Tenoroc Fish Management Area

Reclamation and Mitigation of the Upper Peace River Watershed at the Tenoroc Fish Management Area
Task 1
Restoration Approach and Identification of Work Elements

Prepared for:

FLORIDA

US Army Corps of Engineers®

Prepared by:

BCI ENGINEERS & SCIENTISTS, INC.

RECLAMATION AND MITIGATION OF THE UPPER PEACE RIVER WATERSHED AT THE TENOROC FISH MANAGEMENT AREA TASK 1 RESTORATION APPROACH AND IDENTIFICATION OF WORK ELEMENTS

Prepared for:

THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
THE UNITED STATES ARMY CORPS OF ENGINEERS
AND
THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

Prepared by:

BCI
ENGINEERS & SCIENTISTS, INC.

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TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

LIST OF TABLES

LIST OF TABLES (cont'd)

LIST OF FIGURES

LIST OF FIGURES (cont'd)

LIST OF APPENDICES

LIST OF MAPS

1.0 INTRODUCTION

1.1 Project Site Description

For purposes of this report, it should be noted at the outset that a parcel of land adjoining the northwestern perimeter of the Tenoroc Fish Management Area (TFMA) was recently purchased by the State of Florida for inclusion in the TFMA (the tract was formerly a portion of the Bridgewater development). This property purchase was approved and finalized on February 4, 2000, after activities associated with the completion of Task 1 of the Upper Saddle Creek Restoration Project had already been initiated. Therefore, references to the TFMA and the Bridgewater property throughout the remainder of this report will consider this recently purchased land as being a part of the Bridgewater development.

The TFMA is an approximately 6,430-acre parcel owned by the State of Florida, and operated by the Florida Fish and Wildlife Conservation Commission (FFWCC), formerly known as the Florida Game and Fresh Water Fish Commission (FGFWFC). The site is located between the cities of Lakeland and Auburndale in unincorporated Polk County, Florida. The general location of the site is shown on **Figure 1-1**.

The TFMA lies entirely within the confines of the Upper Saddle Creek sub-basin (USCSB), which is located in the north-central portion of the Upper Saddle Creek watershed, which encompasses an area covering approximately 58 square miles. This region is the northernmost watershed of the Peace River basin, and extends from the southern portion of the Green Swamp Area of Critical State Concern to the northern perimeter of Lake Hancock.

The USCSB comprises the planning area for this restoration project. It is the most mining-affected sub-basin in the watershed, lying between the Green Swamp (north of Interstate Highway 4) and the remaining bottomland forest along Upper Saddle Creek. This bottomland forest represents the present, northernmost extent of the Peace River habitat system, which reaches southward to Charlotte Harbor and formerly extended through the planning area into Green Swamp. The Peace River habitat system is the principal, north-south core habitat reserve for FDEP's Integrated Habitat Network (IHN) concept plan covering the 1.25 million-acre southern phosphate-mining district. This project will be key to tying the IHN into its surrounding, significant habitat resources and protecting its upper core area from degradation due to the hydrological alterations caused by mining and post-mining land use development.

The TFMA lies within Sections 25, 26, 27, 28, 33, 34, 35 and 36, Township 27 South, Range 24 East, Sections 1, 2, 3, 4 and 11, Township 28 South, Range 24 East, and Sections 29, 30, 31 and 32, Township 27 South, Range 25 East. Several roadways bisect portions of the property, including North Combee Road (State Road 659), Saddle Creek Road/Old Dixie Highway (County Road 546), and Tenoroc Mine Road. State Highway 33 and Interstate Highway 4 lie between one and two miles to the west and north of the area, respectively, and the recently completed Polk Parkway (State Road 570) is located immediately east of the site. U.S Highway 92 lies approximately 1.5 miles south of the southern perimeter of the property. A 1996 aerial photograph showing the TFMA and the surrounding properties is provided as **Figure 1-2**.

In 1982, Borden, Inc. (Borden) donated the TFMA property to the State of Florida. Prior to transferring the property to the State, Borden and its subsidiaries had operated the site as an active phosphate mine and phosphate processing plant (the Tenoroc Mine) from the early 1950's through the early 1970's. The site is currently managed and operated by the Florida Fish and Wildlife Conservation Commission (FFWCC), formerly the Florida Game and Freshwater Fish Commission (FGFWFC), as a fisheries research and public fishing/recreational facility.

1.2 Project History and Development

During the late 1970's the Florida State Legislature promulgated legislation requiring an inventory of lands disturbed by phosphate mining prior to July 1, 1975. As a result of this legislation, Zellars-Williams, Inc. published a report that provided an evaluation of these disturbed lands, and recommendations for restoring several watersheds that had been heavily impacted by mining. The Saddle Creek watershed was one of the areas recommended for restoration.

During the 1980's, several reclamation projects were completed on non-mandatory reclamation program areas within the mined areas of the TFMA and several of the adjoining properties within the Upper Saddle Creek watershed. Since that time, several large-scale residential/commercial developments have been planned for these formerly mined areas, specifically the Bridgewater development and the Saddle Creek development. Construction of the Polk Parkway and the proximity to the fast-developing Orlando/Disney World area has accelerated development opportunities within this area. Coordinating this development will provide an opportunity to restore some of the ecologic and hydrologic function of this disturbed area.

In 1994, representatives of the Florida Department of Environmental Protection (FDEP), the Florida Department of Transportation (FDOT) and the Florida Game and Freshwater Fish Commission (FGFWFC), now known as the Florida Fish and Wildlife Conservation Commission (FFWCC), initiated discussions aimed at incorporating design elements for the developments into a planned restoration of the ecological and hydrological functions within portions of the Upper Saddle Creek watershed. Two potential funding sources were recognized: alternative mitigation methods for wetland impacts incurred during construction of the Polk Parkway, and funding from the Nonmandatory Land Reclamation (NLR) Trust Fund.

Significant efforts by the agencies resulted in the development of the Polk County Parkway Interagency Memorandum of Understanding (MOU) that was signed on November 28, 1995. The MOU was agreed to by the U.S. Army Corps of Engineers (USACOE), FDEP, FDOT, FGFWFC and the Southwest Florida Water Management District (SWFWMD). The MOU created a framework to facilitate restoration of ecological and hydrological function in the Upper Saddle Creek watershed. The FDEP developed a scope of work and selected a consultant (BCI Engineers and Scientists, Inc.) to assist in completing the mitigation and reclamation activities outlined in the MOU. A copy of the MOU is provided as **Appendix 1**.

Project planning will involve both the identification and design of individual habitat creation or enhancement projects on State-owned land, and coordination of this design planning with the development goals of adjacent landowners. Individual projects will be sited within the TFMA, which occupies most of the lower half of the USCSB planning area. The upper half of the planning area is occupied primarily by the Williams Company's Saddle Creek tract and a portion of Florida's Legacy, Inc.'s (FLI's) Bridgewater tract, two formerly mined areas now undergoing post-mining development planning and review.

1.3 Project Funding

The Upper Saddle Creek Restoration Project is funded primarily by the two previously mentioned sources: the NLR Trust Fund and the FDOT's wetland mitigation funding for the Polk Parkway. The NLR Trust Fund Committee approved funding for the reclamation of program areas BDN-T-04, BDN-T-05 (B), BDN-T-06, BDN-T-07 and BDN-T-E at the TFMA during their 1998, 1999 and 2000 annual meetings. The total funding for non-mandatory reclamation at the five TFMA parcels is $4,593,896.

The FDOT contributed $3,500,000 for wetland and surface water impacts resulting from construction of the Polk Parkway in the Peace River and Green Swamp watersheds. Impacts to wetlands and surface waters in the Alafia River basin resulted in an additional contribution of $1,800,000, and $105,420 was contributed for the impacts caused by construction of the Kent Access Road. The total FDOT contribution is $5,494,308, as shown in **Table 1-1**.

Table 1-1 Project Funding Summary

Funding Source	Area	Funding Amount
NLR Trust Fund	BDN-T-04 BDN-T-05(B) BDN-T-06	$4,303,096
	BDN-T-07	$232,640
	BDN-T-E	$58,160
Total NLR Trust Fund		$4,593,896
FDOT	Peace River Watershed	$3,500,000
	Alafia River Watershed	$1,800,000
	Kent Access Rd.	$105,420
Total FDOT		$5,405,420
FFWCC		$50,000
Total Restoration Funding		**$10,049,316**

1.4 Project Team Organization

The organization of the project team is defined in the MOU (FDEP, 1995). Also defined are the responsibilities of the five agencies that are parties to the MOU, specifically the FDEP, USACOE, SWFWMD, FDOT, and the FFWCC. The specific responsibilities of each party include activities listed in the MOU, as described below:

- The FDEP will be the chair for the Selection Committee and Advisory Committee (described below). In addition, the FDEP will be the project manager for the restoration project. The FDEP will deposit the FDOT's $5.5 million contribution in the Pollution Recovery Trust Fund (now known as the Ecosystem Management Trust Fund) and will disperse the funds for the mitigation project costs as needed. In addition, the FDEP will assume the full and sole responsibility for meeting the MOU objectives.

- The USACOE will ensure compliance with the conditions in permits #1994005979 (IP-MN), #4011879.02, #4011879.03, #4111875.02 and #4112140.01.

- SWFWMD will ensure compliance with the conditions in Management and Storage of Surface Water (MSSW) permits # 4011879.02 and #4011879.03 and Wetland Resource Permit (WRP) permits #4111875.02 and #4112140.01.

- The FDOT will contribute $5.5 million dollars to the FDEP to complete the mitigation conditions and requirements included in the USACOE and SWFWMD permits.

- The FFWCC may provide management services related to the mitigation projects. Any management services provided by the FFWCC will be specified in amendments to the MOU.

The MOU defines the organization and responsibilities of two groups that will facilitate successful implementation of the restoration project. The specific responsibilities of the Selection Committee and the Advisory Committee are described below:

- The Selection Committee established in the MOU consists of the following parties: the USACOE, FDEP and SWFWMD. The Selection Committee is responsible for the development of requests for proposals (RFPs), reviewing and evaluating proposals received, and selecting contractors for the various project tasks.

- Representatives of each party to the MOU (the USACOE, FDEP, FDOT, FFWCC and SWFWMD) are included in the Advisory Committee. The Advisory Committee also includes affected representatives from Polk County and the Central Florida Regional Planning Councils and other parties. The role of the Advisory committee is to provide assistance and make recommendations regarding the coordination, planning and implementation of restoration projects. The signatories of the MOU may add other parties to the Advisory Committee by mutual consent.

As described in the MOU, the Selection Committee developed a RFP, evaluated written proposals and developed a short list of potential consultants. Three consultants made presentations that were evaluated by representatives of each agency on the Selection Committee. A team of consultants led by BCI Engineers and Scientists, Inc. (BCI) was selected, and a contract between the FDEP and BCI was signed in June 1998. The following summarizes the organizational information for BCI and its principal subconsultants.

BCI Engineers and Scientists, Inc. (BCI)

BCI (formerly Bromwell & Carrier, Inc.) is a multi-disciplinary engineering and environmental consulting firm headquartered in Lakeland, Florida. The firm is directed and managed by three principals:

- Mr. Richard M. Powers, P.G., President;
- Mr. Wayne A. Ericson, P.E., Executive Vice President; and,
- Mr. Walter R. Reigner, P.E., Vice President - Natural Resource Services.

BCI is registered to practice professional engineering and professional geology in the state of Florida, and has provided engineering and environmental services on more than 2,000 projects since its inception in 1977. These projects have dealt with a wide variety of technical services including water resource and storm water management, hydrology, geology, ecology, geotechnical, mining, and environmental engineering.

In the early 1980's, BCI worked with Borden on projects involving the dewatering and abandonment of clay settling areas (CSAs) at the Tenoroc Mine, including reclamation program areas BDN-T-01, 03, and 04. BCI subsequently became involved with the State of Florida's Non-mandatory Land Reclamation Program in 1984, when they were awarded a contract to manage the reclamation design and construction monitoring of program area BDN-T-03 (Tenoroc Area 3) by the Florida Department of Natural Resources (FDNR). Over the next several years, BCI also designed reclamation plans for program areas BDN-T-01, 05(A), and 04 under contract to the FDNR. The reclamation plans for program areas 01 and 05(A) were implemented as proposed.

Post, Buckley, Schuh & Jernigan, Inc. (PBS&J)

PBS&J is a multi-disciplinary consulting engineering firm that offers a comprehensive array of civil/environmental/transportation engineering, environmental sciences, land planning, and construction inspection/management services. Mr. Doug Robison, located in one of PBS&J's Tampa Bay area offices, is the Permitting Task Leader for this project.

PBS&J achieved early successes in large-scale, manmade wetland designs that have set the standards for use in advanced wastewater treatment, and offers a team of qualified ecological scientists experienced in all phases of wetland and upland environmental analyses. Their understanding of regulations regarding water quality and endangered species habitat ensure that compliance issues regarding the Endangered Species Act of 1972 and Section 404 of the Clean Water Act will be properly addressed.

Quest Ecology, Inc. (Quest)

Quest Ecology is a state certified Disadvantaged Business Enterprise (DBE) and Minority Business Enterprise (MBE) specializing in ecological studies and environmental permitting. Ms. Vivienne Handy, President of Quest, is a Certified Professional Wetland Scientist with over 15 years of natural resource management experience. Her wetland delineations, management and monitoring experiences cross over numerous industries and agencies, including extensive experiences with the phosphate mining industry in central Florida.

Live Oak Consulting Group, Inc. (Live Oak)

Live Oak Consulting Group provides a broad spectrum of ecological consulting services with particular emphasis in wetland permitting and development of exotic and nuisance plant control programs. The principal ecologist of Live Oak, Ms. Dorie Faulkner, has 20 years of experience in natural resource regulation, wetland and protected species permitting, applied ecological research, and ecosystem restoration throughout southern and central Florida.

1.5 Permitting Issues

The MOU outlines the specific responsibilities and obligations of the two permitting agencies, namely the USACOE and SWFWMD. These two agencies must ensure that the specific conditions and requirements of the permits referenced in the MOU (and listed previously) are achieved. The MOU itself is the framework for determining compliance with the referenced permit conditions. All information, data, and calculations typically required in a permit application will be generated during the design phase of this project. Construction of mitigation wetlands will be completed in accordance with permitting agency guidelines, and all typically required maintenance and monitoring will be completed. Personnel from the USACOE and SWFWMD will have the opportunity to evaluate the suitability of mitigation wetland design, construction and maintenance throughout the entire process. A Noticed General Permit For Restoration application, pursuant to Section 40D-400.485, Florida Administrative Code (FAC) is anticipated to be sufficient to fulfill the specifics of the MOU for the wetland mitigation to be completed within the Upper Saddle Creek watershed.

1.6 Related Projects

In 1988, BCI was the lead investigator for a Florida Institute of Phosphate Research (FIPR) research project to develop the FIPR Hydrology Model (FHM). This model was developed to better analyze flows from reclaimed clay settling areas, taking into account both surface and ground water components.

In 1999, BCI completed a FIPR research study to develop a procedure for predicting the hydrology of aboveground CSAs. The investigation was conducted in cooperation with the U.S. Geological Survey (USGS). A primary focus of the study was to determine the effects on clay consolidation resulting from differing hydrologic conditions. Four study sites were selected for the investigation, including reclamation program area AC-OP-06, which is an old CSA located in the Williams Company's former phosphate mine area north of the TFMA.

The results of the FIPR study indicated that the hydrology within a CSA changes over time with consolidation, and can be dependent on historical climatological data, as it affects the formation of cracks in the clay. The investigation also concluded that CSAs retain more water, resulting in less discharge and a greater wetland area than would normally be anticipated during reclamation design. A final recommendation of this study was that reclaimed CSAs should be monitored periodically to determine if structural or management alterations are necessary to meet the approved reclamation design objectives.

The University of South Florida (USF) is presently working on two hydrologic investigations related to the Upper Saddle Creek watershed. In one investigation, an integrated surface and ground water model (FHM) is being used to simulate long-term hydrology, which will provide a greater understanding of the overall integrated water balance in the area. The hydrologic model built by USF uses the FHM to represent the Upper Saddle Creek watershed, and is part of a sub-model or "near-field" model of a larger "far-field" model that covers the entire South West Florida Water Management District. The "far-field" model is an ongoing project that has been in development for several years and has gone through several modifications of the underlying programs and parameter representations. Although USF has prepared several reports on the "far-field" model, a report describing the parameters resulting in their latest calibration of the "far-field" or "near-field" models for the Upper Saddle Creek basin has not been completed at this time. As part of BCI's hydrologic evaluation of the project area, the "near-field" model of the Upper Saddle Creek basin was reviewed, and the findings are discussed in **Section 3.4** of this report.

In the second USF hydrologic investigation of this area, the floodplain for large rain events was estimated using the USACOE's Hydrologic Engineering Center–River Analysis System (HEC-RAS) program, which was developed in 1997. Using the HEC-RAS program, the runoff is specified in cubic feet per second (cfs) along the conveyance represented in the model, and the model estimates the stage and flow rates along the conveyance. The estimated stage and flow rates do not account for the timing of the runoff into conveyances or the change in the runoff inflow over time. USF estimated the runoff rates into the conveyance using the previously developed FHM. At the time of this report, USF had not completed an internal review of, or prepared a report describing the HEC-RAS representation of the Upper Saddle Creek watershed. BCI has requested the program input and output files from USF to provide further review for the wetland mitigation objectives outlined in this report.

1.7 Project Meetings

Project team meetings were conducted throughout the course of this first phase of this restoration project, beginning in August 1999. The meetings were held to provide a forum for discussing project activities, to update the team members as to the current status of work-in-progress, and to allow BCI an opportunity to present draft project task deliverables. Copies of the minutes for each meeting from August 1999 through February 2000 are provided in **Appendix 2**.

1.8 Goals and Objectives

The goals and objectives of this restoration project were developed and refined through a succession of meetings, interviews and document review. The basis for the establishment of the goals and objectives include the MOU and the FDEP's Saddle Creek Restoration & Alternative Mitigation Project, Phase I: Conceptual Plan (October 9, 1997). Major agency participants include the USACOE, FDEP, FFWCC, and SWFWMD. Individual contributors include members of the Upper Peace River Ecosystem Planning Committee (UPREPC) and agency representatives from Polk County, FDOT, FIPR, and USF. Other actively interested parties include several adjoining property owners, and representatives of community environmental organizations such as the local chapter of the Sierra Club, and the Lake Region Audubon Society. A listing of UPREPC members is provided in **Appendix 3**.

1.8.1 Reclamation, Mitigation and Restoration Goals

The following lists the reclamation, mitigation and restoration goals developed by the various participating agencies, environmental organizations and private landowners that have an interest in the Upper Peace River Restoration Project:

1. The mitigation of wetlands impacted in the Peace River basin during construction of the Polk Parkway will include at least 84.73 acres of forested wetlands and 37.28 acres of herbaceous wetlands, if feasible, in the USCSB. Mitigation activities will be completed in a manner consistent with the concepts put forth in the FDEP's February 10, 1995 memorandum entitled "Proposed Application of Ecosystem Management, Greenways, and Mitigation Concepts with the Saddle Creek Watershed of the Peace River".

2. The reclamation of program areas BDN-T-04, BDN-T-05(B), BDN-T-06, BDN-T-07 and BDN-T-E has been approved and will be funded through the NLR Trust Fund for up to $4,593,896. NLR funds can only be used within the boundaries of these program areas.

3. Polk Parkway Permit Condition #1 stipulates that $3,500,000 will be used for watershed-core mitigation within the Saddle Creek watershed.

4. Appropriate quantity and quality of flow to Saddle Creek will be replaced, thus enhancing flows to the Peace River.

From the southern boundary of the TFMA northward to Interstate 4, most of the original watershed landscape has been altered by mining and clay/sand disposal activities, as well as catchment, retention, recirculation, and redirection of surface water. Currently, the potential outflow from this 12,000-plus acre portion of the watershed is significantly impounded and produces minimal discharge to Upper Saddle Creek via two unmaintained ditches.

5. The replacement of the appropriate amount and periodicity of flow from the upper watershed through reclamation and mitigation must be planned so that flooding is not exacerbated to the south.

South of the TFMA, other portions of the watershed have also experienced significant mining impacts such as ditched and rerouted streams, clay settling area impoundments and pit lakes. These impacts, in combination with urban development, have resulted in floodplain disruption and encroachment rather than natural water attenuation. Periodic flooding and urban stormwater drainage problems plague this portion of the watershed. Therefore, restoration of the watershed becomes a more complicated exercise than simply replacing the watershed as it existed in the pre-mining state circa 1941.

Replacement of flow can be achieved without exacerbating flooding. A system can be designed to provide storage during periods of heavy rainfall, and to release water during periods of low flow. Total surface water discharge volumes can also be increased without magnifying peak flow events.

6. Reclamation and wetland mitigation within the project area will be designed to restore the ecological connection between the Peace River and the Green Swamp.

Prior to the mining and development impacts that have occurred over the last several decades, the wetlands and floodplains of the Upper Saddle Creek watershed served as a primary ecological connection between the Peace River and the Green Swamp. Reclamation and wetland mitigation within available portions of the watershed should be planned so that, in addition to drainage restoration, a simultaneous benefit of habitat replacement and ecological connectivity is achieved.

7. Wetland mitigation will be incorporated into a landscape that includes extensive, adjacent habitats managed for long-term ecological viability and environmental protection.

Wetland impacts caused by construction of the Polk Parkway require mitigation in the form of reconstruction of a prescribed number of acres of various wetland types. The construction-impacted wetland acres were spread throughout a largely urban landscape along the route of the roadway. Rather than replace these impacted wetlands back in the same disjointed setting, the appropriate mitigation acres will be replaced in a scenario that includes extensive, adjacent habitats managed for long-term viability and protection.

8. Regional opportunities for various outdoor recreation activities will be enhanced.

Replacement of the wetland mitigation acres within the TFMA, as well as the overall drainage and habitat restoration of the watershed, will enhance regional opportunities for various outdoor recreation activities. At this time, an extensive system of hiking and horse trails is being planned within the watershed. Upon completion of the planned restoration and reclamation activities, at least 1,000 additional acres previously not accessible will be available for picnicking, hiking, fishing, hunting, bird watching, and environmental education. The project will significantly increase outdoor recreation opportunities at the TFMA and throughout the watershed.

9. FDEP, SWFWMD and the USACOE regulatory processes have been incorporated into the MOU and all mitigation activities will be coordinated with UPREPC. This coordination will allow for interagency cooperation and facilitate periodic public scrutiny throughout the planning and implementation phases.

In order to achieve the stated goals and objectives of functional watershed replacement, an orchestrated effort has been set into motion which attempts to coordinate previously disjointed regulatory processes, while synthesizing intricate needs and on-ground realities into a common-sense, comprehensive implementation strategy. Rather than creating more chaos in a highly disrupted system characterized by a lack of coordination, the implementation strategy relies upon concentricity and a phased approach.

10. Wetland restoration at the TFMA will be a capstone demonstration project for a decade of FIPR-funded research related to successful wetland restoration on reclaimed clay settling areas. Related research projects include the FIPR Hydrologic Model, the Hydrology and Consolidation of Reclaimed Clay Settling Areas, and projects completed by the University of Florida's Center for Wetlands.

11. Restoration of the Saddle Creek area will also provide an opportunity to showcase a new paradigm of cooperation between federal, state and regional government agencies using public funds to achieve regional watershed restoration to mitigate highway construction impacts.

12. Onsite partners in the wetland restoration include the FFWCC, and offsite partners include the Williams Company, FLI and the City of Auburndale.

Examples of cooperation have been realized through the open dialog with these landowners and commitments from them to provide additional water volume that will ultimately serve the wetland restoration effort and subsequent watershed enhancement.

13. The restoration of the Upper Saddle Creek watershed should include an educational component.

The restoration effort will provide a multitude of educational opportunities. Local public school science programs can participate in the ongoing evolution of the project and assist in planting and monitoring. Students can meet with a variety of engineers and scientists for career planning. The general public can be kept informed with kiosks and/or brochures detailing the reclamation process, native plant identification or a boardwalk through a wetland mitigation area.

1.8.2 Agency Objectives

Appendix 4 includes a summary of various agency concerns (FDEP, SWFWMD, USACOE, Polk County, FFWCC) presented in a tabular format, and the minutes of meetings held specifically to acknowledge the concerns of the agencies involved.

2.0 SITE CHARACTERIZATION

2.1 Pre-Mining Conditions

Prior to the early 1950's, when phosphate mining was initiated at the Tenoroc Mine, the TFMA was part of a large wetland system that formed the headwaters of Saddle Creek, a tributary stream at the northernmost reach of the Upper Peace River basin. Natural drainage from this system contributed to stream flow rates that influenced Saddle Creek and supplemented downstream flows through Lake Hancock and into the Peace River. A 1941 aerial photograph of the area now occupied by the TFMA is provided as **Figure 2-1**.

Based on information illustrated on the 1944 United States Geological Survey (USGS) Topopgraphic Quadrangle Maps of the area, wetland boundaries were approximately consistent with the 120 feet contour line depicted on the maps. A slight ridge was located in the middle of Sections 30 and 31, Township 27 South, Range 25 East, in the eastern portion of what is now the TFMA. An unimproved dirt road provided passage through this area. Citrus groves were located in the northeastern portion of the area in Section 25, Township 27 South, Range 24 East and Section 30, Township 27 South, Range 25 East.

2.2 Mining and Clay Disposal History

2.2.1 Mining History

Phosphate mining was initiated at the Tenoroc Mine during the early 1950s. Mining concluded within the TFMA boundaries in the middle 1970s, however, most of the mining in the area was completed prior to 1960. Approximately 1,130 acres of the TFMA were left unmined and undisturbed.

2.2.2 Clay Disposal History

Clays generated through the phosphate mining and benefication processes were deposited in clay settling areas (CSAs), which are enclosed areas with embankments utilized for the storage of phosphatic clays. A total of six CSAs were constructed within the TFMA boundary during mining operations. **Figure 2-2** illustrates the location of each of the CSAs, and a brief history of each is included below. For purposes of this report, the CSAs shown on the figure are identified by the reclamation program area designations that were assigned in the 1980 Zellars-Williams report.

- BDN-T-01 was built on unmined ground. It is believed to have been the first CSA constructed at the mine. After this dam was filled with clay, approximately 50 percent of the area was covered by 25 feet of tailings sand. The entire CSA was reclaimed in general accordance with the state's NLR rules, including the areas with tailings sand.

- BDN-T-02 was built on mined ground. The area occupied by the CSA was mined out in approximately 1952. Assuming that the CSA was built within the next year or two, this CSA was probably brought on-line in the mid-1950's. A Readiness for Abandonment Report was submitted to the FDNR in November 1982. This CSA was filled with clay and capped with sand tailings. After sand tailings were introduced, the CSA was voluntarily graded and reclaimed by Borden.

- BDN-T-03 was also built on mined ground. This area was mined out in 1956. Under the same assumptions used above, this CSA was likely brought on-line in the late 1950s or early 1960s. This CSA was filled with clay and dewatered. It was reclaimed in general accordance with the Old Lands and NLR rules by pushing-in the perimeter dike material and using this material as a partial cap for the clay. Internal spoil rows were graded and the site was revegetated with both grasses and trees.

- BDN-T-04 was built on mined and unmined ground. The area was mined out in 1953 and subsequently used for waste clay disposal. During the filling period, this CSA was contiguous with the mined tract now occupied by program area BDN-T-06. It was subsequently separated from BDN-T-06 by a northwest-southeast trending dike that appears to have been built in the late 1960's. A Readiness for Abandonment Report was submitted to FDNR in March 1983, and approval for the abandonment was issued on August 11, 1983. This CSA appears to have been only partially filled with clay. Reclamation plans were submitted in 1986, but were never implemented.

- BDN-T-04 (New) was built on unmined ground. After it was filled with clay, it was allowed to remain unreclaimed in a manner similar to BDN-T-04. Some dewatering was accomplished.

- BDN-T-05 was built to store phosphatic clays, but only about ten percent of the area occupied by this CSA was used to store clays. A Readiness for Abandonment Report was submitted to FDNR in April 1983.

- BDN-T-06 was built on mined ground. It was only partially filled with clay and also remains unreclaimed.

2.3 State Land Management

Tenoroc was formerly managed by the Florida Department of Natural Resources (now known as the FDEP), Division of Parks and Recreation. The FFWCC (formerly the FGFWFC) has managed operations at the TFMA since 1993. When the property was first donated to the State, the site was named the Tenoroc State Reserve. Later, the tract was renamed the Tenoroc Recreation Area. In 1993, the site was designated the TFMA to better reflect the FFWCC's primary management objectives for the property.

State land management of the TFMA has been associated with providing a viable public facility for anglers as well as the general public. Management activities have included the installation of boat ramps, hiking trails and horseback riding trails. Thirteen boat ramps have been constructed to allow fishing enthusiasts access to the 1000+ acres of lakes open to the public within the TFMA. A six-mile hiking trail and twelve miles of horseback-riding trails are maintained for visitors' use, as well as picnic areas and a shooting sports facility. The FFWCC conducts ongoing biological and fish management studies in an effort to ensure the future of Florida fishing.

2.4 Literature Review

A review of documents prepared to describe recent and historical conditions, plans and activities at the TFMA and the former Tenoroc Mine was conducted at the following locations:

- the Lakeland office of BCI;
- the TFMA field office of the FFWCC; and,
- the FDEP's Southwest District Hazardous Waste Division office in Tampa.

The results of the document review are summarized in a bibliography that is provided as **Appendix 5**. The records reviewed as part of this task included reports, letters, other correspondence, aerial photographs, maps, drawing, and digital aerial/map files. Please note, additional documents relating to the TFMA have been published since submittal of this bibliography to FDEP in June 1999. The more recent documents are listed in the references provided in **Section 6.0** of this report. In addition, there may be other documents not included in this bibliography that may be available from other sources, such as SWFWMD, USF, FIPR, Polk County, and others. A number of aerial photographs, maps and drawings that are not listed in this bibliography may also be found as attachments to several of the included reports and correspondences.

A collection of the documents listed in this bibliography is archived at BCI's Lakeland office, and is available for public inspection. The bibliography is formatted as shown in the following examples:

Report Format

Author, date of publication (if known). Title, publication number (if applicable). Number of pages.

Letter Format

Author, date of preparation. Addressee, summary of letter content. Number of pages and attachments (if applicable).

Additional Correspondence Format

Author, date of preparation. Summary of content. Number of pages and attachments (if applicable).

Aerial Photograph Format

Flight contractor or client (if known), flight date (if known). Title or description of photograph, photo or sheet identification number (if applicable).

Map Format

Author, date of publication or preparation. Title, figure or sheet identification number (if applicable).

Drawing Format

Author, date of preparation. Title, figure or sheet identification number (if applicable).

Digital File Format

Flight contractor, client, flight date. Title, file number.

2.5 Existing Site Conditions

2.5.1 Physiography and Topography

As shown on **Figure 2-3**, the TFMA is located within the Polk Uplands physiographic province between the Lakeland Ridge and the Winter Haven Ridge (White, 1970). The topographic relief of the site is highly variable, ranging from relatively flat to gently undulating on some of the unmined areas, reclaimed mine sites and old clay settling areas (CSAs), to steeply sloping in areas of remnant overburden spoil piles and CSA embankments. The highest elevations (approximately 160 feet NGVD) lie on some of the unmined areas in the extreme eastern portion of the site, and the lowest elevations (approximately 115 feet NGVD) are found in the south-central portion of the property, near the headwaters of Upper Saddle Creek.

2.5.2 Geology and Stratigraphy

Peninsular Florida is underlain by a thick sequence of carbonate rocks capped by a thin series of siliciclastic rocks that range from mid-Mesozoic to Recent in age (Scott, 1992). The aquifer systems of Florida are found within the rocks deposited in the earliest Tertiary (55 million years ago) to Recent Ages (<100,000 year ago). In west-central Florida, the most prominent structural feature is the Ocala Platform. The Ocala Platform was a positive feature during the Miocene Age. The Ocala limestone comprises the youngest geologic unit present on the crest of the Ocala Platform (east of the project area), and is of Late Eocene Age. It is believed that Hawthorn Group sediments (of Miocene Age) have been removed from the crest of the platform through erosion. In west central Florida, rocks of Eocene Age generally dip to the south, away from the Ocala Platform. Miocene Age rocks follow this trend and thicken appreciably to the south, toward the Okeechobee basin. Rocks of the Late Eocene (40 million years old) to Recent Ages outcrop in Polk County. The significant stratigraphic and hydrogeologic units of west-central Florida are summarized in **Table 2-1**.

Table 2-1 Stratigraphic and Hydrogeologic Units Underlying the TFMA

Age	Stratigraphic Nomenclature	Hydrogeologic Unit (Aquifer)	Approximate Thickness (feet)
Recent to Pleistocene	Undifferentiated Recent to Pleistocene Deposits and the upper portion of the Peace River Formation (Bone Valley Member)	Surficial	60
Miocene	Hawthorn Group (includes the lower Portion of the Peace River Formation (Bone Valley Member) and the Arcadia Formation (including the Tampa Member)	Intermediate	75
Oligocene	Suwannee Limestone	Floridan	75 - 150
Eocene	Ocala Limestone		>200

Note: Source: Swancar and Hutchinson, 1992

Descriptions of these units, taken from Campbell (1986), Cathcart (1989), and Scott (1986, 1989 and 1992), are presented below, and the distribution of these units in Polk County are shown on the geologic cross-sections provided in **Figure 2-4**.

Ocala Limestone

The Late Eocene-age, Ocala Limestone crops out in extreme northwestern Polk County (near the border with Pasco, Lake, and Sumter counties) and is present in the subsurface throughout remaining portions of the county. There are two subdivisions of the formation; a lower unit of granular limestone overlain by an upper unit of variably carbonate muddy, to granular limestone. Both units are fossiliferous. In west central Florida, the Ocala Limestone is up to 200 feet thick. It is typically silicified in its outcrop area.

Suwannee Limestone

The Suwannee Limestone unconformably overlies the Ocala Limestone. The formation is Oligocene in age. The unit outcrops in northwestern Polk County and is present in the subsurface in western portions of the county. The formation is a vuggy, porous, fossiliferous, limestone with local dolomitized and silicified zones. Within the county, the Suwannee Limestone ranges from 75 to 150 feet thick.

Hawthorn Group

The Hawthorn group is a complex series of phosphate-bearing, carbonate and siliciclastic sediments of Miocene age. Hawthorn sediments underlie all of Polk County, with the exception of the outcrop areas of the Suwannee and Ocala limestones (northwestern Polk). In west-central Florida, the Hawthorn Group has been subdivided (in ascending order) into the Arcadia and Peace River formations.

Arcadia Formation

The Arcadia Formation is divided into two lower members, the Nocatee and the Tampa, overlain by an upper undivided section. The Tampa member forms the base of the Arcadia Formation over much of west central Florida, with the exception of southwestern Polk, Hardee, Highlands, DeSoto, and Charlotte counties, where it is underlain by the Nocatee member. Over much of the region, the Tampa member includes rocks formerly mapped as the Tampa Formation (Stewart, 1966, Scott, 1986). Parts of the former Tampa Formation in northern Polk County, however, have been assigned to undivided portions of the Arcadia Formation.

The Tampa member is a slightly phosphatic to non-phosphatic, sandy limestone. A blue-green, clay unit is typically present at the base of the Tampa member. The Nocatee member is a mixture of carbonate-cemented quartz sands, phosphorite, and minor clay. The upper portion of the Arcadia Formation consists of sandy and clayey, phosphatic dolomites and limestones interbedded with sand and calcareous clay units. In Polk County, the Arcadia Formation ranges from 30 feet to over 250 feet in thickness.

Peace River Formation

The Peace River Formation is divided into a lower undivided section, and the upper Bone Valley Member. The formation is present in all areas of the county, except the outcrop areas of the Ocala and Suwannee limestones, and is generally less than 50 feet thick. All of the economic phosphate deposits in the Central Florida Phosphate district can be found within the Peace River Formation.

The undivided section of the Peace River consists of clayey, dolomitic, variably phosphatic quartz sands, to sandy, phosphatic, dolomitic to non-dolomitic, clays. Thin dolomite beds are present in the unit, increasing in abundance with depth to the contact with the Arcadia Formation. The Bone Valley Member consists of a mixture of sand to gravel-sized phosphate grains mixed with variable amounts of quartz sand and clay. The unit hosts the bulk of the minable phosphate deposits in the district and was formerly assigned a formational status (Stewart, 1966). The Bone Valley reaches a maximum thickness of 50 feet and is limited in extent to central and western portions of the county. In northern portions of the county, the Bone Valley comprises the entire section of the Peace River Formation.

Undifferentiated Surficial Sediments

The Hawthorn group is unconformably overlain by undifferentiated marine terrace sands, clayey sands, and clays which range from Pliocene to Pleistocene in age (5.3 million to 10,000 years). Thickness of these sediments range from 10 feet to as much as 120 feet in ridge areas. Recent, Holocene sediments (<10,000 years) consist of localized deposits of sand, silt, clay, and organic materials deposited in flood plains, marshes, and lakes.

2.5.3 Hydrogeology

Three principal hydrogeologic units are present in west-central Florida (**Table 2-1**): the surficial aquifer system; the intermediate system, and 3) the Floridan aquifer system. The surficial aquifer is found primarily in permeable sand units of the undifferentiated surficial sediments, and in upper portions of the Peace River Formation (the Bone Valley Member). The intermediate aquifer system is present in the dolomite and limestone units of the lower portion of the Bone Valley Member and the Arcadia Formation. The intermediate aquifer is equivalent to the secondary artesian aquifer of Stewart (1966). A lower clay-confining unit (the Tampa Member) occurs at the base of the Arcadia Formation. The Floridan aquifer is encountered in the underlying Suwannee and Ocala Limestones.

2.5.4 Meteorology and Climatology

The climate of the area in the vicinity of the TFMA is humid and subtropical. The wet summer period from June through September is characterized by high temperatures and frequent afternoon thundershowers from convective storms. During this period, tropical systems occasionally produce severe storms that generate significant quantities of precipitation. The months of October through May are generally drier, except for a shorter winter wet season that results from frontal storms. Climatic data for the area is recorded at the Lake Alfred Agricultural Research and Education Center, a National Oceanic and Atmospheric Administration (NOAA) climate-reporting station. Long-term rainfall at the Lake Alfred station averaged 50.83 inches per year (in/yr) for the period 1951 to 1980. The average annual air temperature is 71.6 degrees Fahrenheit (°F), and monthly averages range from 59.6 °F in December to 81.9 °F in August (Lee and Swancar, 1997).

2.5.5 Landforms

Sixteen landform designations were identified within the TFMA. The landform designations and acreages are shown in **Table 2-2**. A map delineating all landform boundaries within the TFMA is provided as **Figure 2-5**. Most of the landforms were created by the effects of phosphate mining. The major landforms type that cover at least 200 acres are listed on the following page with brief descriptions.

Mined, Unfilled, Graded These landform areas represent the largest acreage at the TFMA. This landform type is synonymous with current Land and Lakes reclamation methods. No fill was used during reclamation in these areas. Following phosphate mining, existing overburden spoil piles were graded to achieve proper slopes.

Unmined, Undisturbed These landform areas were not mined or disturbed.

Mined, Unfilled, Ungraded These landform types were typical of early phosphate mining. No filling or grading was completed on mined areas.

Mined, Filled (Clay, Sand), Capped and Graded These landform areas were mined and clay settling areas (CSAs) were later constructed within the mined areas. The CSAs were used for storing waste clays from the mining process. The CSAs were then capped with tailings sand and reclaimed.

Mined, Filled (Clay), Uncapped and Graded These landform types were initially mined, and CSAs were then constructed within the mined areas. The CSAs were used to store waste clays during the phosphate mining process. At the end of the settling area life, the CSA embankments were graded and a discharge swale was constructed.

Unmined, Covered (Clay, Sand), Reclaimed These landform areas consist of CSAs constructed on unmined ground. Clays were stored in the settling area during the mining process. The CSAs were then capped with tailings sand and reclaimed.

Mined, Filled (Clay), Ungraded These landform types were mined and subsequently used as CSAs. No reclamation activities were initiated after the CSAs were idled.

Mined, Partially Filled (Clay), Ungraded These landform areas were used as CSAs during the phosphate mining process. The settling areas were never completely filled and no reclamation was initiated.

Unmined, Covered (Overburden), Reclaimed These landform areas were unmined but covered with overburden during the mining process. Reclamation activities included grading and revegetating the overburden.

Table 2-2 Landform Area Designations within the TFMA

Landform	Acres
Mined, Unfilled, Graded	1,742
Unmined, Undisturbed	1,132
Mined, Unfilled, Ungraded	935
Mined, Filled(Clay, Sand)Capped and Graded	495
Mined, Filled(Clay)Uncapped and Graded	452
Unmined, Covered(Clay, Sand)Reclaimed	261
Mined, Filled(Clay)Ungraded	240
Mined, Partial(Clay)Ungraded	235
Unmined, Covered(Overburden)Reclaimed	210
Unmined, Covered(Clay)Reclaimed	196
Unmined, Stripped, Reclaimed	182
Unmined, Covered(Clay) Unreclaimed	139
Mined, Filled(Sand)Uncapped and Graded	100
Unmined, Covered(Sand)Reclaimed	79
Unmined, Covered(Overburden)Unreclaimed	29
Mined, Filled(Clay, Garbage)Capped and Graded	3
Total Acres	**6,430**

2.5.6 Soils

Information relating to surficial soils at the TFMA was obtained primarily for the United States Department of Agriculture's Natural Resource Conservation Service (NRCS), which was formerly known as the Soil Conservation Service (SCS). The Soil Survey of Polk County, Florida (SCS, 1990) provides detailed descriptions and maps identifying soil types throughout Polk County. In addition, historical SCS maps and FDEP and FFWCC personnel familiar with the site provided invaluable sources of information regarding the identification of soil types within the areas of the TFMA that were not delineated in the 1990 SCS report. A total of twenty-eight soil designations were incorporated into the soils map shown on **Figure 2-6**. The ten soil designations representing the largest areas (in acres) are presented below with condensed descriptions taken from the 1990 Soil Survey.

11-Arents-Water Complex This map unit is a series of open pits that are filled with water and are paralleled by long steep mounds of soil material. It is a result of phosphate mining. Slopes are steep to very steep. The Arents portion consists of piles of soil material or overburden that originally covered the phosphate-bearing strata. The water portion of the unit is formed in the mine pits after the phosphate-bearing strata has been removed. The composition of this unit is generally about 55 percent Arents and 45 percent water. Permeability is generally rapid, but can be highly variable. Limitations are present due to slope, erosion, and low available water capacity.

57 – Clayey Haplaquents These soils occur as areas of slime (colloidal clay), a by-product of phosphate mining. The slime has been pumped into holding ponds and allowed to dry. Slopes generally are less than 1 percent. Haplaquents, clayey (locally called "slickens"), are about 88 percent clay, 8 percent silt, and 4 percent sand. The clay is mainly montmorillonite but includes kaolinite, illite, and attapulgite. The soil material is gray and light gray with some yellowish brown mottles. It is neutral to moderately alkaline. Permeability is very slow. Low soil strength and wetness are the main limitations affecting most uses.

39 - Arents, Clayey Substratum These moderately well-drained to somewhat poorly drained soils are a result of phosphate or silica mining. Deflocculated clay is pumped into preshaped trenches or into a series of pits from which phosphate has been removed. The clay comes out as one separate after the phosphate pebbles, ore, and sand have been removed. It has a very high concentration of water and takes a very long time to dry out under natural conditions. After the clay is dry enough to support some vehicular traffic, a cap of soil material (Arents) is spread over the clay. Slopes are smooth to convex. The color and thickness of these soils are brown or yellowish brown to gray or white sand to a depth of two to four feet. Permeability is variable but generally rapid in the surface and very slow in the subsurface layer. Variability of the topsoil and low natural fertility are the main limitations.

7 - Pomona Fine Sand This poorly drained soil is located on broad areas in flatwoods. Slopes are smooth to concave and are generally zero to two percent. Typically, this soil has a very dark gray, fine sand surface layer about six inches thick. The subsurface layer to about 21 inches is sand. It is light brownish gray in the upper part and light gray in the lower part. The subsoil to a depth of about 26 inches is dark reddish brown loamy fine sand. Below that is very pale brown and light gray fine sand to a depth of about 48 inches, light gray fine sandy loam to a depth of about 60 inches, and light gray sandy clay loam to a depth of about 73 inches. The underlying material is light gray loamy sand to a depth of at least 80 inches. Permeability is moderate to moderately slow in the lower part of the subsoil. The wetness and the sandy surface are severe limitations affecting recreational uses.

68 - Arents These highly variable soils have been reworked by earth-moving equipment during phosphate mining. The areas of these soils are reclaimed and planted with grass and pine trees. Slopes are smooth to convex. Permeability is variable but generally ranges from moderately rapid to slow. Low fertility, the hazard of erosion, and soil compaction are limiting factors.

12 - Neilhurst Sand, 1 to 5 percent slopes This excessively drained soil is on broad uplands and low knolls. It formed in homogeneous sandy material from phosphate and silica mining operations. Slopes are mainly smooth to concave. Typically, the soil has a grayish brown sand surface layer about 3 inches thick. The underlying material to a depth of at least 80 inches is light gray sand that is mixed with reddish brown and brown sand. Some areas have coarse sand or fragments of rock. Permeability is very rapid. The sandy surface is a severe limitation affecting recreational uses.

8 – Clayey Hydraquents These soils occur as areas of slime (colloidal clay), a by-product of phosphate mining. The slime has been pumped into holding ponds. These ponds have standing water, and the soil strength is too weak to support a grazing animal. These areas have not dried out. Hydraquents, clayey, are about 85 percent clay, 10 percent silt, and 5 percent sand. The clay is mainly montmorillonite but includes kaolinite, illite, and attapulgite. The soil material is gray and light gray with some yellowish brown mottles. It is neutral to moderately alkaline. Permeability is very slow. The slow settling velocity of the clay is the main limitation affecting most uses.

17 - Smyrna and Myakka Fine Sands This unit consists of poorly drained soils on broad areas in flatwoods. It is about 55 percent Smyrna soil and 40 percent Myakka soil, but the proportion varies in each mapped area. Slopes are smooth to concave and are generally zero to two percent. Permeability is moderate or moderately rapid in the subsoil. Wetness and droughtiness are severe limitations affecting cultivated crops. These soils are severely limited as sites for urban development because of the wetness during rainy periods.

<u>14 - Sparr Sand</u> This somewhat poorly drained soil is in areas of seasonally wet uplands and knolls on flatwoods. Slopes are smooth. Permeability is moderately slow or slow in the subsoil. Wetness is a severe limitation affecting septic tank absorption fields, sewage lagoons and sanitary landfills.

<u>35 - Hontoon Muck</u> This very poorly drained soil is in swamps and marshes. Slopes are generally less than one percent but range between zero and two percent. Typically, this soil is black muck to a depth of about 11 inches and dark brown muck to a depth of about 75 inches. The underlying material is black sandy loam to a depth of at least 80 inches. Permeability is rapid. Wetness is a very severe limitation.

2.5.7 Land Use

The Tenoroc Fish Management Area is comprised of approximately 6,430 acres, most of which was previously mined or utilized for activities associated with phosphate mining. Subsequent reclamation and recreational development has created a land use mosaic that consists primarily of fishing lakes, reclaimed pasture and rangeland, upland forested areas, unreclaimed forested and shrub wetlands, and recreational use and access areas. A map showing the land use types identified within the TFMA is provided as **Figure 2-7**.

The descriptions of the current land uses at the project site were developed using a widely accepted classification system developed by the Florida Department of Transportation (FDOT): The Florida Land Use, Cover and Forms Classification System (FLUCCS) 1985, Level I. Level I provides only general classifications and is used here to show the overall land uses found on the project site, such as the general distribution of uplands, wetlands, waterbodies and developed areas.

Table 2-3 FLUCCS Code Level I Designations within the TFMA

FLUCCS Code and Descriptions	Acres	Percent of Total Cover
100 – Urban and Built-Up	7	<1%
200 - Agriculture	0	0%
300 – Rangeland	2,379	37%
400 – Upland Forests	1,620	26%
500 - Water	897	14%
600 - Wetlands	1,488	23%
700 – Barren Land	0	0%
800 – Transportation, Communication and Utilities	39	<1%

100 – Urban and Built-Up This category includes those areas with structures or fenced-in sites that were identified as being a part of the TFMA's long-term recreational usage. Grassy picnic areas around the structures were classified according to the vegetation coverage and are described below. Although much of the site was mined for phosphate in the past, no areas were identified using the FLUCCS Code 160 (Extractive), due to the present recreational land use, extensive reclamation that has taken place, and the successional vegetative communities that have developed on unreclaimed areas.

200 – Agriculture No agricultural areas have been mapped on the site because although there are improved pasture grasses that could be utilized for cattle grazing, there are no formal agricultural uses by the TFMA.

300 – Rangeland Rangeland is the predominant cover type at Tenoroc and consists mainly of improved pasture grasses that were planted as part of reclamation. Approximately 37 % of the project area is classified as rangeland. Those grassed areas that are not regularly maintained by mowing are being encroached upon by shrubs and vines. Cogon grass makes up about 20% of this category.

400 – Upland Forests Upland Forest includes reclaimed and unreclaimed successional sites, and small areas of native uplands within the TFMA's boundary. Approximately 26% of the project area is covered by upland forests.

500 – Water This category consists mostly of reclaimed and unreclaimed lakes resulting from the previous phosphate mining. Most of these water bodies are used as fishing lakes, which are the primary recreational usage within the park. There are also ditches and streams conveying water around and through the property. Water covers approximately 14% of the total TFMA area.

600 – Wetlands This classification includes both forested and non-forested wetland categories. Included here are unreclaimed CSAs that support a variety of wetland vegetation. Wetland vegetation covers approximately 23% of the project site.

700 – Barren Land No barren land areas have been identified at the Tenoroc site.

800 – Transportation, Communication and Utilities This classification consists primarily of roads, both paved and non-paved, within the TFMA.

