DUKE ENERGY®

Crystal River Nuclear Plant
15760 W. Power Line Street
Crystal River, FL 34428

Docket 50-302
Operating License No. DPR-72

Environmental Protection Plan
(Non-Radiological)
Technical Specifications
Appendix B – Part II

July 15, 2014
3F0714-03

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Crystal River Unit 3 – Reporting Related to the National Pollutant Discharge Elimination System (NPDES) Permit ID# FL0000159-014-IW1S

Dear Sir:

Duke Energy Florida, Inc., hereby provides a copy to the Nuclear Regulatory Commission (NRC) of a revised Thermal (Biological) Plan of Study (POS) as required by the Crystal River Unit 3 Facility Operating License, Appendix B – Part II, Environmental Protection Plan (Non-Radiological) Technical Specifications, Section 3.2, Reporting Related to the NPDES Permit.

Specifically, Section 3.2.2., states, "The licensee shall provide the NRC with a copy of any 316(a) or (b) studies and/or related documentation at the same time it is submitted to the permitting agency."

This letter establishes no regulatory commitments.

If you have any questions regarding this report, please contact Mr. Doug Yowell, Lead Environmental Specialist at (727) 820-5228.

Sincerely,

Blair P. Wunderly

Blair P. Wunderly
Plant Manager
Crystal River Nuclear Plant

BPW/ff

Attachment: Plan of Study for a Thermal Plume Assessment – Crystal River Units 1, 2, and 3 – Citrus County, Florida – July 2014

xc: NRR Project Manager
Regional Administrator, Region I

C001
NRR

DUKE ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50-302 / LICENSE NUMBER DPR-72

REPORTING RELATED TO THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT ID# FL0000159-014-IW1S

ATTACHMENT

PLAN OF STUDY FOR A THERMAL PLUME ASSESSMENT CRYSTAL RIVER UNITS 1, 2, AND 3 CITRUS COUNTY, FLORIDA

JULY 2014

PLAN OF STUDY FOR A THERMAL PLUME ASSESSMENT CRYSTAL RIVER UNITS 1, 2, and 3 CITRUS COUNTY, FLORIDA

July 2014

Submitted by:

Duke Energy Florida, Inc.
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St. Petersburg, Florida 33701

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1.0 INTRODUCTION AND APPROACH

Thermal Considerations

As part of the National Pollutant Discharge Elimination System (NPDES) permit for the Crystal River Units 1, 2, and 3, Duke Energy Florida, Inc. (DEF) is required to develop a Plan of Study (POS) in accordance with Administrative Order AO-024-TL issued April 7, 2014 in conjunction with reissued NPDES Permit No. FL0000159. This plan shall be designed to determine any effects on biological communities from the thermal plume discharge to Crystal Bay. The POS shall address monitoring of the thermal plume, submerged seagrasses, benthic macroinvertebrates, and shall include a proposed implementation schedule and reporting requirements. The POS shall identify data provided by other existing programs as well as any additional monitoring to be conducted by DEF as necessary.

Background

In the application for this renewal permit, the Permittee requested that the Department continue the facility's thermal variance under Section 316(a) of the CWA as part of the permit renewal. The Department reviewed the information provided in the application with reference to the USEPA Region IV guidance document titled, "316 Guidance for Permit Reissuance," dated August 11, 1988 and has determined that the continuation of the 316(a) variance is appropriate for this facility.

Section 316(a) of the CWA allows alternative thermal limitations after demonstration that the WQS limitations are more stringent than necessary to assure the protection and propagation of a balanced, indigenous population of fish and wildlife in, and on, the receiving waters. These limits were established for the facility by EPA in 1988; require the plant to maintain a discharge temperature with a three-hour rolling average not to exceed 96.5°F at the final Point of Discharge (POD) located near the bulkhead line at the end of the site discharge canal.

