inglis Dam, as well as tidal fluctuations associated with the Gulf of Mexico. The pattern of flows is higher during the wet season and lower during the dry season. The channel bottom has areas of exposed limestone and sand in the central channel, and muddy bottoms along the shoreline. The water color is slightly tannic, reflecting organic inputs to the upstream Withlacoochee River.

2.2.3 Nearshore Gulf of Mexico

The NGM in the project vicinity is generally shallow, with depths of 10 feet or less within 3 mi of the shore and depths up to 20 feet approximately 6 mi from shore. Locally, deeper water is found in rivers and dredged canals. Saltmarsh and oyster reefs are common in the shallow nearshore environment and are exposed at low tide. During construction of the CFBC, a channel was dredged into the Gulf of Mexico, creating a series of spoil islands extending offshore for 5.5 mi along the southern boundary of the channel. This line of spoil islands restricts coastal flow north of the CREC discharge area.

Near the CREC, channels and berms border both the intake and discharge canals. The excavated discharge canal extends 1.2 mi west into the Gulf of Mexico with a dike along the southern side. Farther south, two berms border the intake canal, extending 2.7 mi into the Gulf of Mexico. Beyond these berms, a navigational channel extends an additional 3 mi offshore and has a spoil bank along the northern side. The berms along the intake and discharge canals restrict coastal flow south of the CREC discharge area.


LNP 2
LNP 1
N
W
E
S
LEGEND
LNP Property Boundary
CREC Property Boundary
Yankeetown
Inglis
Lake Rousseau
Inglis Lock
Withlacoochee River
Cross Florida Barge Canal
Inglis Dam
Crystal River Energy Complex (CREC)
Gulf of Mexico
CREC Discharge
Sources
LNP Site: Sargent & Lundy, 2007
Imagery: Labins, 2004
0 0.5 1 1.5 2
Kilometers
0 0.5 1 1.5 2
Miles
Progress Energy Florida
Levy Nuclear Plant
Units 1 and 2
Study Area Overview Map
FIGURE 2-1

3.0 CRSMP Monitoring

The purpose of this plan is to collect field data needed to determine if there are any impacts of the proposed withdrawals in the CFBC and OWR. Data collection includes the survey and monitoring of nekton and plankton, as well as a hydrographic survey. Nekton and plankton data will also be collected from the NGM, an area just off the entrance of the CFBC, to document background conditions and biological recruitment potential to the CFBC. In addition, an impingement and entrainment study shall be developed and implemented to validate the assumption of limited or no impact from the impingement and entrainment of organisms during operation of the CWIS.

This section provides an overview of the CRSMP monitoring locations, biological and hydrographic parameters to be sampled, and sampling approach.

3.1 Nekton and Plankton Survey and Monitoring

3.1.1 Sampling Locations

Nekton and plankton data will be collected in the CFBC and OWR study areas, as well as the NGM. Sampling locations within each study area are designed to support a stratified random sampling design as required by the COC. The number and position of locations are consistent with accepted biological monitoring designs in the nearshore and riverine/ stream environments along the Gulf of Mexico, including the Tampa Bay Water's Tampa Bypass Canal/Alafia River Water Supply Projects Hydrobiological Monitoring Program (HBMP) (PBS&J, Inc. [PBS&J], 2000), and the FWC/Fish and Wildlife Research Institute (FWRI) Fisheries Independent Monitoring (FIM) program (FWRI, 2009).

The CFBC aquatic study area extends west from the Inglis Lock to the interface of the canal with the Gulf of Mexico (see Figure 3-1) and is divided into four linear strata of equal length (1.85 mi [2.98 kilometers (km)). CFBC stratum spatial extents are defined in Table 3-1. These strata designations will be used for both nekton and plankton sampling.

TABLE 3-1
Cross Florida Barge Canal Linear Strata Spatial Extents

Stratum	Eastern Limit (km)	Western Limit (km)
CFBC Strata 1	0	2.98
CFBC Strata 2	2.98	5.96
CFBC Strata 3	5.96	8.94
CFBC Strata 4	8.94	11.82

Notes:
Distances are relative to the Inglis Lock.
CFBC = Cross Florida Barge Canal
km = kilometer

The OWR aquatic study area extends from the floating exclusion barrier below the Inglis Dam downstream to the convergence with the CFBC, a distance of 1.5 mi (2.4 km) (see Figure 3-2). The OWR aquatic study area is divided into three linear strata of equal length (0.5 mi [0.8 km]). OWR stratum spatial extents are defined in Table 3-2. These strata designations will be used for both nekton and plankton sampling.

TABLE 3-2
Old Withlacoochee River Strata Spatial Extents

Stratum	Eastern Limit (km)	Western Limit (km)
OWR Strata 1	0	0.80
OWR Strata 2	0.80	1.60
OWR Strata 3	1.60	2.40

Notes:
Distances are relative to the floating exclusion barrier downstream of Inglis Dam.
km = kilometer
OWR = Old Withlacoochee River

The NGM aquatic study area extends from the interface of the CFBC with the Gulf of Mexico to a point 1.91 mi (3.08 km) west (see Figure 3-3). This aquatic study area has two linear strata associated with the dredged channel, and two areal strata (nekton cells) associated with shallow mud flats and oyster reefs. The two NGM linear strata are of equal length of 0.96 mi (1.54 km), and the two nekton cells are each 0.57 square mile (mi^2) 1.48 square kilometers (km^2). The NGM stratum spatial extents are defined in Table 3-3. Sampling efforts for the nekton community in the NGM will be divided between linear strata (deep) and the areal cells (shallow). Sampling efforts for the plankton community will take place within the linear strata (deep) only.

TABLE 3-3
Nearshore Gulf of Mexico Strata Spatial Extents

Stratum	Eastern Limit (km)	Western Limit (km)	Area (km^2)
NGM Strata 1	0	1.54	NA
NGM Strata 2	1.54	3.08	NA
NGM Nekton Cell 1	0	1.54	1.48
NGM Nekton Cell 2	1.54	3.08	1.48

Notes:
Distances are relative to the mouth of CFBC.
km = kilometer
km^2 = square kilometer
NA = not applicable
NGM = nearshore Gulf of Mexico

Spatial Randomization

Locations of samples apportioned to each stratum within an individual study area will be selected at random. The use of spatial randomization in this monitoring plan is consistent with existing biological monitoring plans in the region (PBS&J, 2000; FWRI, 2009).

Linear strata will be subdivided into 3.2-foot (ft) (1-meter [m]) increments along a lengthwise center line, creating discrete locations from which samples will be randomly chosen. Approximately 2,980, 800, and 1,540 sampling loci along the center line will be available for sampling within each linear stratum of the CFBC, OWR, and the NGM, respectively.

The two areal cells associated with the NGM will each be subdivided into a 0.0016-mi^2 (0.0025-km^2) grid for random sample location selection. Approximately 592 sampling loci will be available for sampling within each areal stratum. The randomly selected loci will be sampled using a seine; trawling will not be conducted in the areal cells.

3.1.2 Sampling Parameters and Methods

Biological parameters to be sampled at each location include nekton and plankton communities. Field water quality parameters will also be collected.

Nekton

Nekton includes juvenile to adult fish and motile invertebrates. These organisms will be collected using seining and trawling techniques.

The seining and trawling techniques to be used for the CRSMP are based on standardized procedures presented in *The Fisheries-Independent Monitoring Program Procedure Manual* (FWRI, 2009). These procedures will be field tested and verified prior to implementation of the CRSMP survey. A field testing and verification event will serve to evaluate the FIM procedure relative to actual environments being sampled within each study area, which include the narrow limestone channel in the OWR, the deep, steep-sided channel of the CFBC, and the open water and mudflats of the NGM. Sampling procedures may need to be revised or adjusted to fit actual CRSMP study area field conditions.

Seine sampling will employ "river" and "bay" seining techniques. The river seining technique will be used for sampling along shorelines that drop off rapidly to deeper water. The seine is deployed from a boat as necessary where deeper water prevents traditional seine sets by wading. Study areas that will use the river seine technique include the CFBC, OWR, and the NGM. The bay seine technique, using a fixed pole and seine deployment and closure by wading or boat will be used for sampling shallow estuarine habitats away from shorelines. This technique will be used for areal strata in the NGM study area. These gears and field sampling protocols target fish populations; however, any motile invertebrates collected using these techniques will be retained for identification. A 69.9-ft (21.3-m) center-bag seine will be used for both of these techniques (FWRI, 2009).

