

Crystal Bay Surface Water Monitoring Plan

Prepared for

Progress Energy Florida, Inc.

Prepared by



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Acronyms and Abbreviations

CAMA	Coastal and Aquatic Managed Areas
CB	Crystal Bay associated monitoring location
CBSWMP	Crystal Bay Surface Water Monitoring Plan
CFBC	Cross Florida Barge Canal
COC	Condition of Certification
CREC	Crystal River Energy Complex
CWIS	cooling water intake structure
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FFWCC	Florida Fish and Wildlife Conservation Commission
GPS	Global Positioning System
LNP	Levy Nuclear Plant Units 1 and 2
LNP 1	Levy Nuclear Plant Unit 1
LNP 2	Levy Nuclear Plant Unit 2
µg/L	microgram per liter
mg/L	milligram per liter
mgd	million gallons per day
PEF	Progress Energy Florida, Inc.
psu	practical salinity units (same as parts per thousand)
QA	quality assurance
QC	quality control
SOP	Standard Operating Procedure
SWFWMD	Southwest Florida Water Management District
TKN	total Kjeldahl nitrogen
TN	total nitrogen
TP	total phosphorus
TSS	total suspended solids
WITH	Withlacoochee Bay associated monitoring location
YSI	Yellow Springs Instruments

1.0 Introduction

Progress Energy Florida, Inc. (PEF) is proposing to build and operate a nuclear powered electric 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 4 miles 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 9.6 miles southwest of the proposed plant site.

The Florida Governor and Cabinet, sitting as the State of Florida Siting Board, approved the Final Order on Certification for the Progress Energy LNP on August 26, 2009. The Final Order included Conditions of Certification (COCs; Florida Department of Environmental Protection [FDEP], 2009a). The COC that is addressed by this monitoring plan is Condition SECTION B, XXVII.K, Coastal and Aquatic Managed Areas, which requires the development of a Crystal Bay Surface Water Monitoring Plan (CBSWMP).

1.1 Regulatory Requirements

Condition SECTION B, XXVII.K requires the submittal of a CBSWMP for review and approval pursuant to Chapter 62-302, Florida Administrative Code to the FDEP Office of Coastal and Aquatic Managed Areas (CAMA) and the FDEP Siting Office. The requirements of Condition SECTION B, XXVII.K (FDEP, 2009a) are addressed in this CBSWMP, as described below.

SECTION B, XXVII.K Coastal and Aquatic Managed Areas

Within 180 days following certification, licensee shall submit a Crystal Bay Surface Water Monitoring Plan for review and approval pursuant to Chapter 62-302, [Florida Administrative Code (F.A.C.)] to the DEP Office of Coastal and Aquatic Managed Areas and the DEP Siting Office. At a minimum, the plan shall include the following components unless otherwise approved by CAMA:

- 1. Equally spaced monitoring points from the point of discharge into the Bay to the edge of the St. Martins Marsh and Big Bend Seagrasses Aquatic Preserves. Each monitoring point shall include salinity and temperature. The Licensee should determine from discharge modeling data the appropriate number of water quality sites and locations (This could range from 8-40 monitoring points along transects).*

[Described in Subsections 3.1.1 and 3.1.2, Tables 3-1 and 3-2, and Figure 3-1 of this CBSWMP]

- 2. Discharge, nutrient sampling for Total Phosphorus (TP), and Nitrogen (TN), Total Suspended Solids (TSS) and Dissolved Oxygen (DO) shall be included at each monitoring point.*

[Described in Subsection 3.1.2 and Table 3-2 of this CBSWMP]

3. *Specific monitoring locations, sampling frequencies, methods, specific parameters to be monitored.*

[Described in Sections 3.1 and 4.0,; Tables 3-1, 3-2, 3-3, 4-1, and 4-2; and Figure 3-1 of this CBSWMP]

4. *Duplication of monitoring frequency or sample points with those of other monitoring plans (such as that required by FFWCC under COC XXVII.B.) is not a requirement of the CAMA plan. As such, it is acceptable to incorporate the above requirements within a larger monitoring plan, provided that the above elements of the CAMA monitoring plan are maintained and the related monitoring data is clearly singled out. If the Department determines that the pre- and post operation monitoring indicate potential adverse changes in the surface waters in close proximity to either of the Aquatic Preserves due to the LNP discharges, then the Department may propose additional measures to evaluate or to abate such impacts. Water quality monitoring reports should be made readily available to St. Martins Marsh and Big Bend Seagrasses Aquatic Preserves.*

[Described in Section 5.0 of this CBSWMP]

2.0 Background and Site Description

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

2.1 LNP Intake and Discharge Characteristics

The LNP will use a closed-cycle cooling water system that will withdraw cooling water makeup from the CFBC. The LNP's cooling water intake structure (CWIS) will be constructed on the canal bank at a site south of the LNP site and west of the Inglis Lock on the CFBC, 6.9 miles inland from the Gulf of Mexico. The CWIS will be located on the berm that forms the northern shore of the CFBC. Cooling water will be withdrawn from the CFBC using pumps at a flow rate of approximately 122 million gallons per day (mgd).

The LNP will have a combined wastewater discharge comprised of several wastewater streams. The cooling system will use mechanical draft cooling towers and will have a blowdown capability that will comprise about 98 percent of the LNP wastewater. The LNP wastewater will be piped to the CREC and released into the existing CREC discharge canal, which flows into the Gulf of Mexico. The maximum flow associated with the LNP, about 88 mgd, is equivalent to 4 to 5 percent of the existing permitted discharge from the CREC.

2.2 Aquatic Preserves and Study Area Descriptions

The aquatic preserves closest to the LNP discharge include the Big Bend Seagrasses Aquatic Preserve approximately 6 miles to the northwest and the St. Martins Marsh Aquatic Preserve approximately 4 miles to the southeast (see Figure 2-1). The aquatic study area associated with the CBSWMP encompasses the nearshore area between these preserves, as well as stations at the boundaries of the preserves. Oyster reefs are common in the shallow nearshore environment and are exposed at low tide.

The southern extent of the Big Bend Seagrasses Aquatic Preserve is located just north of the mouth of the Withlacoochee River. This aquatic preserve encompasses tidal lands, islands, seagrass beds, shallow banks, and submerged bottoms from the mean high water line.

The Withlacoochee River and the CFBC connect to the Gulf of Mexico immediately south of the Big Bend Seagrasses Aquatic Preserve. 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 miles along the southern boundary of the channel.