The size of the area covered by the 316(a) thermal variance is conservatively estimated to have been reduced from 3,000 to 300 acres based on the retirement of Unit 3 on February 5, 2013 as this unit will no longer discharge heated once-through cooling water from outfall D-013; and the continued use of the helper cooling towers in conjunction with any necessary de-rating of Units 1 and 2 to meet the 96.5°F discharge temperature limitation. It should also be noted that the pre-Unit 3 thermally influenced area of 300 acres was based on a Units 1 and 2 discharge temperature limit of 102.5°F. With the permanent shutdown and retirement of Unit 3, coupled with the existing temperature limit of 96.5°F that now governs discharges from Units 1 and 2, it is expected that the area influenced by current operations is less than 300 acres.

In addition to the thermal variance under Section 316(a) CWA, the facility is subject to the requirements of Rule 62-302.520(1)(a), F.A.C. which states that facilities with heated water discharges existing on July l, 1972 " shall not increase the temperature of the RBW (receiving body of water) so as to cause substantial damage or harm to the aquatic life or vegetation therein or interfere with beneficial uses assigned to the RBW." Rule 62-302.520(1)(b), F.A.C. further requires that the discharger conduct verification monitoring. In this context, the reissued permit requires the permittee to implement an approved thermal Plan of Study (POS) to evaluate the compliance noted in the previous paragraph. The POS may incorporate existing data from various sources and include new data, as needed.

Proposed POS

As required, this plan shall be designed to determine any effects on biological communities from the thermal plume discharge to Crystal Bay. The POS shall address monitoring of the thermal plume, submerged seagrasses, benthic macroinvertebrates, and shall include a proposed implementation schedule and reporting requirements. The POS shall identify data provided by other existing programs as well as any additional monitoring to be conducted by DEF as necessary.

To understand how to characterize potential impacts to seagrass beds and benthic organisms exposed to the thermal release from the Crystal River Energy Complex, this plan of study is structured as a phased approach that will initially focus on determining and understanding the spatial and temporal distribution of the thermal plume under various environmental and plant operating conditions. Once the location of the plume has been established, (Phase I) it will then be possible to determine how and where to evaluate potential impacts to seagrass beds and benthic organisms exposed to the thermal plume (Phase II).

The Crystal River Energy Complex is an electric generating plant located on a 4,729 acre site adjacent to the Gulf of Mexico in Citrus County, Florida. The Complex is approximately 7.5 miles northwest of the City of Crystal River, within the coastal salt marsh of west central Florida (Figure1). The complex contains five electric generating units. Units 1 and 2 are coal-fired with a combined total name plate rating of 964 MW. Unit 3 was a nuclear-fueled electric generating plant capable of producing 890 MW. These three units utilized once-through condenser cooling and are authorized to discharge cooling water by NPDES permit No. FL0000159. Units 4 and 5 are coal-fired units with a combined nameplate rating of approximately 1,478 MW that utilize closed cycle cooling with natural draft cooling towers. Unit 4 and 5 withdraw cooling tower makeup water from the main site discharge canal.

In February, 2013, the Company announced the permanent shutdown and retirement of Unit 3. The permanent closure of this unit, which had been off-line since September, 2009, has reduced heated cooling water flows to the discharge canal by approximately 52%. Unit 3 currently discharges approximately 18 mgd of non-contact cooling water associated with the spent fuel pool, but this is expected to decrease to approximately 1 mgd of intermittent flow once a project involving replacement of the water-cooled spent fuel pool heat exchanger with an air-cooled system is completed in early 2015.

In early 2014, the Company announced the intent to construct two, 2-on-1 natural gas-fired combined cycle units on the Crystal River site. Condenser cooling of the combined cycle steam turbines will be accomplished via closed-cycle, mechanical draft cooling towers. Cooling tower makeup flows will be provided by pumps located in the existing Unit 3 intake structure located on the site intake canal. Cooling tower blowdown will be directed to the existing site discharge canal. Plans are to retire Crystal River Units 1 and 2 once these combined cycle units become operational. The current schedule is to retire one unit when the first combined cycle unit comes on-line in June, 2018 with the second unit retired in December, 2018 when the second combined cycle unit is expected to come on-line.