An otter trawl will be used to sample deeper habitats within the study area not accessible to seines. These areas include the dredged canal of the CFBC and linear strata within the NGM. Trawling was not selected as a viable gear option for the OWR because of the

narrowness, number of snags, and the non-uniformity of OWR limestone river bottom. A 20.0-ft (6.1-m) otter trawl targets epibenthic fish and motile invertebrates (FWRI, 2009).

All nekton samples will be processed according to the FIM standard set of protocols. These protocols ensure that an accurate representation of species size and number collected are recorded for each species in each sample and that the data taken reflect the entire catch. Processing will entail field identifications to lowest practicable taxonomic level, measurements for total length, and enumeration of organisms. The FIM protocols also detail the subsampling of large collections of organisms, the creation of a representative voucher sample collection, and appropriate documentation. Identification of any unknown specimens, verification of records, and maintenance of a sample reference collection will be conducted by an independent subcontractor with recognized expertise in fisheries taxonomy.

Plankton

Targeted plankton include meroplankton and ichthyoplankton, which will be sampled using a plankton net.

A 333-micron (μ) conical plankton net equipped with a flowmeter will be used to collect samples from the CFBC, OWR, and the NGM. For the CFBC and the NGM study areas, an oblique tow technique will be used. This technique divides the plankton tow into three depths (surface, middle, and bottom) among which tow times are divided evenly. Sampling will be conducted during flood tides and at nighttime only. This plankton sampling methodology is consistent with previous plankton sampling in the CFBC (PEF, 2008) and the HBMP study (PBS&J, 2000). Plankton sampling in the OWR will require a modified plankton tow or pump sampling technique due to the inability of performing standard towing techniques in the narrow, sinuous channel, with irregular bottom contours, especially at night. Modifications to plankton standard operating procedures (SOPs) will be tested and verified in the field before initiation of the CRSMP surveys.

Plankton sample identification, enumeration, and maintenance of a sample reference collection will be conducted by an independent subcontractor with expertise in plankton taxonomy and regional experience.

Water Quality

Field water quality parameters will be measured at each nekton and plankton sampling location during each sampling event. A Yellow Springs Instruments multi-parameter sonde (or similar) will be used to measure depth profiles (1-m intervals) of dissolved oxygen (DO), temperature, pH, conductivity, salinity, and depth. Water transparency will be collected using a Secchi disk only in association with nekton sampling.

3.1.3 Sample Size and Frequency

Nekton and plankton sample size estimates were based on general statistical significance (that is, sample size of 30). Attachment A summarizes sample size analysis in more detail. The COC sample size (minimum of 12 samples per month in the CFBC, 6 samples per month in the OWR, and 6 samples per month in the NGM), is statistically appropriate for population comparisons on a semiannual and annual basis. This degree of sampling size is

similar to the HBMP monitoring efforts and provides a reasonable statistical design to detect status and trends in nekton and plankton populations between pre operational surveys and post operational monitoring.

Nekton and plankton will be sampled monthly as per COC requirements (Section B.XXIX.B.1.a.i and ii). Plankton will be sampled during the nighttime during flood tides. Nighttime plankton sampling is consistent with established sampling protocols used in other monitoring programs (PBS&J, 2000) and warranted based on review of the plankton results from the CFBC during the 2007-2008 aquatic sampling program (CH2M HILL, 2009a) (see Attachment B).

Field Sampling Program Summary

Table 3-4 summarizes the study areas, parameters (nekton, plankton, field water quality), sampling locations (that is, strata), sampling techniques, and number of samples per strata on a monthly and annual basis.

TABLE 3-4
Annual Sampling Summary for Nekton, Plankton, and Field Water Quality

Sampling Parameter	Number of Study Area Spatial Strata	Month of the Year												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
Cross Florida Barge Canal (CFBC)														
Nekton	4 Strata	2 seines[a]/stratum 1 trawl/stratum	2 seines[a]/stratum 1 trawl/stratum	2 seines[a]/stratum 1 trawl/stratum	2 seines[a]/stratum 1 trawl/stratum	2 seines[a]/stratum 1 trawl/stratum	2 seines[a]/stratum 1 trawl/stratum	2 seines[a]/stratum 1 trawl/stratum	2 seines[a]/stratum 1 trawl/stratum	2 seines[a]/stratum 1 trawl/stratum	2 seines[a]/stratum 1 trawl/stratum	2 seines[a]/stratum 1 trawl/stratum	2 seines[a]/stratum 1 trawl/stratum	144
	Sample Total	12	12	12	12	12	12	12	12	12	12	12	12	
Plankton	4 Strata	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	144
	Sample Total	12	12	12	12	12	12	12	12	12	12	12	12	
Field Water Quality	Concurrent	24 profiles	24 profiles	24 profiles	24 profiles	24 profiles	24 profiles	24 profiles	24 profiles	24 profiles	24 profiles	24 profiles	24 profiles	288
Old Withlacoochee River (OWR)														
Nekton	3 Strata	2 seines[a]/stratum	2 seines[a]/stratum	2 seines[a]/stratum	2 seines[a]/stratum	2 seines[a]/stratum	2 seines[a]/stratum	2 seines[a]/stratum	2 seines[a]/stratum	2 seines[a]/stratum	2 seines[a]/stratum	2 seines[a]/stratum	2 seines[a]/stratum	72
	Sample Total	6	6	6	6	6	6	6	6	6	6	6	6	
Plankton	3 Strata	2 hauls/strata	2 hauls/strata	2 hauls/strata	2 hauls/strata	2 hauls/strata	2 hauls/strata	2 hauls/strata	2 hauls/strata	2 hauls/strata	2 hauls/strata	2 hauls/strata	2 hauls/strata	72
	Sample Total	6	6	6	6	6	6	6	6	6	6	6	6	
Field Water Quality	Concurrent	12 profiles	12 profiles	12 profiles	12 profiles	12 profiles	12 profiles	12 profiles	12 profiles	12 profiles	12 profiles	12 profiles	12 profiles	144
Nearshore Gulf of Mexico (NGM)														
Nekton	2 Cells – shallow 2 Strata – channel	2 seine[a,b]/cell 1 trawl/stratum	1 seine[a,b]/cell 1 trawl/stratum	1 seine[a,b]/cell 1 trawl/stratum	1 seine[a,b]/cell 1 trawl/stratum	1 seine[a,b]/cell 1 trawl/stratum	1 seine[a,b]/cell 1 trawl/stratum	1 seine[a,b]/cell 1 trawl/stratum	1 seine[a,b]/cell 1 trawl/stratum	1 seine[a,b]/cell 1 trawl/stratum	1 seine[a,b]/cell 1 trawl/stratum	1 seine[a,b]/cell 1 trawl/stratum	1 seine[a,b]/cell 1 trawl/stratum	72
	Sample Total	6	6	6	6	6	6	6	6	6	6	6	6	
Plankton	2 Strata – channel	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	3 hauls/stratum	72
	Sample Total	6	6	6	6	6	6	6	6	6	6	6	6	
Field Water Quality	Concurrent	12 Profiles	12 Profiles	12 Profiles	12 Profiles	12 Profiles	12 Profiles	12 Profiles	12 Profiles	12 Profiles	12 Profiles	12 Profiles	12 Profiles	144

Notes:
[a]seine = 21.3 m (69.9 ft) center bag seine – river seine technique
[b]seine = 21.3 m (69.9 ft) center bag seine – bay seine technique
trawl = 6.1 m (20.0 ft) otter trawl
haul = 333 µ conical plankton net – oblique tow

3.1.4 Sampling Schedule

COC sections B.XXIX.B.1.a.iv and v require that pre-operational survey and post-operational monitoring be conducted for a period of time to be determined by statistical analysis. However, sufficient background data for nekton and plankton communities were not available to conduct such statistical analysis. The proposed sampling schedule duration described below is intended to capture seasonal variations and will incorporate an adaptive management approach.