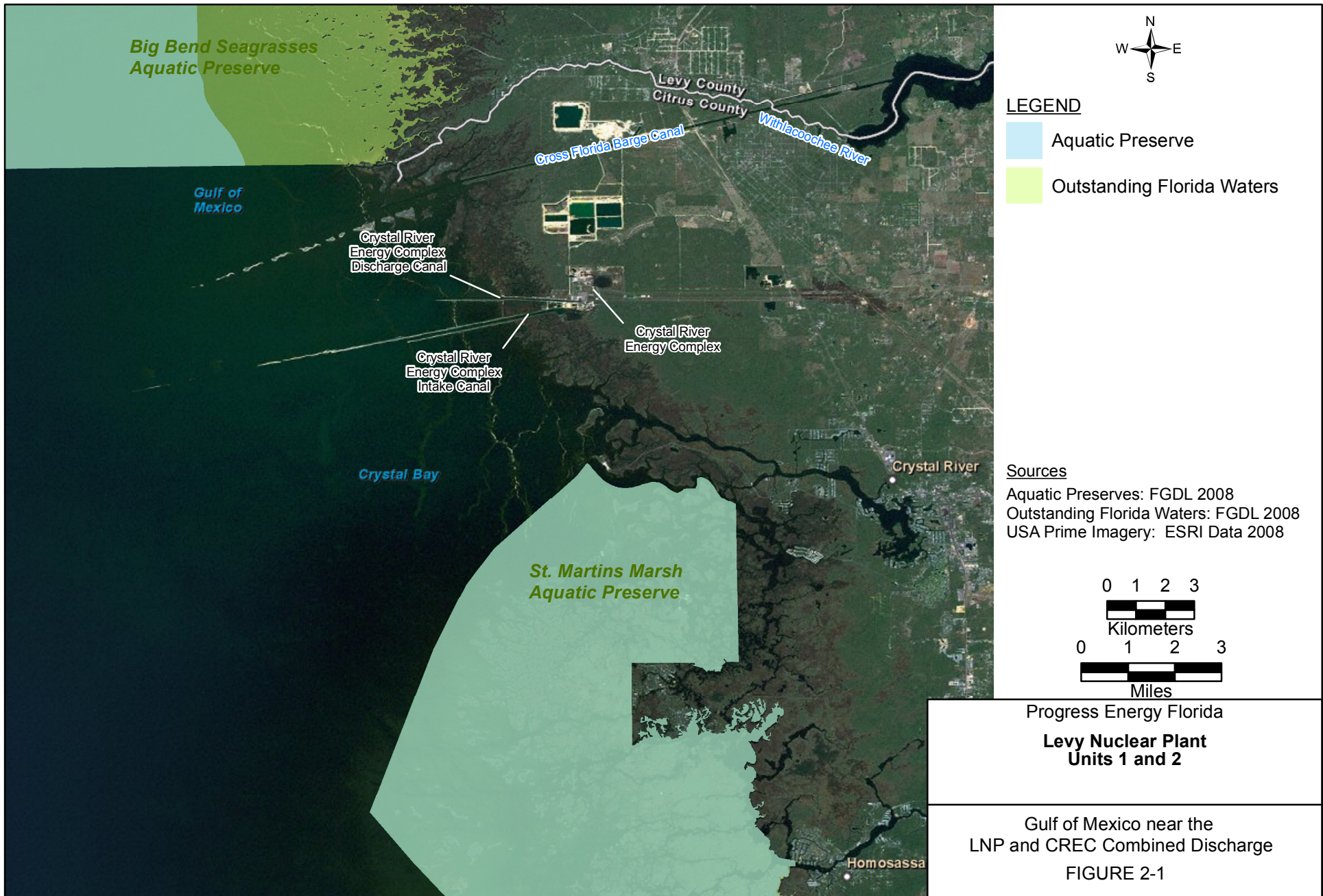
The St. Martins Marsh Aquatic Preserve covers open water areas from the Crystal River to the Homosassa River in coastal Citrus County. This aquatic preserve adjoins upland hammock islands and is composed of open water, mangrove islands, several inlet bays, tidal rivers and creeks, and salt marsh. Two first-magnitude spring-fed rivers, Homosassa River and Crystal River, continuously discharge freshwater into St. Martins Marsh.

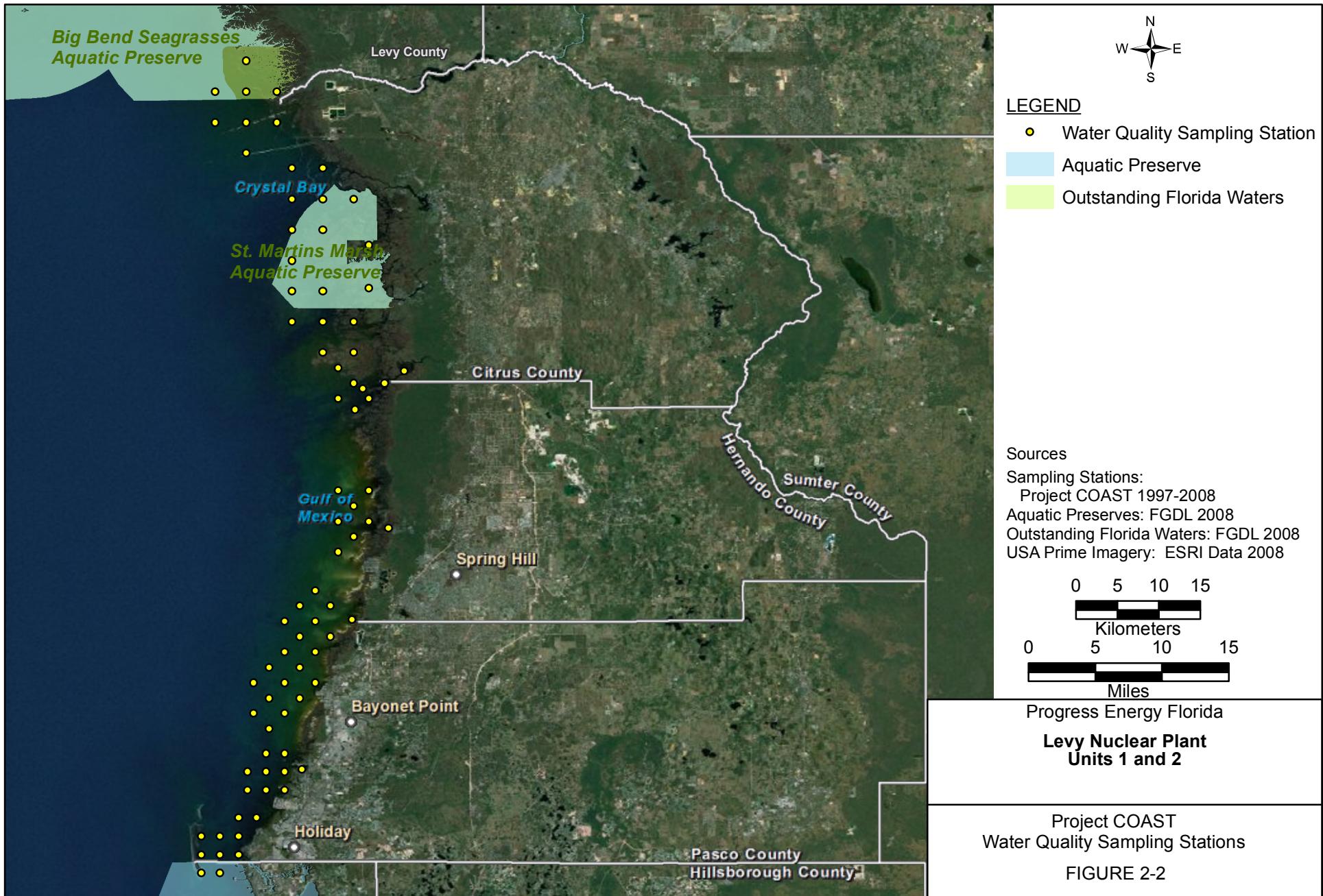
By the CREC facility, channels and berms border both the intake and discharge canals. The excavated discharge canal extends 1.2 miles west into the Gulf of Mexico with a dike along the southern side. Farther south, two berms border the intake canal, extending 2.7 miles into the Gulf of Mexico. Beyond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

2.3 Historical Data

Water quality sampling is conducted in this part of the Gulf of Mexico under Project COAST by the University of Florida and FDEP staff; the project is funded through the Southwest Florida Water Management District's (SWFWMD's) Surface Water Improvement and Management program and Coastal Rivers Basin Board, and the states' Water Quality Assurance Trust Fund (Frazer et al., 2001). As part of Project COAST, monthly water quality monitoring has been conducted since 1997 at an array of stations along the Gulf of Mexico coast extending from southern Levy County through Citrus, Hernando, and Pasco counties and into northern Pinellas County (see Figure 2-2). Water quality results reported for these stations includes Secchi depth, temperature, salinity, DO, pH, TN, TP, chlorophyll, color, and light attenuation coefficient.