Consequently, all open-cycle condenser cooling operations will, in all likelihood, cease during the existing NPDES permit cycle.

During certain times of the year (May 1 through October 31), once-through helper cooling towers (HCTs) are operated to reduce the thermal discharge from Units 1 and 2. Due to the retirement of Unit 3 and the cessation of that units condenser cooling water discharge, typically two of the four towers are required to ensure compliance with the existing POD temperature limit.

The helper cooling towers cool a portion of the heated water which has passed through the condensers from Units 1, and 2 then discharge the cooled water back into the discharge canal. The helper cooling towers are operated as necessary to ensure that the discharge temperature does not exceed the current permit maximum of 96.5 $^{\circ}$ F as a three-hour rolling average at the point of discharge into the Gulf of Mexico. Source water for Units 1, 2, and 3 is withdrawn from a common intake canal located south of the units which extends into the Gulf of Mexico, a Class III marine water.

The most recent study to evaluate the impact of the thermal plume at Crystal River was conducted in 1983 – 1984. As part of a 316 Demonstration, physical studies were conducted in Crystal Bay to collect data for hydrodynamic and hydrothermal modeling. The models were designed to characterize hydrodynamic conditions within the study area, and using that data, simulate the thermal discharge resulting from the operation of Crystal River Units 1, 2, and 3 under various environmental conditions.

To provide comprehensive, synoptic thermal data, thermographs were deployed at 51 near-surface stations throughout the study area. At 21 of these stations, thermographs were also deployed at subsurface stations for detection of stratification. Meteorological, bathymetric, current, and tide data were also collected in support of the hydro-dynamic modeling effort.

Thermal plume delineation was accomplished during the study period under incoming and outgoing diurnal and semi-diurnal tide conditions. Sampling was conducted during August and January when the in situ study was in progress. Boat crews synoptically sampled four basins near the discharge point measuring conductivity and temperature searching for bottom separation of the thermal plume.

The far-field modeling effort for Crystal River Energy Complex was conducted with CAFÉ-1 and DISPER-1, a pair of two-dimensional finite-element mathematical models developed at the Massachusetts Institute of Technology. The objectives of the far-field modeling were to determine the far-field thermal plume configuration and determine the station effects on far-field meroplankton concentrations (source water body analysis).

The selection of a near-field model for the Crystal River Energy Complex was based upon an examination of the results of the thermal plume delineation surveys. No significant or consistent plume stratification could be detected due either to temperature or salinity. Thus, the near-field modeling was conducted utilizing a model which describes a plume uniformly distributed over the water depth. The results of the near-field model were used to modify the isotherm locations predicted by the far-field model. The far-field model supplied an approximate distribution to the average temperature in the region of the point of discharge and the near-field model provided the detailed distribution.

Upon examination of the thermal plumes obtained from physical data collected, the only phases of the tide which exhibited any substantial near-field behavior were ebb tide and low water slack. Near field behavior was apparent by the existence of locally elongated isotherms which follow and enclose a jet emerging from the point of discharge. Furthermore, data supported the conclusion that heated water is primarily confined to the dredged discharge canal throughout its length, especially at low tide levels. True near-field plume behavior did not begin until the discharge emerged from the channel into the bay (Figure 3).

Thermal plume simulation results agreed well with results from the biological and water quality sampling portions of the 316 study. Basin 1, nearest the point of discharge was consistently exposed to water with temperature elevated 5 – 8 $^{\circ}$ C above ambient. On ebb or low slack tides, however, the largest volume of the thermal discharge was confined to the dredged channel adjacent to the discharge spoil. The plume at that point tends toward the southwest, but rapidly becomes well mixed in the relatively shallow water. On flood or high tides, the plume effect is lacking as the discharge spreads quickly over more of the bay. Little variation was seen in the summer or winter cases. Simulations represented worst case, full load operation. Interpretation of the results was complicated by low salinity and sedimentation experienced in Crystal Bay. Particularly with benthic communities, the effects of salinity and sedimentation are very similar to thermal effects, and this was demonstrated by faunal similarities observed between northern area stations and those in area affected by the thermal discharge.