The nekton and plankton survey and monitoring field data collection program will be undertaken during the pre-operational period and after the initiation of operations of Levy Nuclear Plant Unit 1 (LNP 1) and Levy Nuclear Plant Unit 2 (LNP 2). Monthly sampling will be conducted over each monitoring year. A summary of the nekton and plankton survey and monitoring field data collection schedule is as follows:

- Two years of pre-operational nekton and plankton survey and monitoring will be conducted within 3 years of the scheduled operational date for LNP 1.
- Post-operational nekton and plankton survey and monitoring will be conducted during the 2 years following the commencement of operation of LNP 1.
- Post-operational nekton and plankton survey and monitoring will be conducted during the 2 years following the commencement of operation of LNP 2.

The sampling design will be reviewed upon completion of the 2-year pre-operational study. At that time, changes to the sampling design may be applied to the post-operational monitoring program to increase the ability to detect potential changes.

Following the completion of scheduled post-operational monitoring, the need for additional monitoring will be assessed based on results obtained, and the demonstrated potential for, adverse changes.

3.1.5 Data Analysis

This section provides methods to analyze the data collected under the CRSMP. These methods are consistent with standard protocols within existing regional biological monitoring plans.

Nekton

Nekton data will be analyzed by the following methods, which are similar to those used in the Tampa Bay Water HBMP (PBS&J, 2003). The following statistics will be calculated for indicator species to assess potential changes in the nekton community within the CFBC and OWR resulting from the operation of the LNP: (1) the center of abundance (COA), center of frequency (COF), abundance weighted salinity (AWS), and frequency weighted salinity (FWS). For the NGM, general summary statistics including monthly and seasonal abundance and diversity, will be calculated for nekton data to support the description of background conditions and potential recruitment to the CFBC.

The COA and COF are statistics that describe the average position of occurrence for a given taxon over the sampling time period. For the CFBC, the COA and COF will be described in

terms of river kilometers downstream from the Inglis Lock. For the OWR, the COA and COF will be described in terms of river kilometers downstream from the floating exclusion barrier adjacent to the Inglis Dam. COA is calculated by weighting the location of occurrence by the number of organisms of the given species collected at that location and is calculated as follows:

$$COA = \frac{\sum NK}{\sum N}$$

where N = the number of individuals collected per deployment

K = distance in kilometers upstream from the river mouth

COF is the unweighted average of the locations at which a species occurs and is calculated as follows:

$$COF = \frac{\sum K}{\sum f}$$

where K = distance in kilometers upstream from the river mouth for each sample in which the taxon has been collected

f = the number of samples in which the taxon has been collected

AWS and FWS are statistics that describe the salinity range in which a given taxon is found to be most abundant. AWS is calculated by weighting the salinity at each sample collection site by the number or density of organisms of the given species collected at that location and is calculated as follows:

$$\overline{S_N} = \frac{\sum NS}{\sum N}$$

where N = the number of individuals collected per sample

S = salinity at the sample point

FWS is the unweighted average of the salinities at which a species has been collected and is calculated as follows:

$$\overline{S_f} = \frac{\sum S}{\sum f}$$

where S = salinity at the sample point

f = the number of samples in which the taxon was collected

Tables and figures summarizing the results of each sampling event will be generated to provide COA, COF, AWS, and FWS per indicator species for each spatial stratum. Assessment of spatial and temporal variation will be accomplished using parametric or nonparametric statistics. Spatial and temporal trends in nekton will also be qualitatively analyzed in conjunction with field water quality results, as well as rainfall and atmospheric

data from existing nearby recording stations, to determine their potential influence on the nekton results. Climatic data sources will include SWFWMD monitoring stations at the Inglis Lock, including Inglis Lock #22959, which collects rainfall data, and Inglis II ET #22960, which collects air temperature, wind speed, and wind direction data (SWFWMD, 2009). Tidal cycle data will also be considered, as measured at U.S. Geological Survey Station #02313274 on the southeast corner of Chambers Island at the mouth of Bungalow Pass, just north of the CFBC.

Plankton

Plankton data for the CFBC and OWR will be analyzed by calculating the same metrics for nekton, with the following differences. Density will replace the number of individuals in the equations to calculate COA and AWS. Density is expressed as the number of individuals per 100 cubic meters (m^3) and is calculated as follows:

$$Density = \left(\frac{Number\ of\ Individuals}{Volume\left(100\,m^3\right)} \right)$$

COA is calculated by weighting the location of occurrence by the number of organisms of the given species collected at that location and is calculated as follows:

$$COA = \frac{\sum NK}{\sum N}$$

where N = the density of individuals collected per deployment

K = distance in kilometers upstream from the river mouth

COF is the unweighted average of the locations at which a species occurs and is calculated as follows:

$$COF = \frac{\sum K}{\sum f}$$

where K = distance in kilometers upstream from the river mouth for each sample in which the taxon has been collected

f = the number of samples in which the taxon has been collected

AWS is calculated by weighting the salinity at each sample collection site by the number or density of organisms of the given species collected at that location and is calculated as follows:

$$\overline{S_N} = \frac{\sum NS}{\sum N}$$

where N = the density of individuals collected per sample

S = salinity at the sample point

FWS is the unweighted average of the salinities at which a species has been collected and is calculated as follows:

$$\overline{S_f} = \frac{\sum S}{\sum f}$$

where S = salinity at the sample point

f = the number of samples in which the taxon was collected

Tables and figures summarizing the results of each sampling event will be generated to provide COA, COF, AWS, and FWS per indicator species and life stage for each spatial stratum. Assessment of spatial and temporal trends will be accomplished using parametric or nonparametric statistics. Spatial and temporal trends in plankton will also be qualitatively analyzed in conjunction with field water quality results, as well as rainfall and atmospheric data from existing nearby recording stations, to determine their potential influence on the nekton results.

For the NGM, general summary statistics, including monthly and seasonal abundance and diversity, will be calculated for plankton data to support the description of background conditions and potential recruitment to the CFBC.

3.2 Hydrographic Survey

According to COC Section B.XXIX.B.1.a.iii, the CRSMP may include collection of hydrographic data to characterize circulation and flow from the Withlacoochee River south to the CFBC, across and into the CFBC, and south toward the CREC. This section presents the components of a proposed hydrographic study, including monitoring station locations, study parameters and methods, and schedule.

3.2.1 Monitoring Locations and Frequency

Figure 3-4 shows proposed locations for monitoring stations that will be used to collect model calibration and verification data. Stations are labeled with a prefix denoting the type of measurements that will be conducted: *C* for current probe locations, *T* for temperature probe locations, and *WL* for water level probe locations. The coordinates of the stations are listed in Attachment C. These survey locations may be altered slightly depending on the actual conditions found at each site. Any changes in locations will be documented in the final report. In situ salinity and temperature data will be collected at all stations.

For each hydrographic monitoring year, two separate 1-month-long data collection periods are proposed to represent seasonally different conditions: one in winter (January/February) and the other in summer (July/August). All stations will be occupied three times over the course of each data collection period; once for deployment, once at the mid-point of the sampling period, and once at retrieval. In situ salinity and temperature readings will be collected at each station on each scheduled occupation to have independent meter readings to compare with the automated meters.

3.2.2 Survey Methods

Data to be collected for the hydrographic survey include bathymetric data, meteorological data, water level data, current velocities, water temperature, and salinity. Data will be obtained from field studies and historic and current data sources.

Depth data detailing the local bathymetry is necessary for proper description of the project area. Navigation charts and other literature sources, supplemented by field depth readings taken at all station locations, will be used to define the site bathymetry.

Monitoring will include the use of current, temperature, and water level probes. Based on locally gained experience, probes located in shallow conditions (near the coastline) will foul quickly. To limit potential data loss, all probes will be checked and, if necessary, cleaned near the mid-point of their scheduled deployment period (after approximately 2 weeks). The collected data will be reviewed, and any periods that show degraded performance will be discarded.

The forces driving local currents at the project site include tidal water level variations, local winds, river flows, and industrial flows (local intake and discharges). Current data collected at Stations C1 through C4, using either S-4 current meters or acoustic Doppler current profile meters as practicable (dependent on depth and mooring requirements per meter type), will be used to calibrate the model hydrodynamics.

Water level data at Stations WL1 through WL3 will be used to observe changes in tidal range as the tides propagate into the area. Automated depth pressure sensors will be anchored at these locations. Their data will be retrieved at the end of each sampling period and compared with local National Oceanic and Atmospheric Administration tidal data in the region.