2.5.8 Vegetation

General Vegetation Assessment

Vegetation communities found at the TFMA typify those found in reclaimed and unreclaimed phosphate lands in Central Florida. Habitat value within each of these areas varies, depending primarily upon vegetative diversity and exotic species coverage. These areas include:

- lakes that support floating and shoreline emergent aquatic vegetation;
- clay settling areas which are typically dominated by a shrub community of Carolina willow (*Salix caroliniana*), wax myrtle (*Myrica cerifera*), primrose willow (*Ludwigia peruviana*) and/or Brazilian pepper (*Schinus terebinthifolius*);
- unreclaimed spoil banks which have been colonized by upland hardwoods and a variety of exotic trees and shrubs;
- reclaimed forested uplands that support recruited and planted pines and hardwoods; and,
- reclaimed pasture and rangeland dominated by pasture grasses and exotic invaders such as cogon grass (*Imperata cylindrica*).

In order to best assess restoration options, the existing conditions of the entire site were evaluated. This was accomplished by developing a vegetation community/land use map. This effort resulted in the compilation and mapping of all of the vegetative communities found on the project site. This mapping will allow the project team to identify the major habitat types and locate any remnant natural or high quality areas, areas of arrested succession, and areas of high exotic species infestation. The intent is to use this information in the design phase so as to integrate restoration activities into the existing landscape such that high quality areas, remnant natural systems or habitats heavily utilized by wildlife will not be adversely impacted.

Methodology

The vegetation map for the TFMA (**Figure 2-7**) was developed using aerial photo interpretation, field reconnaissance and an extensive review of existing information compiled from various sources. The following information and data sources were utilized:

- **Aerial photographs** - Existing aerial photographs were obtained from a variety of sources. These included color infrared photos, recent black and white digital aerials, and blue-line aerial photos obtained from Polk County and the City of Lakeland.

- **False color infrared** - Interpretations of the false color infrared aerial photographs were the best method of determining vegetation signatures. Subtle color gradations and tonal changes could be easily picked out and transferred onto less informative black and white photographs. These maps were obtained from I.F. Rooks and Associates, Inc. (Rooks), and were flown in January 1999 after an initial earthmoving effort was completed to provide better access in the southeastern portion of the site. This map covered the sites identified as reclamation program areas BDN-T-04, BDN-T-06, BDN-T-03, and the eastern one half of BDN-T-05, at a scale of one inch equals 400 feet.

- **Digital aerials** - Black and white digital aerials were used to complete gaps left from incomplete infrared aerial coverage. These maps were obtained from Polk County and were produced at a scale of one inch equals 200 feet. Additional Polk County aerials included recent blue line aerials of adjacent and non-contiguous areas of the Tenoroc site.

Previous Studies

Additional data sources utilized during this assessment included previous studies and reclamation plans developed for the Tenoroc site and adjacent parcels, and information provided FFWCC personnel. Reclamation planting plans provided details on reclaimed areas and the vegetation communities targeted during reclamation. Previous studies on non-contiguous and adjacent parcels provided land use and vegetative community assessments. These studies included investigations conducted on the Bridgewater parcel, and for the City of Lakeland on Tenoroc and Williams Company parcels.

Field Reconnaissance

Ground-truthing was accomplished using two field teams trained in native and exotic plant identification. At the beginning of the field investigation, the two teams met to develop a list of land classification codes adequately reflecting the project site. Using the FLUCCS system as a base, these land use categories were modified and/or supplemented to provide categories that would best describe the Tenoroc vegetation communities. Local FFWCC staff familiar with the site assisted the two teams. Ground-truthing took place over a period of approximately two months, beginning in June 1999. Based on information collected during field reviews and identification of individual aerial photographic signatures, each vegetative community on the site was mapped and assigned a FLUCCS code. Every effort was made to correlate the photographic signature of a particular vegetative community with its actual counterpart. Field maps with notes listing dominant plant species and vegetative communities were archived for backup information.

Vegetation and Land Use Codes Development

Additional land use codes were chosen from the FDOT's FLUCCS Level III and IV classification groups. Level IV codes were used where appropriate to provide the most detail in those habitats that are particular to the TFMA site either because of a preponderance of nuisance or exotic species, or because a particular habitat was noteworthy. After an initial field investigation, the two teams met with FDEP and FWC staff to discuss developing unique codes for those habitats that were not covered under the existing FLUCCS list. These unique codes are identified in the following table with an asterisk. The usage of additional or modified codes specific to a site is a usual and accepted practice throughout the State. **Table 2-4** lists all of the Level II and IV FLUCCS codes used to construct the existing vegetative cover map. Descriptions of the codes and the dominant species for each category follow the table.

Table 2-4 Level III and IV FLUCCS Codes within the TFMA

Level III and IV FLUCCS Code	Acres	Percent of Total Area
1756 – Maintenance Yards	1	<1
180 – Recreational	6	<1
310 – Herbaceous Rangeland	18	<1
*311 – Cogon Grass	102	2
*312 – Bahia Grass	178	3
*313 – Bahia/Cogon Grass Mix	408	6
*314 – Vine Cover	26	<1
320 – Shrub And Brushland	467	7
321 – Palmetto	82	1
329 – Baccharis/Bahia Mix	1,099	17
411 – Pine Flatwoods	55	<1
421--Xeric Oak	29	<1
422 – Brazilian Pepper	331	5
*422/411 – Pine/Brazilian Pepper/Exotic Mix	4	<1
*424 – Exotic/Hardwood Mix	310	5
428 – Cabbage Palm	<1	<1
434 – Hardwood/Conifer	315	5
438 – Hardwood Mix (<10% Exotics)	538	8
441 – Coniferous Plantations	36	<1
510 – Ditches, Streams, Canals, Etc.	9	<1
520 – Lakes	888	14
611 – Bay Swamp	<1	<1
617 – Mixed Wetland Hardwoods	15	<1
620 – Wetland Coniferous Forest	<1	<1
621 – Cypress	15	<1
*628 – Carolina Willow (<10% Others)	268	4
*628/314 – Carolina Willow/Vine Cover	9	<1
*629 – Wax Myrtle/Willow Mix	463	7
630 – Wetland Forested Mixed	48	<1
*631 – Willow/Cypress and/or Hardwood	436	7
641 – Freshwater Marsh	36	<1
*6412 – Cattail/Primrose Willow	95	1
644 – Floating Mats/Emergents	91	1
6444 – Duckweed	12	<1
814 – Trails/ Roads	39	<1
Total	**6,430**	**100**

1756 – Maintenance Yards This land use type includes fenced-off areas used to store equipment and supplies for maintenance purposes at the TFMA.

180 – Recreational This code covers such uses as the TFMA's main office building, public picnic areas, and shooting ranges. These are established areas that would be excluded from restoration activities.

310 – Herbaceous Rangeland This category covers those non-forested areas that support native grasses and herbs, not dominated by bahia grass (*Paspalum notatum*) or exotics. Because of the high degree of cover by invasive exotics and planted pasture grasses, this vegetation type covers a relatively small area of the TFMA, when compared to other range/herbaceous categories such as 311 and 312 (see below).

311* – Cogon Grass Cogon grass (*Imperata cylindrica*) is a highly invasive upland grass species that typically colonizes disturbed areas such as previously mined lands. This category represents greater than 90% cogon grass coverage, which occurs throughout the site, but is particularly concentrated around non-forested reclaimed and developed areas.

312*– Bahia Grass Includes areas with greater than 90% bahia grass coverage. Because of the common reclamation practice of the creation of large expanses of improved pasture areas suitable for cattle grazing, a significant portion of the TFMA was planted in bahia grass. Bahia grass is also commonly used for erosion control.

313*– Cogon Grass/Bahia Grass Mix Although a general mix of both grasses, cogon grass often forms small dense patches within the Bahia. If not managed properly, the cogon grass will overtake the bahia grass and eventually form a monoculture.

314*– Vines Several species of vines are common throughout the site, however two dominate: pepper vine (*Ampelopsis arborea*) and grape vine (*Vitis rotundifolia*). High coverage by vines is typical of disturbed or recently cleared sites.

320 – Shrub and Brushland This classification is comprised of wax myrtle (*Andropogon* spp.), salt bush (*Baccharis halimifolia*), blackberry (*Rubus* sp.) and mixed pasture grasses with some of the above listed vines evidenced around the edges. Within the TFMA, this vegetation code is indicative of a reclaimed sites planted with pasture grasses that have not been frequently maintained, i.e. mowed or burned.

321 – Palmetto Prairie Thickets of saw palmetto (*Serenoa repens*) predominate with a mixture of sparse native grass coverage. This community is found primarily in unmined areas, interspersed amongst pine and oak hammocks.

329* – Baccharis and Bahia A relatively open overstory is composed of salt bush with a bahia grass groundcover. This is indicative that the pasture is not being maintained and will eventually be shaded out by salt bush and other aggressive colonizers.

411 – Pine Flatwoods This category represents both native and planted pine communities, and consists primarily of slash pine (*Pinus elliottii*).

422 – Brazilian Pepper Brazilian pepper is a very aggressive exotic, and is found in various habitats throughout the site, including lake banks, spoil rows and clay settling areas. Cover ranges from dense monocultures to mixed areas (see below). Understory is typically sparse or non-existent, with occasional low coverage by ferns.

422/411*– Pine/Pepper/Exotic Mix These areas typically support a pine overstory that is being invaded by a brazilian pepper understory.

424* – Exotic/Hardwood Mix (>10% exotics) Areas classified with this code are primarily spoil rows and perimeter dam embankments. The canopy is composed of hardwoods such as live oak (Quercus *virginiana*), laurel oak (*Quercus laurifolia*), sugarberry (*Celtis laevigata*), American elm (*Ulmus americana*), red maple (*Acer rubrum)* and exotics including brazilian pepper, Chinese tallow (*Sapium sebiferum*), camphor tree (*Cinnamomum camphorum*), chinaberry (*Melia australis*), guava (*Psidium guajava*) and lead tree (*Leucaena leucocephala*).

428 – Cabbage Palm Cabbage palm (*Sabal palmetto*) is the dominant overstory plant with a variety of forbs and pasture grasses as the groundcover.

434 – Hardwood/Conifer Neither the conifers or hardwoods achieve a 66% crown canopy dominance in this classification. Dominant species identified included: slash pine, wax myrtle, water oak (*Quercus nigra*), live oak, southern red cedar (*Juniperus silicicola*) and laurel oak.

438 – Hardwood Mix (<10% exotics) This category tends to include the hardwoods listed above under Code 424*, without the exotic cover in the canopy. Oaks, cabbage palm, elm, southern red cedar and wax myrtle are frequent, with laurel oak typically the dominant of these.

441 – Coniferous Plantations Originally planted for silviculture, these areas are not maintained for that usage and are evidencing some growth of hardwoods in the understory. Slash pine is the predominant species.

510 – Ditches, Streams and Canals This code covers a variety of water flow pathways within the project area. There are no unimpacted or natural stream channels identified. Most of these areas support a dense cover by native and exotic wetland and aquatic vegetation.

520 – Lakes These are all man-made lakes resulting from the mining process. These lakes are present on both reclaimed and unreclaimed areas, and several of both types are used for public fishing.

611 – Bay Swamp Bay swamp includes forested wetlands dominated by sweet bay (*Magnolia virginiana*), swamp bay (*Persea palustris*) and/or loblolly bay (*Gordonia lasianthus*). A small remnant bay swamp is found on the east side of the site. Sweet bay is the dominant canopy species.

617 – Mixed Wetland Hardwoods These forested areas are dominated by common wetland tree species such as red maple, sugarberry, American elm, water oak, laurel oak, and wax myrtle, with minimal cover by exotics or Carolina willow.

620 – Wetland Coniferous Forest These areas include non-cypress dominated coniferous wetland forests. Typically, this would include slash pine dominated areas that meet wetland vegetation, soils or hydrology criteria.

621 – Cypress Several natural cypress domes remain within the boundaries of the TFMA. Although impacted by clay deposition and exotic species encroachment, these areas still support a dominant cypress (*Taxodium distichum*) canopy and native understory species.

628* – Carolina Willow (<10% others) This category covers several large portions of the site, a majority of which has developed on old CSAs. As a native pioneer species, this species is typical of both reclaimed and unreclaimed mined areas.

628/314* – Carolina Willow/Vine Cover Similar to the above category, with Carolina willow the dominant canopy species, and heavy invasion by vines such as grape vine and pepper vine.

629* – Wax Myrtle/Willow Mix This makes up the largest forested category found on the site, and represents areas colonized by Carolina willow, but with a hydroperiod such that wax myrtle has been allowed to establish.

630 – Wetland Forested Mixed This category includes coniferous as well as hardwood wetland species. This typically includes species found in FLUCCS code 617, with the addition of cypress and/or slash pine to the canopy.

631* – Willow with Emerging Cypress and/or Hardwoods This is the second largest forested category, which illustrates that some amount of natural succession is taking place across the site.

641 – Freshwater Marsh This category includes both remnant natural marshes, and emergent areas that have developed following mining-associated impacts. Species include pickerelweed (*Pontederia cordata*), arrowhead (*Sagittaria lancifolia*), soft-rush (*Juncus effusus*), smartweed (*Polygonum* sp.) and other similar species typical to herbaceous marsh communities.

6412* – Cattail/Primrose Willow These herbaceous wetland areas include open, deep water pockets found within forested areas, along the margins of lakes, and in disturbed freshwater marsh areas. Cattail (*Typha* sp.) and primrose willow, are dominant.

644 – Floating Mats/Emergents These floating mats of vegetation are found throughout the lakes on the site and are comprised of a variety of aquatic vegetation. Common species include pennywort (*Hydrocotyle* sp.), water hyacinth (*Eichhornia crassipes*), torpedo grass (*Panicum repens*), umbrella grass (*Fuirena* sp.), and umbrella sedges (*Cyperus* spp.).

6444 – Duck Weed This floating aquatic vegetation occurs frequently in lakes throughout the site. Duck weed (*Lemna* sp.) is the dominant vegetation although similar species that may occur include water fern (*Salvinia* sp.) and azolla (*Azolla caroliniana*).

814 – Trails and Roads This land use is a combination of paved or well-maintained dirt or gravel roads that provide public access to the recreational facilities. Additional dirt roads that are not maintained but obviously regularly utilized are included.

Wetland Vegetation

The classification of wetlands (FLUCCS Code 600 series) was based on plant groupings alone. No attempt was made to follow any agency's particular jurisdictional determination guidelines. There are few entirely native or undisturbed wetland communities remaining at the site. The disturbed areas, especially the CSAs, exhibited a tremendous amount of wetland vegetation, i.e. Carolina willow or primrose willow, without other hydrologic indicators of periodic inundation. The presence of these plants can be attributed to the moisture holding capability of the clays. Other wetland areas exhibited constant inundation or fluctuating hydroperiods as evidenced by seasonal high water lines and other field indicators.

Exotic Vegetation

The high degree of coverage by exotic species within the TFMA tends to be typical of unreclaimed or highly disturbed sites, however, the species richness of exotics is also extremely high. These include the very common exotic invaders such as brazilian pepper, cogon grass, water hyacinth and Chinese tallow, as well as many other problematic exotics including, but not limited to: wild taro (*Colocasia esculenta*), water lettuce (*Pistia stratiotes*), torpedo grass, albizia (*Albizia lebbeck*), lantana (*Lantana camera*), camphor tree, air potato (*Dioscorea bulbifera*), Japanese climbing fern (*Lygodium microphyllum*), chinaberry, guava, and lead tree.

Exotic vegetation occurs throughout the site in varying coverages, as monoculture areas and interspersed among native species in lesser densities. For mapping purposes, only those areas dominated by exotics were mapped to the particular species or as an exotic mix. These categories comprise approximately 18% of the total project area, however actual exotic species cover is far greater when the exotic component found within the other categories is taken into consideration.

Although much of the exotic trees and shrubs are heavily utilized by avian species for food, cover, and nesting opportunities, the number and coverage of exotic species is problematic in that natural succession and colonization by native, beneficial species is reduced or arrested entirely. Exotic species cover may be reduced in some areas through the reclamation process, but may gradually increase in other areas as the more aggressive invaders overtake the planted or recruited native species.

QA/QC Review

The field maps were digitized into a computerized Geographical Information System (GIS) for statistical analysis and preparation of a graphic map of the land use and vegetation types. A group comprised of the two field reconnaissance teams, the FDEP's field project manager, and FFWCC staff familiar with the site then reviewed preliminary draft copies of the map. The final map is the result of three comprehensive reviews by this group.

Final Map Format

The final digital format of the land use and vegetative cover map is rendered in the ArcView® GIS. The digital map may be printed in full color at any appropriate scale. A colorized paper copy of the Land Use/Vegetation Map is provided as **Figure 2-7 and Map 2**. The land use polygons may be queried to provide information including, but not limited to, acreage, linear boundary distances, upland/wetland or exotic versus native plant community ratios, or the locations of sighted wildlife to potential habitat. This information will assist in future planning and design efforts, and in choosing potential restoration sites that integrate logically into the overall land use mosaic.

2.5.9 Wildlife

Wildlife observations within the project area were identified by several sources, including the following:

- personal observations and communications with the FFWCC staff;
- record searches obtained from the Florida Natural Areas Inventory and the U.S Fish and Wildlife Service's databases;
- personal observations recorded by the reconnaissance teams during the land use/vegetation assessment; and,
- records from a local Audubon Society bird count that was completed at the TFMA in 1984.

Known occurrences or potential utilization of the site by wildlife species listed as endangered, threatened or of special concern were researched utilizing existing information and databases. The Florida Natural Areas Inventory (FNAI) and the U.S. Fish and Wildlife Service (USFWS) were contacted, and records searches was requested from each. The results of these record searches can be found in **Appendix 6.** Records from the 1984 Audubon Society bird count are provided in **Appendix 7**.

The above information was collected in order to map known locations of rookeries, nest trees or habitat significant to listed or non-listed wildlife species. This information will be utilized in the design phase so as to avoid unnecessary impacts or disturbance to important nesting or foraging habitats. The wildlife species listed in **Table 2-5** include both casual observations that were recorded during the vegetation mapping effort, and species that were not confirmed sightings, but were considered "expected to occur" based on the location and habitat types listed in **Appendix 6.** Only three of the listed species were observed during the vegetation mapping exercise: *Eudocimus albus* – white ibis, *Gopherus polyphemus* – gopher tortoise, and *Alligator mississippiensis* - - American alligator. **Figure 2-8** identifies the observed species and the general locations of each observation.

Table 2-5 Listed Species at the TFMA

Scientific Name	Common Name	Status		Likelihood of Occurrence	Habitats Potentially Utilized in Study Area	Comments
		USFWS	GFC			
Mycteria americana	Wood stork	E	E	High	Lake shorelines, ditches	Observed (Audubon Survey)
Egretta caerulea	Little blue heron	n/a	SSC	High	Lakes, wetlands, ditches	Observed (Audubon Survey)
Eudocimus albus	White ibis	n/a	SSC	High	Lakes, wetlands, ditches	Observed –1999
Egretta tricolor	Tri-colored heron	n/a	SSC	High	Lakes, wetlands, ditches	Observed (Audubon Survey)
Egretta thula	Snowy egret	n/a	SSC	High	Lakes, wetlands, ditches	Observed (Audubon Survey)
Grus canadensis pratensis	Florida sandhill crane	n/a	T	Moderate	pastures, marshes	Observed on Bridgewater Parcel
Speotyto cunicularia	Burrowing owl	n/a	SSC	Low	upland pastures	
Haliaeetus leucocephalus	Bald eagle	T	T	High	Forested uplands, lakes	Observed (Audubon Survey); no nests identified
Falco sparverius paulus	Southeastern American kestrel	n/a	T	High	open pasture/ grasslands	Observed (Audubon Survey)
Aramus guarauna	Limpkin	n/a	SSC	High	Lakes, wetlands	Observed (Audubon Survey)
Gopherus polyphemus	Gopher tortoise	n/a	SSC	High	upland pastures, xeric hammocks & flatwoods	Observed - 1999
Alligator mississippiensis	American alligator	T(s/a)	SSC	High	Lakes	Observed throughout site
Drymarchon corais couperi	Eastern Indigo Snake	T	T	Moderate	Various habitats	
Rana capito	Gopher frog	n/a	SSC	Low	Gopher tortoise burrows	Observed on Bridgewater Parcel
Sciurus niger shermani	Sherman's fox squirrel	N/A	SSC	Low	Open flatwoods & upland forests	Observed on Bridgewater Parcel

2.5.10 Surface Water and Ground Water Quality

Surface Water

In January 1999, BCI personnel collected surface water samples (SW-1 through SW-5) for laboratory analysis at five locations within the southeastern portion of the TFMA. The samples were analyzed to evaluate whether surface water bodies in the vicinity of the former TCL had been affected by potential contaminant migration from the landfill site. The surface water sample locations are shown on **Figure 2-9**.

The samples were collected in accordance with the methods specified in BCI's Comprehensive Quality Assurance Plan (CompQAP), Number 930109, which has been approved Quality Assurance Section of the FDEP. The samples were submitted to Environmental Conservation Laboratories, Inc. (ENCO) for analysis of Florida's Class III Surface Water Standards for Recreational Freshwater (referenced in Section 62-302.530, FAC). The analytical results are provided in ENCO's laboratory report, which is contained in **Appendix 8**. As indicated in the following table, the Class III Surface Water Standards for four parameters were exceeded at several of the five sample locations (SW-1 through SW-5).

Table 2-6 Summary of Class III Surface Water Standard Exceedences

Location	Parameter	Class III Standard	Sample Concentration
SW-1	Endosulfan	0.056 µg/l	0.14 µg/l
SW-2	Iron	1.0 mg/l	1.6 mg/l
SW-3	Fecal Coliform	800 colonies/day	16,400 colonies
	Total Coliform	2,400 colonies/day	TNTC
SW-4	Fecal Coliform	800 colonies/day	2,000 colonies
	Total Coliform	2,400 colonies/day	4,300 colonies

Notes: 1) µg/l = micrograms/liter
2) mg/l = milligrams/liter
3) TNTC = too numerous to count

Endosulfan is a organochlorine-based commercial pesticide that is classified as a human systemic toxicant (Gowan Company, January 2000, and FDEP, June 1994). This compound has the potential to affect the body weight, kidneys, and cardiovascular system of humans, and is toxic to fish, birds and other wildlife. Iron is a naturally-occurring inorganic metal that can produce objectionable taste, color or odor in water, and may affect the blood chemistry and/or gastrointestinal system in humans. Coliforms are naturally occurring or introduced bacteria that can affect human health, but more frequently function as an indicator that other harmful pathogens associated with fecal wastes may exist.

Based on the elevated concentrations of total and fecal coliform bacteria detected in the samples collected from locations SW-3 and SW-4, a second round of surface water samples was collected for coliform analysis at the five previously referenced locations on May 26, 1999. Simultaneous samples were collected with a representative from Polk County's Natural Resources and Drainage Division (NRDD) for confirmatory analysis. BCI's surface water samples were submitted to ENCO, and the NRDD laboratory analyzed Polk County's samples.

None of the samples collected by Polk County exhibited total or fecal coliform concentrations exceeding the Class III Standards, however, the laboratory results for the samples collected by BCI indicated that the total coliform concentrations of the samples collected at locations SW-2 through SW-4 exceeded the Class III Standard. The analytical results are provided in ENCO's laboratory report, which is contained in **Appendix 7**, and are summarized in **Table 2.7**.

Table 2.7 Comparison of May 26, 1999 Coliform Analytical Results

	Sampling Team and Coliform Concentrations			
	BCI		Polk County	
Sample Location	Fecal Coliform Concentration (colonies)	Total Coliform Concentration (colonies)	Fecal Coliform Concentration (colonies)	Total Coliform Concentration (colonies)
SW-1	330	470	<2	810
SW-2	96	2,500	18	1,260
SW-3	145	7,200	9	630
SW-4	17	2,500	<2	1,350
SW-5	64	440	<2	450

Note: 1) bold format indicates values exceeding Class III Surface Water Standards.

At present, there appears to be no definitive quantitative relationship between the concentrations of fecal coliform bacteria and the concentrations of pathogens present in surface water. Surface waters with high concentrations of fecal coliform may, in fact, have low concentrations of bacteria and viruses harmful to humans. In contrast, enteric (intestinal) viruses can be found at significant levels in waters with low fecal coliform bacteria concentrations. For these and other reasons, fecal coliform bacteria are not considered to be ideal indicators of the risk of exposure to pathogens associated with fecal material (Puget Sound Water Quality Authority, 1994).

The results indicate that, at present, the TFMA surface water bodies nearest to the former TCL do not appear to be significantly impacted by potential contaminant migration from the landfill site. The findings relating to elevated coliform levels will be addressed in the forthcoming water quality monitoring permit.

Ground Water

On February 15, 1999, three monitor wells (T-1 through T-3) were installed in the southeastern portion of the TFMA to evaluate whether ground water within the surficial aquifer in the vicinity of the former TCL has been affected by potential contaminant migration from the landfill site. The monitor wells were installed to depths ranging from 18 to 32 feet below ground surface (bgs) at the locations shown on **Figure 2.9**.

The wells were installed using hollow-stem auger drilling techniques, and are constructed of two-inch diameter, threaded, flush-joint, Schedule 40 PVC casing connected to a five-foot section of PVC screen with 0.010-inch openings. The annulus around each well was filled with 20/30 gradation silica sand from the bottom of the borehole to approximately one foot above the top of the screen. A one-foot layer of 30/65 gradation silica sand was then placed on the top of the filter sand, and the remainder of the borehole was filled with neat cement grout to approximately six inches bgs.

Each well is completed with a two-foot square concrete pad and a locking, steel protective casing that extend approximately three feet above grade. Boring and well completion logs for each of three wells are provided in **Appendix 9**. Following completion, wells T-2 and T-3 were developed by pumping and surging to remove visibly suspended sediment from the discharge water. Monitor well T-1 was not developed due to low water levels and an apparently low ground water recharge rate.

On June 4 and June 11, 1999, ground water samples were collected from the three monitor wells in accordance with the methods specified in BCI's CompQAP. The June 4, 1999 sampling event was aborted following collection of the last sample (from monitor well T-1) due to high turbidity. It has been documented that high turbidity can lead to elevated detection levels for volatile constituents and higher total concentrations of metals. Prior to initiating the second sampling event, all three wells were developed until the discharge water was free of visibly suspended sediment. Monitor well T-1 was manually developed with a teflon bailer.

Following completion of the June 11, 1999 sampling event, the samples were submitted to ENCO for analysis of the Appendix IX ground water monitoring list contained in Title 40, Chapter 1, Part 264 of the Code of Federal Regulations (CFR). The Appendix IX list includes purgeable organics, base/neutral and acid extractables, organochlorine pesticides (PCBs), chlorinated herbicides, organophosphorous pesticides, cyanide, sulfide, and 17 metals.

ENCO's laboratory report of results was received on June 29, 1999, and a copy of the report is included in **Appendix 7**. According to the report, none of the Appendix IX (CFR) constituents were detected in the samples collected from monitor wells T-1 and T-2. Lead and vanadium were detected in the sample collected from monitor well T-3 at concentrations of 0.005 and 0.01 milligrams per liter, respectively. Although lead was detected in the T-3 sample, the concentration reported was below Florida's Primary Drinking Water Standard (15 micrograms per liter, or 0.015 milligrams per liter). A maximum concentration limit (MCL) for vanadium is not provided in Florida's Drinking Water Standards, however, as listed in the Ground Water Cleanup Target Levels contained in, Section 62-785 (the Brownfields Cleanup Criteria Rule) of the Florida Administrative Code (FAC), the target level for vanadium is 49 micrograms per liter, or 0.049 milligrams per liter. The concentration of vanadium in the sample collected from monitor well T-3 did not exceed this regulatory criterion.

The results indicate that, at present, ground water within the southeastern portion of the TFMA does not appear to be significantly impacted by potential contaminant migration from the landfill site.

With the assistance of BCI and members of the Selection Committee, FDEP representatives have developed a Water Quality Monitoring Program (WQMP) for implementation at the TFMA. The objectives of the WQMP are to:

- evaluate the baseline water quality characteristics of surface water and ground water entering, residing within, and exiting the TFMA;

- assess potential changes in water quality that may occur as a result of the initiation of future restoration and mitigation activities; and,

- monitor existing and future inflow and outflow sources for compliance with applicable State standards.

Copies of the WQMP and the associated attachments are included as **Appendix 10**.

2.6 Description of Adjoining Properties

The adjoining properties of interest to this study include major land holdings around the perimeter of the TFMA, including tracts owned by Borden, Inc. (Borden), the Williams Company, Florida's Legacy, Inc. (FLI), and the cities of Auburndale and Lakeland. The locations and boundaries of the TFMA and the properties owned by Borden, the Williams Company and FLI are shown on **Figure 1-2 and Map 2**.

2.6.1 Borden, Inc. Property

Borden, the company that originally owned and operated the Tenoroc Mine, owns a parcel of land that adjoins the southeastern portion of the TFMA. The property comprises approximately 183 acres that are located in Sections 31 and 32, Township 27 South, Range 25 East, and Section 5, Township 28 South, Range 25 East (Polk County Property Appraiser, 2000). The property was included within the original boundaries of the Tenoroc Mine, but was separated from that parcel when Borden donated the mine site to the State of Florida in 1982.

Portions of the northern part of the Borden property were affected by mining operations at the Tenoroc Mine in the 1960's, including an area that was subsequently leased to Polk County for operation of a landfill. The approximately 136-acre site was operated by Polk County as the Tri-City Landfill (TCL) from 1972 through 1976. The majority of the disturbed portions of the property have been revegetated with grass, and the site is currently utilized for rangeland.

Historical information relating to operations at the TCL indicates that both domestic and industrial wastes were disposed at the site. Based on the results of an investigation completed under the supervision of the U.S. Environmental Protection Agency (EPA), the site was placed on the EPA's CERCLIS list (Comprehensive Environmental Response, Compensation, and Liability Information System) in June 1983.

A review of files obtained from the FDEP's Southwest District Hazardous Waste Division office, located in Tampa, Florida, revealed reports indicating that pesticide containers were found scattered on the land surface, and buried in trenches located on the property (NUS Corporation, 1984). During 1982, several cattle reportedly died while grazing on the landfill site, and a cowboy tending the livestock became ill with a viral inflammation. The results of studies to determine whether environmental conditions at the landfill might have been the cause of these problems were inconclusive (Ecology and Environment, Inc., 1993.) The references noted above and additional references to site information and historical data relating to the Tri-City Landfill are provided in Appendix **5.**

The pre-mining topography of the TCL site sloped gently downward to the north and west. Mining and landfilling activities have resulted in a relatively flat to gently undulating topography. Surface depressions of various sizes are scattered across the area, and these depressions tend to fill with water during periods of significant precipitation.

A second feature of interest on the Borden property is the Tenoroc Canal, also referred to as the Eastern Ditch, which forms the eastern and southern boundaries of the former TCL. The canal routes surface waters from a remnant bayhead located in the eastern portion of the TFMA, around the eastern and southern perimeters of the TCL, then toward the south and west to the confluence with the western ditch draining the TFMA. The meeting of these two conveyances forms the headwaters of Saddle Creek. Along portions of the canal adjoining the perimeter of the TCL, the ditch is reportedly lined with concrete (E & E, 1993). The analytical results for surface water and sediment samples collected from the ditch during the 1984 and 1993 studies completed for the EPA indicated the presence of detectable concentrations of pesticides and volatile organic compounds.

The Eastern Ditch is currently plugged downstream of the Polk Parkway discharge pipe adjacent to a commercial plant nursery that adjoins the Borden property to the east. Surface waters upstream of the plugged area have created backwater conditions on the TFMA property to the north, and these waters currently flow to the west into a surface water body known colloquially as the Blue Hole.

2.6.2 Williams Company Property

The Williams Company (formerly the Williams Acquisition Holding Company) owns approximately 5,400 acres of previously mined property that adjoins the northern portion of the TFMA. Two mining companies, American Cyanamid Company and Agrico, mined the property during the period from 1957 through 1986. American Cyanamid operated the Orange Park Mine (which encompassed what are now known as the Bridgewater property and the western portion of the Williams Company property) from 1957 through the mid-1960s. The facilities' beneficiation plant was located east of State Road 33 in the western portion of Section 15, Township 27 South, Range 24 East. Non-mandatory reclamation program areas mined by American Cyanamid have the nomenclature AC-OP-02, etc.

Upon exhausting their phosphate reserves, American Cyanamid sold the mined out property, beneficiation plant and draglines to Agrico. Agrico operated the Saddle Creek Mine based on reserves located to the east of the mined out Cyanamid property, in Township 27 South, Range 24 East and Township 27 South, Range 25 East. Agrico also mined the Ebersbach property to the southeast and pumped the matrix to the Saddle Creek beneficiation plant. The Williams Company took control of the property in 1986 when mining was completed. Non-mandatory reclamation program areas mined by Agrico have the nomenclature AGR-SC-01, etc.

2.6.3 Bridgewater Development

Bridgewater is a proposed mixed-use development owned by Florida's Legacy, Inc. (FLI). The site adjoins portions of the northwestern perimeter of the TFMA. As discussed in **Section 1.1** of this report, a portion of the Bridgewater development was recently purchased by the State of Florida for inclusion in the TFMA. The property purchase was approved and finalized after activities associated with this completion of Task 1 of this restoration project had already been initiated. Therefore, the conditions and characteristics of this recently purchased land will be described herein as being a part of the Bridgewater development.

The Bridgewater property totals approximately 3,000 acres in size, and occupies portions of Sections 9, 10, 15, 16, 20, 21, 22, 28, 29, 30, 31, 32, and 33, Township 27 South, Range 24 East, and section 5, Township 28 South, Range 24 East. The majority of the property was mined for phosphate ore from the late 1950's through the early 1970's. The site is currently utilized primarily as improved pastureland for cattle grazing. In general, the topographic relief of the site is relatively flat to gently undulating, with higher elevations on ridge areas lying in the western part of the property, and low-lying marshy areas to the east. Elevations at the site range from approximately 130 to 150 feet, referenced to the National Geodetic Vertical Datum of 1929 (NGVD).

Over much of the property, drainage patterns are local, with surface runoff into numerous closed basin lakes and ponds. These lakes and ponds formed in old mine cuts. The southern portion of the site drains into Lake Parker. A small area in the east-central portion of the study area is drained by an NPDES outfall structure located on the Williams property, east of the site. Discharge from the outfall flows into the western ditch draining the TFMA then on to Saddle Creek, approximately three miles to the south-southeast.

Several small man-made lakes and ponds representing former mine cuts are present within the property boundaries. Most of the lakes have been given colloquial names for reference, including Butterfly Lake, Horseshoe Lake, and Half-Moon Lake. Four large lakes (Lakes Crago, Deeson, Gibson and Parker), adjoin or lie near the site. Lakes Crago and Parker adjoin the southern portion of the site, and Lakes Deeson and Gibson lie to the northeast of the area. Little Lake Parker extends into the Bridgewater development north of the City of Lakeland's C.D. MacIntosh Power Plant and the Northside Wastewater Plant.

2.6.4 City of Lakeland

The City of Lakeland owns property that adjoins the western perimeter of the TFMA. Facilities on the property include the C.D. McIntosh Power Plant and the Northside Wastewater Plant. Fish Lake, east of the McIntosh Power Plant, has been incorporated into a fly ash disposal area used by Lakeland Electric, and is no longer a viable water body. Drainage from the City of Lakeland property flows directly to Lake Parker and should not affect restoration activities at the TFMA.

2.6.5 City of Auburndale

The City of Auburndale and the TFMA have signed a Memorandum of Understanding regarding discharge of wastewater from an advanced wastewater treatment facility located east of the TFMA. The water will undergo quaternary treatment using ultraviolet light prior to land application on upland areas adjacent to the TFMA. The plant operations will be phased and the initial peak flow will be two million gallons per day (mgd). Subsequent expansion will increase the discharge to 4 mgd. Treated wastewater will seep from the sandy ridge to the eastern ditch, and will be incorporated into the restored flow in the eastern portion of the TFMA.

3.0 SURFACE WATER AND GROUND WATER HYDROLOGY

3.1 Overview

One of the objectives of the Upper Peace River restoration project is to create mitigation wetlands to replace those impacted during construction of the Polk Parkway. An integral part of wetland creation and enhancement is to provide the hydrology necessary to maintain wetland health and propagation. The existence and functionality of the plant and animal species within a wetland area is greatly affected by the hydrologic characteristics of the site. Methods for providing sufficient or appropriate wetland hydrology include: adjustment and/or management of wetland surface water inflows and outflows; and, adjusting topographic surface elevations, particularly in relation to surficial aquifer water table elevations and watershed basin configurations.

In general, the goals of a wetland mitigation project should be to:

- manage the hydrologic resources necessary for the successful creation and maintenance of the wetland area;

- enhance the functionality and aesthetic value of existing wetlands; improve the quality of water discharging from the site; and,

- incorporate design elements that will allow for controlling the rate and volume of water discharged from the site.

In order to meet these goals, it is important to describe and understand the existing hydrology of the area. As shown in the 1941 aerial photograph of the project area (**Figure 2-1**), the pre-mining characteristics of the Upper Saddle Creek Sub-basin (USCSB) can best be described as a network of uplands contributing to a system of isolated and interconnected wetlands and lakes. Since that time numerous changes have occurred that have altered hydrologic conditions within the area, including the following:

- the construction of Interstate Highway 4 bisected the northern portion of the USCSB and isolated parts of the basin north of the roadway;

- mining and clay disposal activities within TFMA and the Bridgewater and Williams properties resulted in significant changes in hydrologic routings through the area;

- approximately forty percent of the mined area was converted to CSAs, which tend to reduce surface water outflows and functionally eliminate ground water recharge;

- lakes that were created during mining or reclamation activities have reduced surface water discharges as compared with the pre-mining hydrology of the area;

- nuisance vegetation species have become established on a number of post-mining wetland areas; and,

- surface water discharges from the created lakes would likely have reduced turbidity and dissolved oxygen concentrations when compared with pre-mining conditions.

In addition, regional development activities are occurring or are planned for upstream properties that contribute to the TFMA. These activities may result in a degradation of the quality of surface waters discharging to the TFMA, thus emphasizing the need for increased detention and water quality enhancement within the area.

Figure 3-1 shows existing surface water flow directions within the TFMA, and **Map 3** shows the surface water flow directions and drainage sub-basin divides within the USCSB. The hydrology of the USCSB is partially regulated by water elevations in Lake Parker and Lake Hancock. Water elevations in these lakes are controlled by SWFWMD gated structures. These structures are typically designed to maintain target water levels.

Historical occurrences of flooding have been recorded throughout the USCSB. **Table 3-1** list dates of potential flooding from 1943 through 1999, based on rainfall records and mentions of flooding within local newspapers during the periods identified. In response to heavy rainfall, it is common for lakes and streams within the USCSB to reach or exceed their flood elevations, resulting in nuisance and limited structural flooding. There have been over 60 individual flooding complaints documented within the USCSB and its surrounding region (Keith and Schnars, P.A., 1999).

Table 3-1 Potential Flooding Dates and Rainfall Totals – 1948 through 1999

Daily Rainfall > 4 Inches		Monthly Rainfall > 13 Inches	
Date	**Rainfall (inches)**	**Date**	**Rainfall (inches)**
July 27, 1949	6.02	July 1948	14.34
December 25, 1949	4.88	August 1948	15.57
July 29, 1960	5.69	July 1960	15.67
March 16, 1960	6.96	June 1968	14.86
September 10, 1960	6.33	June 1973	13.55
May 25, 1968	4.22	May 1978	16.03
June 4, 1968	4.62	July 1987	13.77
June 18, 1982	4.38	September 1988	15.18
November 23, 1988	4.83	July 1993	14.74
July 13, 1991	4.22	September 1998	15.65
September 19, 1998	5.87	--	--

3.2 Surface and Ground Water Flow Patterns

Map 3 shows the upper Saddle Creek sub-basins, lakes, interconnecting ditch locations, structures, and surface water flow directions. Average annual discharge from the basin above County Road (CR) 542 was about 15 inches/year in Water Year 1998 (USGS 1999). Surface water runoff is generally from the north to south; with the northern half of the basin divided into an east and west portion that merge above Station 17B. **Table 3-2** shows the estimated surface water flow volumes passing the various gages within the USCSB. The period of observation for these gages includes several large rain events that were recorded in the winter of 1997 during the 'El-Nino' phenomenon.

Flow at station 17B was 5,076 acre-feet/year (ac-ft/yr), and past station 20 was 2,252 ac-ft/yr, with a combined flow of approximately 7,300 ac-ft/yr just downstream of these gages. Flow into the TFMA from the Williams tract was 1,146 ac-ft/yr past station 11, which is approximately 57 percent of the flow past gage 13 within the TFMA, and 23 percent of the flow past gage 17B. Flow into the TFMA from the Williams tract past station 19 was 868 ac-ft/yr, and this flow enters the ground water system at the Blue Hole, just west of Lake Myrtle.

Table 3-2 Surface Water Gaging Station Flow Measurements - August 1996 through August 1998

Station	Flow Volume (ac-ft)	Average Flow (ac-ft/yr)	Average Flow (cfs)
11	2,387	1,146	3.2
13	4,202	2,017	5.7
17A	8,582	4,119	11.6
17B	10,575	5,076	14.3
19	1,809	868	2.4
20	4,691	2,252	6.3
542	45,597	21,887	61.6

Figure 3-1b shows contours of simulated average surficial aquifer water table elevations within the TFMA. Ground water flow directions in the surficial aquifer somewhat mimic those of the surface water system within the watershed. Typically, lakes or streams within the area collect ground water baseflow, which then proceeds downstream through a network of man-made surface water conveyances.

3.3 Stormwater Storage Volume Calculations

The FFWCC manages lake water levels within the TFMA by utilizing a series of control structures installed on several lakes and waterways. The management of lake levels represents an opportunity to make full use of the operational range of lake fluctuations, but will also require considerations aimed at sustaining low flows to sensitive receiving wetlands during seasonal low rainfall periods. As part of this hydrologic evaluation, a number of the reclaimed and unreclaimed lakes in the eastern portion of the TFMA were studied to determine the available stormwater storage capacity. The reclaimed lakes include Picnic Lake and the reclaimed portion of Lake 5. The unreclaimed lakes include Lakes 2, 3, and 4, and the unreclaimed portion of Lake 5.

Field observations and associated measurements indicate that the reclaimed lakes are constructed with side slopes of approximately 4H: 1V or flatter. The unreclaimed lakes have side slopes that were originally cast via dragline and have eroded and weathered with time to slopes averaging 2H: 1V. Based on vegetation indicators and water marks/stain lines noted during field observations, water levels in the lakes were approximately two-feet below normal. Other observations noted indicate that the lakes have the capacity to store and effectively impound an additional six feet of water above the observed lake levels.

Available storage areas were calculated by digitizing the perimeter of the lakes on recent aerial photographs, then using the ArcView® GIS to calculate lake surface areas. The storage capacity of the lakes was then calculated by using the surface area measurments in conjunction with the lake slope characteristics noted in the field. **Table 3-3** shows the calculated stage-area-volume relationship for each individual lake in addition to the combined lake system (assuming independent control in staging the lakes). Based on these calculations, the combined stormwater storage capacity of the five lakes mentioned above is approximately 2,555 acre-feet, with water fluctuating between four feet above and two feet below normal water levels.

By comparing the average annual flows noted in Table 3-2, the potential storage capacity of these five lakes is 100 percent of the annual water volume contributed to the TFMA from offsite inflow from the northeast portion of the Williams Company property, or approximately 50 percent of the runoff volume originating upstream of station 17B. Based on these findings, significant surface water quantity and quality improvements can be realized by using these lakes for stormwater detention and attenuation.

3.4 Integrated Surface & Ground Water Model Evaluation

This section provides a review of the integrated surface and ground water model developed by the University of South Florida (USF) to evaluate the hydrology within the USCSB. USF used the FIPR Hydrologic Model (FHM, Ross et. al. 1997) in their investigation demonstrating the utility of FHM as a planning tool and providing an estimated water balance within the area. This section of the report:

- evaluates model completeness;
- summarizes the model results;
- reviews model assumptions and methods;
- reviews parameter assignments;
- reviews a comparison of the model simulated results and USGS monitor data; and
- reviews surface water routing as represented in the model.

3.4.1 Model Description

FHM is an integrated hydrologic model that simulates the processes of precipitation, interception, transpiration, evaporation, overland flow, interflow, percolation, base flow, stream channel flow, and ground water leakage between aquifers (Ross et. al. 1997). FHM combines a surface water model with a ground water model. The surface water model is the Hydrologic Simulation Program-FORTRAN (HSPF), sponsored by the United States Environmental Protection Agency (EPA). The ground water model is MODFLOW; which is described in "A Modular Three-Dimensional Finite-Difference Ground –Water Flow Model" (McDonald and Harbaugh 1984).

In FHM, the HSPF model is used to describe the processes of precipitation, transpiration, interception, evaporation, percolation, infiltration, interflow and overland flow (i.e., the hydrology above the saturated ground water system). The ground water model MODFLOW is used to describe the saturated ground water system. The integration of the ground water and surface water components in FHM involves the transfer of flow between the two models while respecting the sub-basin-based description in the surface water component, and the grid-based description in the ground water component.

The surface water component of FHM is described as a set of hydrologic basins, sub-basins, and reaches. Parameters are entered into the model describing average sub-basin characteristics. A reach is any stage-surface area-storage-discharge relationship that can be described by a table (an FTABLE). These tables allow a linear routing description of flows between reaches or out of the model (outfall). Subbasins can be routed to reaches, or an outfall.

There are two types of reaches represented in the model: lake and stream reaches. Lake reaches generally have an area that is large enough to warrant specific representation outside of the upland component of the surface water basin. Stream reach areas are generally included as part of basin upland areas. During the FHM simulation, the surface water model component calculates the stage of the reach used to set the stage of rivers in the ground water model component of FHM. A river cell is a boundary condition described within the river package and is used to calculate ground water baseflow to and from the represented reach. In some cases, a reach is represented in the simulation with fixed stages that do not change during the simulation. These reaches are represented with a negative identification number in the model. Other reaches are represented with positive identification numbers in the model, indicating a variable stage capability.

The ground water component of FHM is described as a set of parameters associated with individual model cells. The upper-most layer of cells represent the upper-most aquifer (the surficial aquifer), the second layer of cells represent the next lowest aquifer (the intermediate aquifer), etc. The semi-confining units between layers are represented within the leakance term. The leakance is the vertical conductivity of the confining unit divided by the confining unit thickness and assumes that storage within the unit is negligible.

A recent innovation provided in the newest version of FHM allows a more realistic simulation of the water table fluctuation (Patrick Tara, personal communication). The volume of water above and within the capillary fringe is transferred between the ground water and surface water models. This means that the specific yield of the soils, simulated in the MODFLOW portion of FHM, changes with each stress period.

FHM, as used to simulate the USCSB, is a sub-model of a larger modeled area encompassing the entire Southwest Florida Water Management District (SWFWMD). This 'far field' model was not reviewed as part of this investigation. The model simulated results from the far field model are used to provide boundary conditions for the Saddle Creek or 'near field' model. The simulated ground water levels at each cell are saved for each stress period during the far-field model simulations, and used to calculate boundary conditions represented using the General Head Boundary (GHB) package of MODFLOW, in the near-field model simulations.

3.4.2 Model Setup

USF calibrated the FHM representation of the USCSB for the period from August 1996 through September 1999. The model was setup using a GIS program and a preprocessor for the model. USF's GIS program, HydroGIS, provides a graphical interface used to analyze the system and calculate model parameters (Ross et. al. 1997).

<u>Rainfall</u>

The rainfall stations used in the Saddle Creek model simulations were located at:

- a CSA located on the Williams Company's property, just south of Interstate Highway 4;
- Station 17A, just south of Boy Scout Lake;
- Station 542 at CR 542, and,
- the Lakeland weather station, located approximately eight miles southwest of the TFMA.

Figure 3-2 shows the location of the four stations within the area of the Saddle Creek Drainage basin. Rainfall was collected at station 17A and CR 542 for the entire period simulated. Rainfall was collected at the Williams CSA from 1996 through 1998, with rainfall collected at station 17A used to supplement missing rainfall for this station. Rainfall from the Lakeland weather station was used to supplement missing data at the CR 542 station during the period from 1996 through 1998, since the station had been removed. Other occasional segments of missing data at the four sites were filled in using corresponding data from the nearest station.

A Thiessen polygon network was placed over a map of surface water sub-basins and used to allocate rainfall to each basin. Rainfall was weighted relative to the area of the basin within each Thiessen polygon. **Figure 3-3** shows the observed cumulative rainfall at each of the rain stations during the period simulated. The model used data collected at 15-minute intervals. The period simulated included the 'El Nino' year, with very high rainfall during the period from late 1997 through early 1998, and relatively dry periods both before and after that period. The average annual rainfall during the three-year period simulated ranged from 42 to 57 inches.

Evapotranspiration

Pan evaporation data used in the model simulations was collected at the Lakeland weather station. The pan data was reduced using a conversion coefficient of 0.7 to obtain an estimate of potential evapotranspiration. Pan evaporation was estimated and used in the model simulations (**Figure 3-4**). The hourly average annual rate of pan evaporation used in the model was 69 inches/year (a potential evapotranspiration rate of 48 inches/year).

Surface Water Basins and Routing

Surface water basin boundaries and routing directions were developed using available topographic information and observations noted in the field. USGS topographic quadrangle maps were used outside the TFMA region to delineate model subbasins. Inside the TFMA region, additional field reconnaissance and survey was used to refine basin delineations and estimate hydrologic slopes and lengths. **Map 4** shows the subbasin divides, reach locations, and routing directions used in the model setup and description. This map also shows the location of lakes used in the model. On the map, negative reach identification numbers indicate reaches with a fixed stage during the simulation. Positive reach identification numbers indicate reaches with stages varying in the simulations, based on the model estimated inflows and outflows. **Figure 3-5** provides a node diagram of the modeled basin reaches and routings.

Reaches

Reaches are represented in the surface water component of FHM using an FTABLE; which provides a depth-area-volume-discharge relation for each reach. Reaches that represent lakes or wetlands have a defined surface area that is separate from the runoff-producing basin area. Both the upland area of the sub-basin and the reach area receive rainfall and provide evapotranspiration. In most cases, the depth-area-volume relations for these reaches were estimated by approximating the conveyance as a trapezoidal channel and were adjusted during calibration.