The Project COAST water quality data from January 1997 through June 2008 were obtained from the SWFWMD and evaluated to determine their representativeness to help guide the selection of CBSWMP stations. Stations in proximity to the study area were extracted from the dataset for further analysis (see Attachment A). Relevant statistics for the selected Project COAST water quality data in the CBSWMP study area are presented in Attachment A and are discussed further in Subsection 3.1.1 with the selection of CBSWMP monitoring locations.





3.0 CBSWMP Water Quality Monitoring

The purpose of this plan is to monitor for potential adverse changes in surface water nutrient-related quality in close proximity to these aquatic preserves that may be related to the LNP discharge. This section provides an overview of the CBSWMP water quality monitoring points, parameters to be sampled, sampling methods, and frequency of sampling. Other sections of this plan discuss quality assurance (QA) sampling and procedures, scheduling, and reporting.

3.1 CBSWMP Water Quality Monitoring Points

To the extent possible, the CBSWMP water quality monitoring points will be collocated with Project COAST stations. Collocating CBSWMP points with Project COAST monitoring stations will provide historical information that will allow for the statistical comparison of data over time, providing for both quality control (QC) and data augmentation. The Project COAST data are equally spaced from near the boundary of the two preserves and extend to the vicinity of the LNP combined discharge. However additional points were added in proximity to the combined LNP and CREC discharge to characterize potential nutrient sources better.

A total of 19 locations comprise the CBSWMP water quality network (see Table 3-1 and Figure 3-1); 12 of these points are collocated with existing Project COAST stations. Attachment B provides a list of sampling point latitude/longitude coordinates. The following bulleted list provides an overview of the CBSWMP monitoring point distribution:

- Five monitoring points are in proximity to the boundary to the Big Bend Seagrasses Aquatic Preserve: WITH-4, WITH-5, WITH-7, WITH-8, and WITH-9. These points are collocated with existing Project COAST stations.
- Five monitoring points are in proximity to the boundary of the St. Martins Marsh Aquatic Preserve: CB-0, CB-1, CB-5, CB-6, and CB-8. All points but CB-0 are collocated with existing Project COAST stations.
- Five monitoring points are in proximity to the LNP discharge at the CREC: CREC-3, CREC-4, CREC-7, CREC-8, and WITH-10. Of these, WITH-10 is collocated with an existing Project COAST station.
- Two monitoring points, WITH-0 and WITH-6, are Withlacoochee River source monitoring locations established to monitor inputs from the Withlacoochee River into the study area. WITH-6 is collocated with an existing Project COAST station. WITH-0 will monitor contributions along the main dredged outlet of the Withlacoochee River.
- One monitoring point, CFBC-3, is a CFBC source monitoring location established to monitor discharge from the CFBC into the study area.

- One monitoring point, CB-2, is a Crystal River source monitoring location established to monitor inputs from the Crystal River into the study area. CB-2 is collocated with an existing Project COAST station.

TABLE 3-1
Listing of CBSWMP Water Quality Monitoring Points by Location Group

Station Group	Monitoring Points
Big Bend Seagrasses Aquatic Preserve	WITH-4, WITH-5, WITH-7, WITH-8, WITH-9
St. Martins Marsh Aquatic Preserve	CB-0, CB-1, CB-5, CB-6, CB-8
LNP Discharge Vicinity	CREC-3, CREC-4, CREC-7, CREC-8, WITH-10
Withlacoochee River Source	WITH-0, WITH-6
CFBC Source	CFBC-3
Crystal River Source	CB-2

From the results of the statistical analyses of the Project COAST data presented in Attachment A, the following observations have been made:

- Based on nutrient concentrations, the Project COAST stations can be divided into a northern group located in the Withlacoochee Bay vicinity and a southern group located in the Crystal Bay vicinity. A Project COAST station located near the mouth of the Withlacoochee River (WITH-6) was an outlier because it was significantly different from all other stations in the vicinity at the 95 percent confidence level (see Table A-1).
- Most of the Project COAST stations have similar nutrient levels; however, higher levels were observed near the mouth of the Withlacoochee River (WITH-6). Table A-2 provides a summary of Project COAST water quality results for salinity, TN and TP for the northern group, southern group, and WITH-6 stations. The CBSWMP will position points near the Withlacoochee River to monitor the contribution from this source.
- Salinity data demonstrate a difference between stations located near freshwater sources (see Figure A-1 in Attachment A). The CBSWMP will include monitoring points located near freshwater sources to the study area.
- Some latitudinal differences in TN values exist between stations; with TN concentrations generally being slightly higher in the northern portion of the Project COAST sampling area (see Table A-2 and Figure A-2 in Attachment A). The CBSWMP monitoring points include locations spaced along this gradient between the north and south preserves.