Stations T1 through T12 will be used to monitor temperature in the study area. Single thermisters will be deployed at stations in shallow water. A string of two thermisters will be deployed in areas with sufficiently deep water to monitor both near surface and near bottom temperatures. Station T1 will monitor the plume discharge temperature; Station T11 will provide a background temperature reading away from the influence of the plume; and Stations T2 through T10 will monitor temperature variations within the NGM study area to provide information on potential transport and dispersion of the thermal plume.

Salinity and temperature measurements will be taken three times at each station: when probes are deployed, when they are checked/cleaned, and when they are retrieved. Water depth, obtained using a weighted measuring tape, will also be recorded when probes are set. If the water depth is less than 4 feet, only one sample at mid-depth will be taken for the in situ parameters. In deeper waters, two samples (approximately 1 foot from the top and bottom) will be taken.

Local wind patterns are likely to have significant influence on local circulation patterns and thus are likely to influence the thermal plume. PEF maintains a meteorologic station near the terminus of the CREC discharge canal. Data from this station and other available and representative local weather data will be obtained and reported.

Table 3-5 summarizes the field parameters that will be monitored for the hydrographic survey.

TABLE 3-5
Hydrographic Survey Field Parameters

Parameter/Method	No. of Stations	Accuracy	Frequency	Measurements per Location
Temperature/probe	12	0.1°F	Continuously, 1-month period	1 or 2
Current (velocity)/meter	4	0.001 m/s	Continuously, 1-month period	1 or 2
Water Level/probe	3	0.1 m	Continuously, 1-month period	1
In situ temperature	19	0.1 psu	Deployment, mid-term, retrieval	1 or 2
In situ salinity	19	0.1 psu	Deployment, mid-term, retrieval	1 or 2
Depth/sounding line	19	0.1 m	Deployment	1

Notes:
Continuous sampling will be conducted for two 1-month periods per monitoring year.
Salinity and depth measurements listed above only occur during the survey periods.
Measurements per station depend on depth. Two samples (top and bottom) will be collected when depth exceeds 4 feet.
°F = degree Fahrenheit
m/s = meter per second
psu = practical salinity unit

3.2.3 Sampling Schedule

The hydrographic field data collection program will be undertaken during the pre-operational period and after the initiation of operations of LNP 1 and LNP 2. For each monitoring year, two separate 1-month-long data collection periods are proposed to represent seasonally different conditions: one in winter (January/February) and the other in summer (July/August). A summary of the schedule is as follows:

- One year of pre-operational hydrographic monitoring will be conducted during the 2 years prior to the scheduled operational date for LNP 1.
- One year of post-operational hydrographic monitoring will be conducted during the 2 years following the commencement of operation of LNP 1.
- One year of post-operational hydrographic monitoring will be conducted during the 2 years following the commencement of operation of LNP 2.

3.3 Impingement and Entrainment Study

COC Section B, XXIX.B.1.a.vi requires that the CRSMP include the development and implementation of an impingement and entrainment study at the project's CWIS to validate the assumptions of limited or no impingement and entrainment of organisms. This section provides the individual components of the proposed impingement and entrainment study, including a description of the sampling locations, sampling parameters and methods, and the sampling frequency.

Impingement studies are designed to further characterize the juvenile and adult fishes and shellfishes that could impinged by the CWIS. Entrainment studies are designed to measure

monthly variation in the species composition and abundance of larval fishes and shellfishes that could be entrained. The sampling program is designed to provide current estimates of the abundance, taxonomic composition, diel periodicity, and seasonality of organisms impinged in the CWIS.

3.3.1 Sampling Location

Impingement and entrainment sampling events will take place at the CWIS, constructed on the north CFBC canal bank at a site south of the LNP site and west of the Inglis Lock on the CFBC. Impingement samples will be collected from the screenwash troughs of the CWIS traveling screens. Entrainment samples will be collected immediately ahead of the CWIS intake screen by boat or at another accessible representative point in the intake system.

3.3.2 Sampling Parameters and Methods

Impingement samples will be collected in 0.95-centimeter (3/8-inch mesh) wire baskets fabricated to fit into the screen washwater trough. Baskets will be placed either beneath each rotating screen or within the screenwash trough common to all rotating screens to collect material washed from the screens and to ensure the collection of representative samples. Baskets will be inspected at regular intervals during each sampling event. All fish and shellfish collected during a sample will be identified and counted, and up to 25 individuals of each species will be individually measured (nearest millimeter), and weighed (nearest 0.1 gram). If more than 25 specimens of a given species are collected, then 25 individuals will be randomly selected, measured and weighed; if fewer than 25 specimens are collected, then all will be measured and weighed. Percent initial fish survival and injury of each species will be observed and documented on a data sheet. Water quality (temperature, DO, turbidity, and conductivity), water level, weather conditions, and plant operational data will be collected during each event.

Entrainment sampling will consist of the placement of a conical 1.6-ft (0.5-m)-diameter, 333-μ plankton net with a calibrated flowmeter. Duplicate 333-μ plankton samples will be collected during the day and night of each sampling event. Samples will be timed with a stopwatch to ensure equal duration and similar flow. Water quality (temperature, DO, turbidity, and conductivity), water level, weather conditions, and number of operating pumps will be recorded for during each event.

Plankton samples will be collected by environmental scientists with experience in calibration and deployment of plankton sampling equipment. Samples will be preserved in the field and delivered to a taxonomic laboratory experienced in the identification of plankton collected from the Gulf coast region representative of the study area. The laboratory will enumerate and identify plankton (ichthyoplankton and meroplankton) samples to the lowest practicable identification level.

Nekton will be identified to the lowest practicable taxonomic level. Most nekton will be identified onsite by professional ecologists and released. Specimens of uncertain identity will be retained, preserved, and identified to the lowest practicable taxon by a recognized professional taxonomic expert.

Sample archives will be held for a minimum of 5 years. Voucher collections for nekton and plankton will include preserved specimens and digital photographs. Nekton specimens that are too large for sample preservation will be recorded with digital photography in the field.

3.3.3 Sampling Frequency

Each impingement and entrainment sampling event will take place during the day and night over a 24-hour period. Impingement sampling frequency will be dependent upon rate of debris accumulation. If debris load is manageable, samples will be collected during 6-hour intervals with the traveling screens being rotated every 30 minutes. If debris load becomes problematic, a subset of the 6-hour intervals will be sampled.

Entrainment sampling will be conducted concurrently with the impingement sampling. Two daytime and two nighttime samples will be collected during each monthly sampling event.

3.3.4 Sampling Schedule

Impingement and entrainment sampling will be conducted monthly during the first 2 years of LNP 1 operation. Sampling will also be conducted monthly for 2 years following the commencement of LNP 2 operation. The need for additional monitoring will be assessed based on the results of this monitoring and the demonstrated potential for adverse impacts. Adaptive management approaches, discussed in Section 3.4, will be used to access the adequacy of the post-operational methodologies.

3.3.5 Data Analysis

Impingement

Impingement data will be used for quantitative determination of juvenile and adult fish losses caused by the operation of the LNP. Methods proposed are consistent with state-accepted impingement and entrainment characterization studies under Section 316(b) of the CWA.

Impingement rates will be calculated and expressed as the number of organisms impinged per collecting period. Tables and figures summarizing the results of each sampling event will be generated to provide the number of individuals per species and condition (alive/dead). Numbers of fish and invertebrates impinged per 24 hours determined from the sampling intervals will be extrapolated to provide estimated monthly and annual impingement totals. The total number, mean length, and weight for each species will be calculated and reported in the species composition and length frequency data. Diurnal (night/day) and seasonal variation will be analyzed using a parametric or nonparametric statistics. Diurnal and seasonal variations will be qualitatively analyzed in conjunction with water quality results, as well as rainfall and atmospheric data from existing nearby recording stations.

Entrainment

Entrainment data will be used for quantitative determination of holoplankton, meroplankton, and ichthyoplankton losses resulting from the operation of the LNP. These

methods are consistent with federally and state- approved impingement and entrainment characterization studies under Section 316(b) of the CWA.