As a result of findings from this study, Florida Power Corporation reached a tentative agreement with the U. S. Environmental Protection Agency (EPA) and Florida Department of Environmental

Regulation (FDER) in March 1988 outlining a 3-phased approach towards mitigating impacts from the once-through cooling water system at Units 1, 2, and 3. FPC agreed to install helper cooling towers to reduce thermal impacts, construct and operate a multi-species fish hatchery to address impingement and entrainment impacts, and implement a 15% reduction in overall cooling water flow from November 1 through April to further reduce impingement and entrainment impacts.

Four mechanical draft helper cooling towers designed to cool approximately one-half the condenser cooling water discharged from Crystal River Units 1, 2, and 3 were installed and began operation in 1993. The cooler tower discharge water is reintroduced and mixed in the discharge canal to achieve a three hour average maximum temperature of 96.5 °F at the point of discharge (POD). Due to the retirement of Unit 3 and the cessation of that units condenser cooling water discharge, typically two of the four helper towers are currently used to ensure compliance with the POD temperature limit.

2.0 PLAN OF STUDY

The objective of this POS is to assess the potential impacts of the thermal plume from current operation of Crystal River Units 1 and 2 on submerged grasses, benthic macroinvertebrates, and other aquatic species, as appropriate. This POS is divided into the following phases and sections:

2.1 Monitoring to Determine the Spatial and Temporal Distribution of the Crystal River Energy Complex Thermal Plume

The objective of this phase is to understand the spatial persistence and temporal distribution of the thermal plume as it relates to current plant operations and ambient environmental conditions.

2.1.1 Thermal Plum Delineation

Earlier physical studies provided detailed near-field and far-field thermal plume simulations correlated with extensive physical data collected in and around Crystal Bay. A fairly accurate account of thermal plume spatial and temporal performance was determined from those studies. However, those studies were completed prior to the installation and operation of the helper cooling towers and the resulting NPDES permit condition of a maximum thermal discharge temperature of 96.5 ° F as a three-hour rolling average at the point of discharge into the Gulf of Mexico.

This POS is designed to assess the spatial distribution of the thermal plume resulting from the operation of Crystal River Units 1 and 2 in as well as operation of the helper cooling towers. To map the spatial distribution of the thermal plume a total of 20 sampling stations will be synoptically monitored twice monthly from April through October. Sampling station locations are shown in Figure 2 and are based in part on expected plume trajectories from model simulations run during the previous 316 study. Exact station locations will be determined during the first field effort using GPS. Station location is grid based to enhance statistical analysis and interpolation. Each synoptic survey will take place prior to slack water for both ebb and flood tidal cycles. Surface and bottom temperature, dissolved oxygen, and salinity measurements will be taken at each station. Secchi disc depth will be determined at each station as a measure of light penetration. If water depth at a sampling site is less than one meter, only surface (0.2m) measurements will be taken.

To supplement the synoptic surveys three continuous recorders (datasonde) will be placed at key locations to measure temperature, dissolved oxygen, and salinity 24 hours prior to and after each synoptic survey. A fourth datasonde will be placed as a control south of Crystal Bay outside of the area influenced by the thermal plume. Datasondes will be suspended near the bottom through bottom anchoring and surface floats. The datasondes will be programmed to record data every 15 minutes. The datasondes will provide a continuous record of temperature, salinity, and dissolved oxygen concentrations during each survey period for areas that are expected to be within the thermal plume, as well as a control.

The objective of this study will be to characterize the fate of the thermal plume under present plant operating conditions. The mapping effort will include the establishment of isotherms associated with the thermal plume. The gradient of thermal contours will provide data to establish areas within and outside of the thermal plume, allow comparison to previous modeling results, and dictate location of biological sampling stations. If conditions are encountered that indicate the proposed stations will not allow an adequate delineation of the thermal plume, select stations will be moved or additional stations will be added for adequate temperature mapping.