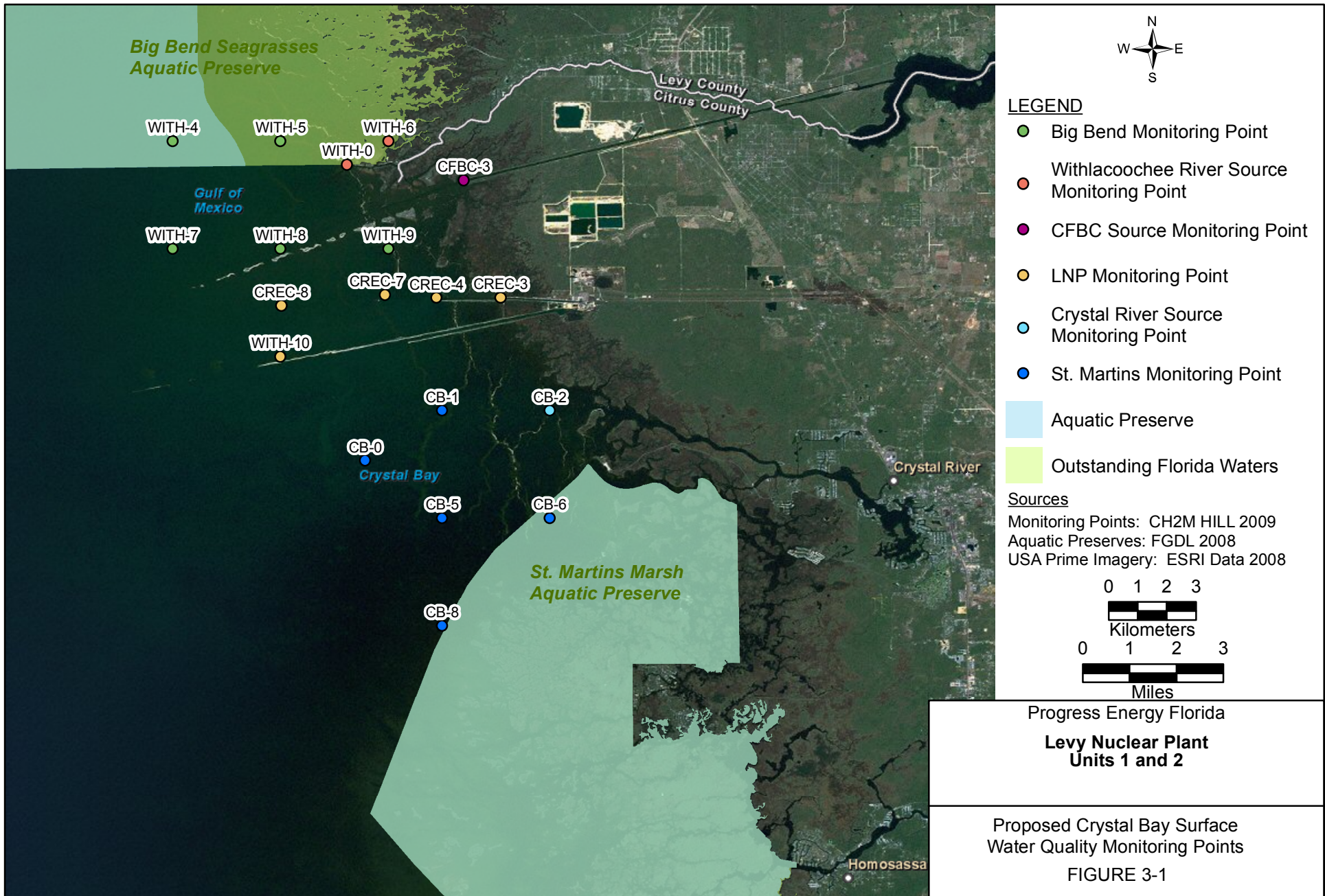
Based on these analyses, it appears that the data collected by the Project COAST program are sufficient to define nutrient concentrations and differences across the CBSWMP study area. The CBSWMP monitoring points will be collocated with established Project COAST locations to form a monitoring network ranging from the Big Bend Seagrasses Aquatic Preserve to the north, through the discharge zone and freshwater sources, to the St. Martins Marsh Aquatic Preserve to the south.

3.2 Sampling Parameters

Table 3-2 presents a summary of CBSWMP water quality monitoring parameters. Field water quality parameters to be measured at each location include depth profiles (1-meter intervals) of DO, salinity, and temperature. Analytical water samples for TN, TP, and TSS will be collected at a 0.5-meter depth from the water surface. Additional information about surface water sampling procedures is detailed in Section 4.3.

TABLE 3-2
Summary of Water Quality Monitoring Parameters at CBSWMP Locations

Parameter	Number of Locations	Test Method	Collection Points for Water Quality Parameters
Dissolved Oxygen	19	Field	Depth profile (1-meter intervals)
Temperature	19	Field	Depth profile (1-meter intervals)
Salinity	19	Field	Depth profile (1-meter intervals)
Total Nitrogen	19	Lab	Surface (0.5-meter depth)
Total Phosphorus	19	Lab	Surface (0.5-meter depth)
Total Suspended Solids	19	Lab	Surface (0.5-meter depth)



4.0 Quality Assurance and Control

The FDEP maintains SOPs for field data collection (Chapter 62-160, F.A.C.). Data collected for this plan will conform to the QA and control measures found in these SOPs (Chapter 62-4.246, F.A.C.). Table 4-1 contains a list of FDEP SOPs that are applicable to the CBSWMP (FDEP, 2009b). A summary of some of the most common elements applicable to this plan are included in this section. In addition to compliance with FDEP protocols, the CBSWMP monitoring team will comply with requirements that cover health and safety, watercraft operations, and compliance with manatee protection plans.

TABLE 4-1
List of FDEP SOPs Applicable to the CBSWMP

Series	Description
FC 1000	Field Decontamination
FD 1000	Documentation
FM 1000	Field Mobilization
FQ 1000	Quality Control
FS 1000	General Sampling
FS 2000	General Water Sampling
FS 2100	Surface Water Sampling
FT 1000	Field Testing General
FT 1300	Field Salinity
FT 1400	Field Temperature
FT 1500	Field Dissolved Oxygen

Notes:

CBSWMP = Crystal Bay Surface Water Monitoring Plan

FDEP = Florida Department of Environmental Protection

SOP = standard operating procedure

Source: <http://www.floridadep.org/labs/qa/sops.htm>, accessed 11/04/2009

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 field work. The field team will maintain its own administrative procedures, which will include company-specific training. Field safety plans will be developed 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.

As the sampling will be conducted from a watercraft, proper water safety is essential. Two or more staff will be involved for every sampling event; the minimum crew is typically two sampling members and a separate boat operator. 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.

4.2 Pre-Sampling Event Preparation

Pre-cleaned sample containers of the required size and type will be obtained from the laboratory. Chain-of-custody forms, which are to be maintained with the samples, will be partially filled out prior to leaving for the sampling event.

Sampling will include inorganic, nonmetallic parameters and physical properties. No volatile substances are involved, so no special trip blanks are required (see Subsection 4.4.1). Sampling equipment will be decontaminated and prepared prior to the sampling event. The equipment for in-situ samples will be calibrated using standard methods according to FDEP SOPs. Operation of the field monitoring equipment will follow the manufacturer's recommended procedures and standards.

4.3 Sample Collection and Handling

The monitoring points are mapped and locations will be found in the field using standard Global Positioning System (GPS) equipment (see Attachment B). Once the sampling team is at a monitoring point, the team will maintain their position by anchoring or by motor, depending upon conditions during sampling. Minor variation in actual sampling position may occur due to drift and sea conditions.

Field parameters (DO, temperature, and salinity) will be collected using a Yellow Springs Instruments (YSI) or equivalent multi-parameter sonde. Depth profile measurements will be made at 1-meter increments from the water surface to approximately 0.5 meter above the ocean bottom. The sonde will be weighted sufficiently to allow the probe to reach the bottom in strong tidal currents. Probe calibrations will be conducted in accordance with FDEP standard operating procedures (SOPs) for each parameter.

Analytical water quality samples will be collected using a peristaltic pump with Teflon tubing at designated sampling depths. Clean sample collection practices will be maintained, but ultra-clean metal sampling is not a requirement of this plan because metals are not being monitored. Samples will be collected near the bow of the watercraft (away from gas engines). The pump tubing will be weighted to keep the end steady at the sample depth. A volume of water sufficient to purge the tubing will be flushed through the tubing prior to sampling. The tubing will not be inserted into the sample containers but held over the container until an adequate volume is obtained. The container will be handled by a "clean hands" crew member who will seal and label each bottle prior to cooling samples on ice within 15 minutes of collection. The "clean hands" field team member will use non-talc, latex gloves.

Water quality sample preservation and holding times will conform to FDEP SOPs. Two inorganic, nonmetallic parameters will be monitored: TN and TP. In accordance with FDEP SOP FS 1000, the pH of the samples will be monitored to ensure samples are preserved appropriately. Coolers with ice will also be transported on the sampling watercraft to cool the samples as soon as they are collected and labeled. Extra sample bottles will be transported and used if needed.