Entrainment data will be subdivided into holoplankton, meroplankton, and ichthyoplankton. Holoplankton in all samples will be enumerated by major taxa, and in selected representative samples, will be identified to the lowest practicable taxon. Meroplankton and ichthyoplankton in all samples will be identified to the lowest practicable taxon and enumerated by life stage. Results will be expressed as density (numbers per 100 m^3).

Tables and figures detailing entrainment density, richness, and diversity of zooplankton will be developed and presented. Statistical analyses that will be considered in evaluating the data include the Shannon-Wiener index H', Margelef's richness, and Pielou's evenness J'. Plankton density temporal and seasonal variation will be analyzed using parametric or nonparametric statistics. Diurnal and seasonal variations will be qualitatively analyzed in conjunction with the water quality results, as well as rainfall and atmospheric data from existing nearby recording stations, to determine their potential influence on the nekton results. Entrainment density will also be compared between monitoring years and with plankton data collected in the CFBC and NGM spatial strata (see Section 3.1).

Annual entrainment losses will be calculated using the measured density of organisms and the LNP flow rate. Entrainment numbers for periods between sampling events will be estimated by interpolation. All entrained species will be evaluated; however, a detailed analysis of representative important species (Section 5.5) will be determined by an equivalent adult analysis using the Goodyear/Horst model (Goodyear, 1978; Horst, 1975).

Representative Important Species

Representative important species (RIS) are defined as those that are known to occur or could be encountered within the study areas and are ecologically, recreationally, or commercially important. A preliminary list of candidate RIS has been compiled based on several sources (see Table 3-6). Existing data were reviewed to provide a list of species inhabiting the study areas and to gain an understanding of the species relative abundance and spatial and temporal variation. Existing monitoring plans were included to provide insight into the role of these species in regional ecosystems and provide additional information as to their regional status and trends. Sources that were reviewed include the following: *Aquatic Ecology Sampling Report, Levy Nuclear Plant* (CH2M HILL, 2009a), *Supplemental 316(b) Information of Potential Impacts to Aquatic Biota at LNP* (CH2M HILL, 2009b), *Crystal River 316 Studies* (Stone and Webster, 1985), *The Fisheries-Independent Monitoring Program Procedure Manual* (FWRI, 2009), and *Tampa Bypass Canal/Alafia River Water Supply Projects HBMP* (PBS&J, 2000). The list of candidate RIS may be refined based on the sampling results of the pre-operational period if some species are found to be absent or in low abundance during sampling events.

TABLE 3-6
Candidate Representative Important Species

Taxon	Scientific Name	Habitat Indicator	Level of ID needed
Fish – Juvenile, Adult, Ichthyoplankton			
Bay anchovy	*Anchoa mitchilli*	ES (some juveniles)	Genus or species
Black drum	*Pogonias cromis*	ES (juveniles)	Species
Centrarchids (Sunfish sp. black bass)	*Lepomis sp., Micropterus sp.*	FW	Genus or species
Cyprinodontids	*Cyprinodon variegatus, Floridichthys carpio*	NA	Species
Flounder	*Paralichthys sp.*	ES (juveniles)	Species
Ladyfish	*Elops saurus*	NA	Species
Menhaden	*Brevoortia sp.*	ES (juveniles)	Genus or species
Mojarras	*Eucinostomus argenteus, E. harengulus, E, gula*	ES (juveniles)	Genus or species
Pinfish	*Lagodon rhomboides*	NA	Species
Killifish, mosquitofish, sailfin mollies	*Heterandria formosa, Gambusia affinis, Poecilia latipinna*	FW	Species
Red drum	*Sciaenops ocellatus*	ES (juveniles)	Species
Sand seatrout	*Cynoscion arenarius*	ES (juveniles)	Species
Sheepshead	*Archosargus probatocephalus*	NA	Species
Silversides	*Antherinopsidae*	ES (juveniles)	Genus or species
Silver perch	*Bairdiella chrysoura*	ES (juveniles)	Species
Spot	*Leiostomus xanthurus*	ES (juveniles)	Species
Spotted seatrout	*Cynoscion nebulosus*	NA	Species
Striped mullet	*Mugil cephalus*	ES (juveniles)	Species
Invertebrates – Juveniles, Adults, Meroplankton			
Pink shrimp	*Farfantepenaeus duorarum*	ES (juveniles)	Species
Blue crab	*Callinectes sapidus*	ES (juveniles)	Species
Atlantic brief squid	*Lolliguncula brevis*	NA	Species

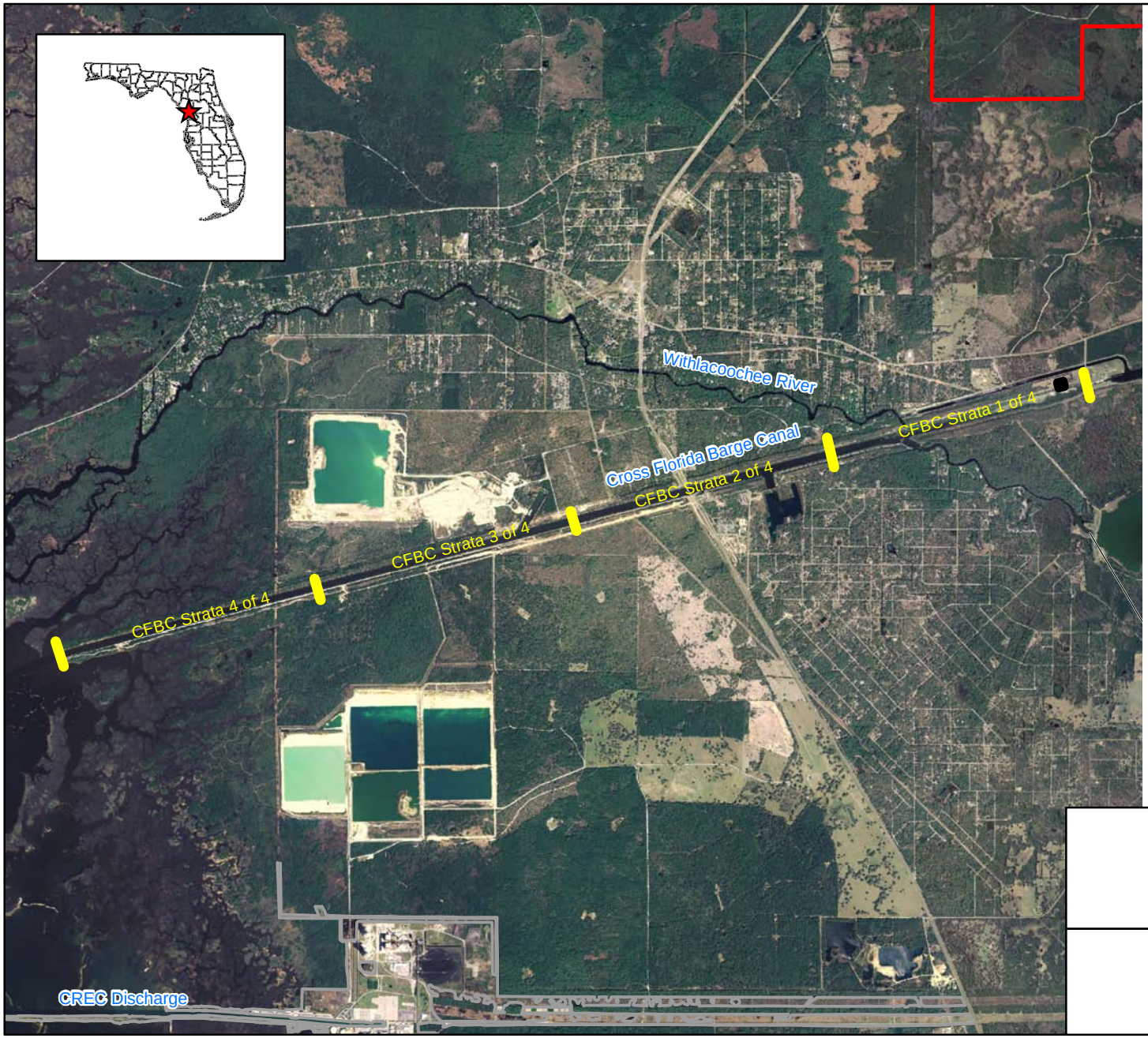
Notes:
ES = estuarine indicator
FW = freshwater indicator
SW = saltwater indicator

3.4 Adaptive Management

An adaptive management approach will be applied during implementation of the pre-operational survey and post-operational monitoring. Generally, the adaptive approach would involve refining the monitoring plan based on information obtained. Adaptation may be used to improve technical methods, improve the capability to detect change, and/or explore alternative ways to more cost effectively meet the monitoring plan objectives.