2.1.2 Sampling Frequency

Synoptic surveys will be conducted twice monthly from April through October during slack low and high tides in order to collect data during worst case, full power demand conditions. This will provide information on the effect of plant operating conditions including worst case on the fate of the thermal plume. Sampling will begin just prior to a slack flood or ebb tide. It is anticipated that sampling will begin pursuant to a schedule to be determined pending approval of this POS by the FDEP.

2.1.3 Environmental Measurements

Concurrent with each survey air temperature, wind speed, direction, rainfall, cloud cover and general weather conditions will be observed and recorded. Meteorological data will be obtained from the meteorological tower operated on the Crystal River Energy Complex site. Also, tide height data will be recorded, and plant operational parameters will be collected for each sampling event.

2.1.4 Water Quality Assessment

In addition to synoptic water quality sampling (temperature, dissolved oxygen, and salinity), mid-depth water samples will be collected once per tidal cycle and once per month at five stations. These samples will be analyzed for dissolved organic carbon, ortho-phosphate, nitrate/nitrite, ammonia, and turbidity. Methods and holding times will follow appropriate 40 CFR Part 136 and FDEP SOP guidelines. Stations to be sampled for water quality parameters are shown in Figure 3.

2.1.5 Data Management

Field and laboratory data sheets will be used to record raw data. All field data will be entered into an ACCESS database with identifiers of station, date, and depth to allow for full analysis of data.

2.1.6 Data Analysis and Results

To determine the fate of the thermal plume under various plant and environmental conditions, data from April through October will be collected and analyzed. Isothermal contours will be generated for 1.0 °C isotherms. Since previous studies indicated little vertical stratification, isotherms will be considered to be consistent throughout the water column.

These isotherms will be compared to near-field isotherms generated during the 1985 316 Demonstration Study. With no significant changes in hydrology or topography it may be possible to compare results from this study to prior conclusions. This will be determined as data becomes available.

The datasonde results will be used to provide information on temperature and dissolved oxygen concentrations at selected areas during periods that bracket the surveys. A comparison will be made between day and night dissolved oxygen concentrations to assess any temperature-dissolved oxygen interactions.

To supplement the thermal plume mapping and assist in determining what additional studies, if any, will be required to evaluate the impact of the existing thermal plume on seagrass beds, available GIS data and maps will be collected and layered with thermal plume data.

In addition, the isotherm mapping will provide data to identify if, and where, benthic sampling should be conducted to be representative of the various temperature contours, as well as identify background temperature areas for comparative purposes. It will also be used to assess the relevancy of the 1985 benthic studies to current isotherm distributions.

2.1.7 QA/QC Plan

It is the policy of the EHSS Department to ensure that all biological activities (field, laboratory, and reporting) are accurate, complete, and repeatable. This policy is accomplished by developing a system of activities outlined in the EHSS Biology Program QA Manual. This manual includes both administrative and technical activities. Vendors performing biological studies for EHSS must comply with the criteria and guidance outlined in the QA manual.

2.1.8 Reporting Requirements

Progress reports will be issued quarterly and will present thermal plume mapping information for temperature, salinity, and dissolved oxygen along with water quality information that is available.

A final report will be prepared within 6 months of the last sampling to discuss the fate of the thermal plume, the assessment of potential biological impacts from available information and recommendations for Phase II sampling.