Field data sheets will be used to record the activity at each site, including weather and general observations at each station. Chain-of-custody forms will be completed, kept with

the coolers, and shipped to the laboratory. The laboratory will check and record the condition of the samples, including preservation, upon arrival.

4.4 Laboratory Sample Analysis

Water quality samples will be analyzed by a state-certified analytical laboratory using methods approved by the State of Florida. TN is calculated by adding the concentration results of total Kjeldahl nitrogen (TKN) and nitrate plus nitrite together. Analytical methods include the U.S. Environmental Protection Agency (EPA) Method 351.32 (Rev 2.0, 1993) for TKN and EPA Method 353.32 (Rev 2.0, 1993) for nitrate plus nitrite. The analytical method for TP is EPA Method 365.2 (Rev 2.0, 1993). The analytical method to be used for TSS is Standard Method 2540 D. These methods are applicable for fresh and saline waters.

4.4.1 Field Duplicates and Equipment Blanks

Equipment blank and field duplicate samples will be collected for TN and TP parameters as noted in Table 4-2. Trip blanks are not required for inorganic parameters. One equipment blank of the pump and tubing will be collected using de-ionized water at least once per event. FDEP FQ 1000 requires the sampling organization to be responsible for ensuring that blanks, excluding trip blanks, are collected at a minimum of 5 percent of each reported test result/matrix combination for the life of a project. One equipment blank per event will satisfy this requirement. Field blanks are not required if equipment blanks are collected. In addition, one field duplicate will be collected per event at a location to be selected by the field team (anonymously labeled for laboratory analysis) and varied between events.

TABLE 4-2
Quality Assurance Sampling Requirements for the CBSWMP

Sample Type	Analysis	Number of Samples	Matrix
Sample Point	TN, TP, TSS	19	Receiving Water
Equipment Blank	TN, TP, TSS	1	De-ionized water, collected during the day and after first use.
Duplicate	TN, TP, TSS	1	Receiving water, vary stations duplicated between sampling events.

Notes:

Above data are for each sampling event.
CBSWMP = Crystal Bay Surface Water Monitoring Plan
TN = total nitrogen
TP = total phosphorus
TSS = total suspended solids

5.0 Reporting

Data collected during field sampling events will be recorded on standardized field data sheets and electronically on water quality meters and GPS devices. The data sheets will be provided in the QA/QC plan. Field data sheets for each event will be controlled by performing checks before entering the information into an electronic database and also by filing the original form into the project records. Results from the monitoring activities will be included in the following reports:

- A summary report of pre-operational water quality monitoring for the LNP. This report will include raw data, descriptive statistics of results collected for this condition requirement, a status update, and any deviations or required changes. The report will be submitted within 6 months of the completion of the first pre-operational monitoring period.
- A summary report of post-operational water quality monitoring for the LNP. Post-operational is defined as after an LNP reactor begins discharging wastewater. The report will include raw data, descriptive statistics of results collected for this condition requirement, Project Coast data, a status update, and any deviations or required changes. The report will include an analysis of spatial and temporal differences and tables and figures summarizing the sampling and analytical results. This report will be submitted within 6 months of completing each 2-year post-operational monitoring interval (one report following the commencement of operation of each generating unit, see Section 6.2).

6.0 Schedule for CBSWMP Monitoring

6.1 Sampling Frequency

A summary of water quality monitoring frequency is provided in Table 6-1. A sampling frequency of bi-monthly (six samples per year) was selected based on an evaluation of the variance in the Project COAST water quality monitoring data using the estuarine stations in the area (see Attachment A). The mean concentrations are relatively low, with 0.35 milligrams per liter (mg/L) for TN and 0.03 mg/L for TP (see Table A-3). The coefficient of variation (defined as the standard deviation divided by the mean) for the nutrient levels of TN and TP in the Project COAST data ranged from 0.4 to 0.6, which indicates a moderate amount of natural variability, which is expected and would make it difficult to demonstrate a significant change in concentration by field monitoring.

A sensitivity analysis was performed to see how many samples would be required to estimate a statistically significant change of approximately 0.05 mg/L for TN and 0.005 mg/L for TP (see Table A-3). These levels of change were considered sensitive enough because they are about 15 percent of the mean values of each parameter and are small increments, about one-half of the smallest significant digit for reliable readings. Table A-3 indicates that 30 samples are needed to meet the target sensitivity. There will be 4 years of post-operational data, with 6 samples per year at each monitoring point for a total of 24 samples available to estimate an effect from the LNP combined discharge at each station. The monthly data for the collocated Project COAST stations are also available to include in statistical analyses; these data can be included to increase the sample size. For example, the LNP discharge vicinity has five monitoring points. Bi-monthly sampling will yield 5 times 6 sampling events per year to create a sample size of 30, plus the extra 6 samples at WITH-10 from Project COAST. This produces a sufficient sample size to allow for the evaluation of significant effects for scheduled reports.

TABLE 6-1
Summary of Water Quality Monitoring Frequency

Parameter	Number of Stations	Frequency	
		Pre-Operational	Post-Operational
Dissolved Oxygen	19	Bi-monthly	Bi-monthly
Temperature	19	Bi-monthly	Bi-monthly
Salinity	19	Bi-monthly	Bi-monthly
Total Nitrogen	19	Bi-monthly	Bi-monthly
Total Phosphorus	19	Bi-monthly	Bi-monthly
Total Suspended Solids	19	Bi-monthly	Bi-monthly

Water quality data will be sampled bi-monthly (six samples per year). Sample months shall be February, April, June, August, October, and December. Dates will typically be regularly spaced (for example, the third week of the month) but may vary as a result of unforeseen delays or weather.

6.2 Monitoring Duration

Two years of bi-monthly sampling for pre-operational data will be collected within 3 years of Levy Nuclear Plant Unit 1 (LNP 1) beginning to discharge wastewater.

Two years of bi-monthly sampling will be conducted after LNP 1 begins discharging to the CREC. Bi-monthly sampling will also be conducted for 2 years after Levy Nuclear Plant Unit 2 (LNP 2) commences operation. These two post-operational periods may overlap or have a gap between them depending on the actual construction schedule.

At the completion of monitoring as described in this monitoring plan, the plan data will be evaluated. In accordance with the COC, the continuation of monitoring will be contingent upon the demonstration of significant adverse water quality impacts in close proximity to aquatic preserve boundaries.

7.0 References

Florida Department of Environmental Protection (FDEP). 2009a. *Levy Nuclear Power Plant Units 1 & 2, Progress Energy Florida Conditions of Certification Plant and Associated Facilities and Transmission Lines*. Certified August 26, 2009.