A power analysis will be performed at the end of each pre-operational monitoring year on the nekton and plankton data sets to evaluate if sample size and frequency are adequate to detect change at the desired comparison scale. This information may be used to adjust monitoring efforts once estimates of the variability in these communities can be established.

Adaptive management focuses on learning and adapting, through partnerships between agency stakeholders and PEF managers. With the increasing body of knowledge about the monitored aquatic system, managers will ideally be able to refine the monitoring plan to more closely meet the original objectives.



N
W E
S

LEGEND

- CFBC Linear Strata Boundary
- LNP Property Boundary
- CREC Property Boundary

Sources

LNP Site: Sargent & Lundy, 2007
Imagery: Labins, 2004

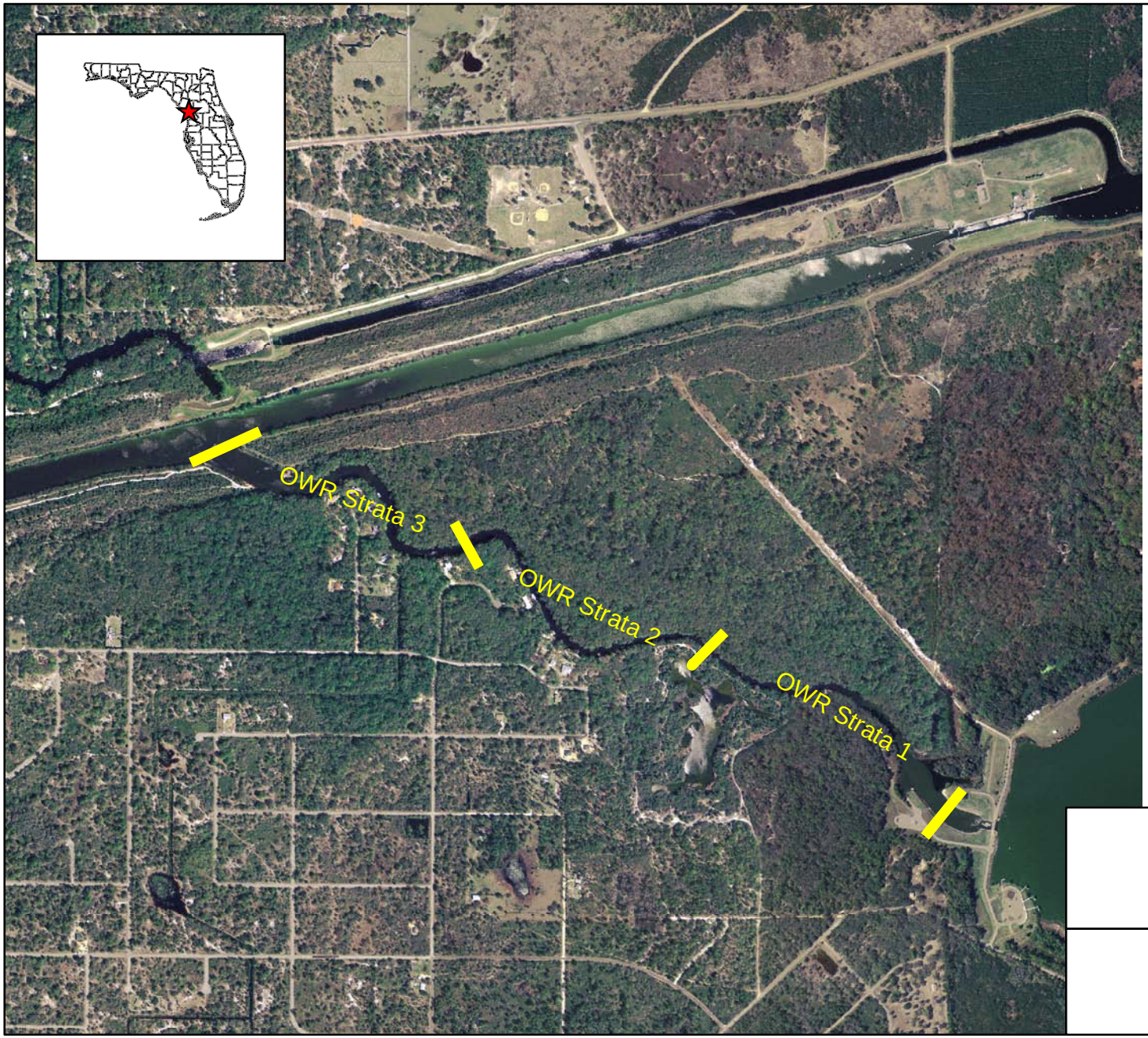
0 0.5 1 1.5 2
Kilometers

0 0.5 1 1.5 2
Miles

Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2

Cross Florida Barge Canal
Spatial Strata
FIGURE 3-1



N
W E
S

LEGEND

OWR Linear Strata Boundary

Sources
Imagery: Labins, 2004

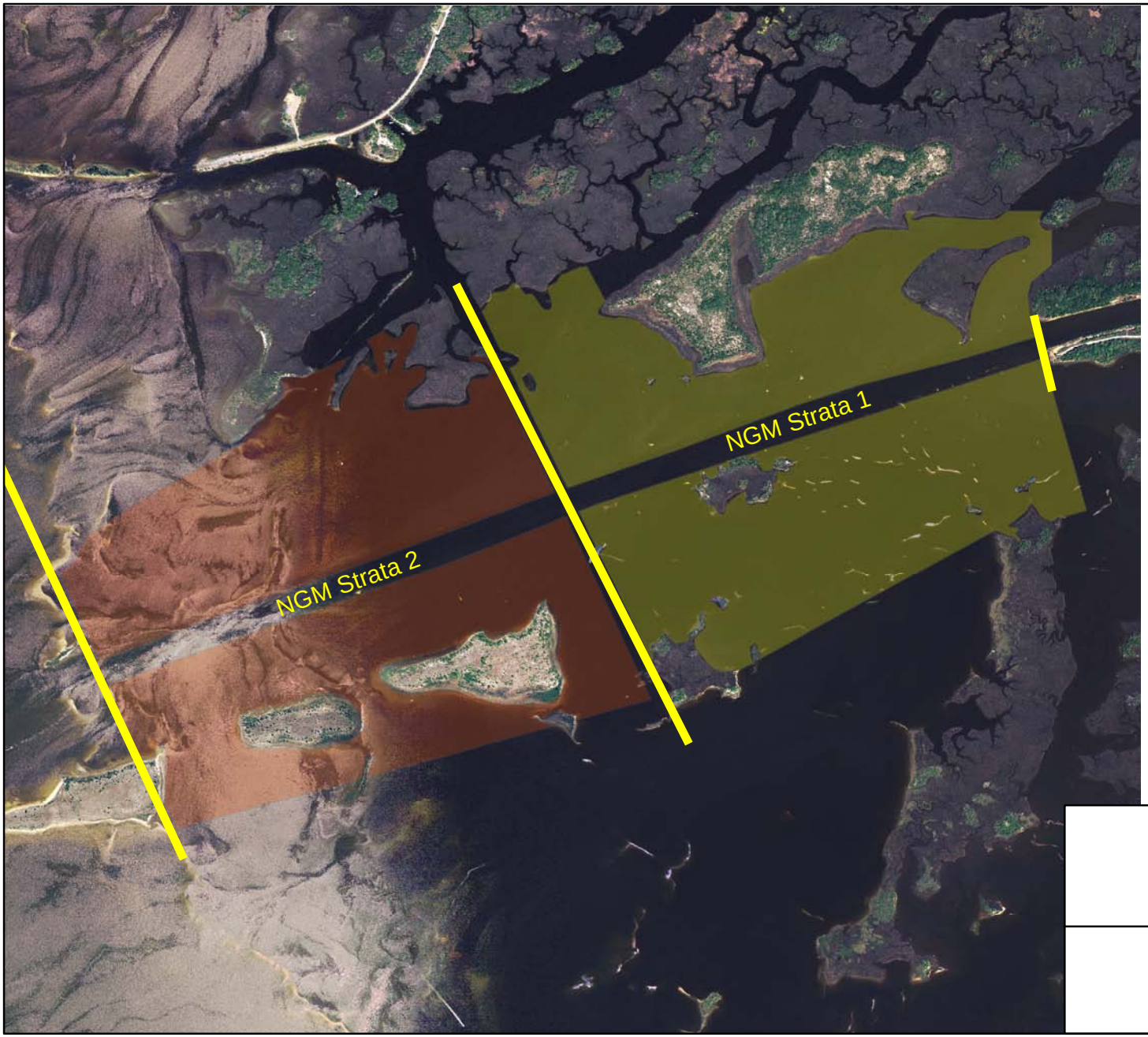
0 0.1 0.2 0.3 0.4
Kilometers

0 0.1 0.2 0.3 0.4
Miles

Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2

Old Withlacoochee River
Spatial Strata
FIGURE 3-2



N
W E
S

LEGEND

NGM Linear Strata Boundary

NGM Nekton Cell 1

NGM Nekton Cell 2

Sources

Imagery: Labins, 2004

0 0.25 0.5
Kilometers

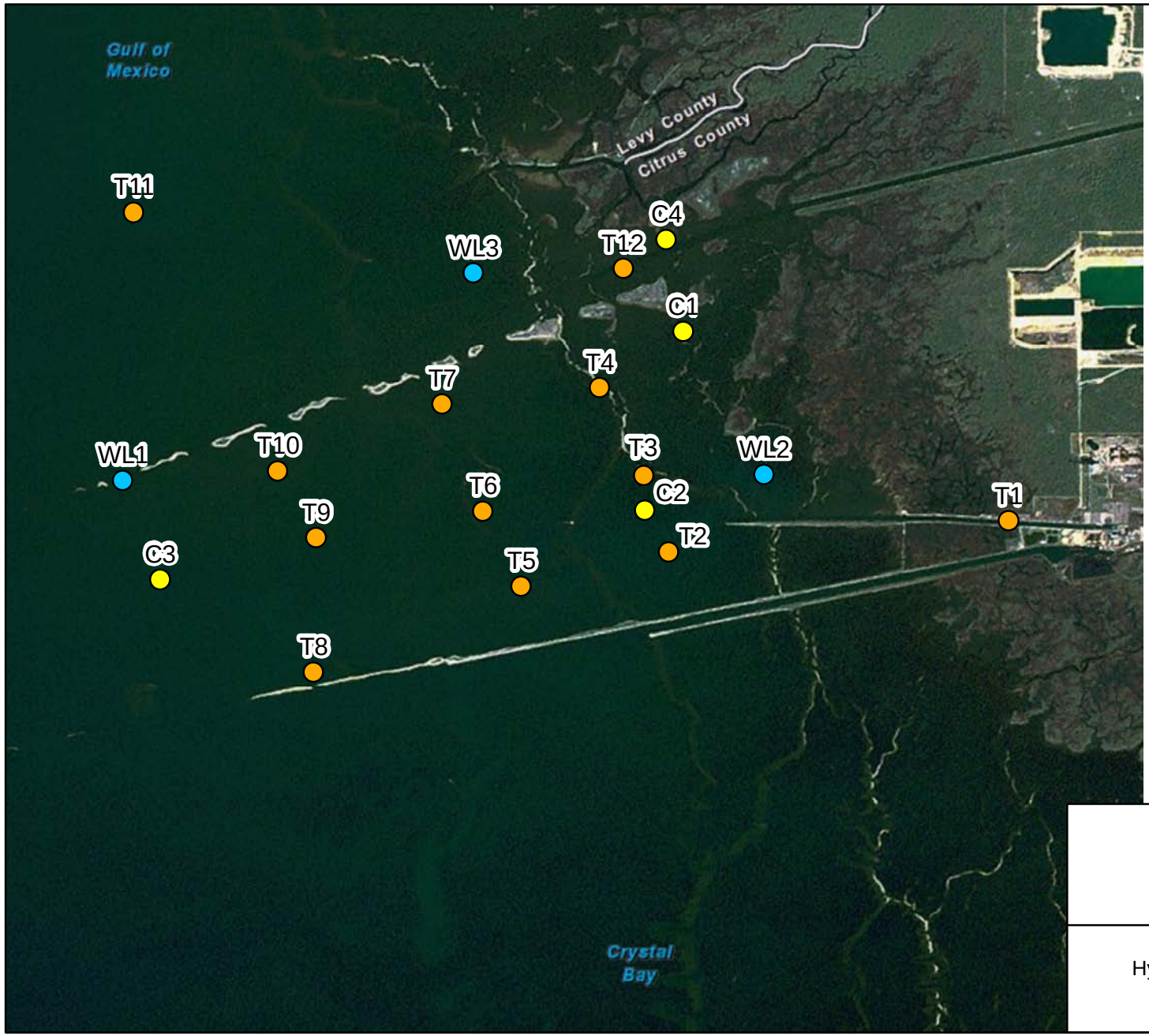
0 0.25 0.5
Miles

Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2

Nearshore Gulf of Mexico
Spatial Strata

FIGURE 3-3



N
W E
S

LEGEND

- Current Probe Location
- Temperature Probe Location
- Water Level Probe Location

Sources

Monitoring Locations: CH2M HILL 2009
USA Prime Imagery: ESRI Data 2008

0 0.5 1 1.5
Kilometers
0 0.5 1 1.5
Miles

Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2

Hydrographic Monitoring Locations

FIGURE 3-4

4.0 Quality Assurance / Quality Control and Data Management

The FDEP maintains SOPs for water quality data collection (Chapter 62-160, Florida Administrative Code [F.A.C.]). Water quality data collected for this program will conform to the quality assurance (QA) and quality control (QC) measures found in these SOPs (Chapter 62-4.246, F.A.C.). Table 4-1 contains a list of FDEP SOPs applicable to this CRSMP. In addition to compliance with FDEP protocols, health and safety, vessel operations, and manatee protection plan requirements will also be followed. Proposed deviations to FDEP water quality sampling protocols that are considered potentially beneficial to the program will be presented for FWC approval prior to implementation.