2.2 Phase II – Conduct a Biological Assessment of Seagrass Beds and Benthic Macroinvertebrates Impacted from the Thermal Plume

2.2.1 Characterization of the Spatial Distribution of Seagrass Beds Likely Affected by the Thermal Plume

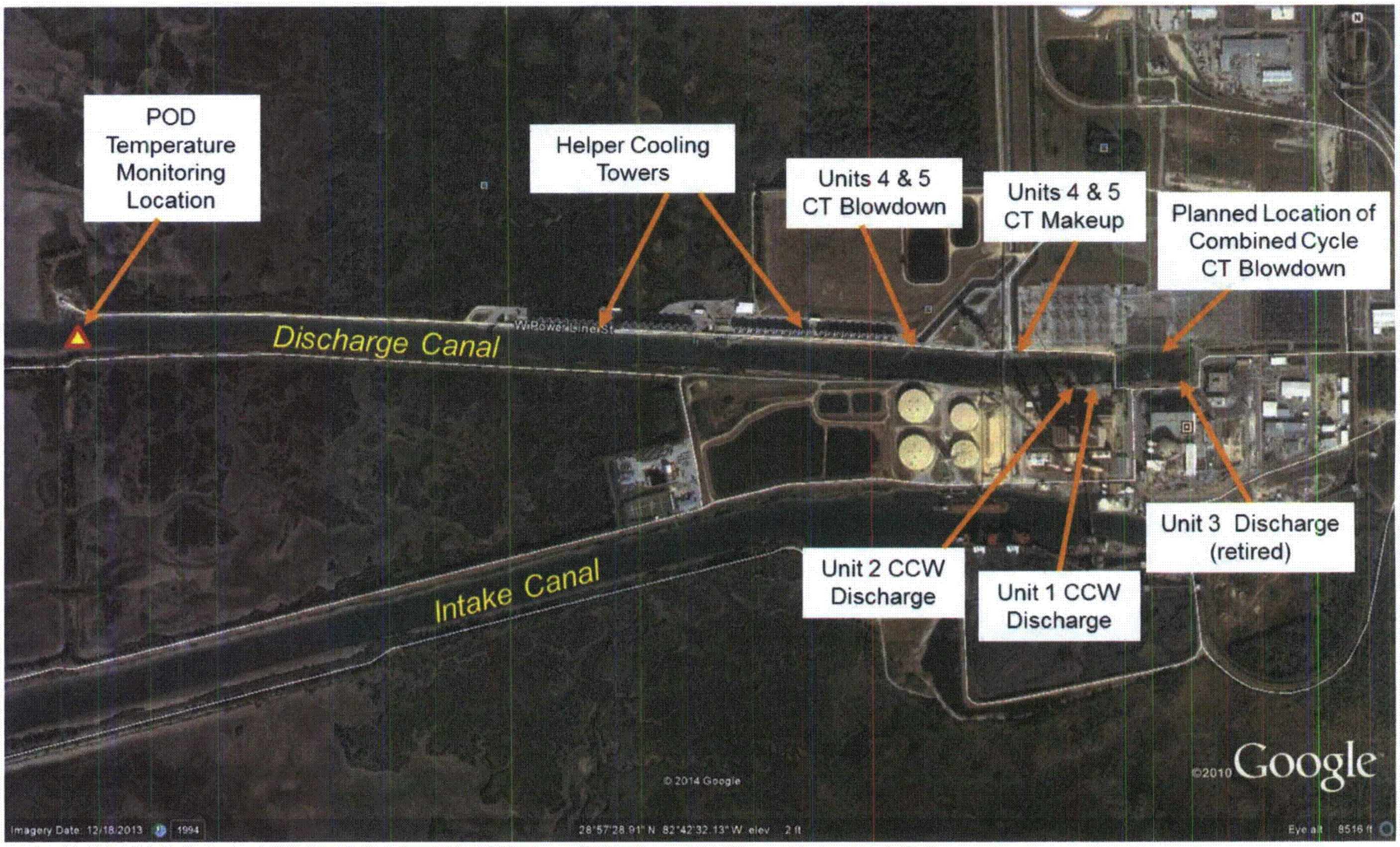
The scope of this study will be deferred until the spatial and temporal extent of the thermal plume is defined and an appropriate Plan of Study can be prepared and submitted to FDEP for approval.