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Summary Statistics for Project COAST Stations Selected within CBSWMP Area

TABLE A-1
Tukey Test of Significance between Groups

Individual Results, 0.05 Significance Level	Station	Total Nitrogen Groupings	Station	Total Phosphorous Groupings	Station	Salinity Groupings
	WITH-6	A	WITH-6	A	WITH-10	A
	WITH-9	B	WITH-9	B	WITH-7	AB
	WITH-5	B	WITH-8	BC	WITH-4	ABC
	WITH-8	BC	WITH-5	CD	CB-5	BDC
	WITH-4	BC	WITH-7	ED	WITH-8	EDC
	CB-8	CE	WITH-4	ED	CB-1	ED
	WITH-7	CFE	WITH-10	E	WITH-5	DEF
	WITH-10	FE	CB-2	E	CB-8	EF
	CB-5	FE	CB-1	EF	WITH-9	GF
	CB-1	FE	CB-6	FG	CB-6	G
	CB-6	F	CB-5	FG	CB-2	H
	CB-2	F	CB-8	G	WITH-6	I

Same analysis with only average annual values, demonstrates stability in the data between years

Annual Averages, 0.05 Significance Level	Station	Total Nitrogen Groupings	Station	Total Phosphorous Groupings	Station	Salinity Groupings
	WITH-6	A	WITH-6	A	WITH-10	A
	WITH-9	AB	WITH-9	AB	WITH-7	A
	WITH-5	AB	WITH-8	BC	WITH-4	A
	WITH-8	AB	WITH-5	BC	CB-5	AB
	WITH-4	BD	WITH-4	CD	WITH-8	AB
	CB-8	BED	WITH-7	CD	CB-1	AB
	WITH-7	BED	WITH-10	D	WITH-5	ABC
	WITH-10	ED	CB-2	D	CB-8	ABC
	CB-5	ED	CB-1	DE	WITH-9	BC
	CB-1	E	CB-6	FE	CB-6	CD
	CB-6	E	CB-5	FE	CB-2	D
	CB-2	E	CB-8	F	WITH-6	E

Notes:

Locations that could have their results combined together based on Tukey Test have same letter. Letters are organized by strength of difference (A = most different, I = least different). Comparisons were made at the alpha = 0.05 level (95% confidence interval).

Project COAST stations are labeled by county, watershed, and station number. The data was coded for analysis using the watershed and station number. For example, W6 is Station 6 in the Withlacoochee Bay watershed in Levy County and is equivalent to WITH6. The Withlacoochee Bay spans across Levy and Citrus Counties. C and CB are associated with the Crystal Bay watershed locations in Citrus County.

A Tukey Multiple Comparison test is used to compare groups of means against each other simultaneously. The Tukey statistical test is usually more conservative in estimating significant differences than other alternative tests (Glantz, 2002).

Project COAST data included monthly results from January 1997 through June 2008.

TABLE A-2

Summary Water Quality Statistics for Project COAST Station Groups used in the Tukey Analysis in the Crystal Bay Surface Water Monitoring Plan Study Area

North Group: Project COAST Stations WITH-4, WITH-5, WITH-7, WITH-8, WITH-9, and WITH-10

South Group: Project COAST Stations WITH-10, CB-1, CB-2, CB-5, CB-6, and CB-8

Outlier: Project COAST Station WITH-6

Parameter	Group	Mean (µg/L)	Standard Deviation	Number of Results	Percentiles						
					Min	5th	25th	Median	75th	95th	Max
Salinity	North	24.3	4.91	735	3.0	15.0	21.7	25.0	27.7	30.9	37.0
Salinity	WITH-6	13.4	6.20	147	0.9	2.9	8.4	13.5	17.8	23.0	30.1
Salinity	South	22.7	5.33	881	3.4	12.9	19.8	23.2	26.5	30.6	34.3
Total Nitrogen	North	388	142.81	741	120	220	290	360	460	650	1170
Total Nitrogen	WITH-6	573	265.15	149	200	250	420	530	670	940	2000
Total Nitrogen	South	311	130.44	889	33	150	230	290	360	560	1490
Total Phosphorous	North	35	17.47	741	5	15	22	31	45	68	126
Total Phosphorous	WITH-6	66	45.34	148	17	28	41	54.5	75	128	379
Total Phosphorous	South	20	12.40	889	3	7	12	17	24	42	122

TABLE A-3
Comparison of Station Group Data by Quarter and Sample Size Estimates

Parameter	Section	Units	Mean	Standard Deviation	Number of Results	Proposed No. of Samples	Sensitivity to Changes in Means (Alpha = 0.05)
Salinity	North	psu	24.3	4.91	735	30	1.8
Salinity	South	psu	22.7	5.33	881	30	1.9
Total Nitrogen	North	µg/L	388	142.81	741	30	51
Total Nitrogen	South	µg/L	311	130.44	889	30	47
Total Phosphorous	North	µg/L	35	17.47	741	30	6
Total Phosphorous	South	µg/L	20	12.40	889	30	4

Notes:

Bi-monthly sampling (Feb., Apr., June, Aug., Oct., Dec.)

Analysis of Project COAST Data for the following stations and groups:

North = WITH-4, WITH-5, WITH-7, WITH-8, WITH-9, and WITH-10. (WITH-6 handled as outlier and is not included in the statistics)