TABLE 4-1
FDEP SOPs Applicable to the CRSMP

Series	Description
FD 1000	Documentation
FM 1000	Field Mobilization
FS 1000	General Sampling
FT 1000	Field Testing General
FT 1100	Field pH
FT 1200	Field Specific Conductance
FT 1300	Field Salinity
FT 1400	Field Temperature
FT 1500	Field Dissolved Oxygen
FT 1700	Field Light Penetration
FT 11900	Field Continuous Monitoring

Notes:
CRSMP = Cross Florida Barge Canal and Withlacoochee River Baseline Survey and Monitoring Plan
FDEP = Florida Department of Environmental Protection
SOP = standard operating procedure

Source: FDEP, 2009

4.1 Field Team Management

A QA Officer will be assigned to oversee the training and documentation of the project. A QA/QC plan will be developed prior to initiation of work. Field safety plans will be developed prior to the program and distributed to field staff during their training. All field

sampling staff will be trained in the proper use of the equipment and SOPs for field sample data collection before field work begins.

Because sampling will be conducted from a watercraft, proper water safety is essential. The field team will comply with U.S. Coast Guard vessel operation requirements. Two or more staff will be involved for every sampling event; typically two sampling members and a separate boat operator is the minimum crew. The watercraft must be of sufficient size to safely handle the crew and samples (weight and volume). The craft must be able to maintain its position at a site during the collection period. Poor weather conditions may require rescheduling sampling events.

4.2 Field Data Records

Data collected during field sampling events will be recorded on standardized field data sheets and electronically on water quality meters and geographic positioning system devices. Data sheets will be provided in a QA/QC plan developed and approved prior to implementation of the pre-operational survey. Field data sheets will include gear deployment records, nekton and plankton sample logs, field water quality profiles, instrument calibration logs, health and safety forms, sample chain of custody forms. Field data sheets will be controlled each month by performing QC checks prior to entry into an electronic database or being filed in project records.