2.2.2 Characterization of the Benthic Community Potentially Affected by the Thermal Plume

The scope of this study will be deferred until the spatial and temporal extent of the thermal plume is defined and an appropriate Plan of Study can be prepared and submitted to FDEP for approval.

CREC Site Layout

Figure 1.



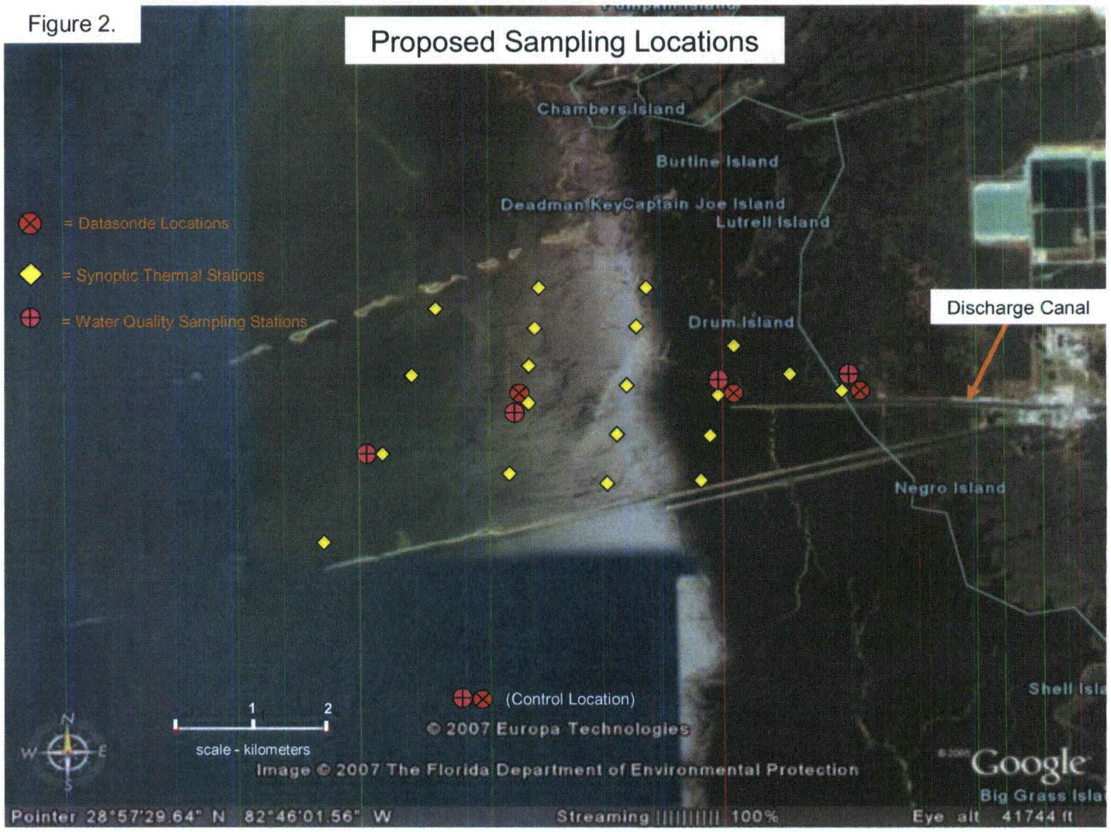


Figure 2.
Proposed Sampling Locations
Chambers Island
Burtine Island
Deadman Key
Captain Joe Island
Lutrell Island
= Datasonde Locations
= Synoptic Thermal Stations
= Water Quality Sampling Stations
Drum Island
Discharge Canal
Negro Island
Shell Isla
(Control Location)
1
2
scale - kilometers
© 2007 Europa Technologies
Image © 2007 The Florida Department of Environmental Protection
Google
Big Grass Isla
Pointer 28°57'29.64" N 82°46'01.56" W
Streaming |||||||||| 100%
Eye alt 41744 ft

Figure 3.

Historical Thermal Plume Profiles