Discharge from Lake Parker (reach 44 of the model) is manually regulated by SWFWMD via a control structure. The discharge from Lake Parker during the calibration period was estimated by the USGS based on the recorded structure opening and lake stage. The flow out of Lake Parker was calculated and represented in the model simulations as a time-series inflow to the Lake Parker outfall (reach 45).

Surface Water Model Parameters

The hydraulic length and slope for each sub-basin were initially estimated using HydoGIS, and were based on sub-basin and topographic surface maps. The soils map (**Map 5**), provided by the NRCS, was used to calculate initial estimates of average basin parameters for infiltration, and unsaturated soil storage. The land use map (**Map 6**), provided by SWFWMD, was used to calculate initial estimates of average basin parameters for depressional storage, interception storage, Manning's roughness coefficients, and plant evapotranspiration coefficients. In some cases, these initial estimates were adjusted during the calibration process.

Ground Water Model Layers

Ground water model layers one through four of FHM represent the surficial aquifer, the intermediate aquifer, the Suwannee and Ocala Member of the Upper Floridan Aquifer, and the Avon Park Member of the Upper Floridan Aquifer, respectively. **Figure 3-6** shows the model cells used to represent the ground water system and the location of monitor wells used in model calibration. The model grid extends some distance outside the area of the sub-basins used to represent the surface water system of the USCSB. The surface water model component of FHM provides an estimate of recharge averaged over the basin and allocates this recharge to each model cell within the sub-basin. A dummy basin (basin 47), representative of average conditions over the USCSB, was used in the model to estimate ground water recharge in the area lying outside of the sub-basin.

The hydraulic conductivity, specific yield, and field capacity of the surficial aquifer were estimated from the soils maps (**Map 5**). The top of the surficial aquifer was estimated from the USGS five-foot topographic surface map shown in **Figure 3-7**. Other surfaces used in the set up of FHM's ground water model component include:

- The bottom of model layer one (**Figure 3-8**);
- The specific yield of model layer one (**Figure 3-9**);
- The leakance at the bottom of layer one (**Figure 3-10**)
- The leakance at the bottom of model layer two (**Figure 3-11**);
- The transmissivity of model layer three (**Figure 3-12**); and,
- The transmissivity of model layer four (**Figure 3-13**).

The hydraulic conductivity of model layer one (the surficial aquifer) was set to ten feet/day. The transmissivity was set to ten $feet^2$/day in model layer two. The leakance of model layer three was set to 0.1 day^{-1}. The storativity of model layers two, three, and four were set to 0.00001, 0.00001, and 0.0005; respectively. During the calibration process for the USCSB model, ground water parameter adjustments were confined primarily to the estimated leakance values.

Over a large portion of the model area, the intermediate aquifer does not occur, since there is no confinement between the limestone of the Hawthorn and Suwannee members. This was represented in the model as areas of low transmissivity and high leakance, which resulted in rapid vertical flow and minimal horizontal flow through this model layer.

Ground Water Model Boundary Conditions

The ground water model boundary conditions of the near-field model were derived from the far-field model. The far field model used two-mile grid spacing and provided estimated heads at the beginning of each stress period along the outer extents of the near-field model. Since the near field model has a ¼ mile grid spacing, the head at each of these cells was interpolated using the GIS. These simulated heads were represented as General Head Boundary Conditions, GHB, in the near field model. The conductance of the GHB's were estimated from the cell size and model layer transmissivities.

Ground Water Pumping

Ground water pumping rates, well locations, and depths were obtained from SWFWMD. The locations of the wells were mapped in the GIS to estimate transmissivities within model layers corresponding to the open interval of the well. If a well was open to more than one layer, the pumping was divided between model layers based on the ratio of transmissivities within the open interval of the well. During the FHM simulations, the pumping rate at each well within each layer is specified for stress periods of 30 days in length.

Two sets of well data were available: 'metered well' and 'estimated well' data. The 'estimated well' pumping rates were not available for 1999, though it was available for 'metered wells'. The pumping rates for 'metered wells' were used to calculate the rate of pumping for 'estimated wells'. For the period prior to 1999, a ratio of 'metered' and 'estimated' pumping rates was calculated and used to extrapolate 'estimated' pumping in 1999. **Figure 3-14** shows the total ground water withdrawals as represented in the model. **Figures 3-15 through 3-17** show the location and quantity of ground water withdrawals represented in the model for the years 1996 through 1999.

3.4.3 Model Results

The simulated model results were compared to observed data during calibration. The observed data used in calibration is listed in **Tables 3-4 through 3-7**. **Figure 3-18 through 3-24** show the observed and simulated daily discharges at the seven gages within the modeled area. The average difference between average daily observed and simulated discharges was less than three cfs (less than 0.8 inch/year) for all stations used in the calibration.

Figures 3-25 through 3-36 show the observed and simulated ground water levels at monitor wells used for calibration. The smallest difference (less than one foot) between observed and simulated ground water levels occurred for monitor well S5 (**Figure 3-29**). The maximum difference between simulated and observed water levels is one to four feet at monitor well USGS 33 Shallow (**Figure 3-36**).

Table 3-4 Surficial Aquifer Monitor Wells Used in Model Calibration

Well Id	Well Depth (ft)	Open Interval (ft)	Top of Casing Elevation (ft NGVD)	Land Surface Elevation (ft NGVD)	Period Available[1]	Interval
S1 office	20	4.9	137.54	134.73	All	weekly
S2 cemetery	30.05		140.69	138.47	All	weekly
S3 picnic	19.9	4.9	132.45	130.20	All	weekly
S4 sand pile	23.35	4.9	140.51	137.79	10/10/99 to 11/30/97	weekly
S5 BCI	25.5	NP	133.63	130.63	10/24/96 to 9/31/99	weekly
Lake F	NP	NP	135.34	NP	10/11/98 to 9/31/99	weekly
Cem 2	NP	NP	140.95	NP	10/11/98 to 9/31/99	weekly
Lake 4-5	NP	NP	139.62	NP	10/11/98 to 9/31/99	weekly
South Gate	NP	NP	118.86	NP	10/11/98 to 9/31/99	weekly
US 33 Shallow	NP	NP	128.77	NP	2/20/97 to 9/31/99	weekly

Note: [1]Within the model simulation period of August 1996 to September 1999

NP = Not Provided

Table 3-5 Upper Floridan Aquifer Monitor Wells Used in Model Calibration

Well Id	Top of Casing (ft NGVD)	Land Surface Elev (ft NGVD)	Period Available[1]	Recorded Interval
F15 N Dike	167.01	178.89	All	weekly
F14 S Dike	179.89	131.86	All	weekly
F13 South	132.86	136.49	All	weekly
F7 sand pile	136.49	131.33	All	weekly
F15 Far	132.33	NP	12/5/96 to 9/31/99	weekly
Tenoroc	133.71	NP	2/13/97 to 9/31/99	weekly
US 33 Deep	139.61	NP	2/20/97 to 9/31/99	weekly

Note: [1]Within the model simulations period of August 1996 to September 1999
NP = Not Provided

Table 3-6 Lake Gages Used in Calibration

Lake Identification	Period Available[1]	Interval
Pond	2/20/97 to 9/31/99	weekly
Derby	2/20/97 to 9/31/99	weekly
Picnic	1/23/97 to 9/31/99	weekly
Lake 2	12/13/96 to 9/31/99	weekly
Lake 3	1/23/97 to 9/31/99	weekly
Lake 4	12/13/96 to 9/31/99	weekly
Lake 5	12/13/96 to 9/31/99	weekly
Lake B	5/15/97 to 9/31/99	weekly
Lake C	5/15/97 to 9/31/99	weekly
Hydrilla	5/31/97 to 9/31/99	weekly
Lake D	3/12/99 to 9/31/99	weekly

Note: [1]Within the model simulations period of August 1996 to September 1999

Table 3-7 Surface Water Discharge Points Used In Model Calibration

Gage Identification	Period Available[1]	Recording Interval
Culvert Btw Lakes 2 & 3	12/16/97 to 3/31/99	biweekly
Culvert Btw Lakes 3 & 4	12/16/97 to 3/31/99	biweekly
Outfall from Picnic Lake	12/3/97 to 3/31/99	biweekly
Blue Hole	2/11/99 to 3/31/99	biweekly
Station 19	All	average daily
Station 11	All	average daily
Station 13	All	average daily
Station 17a	All	average daily
Station 17b	All	average daily
Station 20	All	average daily
Station 542	All	average daily

Note: [1]Within the model simulations period of August 1996 to September 1999

3.5 Floodplain Model Evaluation

The following provides a review and evaluation of the floodplain model developed by USF to evaluate the hydraulics of the USCSB. USF used the USACOE's Hydrologic Engineeering Center – River Analysis System (HEC-RAS) modeling program in their investigation (USACOE, 1998A). The tasks completed as part of this evaluation included:

- a summary of model completeness;
- operation of the model to duplicate results;
- a review of the model assumptions and methods;
- a review of parameter assignments;
- a comparison of the model output with available monitoring data;
- a review of surface water routing; and,
- a discussion of the application of the model for use in updating FEMA mapping of the Upper Saddle Creek watershed.

3.5.1 Model Description

HEC-RAS is used to calculate one-dimensional, gradually varied, steady flow within a conveyance, and provides estimated water surface profiles within these conveyances. The basic computational procedure is based on the solution of the one-dimensional energy equation. Energy losses are evaluated by friction (Manning's Equation) and contraction/expansion (coefficient multiplied by the change in velocity). The momentum equation is utilized in situations where the water surface profile is rapidly varied (i.e., hydraulic jumps, bridges, and river confluences). The hydraulic reference manual for the program provides a more detailed description of the program methodology (USACOE, 1998).

3.5.2 Setup and Simulation Description

There are three general inputs required for HEC-RAS modeling:

- a description of the conveyance;
- boundary conditions; and,
- flow rates.

The description of the conveyance includes stations and elevations along cross-sections, structure shapes and sizes, distances between cross-sections and structures, roughness coefficients, and energy loss coefficients.

One of the first steps in setting up the HEC-RAS model is to indicate the location of the river reach and the location of cross-sections along the reach. USF used a GIS to specify the location of the river reach, and a hand-held Global Positioning System (GPS) unit was used to locate cross-sections. A total of 14 cross-sections are listed in the HEC-RAS input file as 'surveyed' (stations 30000, 29000, 28000, 27000, 25000, 24000, 23000, 22000, 21000, 20000, 17000, 16000, 15000, 14000). Other cross-sections were located along the center line of Saddle Creek, interpolating their distance from other cross-sections in the model. Some of the elevations along the cross-sections were estimated using one-foot topographic contours obtained from SWFWMD aerial topographic maps. In addition, dummy cross-sections were incorporated into the model to provide computational stability. Elevations along dummy cross-sections are automatically set within HEC-RAS by adjusting the elevation of adjacent cross-sections using the slope of the channel bottom.

Lake Hancock was used as the downstream model boundary. Stages at Lake Hancock were taken from recorded lake levels for the calibration simulations, and previous SWFWMD floodplain investigations (event model simulations). **Table 3-8** summarizes the downstream boundary conditions at Lake Hancock. Other boundary conditions used in the model include specified reach connections at junctions (i.e., main and borrow pit upstream and downstream ends), and critical flow depth as an upstream boundary condition.

Table 3-8 Downstream Boundary Conditions at Lake Hancock

Simulation	Estimated Flow (cfs)	Water Level at Lake Hancock (feet)
25-year return Storm	760	101.5
100-year return Storm	970	102.1
Calibration #1 (12/18/1997)	453.8	101.1
Calibration #2 (12/31/1997)	339.6	100
Calibration #3 (9/25/1998)	334.8	100

At least one flow rate must be entered for each reach described in the model. A reach in HEC-RAS is defined by the user and generally represents a length of the conveyance comprised of one or more cross-sections between divergence sections, convergence sections, and/or sections with changes in estimated flow rates. Peak flow rates were estimated using the FHM as described in **Section 3.1** of this report. Flow rates specified in the simulations are provided in **Table 3-9**.

Manning's roughness coefficients were taken from a previous floodplain investigation of Saddle Creek, and were set to 0.06 within the primary flow channel and 0.24 within the over banks. The contraction and expansion coefficients were set to 0.1 and 0.3, respectively, for all channel cross-sections, except for those immediately above and below road crossings. The contraction and expansion coefficients at these cross-sections were set to 0.3 and 0.5, respectively.

Table 3-9 **Specified Flow Rates at Stations Within the USCSB**

	Specified Flow Rate (cfs)				
Station ID	**25-year Return Storm**	**100-Year Return Storm**	**Calibration #1 (12/18/97)**	**Calibration #2 (12/31/97)**	**Calibration # 3 (9/25/98)**
31000	309	326	61	118	1131
30000	309	326	61	118	131
22000	620	740	413	283	291
20000	648	778	400	283	291
18000	704	866	431	332	32
15250	760	970	454	340	335
29957	309	326	60	115	125
29000	309	326	60	115	125
800	270	280	60	115	125
28000	39	46	1	3	6.05
23000	309	326	1	3	6.05
22997	560	664	311	283	291
188000	704	866	431	332	327
15400	760	970	454	340	335

Model Calibration

USF calibrated the HEC-RAS model representation of the USCSB to three average discharges, as recorded by the USGS steam gage located at the intersection of the creek with CR 542. The calibration dates selected represent periods of near steady-state flow. Recorded and simulated average daily flows and stages at CR 542 (station 20600) are provided in **Table 3-10**.

Table 3-10 HEC-RAS Calibration at CR 542 Average Daily Flows and Stages

Date	**USGS Flow (cfs)[0]**	**USGS Stage (feet)[0]**	**HEC-RAS Flow (cfs)[1]**	**HEC-RAS Stage (feet)[1]**	**FHM Flow (cfs)[2]**
12/18/1997	359	105.9	283.4	106.2	288
12/31/1997	392	106.1	291.2	106.1	297
9/25/1998	373	106.0	310.9	106.2	374

[0] Obtained from USGS 1999 and personal communiqué

[1] Obtained from HEC-RAS model input files provided by USF

[2] Obtained from output files of FHM simulations described in section 2.4.8.3

Inflows to the reaches were obtained from FHM simulations as described in **Section 3.1** of this report. During calibration, dummy reach cross-sections were added so that the model provided more stable solutions. At the time of this evaluation, USF had not finished work on the HEC-RAS model representation for the USCSB and had not indicated how these calibration dates were selected, or what model alterations or adjustments were made during calibration.

Event Storm Simulations

After calibration, the HEC-RAS model was used to estimate the peak stage within the creek along its length for the 25-year and the 100-year return storms. The reach flows in HEC-RAS were estimated from the simulated runoff using FHM and are shown in **Table 3-9**.

Sensitivity Analysis

To evaluate the USF representation of the USCSB, sensitivity analyses were performed, making incremental adjustments to the boundary conditions, Manning's roughness coefficients, and inflow rates. **Table 3-11** below lists the values used by USF in their calibrated model and the values changed during the sensitivity analyses.

Table 3-11 Sensitivity Analyses Setup

Simulation	Parameter	USF Value	Test Value
25-Year Return Storm	Downstream Fixed Water Level	101.5 feet	103.4 feet
100-Year Return Storm	Downstream Fixed Water Level	102.1 feet	105.1 feet
25-Year Return Storm	Manning's Roughness	0.24 Right Bank 0.06 Center 0.24 Left Bank	0.1 Right Bank 0.03 Center 0.1 Left Bank
100-Year Return Storm	Manning's Roughness	0.24 Right Bank 0.06 Center 0.24 Left Bank	0.1 Right Bank 0.03 Center 0.1 Left Bank
25-Year Return Storm	Inflow Rates	see Table 3-9 (=Base Case)	Base Case *1.25
100-Year Return Storm	Inflow Rates	see Table 3-9 (=Base Case)	Base Case *1.25
25-Year Return Storm	Solution Equation at Junctions	Energy	Momentum
100-Year Return Storm	Solution Equation at Junctions	Energy	Momentum
25-Year Return Storm	Contraction & Expansion Coefficients	0.1 & 0.3 normal cross-sections 0.3 & 0.5 below and above road crossings	USF selected values * 0.5
100-Year Return Storm	Contraction & Expansion Coefficients	0.1 & 0.3 normal cross-sections 0.3 & 0.5 below and above road crossings	USF selected values * 0.5

3.5.3 Simulation Results

As shown in **Table 3-10**, the parameters and model setup provide a relatively good comparison between the observed and simulated water levels at CR 542 for the three calibration simulations. The maximum difference between the simulated and observed stages was 0.3 feet. **Figure 3-37** shows the simulated extents of the 100-year floodplain overlain on an aerial of the site. **Figure 3-38** shows the simulated extents of the 100-year flood plain overlain on a USGS

Quadrangle with 5-feet topographic contours. **Figure 3-39** shows the simulated extents of the 100-year flood plain overlain on the existing FEMA flood zone map. The USF simulated floodplain is well within the 100-year floodplain shown on the existing FEMA flood zone map.

Table 3-12 lists the simulated stage at select cross-sections for the three calibration periods, the 25-year return storm, 100-year return storm, and the simulations used to test model sensitivity. The peak stage at cross-sections 28000, 23000, 21900, and 20900 are lower during the 100-year return storm than for the 25-year return storm, indicating supercritical flow conditions at these cross-sections. Under sub-critical flow conditions, increased flow rates (cfs) result in higher water surface elevations. But, for supercritical flow rates (or transitions from sub-critical or critical to supercritical flow rates) water elevations decrease with increased flow rates. Critical flow is the unique flow rate at the transition of sub-critical and supercritical flow conditions.

Both the USACOE and SWFWMD have made simulations to estimate the peak stage at Lake Hancock for the 25-year and 100-year return storms. USF used the lower SWFWMD estimated peak stages at Lake Hancock for the 25-year and 100-year return storms. The sensitivity simulations used the higher estimated water levels at the lake (from the USACOE study). The higher downstream boundary condition at Lake Hancock results in a stage increase of greater than one foot for a distance of over 2 miles upstream of the lake.

Reducing the Manning's roughness coefficients generally has the effect of reducing the peak stage simulated by the model. The lower values of Manning's roughness coefficient used in the sensitivity analyses are within the range often used to represent natural Florida channels. In the case of the sensitivity run using reduced Manning's Roughness coefficients, the peak stage was reduced less than two feet, with a greater decrease in water levels for the 25-year return storm than for the 100-year return storm. Near the fixed water levels of Lake Hancock there is very little decrease in water levels with a change in Manning's roughness coefficient.

USF did not calibrate simulated flows downstream of CR 542, so there is possibly significant error in estimated flow below CR 542, as specified in the HEC-RAS simulations. To test the potential error in estimated peak stage, the flow rates (in cfs) along the reach were multiplied by 1.25 along the length of Saddle Creek simulated in HEC-RAS. These higher flow rates increased water levels at each cross-section by less than one foot. In some cases, the water levels were reduced with higher flow rates – indicating supercritical flow conditions at some cross-sections.

Table . 12 Simulated Water Levels at Select Cross-Sections

Simulation	Cross-Section Location								
	29957 at CR 546	28000	23000	21900 at US 92	20900 at CSX RR	20600 at CR 542	18800	15800 at SR 570	13580 at CR 541
Calibration #1 (1)	109.87	108.28	108.27	107.39	107.22	106.21	102.20	101.97	101.31
Calibration #2 (2)	110.83	108.27	108.17	107.25	107.09	106.11	101.23	100.92	100.11
Calibration #3 (3)	110.95	108.43	108.20	107.30	107.14	106.15	101.20	100.90	100.11
Base 25-year (4)	112.10	109.60	109.46	109.10	108.89	107.18	103.19	102.99	102.09
Base 100-year (5)	112.17	109.55	109.30	108.46	107.99	107.53	103.94	103.80	103.07
25-year, Hancock at 103.4 ft NGVD	112.44	109.61	109.47	109.13	108.92	107.21	104.37	104.31	103.96
100-year, Hancock at 105.1 ft NGVD	112.52	109.55	109.31	108.51	108.07	107.64	105.46	105.42	105.10
25-year, reduced Manning's n	111.80	108.98	108.41	107.92	107.64	106.70	102.51	102.41	102.09
100-year, reduced Manning's n	111.90	109.08	108.61	108.20	107.86	106.88	103.42	103.36	103.07
25-year, Inflow * 1.25	112.88	109.62	109.39	108.60	108.12	107.64	103.64	103.43	102.42
100-year, Inflow * 1.25	112.97	109.91	109.73	109.10	108.57	108.02	104.53	104.40	103.63
25-year, Using Momentum Equation	112.45	109.59	109.46	109.10	108.89	107.18	103.19	102.99	102.09
100-year, Using Momentum Equation	112.53	109.54	109.30	108.46	107.99	107.53	103.94	103.80	103.07
25-year, Cont. & Expan. Coeff. * 0.5	112.44	109.57	109.42	109.05	108.84	107.16	103.18	102.98	102.09
100-year, Cont. & Expan. Coeff. * 0.5	112.53	109.53	109.27	108.33	107.85	107.52	103.93	103.79	103.07

Note: Lake Hancock water levels set at (1) 101.5, (2) 102.1, (3) 101.1, (4) 100.0, and (5) 100.0 feet NGVD.

The HEC-RAS representation of the USCSB has two junctions used to represent a convergence or divergence of reaches. In the model simulations, the energy equation was used to calculate flows. In a test of model sensitivity, the momentum equation was used to calculate flow at the divergence and convergence between the main channel of the creek and the borrow pit area. Using the momentum equation at these junctions caused no change in simulated water levels downstream of station 23000 (their downstream convergence), and caused less than a 0.5-foot increase in water levels upstream of their divergence (upstream of station 28000).

Contraction and expansion coefficients cannot be estimated based on field observations alone, and are normally assigned using published values and adjusted through calibration. USF did not indicate that changes were made to these coefficients during calibration. To better estimate the importance of a potential error in the estimate of these coefficients, a sensitivity test was conducted. In general, reducing contraction and expansion coefficients by 50 percent resulted in only a minor decrease in water levels of 0.2 feet. At CR 546, near the upstream extents of the model (with a critical flow boundary condition), water levels increased about 0.4 feet with decreased contraction and expansion coefficients.

3.5.4 Discussion/Conclusions

At the time of this review, USF's HEC-RAS model analysis of the USCSB was incomplete, and may be modified prior to its final release. As part of our model review, simulations were successfully conducted using the USF provided HEC-RAS input files. However, several potential problems were observed as follows:

1. The methodology used by USF in their floodplain investigation does not follow specified instruction outlined in FEMA's *Guidelines and Specifications for Study Contractors* (1995).

2. An average runoff (in inches/acre) was used to estimate flow into Saddle Creek downstream of CR 542. The runoff estimated by FHM downstream of CR 542 was not calibrated.

3. The model was calibrated at only one location (CR 542), due to the limited availability of monitoring data.

4. The downstream water level boundary conditions were set based on previous modeling efforts, therefore, the modeling efforts are not independent.

5. At the divergence between the main creek and a borrow pit, a rationale for the user-specified flow rates in these channels was not provided.

6. Areas of the simulated reach are under supercritical flow conditions.

7. The reach profile specified in HEC-RAS does not align with the center line of the creek

Detailed modeling has been conducted for the upper portion of Saddle Creek to develop FEMA floodplain maps. To revise an existing map using guidelines set by FEMA (FEMA 1995), the study should start with the existing (effective) model. Detailed modeling of Upper Saddle Creek was conducted to assess floodplain extents, as affected by the construction of the Polk Parkway (Kisinger, Campo & Associates Corp., 1992). USF should have calibrated their model to the floodplain extents simulated in this previous effective model. USF did not follow the guidelines set by FEMA, and therefore, the model results would not be acceptable (by FEMA) for assessing potential modifications of floodplain extents.

The USF developed HEC-RAS representation of the USCSB does not include explicit representation of Lake Parker and its outfall, or the structures within the Bridgewater Development or the TFMA. Explicit representation of these sites and their structures is important for estimating the downstream impacts of changes to structures and conveyances within these areas. In addition, HEC-RAS represents steady-state flow conditions and cannot estimate possible changes in timing of peak flow or water levels.

The sensitivity analyses conducted for this report indicate that the greatest change in estimated water levels may occur from errors in selecting water levels at Lake Hancock. As indicated in **Table 3-12**, USF selected water levels at Lake Hancock for the 25-year and 100-year storm event below those observed for the three calibration events with flow near those expected for the 10-year return period. The changes in estimated water levels were less than one foot for the other sensitivity tests. The error expected from mapping the floodplain based on the available topographic information is greater than one foot. Therefore the errors in estimated water levels are probably not significant relative to our ability to map the data.

The USACOE's estimate of peak flow in Saddle Creek upstream of Lake Hancock was 1,740 cfs for August 1974. USF's estimated peak flow for the same location and time period was 940 cfs. This, in part, along with the unexpected and unreasonable supercritical flow conditions, may account for the much-reduced area of flooding estimated in the USF analysis. The USACOE report does not provide sufficient information to evaluate the reasonableness of their flow estimates or stage at Lake Hancock.

One of the weaknesses with USF's present HEC-RAS investigation is the use of Lake Hancock as a downstream boundary condition. The water levels and timing of peak stage at Lake Hancock may affect the interpretation of inflows from basins upstream and downstream of Lake Hancock. Future investigations should re-evaluate the water levels used at Lake Hancock as a boundary condition, or include the lake and its contributing basins, allowing Lake Hancock water levels to fluctuate relative to the simulated inflows.

To delineate the floodplain extents and investigate methods of alleviating flooding, BCI suggests the use of two parallel models in conjunction with HEC-RAS. The two models include the Advanced Interconnected Pond Routing (adICPR) program, developed by Streamline Technologies, Inc. in 1995, and the U.S. Environmental Protection Agency's (EPA's) Storm Water Management Model (SWMM), developed in 1987. These models should incorporate the control structures and conveyances upstream of U.S. Highway 92. Input for these models will require a more detailed survey of conveyances, lake bottoms, and wetland bottoms; especially in areas of proposed wetland development or modification. Using this approach, SWMM will provide estimates of surface water level fluctuations in areas of concern.

Figure 3-37
HEC-RAS Model Input,
Location of Cross Section Along Saddle Creek

4.0 RESTORATION CONSIDERATIONS

4.1 General Restoration Issues

The Upper Peace River Restoration Project will require the consideration of many technical issues, and the cooperation and input from a wide range of government agencies, environmental organizations and private landowners. Most of the issues are related to the quantity and quality of water that flows to, through, and out of the TFMA. Water quality issues include the feasibility of constructing pre-treatment wetlands, lake water quality and specific water quality parameters such as dissolved oxygen, turbidity and suspended solids. Issues related to water quantity include the option of attenuating water in lakes, restoration of surface water flow patterns, the nature and types of control structures used, and potential water contributions from upstream locations. In addition, other considerations such as determining the feasibility of wetlands on clay, minimizing the impacts to existing lakes, controlling exotic plants and other restoration issues will be addressed during the development of restoration alternatives.

4.2 Detaining Water in Lakes

The detention of surface water within the TFMA would be expected to minimize flooding conditions downstream, while also providing improved water quality. As indicated in **Section 3.3** of this report, approximately 2,500 acre-feet of stormwater storage capacity is available within the five lakes (Lakes 2, 3, 4, 5 and Picnic Lake) studied during this investigation. Control structures at the outfalls from these lakes can be used to detain discharge within the limits of this available storage element. Water captured during the wet season can be used as a source to sustain flows to the created wetland areas during the dry season. In addition, peak flow rates discharging from the TFMA should be reduced and the timing of peak flows should be delayed. Both of these characteristics of flow detention should help to alleviate some of the historic flooding problems within the Upper Saddle Creek floodplain, south of the TFMA.

4.3 Feasibility of Wetlands on Clay

The feasibility of designing, constructing and maintaining wetlands on CSAs has been a widely discussed and researched topic over the last two decades. Numerous examples of unsuccessful wetlands exist, but for many of these, the CSA wetland was an accident or an afterthought. Shortfalls in the construction of wetlands on clay were described in an FDEP report (Callahan, 1991). Since that time, additional wetlands have been built, and FIPR has funded a study of the hydrology of reclaimed wetlands (BCI, 1999) that includes several recommendations relating to restoring wetlands on CSAs.

Above-Grade CSAs

A study completed by the FDEP in 1991 (Callahan, et al., 1991) attempted to evaluate the status of wetlands reclaimed on CSAs. The study included a field evaluation of 12 above-grade CSAs with reclamation completed through revegetation. Four factors determined to be critical to the success of wetland restoration on above-grade CSAs included 1) the nature of the clay and other soil; 2) hydrology; 3) revegetation and site management; and, 4) habitat objectives. The major findings for each parameter are listed below.

1. Active dewatering resulted in a more workable clay surface that facilitated establishing post-reclamation drainage.

2. None of the study sites had incorporated the many hydrologic variables that assure long-term wetland viability.

3. Unpredictable hydrologic characteristics, and competition from exotic and nuisance vegetation were identified as contributors to low survivability and growth rates for wetland vegetation.

4. Poorly vegetated wetlands resulted in more cosmopolitan and opportunistic wildlife species.

The FDEP study concluded that successful wetland restoration on above-grade clay settling areas would require the following.

- the understanding of the hydrology of reclaimed CSAs must be improved to more accurately predict the wetland's hydroperiod;

- the accuracy of predicting clay consolidation should be improved; and,

- new methods to control nuisance and exotic plants should be developed.

At-Grade CSAs

At-grade wetlands were created at the Regional Drainage project in south Lakeland. The project linked several former at-grade CSAs in a drainage improvement and habitat restoration project. The wetlands constructed on at-grade clay included mostly cypress-forested systems planted in 1988. For a variety of reasons, there has been no maintenance or monitoring of these wetlands, and cattle have had continuous access to the areas. BCI recently completed an inspection of this area and observed the detrimental effects that the cattle have had on the existing herbaceous vegetation due to overgrazing. In addition, some of the cypress trees seem to be smaller than expected, given their current age (12 years). A more detailed reconnaissance of this area would provide more information regarding the successful restoration of wetlands on at-grade clays.

FIPR Research

BCI recently completed a FIPR-funded research project included monitoring the timing and magnitude of clay consolidation. The study determined that the ultimate height of consolidated clay has a significant impact on the accuracy of post-reclamation hydrologic predictions. Consolidation, and therefore changes in clay surface elevation, are most rapid following dewatering, and the rate slows with time. Incorporating the following steps into modeling methods after filling and quiescent consolidation will increase the accuracy of CSA elevation predictions.

1. Obtain clay elevation topographic information at the start of dewatering activities.

2. Reestablish the clay elevation when the CSA is released by the FDEP.

3. Base ultimate elevation estimates on the most accurate information available.

By utilizing the most accurate input data in the consolidation analyses, post-reclamation clay elevation predictions can be improved significantly. Reliable predictions of ultimate clay elevations will aid in proper placement of wetlands and uplands, and insure the restoration of viable post-reclamation hydrology.

The FIPR report provides a methodology for improving the post-reclamation hydrologic function of CSAs (BCI, 1999). The following summarizes a number of the guidelines that may be appropriate for facilitating the restoration of wetlands on CSAs:

1. Document the pre-fill topography for each CSA.

2. Collect and refine consolidation parameters, tonnage and filling history.

3. Determine the clay surface topography prior to dewatering.

4. Develop end-of-fill clay thickness map from pre- and post-fill topographic maps.

5. Conduct clay modeling – develop relationship between clay thickness and consolidation.

6. Apply relationships to clay thickness map to generate a predicted post-reclamation clay surface topographic map.

7. Utilize the post-reclamation topographic map as a guide in defining grading/ earthmoving, revegetation, and drainage plans.

8. Conduct coarse-level modeling to establish preliminary outfall geometry and invert elevation.

9. Complete earthmoving and revegetation activities.

10. Develop as-built topographic maps and compare to post-reclamation topographic maps - refine as necessary.

11. Review and refine as necessary the event-based hydrologic model.

12. Install preliminary outfall and develop stage/discharge relationship.

13. After several years, initiate coarse level hydrologic/meteorological monitoring.

14. Revisit hydrologic analyses – Refine event-based (25-year return interval) model.

15. Evaluate long-term functionality utilizing continuous or small magnitude event based analyses.

16. Adjust outfall configuration and invert elevation as necessary to optimize and balance flood protection and baseflow reestablishment.

Project Specific Issues

A variety of post-mining landforms, both unreclaimed and reclaimed, are available at the TFMA for constructing mitigation wetlands. Several CSAs could be incorporated into the restored watershed and one or more will likely be selected for construction of mitigation wetlands. Past and recent observations as well as significant research efforts have identified the potential problems and real opportunities CSAs offer for wetlands reclamation. By incorporating the factors below, the at-grade clay areas at the TFMA can be successfully incorporated into the restoration of the Upper Saddle Creek watershed.

1. Collect sufficient field data to provide input data for clay consolidation modeling to accurately predict the short and long-term consolidation of the clay surface.

2. Appropriate adjacent upland areas should be incorporated into the landscape adjacent to CSA wetlands. These uplands will provide the following important functions:

   - Provide upland contributing areas for the wetlands;
   - Establish a vegetated buffer for the mitigation wetlands; and,
   - Act as a wildlife connection to adjacent habitat areas.

3. Complete sufficient hydrologic modeling to ensure appropriate quantity and timing of water inflow.

4. Monitor the hydrologic behavior of the wetland areas and be prepared to modify the hydrologic controls, if necessary.

4.4 Post-Restoration Surface Water Flow Patterns

Prior to phosphate mining, the USCSB was characterized as topographically flat with large areas of isolated and interconnected wetlands having only a few ditch connections. With mining and subsequent reclamation of some parcels, lakes and interconnecting ditches have been added along with a relatively steep topographic gradient in the form of a cascading mix of above and at grade clay settling areas. Under existing conditions, the USCSB discharges to Lake Hancock; a hypereutrophic water body plagued by very poor water quality.

The primary goal of this project to restore the environmental functionality of the TFMA by returning the remnants of past mining activities to systems that more closely mimic a natural Florida hydrologic and wetland system. Some of the restoration objectives proposed in this endeavor include:

- enhancement of existing lakes and wetlands;
- enhanced water quantity and quality of discharge downstream to Lake Hancock;
- improve distribution and seasonality of flows to Saddle Creek and Lake Hancock;
- incorporation of newly created wetlands as part of mitigation;
- balancing lake inflows and outflows as necessary to maintain the existing fisheries resource within the lakes of the Tenoroc FMA; and,
- replacement of linear ditch features with conveyances that more closely mimic pre-mined conditions.

Preliminarily investigations indicate that some of these enhancements can be created by:

- replacing ditches with floodplain connections and meandering streams;
- adjustment of discharge control structure (or their operations) to manage on-site storage and discharge; and,
- increasing wetland acreage and enhancing existing wetland functionality.

Though there may be changes to the conveyances and storage components within the USCSB, the overall surface water flow within the TFMA will remain essentially unchanged under the proposed restored conditions.

4.5 Constructing Pre-treatment Wetlands

Increased residential, industrial, and commercial development is planned upstream of the TFMA. Pre-treatment of surface water discharges from these areas before they enter the Tenoroc area will be important, and should be planned as part of the post-restoration project.

The pre-treatment of discharge upstream of the TFMA can be provided through created wetlands and the interconnection of existing isolated lakes and wetlands. These features would provide water quality treatment through decrease flow velocities without decreasing flow volumes (i.e., the inflows will be treated but not attenuated).

4.6 Minimizing Impacts to Existing Lakes

Within the TFMA, a number of the former mine pit lakes are used and managed intensively for fishing and fisheries research. Therefore, as long as the fisheries element of these lakes is not compromised, some enhancements will be considered as part of the overall restoration effort. These enhancements may include:

- Improved water circulation;
- Managed/controlled water levels;
- Increased and improved littoral shelf areas;
- Contiguous and connected wetland areas; and,
- Pretreatment of concentrated surface water inflows.

Increased flow through these lakes is expected with restoration by maximizing offsite inflows and optimizing flow patterns within the overall headwater system. In addition, water control structures can be used to manage lake levels and discharge timing. Within areas of isolated lakes, wetland creation could be conducted so as not to deprive the existing wetland and lake systems of water. The project team is investigating the possibility of establishing additional offsite inflow to the TFMA as the adjacent upstream areas begin to plan for future property development. These offsite areas include the Williams Company Property and the Bridgewater Development, which are located to the north and west of the TFMA, respectively.

These developments will increase the imperviousness of the contributing basin area, resulting in increased runoff volumes. Typically, the development entity is responsible for maintaining similar pre and post-development discharges by incorporating ample onsite flow attenuation. In this case; however, the TFMA project is being considered to provide all of the attenuation capacity required by future development with the agreement that treatment of storm water (first inch only) would be provided as normally required by SWFWMD.

To further reduce the impact of offsite inflows on the fishing lakes, wetland areas will be created at areas of concentrated inflow. The increase in wetland areas would provide increased sport fish spawning, nursery habitat, and production of invertebrates that are a vital component of the fresh water food chain. This should provide long-term improvements to what is already an outstanding recreational fishery resource. Additional aesthetic benefits would also be obtained via heightened vegetation management practices and improved wildlife utilization.

4.7 Nature and Type of Water Control Structures

To accommodate the proposed restoration plan for the TFMA, the hydrologic and storage characteristics of the area can be adjusted and optimized. To assist in this effort, a variety of water control and conveyance practices could be utilized. These practices can be used to balance a number of competing issues that include:

- optimizing water levels in support of ongoing fisheries management;
- providing sufficient flow and water level fluctuation as needed to support created wetland systems;
- provide improved seasonality of flows to Saddle Creek and the Peace River; and,
- reduce flood flows in Saddle Creek by attenuating water within the TFMA.

The use of structures would enable the design team to control the movement of water into, through, and out of the TFMA. In this manner, the fluctuation and timing of flow releases can be assigned and evaluated utilizing hydrodynamic modeling techniques. Some of the control and conveyance practices that may be implemented include:

1. Drop inlet spillways;
2. Adjustable and fixed weir structures;
3. Adjustable gates;
4. Meandering flow ways;
5. Orifices;
6. Culverts; and,
7. Rip-rap breaches.

Structures and conveyances should be designed as passive systems to the greatest extent possible; however, some of the major controls will need to be adjustable to provide water level management capabilities. Structures should also be designed with maintenance and operation in mind. For example, the passive, fixed crested controls could be designed such that little maintenance is required and the resistance to degradation caused by erosion, scour, and corrosion is maximized. Controls having adjustable crests or openings may incorporate remote monitoring and adjustment capabilities.

In addition, all of the structures within the TFMA will be evaluated from the standpoint of remaining life expectancy. Many of the existing structures have deteriorated significantly and are susceptible to failure at any time. These structures will be replaced and upgraded as necessary as part of the overall restoration plan.

4.8 Water Quality

One of the goals for wetland restoration in the TFMA is to improve water quality. To quantify the improvements, the quality of water currently flowing into and out of the TFMA will be established. An on-going water quality monitoring program must be developed to periodically test and document the water quality both before and after wetland construction. In addition, turbidity and other parameters will be measured during construction. Finally, the impacts of the former Tri-City Landfill on surface water quality may be monitored depending on the level of work planned near the landfill. In order to accomplish the multifaceted goals of monitoring water quality prior to, during and after restoration activities are complete; a detailed water quality monitoring plan has been developed and should be implemented by mid-2000.

4.9 Treatment Wetlands

Wetland creation is a major driving factor fueling the restoration efforts within the TFMA. Not only will new wetlands provide compensation for impacts generated during construction of the Polk Parkway; they can also be used to pre-treat runoff entering the site. This would improve overall water quality, detain floodwaters, provide increased habitat for desirable plant and animal species, and offer an additional educational element to amenities of the TFMA.

Wetlands can serve to remove nutrients from surface waters by extending residence/contact time, reducing flow velocities, providing natural filtration, and biologically assimilating nutrients necessary for plant growth. In addition, the enhanced coverage and diversity of plant growth would contribute to higher dissolved oxygen levels and increased aerobic bacterial decomposition of contaminants.

Wetland areas proposed within the TFMA will need to be actively managed and monitored to optimize overall success. For example, accumulated sediments can result in negative impacts on water quality via pollutant recycling. The choice of vegetation is an important consideration so that a wetland will provide a net nutrient sink or removal function. Removal (harvesting) of wetland vegetation is also an effective means of nutrient removal, but is not a proposed management activity at this time. Use of woody species can provide a means of continuing nutrient removal since nutrient uptake continues as total biomass increases. However, a good understanding of plant growth and die-back is needed to prevent the wetland from rapidly reaching equilibrium.

Mature wetlands have been shown to export nutrients to the downstream systems during the winter die-back season. This phenomenon is moderated somewhat by the mild temperature differentials typical of Florida's climate. However, even wetlands that provide no net removal over the entire year can provide a valuable function by changing the temporal character of nutrient releases. Certain herbaceous species are effective at forming an organic layer over time that further benefits vegetation propagation and diversity and provides a good substrate for food on which many wetland inhabitants rely.

The existing chain-of-lakes system within the TFMA may be modified to incorporate treatment wetlands at areas of concentrated inflow. These treatment wetlands could provide a localized area for management/maintenance that may include removal of sediments and plant harvesting. Some of these inflows are or will be comprised of "treated" urban runoff contributions that would be further treated prior to discharge to the TFMA lake system.

Nutrient and pollutant removal efficiencies by wetlands are seasonal, specific to the nature of inflows, flow rates, plant species, microbial species, soils, and other factors. Though high rates of nutrient and sediment removal efficiencies have been reported, caution should be taken in extrapolating these estimates to other areas and wetlands. The literature (Hammer 1989, Reddy and Smith 1987) indicates that significant nutrient and pollutant removal has been achieved with proper design in some created wetland systems.

4.10 Potential Surface Water Contributions From Upstream Sources

A significant volume of water enters the TFMA from upstream areas that include the Williams and Bridgewater tracts. These areas are currently comprised of reclaimed and unreclaimed remnant mining areas; however, plans are now on the drawing board for future development and the DRI process is well underway.

In association with these future development activities, their exists some possibility that the TFMA could receive an increased volume of water. As development begins in these areas, the percentage of imperviousness will increase, thereby increasing the volume and possibly the rate of offsite discharge. Current regulations require that this increase of flow be attenuated on-site such that the post development discharge does not exceed the pre-development conditions. Regulations also require that the first one-half to one inch of stormwater runoff be treated on-site using retention, detention, filtration, or biological methods.

In an effort to increase the volume of water that flows through the TFMA site, the project team is currently investigating the possibility of providing the required attenuation requirements for these future development activities within the TFMA. Treatment of runoff would be provided as part of the development activities; however, any required detention necessary to maintain pre-development conditions would be provided within the TFMA. In this manner, FFWCC would assume control of this water as required to satisfy various restoration goals.

This option should be particularly attractive to the developers since it would allow them to maximize their developable area. In the end, the developer's decision to accept this type of arrangement will likely become a balance between aesthetics (lake front property) and economics.

4.11 Development of Restoration Alternatives

Prior to detailed design of mitigation wetlands in the Upper Saddle Creek watershed, several restoration alternatives will be developed. This phased approach is outlined in the MOU, and the FDEP's 1998 Request for Statements of Qualification (RFSOQ) for the project. The RFSOQ outlines Task 2 as "Development of Restoration Alternatives". Working with the Selection Committee, BCI will develop alternatives that are "conceptually reasonable, achievable and practical" (FDEP, 1998). Elements of each alternative conceptual design should include the following restoration goals.

1. provide basic hydrologic and hydraulic functions;

2. achieve adequate water quality;

3. provide ecological and environmental connectivity;

4. enhance wildlife values;

5. facilitate regional outdoor recreational opportunities; and,

6. create functional and sustainable wetlands that meet mitigation requirements.

The preliminary development of the restoration alternatives will be completed by BCI, with considerable input and guidance from the project team and Selection Committee. Restoration alternatives will incorporate the following design elements:

- the goals and objectives of the Upper Saddle Creek Restoration Project will guide the development of restoration alternatives;

- existing conceptual designs such as those included in "A Proposed Ecosystem Plan for the Upper Peace River: Alternative Mitigation for Upper Saddle Creek" (King, et al., 1994);

- input from the UPREPC Committee; and,

- the USF hydrologic model will be used as a framework for additional, subsequent site-specific hydrologic modeling.

Section 1.8 of this report outlines the goals and objectives of the project, several which are discussed below in the context of restoration alternative development:

- Creation and/or restoration of wetland impacts in the Peace River basin will include at least 84.73 acres of forested wetlands and 37.28 acres of herbaceous wetlands within the boundaries of the Tenoroc Fish Management Area.

- Appropriate quantity and quality of flow to Saddle Creek will be replaced, thus enhancing flows to the Peace River.
- Reclamation and mitigation should replace the appropriate amount and periodicity of flow from the upper portion of the watershed so that flooding is not exacerbated to the south.

- Reclamation and wetland mitigation within the project area will be designed to restore the ecological connection between the Peace River and the Green Swamp.

- Wetland mitigation will be incorporated into a landscape that includes extensive, adjacent habitats managed for long-term ecological viability and environmental protection.

- Existing desirable vegetative communities within the project area will be enhanced where possible to facilitate creation of a diverse landscape.

A preliminary list of conceptual restoration alternatives will be developed by BCI for review by the project team and the Selection Committee. Each element of the various alternatives will be evaluated and ranked based on how well it meets the restoration goals. Following selection of the most beneficial restoration plan, BCI, with input from the project team, will produce a report that describes each of the proposed alternatives, summarizes the evaluation process, and documents the rationale for selecting the preferred design. The Selection Committee will then review and comment on the report, and prepare recommendations for implementing the selected restoration plan in an efficient and expeditious manner.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations provide general project-related concepts for the participating agencies, environmental organizations and the general public to consider prior to development of the more detailed activities to be completed during Task 2 of this project. These general comments are followed by a more detailed discussion of specific conclusions and recommendations regarding the hydrology and surface water hydraulics of the site.

5.1 General Conclusions and Recommendations

1. As stated in the Saddle Creek Restoration and Alternative Mitigation Project Phase I: Conceptual Plan, a primary objective of the project is to replace the hydrologic and ecological connections that originally existed in the Upper Saddle Creek Basin. The Upper Saddle Creek Basin consists of approximately 12,000 acres, and includes the Tenoroc Fish Management Area (TFMA), the Williams Company property north of Tenoroc, and a portion of the former Bridgewater development, which drains southeast toward the TFMA. A specific requirement of the project is the replacement of 87.24 acres of forested wetlands and 37.28 acres of herbaceous wetlands (total = 124.52 acres) impacted in the Saddle Creek watershed during the construction of the Polk Parkway. Funding for the project is provided by wetland mitigation funds from the Florida Department of Transportation and Non-mandatory Land Reclamation Program funds for five parcels (mined prior to July 1, 1975) within the TFMA.

   The TFMA consists of 6,430 acres of state-owned land at the core of the Upper Saddle Creek Basin The Florida Fish and Wildlife Conservation Commission (FFWCC), which manages the site, has entered into a Memorandum of Understanding (MOU) to participate in the mitigation project and to allow the required mitigation to take place at the TFMA. There are no such agreements with the private landowners, i.e., the Williams Company and the current owners of the Bridgewater development. Since the land use agreement and most of the funding are tied directly to Tenoroc, it is the recommendation of the Task 1 Report that the mitigation work be done within the boundaries of the TFMA.

   However, it is obvious that the overall objective of the project, i.e., the restoration of the ecological and hydrological connections that originally existed in the Upper Saddle Creek Basin, cannot be achieved if the restoration work is restricted to the TFMA. In order to achieve this overall objective, it is important that the Williams Company property north of

Tenoroc and the portion of the Bridgewater property that drains to the TFMA be included in the restoration process, if at all possible. It is the recommendation of this Task 1 Report that the project team work cooperatively with these private property owners to achieve, where possible, results beneficial to all parties. Specific mechanisms for such cooperative action include the following:

- Meeting periodically with the property owners or their representatives to keep them informed of the mitigation activities proposed for Tenoroc, and to explore possibilities for cooperative action. One example of such cooperative action is the proposal under consideration for the TFMA to handle the stormwater attenuation for the two upstream private property owners.

- Providing incentives for the private property owners to include appropriate ecological and hydrological connections in their developments. Both the Williams Company and the Bridgewater properties are being considered for residential/commercial development. Under an agreement with the Bureau of Mine Reclamation (BOMR), the Williams Company has agreed to include an Integrated Habitat Network (IHN) component on all of its property. A Development of Regional Impact (DRI) has now been filed for a portion of this property. A review of the DRI provides an opportunity both to recognize the company for its commitment to providing wildlife corridors, and to coordinate corridor and drainage plans between the private development and the Upper Peace River Restoration Project.

2. In addition to providing mitigation acreage for wetlands impacted by the Polk Parkway in the Saddle Creek Watershed, the Upper Peace Rive Restoration Project is required to address mitigation for 5.67 acres of forested wetlands and 34.27 acres of herbaceous wetlands (a total of 39.94 acres) impacted by the Polk Parkway in the Alafia River watershed. Although the Selection Committee is authorized to include this additional acreage and associated funding in the restoration project, according to the terms of the agreement, this can only be done "in an area providing direct benefit to the Alafia River watershed." Wetland reclamation in the Upper Saddle Creek watershed, regardless of how badly needed or how well done, cannot be considered to be of direct benefit to the Alafia River watershed

   The Alafia River watershed contains significant areas disturbed by mining and other activities that could certainly benefit from wetland reclamation. No specific sites have been identified and the problems of locating a separate site and undertaking a separate project are certainly formidable. Nevertheless, it is the recommendation of this Task 1 Report that the Alafia River watershed wetlands not be included in the Upper Peace River Project, and that a separate project be initiated to mitigate for those wetlands.

3. The FFWCC manages the TFMA primarily as a public fishing area, and utilizes both the reclaimed and unreclaimed lakes left by mining for this purpose. Large-scale conversion of lakes to wetlands is, therefore, unacceptable to the FFWCC. Moreover, the lakes in conjunction with an appropriate structure or structures, provide a potential means of attenuating flood flows from upstream and releasing water in a controlled manner. It is the recommendation of this Task 1 Report that the lakes continue to be used for this purpose. In addition to preserving the lakes for their current use as public fishing areas, this will also provide a means for maintaining a more sustained flow to Saddle Creek downstream without increasing the potential for downstream flooding.