Meters will be field calibrated at the beginning of each sampling day, and again following final measurements of the day. Field calibrations will be conducted in accordance with FDEP SOPs, or equipment manufacturer SOPs. Water transparency will be measured using a Secchi disk following the applicable portions of SOP FT 1700.

4.3 Electronic Database

An electronic database will be created, managed, and controlled to allow for data retrieval and analysis in a secure environment. All raw data collected under this monitoring plan will be integrated into the database. Access to the data will be controlled at both the server and database level. Data will be managed in a secure environment using Microsoft SQL Server or equivalent program. Project data reporting tools will be developed using a Microsoft Access 2003 interface or equivalent program. The database will support the generation of report deliverables through a standardized and automated approach. All data report deliverables generated from the database toolset will use queries and/or visual basic code. All queries will be reviewed and validated as accurate in both approach and calculation.

5.0 Reporting

Results from the monitoring activities will be reported in annual progress reports and will include all data and analyses resulting from the survey and monitoring requirements.

The reports will be submitted by April 1 of each year after the first pre-operational monitoring period. PEF will submit the final annual reports, with any required supporting information, to the FWC and the FDEP Siting Office for review.

As part of the CRSMP survey and monitoring program, the following reports will be produced:

Nekton and Plankton

- Annual reports of nekton and plankton surveys and associated field water quality parameters collected during each monitoring year. The reports will include raw data, descriptive statistics of results, a status update, and any recommended changes for future monitoring.
- A summary report of nekton and plankton surveys and associated field water quality parameters at the end of the baseline period. This report will be combined with the annual report for the final preoperational monitoring year. The report will include summary statistics, analyze spatial and temporal trends, and will include figures and tables summarizing the sampling results.
- Once the LNP is operational and the post-operational period begins, annual reports will include an analysis comparing current data to preoperational survey data. A summary report comparing current data to preoperational survey data will be submitted a minimum of 6 months prior to the renewal of the NPDES permit.

Hydrographic Survey

- A summary report of pre-operational hydrographic survey results. This report will include an analysis documenting the flow and circulation patterns in the nearshore areas during 1 year of pre-operational monitoring.
- Summary reports of post-operational hydrographic survey results following the commencement of operations of LNP 1 and LNP 2. Each report will include an analysis documenting the flow and circulation patterns in the nearshore areas during one year of post-operational monitoring. The reports will also compare post-operational data to pre-operational survey data.

Impingement and Entrainment Study

- Annual reports of impingement and entrainment surveys and associated field water quality parameters for scheduled post-operational monitoring years. The reports will include raw data, descriptive statistics of results, a status update, and any recommended changes for future monitoring.

6.0 References

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ATTACHMENT A

Sample Size Determinations for Nekton and Plankton

The Conditions of Certification (COCs) adopted by the "Final Order on Certification for the Progress Energy Levy Nuclear Power Plant Units 1 and 2," dated August 26, 2009, suggests a minimum of 12 samples per month in the Cross Florida Barge Canal (CFBC), 6 samples per month in the Old Withlacoochee River, and 6 samples per month in the nearshore Gulf of Mexico for both plankton and nekton. This level of sampling would be considered statistically significant (greater than 30 samples) when compared on a semiannual and annual basis (see Table A-1). In addition, the COC recommended minimum sampling effort would be enough to compare plankton and nekton populations in the CFBC on a quarterly basis, if desired.

TABLE A-1
Suggested Sample Sizes and Temporal Comparison Scales

Study Areas	COC Suggested Sampling Effort[a]	Population Comparison Scale		
		Quarterly	Semiannually	Annually
CFBC	12	36	72	144
Old Withlacoochee River	6	18	36	72
Nearshore Gulf of Mexico	6	18	36	72

Notes:
CFBC = Cross Florida Barge Canal
COC = Condition of Certification
[a]Monthly sampling effort for both nekton and plankton

A review of existing regional biological monitoring plans indicated that sampling intensities were also within the ranges shown in Table A-1 and were similar to the COC suggested minimums for the study areas. Comparison scales varied from quarterly to semiannually within the hydrobiological monitoring plan (HBMP) (PBS&J, Inc., 2000). The HBMP was designed to account for varied surface water withdrawal schedules and to collect a statistically significant number of samples (30 samples) per study area to compare populations because existing data was unavailable for a power analysis. Sample sizes were divided among defined spatial strata and a ratio of 2 seines to 1 trawl was used also in keeping with COC suggested efforts for the Cross Florida Barge Canal and Withlacoochee River Baseline Survey and Monitoring Plan (CRSMP).

The COC sample size request is considered appropriate for the design of the CRSMP for population comparisons on a semiannual basis. This degree of sampling size is similar with the HBMP monitoring efforts and provides a reasonable statistical design to detect status and trends in nekton and plankton populations between pre-operational surveys and post-operational monitoring.

ATTACHMENT B

Evaluation of Diurnal (Day/Night) Zooplankton Community Variations

Diurnal zooplankton variation was evaluated to determine if nighttime sampling alone would provide the necessary data to evaluate potential changes in the zooplankton community due to the proposed cooling water intake structure (CWIS) withdrawal.

Statistical Analyses

An Analysis of Variance (ANOVA) was used to examine differences of zooplankton abundance between night and day using the three replicates per station per date as the within station sampling error. ANOVA is a technique designed to determine whether the mean values of multiple groups are statistically different from one another. The probability that observed differences between the various effects could be due to random variability in the data was calculated and compared to a significance level of 0.05. If the calculated probability for an effect is less than 0.05, that effect is typically deemed significant. The lower the calculated probability, the more significant the effect is based on the ANOVA evaluation. Determining that an effect is significant indicates that all the groups considered are not equivalent (at least one is different from the others, or perhaps all are different from one another). ANOVA is often applied directly to measured data, but if that data is not normally distributed, the calculated probabilities can be biased. To avoid biased probabilities, a rank transformation was performed on the density data before the ANOVA was performed.

To determine which individual groups are significantly different from one another, a test of contrasts was performed. The *post hoc* test employed for this evaluation was the Tukey comparison ($p < 0.05$). For each constituent, the group with the largest mean value is assigned the letter A. If the mean values of all groups are statistically similar to one another, then they all are assigned the letter A. If the mean value of a group is statistically lower than the one designated as A, then it is designated as a B. If the mean value is not statistically different between two categories (A or B), it is given the designation AB.

Conclusions

The evaluation indicates that sampling during the nighttime only will provide the necessary data to evaluate changes in the zooplankton community due to the proposed CWIS withdrawal. The taxa that comprised the majority of the zooplankton community and had the highest percent composition during the day were found at relatively the same proportions at night. These abundant taxa include copepods, Panopeidae crab larvae, anchovy eggs and larvae and goby larvae. Furthermore, plankton abundance was either not statistically different during the day versus night or statistically higher during the night.

TABLE B-1
ANOVA Results

Plankton Type	Effect	Rank Transformed Results
Zooplankton	Day/Night	<0.0001
Holoplankton	Day/Night	<0.0001
Meroplankton	Day/Night	0.1035
Fish Eggs	Day/Night	0.8669
Fish Larvae	Day/Night	0.006

Notes:
Non-significant results are shaded gray.
ANOVA = Analysis of Variance

TABLE B-2
Tukey's Test Results

Plankton Type	Group	Rank Transformed Results
Zooplankton	Day	B
	Night	A
Holoplankton	Day	B
	Night	A
Fish Larvae	Day	A
	Night	A

Notes:
Tukey's test was not performed on meroplankton and fish egg abundances since there were no significant differences using an ANOVA.

ATTACHMENT C

Hydrographic Survey Monitoring Location Coordinates

TABLE C-1
Hydrographic Survey Monitoring Coordinates

Station	Latitude	Longitude
C1	28.98149	82.74863
WL2	28.96483	82.73919
T2	28.95580	82.75030
T3	28.96469	82.75322
T10	28.96524	82.79585
T5	28.95177	82.76752
T6	28.96052	82.77196
T7	28.97302	82.77669
C2	28.96066	82.75308
T4	28.97497	82.75835
C4	28.99219	82.75058
T12	28.98885	82.75558
WL3	28.98830	82.77308
T9	28.95747	82.79141
T8	28.94177	82.79168
C3	28.95261	82.80960
T11	28.99538	82.81265
WL1	28.96413	82.81390
T1	28.95941	82.71072