South = WITH-10, CB-1, CB-2, CB-5, CB-6, and CB-8

psu = practical salinity units

µg/L = micrograms per liter

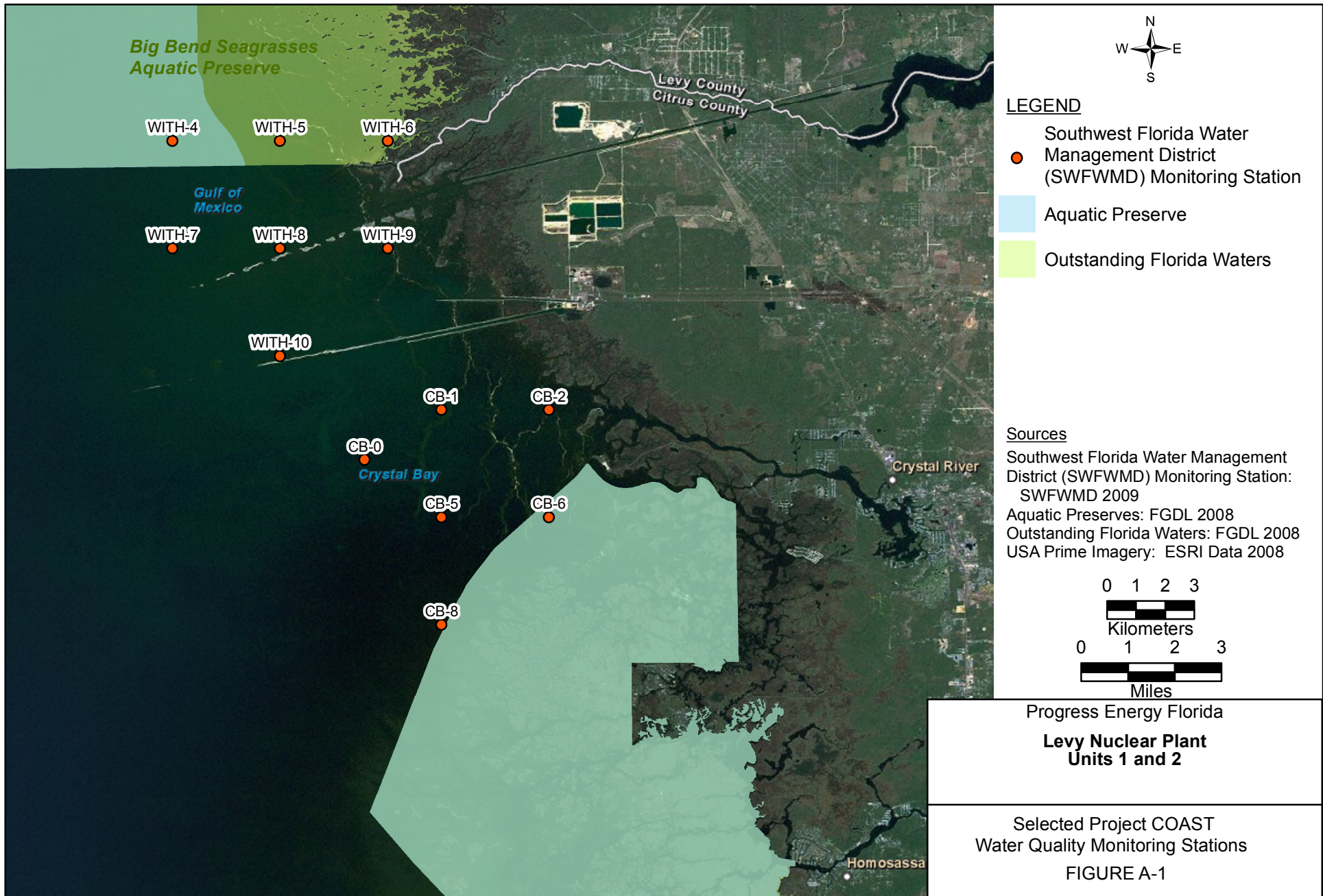


Figure A-2. Box and Whisker Plots for Total Nitrogen by Location and Quarter

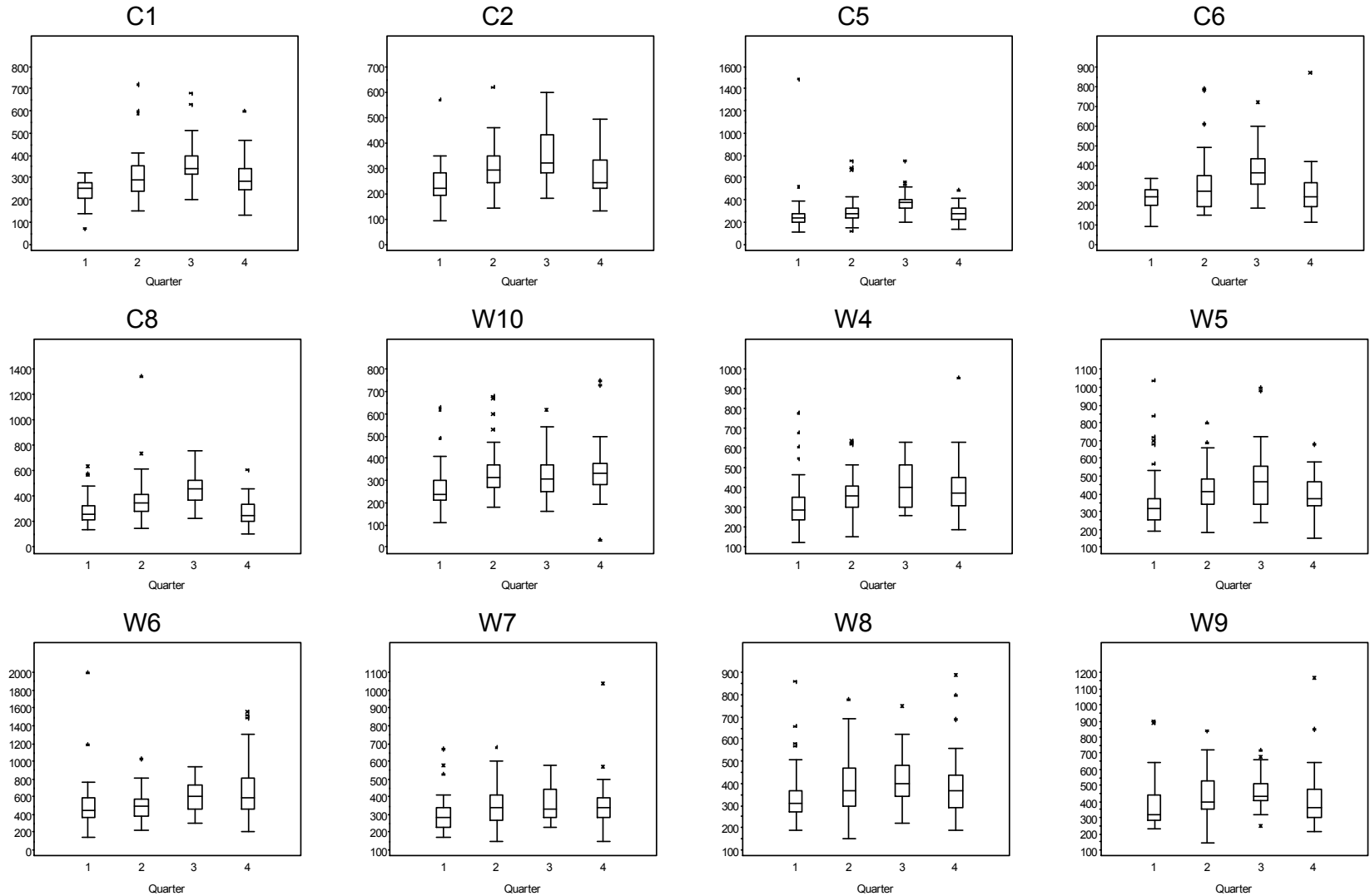


Figure A-3. Box and Whisker Plots for Total Phosphorus by Location and Quarter

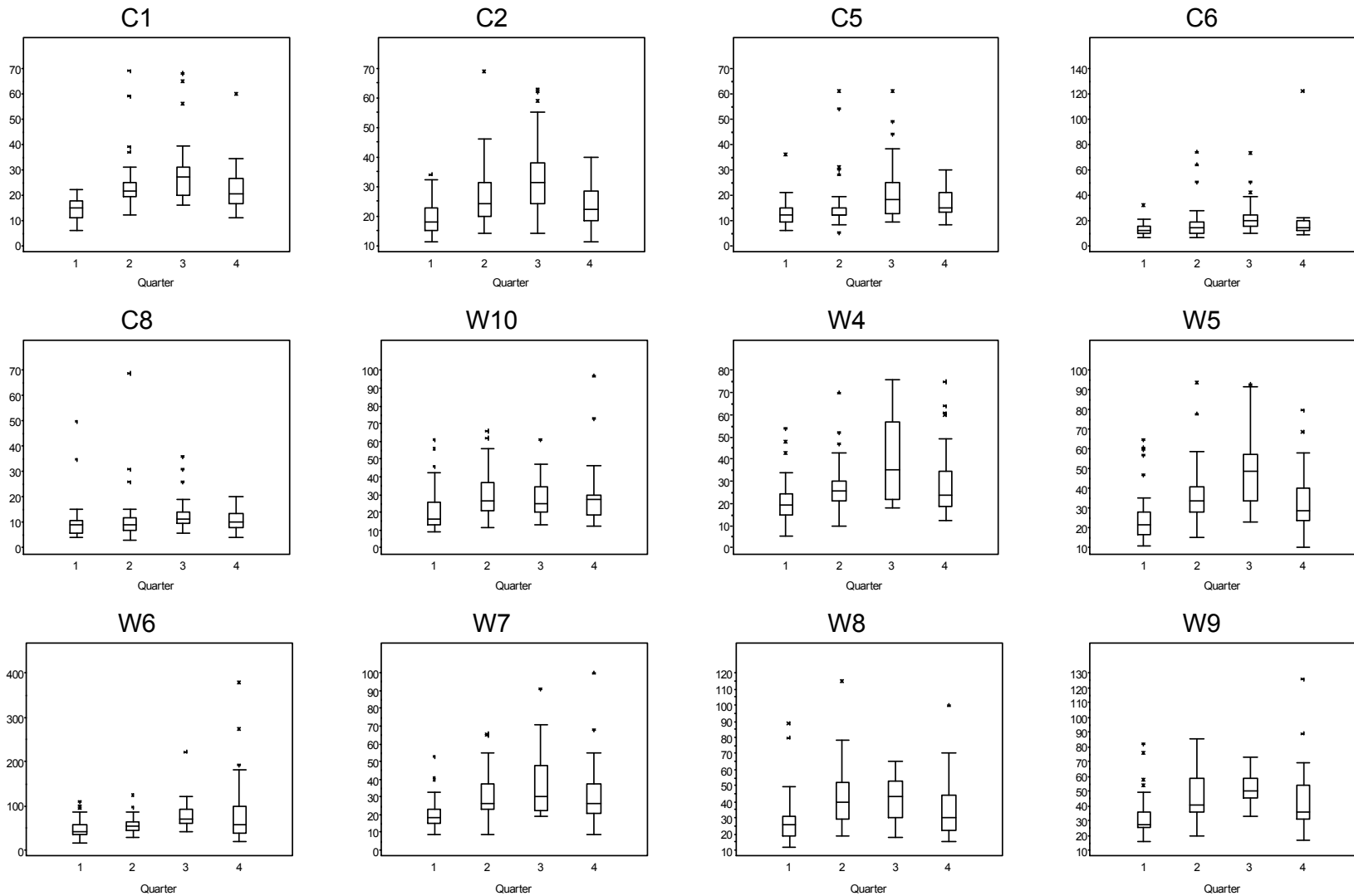
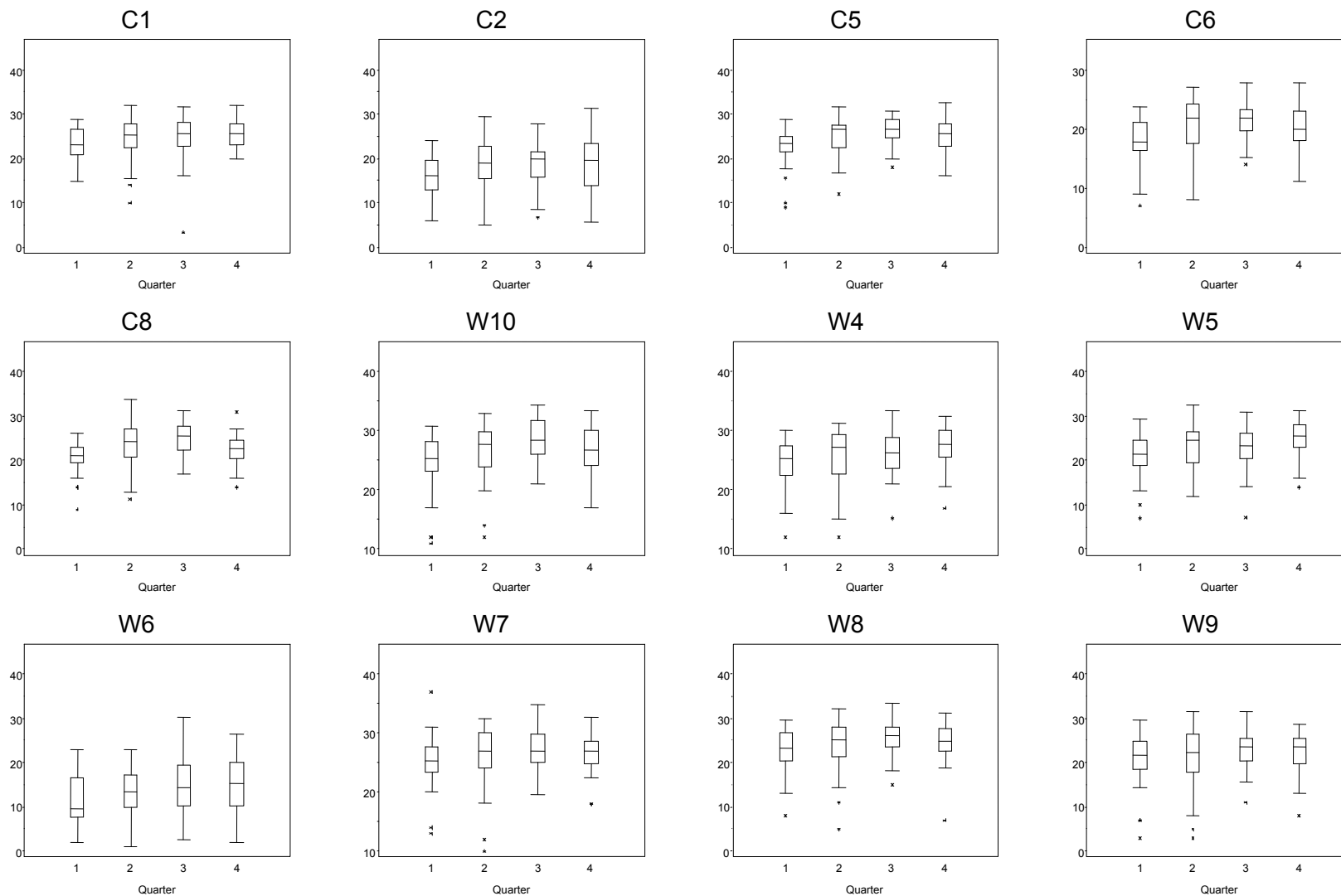


Figure A-4. Box and Whisker Plots for Salinity by Location and Quarter



Monitoring Point Coordinates Table

TABLE B-1
 Crystal Bay Surface Water Monitoring Plan Water Quality Monitoring Point Coordinates

Monitoring Point Name	Latitude	Longitude
CB-0	28.909545	82.765554
CB-1 (Citrus County Station 1)	28.925000	82.741670
CB-2 (Citrus County Station 2)	28.925000	82.708330
CB-5 (Citrus County Station 5)	28.891670	82.741670
CB-6 (Citrus County Station 6)	28.891670	82.708330
CB-8 (Citrus County Station 8)	28.858330	82.741670
CFBC-3	28.996337	82.735017
CREC-3	28.959941	82.723691
CREC-4	28.959856	82.743489
CREC-7	28.960875	82.759405
CREC-8	28.957422	82.791491
WITH-0	29.001145	82.771179
WITH-10 (Citrus County Station 10)	28.941670	82.791670
WITH-4 (Levy County Station 4)	29.008330	82.825000
WITH-5 (Levy County Station 5)	29.008330	82.791670
WITH-6 (Levy County Station 6)	29.008330	82.758330
WITH-7 (Citrus County Station 7)	28.975000	82.825000
WITH-8 (Citrus County Station 8)	28.975000	82.791670
WITH-9 (Citrus County Station 9)	28.975000	82.758330

Notes:

Monitoring points collocated with Project COAST stations have county and SWFWMD station number in parenthesis

CB = Crystal Bay associated monitoring location

CFBC = Cross Florida Barge Canal associated monitoring location

CREC = Crystal River Energy Complex associated monitoring location

WITH = Withlacoochee Bay associated monitoring location