4. Prior to mining, the Upper Saddle Creek Basin consisted of a largely undeveloped, low-lying flatwoods area with numerous cypress swamps that collected drainage from the flatwoods. Bayheads along the eastern margin of the basin captured seepage from the Winter Haven Ridge. These forested wetlands constituted broad natural drainageways that converged near the present southern boundary of the TFMA to form Saddle Creek. Mining and the associated phosphate processing disposal activities eliminated these natural drainage ways. Currently, drainage is provided by a system of man-made ditches. Due to costs and a lack of detailed data regarding the pre-mining conditions of the site, it is not practical to restore the drainage system to its original configuration. However, in some cases, it may be practical to convert some existing ditches to broad reclaimed floodplains and/or to reroute the flow from existing ditches through reclaimed floodplains. These floodplains could be used to route drainage into the existing on-site lake system.

5. The TFMA includes large areas of mined-out land that have been partially filled with phosphatic clay. These areas differ from conventional clay settling areas in that many are at or near natural grade. Some actually receive drainage from offsite and serve as flow-through systems. Most of these areas have developed a volunteer cover of wetland species, mostly pioneer species such as Carolina willow, cattail, and primrose willow. Some have a sprinkling of more desirable species such as red maple, Florida elm and sweetgum. These partially filled mine-cuts offer the best opportunity on-site for large-scale reclamation of wetlands areas, and it is the recommendation of this Task 1 Report that they be used for this purpose. Where possible, these reclaimed wetlands should be constructed downstream of lake outfall structure(s) so that the wetlands can serve as filters for the flow exiting the lake systems.

6. The eastern portion of the TFMA contains a large natural wetland area that collects seepage from the Winter Haven ridge. Prior to mining, this wetland area served as the

headwaters for a tributary to Saddle Creek that drained to the west. During the course of mining, however, the wetland area was ditched to divert surface water flow southward around the perimeter of the Tenoroc Mine. After mining operations ceased, the ditch was no longer maintained, and it subsequently developed flow restrictions. This has caused surface water to build-up in the eastern wetland, altering its former hydrology and vegetation, and affecting local site access and land use. Mining also encroached into the seepage slope above the wetland, leaving an unreclaimed pit that extends from the wetland into the adjacent pastureland. This area is the focus of an agreement between the City of Auburndale and the FFWCC to introduce advanced-treated wastewater into the Tenoroc FMA from the City's Regional Wastewater Treatment Plant (RWTP).

The plan entails constructing a spray-irrigation field in the pasture area above the wetland and the mine pit, allowing the reclaimed water to infiltrate the soil and augment local water table seepage. This should allow the mine pit to be reclaimed as an extension of the existing wetland, and enhance the capacity of the area to function as a water supply source for other wetland reclamation projects downstream. Accordingly, it is the recommendation of this Task 1 Report that reclamation activities in the eastern portion of the TFMA be designed to accommodate the added seepage from Auburndale's RWTP and alleviate the impounded condition of the area's natural wetland in a way that will both restore and enhance the former function of the area as a headwaters site, replenishing the re-created wetlands downstream.

7. The Survey of the existing vegetative cover at the TFMA confirmed the viewpoint of Lake Region Audubon Society representative, Chuck Geanangel, that portions of the site, both mined and unmined, contain a diverse vegetative cover. Moreover, the survey confirmed that the existing cover currently provides significant habitat for native wildlife. It is the recommendation of this Task 1 Report that the restoration effort should preserve as much of the existing desirable habitat as practical.

8. Land management plans for state-owned land typically encourage the active elimination of all exotic and nuisance species. Since it is a former phosphate mine, the Tenoroc FMA is not a typical site. The site contains an abundance of exotic and nuisance species, particularly cogon grass and brazilian pepper. The complete eradication of these species from the site is probably impractical, and certainly beyond the scope and funding of this project. It is the recommendation of this Task 1 Report that management plans for controlling exotic and nuisance species be incorporated into the restoration plans for the project. These management plans should be based on the best scientific information available for the type of site in question, notably the research done by the Florida Institute of Phosphate Research in

controlling exotic and nuisance species on reclaimed phosphate-mined sites. One example of such a management plan for cogon grass would be to utilize active control measures such as herbicides and cultivation during active reclamation, followed by dense reforestation plantings that would eventually shade out the inevitable regrowth of cogon grass.

9. All information, data, and calculations typically required in a normal permit application will be generated during the design phase of this restoration project. Although the FDEP is responsible for project management, all recommendations of the FDEP are subject to the public review by the Upper Peace River Ecosystem Planning Committee (UPREPC), whose membership includes all signatories to the MOU (the USACOE, FDEP, FDOT, FFWCC, and SWFWMD) as well as affected counties, affected regional planning councils, and other interested parties. All actions of the FDEP must be approved by the Project Selection Committee, which includes representatives from SWFWMD and the USACOE along with the FDEP. The meetings of the UPREPC and Selection Committee will be properly noticed to qualify as the required public meetings. Under these circumstances, it is the recommendation of this Task 1 Report that the Upper Peace River Restoration Project proceed under a Noticed General Permit for Restoration, pursuant to 40D-400.485, Florida Administrative Code.

5.2 Specific Hydrology Related Issues

USF was secured by FIPR to demonstrate the ability of the FIPR Hydrologic Model (FHM) to representing a "regional system" and to provide a detailed understanding of the water balance within the USCSB. The model setup utilized reasonable parameters based on accepted sources, assumptions, and engineering practices. However, the model is inadequate for supporting detailed 'basin scale' hydrologic analyses as required for proposed wetland restoration and mitigation design within the USCSB.

Since FHM allows representation of the combined ground water and surface water systems and their interaction, it provides a better estimate of the water balance than other models representing only the surface water or ground water components. FHM has the ability to simulate ground water level fluctuations and estimates depths to the water table at individual model cells. These estimates, in conjunction with field reconnaissance, can be used to provide an initial screen to identify potential wetland areas.

The FHM program provides a simplified representation of reaches and reach routings within the USCSB. There are two reasons for this: the limited number of monitoring stations within the area modeled, and the limited ability of FHM to represent detailed routing. In FHM, the direction and rates of flow between reaches are set by the user and not influenced by downstream stages or flow constrictions. FHM uses a depth-area-volume-discharge relation specified in the FTABLES of HSPF to describe reaches and does not explicitly describe the geometry of weirs, orifices, culverts, and bridges that sometimes control the flow. It is difficult to determine the hydrologic significance of changes at these structures using FHM, and it is usually necessary to use other models when making these inquiries.

The reaches in FHM represent joined sets of conveyances or storage nodes (i.e., lakes and wetlands). While this approach is reasonable for a regional model, it does not provide the level of definition required for specific floodplain or wetland mitigation design. By grouping conveyances, limited confidence in calibration is provided; since calibration is to the sum of flows and not the individual conveyance flows. This, in turn, provides limited information about possible changes in hydrology caused by modifications to the conveyances and/or their contributing area.

Ecologists have the ability to recognize the suitability of a particular area for wetland creation (hardwood, mixed, and herbaceous) given a description of the soils and hydrologic character. To provide the hydrologic information required by the ecologists, the model simulations should provide an estimate of the depth to the water table over time, the rate of flow into and out of the wetland, and the fluctuation and duration of water levels within wetlands. In some special cases, the present FHM model may be able to provide these descriptions; though it is likely that significant modifications will be required. This is true particularly in the areas that FHM does not provide detailed representation of lakes (e.g., lakes represented as constant head lakes), where ground water fluctuations will not be realistically simulated.

FHM and the USGS monitoring data provide a source of physically-based parameters and valuable water balance information that can be used to setup and calibrate a hydrodynamic model. Wetland mitigation planning and design requires a detailed understanding of the hydrology (including routing). BCI suggests the use of a model such as SWMM, XP-SWMM, or adICPR that allows more detailed representation of structures, conveyances, and backwater effects. FHM should be run in parallel to address possible impacts to the integrated water balance caused by landform modifications. Input for the hydrodynamic model will require detailed aerial topographic information within areas of proposed wetland and hydrologic modifications; and a more detailed survey of conveyances, lake bathymetry, and wetland bottoms.

The hydrodynamic model will be used to investigate possible changes in the USCSB and its conveyances, including:

- modifications of structures;
- changes in drainage patterns;
- enhancement of ditch conveyances;
- the effects of detaining water; and,
- the effects of future development.

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FDOT Reference Number ___________________________

USACOE Reference Number ___________________________

FDEP Reference Number ___________________________

FGFWC Reference Number ___________________________

SWFWMD Reference Number ___________________________

MEMORANDUM OF UNDERSTANDING

AMONG THE
UNITED STATES ARMY CORPS OF ENGINEERS
AND THE
FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
AND THE
FLORIDA DEPARTMENT OF TRANSPORTATION
AND THE
FLORIDA GAME AND FRESH WATER FISH COMMISSION
AND THE
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
for
Mitigation for the Polk County Parkway
Florida Turnpike District Toll Road 570

THIS MEMORANDUM OF UNDERSTANDING is made and entered into this 28 day of November, 1995, among the United States Army Corps of Engineers (USACOE), the Florida Department of Environmental Protection (FDEP), the Florida Department of Transportation (FDOT), the Florida Game and Fresh Water Fish Commission (FGFWFC) and the Southwest Florida Water Management District (SWFWMD).

WITNESSETH:

WHEREAS, the FDOT is constructing the Polk County Parkway which will impact certain wetlands, and

WHEREAS, the permits issued to FDOT by the SWFWMD and the USACOE in relation to the Polk County Parkway require certain mitigation for wetlands impacts, and

WHEREAS, the FDOT desires to satisfy its mitigation obligations by providing funding to the FDEP which shall be used to perform the mitigation requirements set forth in FDOT's permits, and

WHEREAS, the parties desire and anticipate that the mitigation shall be consistent with the two (2) Conceptual Mitigation Plans (hereinafter MITIGATION PLANS) attached hereto as Exhibits B1 and B2 and,

WHEREAS, the parties desire to perform specific projects (hereinafter MITIGATION PROJECT) which result from the MITIGATION PLANS and are deemed to be feasible, and

WHEREAS, the SWFWMD and the USACOE will have certain input and authority relating to FDEP's expenditure of the mitigation funding, and

WHEREAS, the FGFWFC manages a portion of the state-owned land where mitigation may be performed and anticipates having certain management authority and obligations with regard to certain projects resulting from the mitigation, and

WHEREAS, all parties hereto desire to enter into this MOU for the purpose of establishing the relationship and responsibilities of each party in relation to the mitigation required in the permits issued by the SWFWMD [MSSW permits #4011879.02 and #4011879.03 and WRP permits #4111875.02 and #4112140.01] and the USACOE [ACOE permit #1994005979(IP-MN)].

NOW, THEREFORE, the USACOE, the FDEP, the FDOT, the FGFWFC and the SWFWMD, in consideration of the mutual terms, covenants and conditions set forth herein, hereby agree as follows:

1. **OBLIGATION OF EACH PARTY**. Each party to this MOU shall serve on the Advisory Committee and the Selection Committee, as designated, and be responsible for performing its obligations as set forth below:

    a. The SWFWMD shall participate in the activities set forth in this MOU to ensure compliance with the conditions set forth in MSSW permits #4011879.02 and #4011879.03 and WRP permits #4111875.02 and #4112140.01. These conditions are set forth in Exhibit "A" (Permit Conditions).

    b. The USACOE shall participate in the activities set forth in this MOU to ensure compliance with the conditions set forth in permits #1994005979(IP-MN), #4011879.02, #4011879.03, #4111875.02 and #4112140.01.

    c. The FDOT, in accordance with the permit conditions set forth in Exhibit "A," shall advance $5.5 million dollars to FDEP to be deposited into the Pollution Recovery Trust Fund for the purpose of carrying out the mitigation requirements/conditions set forth in the aforementioned permits.

        1) All parties understand and agree that the FDOT's performance and obligation to pay under this contract is contingent upon an annual appropriation by the Legislature.

        2) In the event this MOU is in excess of $25,000 or has a term for a period of more than one year, the parties also understand and agree that the provisions of Chapter 339.135(6)(a), Florida Statutes, are hereby incorporated:

"The FDOT, during any fiscal year, shall not expend money, incur liability, or enter into any contract which, by its terms involves the expenditure of money in excess of the amounts budgeted as available for expenditure during such fiscal year. Any contract, verbal or written, made in violations of this subsection shall be null and void, and no money shall be paid thereon. The FDOT shall require a statement from the Comptroller of the FDOT that funds are available prior to entering into any such contract or other binding commitment of funds. Nothing herein shall prevent the making of contracts for a period exceeding one year, but any contract so made shall be executory only for the value of the services to be rendered or agreed to be paid for in succeeding fiscal years, and this paragraph shall be incorporated verbatim in all contracts of the FDOT which are for an amount in excess of twenty-five thousand dollars and having a term for a period of more than one year."

d. The FDEP shall function as chair for each committee and act as Project Manager for all MITIGATION PROJECT(s) resulting from the MITIGATION PLANS.

1) The FDEP shall hold the $5.5 million dollars of mitigation funding in trust and shall disburse said funds only for direct MITIGATION PROJECT costs approved by the SELECTION COMMITTEE (described below). The FDEP shall accept full and sole responsibility for meeting the objectives of this MOU.

2) The parties anticipate that FDEP will enter into contracts to fulfill it's obligations under this MOU. The FDEP shall use it's standard contracting procedures as required by Florida laws.

e. The FGFWFC anticipates that it will provide certain management services in relation to the MITIGATION PROJECT(s). The specific management services to be provided by the FGFWFC shall be set forth in subsequent Amendments to this MOU, as discussed above.

f. All parties to the MOU shall provide technical assistance in water resource data, hydrology, and engineering as needed in the design of the hydrologic study and MITIGATION PROJECT(s).

2. **AMENDMENTS**. The parties hereto shall execute Amendments to this MOU to set forth specific MITIGATION PROJECT(s) and scopes of work to be performed in relation to, and as a result of, the MITIGATION PLANS. This shall be performed after considering the recommendations of the Advisory Committee (described below).

3. **HYDROLOGIC STUDY**. This MOU shall be first amended by the parties hereto for the purpose of setting forth the terms and conditions specifically relating to the performance of a hydrologic study to determine the scope, extent and feasibility of the MITIGATION PROJECT(s) which relate to and result from the MITIGATION PLANS.

4. **MITIGATION PLANS**. Attached hereto as Exhibits "B-1" and "B-2" (and referenced in the permit conditions) are two (2) conceptual plans which, if determined feasible, are anticipated by the parties to be fully or partially carried out via specific MITIGATION PROJECT(s) to provide mitigation as required by conditions of permits #1994005979(IP-MN), #4011879.02, #4011879.03, #4111875.02 and #4112140.01.

5. **MITIGATION PROJECT(s)**. Upon completion of the hydrologic study, the specific MITIGATION PROJECT(s) shall be selected, designed, constructed and managed.

6. **SELECTION COMMITTEE**. There is hereby established a Selection Committee which shall consist of the following parties: USACOE, FDEP and SWFWMD. The Selection Committee shall assist in the development of requests for proposals, review and evaluate all proposals and bids received by the FDEP in relation to performing the PROJECT(s) and shall each have equal input into the selection of the contractor to be awarded the requested services or goods.

7. **ADVISORY COMMITTEE**. There is hereby established an Advisory Committee which shall consist of representatives of each party to this MOU and shall also consist of representatives of the following entities: affected counties, affected Regional Planning Councils and other parties as added pursuant to this paragraph. The Advisory Committee shall assist and make recommendations in relation to the coordination, planning and implementation of the PROJECT(s). Other parties may be added to the ADVISORY COMMITTEE with the mutual consent of the signatories to this MOU.

8. **RECORDS AND DOCUMENTS**. Each party shall, upon reasonable request, permit another party to examine or audit all service related records, books, documents and papers relating to this MOU and the MITIGATION PROJECT(s). Each party shall maintain the records, books, documents and papers relating to the MITIGATION PROJECT(s) for at least three (3) years after this MOU is terminated.

9. **PUBLIC ACCESS TO RECORDS**. The parties shall allow public access to all documents, papers, letters, or other material subject to the provisions of Chapter 119, Florida Statutes, and made or received by the parties in conjunction with this MOU. Failure by any party to grant such public access shall be grounds for immediate unilateral cancellation of this MOU by any party.

10. **TERM**. The term of this MOU shall commence on the date of this MOU and shall continue through completion of the MITIGATION PROJECT(s) or twenty (20) years after the date of this MOU, whichever occurs first. If the MITIGATION PROJECT(s) are not completed within the aforementioned time period, this MOU will expire unless an extension of the time period is agreed upon by the parties.

11. **TERMINATION**. This MOU may be terminated by any party only upon another party's failure to substantially comply with the terms and condition of this MOU. The terminating party shall give all other parties thirty (30) days written notice of its intent to terminate. Termination shall be effective upon the thirtieth (30th) day after all party's receive said notice. If the terminating party is the FDEP, then the FDEP shall return to the FDOT all funds which have

not been previously obligated pursuant to the terms and conditions of this MOU and the FDOT shall cooperate in good faith with the USACOE and SWFWMD to accomplish appropriate mitigation with the remaining funds.

12. **LIABILITY**. Each party shall be solely responsible for the wrongful acts of its employees. contractors and agents. However, no party in any way waives its right to state or Federal sovereign immunity, as applicable.

13. **ASSIGNMENT**. No party may assign or transfer its rights or obligations under this MOU without prior written consent of all other parties.

14. **NOTICES**. All notices or reports required to be given under this MOU shall be sent by U. S. mail, postage paid, or hand delivered to the parties at their addresses below:

For SWFWMD: Southwest Florida Water Management District
Attention: Clark Hull
2379 Broad Street
Brooksville, Florida 34609-6899

For the FDEP: Florida Department of Environmental Protection
Bureau of Mine Reclamation
Attention: James W. H. Cates
2051 East Dirac Drive
Tallahassee, Florida 32310

For the USACOE: United States Army Corps of Engineers
Attention: Mike Nowicki
Post Office Box 4970
Jacksonville, Florida 32232-0019

For the FDOT: Florida Department of Transportation
Turnpike District
Attention: Raymond A. Ashe, Jr.
MS 98, Burns Building
Tallahassee, Florida 32399

For the FGFWFC: Florida Game and Fresh Water Fish Commission
Attention: Tim King
3900 Dranefield Road
Lakeland, Florida 33811

IN WITNESS WHEREOF, the parties hereto, or their lawful representatives, have executed this Memorandum of Understanding as of the date first above written.

Signed and delivered
in the presence of:

UNITED STATES ARMY CORPS OF ENGINEERS

_______________ By: _______________________

Witness

Terry L. Rice
Colonel U.S. Army
District Engineer

Federal ID#: ____________________

IN WITNESS WHEREOF, the parties hereto, or their lawful representatives, have executed this Memorandum of Understanding as of the date first above written.

Signed and delivered
in the presence of:

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Witness By: Virginia B. Wetherell, Secretary

Federal ID#: ______________________

IN WITNESS WHEREOF, the parties hereto, or their lawful representatives, have executed this Memorandum of Understanding as of the date first above written.

Signed and delivered
in the presence of:

Legal Review ____ 11-28-95
Fiscal Review ____

FLORIDA DEPARTMENT OF TRANSPORTATION

Initial: ____ Date: ____

____
Witness

By: ____
James L. Ely, Turnpike District Secretary

Federal ID#: ____

IN WITNESS WHEREOF, the parties hereto, or their lawful representatives, have executed this Memorandum of Understanding as of the date first above written.

Signed and delivered
in the presence of:

FLORIDA GAME AND FRESH WATER FISH COMMISSION

Bonnie J. Holcomb By: [signature]
Witness Dr. Allan L. Egbert, Executive Director

Federal ID#: 47-04-025954-52C

IN WITNESS WHEREOF, the parties hereto, or their lawful representatives, have executed this Memorandum of Understanding as of the date first above written.

Signed and delivered
in the presence of:

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

________________ By: ____________________
Witness Peter G. Hubbell, Executive Director

Federal ID#: 59-0965067

EXHIBIT A

Permit Conditions for Polk County Parkway Permit Modifications:

1. As total mitigation for all impacts to wetlands and surface waters in the Peace River and Green Swamp watersheds, the permittee shall encumber $3,500,000 toward the creation/restoration and management of at least 84.73 acres of forested wetlands and 37.28 acres of herbaceous wetlands. This mitigation shall be located, if feasible, in the Saddle Creek sub-basin in a manner consistent with the conceptual mitigation concepts put forth in the September, 1994 memorandum entitled "A Proposed Ecosystem Plan for the Upper Peace River: Alternative Mitigation for Upper Saddle Creek" or the March, 1994 report entitled "A Three-Part Regional Habitat Mitigation Plan as the Foundation for the Southern Phosphate District of Florida's Integrated Habitat Network". Monies encumbered per this condition shall be paid, on or before December 1, 1995, to the Department of Environmental Protection to coordinate and oversee the mitigation activities as detailed in the Memorandum of Understanding between the SWFWMD, FDEP, FGFWFC, USACOE and FDOT, for mitigation for the Polk County Parkway.

2. In addition to payment required in the above condition, the Turnpike District (FDOT) shall fund a hydrologic study to determine the feasibility of conducting the mitigation contemplated in the memorandum entitled "Proposed Application of Ecosystem Management, Greenways, and Mitigation Concepts Within the Saddle Creek Watershed of the Peace River", with specific emphasis on determining the rate and volume of water which can be released from the Saddle Creek watershed without causing downstream flooding. The amount of payment encumbered by the Turnpike District for this hydrologic study shall be $200,000, although additional monies may be obtained from other sources as supplemental funding. Monies encumbered for this hydrologic study shall be paid December 1, 1995.

3. As total mitigation for all impacts to wetlands and surface waters in the Alafia River and Hillsborough River watersheds, the permittee shall encumber $1,800,000 toward the creation/restoration and management of at least 5.67 acres of forested wetlands and 34.27 acres of herbaceous wetlands. This mitigation shall be located in the Alafia River watershed or in an area providing direct benefit to the Alafia River watershed preferably in a manner consistent with the conceptual mitigation concepts put forth in the March 1994 report entitled "A Three-Part Regional Habitat Mitigation Plan as the Foundation for the Southern Phosphate District of Florida's Integrated Habitat Network". Monies encumbered per this condition shall be paid, on or before December 1, 1995, to the Department of Environmental Protection to coordinate and oversee the mitigation activities as detailed in the Memorandum of Understanding between the SWFWMD, FDEP, FGFWFC, USACOE and FDOT, for mitigation for Polk County Parkway.

EXHIBIT B-1

A PROPOSED ECOSYSTEM PLAN FOR THE UPPER PEACE RIVER:

ALTERNATIVE MITIGATION FOR UPPER SADDLE CREEK

by

Tim King
Florida Game and Fresh Water Fish Commission

Danon Moxley
Florida Game and Fresh Water Fish Commission

Bud Cates
Florida Department of Environmental Protection

September 1994

A Proposed Ecosystem Plan for the Upper Peace River:

Alternative Mitigation for Upper Saddle Creek

Introduction

The Peace River is the most significant habitat and hydrologic system in west central Florida. As a habitat system, it provides refuge for forest and wetland wildlife in the extensively developed area between Charlotte Harbor and Green Swamp; connects otherwise isolated habitat in what is today one of the most fragmented regions of the state; and is a source of fish and wildlife colonizers for habitat reclamation in the state's 2.5 million-acre southern phosphate mining district. As a hydrologic system, the Peace River drains a basin of over 2,000 square-miles; is a major supplier of fresh water to industry, agriculture, municipalities, and the Charlotte Harbor estuary; and is responsible for hydroperiod maintenance of associated riparian wetlands along the river's 120-mile length.

Consistent with its recognized importance, ecological functions of the river are under consideration in a number of on-going state and regional planning initiatives. The Peace River is being evaluated by the Southwest Florida Water Management District (SWFWMD) as a source for new domestic water supplies. This evaluation should lead into further cooperative investigations with the Florida Game and Fresh Water Fish Commission (FGFWFC) regarding the relationship between flow reductions and the river's overall ecological health. The river is also an integral part of numerous other planning initiatives including: the Surface Water Improvement and Management Plan for Charlotte Harbor (SWFWMD), the Integrated Habitat Network and Coordinated Development Area Plans for the Southern Phosphate Mining District (Florida Department of Environmental Protection), the Suncoast and Governor's Greenways Commission Plans (1000 Friends of Florida), the Conceptual Management Plan for the Tenoroc Fish Management Area (FGFWFC), a Peace Creek restoration plan (Polk County), and the Green Swamp Area of Critical State Concern (Florida Department of Community Affairs).

Unlike the environmental values recognized for Peace River as a whole, its headwater area, especially the upper-most tributary, Saddle Creek, is notable for the considerable environmental alteration that it has sustained and for that which it stands to sustain from an unusual concentration of development activities within its basin. Virtually no remnant of the original stream and floodplain remains in the area. Historical alterations have included extensive phosphate mining, agricultural development, and stream channelization. Planned alterations are intended to both reclaim old mined lands and further enhance the area's commercial, residential, agricultural, and transportation capabilities. These activities are most concentrated in the portion of the basin between Interstate Highway 4 (I-4) and the Tenoroc Fish Management Area (Figure 1).

Most responsible for the presently altered environment was phosphate mining, with about 70 percent of the area having been strip-mined or used for mine waste disposal and left unreclaimed by the original mine operators. The state of Florida created a Nonmandatory Reclamation Program and Trust Fund to reimburse landowners for voluntary reclamation of phosphate mine parcels disturbed before 1975. The upper Saddle Creek basin has 11 Nonmandatory Program parcels that either have funded projects underway or that are unreclaimed and eligible for funding. Three of the funding-available parcels are on state-owned land at Tenoroc, while the remaining eight are on private land to the North. None of the reclamation completed in the area was planned with the intent of restoring Saddle Creek, nor was the state funding expenditure, by rule, more than that necessary to achieve minimal reclamation.

Creation of usable land in proximity to the region's major interstate has been, in turn, largely responsible for the unusual surge in development activity in the upper Saddle Creek. Presently under state permit review are plans for three Developments of Regional Impact (Bridgewater, Williams Parkway Center, and Polk Commerce Centre), two new highways (the Polk Parkway and the East-West Expressway), a major renovation of I-4, a natural gas pipeline (SunShine Pipeline Company), and a 500-Kv transmission line (Florida Power Corporation) (Figure 2). Environmental mitigation requirements of these projects could add substantially to the recognized habitat extent in what is now a mostly altered basin.

The purpose of this report is to initiate formulation of an alternative mitigation plan for the upper Saddle Creek. This plan could then be used to coordinate and draw upon mitigation commitments emerging from various reclamation and land use development projects requiring state application approval within the affected basin. Orchestration of the overall mitigation effort toward a single upper Saddle Creek restoration plan would be more an exercise in ecosystem healing than merely a patching of local wounds that would result from individual permit application review and approval.

Upper Saddle Creek Ecosystem Plan

Objectives

The intent of alternative mitigation is to restore the more significant functions of a damaged ecosystem rather than just repair or replace peripheral elements. Significant ecological functions of Saddle Creek considered in this plan are those that enhance the larger Peace River habitat and hydrologic systems that the creek is a part of.

From a habitat standpoint, Saddle Creek once served as an extension of Peace River into the Green Swamp; a connection that joined the region's most extensive habitat system into one of its most biologically diverse. The significance of that connection may have grown in recent times as phosphate mining moved south through the Peace River valley, leaving in its wake an expanse of emerging reclaimed habitat with a demand for new plant and animal colonizers to fill the evolving niche structure. The capacity to draw upon the region's full assortment of species for reclaimed land re-colonization may have been impaired by the earlier decision to mine through Saddle Creek at Tenoroc and to sever the connection between Peace River and Green Swamp with I-4. The habitat objective of the alternative mitigation plan would be to re-enable this former habitat connection by: 1) protecting remaining habitat in the mined-over area at and near Tenoroc; 2) replacing stream forest and wetland habitat lost due to mining; and 3) extending reclaimed forest through the mined area to a potential bridge location at I-4.

As a headwater stream, Saddle Creek's hydrologic role in the Peace River ecosystem is to collect run-off and seepage, and route it to the river through channels and wetlands capable of effective flow detention and treatment. Mining impaired this role in three ways: it impounded large portions of the basin and reduced the river's water supply; it replaced former streams and floodplains with diversion ditches; and it re-routed surface drainage through mine pit/lakes connected into groundwater. The net result was to exacerbate recognized problems in the upper Peace River; namely, its low total flow volume, localized flooding, and poor water quality. The hydrological objective of the alternative mitigation plan would be to help correct water quantity and quality problems in the upper Peace River by: 1) restoring Saddle Creek and its floodplain within the former mine area; 2) enhancing flow contribution from each sub-basin by un-impounding former mine areas and minimizing flows through mine pit lakes; and 3) enhancing water detention and treatment within each sub-basin by directing flows through natural and reclaimed wetlands.

Project Areas

Although the alternative plan would draw from development mitigation commitments throughout the Saddle Creek basin, it would be carried out on key former mine sites in and around the Tenoroc Fish Management Area (Tenoroc). Project areas would include state-owned land at Tenoroc managed by the FGFWFC and private land held by American Cyanamid, the Williams Acquisition Holding Company, and the group of owners represented by the Polk Commerce Centre Community Redevelopment Agency.

The 6,040-acre Tenoroc Fish Management Area offers the most opportunity for mitigation projects since it is publicly-owned and has restoration of Saddle Creek as one of its conceptual management goals. There are five possible project areas on the property (Figure 3). Each of the five has stream, wetland, and forest enhancement opportunities, three offer xeric habitat mitigation sites, and two include Nonmandatory Program areas that are eligible for funding (Table 1). Existing habitats in each planning area could benefit from drainage or vegetation improvement.

There are three other landscape features outside Tenoroc that should be included in the alternative mitigation plan: the clay-settling ponds north of Tenoroc (Clay Pond Tract); the mostly mined and reclaimed land between the clay ponds and Interstate 4 (I-4 Tract); and the surface water diversion system created during mining (Ditch System) (see Figure 3). The Clay Pond Tract north of Tenoroc accounts for about five square-miles of mining impoundment. It is owned by the Williams Company but is not included in their pending Development of Regional Impact (DRI). Three of the clay impoundments have Nonmandatory Program projects underway, but their plans will, according to SWFWMD, need to be revised so that water discharge would not exacerbate local flooding problems. Originally, any water discharge from the projects was planned to be diverted into the existing mine ditch system. None of the plans call for extensive habitat creation or protection.

The I-4 Tract is jointly owned by American Cyanamid, Inc. and the Williams Company. American Cyanamid owns a small portion just east of the I-4 and SR 33 interchange. They plan to set aside portions above and below the interstate for habitat preservation. The Williams Company owns the majority of the I-4 Tract, and has included its eastern portion in a pending DRI. An east-west arterial roadway is proposed along the tract's southern edge and a Polk Parkway interchange is proposed along its eastern edge. Habitat preservation is planned for the Polk Parkway interchange, but it would be isolated by surrounding roadways and development. Midway through the Williams Company portion is a drain under I-4 and some cypress wetlands immediately north and south of the interstate.

The Ditch System that has replaced upper Saddle Creek has western, eastern, and central extensions. The western mine ditch runs along the northern and western sides of the Clay Pond Tract, and then southward through Tenoroc. There are lateral drains feeding it along and under I-4, along SR 33, and from American Cyanamid property to the West. A portion of the flow near the junction of I-4 and SR 33 is being drained northward under the interstate into a reclaimed mine pit/lake. On the other side of the planning area, the eastern mine ditch runs generally along the edge of the Clay Pond Tract and along the eastern and southern boundaries of Tenoroc. A small segment at the southeast corner is routed around a former landfill included in the Polk Commerce Centre DRI. This mine ditch has lateral connections into mine pit/lakes and Lake Myrtle. The central mine ditch is the shortest of the three. It runs south from Tenoroc along the eastern side of Area 3, draining an inter-connected system of pit/lakes on Tenoroc and the Clay Pond Tract. The three mine ditches join in an unmined wooded area just south of Tenoroc along SR 546.

Habitat System Options

There are two options for re-extending Peace River habitat through Tenoroc: a central route and an eastern route (Figure 4). The central route would pass through Areas 1, 2, and 3, and would accommodate Tenoroc's main office, a fishing derby lake, and an adjacent hunter safety shooting range. These are not the intense, 24-hour per day operations that would preclude surrounding habitat use, and the route has an advantage of tying-in to adjacent property to the North that is not included in the Williams Company pending DRI. The alternative eastern route would pass through Areas 3, 4, and 5. It would not encroach upon any of the actively used areas at Tenoroc, but it would tie into the Williams Company DRI tract where there is less likelihood of any further habitat extension.

There are three options for extending habitat from Tenoroc to I-4; a western, central, or eastern option (Figure 5). Regarding a preferred route for this extension, it could prove more feasible to establish a meaningful habitat crossing into the Green Swamp where bridge construction is already anticipated. This implies western and eastern options for the added extension. The western extension to the I-4 and SR 33 junction has the advantage of reaching the interstate near the point where protected habitat in the Green Swamp is being consisdered as part of the Bridgewater DRI. The eastern extension, toward the proposed I-4 and Polk Parkway interchange, has no obvious Green Swamp tie-in. It could, however, offer improved habitat along its length if it could be routed through habitat preserves in the Williams Company DRI. Should it prove feasible to establish a habitat connection through I-4 where no bridge is now planned, a central habitat extension may be worthy of consideration in the area of the existing I-4 drain and nearby cypress wetlands.

Hydrologic System Options

A drainage study would be a necessary part of the alternative mitigation plan to verify the feasibility of the hydrologic system options under consideration. In lieu of verification, the planning area would seem to offer sites suitable for the restoration of an upper Saddle Creek main stem and four tributary sub-basins (Figure 6). In this presently anticipated scenario, the main stem of Saddle Creek would pass through Tenoroc Areas 1, 2, and 3. Existing wetlands reclaimed on clays in Areas 1 and 3 would serve as a new floodplain, while a connecting stream would have to be constructed between the two wetlands through Area 2. Existing wetlands in the proposed floodplain area have so far exhibited marginal development of preferred vegetation; most likely due to inadequate planting and poor internal site drainage.

The western sub-basin would likely have the largest drainage area of the four proposed tributaries. It would drain all the land along I-4 and SR 33, and those portions of the American Cyanamid and Tenoroc properties that presently drain into the existing western mine ditch under SR 33 and SR 659. Areas above I-4 also apparently drain under the road into this mine ditch. The drainage from the areas above I-4 could be increased if the present drainage diversion into the reclaimed lake north of the interstate was blocked.

Where the existing western mine ditch reaches the upper end of the proposed floodplain in Tenoroc Area 1, there is a mine pit/lake. Water level in the ditch and lake at this location is below the bottom of the Area 1 wetland, while natural ground around the ditch and lake is at or slightly above the wetland. It would be necessary to raise the water level in the adjacent ditch and lake in order for it to spill through a constructed dam breach into Area 1. This may require additional wetland creation and containment on Williams Company property immediately above the inflow breach.

The proposed northwestern sub-basin would drain approximately one-third of the Clay Pond Tract into the Area 1 wetland. The elevation of this portion of the Clay Pond Tract is above that of the Area 1 wetland, but the slope of the land is to the North. The current plan for reclaiming this area takes advantage of the existing slope and incorporates surface channels that route internal drainage northward to breaches into the western ditch. As indicated earlier, SWFWMD is concerned that this added contribution to the drainage area would exacerbate downstream flooding, and they may not permit the additional discharge. It may be possible to avoid the permitting dilemma by routing drainage southward, thus creating the proposed northwestern tributary sub-basin. This, however, would require additional ditching effort that would likely exceed the minimal reclamation design standards of the Nonmandatory Program that is funding the on-going work.

A northeastern sub-basin would accommodate drainage from the central third of the Clay Pond Tract that slopes toward the Southeast. Presently, overflow drainage from some of this area is routed into Tenoroc fishing pit/lakes. There is concern that this, as well as any additional untreated, off-site drainage, could affect the water quality at Tenoroc. The proposed northeastern tributary would re-route flows out of the fishing lakes into the Area 2 connecting channel and then into the Area 3 wetland for detention and treatment.

Lastly, an eastern tributary stream and floodplain restoration project is proposed as an alternative to the existing mine ditch. Nonmandatory Program funding is available for Tenoroc Areas 4 and 5, and could be used to create broad wetland areas from the present mine pits and clay impoundments. Flow from the Williams Company and Polk Commerce Centre DRI sites could be routed into and through these reclaimed wetlands to create a functional floodplain. Based on results of earlier Nonmandatory Program projects at Tenoroc, it may be necessary to go beyond normal program standards to achieve a quality reclamation product.

Implementation Strategy

It is proposed that the final selection and implementation of any alternative mitigation plan for the Upper Peace River should be directed by an Upper Peace River Ecosystem Planning Committee (UPREPC). This committee would consist of one designated representative from each governmental agency having permitting authority over, or substantial public funding interest in, land development activities within the subject area. The UPREPC would identify and involve the active participation of affected landowners or permit applicants. Membership could include eight agency and five stakeholder representatives (Table 2).

The UPREPC would review the overall project objectives and mitigation options, and formulate a draft plan for the upper Saddle Creek basin. The draft plan would be distributed to appropriate agency staff for compliance review. Agency staff review comments would be compiled to assist the committee in formulating a final Preferred Ecosystem Plan. This final plan would be based upon a well-considered draft with associated compliance evaluation and discussion. The Preferred Ecosystem Plan would then be presented to each involved agency head for consideration and approval before issuance of permits.

Table 1. Habitat type enhancement opportunities for each of five areas available for mitigation projects at the Tenoroc Fish Management Area.

	OPPORTUNITY				
	Stream	Wetland	Forest	Xeric	Funding*
Area 1	X	X	X	X	
Area 2	X	X	X	X	
Area 3	X	X	X		
Area 4	X	X	X		X
Area 5	X	X	X	X	X

* Nonmandatory Reclamation Program Trust Fund

Table 2. Anticipated membership of the Upper Peace River Ecosystem Planning Committee.

Agencies:

Florida Department of Environmental Protection
Southwest Florida Water Management Agency
U.S. Army Corps of Engineers
Florida Game and Fresh Water Fish Commission
Central Florida Regional Planning Council
Polk County Board of County Commissioners
Florida Department of Transportation
Florida Turnpike Authority

Stakeholders:

American Cyanamid, Inc.
The Williams Acquisition Holding Company
Polk Commerce Centre Community Redevelopment Agency
SunShine Pipeline Company
Florida Power Corporation

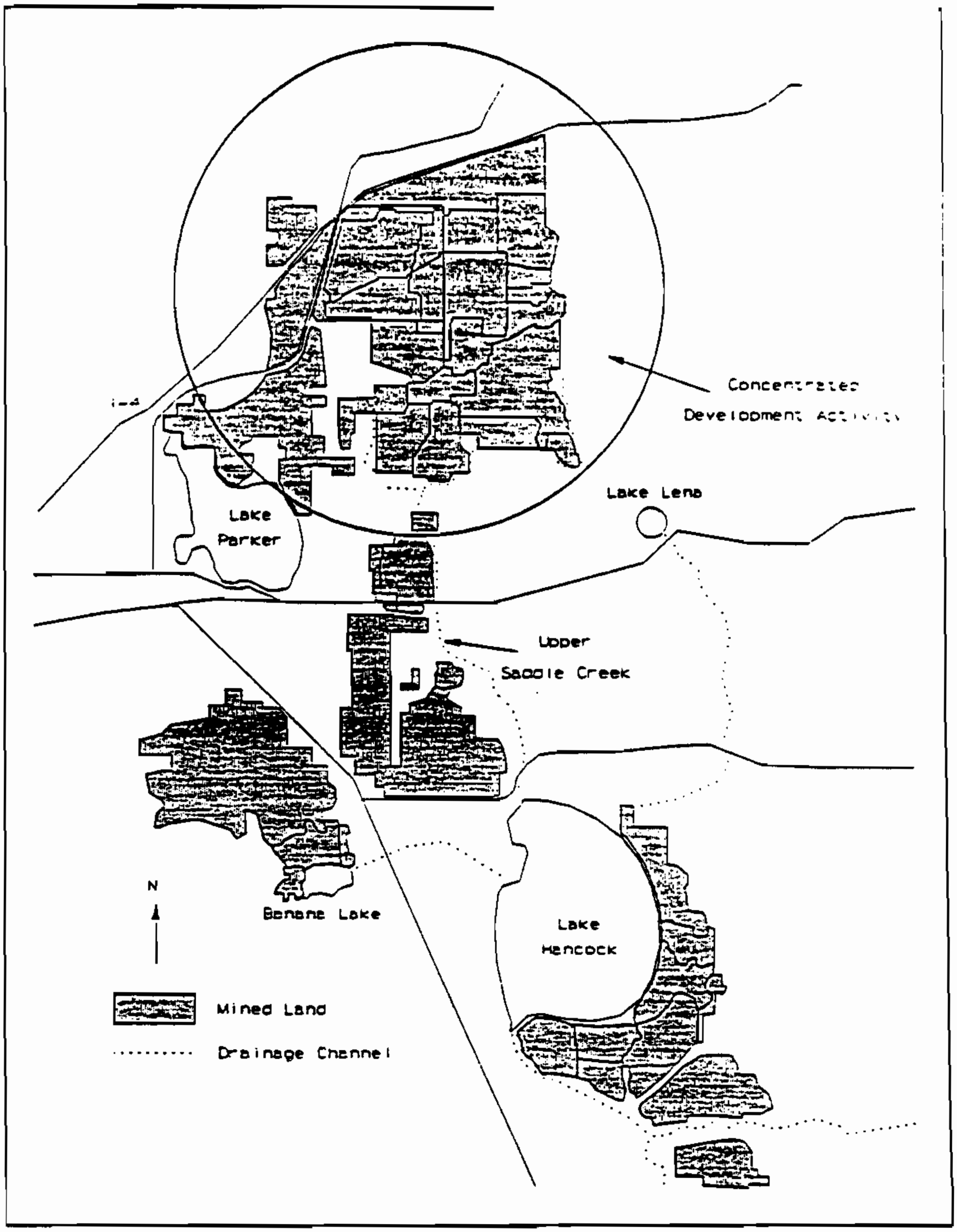

Figure 1. The upper Saddle Creek basin showing the area of concentrated development activity between I-4 and Tenoroc.

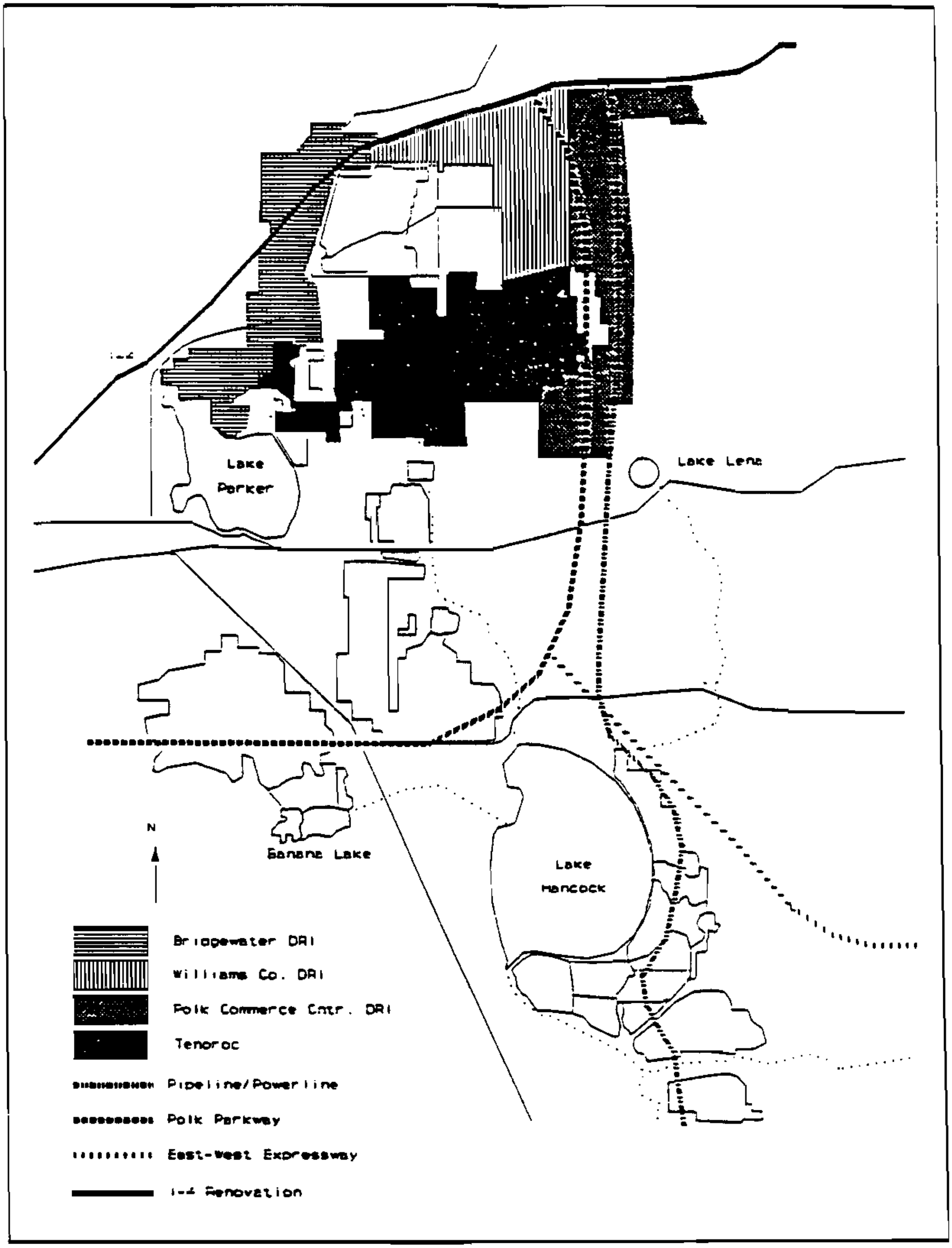

Figure 2. Development projects presently being planned in the upper Saddle Creek basin.

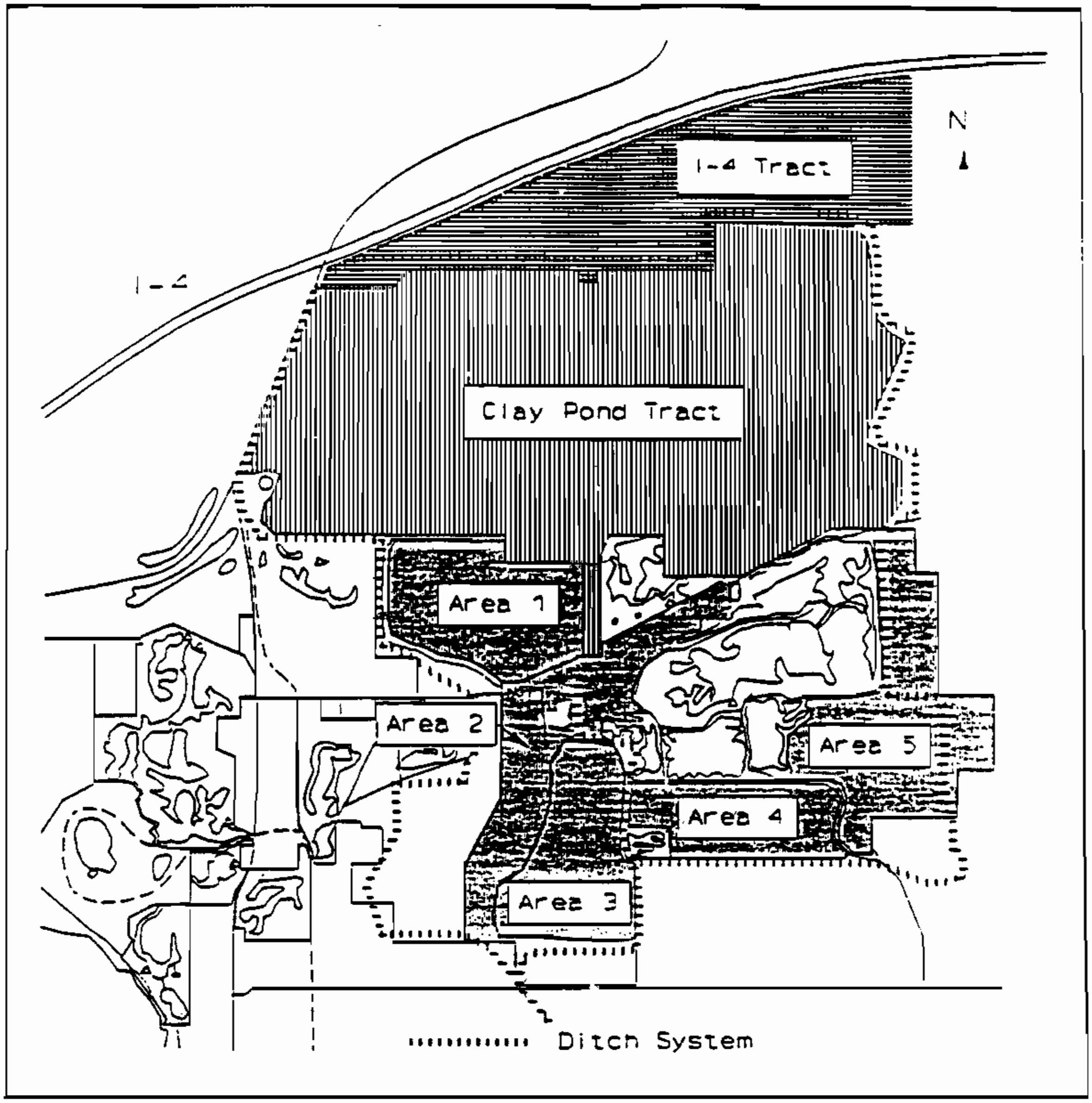

Figure 3. Planning areas available for alternative mitigation in the upper Saddle Creek basin.

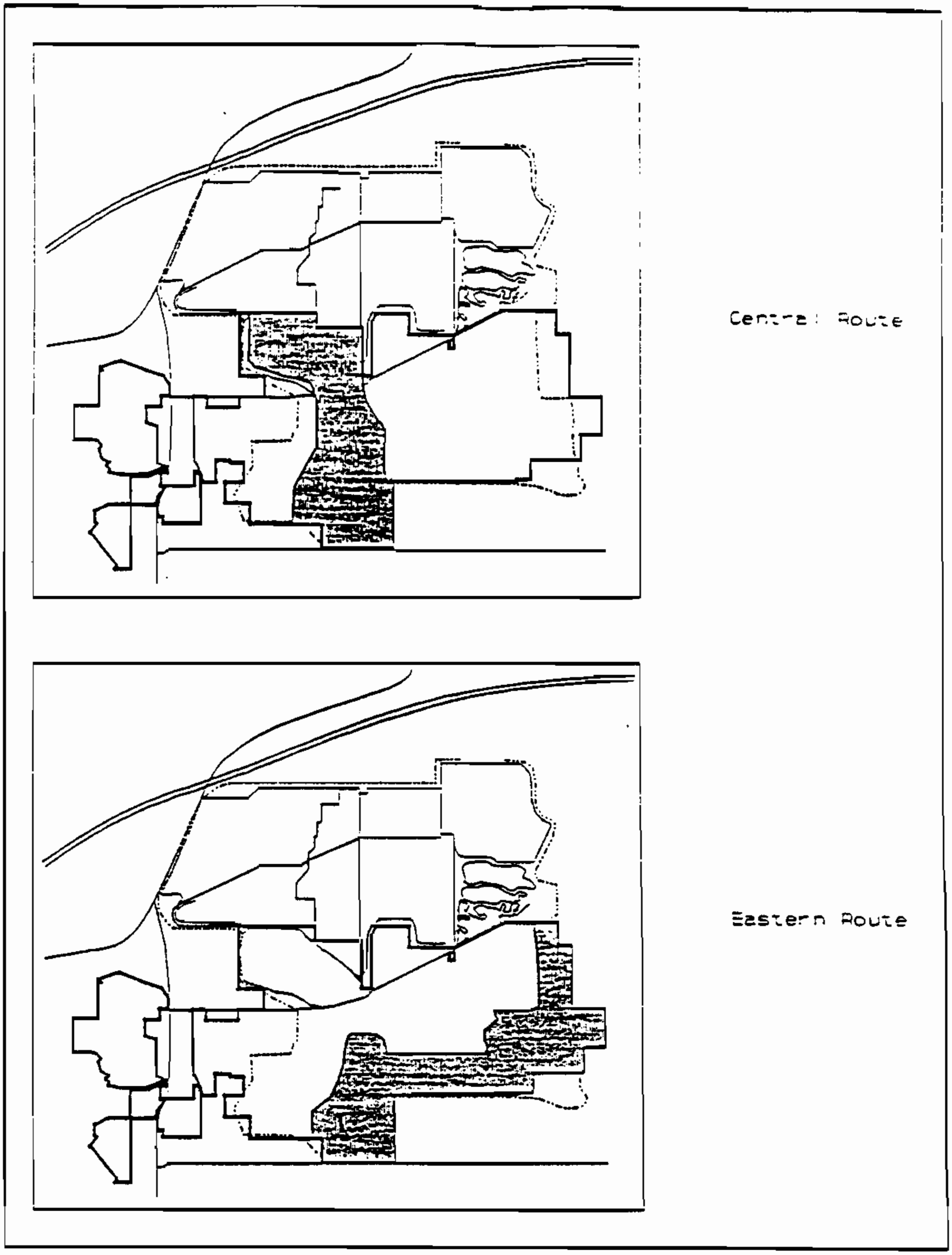

Figure 4. Two options for re-extending Peace River habitat through Tenoroc.

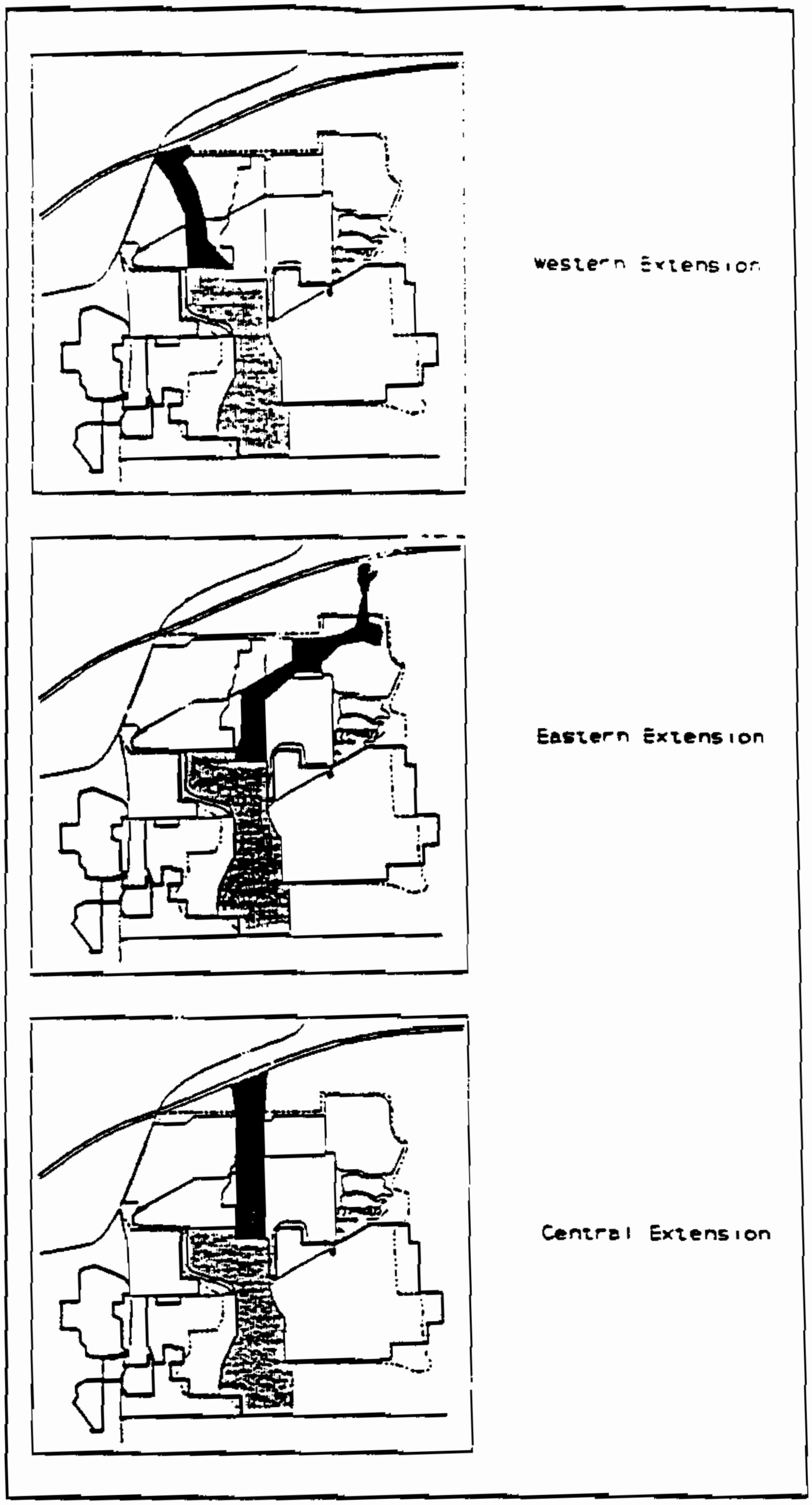

Figure 5. Options for extending Peace River habitat beyond Tenoroc to I-4.

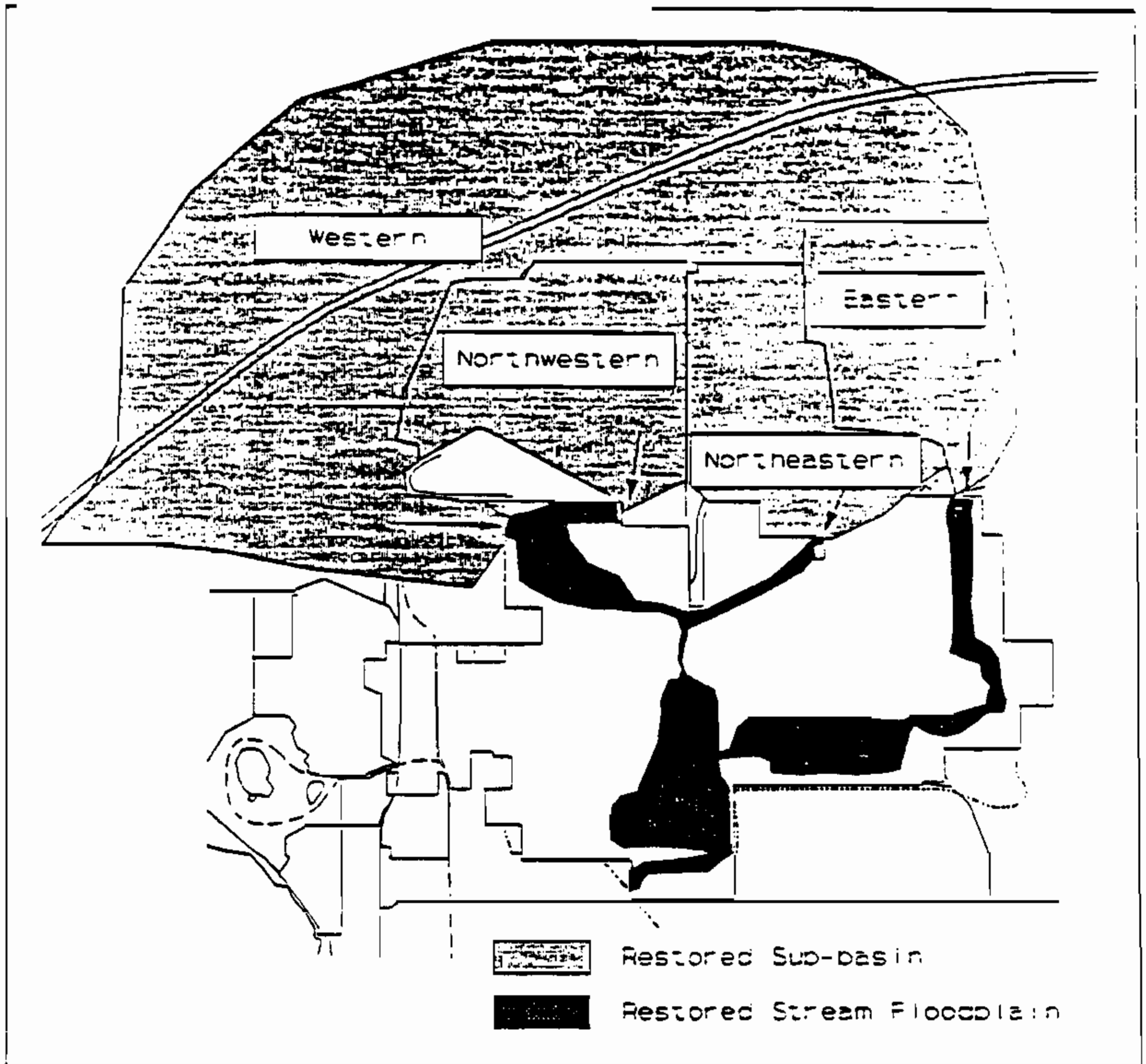

Figure 6. An unverified plan for restoration of the upper Saddle Creek hydrologic system.

EXHIBIT B-2

A Three-Part Regional Habitat Mitigation Plan as the Foundation for the Southern Phosphate District of Florida's Integrated Habitat Network

by

Tim King
Office of Environmental Services
Florida Game and Fresh Water Fish Commission

and

Bud Cates
Bureau of Mine Reclamation
Florida Department of Environmental Protection

March 1994

Introduction

The Florida Department of Environmental Protection (FDEP) has proposed an integrated habitat network (IHN) and a complementary coordinated development area (CDA) as goals for mine planning within the southern phosphate district of Florida (Cates, 1992). The Florida Game and Fresh Water Fish Commission supports this regional conceptual plan and is assisting FDEP in implementing the IHN/CDA through coordinated dredge and fill and mine reclamation permitting. The evolving regulatory approach uses environmental systems rather than ecosystem-arbitrary mine units as the basis for site design planning and review. The result should be a more effective level of mitigation for phosphate mining-related impacts to fish and wildlife, and a more functionally-relevant context for mine permit decision making.

To satisfy the diverse complement of stakeholders with an interest in post-mining landforms and land use, the IHN/CDA concept embraces a wide range of interpretation. The plan is variously viewed as a system of wildlife travel corridors, recreational greenways, hydrological units, land use zones, and so forth. In fact, upon completion, the IHN/CDA will be a composite of regional and local system plans that reflect the varied yet compatible intent of the landowners and industry regulators. The purpose of this report is to describe a region-wide base plan that will serve as the foundation on which subsequent detailed plan elements are to be overlain. The targeted beneficiary of the base plan is regional fish and wildlife.

The IHN portion of the concept is clearly intended to provide mitigation for mining-related impacts to regional fish and wildlife. The objectives are to ensure conservation of each species during mining and to produce a self-sufficient and persistent habitat system with all of the functional parts necessary to support at least as broad a complement of species and individuals after mining as occurred prior to mining. Like many conservation strategies today (Noss, 1992), the plan has three distinct functional parts: 1) a core reserve of protected habitat, 2) surrounding complementary habitat, and 3) connections to other habitats outside the planning area (Figure 1). The following chapters describe the three parts of the IHN's regional habitat mitigation plan.

A Riverine-Based Core Habitat Reserve

In the agriculturally-developed southern phosphate district, bottomland areas along rivers and streams typically provide the most consistent wildlife habitat. This is because they are unsuited to most intensive land uses and are relatively protected from development by wetland regulations. They are also among the least likely of sites to be permitted for mining. This combination of habitat consistency and protection makes the complement of riverine bottomlands within the mining district an inherently functional fish and wildlife reserve.

Riverine bottomlands also provide habitat for a cross-section of a region's fish and wildlife. The sites usually contain a range of aquatic, wetland, and upland communities that support a correspondingly broad range of species; while their relative isolation from human disturbance allows them to serve as passageways between otherwise inaccessible habitat blocks into which

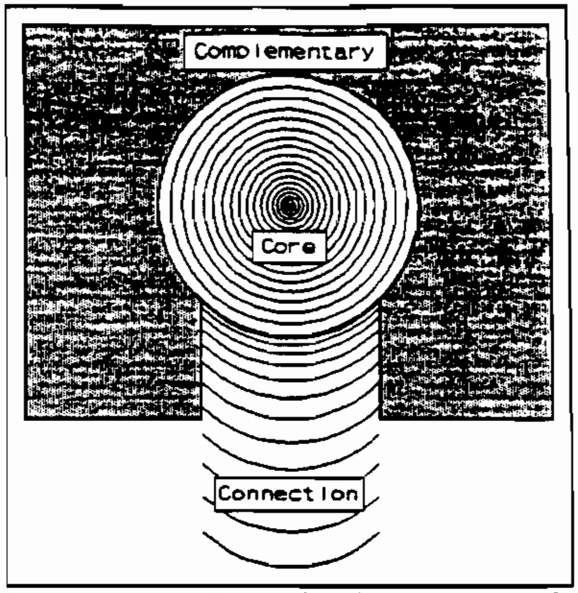

Figure 1. Three habitat parts of a mitigation plan.

they connect. Riverine areas may thus support a complement of species that reflects not only their own assortment of habitat types but the types of habitats that they connect with as well.

To optimally function as the core of a mine region habitat mitigation plan, the protected riverine reserve should be as large and extensive as possible. Its dual functions are to assure maintenance of viable populations of the fish and wildlife species dislocated by mining, and to provide a steady and diverse pool of colonizers for the replacement habitats created through reclamation. A large reserve can accommodate more species, while a more extensive reserve can connect into a larger assortment of donor and receiving habitats.

The major part of the southern phosphate district's core habitat reserve will consist of un-minable segments of the five major river systems that drain the area - the Peace, Alafia, Little Manatee, Manatee, and Myakka. But there are no protected habitats linking these systems together and there are gaps in the Peace and Alafia Rivers where historically weaker regulatory oversight allowed portions to be mined over. Connecting individual river systems and their pieces together with protected habitat corridors would create the largest possible core reserve in the region with the broadest attainable species accommodation. This is one of two design goals for the core component of the regional habitat mitigation plan.

The other goal is to extend protected core habitat into otherwise isolated reclamation tracts. Extension of mining limits is normally an exercise in mine permitting. But in older portions of the southern phosphate district, past mining has encroached into tributary areas that would not be permitted for mining today. There is a need to re-extend protected core reserve into some mining tracts that contain otherwise isolated habitats still undergoing reclamation and developmental recovery.

For the portion of the southern phosphate district that has already been permitted for mining or has new mine permits presently under review, nine special core habitat enhancement projects have been identified (Figure 2). Four of these are core habitat connector projects while the remaining five are core habitat extensions.

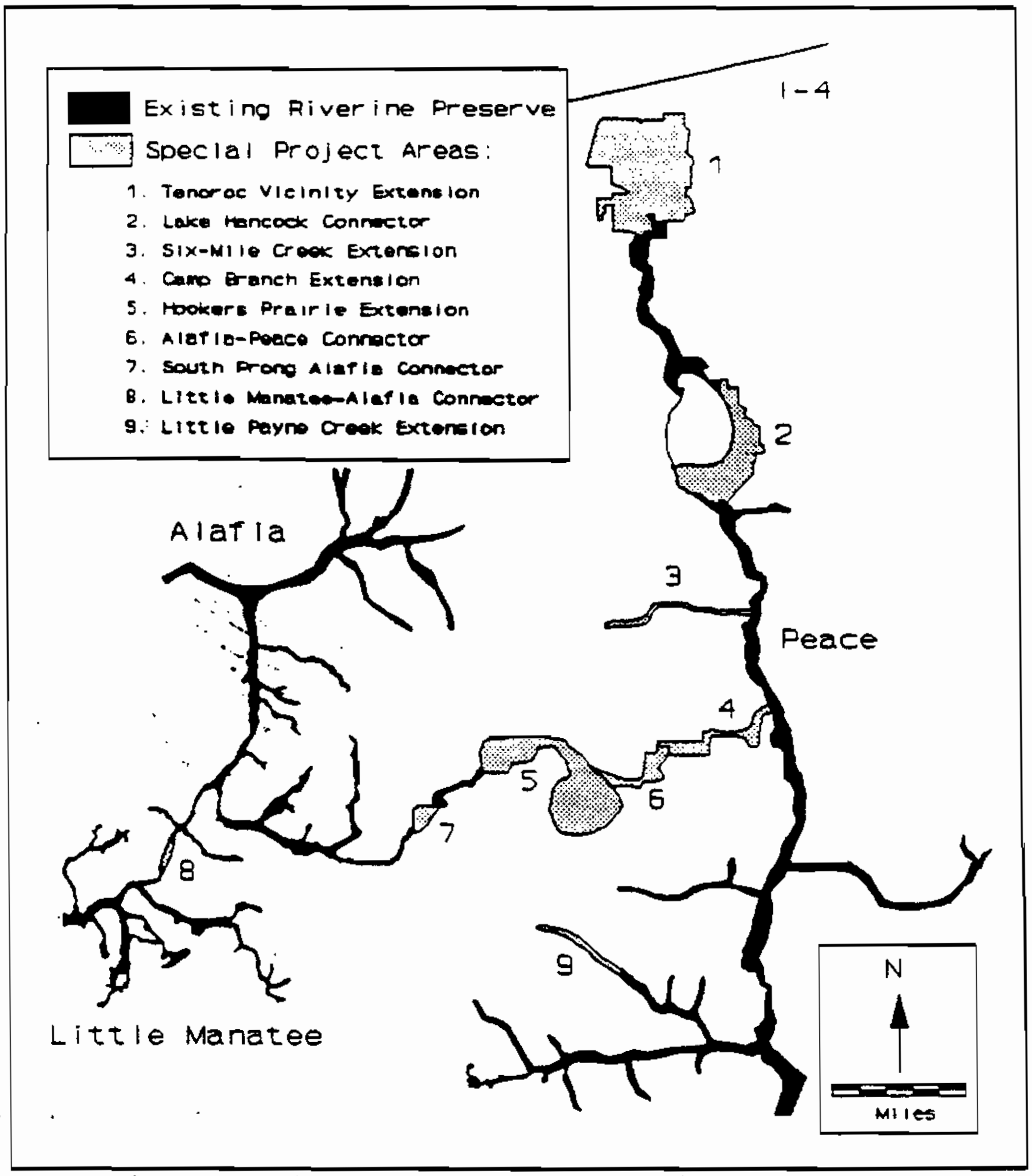

Figure 2. Core habitat enhancement projects.

Core Habitat Connector Projects

Lake Hancock (see Fig. 2, no. 2): The eastern and southern shores of Lake Hancock were mined in the 1960's while the western shoreline was developed for agriculture and housing. This severed Peace River proper from its headwater habitats along Saddle Creek. While on-going reclamation will create wetland and forest habitat in the former mine area adjacent to the lake, a plan is needed to coordinate the reclamation to produce an uninterrupted band of habitat between Saddle Creek north of Lake Hancock and Peace River to the south.

Alafia-Peace (see Fig. 2, no. 6): The divide between the Peace and Alafia River habitats is narrowest where a mined-over tributary to Peace River, Camp Meeting Ground Branch (i.e. Camp Branch), reaches westward toward Hookers Prairie, a large marsh that forms the headwater of the Alafia's South Prong. The FDEP is negotiating with landowners in and adjacent to a stretch of mined land between Hookers Prairie and the Camp Branch headwaters to either acquire the property for the state or otherwise limit land use development in the area. Once protection is assured, the state would then need to develop and implement a habitat reclamation and management plan for this Alafia-Peace connector.

South Prong Alafia (see Fig. 2, no. 7): About two miles downstream from Hookers Prairie, an approximate one-mile segment of the South Prong Alafia River was mined over and used for clay settling. The river is presently diverted through a channel around the settling pond's northern and western dams. Both the clay pond and the area along the channel have been reclaimed to pasture. To repair the habitat gap, a band of forest would need to be planted either through the clay pond or along the river diversion channel. Once accomplished, Tampa Electric Company has agreed to consider including this core habitat connector in the wildlife management program for a power station to be constructed nearby.

Little Manatee-Alafia (see Fig. 2, no. 8): The habitat gap between the Alafia and Little Manatee Rivers is narrowest where Hurrah Creek, a tributary to the South Prong Alafia, reaches within a mile of an unnamed tributary to the Little Manatee. The area is largely pasture, but IMC-Agrico Company intends to mine and replace the existing gap with upland forest. That plan is part of a pending application to extend the company's mine in Hillsborough County. The proposed Little Manatee-Alafia core habitat connector needs to be duly planned and recognized in the mine permit review process.

Core Habitat Extension Projects

Tenoroc Vicinity (see Fig. 2, no. 1): Saddle Creek between Lake Hancock and Interstate Highway 4 (I-4) is the northern-most extension of the Peace River habitat system. Largely prior to 1975, the upper five miles of Saddle Creek were mined. The area is gradually being reclaimed, and some - including most of the 6,000-acre Tenoroc State Reserve in the southern portion of the mine area - is being reclaimed or managed as fish and wildlife habitat. Yet there is no continuity of habitat through Tenoroc nor are there definite plans to extend reclaimed habitat through the privately held lands to the north. Additional habitat acreage will be needed to re-establish a continuous band of protected habitat through Tenoroc to I-4, and thereby re-establish this northern-most extension of the regional core reserve.

Six-Mile Creek (see Fig. 2, no. 3): Six-Mile Creek, a tributary to Peace River, drains an almost completely mined 20-square mile basin.

The land is gradually being reclaimed through more than 80 individual reclamation projects. Many of these have habitat reclamation tied into the Six-Mile Creek drainage. The creek itself, however, has been mined and its flow is now routed largely through mine pit lakes and canals. To tie habitat reclamation throughout the basin into the region's core reserve, a band of protected habitat needs to be re-established along the length of Six-Mile Creek from its headwaters to Peace River.

Camp Branch (see Fig. 2, no. 4): The route for Peace River's extension to the Alafia-Peace connector is along Camp Branch, a mined-over tributary. Florida Power Corporation plans to create and maintain habitat in the headwater area bordering the donated connector site, but there is no plan for protected habitat further downstream. If the Peace and Alafia River habitats are to be joined, and if planned habitat reclamation in the Camp Branch headwater is to be joined into the regional habitat reserve, then a plan for creation of protected habitat along the entire length of the mined-over stream will be needed.

Hookers Prairie (see Fig. 2, no. 5): Hookers Prairie is the route for the Alafia River's extension to the Alafia-Peace. Present plans are to mine and restore Hookers Prairie to sawgrass marsh. While this would maintain a protected habitat extension, it would not provide the diversity and species accommodation common to the rest of the reserve. If the Hookers Prairie core extension is to serve a large complement of species, then it will be necessary to either extend protection beyond the prairie into reclaimed forest along the prairie's upland shoreline, or to diversify reclamation within the protected bottomland portion of the prairie itself.

Little Payne Creek (see Fig. 2, no. 9): The extensive upper basin of Little Payne Creek has been almost completely mined. While a continuous lower reach of stream was not mined, the upper portion of this was impounded by mining activities and has become a cattail marsh. Although protected by wetland regulations, the marsh is not expected to function as an effective core reserve because of its low habitat diversity. A plan is needed to either un-impound and reclaim the upper unmined portion of Little Payne Creek, or extend protection outward into reclaimed habitats that border the cattail marsh.

Complementary Basin Reclamation

Once mining limits have been set for each mine, then the tributary systems planned for mining have likewise been identified. Since an intent of ecosystem permitting is that each of these mined tributaries be restored, the entire reclamation area of each mine may be subdivided into pre-planned stream tributary sub-basin and interbasin planning areas that will tie into the protected riverine core reserve (Figure 3). Such basin reclamation units can be designed not only to meet local water quantity, water quality, and wetland replacement goals, but to complement the regional habitat mitigation plan by providing a land use buffer for the core reserve and accessible new habitat for fish and wildlife population re-expansion after mining.

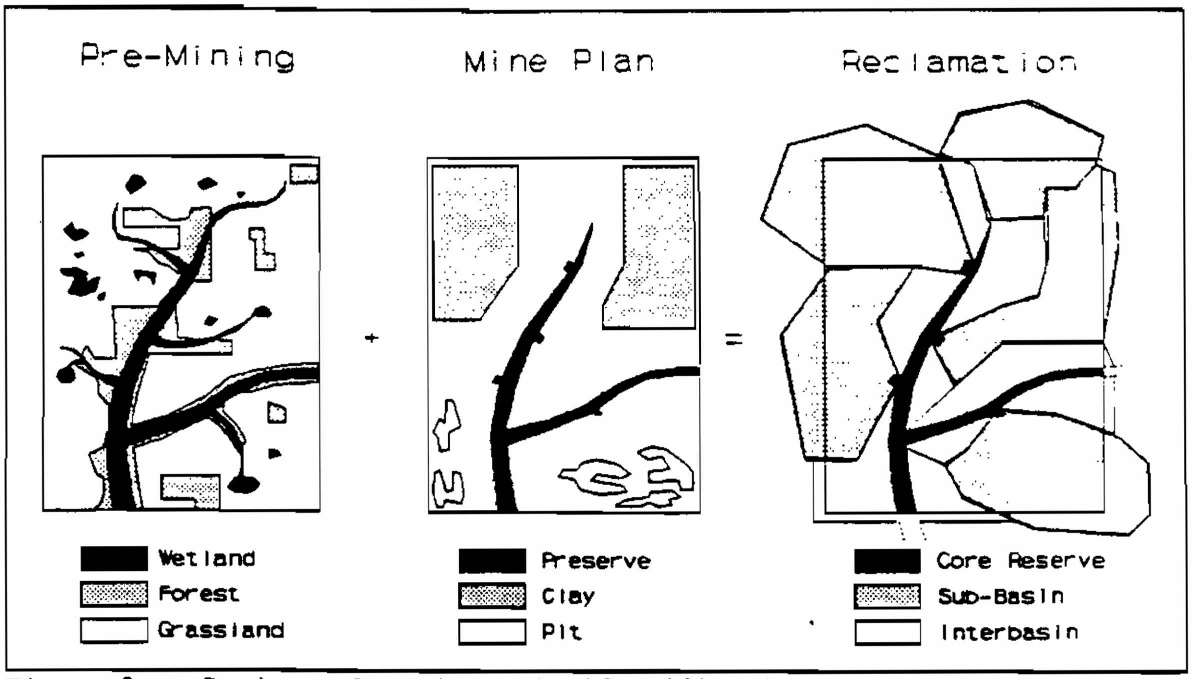

Figure 3. Basin reclamation unit identification.

Habitat-related goals for the basin planning units are to replace pre-mining heterogeneity and maximize contiguity. Habitat heterogeneity refers to the mix of community types within a particular area. It can be largely responsible for local fish and wildlife diversity. While replacement of pre-mining heterogeneity may imply type-for-type restoration of the original community types within each reclamation unit, changes in soils and landform after mining typically make this unrealistic. Nevertheless, an attempt to restore native communities would intentionally vary reclamation practices within each basin and should at least promote recovery of the pre-mining degree of habitat mixture. Guidelines for reclamation of 11 habitat categories representing the range of native communities within the southern phosphate district have been drafted (Cates and Zippay, 1993). If followed, such guidelines could promote recovery of a variable mix of habitats capable of supporting as wide a range of locally occurring species as possible.

On the other hand, creating a range of useable habitats does not in itself ensure that they will be used. Created habitats must be both useable and accessible. A problem with traditional mine unit reclamation planning has been that the resulting habitat tends to be fragmented (Figure 4). Basin reclamation planning provides a means to overcome the tendency toward replacement habitat fragmentation since reclaimed stream basins and the interbasins between them always connect into the regional core reserve and thereby combine preserved and reclaimed habitats into individual planning units. Siting all reclaimed habitats in and along the mining region's preserved and reclaimed riverine features would result in a fully integrated habitat network that is clearly segregated from, and thus coordinated with, the land use development area that will surround it (Figure 5).

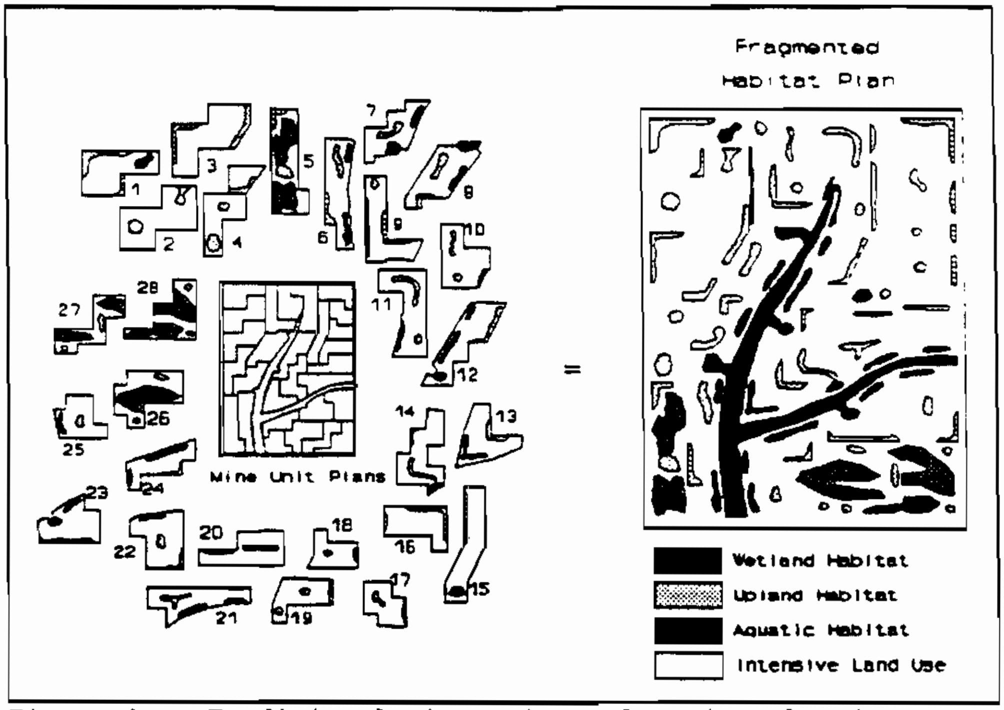

Figure 4. Traditional mine unit reclamation planning.

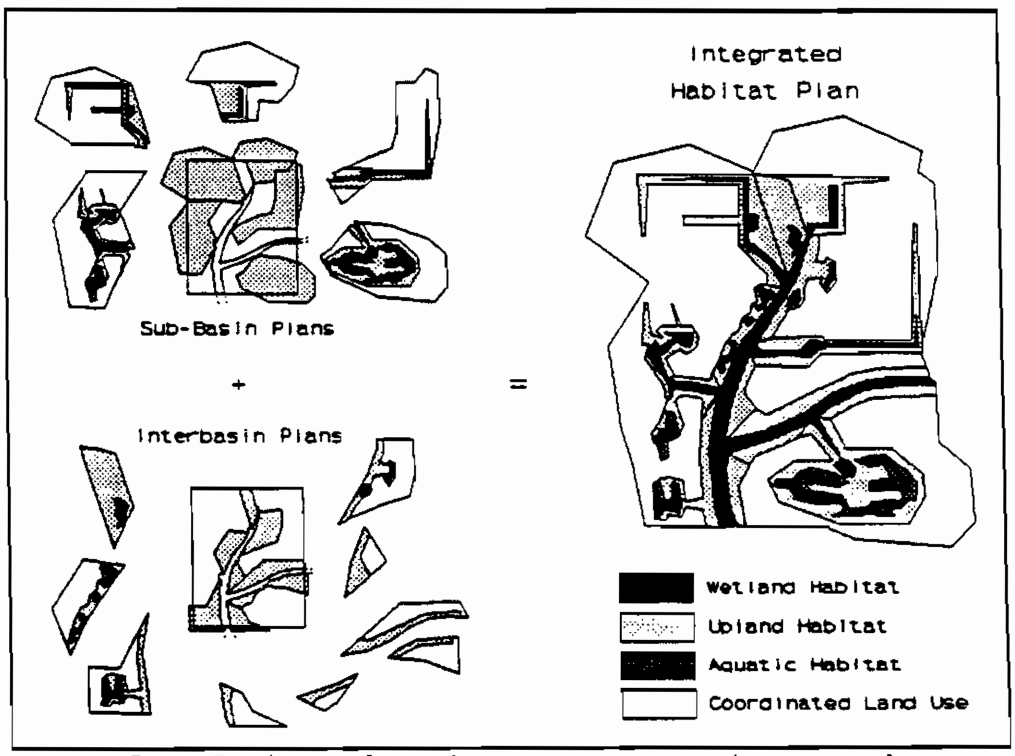

Figure 5. Basin reclamation to create an integrated habitat mitigation plan.

Habitat Linkages

While the IHN's regional fish and wildlife habitat mitigation plan is intended to address mining impacts within the southern phosphate district, it should not be considered to function in isolation from other habitats in the state. Large tracts of public and private habitat occur in surrounding regions, and these likely support native species that do not occur in the habitat-fragmented mining district. Increasing the number and quality of linkages to significant outside habitats would further enhance the regional mine mitigation plan's total species accommodation and thus improve its overall value.

The plan is already tied-in to riverine and connected habitat features downstream along each of the five major rivers draining the mining district. Included are linkages to Tampa Bay, Charlotte Harbor, the Manatee and Little Manatee River State Reserves, the Myakka River State Park, and the C.M Webb Wildlife Management Area (via the Shell Creek tributary to Peace River).

Less apparent are connections into significant habitat to the north and east outside the mining district's drainage basins. Linkages to these areas would require upland bridges and special habitat creation projects not directly related to phosphate mining. Two such projects have so far been identified.

Hillsborough/Green Swamp Linkage

Northwest of the mining district lies the Hillsborough River State Park and the Upper Hillsborough Wildlife Management Area. They are connected through the Withlacoochee River to the Green Swamp Area of Critical State Concern that lies north and northeast of the mining district. The Tenoroc vicinity extension, which is the northernmost element of the IHN habitat mitigation plan, is the likely point of connection into this extensive outside habitat block.

Although I-4 would seem a barrier to a northward habitat linkage, the Florida Department of Transportation (FDOT) intends to widen the highway and is in the process of identifying possible wildlife underpasses and other special habitat compensation programs in the area. They also plan to construct and mitigate for a regional parkway that will tie into I-4 northeast of Tenoroc. To draw upcoming FDOT highway mitigation programs into the regional mine mitigation effort, a plan is needed to identify possible linkages between the IHN and the Hillsborough/Green Swamp habitat system through I-4.

Trans-Ridge Linkage

The Avon Park Wildlife Management Area and the extensive native habitat along Lake Kissimmee are separated from the southern phosphate district by the Lake Wales Ridge. The ridge has undergone extensive land use development and has restricted habitat bridging opportunities.

Perhaps the most likely opportunity for linkage occurs where the upper reaches of two eastern tributaries to Peace River, Bowlegs Creek and Charlie Creek, approach Lake Livingston south of Frostproof. Lake Livingston is connected to the Avon Park Wildlife Management Area through the Arbuckle Wildlife Management Area. It is separated from the headwaters of the two Peace River tributaries by US Highway 27 and several miles of partially developed upland. A plan is needed to identify possibilities for bridging the highway and creating forest habitat in the privately-owned lands along the western portion of this possible trans-ridge linkage.

Literature Cited

Cates, James W.H. "A Regional Conceptual Reclamation Plan for the Southern Phosphate District of Florida." Florida Department of Natural Resources, Bureau of Mine Reclamation. July 20, 1992.

Cates, J.W.H. and L.M. Zippay. "Guidelines for the Reclamation, Management and Disposition of Lands within the Southern Phosphate District of Florida: Draft #2." Florida Department of Natural Resources, Bureau of Mine Reclamation. January 20, 1993.

Noss, Reed F. "The Wildlands Project: Land Conservation Strategy." In Wild Earth, Special Issue, pp. 10-25. Publ. by the Cenozoice Society, 1992.

MEMORANDUM

TO: BUD CATES

FROM: WINK WINKLER

SUBJECT: AUGUST 5 1999 PROJECT MEETING
BCI CONFERENCE ROOM, LAKELAND, FL

DATE: 03/06/00

CC: BILL HAWKINS, FDEP, HOMELAND
TIM KING, FCFWC
CANDIE PEDERSEN, BCI
TOM SHAW, BCI
WALT REIGNER, BCI

MINUTES FOR THE MEETING

AUGUST5, 1999, 10:30 AM
BCI Conference Room, Lakeland, Florida

In Attendance : Bud Cates, FDEP
Bill Hawkins, FDEP
Tim King, FCFWC
Candie Pedersen, BCI
Walt Reigner, BCI
Tom Shaw, BCI
Wink Winkler, BCI

A project meeting of the Upper Peace River Watershed restoration project team was held on August 5, 199. Listed below are the major topics of conversation and any action items identified.

We discussed the deadlines for the various tasks and the need to modify the task order(s) to refine dates and deliverables where appropriate. This will be done in September.

The following items were discussed:

- This meeting and future meetings should include meeting minutes as a deliverable.

- Bill Hawkins is working with the contracts people to get a time and materials earthmoving contract generated

- BCI tasks 7.4 and 7.5 may be combined and possibly go to a time and materials basis.

- Future UPREPC meetings will have to be advertised in the Administrative Weekly. One of the meetings will be designated as the public meeting for the SWFWMD Noticed General Permit.

- The existing cypress area in Area 4 is not currently functional and enhancement would improve its water quality function.

- Non-mandatory parcels 07 and E are not appropriated. Jack at the FDEP is working on it.

- Goals and objectives should include a reference to the funding from the Non-mandatory Trust Fund.

- Goals and objectives should encourage participation by off-site nearby landowners.

The following possible additional task assignments were discussed.

- Surface water sampling and testing should be completed to determine baseline conditions and should be continued during construction and revegetation activities.
- Coliform testing should be initiated.

Action Items:

1. Walt Reigner will write a letter summarizing the recent meeting with Mark Ross.

2. The September meeting was tentatively slated for September 9 in Lakeland.

3. BCI to contact Dr. Rose and deliver scope and budget to further investigate high coliform data.

MEMORANDUM

TO: BUD CATES

FROM: WINK WINKLER

SUBJECT: SEPTEMBER 9, 1999 MONTHLY PROJECT MEETING
BCI CONFERENCE ROOM, LAKELAND, FL

DATE: 03/06/00

CC: BILL HAWKINS, FDEP, HOMELAND
TIM KING, FCFWC
CANDIE PEDERSEN, BCI
TOM SHAW, BCI
WALT REIGNER, BCI

MINUTES FOR THE MEETING

SEPTEMBER 9, 1999, 9:00 AM
BCI Conference Room, Lakeland, Florida

In Attendance : Bud Cates, FDEP
Bill Hawkins, FDEP
Tim King, FCFWC
Candie Pedersen, BCI
Walt Reigner, BCI
Tom Shaw, BCI
Wink Winkler, BCI

A monthly meeting of the Upper Peace River Watershed restoration project team was held on September 9, 199. Listed below are the major topics of conversation and any action items identified.

- **Task 1.5.1**

This task is complete and a narrative expanding the goals will be included in the report.

- **Task 1.5.2A**

BCI will translate the USF data on flows into the BCI GIS system. This will include the following:

Show basin to basin flows

Show basin to reach flows

Show basin names – common names and USF designations

BCI is to provide DEP with the cost to accomplish this work.

- **Task 1.5.2B**

Bill Hawkins requested that the existing soils map be revised to incorporate the SCS soils designations included in the 1983 Polk county soil survey. Bill felt that this should be completed within the existing budget. Bud Cates acknowledged that there was some extra work and asked Wink to provide an estimate of the work that would be needed to upgrade the map.

Tim and bill will meet to identify some specific areas on the map that need revision. Jim Mills will help identify areas in Areas 3 & 5 that have pockets of soft clay. The new map will include spoil areas in Area 4. This map will be plotted at the same scale as the aerial to facilitate map comparisons.

- **Task 1.5.3**

This task is complete and the invoice dated August 3, 1999 should be separated into two invoices, one for each task.

- **Task 1.5.4B**

This task has encompassed developing the scope for tasks 1.11 to 1.17, working with Dr. Rose regarding developing a scope for the coliform investigation, and refining the water quality testing parameters. Once the last tow issues are resolved, BCI will bill for this task.

- **Task 1.6**

BCI will incorporate the following map coverages into one Arcview file and submit it to the DEP. This will complete this task.

1. Soils
2. Land Use
3. Landform
4. Aerial photograph
5. Hydrologic basins

- **Task 1.7**

BCI to write letter to Steve Richardson giving asking where the USF data is for the FIPR funded study. Also, BCI will follow-up with a telephone call to Mark

Ross to check on the status. The report will be generated with or without the USF information, but this task cannot be completed without it.

New Tasks:

- **Task 1.11**

  The delivery date was changed to October 15

- **Task 1.12**

  This task should include as-builts where necessary. Paper maps will be at whatever scale they happen to be. The digital map will show mapped areas with mapping date, scale and contour interval.

- **Task 1.13**

  Historical research will include 1960 to present and major storms before that.

  The deliverables will include a chronology or time-line of events

- **Task 1.14**

  The calculations will be based on assumed slopes estimated from a field visit. Volumes will be for 4 feet above and 2 feet below the existing lake elevations. The delivery date for the letter was moved to October 15th.

- **Task 1.15**

  No change to this task.

- **Task 1.16**

  No change to this task.

- **Task 1.17**

  No change to this task.

General comments

1. Walt will assist Wink in formatting future task orders similar to the FDOT format to ensure well defined scopes and deliverables.

2. All maps will incorporate the boundary change on the west side of the property to exclude a triangular area not part of the Tenoroc FMA.

3. BCI to issue progress reports and Bud will edit and distribute. This is a new task.

4. GIS Arcview/PowerPoint presentation should be developed. This is a new task.

5. The project schedule Ghant chart should be revised

6. The report should be finalized, the DEP Secretary should be briefed and then the results should be shared with the Polk County Commission.

7. These conceptual plan should be somewhat broad brush and include large areas that wetlands could be located and several surface water flow patterns.

8. The final plan will have the strategy for wetland replacement explained in detail.

9. Water quality discussion concluded that some additional prices should be obtained for chlorophyll, etc and a subgroup will meet to make a recommendation to the group regarding water quality sampling and testing.

Action Items

1. Wink will call the EPA consultant and check on the status of the groundwater and soils data.

2. Wink to revise Task 1.11 to 1.17 scope and budget and get to Bill and Bud ASAP

3. Bill to call Brian Sodt at the CFRPC and discuss timing of a meeting with the Williams Company.

4. The October meeting was tentatively slated for October 14 in Lakeland.

MEMORANDUM

TO: BUD CATES

FROM: WINK WINKLER

SUBJECT: OCTOBER 12, 1999 PROJECT MEETING
BCI CONFERENCE ROOM, LAKELAND, FL

DATE: 03/06/00

CC: BILL HAWKINS, FDEP, HOMELAND
TIM KING, FFWCC
WALT REIGNER, BCI
CANDIE PEDERSEN, BCI
TOM SHAW, BCI

MINUTES FOR THE MEETING

October 12, 1999, 9:00 AM
BCI Conference Room, Lakeland, Florida

In Attendance : Bill Hawkins, FDEP
Tim King, FFWCC
Wayne Ericson, BCI
Walt Reigner, BCI
Wink Winkler, BCI
Tom Shaw, BCI
Vivienne Handy, Quest Ecology

A project meeting of the Upper Peace River Watershed restoration team was held on October 12, 1999. Listed below are the major topics of conversation and any action items identified.

- **Next Meeting Scheduled**

The next project meeting will be held in BCI's Lakeland office on November 16, 1999. A starting time for the meeting was not set.

- **Task 1.5.2A**

Surface Water and Ground Water Flow

Walt Reigner forwarded an e-mail request to USF requesting the status of their delinquent deliverables. To date, no reply has been received. Bill Hawkins and Walt will work jointly to draft a letter for Steve Partney formally requesting said information. Bill will invite Mr. Partney, Mark Ross of USF and Steve Richardson of FIPR to the next project meeting.

EPA Sample Analytical Data

BCI received a portion of the EPA analytical data for the former Tri-City Landfill during the meeting. Upon receipt of the remaining data, a summary of the data will be prepared for submittal.

- **Task 1.5.2B**

Revisions to the Landforms and Soils Maps were discussed. Bill and Tim King will make additional revisions prior to finalization of the maps.

- **Task 1.5.2C**

The vegetation and wildlife maps have been finalized. Copies of the maps will be submitted to FDEP within the next week.

- **Task 1.5.4B**

Bill, Tim and Tom Shaw met with Drs. Joan Rose and Valerie Harwood from USF to discuss their proposed coliform tracing study. Tom contacted Dr. Mark Tamplin from the University of Florida regarding his research involving DNA fingerprinting of coliform bacteria. Coliform research has been tabled until Bud Cates completes his consultation with FDEP water quality experts to develop a surface water sampling program for the TFMA. The previously proposed surface water sampling program and subsequent revisions will be formally submitted to FDEP later this week.

Wink Winkler has submitted the scope and budget for Tasks 1.11 through 1.17 to FDEP.

- **Task 1.6**

Work is progressing on completion of the GIS database. All relevant mapping and database files will be submitted to FDEP upon finalization of the remaining mapping tasks.

- **Task 1.7**

This task has not been initiated due to the lack of data and other deliverables from USF. BCI's final report will be generated with or without the USF information, but this task cannot be completed without it.

Recently Approved Tasks:

- **Task 1.11**

I.F. Rooks and Associates are finalizing the composite 1941 aerial photograph of the TFMA and the surrounding area and expect to have digital and paper copies of the map completed by the October 15^{th} due date.

- **Task 1.12**

Tom presented a spreadsheet listing the topographic maps currently maintained by BCI. The maps were reviewed and additional sources of topographic data were discussed, including the Williams Company, Keith & Schnars, and the City of Lakeland.

Task 1.13

Tom presented research indicating that as many as 70 potential flooding events may have occurred in the Upper Peace River Basin during the period from 1948 through 1995. The Lakeland Ledger archive retrieval service was contacted to provide a cost estimate for researching local newspaper articles during this period. A letter requesting flooding data will be submitted to the USGS, SWFWMD, Polk County and FEMA.

- **Task 1.14**

Wink requested that the deliverable date for this task be moved back to allow Walt time complete the data reduction and calculations.

- **Task 1.15**

Bill has not yet received a reply from the Williams Company or Bridgewater representatives regarding a meeting to discuss possible offsite water contributions to the TFMA. Task activities will be reinitiated after Walt completes Task 1.14.

Additional Action Items

- Invite FDEP water quality experts to next project meeting.
- BCI to furnish Bud Cates with map showing surface water flows and previous water sample analytical data.
- Bill to inquire as to whether TFMA surface water sample analytical data can be released to EPA consultant.
- Bill to check with Bud regarding a request to include a SWFWMD representative as an active participant in the project.
- BCI to prepare a table cross-referencing FDEP Task Numbers with BCI project accounting codes.

MEMORANDUM

To: Bud Cates
From: Wink Winkler
Subject: November 16, 1999 Meeting – Upper Peace River Restoration Project
Date: 12/15/99

CC: Bill Hawkins, FDEP, Homeland
Tim King, FFWCC
Walt Reigner, BCI
Candie Pedersen, BCI
Tom Shaw, BCI

Minutes for the Meeting
November 16, 1999, 8:30 AM
BCI Conference Room, Lakeland, Florida

In Attendance: Bud Cates, FDEP
Bill Hawkins, FDEP
Tim King, FFWCC
Danon Moxley, FFWCC
Wayne Ericson, BCI
Walt Reigner, BCI
Wink Winkler, BCI
Candie Pedersen, BCI
Tom Shaw, BCI
Doug Roberson, PBS&J
Elliot Grosch, PBS&J

A meeting of the Upper Peace River Restoration Project team was held on November 16, 1999. Listed below are the major topics of conversation and any action items identified.

Next Meeting Scheduled

The next project meeting will be held in BCI's Lakeland office on December 16, 1999 at 8:30 a.m.

Task 1.5.2A Determine Surface Water and Surficial Aquifer Characteristics

Hydrologic Modeling

Walt Reigner summarized the situation regarding the USF modeling data received to date. Bud Cates is now the FDEP contract manager for the USF modeling project. Bud asked Walt to review the data that has been submitted to the FDEP under this contract.

USF has determined there is not much interaction between the groundwater and surface water regimes, and has calibrated the model to surface water conditions. A new Ph.D. student at USF will work on the surface water modeling and Patrick Tara will concentrate on the integrated modeling for FIPR that will include calibration to surface water fluctuations. USF committed to the following schedule for deliverables.

- The existing conditions model will be completed by the week of November 15, 1999.
- The alternatives modeling will be completed by the week of December 13, 1999.

The data shows that the 15,000 acre-feet discharged from the TFMA is comprised of a 31 percent contribution from the west drain, a 56 percent contribution from the central drain, and a 13 percent contribution from the east drain.

EPA Environmental Assessments

BCI received a portion of the analytical data from the EPA's sample collection activities conducted at the former Tri-City landfill in May 1999. The remaining analytical data should be available before the next project meeting.

Danon Moxley received a request from the EPA to collect fish, soil, ground water and surface water samples from Tenoroc to analyze for radiation, reagents, etc. Danon will work with Bud to resolve the issue and report status in December.

Water Quality

Bill Hawkins mentioned that a surface water sampling plan needs to be in place before dewatering activities are initiated. Bud will get information from the FDEP in Tallahassee on the water quality testing program.

Task 1.5.2B Landforms and Soils Maps

The landforms and soils maps have been incorporated into the GIS database. This task is now complete.

Task 1.5.2C Vegetation and Wildlife Maps

The vegetation and wildlife maps have been incorporated into the GIS database. This task is now complete.

Task 1.6 GIS Database

The GIS database has been completed. Digital copies of the database have been delivered to Bill.

Task 1.7 Hydrologic Model Review

This task has not been initiated due to the lack of data and other deliverables from USF. BCI's final report will be generated with or without the USF information, but this task cannot be completed without it.

Recently Approved Tasks:

Task 1.12 Topographic Mapping and Aerial Photography

Tom Shaw presented a draft letter report summarizing the available historic and recent topographic data for the project area. The report provided rough estimates of costs for completing new aerial photography and topographic mapping. The two options discussed included mapping of the entire project area (Tenoroc, Williams and Bridgewater), and mapping of only those areas for which recent maps are not available. Walt stressed the need for accurate topographic information in upstream contributing areas to accurately define storage volumes. Accurate topography will also allow for the following.

- help determine attenuation
- provide a guide for use in dewatering efforts
- better define reclamation alternatives
- identify existing water levels in lakes, etc.

BCI will contact Sellon Miller to obtain additional topographic information for the Williams property, if available. BCI will then prepare a finalized task and budget for aerial photography and topographic mapping, which will be presented at the next project meeting.

Task 1.13 Research Flooding

The Lakeland Ledger Archive Retrieval Service (LARS) has initiated research on historical flooding events within the Saddle Creek and Upper Peace River basins.

Task 1.14 Calculate Available Stormwater Storage Capacity

Walt summarized the results of volumetric calculations used to estimate the available stormwater storage capacity of Lakes 2, 3, 4, 5 and Picnic Lake. Using 2H:1V slopes in Lakes 2, 3 and 4, and 6H:1V slopes in Lake 5 and Picnic Lake, the estimated maximum storage capacity is approximately 2,500 acre-feet. This estimated volume is roughly equivalent to the annual outflow from the Williams Company property.

Walt noted that the estimated maximum storage capacity was based on an assumption that each lake functions independently of the others. In actuality, several of the lakes are connected by various conveyances, such as culverts. The development of a more accurate estimate of storage capacity based on these interconnections will be addressed during future planning activities

Task 1.15 Coordination with Upstream Developers Regarding Surface Water Flow

Bill will contact Brian Sodt at the Central Florida Regional Planning Council to arrange a meeting with the Williams Company now that volumetric data from Task 1.14 is available.

Additional Action Items

BCI needs to rework the dewatering task to incorporate the following activities:

- Design of the dewatering plan;
- surface water monitoring; and,
- construction monitoring

MEMORANDUM

To: Bud Cates
From: Wink Winkler
Subject: December 16, 1999 Meeting – Upper Peace River Restoration Project
Date: 03/06/00

CC: Bill Hawkins, FDEP, Homeland
Tim King, FFWCC
Walt Reigner, BCI
Candie Pedersen, BCI
Tom Shaw, BCI

Minutes for the Meeting
December 16, 1999, 8:30 AM
BCI Conference Room, Lakeland, Florida

In Attendance: Bud Cates, FDEP
Bill Hawkins, FDEP
Tim King, FFWCC
Danon Moxley, FFWCC
Wayne Ericson, BCI
Wink Winkler, BCI
Walt Reigner, BCI
Tom Shaw, BCI
Melanie Blackford, BCI

A meeting of the Upper Peace River Restoration Project team was held on December 16, 1999. Listed below are the major topics of conversation and any action items identified.

Next Meeting Scheduled

The next project meeting will be held at the NRCS office in Gainesville, Florida on January 20, 1999 at 9:30 a.m.

Task 1.12 Topographic Mapping and Aerial Photography

Options for developing updated aerial photography and topographic mapping of the project area were discussed, using information and estimates provided by I.F. Rooks and Associates, Inc. A decision was made to develop a new task for these activities, utilizing the existing, recent mapping of particular portions of the study area (option 4).

The existing topographic data in digital format will be electronically merged with the mapping developed during this task, and the older map data will be digitized to tie elevation contours into the new maps.

Wayne Ericson and Walt Reigner suggested that two-foot contour intervals would provide adequate information for upcoming dewatering and planning efforts, however, final design of the selected wetland/surface water storage areas will require more detailed mapping (one-foot contour intervals recommended).

Deliverables

- Digital versions of aerial photographs and topographic maps, in formats selected by BCI.

- Blueline and mylar copies (one each) of aerial photographs at a scale of 1 inch equals 1,000 feet.

- Topography superimposed on top of aerial photographs at a scale of 1 inch equals 200 feet (One sheet per Section).

Task 1.19 Dewatering Planning and Monitoring in Program Areas BDN-T-04, BDN-T-05 and BDN-T-06

Wink Winkler presented a draft document detailing the proposed activities to be conducted as part of this task assignment. This task will be broken down into the following separate phases:

A Dewatering Plan Preparation, Submittal and Response
B Construction Monitoring
C Reditching Evaluation
D Reditching Monitoring
E Aerial Photography
F Dam Abandonment BDN-T-06

Water Quality

Bill recommended that the turbidity and dissolved oxygen (DO) levels of the discharge and receiving waters be monitored on a weekly basis during construction and reditching activities. The project team discussed the possible routing of impounded water in the dewatering areas to Lakes 4 and 6. Installation of a spillway or riprap channel was recommended to improve the DO levels of the impounded water prior to entering these lakes. Tim and/or Danon will discuss the issue of biological oxygen demand (BOD) with FFWCC water quality experts to see if potential problems could occur.

Bud Cates reported that he has met with Gail Sloane of the FDEP's Ambient Water Quality Monitoring Program to discuss site-specific water quality issues. Walt provided Bud with an updated version of a map showing the inflow and outflow data for the site. Bud will forward the map to Gail for review. Bill recommended that Gail talk with Dr. Joan Rose to see if FDEP's lab could do some of the analyses for her proposed coliform research.

Tim King reported that the EPA will be at Tenoroc on February 14, 2000 to collect fish, soil, sediment and water samples for laboratory analysis. The sampling program is not expected to cause any delays to the activities currently planned as part of this restoration project.

Earthmoving and Revegetation Contractual Issues

Bud and Bill have determined that the earthmoving contract needs to be processed through standard public notice bidding. The revegetation contract can be awarded without bidding. Currently, the FDEP Contracts office is reviewing bid specifications for the earthmoving contract, and the revegetation contract is being routed through several FDEP administrators for approval.

Surveying

The project team discussed the necessity for general, as-needed surveying services during the course of construction activities. BCI will develop a task assignment for these services, which will be billed on a half-day per trip basis. The task assignment will be structured to allow for up to twenty (20) separate trips.

Task 1.5.2A Determine Surface Water and Surficial Aquifer Characteristics

Bud, Bill and Walt are scheduled to meet with Dr. Mark Ross and Patrick Tara of USF on December 20, 1999 to discuss the current status of the their FDEP hydrologic modeling project. USF has been notified that they are to provide all currently available deliverables, and be prepared to discuss the status of those deliverables that are due but not completed. USF is expected to provide the FDEP with a calibrated HSPF model and maps, representing background conditions for surface water only.

Based on the results of this meeting, the USF contract may be terminated or rewritten to allow the remaining work to be completed under the supervision of BCI. The FDEP will determine the appropriate course of action. Tim expressed some concern that FIPR's integrated surface and ground water model is not planned to be utilized for this project.

Walt presented a revised map showing surface water inflows and outflows, with flow paths and percent contributions for the east, central, and west drains. Danon Moxley reported that the FFWCC has bathymetric maps of Lakes 2, 3 and other smaller lakes at the Tenoroc site. These maps may be used to refine the preliminary estimates of available storage volume, which were presented during the November 1999 project meeting.

Task 1.15 Coordination with Upstream Developers Regarding Surface Water Flow

Bill spoke with Brian Sodt of the Central Florida Regional Planning Council, and he is prepared to discuss potential surface water contributions to the Tenoroc site from the adjoining properties (the Williams and Bridgewater properties). No responses have been received from George Shahadi (Williams Company) or M.C. Davis (Bridgewater's engineering representative) with regard to these potential surface water contributions.

Miscellaneous Items

Tim reported that the FFWCC has received a letter of commitment from FDOT to build a wildlife underpass beneath Interstate 4.

Action Items

Based on discussions and decisions made during this meeting, BCI will finalize new task assignments for the dewatering, aerial photography, and surveying activities.

MEMORANDUM

To: Bud Cates
From: Wink Winkler
Subject: January 20, 2000 Meeting – Upper Peace River Restoration Project
Date: 03/06/00

CC: Bill Hawkins, FDEP, Homeland
Tim King, FFWCC
Mark Brown, SWFWMD
Walt Reigner, BCI
Candie Pedersen, BCI
Tom Shaw, BCI

Minutes for the Meeting
January 20, 2000, 9:30 AM
Main Conference Room
USDA-NRCS State Office Building, Gainesville, Florida

In Attendance: Bud Cates, FDEP
Bill Hawkins, FDEP
Tim King, FFWCC
Mark Brown, SWFWMD
Wink Winkler, BCI
Walt Reigner, BCI
Tom Shaw, BCI

A meeting of the Upper Peace River Restoration Project team was held on January 20, 2000. Listed below are the major topics of conversation and any action items identified.

Next Two Meetings Scheduled

The next project meeting will be held at the USDA-NRCS office in Gainesville, Florida on February 17, 2000 at 10:00 a.m. The subsequent project meeting will be held at BCI's Lakeland office on March 16, 2000.

Task 1.5.2A Determine Surface Water and Surficial Aquifer Characteristics

Tom Shaw presented a summary of the draft sample analytical data from the EPA Region IV Superfund Technical Assessment and Response Team's (START's) May 1999 investigation at the Tri-City Landfill (TCL). The sample concentration of several constituents exceeded the maximum values listed in various State regulatory and guidance criteria, including acetone, arsenic, benzene, beryllium, polychlorinated biphenyls (PCBs), and Radium-226. To avoid any unnecessary speculation as to the EPA's forthcoming decision regarding future activities at the TCL, the START Project Manager has requested that the data not be publicly distributed until their final report is submitted in March or April 2000.

The project team discussed possible methodologies for obtaining data necessary to develop a map illustrating Surficial Aquifer flow patterns at the TFMA. Walt reported that USF should have a database of historical Surficial Aquifer water elevations that were collected as part of their hydrology study. The due date for the remaining deliverables for this task was set for February 15, 2000.

Task 1.7 Hydrological Modeling and Mapping

Bud Cates, Bill Hawkins and Walt Reigner met with Dr. Mark Ross and Patrick Tara of USF on December 20, 1999 to discuss the current status of their FDEP hydrologic modeling project. USF promised delivery of the existing conditions model by January 1, 2000. Walt received the model on January 20, and is preparing to conduct a review of the data. Walt recommended that USF's final deliverable for the FDEP project should be to provide the results of floodplain modeling for the existing conditions. Subsequent hydrologic modeling for the project should be completed under the supervision of BCI. Due to the delays caused by USF, the project team decided to extend the completion date for the hydrological modeling review and write-up until April 1, 2000. The results of the review will be incorporated into the draft report, discussed below.

Tasks 1.8 - 1.10 Committee Presentation, Draft Report and Final Report

The project team discussed a proposed schedule for preparation and submittal of the draft report and final reports, and the timing of those submittals in relation to the upcoming UPREPC Meeting. The proposed schedule is shown in the table below.

Task	Date	Activity
Draft Report	March 1, 2000	Submit preliminary draft to project team for review
	March 16, 2000	Discuss comments at project team meeting
	March 16-31, 2000	Address comments and complete revisions
	April 1, 2000	Incorporate hydrologic modeling results into final draft report
	April 3, 2000	Submit final draft report to selection committee
	April 15, 2000	Present summary of draft report at UPREPC meeting
	May 8-31, 2000	Address UPREPC comments and complete revisions
Final Report	June 1, 2000	Submit final report to FDEP

Task 1.12 Topographic Mapping and Aerial Photography

This task was completed in November 1999. The project team discussed revisions to the area selected for the proposed aerial photography and topographic mapping. Wink Winkler presented several draft task assignments, one of which details the activities and costs associated with completing this proposed work. Bill reported that FDEP has obtained a digital copy of the Williams DRI topography. This data can be incorporated into the topographic information collected as part of the new task assignment.

Task 1.13 Flooding Research

Tom presented a draft report that was prepared to document historical flooding problems in the Upper Peace River basin. The project team discussed the potential for incorporating the available data into the existing conditions model. The draft report text and other deliverables required for completion of this task will be submitted on or before February 15, 2000.

Proposed New Task Assignments

Wink distributed draft copies of several proposed task assignments for team member review. The new task assignments are designed to address the following activities and issues:

- Aerial Photography and Topographic Mapping (Proposed Task No. 1.18)
- USF Hydrologic Data Review (Proposed Task No. 1.19)
- Upper Saddle Creek Flow Maps (Proposed Task No. 1.20)
- Research Eastern Ditch (Proposed Task No. 1.21)
- Surveying Services (Proposed Task No. 1.22)
- Dewatering Planning and Monitoring in Reclamation Program Areas BDN-T-04 and BDN-T-06

Additional Discussion

Tim King expressed his concern that the City of Auburndale will be prepared to begin discharging treated wastewater at their disposal area east of Tenoroc by October 2000. The project team discussed the possibility of expediting the initiation of reclamation activities in program areas BDN-T-07 and BDN-T-E. Bud reported that it should be possible to proceed at a faster pace by funding the work through the non-mandatory reclamation program.

Bill reported that a pre bid meeting would be held at Tenoroc on January 22, 2000 for contractors interested in bidding on the earthmoving contract. Pre-qualified bid packages have been distributed to McDonald Construction, Kimmins Contracting, Kovacs Brothers, and Bulger Contracting.

Action Items

- Bud Cates will call Mark Ross to request cost breakdown for his budget, list of structures and the status of downstream HECRAS modeling.
- Tom Shaw will talk to Harry Hall, David Bunch, or Al Belloto regarding flooding.
- Tom Shaw will incorporate information in Lakeland Public Library Special Collection regarding flooding.
- Bill Hawkins will determine status of Williams Company permit submittals.
- Tim King will find out the details/timing of the Auburndale permit.
- Bud Cates will follow-up and determine funding status of reclamation program areas BDN-T-07 and BDN-T-E.

MEMORANDUM

To: Bud Cates
From: Wink Winkler
Subject: February 17, 2000 Meeting – Upper Peace River Restoration Project
Date: 03/06/00

CC: Bill Hawkins, FDEP, Homeland
Tim King, FFWCC
Mark Brown, SWFWMD
Walt Reigner, BCI
Tom Shaw, BCI

Minutes for the Meeting
February 17, 2000, 10:00 AM
Main Conference Room
USDA-NRCS State Office Building, Gainesville, Florida

In Attendance: Bud Cates, FDEP
Bill Hawkins, FDEP
Tim King, FFWCC
Mark Brown, SWFWMD
Wink Winkler, BCI
Walt Reigner, BCI
Tom Shaw, BCI

A meeting of the Upper Peace River Restoration Project team was held on January 20, 2000. Listed below are the major topics of conversation and any action items identified.

Next Meeting Schedule

The next meeting will be on March 16 in Lakeland at Tenoroc if the weather is dry and at BCI if it rains.

General discussion

Project team needs to discuss with Jeff Spence issues Polk County has with storing water in TFMA, FEMA mapping needs, Canoy Drive, etc. BCI will remind Polk County that they are welcome to attend all meetings. Also, need to find out what the County is proposing in Saddle Creek and make sure we coordinate efforts. Get video of Saddle Creek flooding.

The project team needs to push ahead in talking to Williams DRI consultants regarding maximizing discharge volumes to TFMA.

Task 1.5.2A Determine Surface Water and Surficial Aquifer Characteristics

Surficial groundwater flow direction map should be refined to smooth the water level contour lines. The flow distribution information should be sent to Tim and Bud.

Task 1.13 Flooding

Information is somewhat sparse and does not provide a lot of information regarding past flooding in the Saddle Creek area. Get video of Saddle Creek flooding. SWFWMD and ACOE have requested this information. In report, explain what has been done to define past flooding impacts. Also, make recommendations for improvement – complaint tracking, water level monitoring, etc. Consider perception of public WRT TFMA. The report will need to address the fact that there are many ongoing proposed activities that would influence flood levels in Saddle Creek. Include in the report any interviews we conducted with various people regarding historic flooding in Saddle Creek.

Task 1.7 Hydro Model Review

BCI will complete review USF's hydraulic model (85% complete now), complete punch list and get back with Bud. The review will look at how it would be used to update FEMA maps.

Task 1.7 Hydro Model Review

Bulger Construction has been selected as the earthmoving contractor and contract preparation is ongoing.

Task 1.26

Consider evaluating the percent of flow attributed to TFMA at various locations within Saddle Creek downstream of Tenoroc – develop summary table. Discuss details of steady state vs. dynamic flood routing – timing aspects – K&S activities, etc.

Task 1.9 Draft Report

We will need to explain why Alafia funding might be better spent in the Tenoroc area. Some issues are economy of scale, scattering of forces, initiating a project in that basin from scratch, finding suitable state-owned property for the mitigation site, etc.

Action Items

Walt Reigner will meet with Polk County to discuss project-related issues and invite them to participate more actively in the project.

Tom Shaw will make recommended changes in the groundwater flow direction map.

UPREPC Member Directory
Updated March 23, 2000

First Name	Last Name	Organization Name	Address	City	State	Zip Code	WorkPhone	FaxNumber
Raymond	Ashe	FL Dept of Transportation	605 Suwanne Street, MS 98	Tallahassee	FL	32399-0450	(850) 488-4671	(850) 487-4340
Merle	Bishop	Polk County Commissioner Planning Di	P O Box 9005	Bartow	FL	33831-9005		
Al	Bellotto	Al Bellotto, Inc.	3905 Winter Lake Rd	Lakeland	FL	33803	(941) 665-1315	
Jack P.	Brandon	Peterson & Myers PA	Post Office Box 1079	Lake Wales	FL	33859-1079		
Mark	Brown	SW FL Water Mgmt Dist	2379 Broad Street	Brooksville	FL	34609-6899		
Dr. Mark	Brown	Univ of FL Center for Wetlands	1 Phelps Laboratory	Gainesville	FL	32611	(904) 392-2424	(904) 392-3624
David F.	Bunch	Hauger-Bunch Inc Realtors	Post Office Box 3648	Lakeland	FL	33802-3648	(914) 682-6147	(914) 686-8396
David	Carpenter	SW FL Water Mgmt Dist	170 Century Blvd	Bartow	FL	33830-7700	(941) 534-1448	(941) 534-7058
Richard	Coleman	Sierra Club	203 Lake Pansy	Winter Haven	FL	33881	(941) 956-3771	(941) 956-3771
Neil	Combee	Polk County Commissioner	P O Box 9005 Drawer BCO1	Bartow	FL	33831-9005		
Jeremy	Craft	Craft Environmental Consulting	1211 Spring Haven	Tallahassee	FL	32311	(850) 942-0920	(850) 942-2432
Rick	Dantzler	Frost and Saunders, P.A.	395 South Central Avenue	Bartow	FL	33830		
M.C.	Davis		151 Regions Way Suite 2C	Destin	FL	32541		
Rep. Paula	Dockery	Representative, District 64	P O Drawer 2395	Lakeland	FL	33806		
John	Dickson, Acting Director	Utility Waste Water	1300 Recker Highway	Auburndale	FL	33823		
Marlene	Duffy-Young	Polk County Commissioner	P O Box 9005 Drawer BCO1	Bartow	FL	33831-9005		
Steven A.	Dutch, P.E.	Chastain Skillman, Inc.	4705 Old Highway 37	Lakeland	FL	33807-5710	(941) 646-1402	(941) 647-3806
Allen	Egbert, Ex Dir	FL Fish & Wildlife Consv. Comm	620 South Meridian St	Tallahassee	FL	32399-1600		
Wayne A.	Ericson, P.E.	BCI, Engineers & Scientists, Inc.	Post Office Box 5467	Lakeland	FL	33807	(941) 667-2345	(941) 667-2662
Dori	Faulkner	Live Oak Consulting Group, Inc.	Post Office Box 1917	Valrico	FL	33595	(813) 677-9340	
Sid	Flannery	SW FL Water Mgmt Dist	2379 Broad St	Brooksville	FL	34609-6899	(904) 796-7211	(904) 754-6885
Charles	Geanangel	Audubon	330 East Swoope	Lake Alfred	FL	33850	(941) 956-4928	
Bob	Goodrich	IMC-Agrico Company	P O Box 2000	Mulberry	FL	33860		
Deborah	Getzoff	FL Dept of Env Protection	3804 Coconut Palm Dr	Tampa	FL	33618-8318	(813) 744-6084	(813) 744-6084
Robert	Green, City Mgr	City of Auburndale	Post Office Box 186	Auburndale	FL	33823	(941) 965-5500	
Vivienne	Handy	Quest Ecology, Inc.	3208 North Rome Avenue	Tampa	FL	33607	(813) 258-5589	(813) 258-4556
Scott	Hardin	FL Fish & Wildlife Consv. Comm	620 South Meridian St	Tallahassee	FL	32399-1600	(850) 488-4068	
Nancy	Hedrick	Polk County Commissioner	P O Box 9005 Drawer BCO1	Bartow	FL	33831-9005		
Walter E.	Holm, Jr.		511 Farmer Brown Rd	Lakeland	FL	33801		
Clark	Hull	SW FL Water Mgmt Dist	2379 Broad Street	Brooksville	FL	34609-6899	(352) 796-7211	(904) 544-2328
Leroy	Irwin	FL Dept of Transportation	605 Suwannee St MS 37	Tallahassee	FL	32399-0450		
Ron	Johnson	E.R. Jahna Industries, Inc.	P O Box 840	Lake Wales	FL	33859-0840		
C. Fred	Jones		504 Arneson Avenue	Auburndale	FL	33823		
Joy	Jones	FL Dept of Transportation	Post Office Box 1249	Bartow	FL	33830	(941) 519-2380	(941) 519-1922
Jim	Keene, Co. Admin	Polk County Commissioner	Post Office Bocx 60	Bartow	FL	33830		
Tim	King	FL Fish & Wildlife Consv. Comm	3829 Tenoroc Mine Rd	Lakeland	FL	33805	(941) 499-2421	(941) 499-2692
Senator John	Laurent	District 17	250 North Clark Ave	Bartow	FL	33830-4804		

R Douglas	Leonard	Central FL Regional Planning Council	Post Office Box 2089	Bartow	FL	33830		
Janet	Llewellyn	DEP/Div. of Water Resource Mgmt	2600 Blairstone Road	Tallahassee	FL	32301	(850) 921-9905	
Bill	Lewelling	USGS	4710 Eisenhower Blvd. Suite B-5	Tampa	FL	33634	(813) 884-9336	
Bill	Lynn	FL Dept of Transportation	1203 Governors Sq Blvd, Ste 400	Tallahassee	FL	32301	(850) 942-8587	(850) 942-8295
Danon	Moxley	FL Fish & Wildlife Consv. Comm	3829 Tenoroc Mine Rd	Lakeland	FL	33805	(941) 499-2421	(941) 499-2692
Kenneth	Murray	USDA Nat Res Conservation Srvc	Post Office Box 141510	Gainesville	FL	32614	(352) 338-9509	(352) 338-9578
Paul C.	Myers	Applied Aquatic Management, Inc.	Post Office Box 1437	Eagle Lake	FL	33839	(941) 533-8882	
Mike	Nowicki	US Army Corps of Engineers	Post Office Box 4970	Jacksonville	FL	32232	(904) 232-2171	(904) 232-1684
Felipe L	Olivera MSE	Chastain Skillman, Inc	4705 Old Highway 37	Lakeland	FL	33807-5710	(941) 646-1402	(941) 647-3806
Bruce	Parker	Polk County Commissioner	P O Box 9005 Drawer BCO1	Bartow	FL	33831-9008		
Michael	Perry	SW FL Water Mgmt Dist	7601 Highway 301 North	Tampa	FL	33637	(813) 985-2481	(813) 987-6747
Mary Lou	Rajchel	Florida Phosphate Council	215 South Monroe St, Suite 703	Tallahassee	FL	32301		
Walt	Reigner	BCI, Engineers & Scientists, Inc.	Post Office Box 5467	Lakeland	FL	33807	(941) 667-2345	(941) 667-2662
Marsha	Rickman	DEP/Office of Greenways & Trails	3900 Commonwealth Blvd	Tallahassee	FL	32399-3000		
Steven	Richardson	FL Institute of Phosphate Research	1855 West Main St	Bartow	FL	33830-7718	(941) 534-7160	(941) 534-7165
Doug	Robison	PBS&J, Inc.	5300 West Cypress, #300	Tampa	FL	33607	(813) 877-7275	(813) 287-1745
Lou	Roeder	Old Florida Plantation Ltd	7414 Sparkling Lake Road	Orlando	FL	32819		
I. F.	Rooks	I. F. Rooks & Associates	106 NW Drane Street	Plant City	FL	33566	(813) 752-2113	
Mark	Ross	University of South FL	END118 4202 E Fowler Ave	Tampa	FL	33602	(813) 974-5836	(813) 974-5835
John & Marian	Ryan	Polk Sierra Group	P O Box 773	Winter Haven	FL	33882		
Sandra	Russo	University of Florida	Post Office Box 11325	Gainesville	FL	32611-3225	(352) 392-6783	(352) 392-8379
Paul	Schmidt	PBS&J, Inc.	7785 Baymeadows Way Ste 202	Jacksonville	FL	32256	(904) 367-8683	(904) 733-6621
George	Shahadi	Williams Company	Post Office Box 2400	Tulsa	OK	74172	(918) 588-2857	(918) 588-2296
Gaye	Sharpe	Polk Co Nat Resources Div	4177 Ben Durrance Rd	Bartow	FL	33830	(941) 534-7377	(941) 534-7374
Janet	Shearer	Polk County Commissioner	P O Box 9005 Drawer BCO1	Bartow	FL	33831-9008		
Ron	Silver	US Army Corps of Engineers	Post Office Box 4970	Jacksonville	FL	32232		
Brian	Sodt	Central FL Regional Planning Council	Post Office Box 2089	Bartow	FL	33831	(941) 534-7130	(941) 534-7138
Jeffrey	Spence	Polk Co Natural Resources Div	4177 Ben Durrance Rd	Bartow	FL	33830	(941) 534-7377	(941) 534-7374
Steve	Thompson	FL Dept of Env Protection	170 Century Blvd	Bartow	FL	33830-7700	(941) 534-1448	(941) 534-7058
Dawn	Turner	SW FL Water Mgmt Dist	7601 Highway 301 North	Tampa	FL	33805	(813) 499-2421	
Sonny	Vergara	SW FL Water Mgmt Dist	2379 Broad Street	Brooksville	FL	34609-6899		
Randy	Wilkinson	Polk County Commissioner	P O Box 9005 Drawer BCO1	Bartow	FL	33831-9008		
Wink	Winkler	BCI, Engineers & Scientists, Inc.	Post Office Box 5467	Lakeland	FL	33807	(941) 667-2345	
Jack	Woodard	DEP/Bureau of Mine Reclamation	2051 East Dirac Drive	Tallahassee	FL	32310-3760	(850) 488-8217	
Marlene	Young	Polk County Commissioner	P O Box 9005 Drawer BCO1	Bartow	FL	33831-9008		
David	Zeigler	FL Dept of Transportation	605 Suwannee Street MS 37	Tallahassee	FL	32399-0405	(850) 488-2911	(850) 922-7292
							Updated 03/23/00	

UPPER PEACE RIVER RESTORATION PROJECT

AGENCY CONCERNS

AGENCY CONCERN	USACOE	FGFWFC	SWFWMD	POLK COUNTY
Increase downstream water quantity		✓	✓	✓
Decrease flooding downstream through additional storage and level management		✓	✓	✓
Document historical flooding within the Saddle Creek basin			✓	
Maintain downstream water quality during reclamation				✓
Improve long-term downstream water quality				✓
Mitigate for wetland losses & meet permit criteria	✓		✓	
Identification and protection of existing habitat	✓	✓		
Increase recreational opportunities		✓		
Offsite property acquisitions or easements		✓	✓	✓
Mitigate for some wetlands on clay settling areas		✓		
Additional littoral zones in fishing lakes		✓		
Replace old structures in order to manage water levels		✓		
No conversion of lakes to wetlands		✓		
Determine upstream flow contributions and potential alterations to flows		✓	✓	✓
Long term Exotic vegetation management plan needed		✓		
Concern for public safety in active work areas		✓		

MEMORANDUM

TO: BILL HAWKINS

FROM: CANDIE PEDERSEN

SUBJECT: JUNE 2, 1999 MEETING AT TENOROC, TASK 1.5.4 CHUCK GEANANGEL(LAKE REGION AUDUBON) CONCERNS

DATE: 03/03/00

CC: CORNELIS WINKLER III, P.G.

MINUTES TO THE MEETING

JUNE 2, 1999, 1:00 PM
Tenoroc Fish Management Picnic Table with Lake region Audubon

IN ATTENDANCE: Chuck Geanangel, Lake Region Audubon
Tim King, FGFWFC
Sue Muntner, Quest Ecology
Candie Pedersen, BCI

As part of Task 1.5.4, a meeting was conducted with Mr. Chuck Geanangel, Lake Region Audubon Society, as an interested third party for determining the specific concerns and perspectives of that group regarding reclamation and mitigation activities for the Saddle Creek basin area.

The following paragraphs summarize the viewpoints of Mr. Geanangel and what considerations are appropriate to the goals of this project:

- Mr. Geanangel identified known rookeries or areas at Tenoroc that are known to support seasonal bird populations and provided a 1984 bird survey. Protecting those populations should be a priority of the planning process. See attached map for general locations and descriptions. Mr. Geanangel will assist in identifying "no work zones or restricted work zones" that fall within the project boundary.
- He supports changes that would add more water to Tenoroc without drastically altering the landscape and perhaps destroying important habitat.
- It would not be acceptable to herbicide large tracts for the purpose of exotic species eradication since there is no long-term plan to manage exotic species. It would be preferable to enhance some areas with additional planting and a minimal amount of disturbance
- Would like to see creation of seasonal mud flats for shore birds as part of the reclamation plan.

MEMORANDUM

TO: BILL HAWKINS

FROM: CANDIE PEDERSEN

SUBJECT: APRIL 27, 1999 MEETING AT TENOROC, TASK 1.5.4 FGFWFC CONCERNS

DATE: 03/03/00

CC: CORNELIS WINKLER III, P.G.

MINUTES TO THE MEETING

APRIL 27, 1999, 1:30 PM
Tenoroc Fish Management Office with FGFWFC

IN ATTENDANCE: Danon Moxley, FGFWFC
Tim King, FGFWFC
Ray Watson, FGFWFC
Bill Hawkins, DEP
Candie Pedersen, BCI

As part of Task 1.5.4, a meeting was conducted with FGFWFC for the purpose of determining the specific concerns and perspectives of that agency regarding reclamation and mitigation activities for the Saddle Creek basin area. Mr. Hawkins initiated the meeting by restating the goals of this project: to restore the hydrologic and ecological connections to the Upper Peace River Watershed, and to construct 87.24 acres of forested wetlands and 37.28 acres of herbaceous wetlands. Mr. Hawkins also defined the work area to be within the boundaries of the Tenoroc Fish Management Area while recognizing that there are changes currently proposed outside those boundaries that could influence water routing and total volumes.

The following paragraphs summarize the viewpoints of the FGFWFC and what considerations are appropriate to the goals of this project:

- Chronic low flows and concomitant poor water quality to the Peace River could be ameliorated through restoration of minimum flows from the Saddle Creek basin using Tenoroc Park lakes as storage basins, and constructed or enhanced wetlands as water treatment areas.
- The ability to manage water levels within the park is a concern because the structures are either very old and not safe or are nonexistent. FGFWFC would provide design recommendations and manage and maintain the structures. They would work with SWFWMD on an overall management plan for the water if structures are replaced or constructed.
- It would not be acceptable to convert fishing lakes into wetlands. A preference would be to construct wetlands on clay ponds and areas between the lakes and clay ponds. The clay settling areas are not presently valuable to Tenoroc for recreational usage; they are remote and would provide better habitat if a water balance could be maintained.

- It would be preferable to have additional littoral zone in the fishing lakes. The extent and configuration of littoral zones will depend upon the lakes use for water storage and expected water level fluctuations.

- There is a need to address and perhaps alter offsite flows to the extent that all parties are agreeable and that Tenoroc can receive and store additional inflow.

- One recommendation is to replace nuisance vegetation through time in order to lessen the impacts to wildlife currently utilizing the habitat the exotics provide, i.e. migratory songbirds and brazilian pepper. Additionally, any control of nuisance or exotic vegetation will be a long-term management investment that current Tenoroc staff cannot budget resources for at this time.

- Identification and protection of existing mature native vegetation and wildlife populations from impacts during the reclamation process should be a priority of the planning process. FGFWFC, DEP and BCI will work together in identifying "no work zones or restricted work zones"that fall within the project boundary.

- Because Tenoroc is a public access recreational facility there is some concern for public safety in active work areas. BCI will coordinate with FGFWFC staff regarding schedules and work zones. FGFWFC staff will post and close access to work areas as necessary.

- A desirable outcome of the reclamation/mitigation would be to open currently unusable areas to public use, including education.

MEMORANDUM

TO: BILL HAWKINS

FROM: CANDIE PEDERSEN

SUBJECT: APRIL 30, 1999 MEETING AT POLK COUNTY NATURAL RESOURCES AND DRAINAGE, TASK 1.5.4 POLK COUNTY CONCERNS

DATE: 03/03/00

CC: CORNELIS WINKLER III, P.G.

MINUTES TO THE MEETING

APRIL 30, 1999, 10:00 AM
Polk County Natural Resources & Drainage

IN ATTENDANCE:
Jeff Spence, Polk County
Robert Wiseman, Polk County
Bill Hawkins, DEP
Wayne Ericson, BCI
Candie Pedersen, BCI
Sue Woodbery, Keith & Schnars
Mike Phelps, Keith & Schnars

As part of Task 1.5.4, a meeting was conducted with Polk County Natural Resources and Drainage Divivsion for the purpose of determining the specific concerns and perspectives of that agency regarding reclamation and mitigation activities for the Saddle Creek basin area. Mr. Hawkins initiated the meeting by restating the goals of this project: to restore the hydrologic and ecological connections to the Upper Peace River Watershed, and to construct 87.24 acres of forested wetlands and 37.28 acres of herbaceous wetlands. Mr. Hawkins also defined the work area to be within the boundaries of the Tenoroc Fish Management Area while recognizing that there are changes currently proposed outside those boundaries that could influence water routing and total volumes.

Keith and Schnars consulting firm is currently mapping the Saddle Creek basin and will provide relevant information to BCI as it is collected. The mapping effort will include flow paths, structures, blockages, and confluences from Saddle Creek to Peace Creek in GIS point format. Wayne Ericson provided water routing background information on previously planned and/or completed reclamation projects within the basin.

Polk County has offered to assist with additional fecal coliform samplings. BCI will schedule with Robert Wiseman, P.E., Environmental Management Engineer with Polk County Natural Resources and Drainage Division.

The following paragraphs summarize the viewpoints of Polk County and what considerations are appropriate to the goals of this project:

- Downstream flooding is a major concern. "More water is not a problem, and more water we would support. Just don't add more water all at once." The quote brings to issue lowering peak discharges while encouraging additional mass flow to Saddle Creek and ultimately to Peace River. Target areas for flood reduction are: south of Tenoroc in Section 2 and west of SC-01, K-ville, Cabbage Branch, due south of Saddle Creek park, and the Lake Bonnie connection to Lake Parker.

- Water quality discharges from the work site are also a major concern to Polk County. There are three known possibilities for poor water quality discharges off the site: Auburndale wastewater treatment plant, Borden landfill, and turbid water discharge from active reclamation sites. Construction of onsite or offsite sedimentation ponds could be accomplished.

- A question was posed regarding use of the available monies, either Nonmandatory Trust funds or DOT Wetland Mitigation funds. "Is purchase of properties or easement acquisitions an option if the property is crucial to address some of the drainage concerns?" There is the potential for offsite property to have a major influence, i.e. a constriction, that is controlled by other property owners. A purchase or easement may allow access and manipulation to the benefit of this project.

MEMORANDUM

TO: BILL HAWKINS

FROM: CANDIE PEDERSEN

SUBJECT: MAY 13, 1999 MEETING AT SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT BARTOW OFFICE, TASK 1.5.4 SWFWMD AND U.S. ACOE CONCERNS

DATE: 03/03/00

CC: CORNELIS WINKLER III, P.G.

MINUTES TO THE MEETING

MAY 13, 1999, 9:00 AM
Southwest Florida Water Management District Bartow Office

IN ATTENDANCE:
David Carpenter, SWFWMD
Bud Cates, DEP (on conference call)
Mike Nowicki, U.S. Army Corps of Engineers (on conference call)
Bill Hawkins, DEP
Candie Pedersen, BCI

As part of Task 1.5.4, a meeting was conducted with SWFWMD and ACOE for the purpose of determining the specific concerns and perspectives of those agencies regarding reclamation and mitigation activities for the Saddle Creek basin area. It should be noted here that these two agencies are signatories of the MOU and carry a slightly different outlook to this meeting.

Mr. Cates initiated the meeting by discussing the current status of the project. In addition, he discussed planning activities within the watershed including Bridgewater who has an approved DRI, and the east one-half of the Williams Company property that is in the pre-application phase. Mr. Hawkins provided some background information on the purpose of this meeting and narrated some of the concerns and desires of previously interviewed Florida Game and Freshwater Fish Commission and Polk County. He stated the need to discuss permitting for possible future impacts at the project site during this planning phase.

The following paragraphs summarize the viewpoints of the SWFWMD and what considerations are appropriate to the goals of this project:

- The reclaimed habitat types must meet the existing permit criteria when mitigating for the Parkway wetlands.
- Mr. Carpenter is concerned about flooding problems in the Upper Saddle Creek basin. While the District would like to get more total flow downstream to Lake Hancock and ultimately to Charlotte Harbor, he emphasized that the Upper Saddle Creek Restoration Project must not increase peak flows in the Upper Saddle Creek basin.

- Mr. Carpenter discussed alternative methods of addressing permit issues for the project. The District's standard permitting process would insure that issues such as downstream flooding and public notice were adequately addressed. However, he also noted that the Upper Saddle Creek Restoration Project is clearly an environmental restoration or enhancement project specifically addressed in a Memorandum of Understanding signed by the District, along with the U.S. Army corps of Engineers, the Florida department of Environmental protection (FDEP), the Florida Department of transportation (FDOT), and the Florida Game and Freshwater Fish Commission (FGFWFC). As such, it appears the project could proceed under a Notice General Permit 40D400.485, if it meets the specific criteria of that permit, possibly, Paragraph (2)(b). The FDEP would need to decide if the project meets all the criteria. The scheduled UPREPC meeting before November 1, 1999, could be appropriately advertised to qualify as a public meeting. Mr. Carpenter stated that the Notice General Permit approach would be acceptable to the District as long as engineering calculations of flows are signed and sealed by a registered engineer, public meetings are properly noticed, etc. Mr. Carpenter further stated that he would advise Mr. Cates if there was need to brief or make a presentation to the Basin Board or the full District Board in the future.

- An interest was expressed in the possibility of floodplain acquisition downstream since the area between Saddle Creek and Lake Hancock is not currently on any list of environmentally sensitive land acquisition or preservation. Presently a site is under consideration for acquisition as mitigation. The property is a 32-acre wetland in the floodplain off Farmer Brown Road and adjacent to property owned by Florida Audubon, who may accept the property.

- Would like to see some documentation on the historical flooding problems within the Saddle Creek basin.

The following paragraphs summarize the viewpoints of the ACOE and what considerations are appropriate to the goals of this project:

- Mr. Nowicki stated that since the project is required as mitigation for the Polk Parkway, there may not need to be a separate permit because it is not an Agenda Item and may be self--mitigating. As part of the review process for the Tenoroc project, the plan could be treated as the permit.
- Any additional wetlands added to the project in the future would have to use the Wetland Functional Analysis.

1.0 REPORTS

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2.0 LETTERS

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4.0 AERIAL PHOTOGRAPHS

Aero-Fax Corporation, January 11, 1977. Northern Portion of Tenoroc. [1]

Aero-Fax Corporation, January 11, 1977. Northwestern Portion of Tenoroc. [1]

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Author unknown, November 30, 1971. Northern Portion of Tenoroc, Photo Number 1-129. [1]

Author unknown, November 30, 1971. Southwestern Portion of Tenoroc, Photo Number 1-130. [1]

Author unknown, November 30, 1971. Western Portion of Tenoroc, Photo Number 1-160. [1]

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4.0 AERIAL PHOTOGRAPHS (continued)

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4.0 AERIAL PHOTOGRAPHS (continued)

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4.0 AERIAL PHOTOGRAPHS (continued)

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Southwest Florida Water Management District (SWFWMD), March 4, 1998. Color Infrared, Tenoroc and Surrounding Area, SWFWMD ID – Task 2, Roll 2, Flight Line 07, Exposure 03. [1]

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4.0 AERIAL PHOTOGRAPHS (continued)

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USDA-SCS, March 5, 1941. Southeastern Portion of Tenoroc and Tri-City Landfill (prior to mining and landfilling), Photo Number CTU-11B-78. [1]

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USDA-SCS, March 5, 1941. Composite of Aerial Photographs, Northwestern Polk County.

USDA-SCS, 1974. Northeastern Portion of Tenoroc, Sheet Number 39, 1990 Soil Survey of Polk County, Florida. [1]

USDA-SCS, 1974. Northwestern Portion of Tenoroc, Sheet Number 38, 1990 Soil Survey of Polk County, Florida. [1]

USDA-SCS, 1974. Southeastern Portion of Tenoroc, Sheet Number 46, 1990 Soil Survey of Polk County, Florida. [1]

USDA-SCS, 1974. Southwestern Portion of Tenoroc, Sheet Number 45, 1990 Soil Survey of Polk County, Florida. [1]

Williams Acquisition Company, February 9, 1995. Tenoroc and Surrounding Area, Showing Proposed Right-of-Way Alignment for the Polk County Parkway. [2]

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5.0 MAPS

Bromwell Engineering, date unknown. Tenoroc Mine Site, Figure Number 1. [1]

I.F. Rooks and Associates, Inc., September 13, 1989. Topographic Map with Spot Elevations, Parcels BDN-T-01 and BDN-T-02(B), Sheet Numbers 1 and 2. [1]

United States Geological Survey (USGS), 1944. 7.5 Minute Topographic Map, Auburndale Quadrangle. [1]

USGS, 1944. 7.5 Minute Topographic Map, Lakeland Quadrangle. [1]

USGS, 1944. 7.5 Minute Topographic Map, Providence Quadrangle. [1]

USGS, 1975. 7.5 Minute Topographic Map, Auburndale Quadrangle. [1]

USGS, 1975. 7.5 Minute Topographic Map, Lakeland Quadrangle. [1]

USGS, 1975. 7.5 Minute Topographic Map, Providence Quadrangle. [1]

USGS, 1987. Photorevised 7.5 Minute Topographic Map, Auburndale Quadrangle. [1]

USGS, 1987. Photorevised 7.5 Minute Topographic Map, Lakeland Quadrangle. [1]

USGS, 1988. Photorevised 7.5 Minute Topographic Map, Providence Quadrangle. [1]

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6.0 DRAWINGS

Agrico, Inc., December 13, 1982. Saddle Creek Settling Areas. Drawing Number 42 66 09 001.[1]

BCI Engineers and Scientists, Inc., May 7, 1999. Tenoroc BDN-T-04 and BDN-T-06, Drawing Number 9657SITE.DWG.[1]

Borden Chemical, Smith-Douglass Division, April 23, 1968. Map Showing New Location of Lake Parker Drive.[2]

Borden Chemical, Smith-Douglass Division, December 12, 1968. Proposed Power Transmission Line.[2]

Borden Chemical, Smith-Douglass Division, September 4, 1969. Return Waterway from Number 6 Settling System.[2]

Bromwell Engineering, June 1979. Tenoroc Mine Site, Figure Number 1 (Bromwell Engineering report dated June 1979).[1]

Bromwell Engineering, June 1979. Plan of Existing Tenoroc Settling Areas, Figure Numbers 2(a) through 2(c) (Bromwell Engineering report dated June 1979).[1]

Bromwell Engineering, June 1979. Tenoroc Site Prior to Mining: Assumed Runoff Conditions, Figure Number 6 (Bromwell Engineering report dated June 1979).[1]

Bromwell Engineering, June 1979. Proposed Drainage System, Alternative 1: Drain Settling Areas and Form Crust, Figure 10(a) (Bromwell Engineering report dated June 1979).[1]

Bromwell Engineering, June 1979. Proposed Drainage System, Alternative 2: Remove and Dispose of Above-Grade Waste Clay, Figure 10(b) (Bromwell Engineering report dated June 1979).[1]

Bromwell Engineering, June 1979. Proposed Drainage System, Alternative 3: Permanently Impound Water in Settling Areas, Figure 10(c) (Bromwell Engineering report dated June 1979).[1]

Bromwell and Carrier, Inc., October 1984. Revegetation Plan – North, Tenoroc State Reserve Reclamation Area 3-A, Drawing Number 715-84-08.[2]

Bromwell and Carrier, Inc., October 1984. Revegetation Plan – South, Tenoroc State Reserve Reclamation Area 3-A, Drawing Number 715-84-09.[2]

Bromwell and Carrier, Inc., October 1985. Site Location, Parcels BDN-T-01 and BDN-T-02(B), Drawing Number 880-85-2.[1]

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6.0 DRAWINGS (continued)

Bromwell and Carrier, Inc., October 1985. Boundary Survey, Parcels BDN-T-01 and BDN-T-02(B), Drawing Number 880-85-3. [1]

Bromwell and Carrier, Inc., October 1985. Aerial Photo and Landforms, Parcels BDN-T-01 and BDN-T-02(B), Drawing Number 880-85-4. [1]

Bromwell and Carrier, Inc., October 1985. Pre-Construction Topography, Parcels BDN-T-01 and BDN-T-02(B), Drawing Numbers 880-85-5 and 880-85-6. [1]

Bromwell and Carrier, Inc., October 1985. Site Plan – Proposed Topography and Landforms, Parcels BDN-T-01 and BDN-T-02(B), Drawing Numbers 880-85-7 and 880-85-8. [1]

Bromwell and Carrier, Inc., October 1985. Profile Lines, Parcels BDN-T-01 and BDN-T-02(B), Drawing Number 880-85-9. [1]

Bromwell and Carrier, Inc., October 1985. Cross Sections, Parcels BDN-T-01 and BDN-T-02(B), Drawing Numbers 880-85-10 and 880-85-11. [1]

Bromwell and Carrier, Inc., October 1985. North Dike Cross Sections, Parcels BDN-T-01 and BDN-T-02(B), Drawing Number 880-85-11A. [1]

Bromwell and Carrier, Inc., April 7, 1986. Tree Planting Areas, Parcel BDN-T-03. [1]

Bromwell and Carrier, Inc., June 1986. Site Location. Parcel BDN-T-04, Zone 4A, Drawing Number 983-86-2. [1]

Bromwell and Carrier, Inc., June 1986. Boundary Survey, Parcel BDN-T-04, Zone 4A, Drawing Number 983-86-3. [1]

Bromwell and Carrier, Inc., June 1986. Aerial Photo and Existing Landforms, Parcel BDN-T-04, Zone 4A, Drawing Number 983-86-4. [1]

Bromwell and Carrier, Inc., June 1986. Aerial Photo and Proposed Landforms, Parcel BDN-T-04, Zone 4A, Drawing Number 983-86-5. [1]

Bromwell and Carrier, Inc., June 1986. Cross Sections, Parcel BDN-T-04, Zone 4A, Drawing Numbers 983-86-6 through 983-86-10. [1]

Bromwell and Carrier, Inc., June 1986. Revegetation, Parcel BDN-T-04, Zone 4A, Drawing Number 983-86-11. [1]

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6.0 DRAWINGS (continued)

Bromwell and Carrier, Inc., April 1987. As-Built Site Location, Tenoroc State Reserve Reclamation Area 3-A, Drawing Number 715-84-01. [1]

Bromwell and Carrier, Inc., April 1987. As-Built Existing Site Topography-North, Tenoroc State Reserve Reclamation Area 3-A, Drawing Number 715-84-02. [1]

Bromwell and Carrier, Inc., April 1987. As-Built Existing Site Topography-South, Tenoroc State Reserve Reclamation Area 3-A, Drawing Number 715-84-03. [1]

Bromwell and Carrier, Inc., April 1987. As-Built Existing Topographic Cross Sections, Tenoroc State Reserve Reclamation Area 3-A, Drawing Number 715-84-04. [1]

Bromwell and Carrier, Inc., April 1987. As-Built Drainage and Reclamation Plan-North, Tenoroc State Reserve Reclamation Area 3-A, Drawing Number 715-84-05. [1]

Bromwell and Carrier, Inc., April 1987. As-Built Drainage and Reclamation Plan-South, Tenoroc State Reserve Reclamation Area 3-A, Drawing Number 715-84-06. [1]

Bromwell and Carrier, Inc., April 1987. As-Built Reclamation Plan Cross Section, Tenoroc State Reserve Reclamation Area 3-A, Drawing Number 715-84-07. [1]

Bromwell and Carrier, Inc., February 1988. As-Built Site Location, Tenoroc State Reserve Reclamation Area 5-A, Drawing Number 805-84-2. [1]

Bromwell and Carrier, Inc., February 1988. As-Built Existing Site Topography, Tenoroc State Reserve Reclamation Area 5-A, Drawing Number 805-84-3. [1]

Bromwell and Carrier, Inc., February 1988. As-Built Final Topography, Tenoroc State Reserve Reclamation Area 5-A, Drawing Number 805-84-4. [1]

Bromwell and Carrier, Inc., February 1988. As-Built Typical Sections, Tenoroc State Reserve Reclamation Area 5-A, Drawing Numbers 805-84-5 through 805-84-9. [1]

Bromwell and Carrier, Inc., February 1988. As-Built Final Revegetation, Tenoroc State Reserve Reclamation Area 5-A, Drawing Number 805-84-10. [1]

Bromwell and Carrier, Inc., February 1988. As-Built Parcel and Work Limits Boundary, Tenoroc State Reserve Reclamation Area 5-A, Drawing Number 805-84-11. [1]

Bromwell and Carrier, Inc., June 1989. As-Built Post-Construction Aerial, Parcels BDN-T-01 and BDN-T-02(B), Drawing Number 880-89-4. [1]

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6.0 DRAWINGS (continued)

Bromwell and Carrier, Inc., June 1989. As-Built Post-Construction Topography, Parcels BDN-T-01 and BDN-T-02(B), Drawing Numbers 880-89-7 and 880-89-8. [1]

Bromwell Engineering, date unknown. Plan of Existing Tenoroc Settling Areas. Figure Numbers 2A, 2B and 2C. [1]

Bromwell Engineering, 1982. Tenoroc Site Drawing with Reclamation and Vegetation Details, Figure Number 00. [1]

Chastain-Skillman, Inc., October 23, 1984. Boundary Survey, Tenoroc State Reserve Reclamation Area Number 5. [1]

Coronet Phosphate, Inc., April 1960. Ownership Map, Tenoroc-Lake Parker Area. [2]

FDNR-DRP, March 1983. Base Map, Tenoroc State Reserve. [2]

Kucera and Associates, Inc., January 29, 1979. Aerial Photograph with Reclamation Program Boundaries, Township 27 South, Range 24 East. [2]

Kucera and Associates, Inc., January 29, 1979. Aerial Photograph with Reclamation Program Boundaries, Township 27 South, Range 25 East. [2]

Kucera and Associates, Inc., January 29, 1979. Aerial Photograph with Reclamation Program Boundaries, Township 28 South, Range 24 East. [2]

Kunde, Sprecher, Yaskin and Associates, date unknown. Aerial Photograph with Wetlands Impacted by the Polk County Parkway. [2]

Pickett and Associates, Inc., December 18, 1997. Topographic Survey of Tenoroc BDN-T-01 Site. [2]

Pickett and Associates, Inc., December 18, 1997. Topographic Survey of Tenoroc BDN-T-03 Site, Drawing Number LD 1362. [1]

Southwest Florida Water Management District (SWFWMD), April 1978. Aerial Photography with Contours, Lake Parker, Sheet Number 2-28-24. [1]

SWFWMD, May 1978. Aerial Photography with Contours, West Lake Juliana, Sheet Number 1. [1]

SWFWMD, May 1978. Aerial Photography with Contours, West Lake Juliana, Sheet Numbers 2, 3 and 4. [2]

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6.0 DRAWINGS (continued)

SWFWMD, May 1978. Aerial Photography with Contours, West Lake Juliana, Sheet Number 25-27-24. [1]

SWFWMD, May 1978. Aerial Photography with Contours, West Lake Juliana, Sheet Number 30-27-25. [1]

SWFWMD, May 1978. Aerial Photography with Contours, West Lake Juliana, Sheet Number 31-27-25. [1]

SWFWMD, May 1978. Aerial Photography with Contours, West Lake Juliana, Sheet Number 36-27-24. [1]

SWFWMD, May 1978. Aerial Photography with Contours, West Lake Juliana, Sheet Number 36-26-24. [1]

SWFWMD, May 1978. Aerial Photography with Contours, Lake Parker North, Sheet Number 2. [2]

SWFWMD, April 1979. Aerial Photography with Contours, Lake Parker North, Sheet Number 26-27-24. [1]

SWFWMD, April 1979. Aerial Photography with Contours, Lake Parker North, Sheet Number 27-27-24. [1]

SWFWMD, April 1979. Aerial Photography with Contours, Lake Parker North, Sheet Number 34-27-24. [1]

SWFWMD, April 1979. Aerial Photography with Contours, Lake Parker North, Sheet Number 35-27-24. [1]

SWFWMD, October 1980. Aerial Photography with Contours, Lake Hamilton West, Sheet Number 1-28-24. [1]

SWFWMD, October 1980. Aerial Photography with Contours, Lake Hamilton West, Sheet Number 6-28-25. [1]

SWFWMD, February 1983. Aerial Photography with Contours, Lakeland to Bartow, Sheet Number 1-28-24. [1]

Sutherland Land Surveying, May 21, 1982. Boundary Survey, Parcel BDN-T-03. [1]

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6.0 DRAWINGS (continued)

Zellars-Williams, Inc., 1975. Aerial Photograph with Reclamation Program Boundaries, Township 27 South, Range 24 East.[2]

Zellars-Williams, Inc., 1975. Aerial Photograph with Reclamation Program Boundaries, Township 27 South, Range 25 East.[2]

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7.0 DIGITAL FILES

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecosystem Office
P.O. Box 2676
Vero Beach, Florida 32961-2676

July 9, 1999

W. David Gordon, Project Ecologist
Quest Ecology, Inc.
1080 Chert Rock Trail
Lithia, Florida 33547

Dear Mr. Gordon:

Thank you for your letter to the Fish and Wildlife Service (Service) requesting information on the presence of federally listed species or their habitats in the vicinity of the Teneroc Fish Management Area. The proposed project is located in sections 25, 26, and 34-36, Township 27S, Range 24E; sections 29-32, Township 27S, Range 25E; and sections 1-3, Township 28S, Range 24E, Polk County, Florida.

PROJECT DESCRIPTION

The proposed project involves designing a restoration plan for this area, which was previously mined for phosphate.

THREATENED AND ENDANGERED SPECIES

The Service has reviewed the information in your letter, as well as information available to us on the presence of threatened or endangered species in the vicinity of the proposed project. We find no recorded locations of federally listed species in the project area. No critical habitat has been designated in the project area.

The recorded locations of threatened and endangered species in or adjacent to the proposed project site are based on a review of Geographic Information Systems (GIS) data maintained by the Service's South Florida Field Office. The GIS database is a compilation of data received from several sources. The GIS database is updated as new data is received.

We have provided for your consideration a list of species that are protected as either threatened or endangered under the Endangered Species Act (16 U.S.C. 1531 *et seq.*) which may be present in Polk County. Since this list does not include State-listed species, the Florida Fish and Wildlife Conservation Commission should be contacted to identify those species potentially present in the vicinity.

In addition to the above information, we are providing you with a list of species that we would consider during our review of any proposal associated with this project. This list represents species that the Service is required to protect and conserve under other authorities, such as the Fish and Wildlife Coordination Act (16 U.S.C. 661 *et seq.*) and the Migratory Bird Treaty Act (16 U.S.C. 701 *et seq.*). We are providing this list as technical assistance only. If you would like to discuss means and methods to conserve these species, please contact this office.

Thank you for the opportunity to provide this information. If you have any questions, please contact Wesley Shockley at (561) 562-3909, extension 257.

Sincerely,

Kalani D. Cairns

for James J. Slack
Project Leader
South Florida Field Office

Enclosures

cc: FFWCC, Vero Beach, FL (w/o enclosures)

ORDER GAVIIFORMES
FAMILY GAVIIDAE
Gavia stellata, Red-throated Loon
Gavia immer, Common Loon
Gavia pacifica, Pacific Loon

ORDER PODICIPEDIFORMES
FAMILY PODICIPEDIDAE
Tachybaptus dominicus, Least Grebe
Podilymbus podiceps, Pied-billed Grebe
Podiceps auritus, Horned Grebe
Podiceps nigricollis, Eared Grebe

ORDER PROCELLARIIFORMES
FAMILY PROCELLARIIDAE
Calonectris diomedea, Cory's Shearwater
Puffinus gravis, Greater Shearwater
Puffinus griseus, Sooty Shearwater
Puffinus puffinus, Manx Shearwater
Puffinus lherminieri, Audubon's Shearwater

FAMILY HYDROBATIDAE
Oceanites oceanicus, Wilson's Storm-Petrel
Oceanodroma leucorhoa, Leach's Storm-Petrel
Oceanodroma castro, Band-rumped Storm-Petrel

ORDER PELECANIFORMES
FAMLY PHAETHONTIDAE
Phaethon lepturus, White-tailed Tropicbird
Phaethon aethereus, Red-billed Tropicbird

FAMILY SULIDAE
Sula dactylatra, Masked Booby
Sula leucogaster, Brown Booby
Sula sula, Red-footed Booby
Sula bassanus, Northern Gannet

FAMILY PELECANIDAE
Pelecanus erythrorhynchos, American White Pelican
Pelecanus occidentalis, Brown Pelican

FAMILY PHALACROCORACIDAE
Phalacrocorax carbo, Great Cormorant
Phalacrocorax auritus, Double-crested Cormorant

FAMILY ANHINGIDAE
Anhinga anhinga, Anhinga

FAMILY FREGATIDAE
Fregata magnificens, Magnificent Frigatebird

ORDER CICONIIFORMES
FAMILY ARDEIDAE
Botaurus lentiginosus, American Bittern
Ixobrychus exilis, Least Bittern
Ardea herodias, Great Blue Heron
Casmerodius albus, Great Egret
Egretta thula, Snowy Egret
Egretta caerulea, Little Blue Heron
Egretta tricolor, Tricolored Heron
Egretta rufescens, Reddish Egret
Bubulcus ibis, Cattle Egret
Butorides striatus, Green-backed Heron
Nycticorax nycticorax, Black-crowned Night Heron
Nycticorax violaceus, Yellow-crowned Night Heron

FAMILY THRESKIORNITHIDAE
Eudocimus albus, White Ibis
Eudocimus ruber, Scarlet Ibis
Plegadis falcinellus, Glossy Ibis
Plegadis chihi, White-faced Ibis
Ajaia ajaja, Roseate Spoonbill

FAMILY CICONIIDAE
Mycteria americana, Wood Stork

ORDER PHOENICOPTERIFORMES
FAMILY PHOENICOPTERIDAE
Phoenicopterus ruber, Greater Flamingo

ORDER ANSERIFORMES
FAMILY ANATIDAE
Dendrocygna bicolor, Fulvous Whistling-Duck
Dendrocygna autumnalis, Black-bellied Whistling-Duck
Anser albifrons, Greater White-fronted Goose
Chen caerulescens, Snow Goose
Branta bernicla, Brant
Branta canadensis, Canada Goose
Aix sponsa, Wood Duck
Anas crecca, Green-winged Teal
Anas rubripes, American Black Duck
Anas fulvigula, Mottled Duck
Anas platyrhynchos, Mallard
Anas bahamensis, White-cheeked Pintail
Anas acuta, Northern Pintail
Anas discors, Blue-winged Teal
Anas cyanoptera, Cinnamon Teal
Anas clypeata, Northern Shoveler
Anas strepera, Gadwall
Anas penelope, Eurasian Wigeon
Anas americana, American Wigeon
Aythya valisineria, Canvasback
Aythya americana, Redhead
Aythya collaris, Ring-necked Duck
Aythta marila, Greater Scaup
Aythya affinis, Lesser Scaup
Somateria mollissima, Common Eider
Somateria spectabilis, King Eider
Histrionicus histrionicus, Harlequin Duck
Clangula hyemalis, Oldsquaw
Melanitta nigra, Black Scoter
Melanitta perspicillata, Surf Scoter
Melanitta fusca, White-winged Scoter
Bucephala clangula, Common Goldeneye

Bucephala albeola, Bufflehead
Lophodytes cucullatus, Hooded Merganser
Mergus merganser, Common Merganser
Mergus serrator, Red-breasted Merganser
Oxyura jamaicensis, Ruddy Duck
Oxyura dominica, Masked Duck

ORDER FALCONIFORMES
FAMILY CATHARTIDAE
Coragyps atratus, Black Vulture
Cathartes aura, Turkey Vulture

FAMILY ACCIPITRIDAE
Pandion haliaetus, Osprey
Elanoides forficatus, American Swallow-tailed Kite
Elanus caeruleus, Black-shouldered Kite
Rhostrhamus sociabilis, Snail Kite
Ictinia mississippiensis, Mississippi Kite
Haliaeetus leucocephalus, Bald Eagle
Circus cyaneus, Northern Harrier
Accipiter striatus, Sharp-shinned Hawk
Accipiter cooperii, Cooper's Hawk
Buteo lineatus, Red-shouldered Hawk
Buteo platypterus, Broad-winged Hawk
Buteo brachyurus, Short-tailed Hawk
Buteo swainsoni, Swainson's Hawk
Buteo jamaicensis, Red-tailed Hawk

FAMILY FALCONIDAE
Polyborus plancus, Crested Caracara
Falco sparverius, American Kestrel
Falco columbarius, Merlin
Falco peregrinus, Peregrine Falcon

ORDER GRUIFORMES
FAMILY RALLIDAE
Coturnicops noveboracensis, Yellow Rail
Laterallus jamaicensis, Black Rail
Rallus longirostris, Clapper Rail
Rallus elegans, King Rail
Rallus limicola, Virginia Rail
Porzana carolina, Sora
Porphyrula martinica, Purple Gallinule
Gallinula chloropus, Common Moorhen
Fulica americana, American Coot

FAMILY ARAMIDAE
Aramus guarauna, Limpkin

FAMILY GRUIDAE
Grus canadensis, Sandhill Crane

ORDER CHARADRIIFORMES
FAMILY CHARADRIIDAE
Pluvialis squatarola, Black-bellied Plover
Pluvialis dominica, Lesser Golden-Plover
Charadrius alexandrinus, Snowy Plover
Charadrius wilsonia, Wilson's Plover
Charadrius semipalmatus, Semipalmated Plover
Charadrius melodus, Piping Plover
Charadrius vociferus, Killdeer
Charadrius montanus, Mountain Plover

FAMILY HAEMATOPODIDAE
Haematopus palliatus, American Oystercatcher

FAMILY RECURVIROSTRIDAE
Himantopus mexicanus, Black-necked Stilt
Recurvirostra americana, American Avocet

FAMILY SCOLOPACIIDAE
Tringa melanoleuca, Greater Yellowlegs
Tringa flavipes, Lesser Yellowlegs
Tringa solitaria, Solitary Sandpiper
Catoptrophorus semipalmatus, Willet
Actitus macularia, Spotted Sandpiper
Bartramia longicauda, Upland Sandpiper
Numenius phaeopus, Whimbrel
Numenius americanus, Long-billed Curlew
Limosa limosa, Black-tailed Godwit
Limosa haemastica, Hudsonian Godwit
Limosa fedoa, Marbled Godwit
Arenaria interpres, Ruddy Turnstone
Aphriza virgata, Surfbird
Calidris canutus, Red Knot
Calidris alba, Sanderling
Calidris pusilla, Semipalmated Sandpiper
Calidris mauri, Western Sandpiper
Calidris minutilla, Least Sandpiper
Calidris fuscicollis, White-rumped Sandpiper
Calidris bairdii, Baird's Sandpiper
Calidris melanotos, Pectoral Sandpiper
Calidris acuminata, Sharp-tailed Sandpiper
Calidris maritima, Purple Sandpiper
Calidris alpina, Dunlin
Calidris ferruginea, Curlew Sandpiper
Calidris himantopus, Stilt Sandpiper
Tryngites subruficollis, Buff-breasted Sandpiper
Philomachus pugnax, Ruff
Limnodromus griseus, Short-billed Dowitcher
Limnodromus scolopaceus, Long-billed Dowitcher
Gallinago gallinago, Common Snipe
Scolopax minor, American Woodcock
Phalaropus tricolor, Wilson's Phalarope
Phalaropus lobatus, Red-necked Phalarope
Phalaropus fulicaria, Red Phalarope

FAMILY LARIDAE
Stercorarius pomarinus, Pomarine Jaeger
Stercorarius parasiticus, Parasitic Jaeger
Stercorarius longicaudus, Long-tailed Jaeger
Larus atricilla, Laughing Gull
Larus pipixcan, Franklin's Gull
Larus minutus, Little Gull
Larus ridibundus, Common Black-headed Gull
Larus philadelphia, Bonaparte's Gull

Larus delawarensis, Ring-billed Gull
Larus argentatus, Herring Gull
Larus thayeri, Thayer's Gull
Larus fuscus, Lesser Black-backed Gull
Larus hyperboreus, Glaucous Gull
Larus marinus, Great Black-backed Gull
Rissa tridactyla, Black-legged Kittiwake
Xema sabini, Sabine's Gull
Sterna nilotica, Gull-billed Tern
Sterna caspia, Caspian Tern
Sterna maxima, Royal Tern
Sterna sandvicensis, Sandwich Tern
Sterna dougallii, Roseate Tern
Sterna hirundo, Common Tern
Sterna paradisaea, Arctic Tern
Sterna forsteri, Forster's Tern
Sterna antillarum, Least Tern
Sterna anaethetus, Bridled Tern
Sterna fuscata, Sooty Tern
Chlidonias niger, Black Tern
Anous stolidus, Brown Noddy
Anous minutus, Black Noddy
Rynchops niger, Black Skimmer

FAMILY ALCIDAE
Alle alle, Dovekie
Alca torda, Razorbill

ORDER COLUMBIFORMES
FAMILY COLUMBIDAE
Columba squamosa, Scaly-naped Pigeon
Columba leucocephala, White-crowned Pigeon
Columba fasciata, Band-tailed Pigeon
Zenaida asiatica, White-winged Dove
Zenaida aurita, Zenaida Dove
Zenaida macroura, Mourning Dove
Columbina passerina, Common Ground-Dove
Geotrygon chrysia, Key West Quail-Dove
Geotrygon montana, Ruddy Quail-Dove

ORDER CUCULIFORMES
FAMILY CUCULIDAE
Coccyzus erythropthalmus, Black-billed Cuckoo
Coccyzus americanus, Yellow-billed Cuckoo
Coccyzus minor, Mangrove Cuckoo
Crotophaga ani, Smooth-billed Ani
Crotophaga sulcirostris, Groove-billed Ani

ORDER STRIGIFORMES
FAMILY TYTONIDAE
Tyto alba, Common Barn-Owl

FAMILY STRIGIDAE
Otus asio, Eastern Screech-Owl
Bubo virginianus, Great Horned Owl
Athene cunicularia, Burrowing Owl
Strix varia, Barred Owl
Asio otus, Long-eared Owl
Asio flammeus, Short-eared Owl
Aegolius acadicus, Northern Saw-whet Owl

ORDER CAPRIMULGIFORMES
FAMILY CAPRIMULGIDAE
Chordeiles acutipennis, Lesser Nighthawk
Chordeiles minor, Common Nighthawk
Chordeiles gundlacchii, Antillean Nighthawk
Caprimulgus carolinensis, Chuck-will's-widow
Caprimulgus vociferus, Whip-poor-will

ORDER APODIFORMES
FAMILY APODIDAE
Chaetura pelagica, Chimney Swift
Tachornis phoenicobia, Antillean Palm Swift

FAMILY TROCHILIDAE
Amazilia yucatenensis, Buff-bellied Hummingbird
Calliphlox evelynae, Bahama Woodstar
Archilochus colubris, Ruby-throated Hummingbird
Archilochus alexandri, Black-chinned Hummingbird
Selasphorus rufus, Rufous Hummingbird

ORDER CORACIIFORMES
FAMILY ALCEDINIDAE
Ceryle alcyon, Belted Kingfisher

ORDER PICIFORMES
FAMILY PICIDAE
Melanerpes erythrocephalus, Red-headed Woodpecker
Melanerpes carolinus, Red-bellied Woodpecker
Sphyrapicus varius, Yellow-bellied Sapsucker
Picoides pubescens, Downy woodpecker
Picoides villosus, Hairy woodpecker
Picoides borealis, Red-cockaded woodpecker
Colaptes auratus, Northern Flicker
Dryocopus pileatus, Pileated Woodpecker
Campephilus principalis, Ivory-billed Woodpecker

ORDER PASSERIFORMES
FAMILY TYRANNIDAE
Contopus borealis, Olive-sided flycatcher
Contopus virens, Eastern Wood-Pewee
Empidonax flaviventris, Yellow-bellied Flycatcher
Empidonax virescens, Acadian Flycatcher
Empidonax alnorum, Alder Flycatcher
Empidonax traillii, Willow Flycatcher
Empidonax minimus, Least Flycatcher
Sayornis nigricans, Black Phoebe
Sayornis phoebe, Eastern Phoebe
Sayornis saya, Say's Phoebe
Pyrocephalus rubinus, Vermilion Flycatcher
Myiarchus cinerascens, Ash-throated Flycatcher
Myiarchus crinitus, Great Crested Flycatcher
Myiarchus tyrannulus, Brown-crested Flycatcher
Tyrannus vociferans, Cassin's Kingbird

Tyrannus verticalis, Western Kingbird
Tyrannus tyrannus, Eastern Kingbird
Tyrannus dominicensis, Gray Kingbird
Tyrannus caudifasciatus, Loggerhead Kingbird
Tyrannus forficatus, Scissor-tailed Flycatcher
Tyrannus savana, Fork-tailed Flycatcher

FAMILY ALAUDIDAE
Eremophila alpestris, Horned Lark

FAMILY HIRUNDINIDAE
Progne subis, Purple Martin
Tachycineta bicolor, Tree Swallow
Tachycineta cyaneoviridis, Bahama Swallow
Stelgidopteryx serripennis, Northern Rough-winged Swallow
Riparia riparia, Bank Swallow
Hirundo pyrrhonota, Cliff Swallow
Hirundo fulva, Cave Swallow
Hirundo rustica, Barn Swallow

FAMILY CORVIDAE
Cyanocitta cristata, Blue Jay
Aphelocoma coerulescens, Scrub Jay
Corvus brachyrhynchos, American Crow
Corvus ossifragus, Fish Crow

FAMILY PARIDAE
Parus carolinensis, Carolina Chickadee
Parus bicolor, Tufted Titmouse

FAMILY SITTIDAE
Sitta canadensis, Red-breasted Nuthatch
Sitta pusilla, Brown-headed Nuthatch

FAMILY CERTHIIDAE
Certhia americana, Brown Creeper

FAMILY TROGLODYTIDAE
Thryothorus ludovicianus, Carolina Wren
Troglodytes aedon, House Wren
Troglodytes troglodytes, Winter Wren
Cistothorus platensis, Sedge Wren
Cistothorus palustris, Marsh Wren

FAMILY MUSCICAPIDAE
SUBFAMILY SYLVIINAE
Regulus satrapa, Golden-crowned Kinglet
Regulus calendula, Ruby-crowned Kinglet
Polioptila caerulea, Blue-gray Gnatcatcher

SUBFAMILY TURDINAE
Oenanthe oenanthe, Northern Wheatear
Sialis sialis, Eastern Bluebird
Catharus fuscescens, Veery
Catharus minimus, Gray-cheeked Thrush
Catharus ustulatus, Swainson's Thrush
Catharus guttatus, Hermit Thrush
Hylocichla mustelina, Wood Thrush
Turdus migratorius, American Robin
Ixoreus naevius, Varied Thrush

FAMILY MIMIDAE
Dumetella carolinensis, Gray Catbird
Mimus polyglottos, Northern Mockingbird
Toxostoma rufum, Brown Thrasher

FAMILY MOTACILLIDAE
Anthus spragueii, Sprague's Pipit

FAMILY BOMBYCILLIDAE
Bombycilla cedrorum, Cedar Waxwing

FAMILY LANIIDAE
Lanius ludovicianus, Loggerhead Shrike

FAMILY VIREONIDAE
Vireo griseus, White-eyed Vireo
Vireo bellii, Bells' Vireo
Vireo solitarius, Solitary Vireo
Vireo flavifrons, Yellow-throated Vireo
Vireo gilvus, Warbling Vireo
Vireo philadelphicus, Philadelphia Vireo
Vireo olivaceus, Red-eyed Vireo
Vireo altiloquus, Black-whiskered Vireo

FAMILY EMBERIZIDAE
SUBFAMILY PARULINAE
Vermivora bachmanii, Bachman's Warbler
Vermivora pinus, Blue-winged Warbler
Vermivora chrysoptera, Golden-winged Warbler
Vermivora peregrina, Tennessee Warbler
Vermivora celata, Orange-crowned Warbler
Vermivora ruficapilla, Nashville Warbler
Parula americana, Northern Parula
Dendroica petechia, Yellow Warbler
Dendroica pensylvanica, Chestnut-sided Warbler
Dendroica magnolia, Magnolia Warbler
Dendroica tigrina, Cape May Warbler
Dendroica caerulescens, Black-throated Blue Warbler
Dendroica coronata, Yellow-rumped Warbler
Dendroica nigrescens, Black-throated Gray Warbler
Dendroica townsendi, Townsend's Warbler
Dendroica virens, Black-throated Green Warbler
Dendroica fusca, Blackburnian Warbler
Dendroica dominica, Yellow-throated Warbler
Dendroica pinus, Pine Warbler
Dendroica kirtlandii, Kirtland's Warbler
Dendroica discolor, Prairie Warbler
Dendroica palmarum, Palm Warbler
Dendroica castanea, Bay-breasted Warbler
Dendroica striata, Blackpoll Warbler
Dendroica cerulea, Cerulean Warbler
Mniotilta varia, Black-and-White Warbler
Setophaga ruticilla, American Redstart
Protonotaria citrea, Prothonotary Warbler
Helmitheros vermivorus, Worm-eating Warbler
Limnothlypis swainsonii, Swainson's Warbler
Seiurus aurocapillus, Ovenbird
Seiurus noveboracensis, Northern Waterthrush
Seiurus motacilla, Louisiana Waterthrush

Oporornis formosus, Kentucky Warbler
Oporornis agilis, Connecticut Warbler
Oporornis philadelphia, Mourning Warbler
Geothlypis trichas, Common Yellowthroat
Wilsonia citrina, Hooded Warbler
Wilsonia pusilla, Wilson's Warbler
Wilsonia canadensis, Canada Warbler
Icteria virens, Yellow-breasted Chat

SUBFAMILY THRAUPINAE
Spindalis zena, Stripe-headed Tanager
Piranga rubra, Summer Tanager
Piranga olivacea, Scarlet Tanager
Piranga ludoviciana, Western Tanager

SUBFAMILY CARDINALINAE
Cardinalis cardinals, Northern Cardinal
Pheucticus ludovicianus, Rose-breasted Grosbeak
Pheucticus melanocephalus, Black-headed Grosbeak
Guiraca caerulea, Blue Grosbeak
Passerina amoena, Lazuli Bunting
Passerina cyanea, Indigo Bunting
Passerina ciris, Painted Bunting
Spiza americana, Dickcissel

SUBFAMILY EMBERIZINAE
Pipilo erythrophthalmus, Rufous-sided Towhee
Tiaris bicolor, Black-faced Grassquit
Aimophila aestivalis, Bachman's Sparrow
Spizella passerina, Chipping Sparrow
Spizella pallida, Clay-colored Sparrow
Spizella pusilla, Field Sparrow
Pooecetes gramineus, Vesper Sparrow
Chondestes grammacus, Lark Sparrow
Calamospiza melanocorys, Lark Bunting
Passerculus sandwichensis, Savannah Sparrow
Ammodramus savannarum, Grasshopper Sparrow
Ammodramus henslowii, Henslow's Sparrow
Ammodramus leconteii, Le Conte's Sparrow
Ammodramus caudacutus, Sharp-tailed Sparrow
Ammodramus maritimus, Seaside Sparrow
Melospiza melodia, Song Sparrow
Melospiza lincolnii, Lincoln's Sparrow
Melospiza georgiana, Swamp Sparrow
Zonotrichia albicollis, White-throated Sparrow
Zonotrichia leucophrys, White-crowned Sparrow
Zonotrichia querula, Harris' Sparrow
Junco hyemalis, Dark-eyed Junco
Calcarius lapponicus, Lapland Longspur

SUBFAMILY ICTERINAE
Dolichonyx oryzivorus, Bobolink
Agelaius phoeniceus, Red-winged Blackbird
Sturnella magna, Eastern Meadowlark
Sturnella neglecta, Western Meadowlark
Xanthocephalus xanthocephalus, Yellow-headed Blackbird
Euphagus carolinus, Rusty Blackbird
Euphagus cyanocephalus, Brewer's Blackbird
Quiscalus major, Boat-tailed Grackle
Quiscalus quiscula, Common Grackle
Molothrus bonariensis, Shiny Cowbird
Molothrus aeneus, Bronzed Cowbird
Molothrus ater, Brown-headed Cowbird
Icterus spurius, Orchard Oriole
Icterus galbula, Northern Oriole

FAMILY FRINGILLIDAE
SUBFAMILY CARDUELINAE
Carpodacus purpureus, Purple Finch
Carduelis pinus, Pine Siskin
Carduelis tristis, American Goldfinch

**FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES
AND CANDIDATES FOR FEDERAL LISTING
IN POLK COUNTY, FLORIDA**

Birds

Audubon's crested caracara	*Polyborus plancus audubonii*	T
Bald eagle	*Haliaeetus leucocephalus*	T
Florida grasshopper sparrow	*Ammodramus savannarum floridanus*	E
Florida scrub-jay	*Aphelocoma coerulescens*	T
Peregrine falcon	*Falco peregrinus*	E (S/A)
Red-cockaded woodpecker	*Picoides (= Dendrocopos) borealis*	E
Wood stork	*Mycteria americana*	E

Reptiles

American alligator	*Alligator mississippiensis*	T (S/A)
Blue-tail (blue-tailed) mole skink	*Eumeces egregius lividus*	T
Eastern indigo snake	*Drymarchon corais couperi*	T
Sand skink	*Neoseps reynoldsi*	T

Plants

Avon Park harebells	*Crotalaria avonensis*	E
Britton's beargrass	*Nolina brittoniana*	E
Carter's mustard	*Warea carteri*	E
Florida bonamia	*Bonamia grandiflora*	T
Florida perforate cladonia	*Cladonia perforata*	E
Florida ziziphus	*Ziziphus celata*	E
Highlands scrub hypericum	*Hypericum cumulicola*	E
Lewton's polygala	*Polygala lewtonii*	E
Papery whitlow-wort	*Paronychia chartacea (= Nyachia pulvinata)*	T
Pigeon wings	*Clitoria fragrans*	T
Pygmy fringe-tree	*Chionanthus pygmaeus*	E
Sandlace	*Polygonella myriophylla*	E
Scrub blazing star	*Liatris ohlingerae*	E
Scrub buckwheat	*Eriogonum longifolium* var. *gnaphalifolium*	T
Scrub lupine	*Lupinus aridorum*	E
Scrub plum	*Prunus geniculata*	E
Short-leaved rosemary	*Conradina brevifolia*	E
Wide-leaf warea	*Warea amplexifolia*	E
Wireweed	*Polygonella basiramia* (= *ciliata* var. *b.*)	E

E=Endangered; T=Threatened; C=Candidate; E (S/A)=Endangered due to Similar Appearance; T (S/A)=Threatened due to Similar Appearance; XN=Experimental population; CH = Critical Habitat has been designated for this species in this county

FLORIDA NATURAL AREAS INVENTORY

1018 Thomasville Road, Suite 200-C · Tallahassee, Florida 32303 · (850) 224-8207 · FAX (850) 681-9364 · www.fnai.org

June 1, 1999

W. David Gordon
Quest Ecology, Inc.
1080 Chert Rock Trail
Lithia, FL 33547

Dear Mr. Gordon:

Thank you for your request for information from the Florida Natural Areas Inventory (FNAI). Your data request, received on May 20, 1999, specified an area located in the Tenoroc Fish Management Area in Polk County.

A search of our maps and database indicates that currently we have 26 Element Occurrence Records mapped within the vicinity of the study area (see enclosed map and table). Note that the map legend indicates the precision of the element occurrence location, defined as second (within about 300 feet), minute (within about one mile), or general (within about 5 miles). Also note the locations of breeding colony sites identified by the Florida Game and Fresh Water Fish Commission Breeding Bird Atlas Project.

Please note that Potential Natural Areas are located near the site. These are private lands which are not managed for conservation, but which may have features of environmental significance, as determined by FNAI scientists. Potential Natural Areas should be considered important information for planning purposes. Please see the enclosed explanation sheet for more information.

FNAI strongly suggests that a site specific survey be conducted to determine the current presence or absence of rare, threatened, or endangered species. Surveys should be conducted by individuals familiar with Florida's flora and fauna. For your convenience, a summary of the elements recorded for Polk County is enclosed.

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

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

Thank you for your use of FNAI services. A copy of the invoice is enclosed for your information; the original will be mailed to your accounts payable department. If I can be of further assistance, please give me a call at (850) 224-8207.

Sincerely,

Jonathan Oetting
Conservation Information Coordinator

encl

FNAI ELEMENT OCCURRENCE RECORDS ON OR NEAR SITE

GISID	EOCODE	SCIENTIFIC NAME	COMMON NAME	DATE OBSERVED	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS	DESCRIPTION	COMMENTS
281170034	AMAFB07043*037*FL	SCIURUS NIGER SHERMANI	SHERMAN'S FOX SQUIRREL	1988-05-18	G5T2	S2	N	LS	OPEN CANOPY BAYHEAD WITH PINE FRINGE, SURROUNDED BY IMPROVED PASTURE.	1988-05: ONE ADULT MALE OBSERVED BY B. WINCHESTER IN OPEN PASTURE IMMED. S OF BAYHEAD (RAN INTO BAYHEAD).
281171702	AMAFB07043*123*FL	SCIURUS NIGER SHERMANI	SHERMAN'S FOX SQUIRREL	1989-05-25	G5T2	S2	N	LS	Golf course.	1989-05-25: B.A. Millsap, GFC, observed 1 adult on golf course.
281180001	ARACH01043*004*FL	EUMECES EGREGIUS LIVIDUS	BLUE-TAILED MOLE SKINK	1966-01-04	G4T2	S2	LT	LT	IN GEOMYS MOUND.	1966-01-04: LEE COLLECTED A SPECIMEN HERE.
281180004	ORKER00000*357*FL	BIRD ROOKERY		1987-04-28			N	N	Colony site is phosphate mine water impoundment; habitat surrounding colony is willows; nesting substrate is willows at seasonally flooded site.	Multi-species rookery, 7 species. >1,000 birds 1976-06, vacant 1977-07, >1,000 birds 1978-04 and 1978-07, 101-250 birds 1987-04-28, vacant 1989-05-17. Great Egret present 1976-06, 1978-04; Snowy Egret present 1976-06; Little Blue Heron present 1978-04; W
281180005	ABNGA04040*200*FL	ARDEA ALBA	GREAT EGRET	1978-04	G5	S4	N	N	Colony site is phosphate mine water impoundment; habitat surrounding colony is willows; nesting substrate is willows at seasonally flooded site.	Species present 1976-06 and 1978-04 (100-150 nesting pairs on both dates--U82NES01). Not observed 1977-07, 1978-07, 1987-04-28, and 1989-05-17.
281180006	ABNGA06030*121*FL	EGRETTA THULA	SNOWY EGRET	1976-06	G5	S4	N	LS	Colony site is phosphate mine water impoundment; habitat surrounding colony is willows; nesting substrate is willows at seasonally flooded site.	Species present 1976-06 ("++"in U82NES01). Not observed 1977-07, 1978-04, 1978-07, 1987-04-28, and 1989-05-17.
281180007	ABNGA06040*147*FL	EGRETTA CAERULEA	LITTLE BLUE HERON	1978-04	G5	S4	N	LS	Colony site is phosphate mine water impoundment; habitat surrounding colony is willows; nesting substrate is willows at seasonally flooded site.	Species present 1978-04 ("+++" in U82NES01). Not observed 1976-06, 1977-07, 1978-07, 1987-04-28, and 1989-05-17.
281180008	ABNGE01010*109*FL	EUDOCIMUS ALBUS	WHITE IBIS	1978-07	G5	S4	N	LS	Colony site is phosphate mine water impoundment; habitat surrounding colony is willows; nesting substrate is willows at seasonally flooded site.	Species present 1978-04 (200-300 nesting pairs--U82NES01) and 1978-07 ("+" in U82NES01). Not observed 1976-06, 1977-07, 1987-04-28, and 1989-05-17.
281180009	ORKER00000*358*FL	BIRD ROOKERY		1989-06-12			N	N		Multi-species rookery, 6 species. 501-750 birds 1989 04-18, >1,000 birds 1989-04-24, 11-100 birds 1989-05-17, 751-1,000 birds 1989-06-12. Great Egret present 1989-04-18, 1989-04-24, 1989-06-12; Snowy Egret present 1989-06-12; Little Blue Heron present 19
281180010	ABNGA04040*201*FL	ARDEA ALBA	GREAT EGRET	1989-06-12	G5	S4	N	N		Species present 1989-04-18, 1989-04-24, and 1989-06-12. Not observed 1989-05-17.
281180011	ABNGA06030*122*FL	EGRETTA THULA	SNOWY EGRET	1989-06-12	G5	S4	N	LS		Species present 1989-06-12. Not observed 1989-04-18, 1989-04-24, and 1989-05-17.

FNAI ELEMENT OCCURRENCE RECORDS ON OR NEAR SITE

GISID	EOCODE	SCIENTIFIC NAME	COMMON NAME	DATE OBSERVED	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS	DESCRIPTION	COMMENTS
281180012	ABNGA06040*148*FL	EGRETTA CAERULEA	LITTLE BLUE HERON	1989-06-12	G5	S4	N	LS		Species present 1989-06-12. Not observed 1989-04-18, 1989-04-24, and 1989-05-17.
281180013	ARAAF01030*A89*FL	GOPHERUS POLYPHEMUS	GOPHER TORTOISE	1998-12-21	G3	S3	N	LS	SMALL DISTURBED SANDHILL, FEW MATURE PINUS PALUSTRIS, SEEDLINGS COMMON; MUCH OF HILLTOP COVERED BY XERIC HAMMOCK; ARISTIDA STRICTA COMMON AND WIDESPREAD, MESIC FLATWOODS DOWNSLOPE TO SOUTHWEST (PNDSCH03).	98-12-21: 5 ABANDONED BURROWS IN SANDHILL, 1 ACTIVE BURROW (ADULT) OBSERVED AT EDGE OF MESIC FLATWOODS (PNDSCH03).
281270003	ABNKC10010*578*FL	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	1991	G4	S3	LT	LT		NEST: 1991: DESTROYED, 0 YOUNG; 1990: PRODUCTIVITY UNKNOWN; 1989: PRODUCED 1 YOUNG; 1985-1988 ACTIVE. FLEDGED YOUNG 1986, 1988, UNKNOWN 1985.
281270005	ORKER00000*359*FL	BIRD ROOKERY		1989-06-12			N	N	Strip mine.	Multi-species rookery, 11 species. 501-750 birds 1987-04-28, >1,000 birds 1987-04-28, vacant 1989-05-17; Great Egret, Cattle Egret, Double-crested Cormorant present 1989-05-17 (no estimate of abundance), >1,000 birds 1989-06-12. Great Egret present 1987-
281270006	ABNGA04040*202*FL	ARDEA ALBA	GREAT EGRET	1989-06-12	G5	S4	N	N	Strip mine.	Species present 1987-04-28 (both surveys), 1989-05-17 (second survey), and 1989-06-12. Not observed 1989-05-17 (first survey).
281270007	ABNGA06030*123*FL	EGRETTA THULA	SNOWY EGRET	1989-06-12	G5	S4	N	LS	Strip mine.	Species present 1987-04-28 (both surveys), and 1989-06-12. Not observed 1989-05-17 (both surveys).
281270008	ABNGA06040*149*FL	EGRETTA CAERULEA	LITTLE BLUE HERON	1989-06-12	G5	S4	N	LS	Strip mine.	Species present 1987-04-28 (second survey), and 1989-06-12. Not observed 1987-04-28 (first survey) and 1989-05-17 (both surveys)
281270009	ABNGA06050*119*FL	EGRETTA TRICOLOR	TRICOLORED HERON	1987-04-28	G5	S4	N	LS	Strip mine	Species present 1987-04-28 (second survey). Not observed 1987-04-28 (first survey), 1989-05-17 (both surveys), and 1989-06-12.
281270010	ABNGA11010*039*FL	NYCTICORAX NYCTICORAX	BLACK-CROWNED NIGHT-HERON	1987-04-28	G5	S3?	N	N	Strip mine.	Species present 1987-04-28 (both surveys). Not observed 1989-05-17 (both surveys), and 1989-06-12.
281270011	ABNGE01010*110*FL	EUDOCIMUS ALBUS	WHITE IBIS	1987-06-12	G5	S4	N	LS	Strip mine.	Species present 1987-04-28 (both surveys), and 1989-06-12. Not observed 1989-05-17 (both surveys).
281270012	ABNGE02010*014*FL	PLEGADIS FALCINELLUS	GLOSSY IBIS	1989-06-12	G5	S2	N	N	Strip mine.	Species present 1987-04-28 (second survey), and 1989-06-12. Not observed 1987-04-28 (first survey), and 1989-05-17 (both surveys).

FNAI ELEMENT OCCURRENCE RECORDS ON OR NEAR SITE

GISID	EOCODE	SCIENTIFIC NAME	COMMON NAME	DATE OBSERVED	GLOBAL RANK	STATE RANK	FEDERAL STATUS	STATE STATUS	DESCRIPTION	COMMENTS
281271190	ABNGA06030*230*FL	EGRETTA THULA	SNOWY EGRET	1987-04-28	G5	S4	N	LS	Artificial lake, pond, or borrow pit; mine, rock quarry	1987/04/28: D.E. Runde, GFC. Unable to separate from photos of Tenoroc but no counts possible anyway. Aerial estimates only included here - see CBR forms for data from ground visit. "Total" = E (includes GREG, SNEG, CAEG, GBHE, BCNH, WHIB, ANHI, DCCO, SM
281271320	ABNGA06030*240*FL	EGRETTA THULA	SNOWY EGRET	1987-04-30	G5	S4	N	LS	Artificial lake, pond, or borrow pit	1987/04/30: B.A. Millsap, GFC. WADING BIRD RECORD FROM MILLSAP@S OCCUR.DBF
281271571	ABNGA11010*091*FL	NYCTICORAX NYCTICORAX	BLACK-CROWNED NIGHT-HERON	1987-04-30	G5	S3?	N	N	Artificial lake, pond, or borrow pit	1987-04-30: B.A. Millsap, GFC, observation 10 individuals. WADING BIRD RECORD FROM MILLSAP@S OCCUR.DBF
281272291	ABNGA06040*347*FL	EGRETTA CAERULEA	LITTLE BLUE HERON	1989-06-12	G5	S4	N	LS	Old phosphate mine area, willow trees, large phosphate mine zone	1987/04/28: D.E. Runde, GFC, observation. DCCO postnesting, WHIB incubating and hatching. No obs. on nesting status of other spp. "Total" (individuals?) = 2873 (also includes GREG, SNEG, CAEG, LBHE, TCHE, BCNH, GLIB, ANHI). 1989/06/12: R.B. Renken, GFC,

Florida Natural Areas Inventory: Areas of Conservation Interest (ACI) and Potential Natural Areas (PNA) Data Layers

Effective January 1, 1998, the former Areas of Conservation Interest data layer categories A, B and C have been reclassified into two separate layers known as Areas of Conservation Interest (ACI) and Potential Natural Areas (PNA). The former ACI categories B and C have been renamed and assigned new ranks as explained below. The only changes made have been in data layer names and rank assignments. The actual information contained in the data layers remains the same.

I. Areas of Conservation Interest (ACI)

(Formerly ACI Category A, no internal ranking assigned)

The Areas of Conservation Interest data layer indicates, throughout the State of Florida, natural resource areas that remain in private ownership and are not managed or listed for conservation purposes. These areas have been identified on the basis of extensive ground-truthing and/or the presence of highly ranked (FNAI G1/S1) documented plant, animal, or natural community element occurrences. The database information was supplemented by FNAI's scientific staff interpretation of landscape vegetation from Florida Department of Transportation (FDOT) aerial photographs. FNAI occurrence information is compiled from a variety of sources including field surveys by FNAI staff, published literature, herbaria and museum collections and personal communication or unpublished notes.

II. Potential Natural Areas (PNA)

(Formerly ACI Category B and C; ranking of 1-5 assigned with 1 indicating the highest quality natural communities)

The Potential Natural Areas data layer indicates, throughout the State of Florida, lands that are in private ownership and are not managed or listed for conservation purposes that are possible examples of good quality natural communities. These areas were determined from FNAI's scientific staff vegetative interpretation of 1988-1993 FDOT aerial photographs and from input received during Regional Ecological Workshops held for each regional planning council. These workshops were attended by experts familiar with natural areas in the region. Element occurrences in the FNAI database may or may not be present on these sites. In order to be classified as a Potential Natural Area (with the exception of internal rank PNA-5) the natural communities identified through aerial photographs must meet the following criteria:

1. Must be a minimum of 500 acres. *Exceptions*: sandhill, min. 320 acres; scrub, min. 80 acres; pine rockland, min. 20 acres; dry prairie, min. 320 acres; *or* any example of coastal rock barren, upland glade, coastal dune lake, spring-run stream or terrestrial cave.

2. Must contain at least one of the following:
   a. One or more high quality examples of FNAI state ranked S3 or above natural communities.
   b. An outstanding example of any FNAI tracked natural community.

Potential Natural Areas have been assigned ranks of PNA-1 through PNA-4 mostly based on size and perceived quality and type of natural community present. The areas included in internal rank PNA-5 (former ACI Category C) are exceptions to the above criteria. These areas were identified through the same process of aerial photographic interpretation and regional workshops as the PNA 1 through 4 ranked sites, but do not meet the standard criteria. These PNA 5 areas are considered lower priority for conservation than areas ranked PNA 1- 4, but nonetheless are believed to be ecologically viable tracts of land representative of Florida's natural ecosystems.

RANK EXPLANATIONS

for FNAI Global Rank, FNAI State Rank, Federal Status, and State Status

The Nature Conservancy and the Natural Heritage Program Network (of which FNAI is a part) define an element as any exemplary or rare component of the natural environment, such as a species, natural community, bird rookery, spring, sinkhole, cave, or other ecological feature. An element occurrence (EO) is a single extant habitat that sustains or otherwise contributes to the survival of a population or a distinct, self-sustaining example of a particular element.

Using a ranking system developed by The Nature Conservancy and the Natural Heritage Program Network, the Florida Natural Areas Inventory assigns two ranks to each element. The global rank is based on an element's worldwide status; the state rank is based on the status of the element in Florida. Element ranks are based on many factors, the most important ones being estimated number of Element occurrences, estimated abundance (number of individuals for species; area for natural communities), range, estimated adequately protected EOs, relative threat of destruction, and ecological fragility.

Federal and State status information is from the U.S. Fish and Wildlife Service; and the Florida Game and Freshwater Fish Commission (animals), and the Florida Department of Agriculture and Consumer Services (plants), respectively.

FNAI GLOBAL RANK DEFINITIONS

G1	=	Critically imperiled globally because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.
G2	=	Imperiled globally because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
G3	=	Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction of other factors.
G4	=	apparently secure globally (may be rare in parts of range)
G5	=	demonstrably secure globally
GH	=	of historical occurrence throughout its range, may be rediscovered (e.g., ivory-billed woodpecker)
GX	=	believed to be extinct throughout range
GXC	=	extirpated from the wild but still known from captivity or cultivation
G#?	=	tentative rank (e.g., G2?)
G#G#	=	range of rank; insufficient data to assign specific global rank (e.g., G2G3)
G#T#	=	rank of a taxonomic subgroup such as a subspecies or variety; the G portion of the rank refers to the entire species and the T portion refers to the specific subgroup; numbers have same definition as above (e.g., G3T1)
G#Q	=	rank of questionable species - ranked as species but questionable whether it is species or subspecies; numbers have same definition as above (e.g., G2Q)
G#T#Q	=	same as above, but validity as subspecies or variety is questioned.
GU	=	due to lack of information, no rank or range can be assigned (e.g., GUT2).
G?	=	not yet ranked (temporary)

FNAI STATE RANK DEFINITIONS

S1	=	Critically imperiled in Florida because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.
S2	=	Imperiled in Florida because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
S3	=	Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction of other factors.
S4	=	apparently secure in Florida (may be rare in parts of range)
S5	=	demonstrably secure in Florida

FNAI STATE RANK DEFINITIONS (cont.)

SH	=	of historical occurrence throughout its range, may be rediscovered (e.g., ivory-billed woodpecker)

FLORIDA NATURAL AREAS INVENTORY

1018 Thomasville Road, Suite 200-C, Tallahassee, FL 32303 (850) 224-8207

Polk County Summary

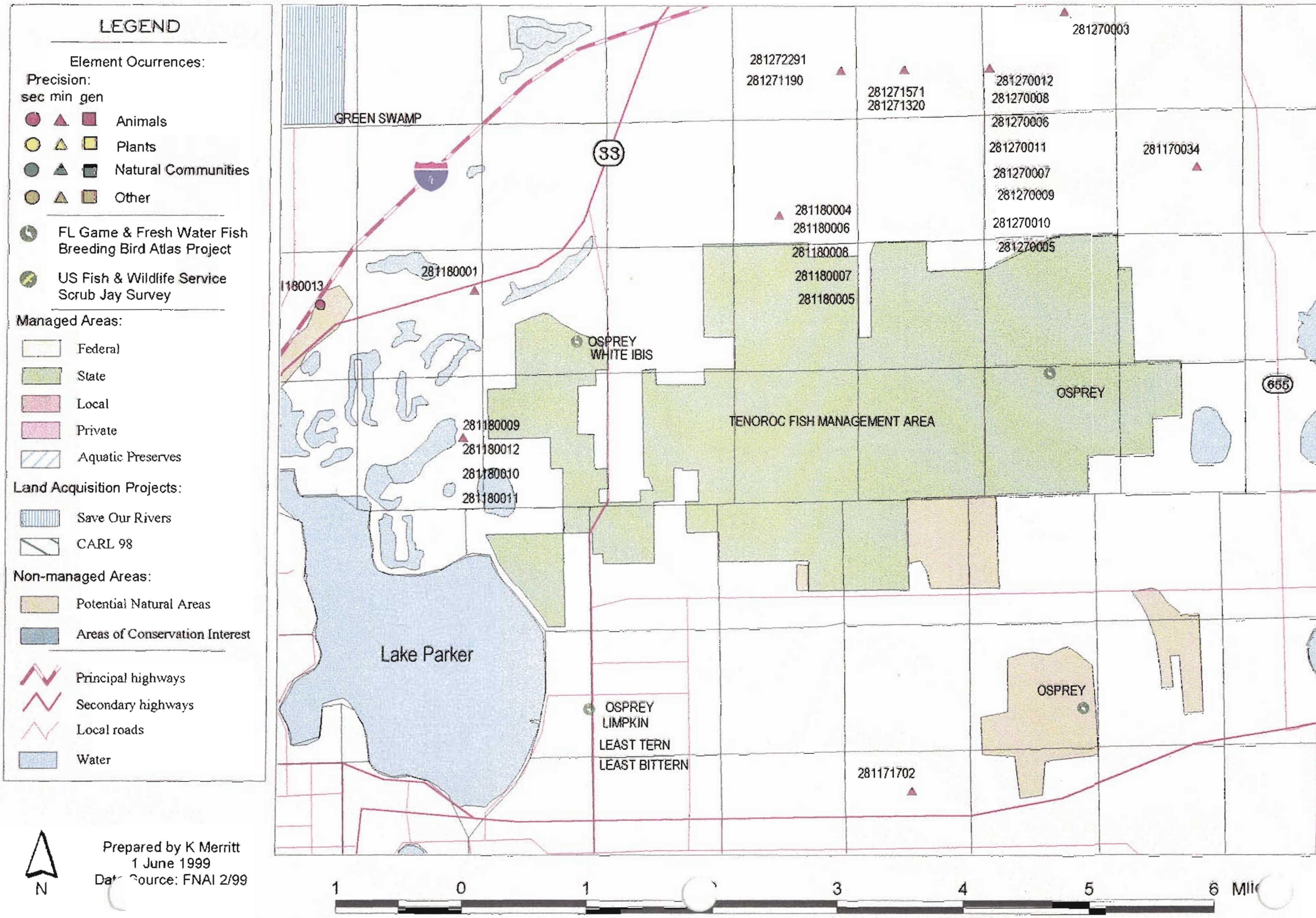
Rare Species and Natural Communities

Scientific Name	Common Name	Global Rank*	State Rank*	Federal Status*	State Status*	Occurrence Status†
AMPHIBIANS						
Rana capito	gopher frog	G4	S3	N	LS	C
REPTILES						
Alligator mississippiensis	American alligator	G5	S4	T(S/A)	LS	C
Clemmys guttata	spotted turtle	G5	S3?	N	N	C
Crotalus adamanteus	eastern diamondback rattlesnake	G5	S3	N	N	C
Drymarchon corais couperi	eastern indigo snake	G4T3	S3	LT	LT	C
Eumeces egregius lividus	blue-tailed mole skink	G4T2	S2	LT	LT	C
Gopherus polyphemus	gopher tortoise	G3	S3	N	LS	C
Lampropeltis calligaster	mole snake	G5	S2S3	N	N	P
Neoseps reynoldsi	sand skink	G2	S2	LT	LT	C
Pituophis melanoleucus mugitus	Florida pine snake	G5T3?	S3	N	LS	C
Pseudemys concinna suwanniensis	Suwannee cooter	G5T3	S3	N	LS	P
Sceloporus woodi	Florida scrub lizard	G3	S3	N	N	C
Stilosoma extenuatum	short-tailed snake	G3	S3	N	LT	P
BIRDS						
Accipiter cooperii	Cooper's hawk	G4	S3?	N	N	P
Aimophila aestivalis	Bachman's sparrow	G3	S3	N	N	C
Ajaia ajaja	roseate spoonbill	G5	S2S3	N	LS	P
Ammodramus savannarum floridanus	Florida grasshopper sparrow	G5T1	S1	LE	LE	C
Aphelocoma coerulescens	Florida scrub-jay	G3	S3	LT	LT	C
Aramus guarauna	limpkin	G5	S3	N	LS	P
Ardea alba	great egret	G5	S4	N	N	C
Buteo brachyurus	short-tailed hawk	G4?	S3	N	N	P
Caracara plancus	crested caracara	G5	S2	LT	LT	C
Egretta caerulea	little blue heron	G5	S4	N	LS	C
Egretta thula	snowy egret	G5	S4	N	LS	C
Egretta tricolor	tricolored heron	G5	S4	N	LS	C
Elanoides forficatus	swallow-tailed kite	G4	S2S3	N	N	P
Eudocimus albus	white ibis	G5	S4	N	LS	C
Falco columbarius	merlin	G5	SU	N	N	P
Falco peregrinus	peregrine falcon	G4	S2	LE	LE	P
Falco sparverius paulus	southeastern American kestrel	G5T3T4	S3?	N	LT	P
Grus canadensis pratensis	Florida sandhill crane	G5T2T3	S2S3	N	LT	C
Haliaeetus leucocephalus	bald eagle	G4	S3	LT	LT	C
Ixobrychus exilis	least bittern	G5	S4	N	N	P
Mycteria americana	wood stork	G4	S2	LE	LE	C
Nyctanassa violacea	yellow-crowned night-heron	G5	S3?	N	N	C
Nycticorax nycticorax	black-crowned night-heron	G5	S3?	N	N	C
Pandion haliaetus	osprey	G5	S3S4	N	LS**	C
Picoides borealis	red-cockaded woodpecker	G3	S2	LE	LT	C
Picoides villosus	hairy woodpecker	G5	S3?	N	N	P
Plegadis falcinellus	glossy ibis	G5	S2	N	N	C
Rostrhamus sociabilis plumbeus	snail kite	G4G5T1	S1	LE	LE	C
Rynchops niger	black skimmer	G5	S3	N	LS	P
Speotyto cunicularia floridana	Florida burrowing owl	G4T3	S3	N	LS	P
Sterna caspia	Caspian tern	G5	S2?	N	N	P

Florida Natural Areas Inventory

1018 Thomasville Rd., 200-C
Tallahassee, FL 32303
(850) 224-8207

Tenoroc Fish Management Area



Prepared by K Merritt
1 June 1999
Dat- Source: FNAI 2/99

Polk County Summary

Rare Species and Natural Communities

Scientific Name	Common Name	Global Rank*	State Rank*	Federal Status*	State Status*	Occurrence Status†
Sterna sandvicensis	sandwich tern	G5	S2	N	N	P
MAMMALS						
Corynorhinus rafinesquii	Rafinesque's big-eared bat	G3	S3?	N	N	C
Eptesicus fuscus	big brown bat	G5	S3	N	N	C
Mustela frenata peninsulae	Florida long-tailed weasel	G5T3	S3?	N	N	C
Neofiber alleni	round-tailed muskrat	G3	S3	N	N	C
Podomys floridanus	Florida mouse	G3	S3	N	LS	C
Sciurus niger shermani	Sherman's fox squirrel	G5T2	S2	N	LS	C
Sorex longirostris longirostris	southeastern shrew	G5T5	S4	N	N	C
Ursus americanus floridanus	Florida black bear	G5T2	S2	C	LT**	P
INVERTEBRATES						
Cicindela highlandensis	Lake Wales Ridge tiger beetle	G2	S1	N	N	C
Cicindela hirtilabris	peninsular tiger beetle	G4	S?	N	N	C
Cicindela scabrosa	scrub tiger beetle	G3	S?	N	N	C
VASCULAR PLANTS						
Agrimonia incisa	incised groove-bur	G3	S2	N	N	C
Aristida rhizomophora	Florida three-awned grass	G2	S2	N	N	C
Asclepias curtissii	Curtiss' milkweed	G3	S3	N	LE	C
Bonamia grandiflora	Florida bonamia	G3	S3	LT	LE	C
Calamintha ashei	Ashe's savory	G3	S3	N	LT	C
Centrosema arenicola	sand butterfly pea	G2	S2	N	N	C
Cheiroglossa palmata	hand fern	G4	S2	N	LE	C
Chionanthus pygmaeus	pygmy fringe tree	G3	S3	LE	LE	C
Clitoria fragrans	pigeon-wing	G3	S3	LT	LE	C
Coelorachis tuberculosa	piedmont jointgrass	G3	S3	N	N	C
Conradina brevifolia	short-leaved rosemary	G2Q	S2	LE	LE	C
Crotalaria avonensis	Avon Park rabbit-bells	G1	S1	LE	LE	C
Dicerandra frutescens	scrub mint	G1	S1	LE	LE	C
Drosera intermedia	spoon-leaved sundew	G5	S3	N	LT	C
Eriogonum longifolium var gnaphalifolium	scrub buckwheat	G4T3	S3	LT	LE	C
Eryngium cuneifolium	wedge-leaved button-snakeroot	G1	S1	LE	LE	R
Gymnopogon chapmanianus	Chapman's skeletongrass	G2	S2	N	N	C
Hartwrightia floridana	hartwrightia	G2	S2	N	LT	C
Hypericum cumulicola	Highlands scrub hypericum	G2	S2	LE	LE	C
Hypericum edisonianum	Edison's ascyrum	G2	S2	N	LE	C
Ilex opaca var arenicola	scrub holly	G5T3	S3	N	N	C
Illicium parviflorum	star anise	G1G2	S1	N	LE	C
Lechea cernua	nodding pinweed	G3	S3	N	LT	C
Lechea divaricata	pine pinweed	G2	S2	N	LE	C
Liatris ohlingerae	Florida blazing star	G3	S3	LE	LE	C
Lupinus westianus var aridorum	scrub lupine	G2T1	S1	LE	LE	C
Matelea floridana	Florida spiny-pod	G2	S2	N	LE	C
Myriophyllum laxum	piedmont water-milfoil	G3	S2S3	N	N	C
Nemastylis floridana	fall-flowering ixia	G2	S2	N	LE	C
Nolina brittoniana	Britton's beargrass	G2	S2	LE	LE	C
Panicum abscissum	cutthroat grass	G2	S2	N	LE	C

Polk County Summary

Rare Species and Natural Communities

Scientific Name	Common Name	Global Rank*	State Rank*	Federal Status*	State Status*	Occurrence Status†
Paronychia chartacea ssp chartacea	paper-like nailwort	G3T3	S3	LT	LE	C
Pavonia spinifex	yellow hibiscus	G4G5	S2S3	N	N	C
Persea humilis	scrub bay	G3	S3	N	N	C
Physostegia leptophylla	slender-leaved dragon-head	G4?	S3S4	N	N	C
Platanthera integra	yellow fringeless orchid	G4	S3S4	N	LE	C
Polygala lewtonii	Lewton's polygala	G2	S2	LE	LE	C
Polygonella basiramia	hairy jointweed	G3	S3	LE	LE	C
Polygonella myriophylla	Small's jointweed	G3	S3	LE	LE	C
Prunus geniculata	scrub plum	G2G3	S2S3	LE	LE	C
Pteroglossaspis ecristata	wild coco	G2G3	S2	N	LT	C
Rhynchospora decurrens	decurrent beakrush	G3G4	S2	N	N	C
Salix floridana	Florida willow	G2	S2	N	LE	C
Schizachyrium niveum	scrub bluestem	G1	S1	N	N	C
Stillingia sylvatica ssp tenuis	queen's delight	G4G5T2	S2	N	N	C
Stylisma abdita	scrub stylisma	G2G3	S2S3	N	LE	C
Warea amplexifolia	clasping warea	G1	S1	LE	LE	C
Warea carteri	Carter's warea	G1G2	S1S2	LE	LE	C
Zephyranthes simpsonii	rain lily	G2G3	S2S3	N	LT	C
Ziziphus celata	scrub ziziphus	G1	S1	LE	LE	C
NON-VASCULAR PLANTS						
Cladonia perforata	perforate reindeer lichen	G1	S1	LE	LE	C
NATURAL COMMUNITIES						
Basin Swamp		G4?	S3	N	N	C
Baygall		G4?	S4?	N	N	C
Blackwater Stream		G4	S2	N	N	C
Depression Marsh		G4?	S3	N	N	C
Dry Prairie		G2	S2	N	N	C
Floodplain Forest		G?	S3	N	N	C
Floodplain Marsh		G3?	S2	N	N	C
Floodplain Swamp		G?	S4?	N	N	C
Hydric Hammock		G?	S4?	N	N	C
Mesic Flatwoods		G?	S4	N	N	C
Prairie Hammock		G4	S4	N	N	C
Sandhill Upland Lake		G3	S2	N	N	C
Sandhill		G2G3	S2	N	N	C
Scrubby Flatwoods		G3	S3	N	N	C
Scrub		G2	S2	N	N	C
Seepage Slope		G3?	S2	N	N	C
Slough		G4	S4?	N	N	C
Swale		G4?	S3	N	N	C
Wet Flatwoods		G?	S4?	N	N	C
Wet Prairie		G?	S4?	N	N	C
Xeric Hammock		G?	S3	N	N	C
OTHER						
Bird rookery				N	N	C

Polk County Summary

Rare Species and Natural Communities

Scientific Name	Common Name	Global Rank*	State Rank*	Federal Status*	State Status*	Occurrence Status†

* See attached ***FNAI Rank Explanations*** sheet for definitions of Global and State Ranks, and **State and Federal Status**

** See attached *FNAI Rank Explanations* sheet, *Special Animal Listings - State and Federal Status* section

† COUNTY OCCURRENCE STATUS

Vertebrates and Invertebrates:

- **C = (Confirmed)** Occurrence status derived from a documented record in the FNAI data base.
- **P = (Potential)** Occurrence status derived from a reported occurrence for the county, or the occurrence lies within the published range of the taxon.
- **N = (Nesting)** For sea turtles only; occurrence status derived from documented nesting occurrences.

Plants, Natural Communities, and Other:

- **C = (Confirmed)** Occurrence status derived from a documented record in the FNAI data base or from a herbarium specimen.
- **R = (Reported)** Occurrence status derived from published reports.

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Tenoroc State Preserve

1983-84

Species	*Nov*	*Jan*	*Apr*	*May*	*Sep84*	*Total*
Pied-billed Grebe	20	20	9	8	15	72
American White Pelican		560	137			697
Double-crested Cormorant	690	800	260	300	220	2270
Anhinga	96	25	117	29	55	322
American Bittern	+					
Least Bittern				1	3	4
Great Blue Heron	55	43	44	36	34	212
Great Egret	65	35	42	58	60	260
Snowy Egret	8	9	6	13	8	44
Little Blue Heron	29	15	17	17	9	87
Tricolored Heron	16	3	5	11	11	46
Cattle Egret	50	60	50	110	210	480
Green-backed Heron	14	9	7	16	9	57
Bl-crowned Night Heron	39	6		16	6	68
White Ibis	112	76	310	86	108	692
Glossy Ibis	55	37	27	17	62	198
Wood Stork	37	27	10	1	6	81
Snow Goose	+					
Wood Duck	3	1		2		6
Green-winged Teal	4					4
Mottled Duck	19	9	1	5		34
Mallard	1				13	14
Blue-winged Teal	26	5	13			44
Northern Shoveler	10	2				12
American Wigeon		6				6
Canvasback	3	3	2			7
Redhead		2				2
Ring-necked Duck	42	170				212
Lesser Scaup	3					3
Red-breasted Merganser			1			1
Black Vulture	4	4	16	1	2	27
Turkey Vulture	27	425	35	4	11	502
Osprey	7	9	18		3	37
Bald Eagle	2	2	2	2	1	9
Northern Harrier	16	14	6		3	39
Sharp-shinned Hawk	8	4	4		1	17

Cooper's Hawk					1	1
Red-shouldered Hawk	3	6	3	4	7	23
Red-tailed Hawk	14	7	3	6	5	35
American Kestrel	18	7	4		1	30
Merlin	1					1
Northern Bobwhite	1	18	15	51	14	99
King Rail				4	2	6
Sora		6		7		13
Common Moorhen	103	69	73	49	134	428

Species	*Nov*	*Jan*	*Apr*	*May*	*Sept84*	*Totals*
American Coot	184	560	228	5	2	979
Limpkin	4			10		14
Killdeer	66	21	29	17	21	154
Black-necked Stilt			2	2		4
Greater Yellowlegs	3					3
Lesser Yellowlegs	15	2	10		1	28
Solitary Sandpiper					1	1
Spotted Sandpiper					1	1
Western Sandpiper	10					10
Least Sandpiper	1					1
Dowitcher sp.			1			1
Common Snipe	17	29	26			72
Laughing Gull	11	1	34	2		48
Bonaparte's Gull		1				1
Ring-billed Gull	5	220	39	11	8	283
Caspian Tern		3	9			12
Forster's Tern	1	46	2			49
Least Tern				1		1
Rock Dove	7	15			2	24
Mourning Dove	38	8	16	44	36	142
Common Ground Doe	23	3	8	24	26	84
Yellow-billed Cuckoo			12	4		16
Barn Owl	3	2				5
Great Horned Owl		1	1	1		3
Barred Owl	1					1
Common Nighthawk				7	6	13
Chuck-will's-widow				6		6
Chimney Swift				4	3	7
Belted Kingfisher	11	6	2		2	21
Red-headed Woodpecker		1				1
Red-bellied Woodpecker	4	3	7	8	3	25
Downy Woodpecker	1	3		5	7	16
Northern Flicker	8	10	10	11	6	45

Pileated Woodpecker	2	4	4		1	11
Eastern Wood-Pewee					1	1
Eastern Phoebe	28	7	2			37
Western Kingbird	+					
Eastern Kingbird				1	1	2
Purple Martin			10	2		12
Tree Swallow	22	780	610			702
N.Rough-winged Swallow				2	4	6
Barn Swallow			1		22	23
Blue Jay	51	21	26	51	39	188
Fish Crow	148	64	115	68	97	492
Tufted Titmouse		7	13	2	2	24
Carolina Wren	15	15	15	49	31	134
House Wren	26	16	9			51
Sedge Wren	1	11	4			16
Marsh Wren	1	1				2
Ruby-crowned Kinglet	33	27	13		1	74

Species	***Nov***	***Jan***	***Apr***	***May***	***Sep84***	***Total***
Blue-gray Gnatcatcher	29	16	16		18	79
Veery					2	2
Hermit Thrush		1	1			2
American Robin	220	800	15			1035
Gray Catbird	32	13	9	1	2	57
Northern Mockingbird	21	19	39	48	45	172
Brown Thrasher	6	5	2	7	12	32
Water Pipit		+				
Cedar Waxwing		9				9
Loggerhead Shrike	41	25	15	32	41	154
European Starling	7	7	4	2	34	54
White-eyed Vireo	11	10	40	39	17	117
Solitary Vireo			4			4
Red-eyed Vireo					2	2
Tennessee Warbler					1	1
Orange-crowned Warbler		7				7
Northern Parula		1	18	14	6	39
Yellow Warbler					4	4
Chestnut-sided Warbler					1	1
Magnolia Warbler					2	2
Yellow-rumped Warbler	234	254	115			499
Blackburnian Warbler					5	5
Yellow-throated Warbler	1	3	2		3	9
Pine Warbler	1	4	9	6	4	24
Prairie Warbler	3	1			9	13
Palm Warbler	147	63	13		7	230

Blackpoll Warbler				1		1
Cerulean Warbler					1	1
Black-and-white Warbler			4		4	8
American Redstart					8	8
Ovenbird					2	2
Common Yellowthroat	47	35	33	19	16	150
Northern Cardinal	16	21	47	85	40	209
Rose-breasted Grosbeak					1	1
Indigo Bunting				1		1
Rufous-sided Towhee	39	27	53	83	45	247
Field Sparrow		2	6			8
Savannah Sparrow	34	43	25		1	103
Henslow's Sparrow		1				1
Song Sparrow		1	1			2
Swamp Sparrow	20	15	29			64
White-throated Sparrow		1				1
Red-winged Blackbird425	190	325	266	722		1928
Eastern Meadowlark	104	60	54	63	32	313
Boat-tailed Grackle	403	46	153	160	220	982
Common Grackle	131	104	11	51	700	997
Brown-headed Cowbird					2	2
Northern Oriole					3	3
American Goldfinch	1	11	59			71
House Sparrow					1	1
Total species	90	95	87	68	90	146
Total Birds	6226	6151	3592	2087	3387	21443

+ Species found outside of count week

Compiled by: Charles Geanangel
330 East Swoope Street
Lake Alfred, Florida,33850

January 1994

Environmental Conservation Laboratories
10207 General Drive
Orlando, Florida 32824-8529
407 / 826-5314
Fax 407 / 850-6945
www.encolabs.com

ENCO Laboratories

DHRS Certification No. E83182

CLIENT : Bromwell & Carrier, Inc.
ADDRESS: P.O. Box 5467
Lakeland, FL 33807-5467

REPORT # : OR5212
DATE SUBMITTED: January 26, 1999
DATE REPORTED : February 5, 1999

ATTENTION: Tom Shaw

SAMPLE IDENTIFICATION

Samples submitted and
identified by client as:

PROJECT #: 979657

DEP-Tenoroc

01/26/99

#1 - SW-1 @ 12:35
#2 - SW-2 @ 13:45
#3 - SW-3 @ 16:10
#4 - SW-4 @ 16:25
#5 - SW-5 @ 15:15

)JECT MANAGER ______________________
Marcia C. Terlep

RESULTS OF ANALYSIS

EPA METHOD 625 - BASE/NEUTRAL-ACID SVOAS	SW-1	SW-2	Units
Acenaphthene	10 U	10 U	µg/L
Acenaphthylene	10 U	10 U	µg/L
Anthracene	10 U	10 U	µg/L
p-(dimethylamino)azobenzene	10 U	10 U	µg/L
Benzidine	10 U	10 U	µg/L
Benzo(a)anthracene	10 U	10 U	µg/L
Benzo(b)fluoranthene	10 U	10 U	µg/L
Benzo(k)fluoranthene	10 U	10 U	µg/L
Benzo(g,h,i)perylene	10 U	10 U	µg/L
Benzo(a)pyrene	10 U	10 U	µg/L
Benzylbutyl phthalate	10 U	10 U	µg/L
Bis(2-chloroethoxy)methane	10 U	10 U	µg/L
Bis(2-chloroethyl)ether	10 U	10 U	µg/L
Bis(2-chloroisopropyl)ether	10 U	10 U	µg/L
Bis(2-ethylhexyl)phthalate	10 U	10 U	µg/L
4-Bromophenylphenyl ether	10 U	10 U	µg/L
2-Chloronaphthalene	10 U	10 U	µg/L
4-Chlorophenyl phenyl ether	10 U	10 U	µg/L
Chrysene	10 U	10 U	µg/L
Dibenzo(a,h)anthracene	10 U	10 U	µg/L
1,2-Dichlorobenzene	10 U	10 U	µg/L
1,3-Dichlorobenzene	10 U	10 U	µg/L
1,4-Dichlorobenzene	10 U	10 U	µg/L
3,3'-Dichlorobenzidine	20 U	20 U	µg/L
Diethyl phthalate	10 U	10 U	µg/L
Dimethyl phthalate	10 U	10 U	µg/L
Di-n-butyl phthalate	10 U	10 U	µg/L
Di-n-octyl phthalate	10 U	10 U	µg/L
2,4-Dinitrotoluene	10 U	10 U	µg/L
2,6-Dinitrotoluene	10 U	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 625 (cont.) - BASE/NEUTRAL-ACID SVOAS	**SW-1**	**SW-2**	**Units**
Fluoranthene	10 U	10 U	µg/L
Fluorene	10 U	10 U	µg/L
Hexachlorobenzene	10 U	10 U	µg/L
Hexachlorobutadiene	10 U	10 U	µg/L
Hexachlorocyclopentadiene	10 U	10 U	µg/L
Hexachloroethane	10 U	10 U	µg/L
Indeno(1,2,3-cd)pyrene	10 U	10 U	µg/L
Isophorone	10 U	10 U	µg/L
1-Methylnaphthalene	10 U	10 U	µg/L
2-Methylnaphthalene	10 U	10 U	µg/L
Naphthalene	10 U	10 U	µg/L
Nitrobenzene	10 U	10 U	µg/L
N-Nitrosodimethylamine	10 U	10 U	µg/L
N-Nitrosodi-n-Propylamine	10 U	10 U	µg/L
N-Nitrosodiphenylamine	10 U	10 U	µg/L
Phenanthrene	10 U	10 U	µg/L
Pyrene	10 U	10 U	µg/L
1,2,4-Trichlorobenzene	10 U	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD 625 (cont.) -

BASE/NEUTRAL-ACID SVOAS	**SW-1**	**SW-2**	**Units**
4-Chloro-3-methylphenol	10 U	10 U	µg/L
2-Chlorophenol	10 U	10 U	µg/L
2,4-Dichlorophenol	10 U	10 U	µg/L
2,4-Dimethylphenol	10 U	10 U	µg/L
2,4-Dinitrophenol	10 U	10 U	µg/L
2-Methyl-4,6-Dinitrophenol	10 U	10 U	µg/L
2-Nitrophenol	10 U	10 U	µg/L
4-Nitrophenol	10 U	10 U	µg/L
Pentachlorophenol	10 U	10 U	µg/L
Phenol	10 U	10 U	µg/L
2 ,6-Trichlorophenol	10 U	10 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
Nitrobenzene -D5	73	76	53-132
2-Fluorobiphenyl	62	64	50-128
Terphenyl -D14	97	97	51-160
Phenol -D5	32	37	15-114
2-Fluorophenol	44	32	30-116
2,4,6-Tribromophenol	75	63	55-148
Date Extracted	01/27/99	01/27/99	
Date Analyzed	02/02/99	02/03/99	

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RESULTS OF ANALYSIS

EPA METHOD 608 - ORGANOCHLORINE PESTICIDES	SW-1	SW-2	Units
alpha-BHC	0.050 U	0.050 U	µg/L
beta-BHC	0.050 U	0.050 U	µg/L
gamma-BHC (Lindane)	0.050 U	0.050 U	µg/L
Heptachlor	0.050 U	0.050 U	µg/L
delta-BHC	0.050 U	0.050 U	µg/L
Aldrin	0.050 U	0.050 U	µg/L
Heptachlor Epoxide	0.050 U	0.050 U	µg/L
Chlordane gamma	0.050 U	0.050 U	µg/L
Chlordane alpha	0.050 U	0.050 U	µg/L
Endosulfan I	0.050 U	0.050 U	µg/L
[illegible]'-DDE	0.050 U	0.050 U	µg/L
Dieldrin	0.050 U	0.050 U	µg/L
Endrin	0.050 U	0.050 U	µg/L
4,4'-DDD	0.050 U	0.050 U	µg/L
Endosulfan II	0.050 U	0.050 U	µg/L
4,4'-DDT	0.050 U	0.050 U	µg/L
Endrin aldehyde	0.050 U	0.050 U	µg/L
Endosulfan sulfate	**0.14**	0.050 U	µg/L
Methoxychlor	0.10 U	0.10 U	µg/L
Endrin Ketone	0.050 U	0.050 U	µg/L
Chlordane (Total)	1.0 U	1.0 U	µg/L
Toxaphene	2.0 U	2.0 U	µg/L
PCB-1016/1242	1.0 U	1.0 U	µg/L
PCB-1221	1.0 U	1.0 U	µg/L
PCB-1232	1.0 U	1.0 U	µg/L
PCB-1248	1.0 U	1.0 U	µg/L
PCB-1254	1.0 U	1.0 U	µg/L
PCB-1260	1.0 U	1.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
2,4,5,6-TCMX	100	80	30-150
DBC	60	60	27-167
Date Extracted	01/29/99	01/29/99	
Date Analyzed	02/04/99	02/04/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 614 - ORGANOPHOSPHORUS PESTICIDES	SW-1	SW-2	Units
Demeton	1.0 U	1.0 U	µg/L
Diazinon	1.0 U	1.0 U	µg/L
Disulfoton	1.0 U	1.0 U	µg/L
Methyl Parathion	1.0 U	1.0 U	µg/L
Malathion	1.0 U	1.0 U	µg/L
Ethyl Parathion	1.0 U	1.0 U	µg/L
Ethion	1.0 U	1.0 U	µg/L
Azinphos methyl	1.0 U	1.0 U	µg/L
Chlorpyrifos	1.0 U	1.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
Tributyl Phosphate	133	133	65-137
Triphenyl Phosphate	83	73	61-127
Date Extracted	01/29/99	01/29/99	
Date Analyzed	02/04/99	02/04/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD 615 - CHLORINATED HERBICIDES	SW-1	SW-2	Units
Dalapon	1.0 U	1.0 U	μg/L
Dicamba	1.0 U	1.0 U	μg/L
MCPP	50 U	50 U	μg/L
MCPA	50 U	50 U	μg/L
Dichloroprop	1.0 U	1.0 U	μg/L
2,4-D	1.0 U	1.0 U	μg/L
2,4,5-TP (Silvex)	1.0 U	1.0 U	μg/L
2,4,5-T	1.0 U	1.0 U	μg/L
2,4-DB	1.0 U	1.0 U	μg/L
Dinoseb	1.0 U	1.0 U	μg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
2,4-DCAA	100	88	10-218
Date Extracted	02/03/99	02/03/99	
Date Analyzed	02/05/99	02/05/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	SW-1	SW-2	Units
Aluminum	202.1	1.0 U	1.0 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Antimony	204.2	0.0050 U	0.0050 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Arsenic	206.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Barium	208.1	0.50 U	0.50 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Beryllium	210.2	0.0010 U	0.0010 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Boron *	200.7	0.100 U	**0.138**	mg/L
Date Analyzed		01/28/99	01/28/99	
Cadmium	213.2	0.0020 U	0.0020 U	mg/L
Date Analyzed		01/31/99	01/31/99	
Chromium	218.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/30/99	01/30/99	
Copper	220.2	**0.0050**	0.0010 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Iron	236.1	**0.60**	**1.6**	mg/L
Date Analyzed		01/28/99	01/28/99	
Lead	239.2	0.0050 U	0.0050 U	mg/L
Date Analyzed		01/31/99	01/31/99	
Manganese	243.1	0.050 U	**0.070**	mg/L
Date Analyzed		01/28/99	01/28/99	

= Subcontract laboratory FL DHRS #83331 and #E83012.
U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	SW-1	SW-2	Units
Mercury	245.1	0.00020 U	0.00020 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Nickel	249.1	0.10 U	0.10 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Selenium	270.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Silver	272.2	0.00050 U	0.00050 U	mg/L
Date Analyzed		02/01/99	02/01/99	
Thallium	279.2	0.0020 U	0.0020 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Zinc	289.1	0.050 U	**0.090**	mg/L
Date Analyzed		01/28/99	01/28/99	

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ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

MISCELLANEOUS	METHOD	SW-1	SW-2	Units
Alkalinity (as CaCO3)	310.1	**50**	**60**	mg/L
Date Analyzed		01/30/99	01/30/99	
Ammonia-N	350.1	**0.10** I	**0.11** I	mg/L
Date Analyzed		01/28/99	01/28/99	
Unionized Ammonia	DRAFT	0.030 U	0.030 U	mg/L
Date Analyzed		02/04/99	02/04/99	
Specific Cond.	120.1	**200**	**160**	µmhos/cm
Date Analyzed		01/30/99	01/30/99	
Hexavalent Chromium	SM 3500 CR D	0.050 U	0.050 U	mg/L
Date Analyzed		01/27/99	01/27/99	
Cyanide, Total	335.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Fluoride	340.2	0.20 U	**0.38** I	mg/L
Date Analyzed		02/01/99	02/01/99	
MBAS	425.1	**0.11**	0.010 U	mg/L
Date Analyzed		01/27/99	01/27/99	
Nitrate-N	353.1	**1.6**	0.020 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Nitrogen, Total	351.2/353.1	**2.2**	**6.5**	mg/L
Date Analyzed		02/03/99	02/03/99	

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I Analyte detected; value is between the Method Detection Level (MDL) and the Practical Quantitation Level (PQL).

RESULTS OF ANALYSIS

MISCELLANEOUS	METHOD	SW-1	SW-2	Units
Phosphorus, Total	365.4	**0.41**	**2.7**	mg/L
Date Analyzed		02/02/99	02/02/99	
pH	150.1	**7.1**	**6.6**	S.U.
Date Analyzed		01/27/99	01/27/99	
Phenols	420.1	0.050 U	0.050 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Oil and Grease	413.1	1.0 U	1.0 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Fecal Coliform *	SM9222D	**620** BQ	**180** B	cols/100ml
Date Analyzed		01/26/99	01/26/99	
Total Coliform *	SM9222B	**1700** BQ	**400** B	cols/100ml
Date Analyzed		01/26/99	01/26/99	
Gross Alpha **	900.0	<1.1 ± 0.7	1.7 ± 0.8	pCi/l
Date Analyzed		01/30/99	01/30/99	

* = Subcontract laboratory FL DHRS #83331 and #E83012.
** = Subcontract laboratory FL DHRS #83141.
B = The total number of coliform colonies exceeds the metho indicated ideal ranges: Total Coliforms (20-80 colonies), Fecal Coliforms (20-60 colonies).
Q Sample analyzed after the approved holding time.
U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD 625 - BASE/NEUTRAL-ACID SVOAS	**SW-3**	**SW-4**	**Units**
Acenaphthene	10 U	10 U	µg/L
Acenaphthylene	10 U	10 U	µg/L
Anthracene	10 U	10 U	µg/L
p-(dimethylamino)azobenzene	10 U	10 U	µg/L
Benzidine	10 U	10 U	µg/L
Benzo(a)anthracene	10 U	10 U	µg/L
Benzo(b)fluoranthene	10 U	10 U	µg/L
Benzo(k)fluoranthene	10 U	10 U	µg/L
Benzo(g,h,i)perylene	10 U	10 U	µg/L
Benzo(a)pyrene	10 U	10 U	µg/L
Benzylbutyl phthalate	10 U	10 U	µg/L
Bis(2-chloroethoxy)methane	10 U	10 U	µg/L
Bis(2-chloroethyl)ether	10 U	10 U	µg/L
Bis(2-chloroisopropyl)ether	10 U	10 U	µg/L
Bis(2-ethylhexyl)phthalate	10 U	10 U	µg/L
4-Bromophenylphenyl ether	10 U	10 U	µg/L
2-Chloronaphthalene	10 U	10 U	µg/L
4-Chlorophenyl phenyl ether	10 U	10 U	µg/L
Chrysene	10 U	10 U	µg/L
Dibenzo(a,h)anthracene	10 U	10 U	µg/L
1,2-Dichlorobenzene	10 U	10 U	µg/L
1,3-Dichlorobenzene	10 U	10 U	µg/L
1,4-Dichlorobenzene	10 U	10 U	µg/L
3,3'-Dichlorobenzidine	20 U	20 U	µg/L
Diethyl phthalate	10 U	10 U	µg/L
Dimethyl phthalate	10 U	10 U	µg/L
Di-n-butyl phthalate	10 U	10 U	µg/L
Di-n-octyl phthalate	10 U	10 U	µg/L
2,4-Dinitrotoluene	10 U	10 U	µg/L
2,6-Dinitrotoluene	10 U	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD 625 (cont.) - BASE/NEUTRAL-ACID SVOAS	**SW-3**	**SW-4**	**Units**
Fluoranthene	10 U	10 U	µg/L
Fluorene	10 U	10 U	µg/L
Hexachlorobenzene	10 U	10 U	µg/L
Hexachlorobutadiene	10 U	10 U	µg/L
Hexachlorocyclopentadiene	10 U	10 U	µg/L
Hexachloroethane	10 U	10 U	µg/L
Indeno(1,2,3-cd)pyrene	10 U	10 U	µg/L
Isophorone	10 U	10 U	µg/L
1-Methylnaphthalene	10 U	10 U	µg/L
2-Methylnaphthalene	10 U	10 U	µg/L
Naphthalene	10 U	10 U	µg/L
Nitrobenzene	10 U	10 U	µg/L
N-Nitrosodimethylamine	10 U	10 U	µg/L
N-Nitrosodi-n-Propylamine	10 U	10 U	µg/L
N-Nitrosodiphenylamine	10 U	10 U	µg/L
Phenanthrene	10 U	10 U	µg/L
Pyrene	10 U	10 U	µg/L
1,2,4-Trichlorobenzene	10 U	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 625 (cont.) - BASE/NEUTRAL-ACID SVOAS	SW-3	SW-4	Units
4-Chloro-3-methylphenol	10 U	10 U	µg/L
2-Chlorophenol	10 U	10 U	µg/L
2,4-Dichlorophenol	10 U	10 U	µg/L
2,4-Dimethylphenol	10 U	10 U	µg/L
2,4-Dinitrophenol	10 U	10 U	µg/L
2-Methyl-4,6-Dinitrophenol	10 U	10 U	µg/L
2-Nitrophenol	10 U	10 U	µg/L
4-Nitrophenol	10 U	10 U	µg/L
Pentachlorophenol	10 U	10 U	µg/L
Phenol	10 U	10 U	µg/L
2 ,6-Trichlorophenol	10 U	10 U	µg/L
Surrogate:	% RECOV	% RECOV	LIMITS
Nitrobenzene -D5	63	66	53-132
2-Fluorobiphenyl	51	47	50-128
Terphenyl -D14	88	81	51-160
Phenol -D5	43	35	15-114
2-Fluorophenol	51	50	30-116
2,4,6-Tribromophenol	105	90	55-148
Date Extracted	01/27/99	01/27/99	
Date Analyzed	02/03/99	02/03/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 608 - ORGANOCHLORINE PESTICIDES	SW-3	SW-4	Units
alpha-BHC	0.050 U	0.050 U	µg/L
beta-BHC	0.050 U	0.050 U	µg/L
gamma-BHC (Lindane)	0.050 U	0.050 U	µg/L
Heptachlor	0.050 U	0.050 U	µg/L
delta-BHC	0.050 U	0.050 U	µg/L
Aldrin	0.050 U	0.050 U	µg/L
Heptachlor Epoxide	0.050 U	0.050 U	µg/L
Chlordane gamma	0.050 U	0.050 U	µg/L
Chlordane alpha	0.050 U	0.050 U	µg/L
Endosulfan I	0.050 U	0.050 U	µg/L
4,4'-DDE	0.050 U	0.050 U	µg/L
Dieldrin	0.050 U	0.050 U	µg/L
Endrin	0.050 U	0.050 U	µg/L
4,4'-DDD	0.050 U	0.050 U	µg/L
Endosulfan II	0.050 U	0.050 U	µg/L
4,4'-DDT	0.050 U	0.050 U	µg/L
Endrin aldehyde	0.050 U	0.050 U	µg/L
Endosulfan sulfate	0.050 U	0.050 U	µg/L
Methoxychlor	0.10 U	0.10 U	µg/L
Endrin Ketone	0.050 U	0.050 U	µg/L
Chlordane (Total)	1.0 U	1.0 U	µg/L
Toxaphene	2.0 U	2.0 U	µg/L
PCB-1016/1242	1.0 U	1.0 U	µg/L
PCB-1221	1.0 U	1.0 U	µg/L
PCB-1232	1.0 U	1.0 U	µg/L
PCB-1248	1.0 U	1.0 U	µg/L
PCB-1254	1.0 U	1.0 U	µg/L
PCB-1260	1.0 U	1.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
2,4,5,6-TCMX	80	84	30-150
DBC	60	68	27-167
Date Extracted	01/29/99	01/29/99	
Date Analyzed	02/04/99	02/04/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD 614 - ORGANOPHOSPHORUS PESTICIDES	SW-3	SW-4	Units
Demeton	1.0 U	1.0 U	µg/L
Diazinon	1.0 U	1.0 U	µg/L
Disulfoton	1.0 U	1.0 U	µg/L
Methyl Parathion	1.0 U	1.0 U	µg/L
Malathion	1.0 U	1.0 U	µg/L
Ethyl Parathion	1.0 U	1.0 U	µg/L
Ethion	1.0 U	1.0 U	µg/L
Azinphos methyl	1.0 U	1.0 U	µg/L
Chlorpyrifos	1.0 U	1.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
Tributyl Phosphate	103	117	65-137
Triphenyl Phosphate	67	67	61-127
Date Extracted	01/29/99	01/29/99	
Date Analyzed	02/04/99	02/04/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD 615 - CHLORINATED HERBICIDES	SW-3	SW-4	Units
Dalapon	1.0 U	1.0 U	µg/L
Dicamba	1.0 U	1.0 U	µg/L
MCPP	50 U	50 U	µg/L
MCPA	50 U	50 U	µg/L
Dichloroprop	1.0 U	1.0 U	µg/L
2,4-D	1.0 U	1.0 U	µg/L
2,4,5-TP (Silvex)	1.0 U	1.0 U	µg/L
2,4,5-T	1.0 U	1.0 U	µg/L
2,4-DB	1.0 U	1.0 U	µg/L
Dinoseb	1.0 U	1.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
2,4-DCAA	80	92	10-218
Date Extracted	02/03/99	02/03/99	
Date Analyzed	02/05/99	02/05/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	SW-3	SW-4	Units
Aluminum	202.1	1.0 U	1.0 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Antimony	204.2	0.0050 U	0.0050 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Arsenic	206.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Barium	208.1	0.50 U	0.50 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Beryllium	210.2	0.0010 U	0.0010 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Boron *	200.7	**0.136**	0.100 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Cadmium	213.2	0.0020 U	0.0020 U	mg/L
Date Analyzed		01/31/99	01/31/99	
Chromium	218.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/30/99	01/30/99	
Copper	220.2	0.0010 U	0.0010 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Iron	236.1	**0.38**	**0.26**	mg/L
Date Analyzed		01/28/99	01/28/99	
Lead	239.2	0.0050 U	0.0050 U	mg/L
Date Analyzed		01/31/99	01/31/99	
Manganese	243.1	**0.30**	0.050 U	mg/L
Date Analyzed		01/28/99	01/28/99	

* Subcontract laboratory FL DHRS #83331 and #E83012.
U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	SW-3	SW-4	Units
Mercury	245.1	0.00020 U	0.00020 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Nickel	249.1	0.10 U	0.10 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Selenium	270.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Silver	272.2	0.00050 U	0.00050 U	mg/L
Date Analyzed		02/01/99	02/01/99	
T llium	279.2	0.0020 U	0.0020 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Zinc	289.1	**0.050**	0.050 U	mg/L
Date Analyzed		01/28/99	01/28/99	

U - Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

MISCELLANEOUS	**METHOD**	**SW-3**	**SW-4**	**Units**
Alkalinity (as $CaCO_3$)	310.1	**34**	**32**	mg/L
Date Analyzed		01/30/99	01/30/99	
Ammonia-N	350.1	**0.080** I	**0.050** I	mg/L
Date Analyzed		01/28/99	01/28/99	
Unionized Ammonia	DRAFT	0.030 U	0.030 U	mg/L
Date Analyzed		02/04/99	02/04/99	
Specific Cond.	120.1	**130**	**110**	µmhos/cm
Date Analyzed		01/30/99	01/30/99	
Hexavalent Chromium	SM 3500 CR D	0.050 U	0.050 U	mg/L
Date Analyzed		01/27/99	01/27/99	
Cyanide, Total	335.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Fluoride	340.2	**0.44** I	**0.40** I	mg/L
Date Analyzed		02/01/99	02/01/99	
MBAS	425.1	**0.090**	**0.070**	mg/L
Date Analyzed		01/27/99	01/27/99	
Nitrate-N	353.1	0.020 U	0.020 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Nitrogen, Total	351.2/353.1	**6.0**	**1.0**	mg/L
Date Analyzed		02/03/99	02/03/99	

U = Compound was analyzed for but not detected to the level shown.
I Analyte detected; value is between the Method Detection Level (MDL) and the Practical Quantitation Level (PQL).

ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

MISCELLANEOUS	**METHOD**	**SW-3**	**SW-4**	**Units**
Phosphorus, Total	365.4	**2.1**	**0.93**	mg/L
Date Analyzed		02/02/99	02/02/99	
pH	150.1	**6.2**	**6.3**	S.U.
Date Analyzed		01/27/99	01/27/99	
Phenols	420.1	0.050 U	0.050 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Oil and Grease	413.1	1.0 U	1.0 U	mg/L
Date Analyzed		01/29/99	01/29/99	
F ̦al Coliform *	SM9222D	**16400** B	**2000**	cols/100ml
Date Analyzed		01/26/99	01/26/99	
Total Coliform *	SM9222B	**1** Z	**4300**	cols/100ml
Date Analyzed		01/26/99	01/26/99	
Gross Alpha **	900.0	2.0 ± 0.9	1.9 ± 0.7	pCi/l
Date Analyzed		01/31/99	01/31/99	

* = Subcontract laboratory FL DHRS #83331 and #E83012.
** = Subcontract laboratory FL DHRS #83141.
B = The total number of coliform colonies exceeds the metho indicated ideal ranges: Total Coliforms (20-80 colonies), Fecal Coliforms (20-60 colonies)
Z = Too many colonies were present (TNTC), the numerical value represents the filtration volume.
U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 625 - BASE/NEUTRAL-ACID SVOAS	SW-5	LAB BLANK	Units
Acenaphthene	10 U	10 U	µg/L
Acenaphthylene	10 U	10 U	µg/L
Anthracene	10 U	10 U	µg/L
p-(dimethylamino)azobenzene	10 U	10 U	µg/L
Benzidine	10 U	10 U	µg/L
Benzo(a)anthracene	10 U	10 U	µg/L
Benzo(b)fluoranthene	10 U	10 U	µg/L
Benzo(k)fluoranthene	10 U	10 U	µg/L
Benzo(g,h,i)perylene	10 U	10 U	µg/L
Benzo(a)pyrene	10 U	10 U	µg/L
Benzylbutyl phthalate	10 U	10 U	µg/L
Bis(2-chloroethoxy)methane	10 U	10 U	µg/L
Bis(2-chloroethyl)ether	10 U	10 U	µg/L
Bis(2-chloroisopropyl)ether	10 U	10 U	µg/L
Bis(2-ethylhexyl)phthalate	10 U	10 U	µg/L
4-Bromophenylphenyl ether	10 U	10 U	µg/L
2-Chloronaphthalene	10 U	10 U	µg/L
4-Chlorophenyl phenyl ether	10 U	10 U	µg/L
Chrysene	10 U	10 U	µg/L
Dibenzo(a,h)anthracene	10 U	10 U	µg/L
1,2-Dichlorobenzene	10 U	10 U	µg/L
1,3-Dichlorobenzene	10 U	10 U	µg/L
1,4-Dichlorobenzene	10 U	10 U	µg/L
3,3'-Dichlorobenzidine	20 U	20 U	µg/L
Diethyl phthalate	10 U	10 U	µg/L
Dimethyl phthalate	10 U	10 U	µg/L
Di-n-butyl phthalate	10 U	10 U	µg/L
Di-n-octyl phthalate	10 U	10 U	µg/L
2,4-Dinitrotoluene	10 U	10 U	µg/L
2,6-Dinitrotoluene	10 U	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD 625 (cont.) - BASE/NEUTRAL-ACID SVOAS	SW-5	LAB BLANK	Units
Fluoranthene	10 U	10 U	µg/L
Fluorene	10 U	10 U	µg/L
Hexachlorobenzene	10 U	10 U	µg/L
Hexachlorobutadiene	10 U	10 U	µg/L
Hexachlorocyclopentadiene	10 U	10 U	µg/L
Hexachloroethane	10 U	10 U	µg/L
Indeno(1,2,3-cd)pyrene	10 U	10 U	µg/L
Isophorone	10 U	10 U	µg/L
1-Methylnaphthalene	10 U	10 U	µg/L
2-Methylnaphthalene	10 U	10 U	µg/L
Naphthalene	10 U	10 U	µg/L
Nitrobenzene	10 U	10 U	µg/L
N-Nitrosodimethylamine	10 U	10 U	µg/L
N-Nitrosodi-n-Propylamine	10 U	10 U	µg/L
N-Nitrosodiphenylamine	10 U	10 U	µg/L
Phenanthrene	10 U	10 U	µg/L
Pyrene	10 U	10 U	µg/L
1,2,4-Trichlorobenzene	10 U	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD 625 (cont.) - BASE/NEUTRAL-ACID SVOAS	SW-5	LAB BLANK	Units
4-Chloro-3-methylphenol	10 U	10 U	µg/L
2-Chlorophenol	10 U	10 U	µg/L
2,4-Dichlorophenol	10 U	10 U	µg/L
2,4-Dimethylphenol	10 U	10 U	µg/L
2,4-Dinitrophenol	10 U	10 U	µg/L
2-Methyl-4,6-Dinitrophenol	10 U	10 U	µg/L
2-Nitrophenol	10 U	10 U	µg/L
4-Nitrophenol	10 U	10 U	µg/L
Pentachlorophenol	10 U	10 U	µg/L
Phenol	10 U	10 U	µg/L
2 ',6-Trichlorophenol	10 U	10 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
Nitrobenzene -D5	66	88	51-131
2-Fluorobiphenyl	46	46	50-131
Terphenyl -D14	92	104	47-165
Phenol -D5	41	51	12-122
2-Fluorophenol	58	65	33-114
2,4,6-Tribromophenol	110	96	57-147
Date Extracted	01/27/99	01/27/99	
Date Analyzed	02/03/99	02/02/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 608 - ORGANOCHLORINE PESTICIDES	SW-5	LAB BLANK	Units
alpha-BHC	0.050 U	0.050 U	µg/L
beta-BHC	0.050 U	0.050 U	µg/L
gamma-BHC (Lindane)	0.050 U	0.050 U	µg/L
Heptachlor	0.050 U	0.050 U	µg/L
delta-BHC	0.050 U	0.050 U	µg/L
Aldrin	0.050 U	0.050 U	µg/L
Heptachlor Epoxide	0.050 U	0.050 U	µg/L
Chlordane gamma	0.050 U	0.050 U	µg/L
Chlordane alpha	0.050 U	0.050 U	µg/L
Endosulfan I	0.050 U	0.050 U	µg/L
4,4'-DDE	0.050 U	0.050 U	µg/L
Dieldrin	0.050 U	0.050 U	µg/L
Endrin	0.050 U	0.050 U	µg/L
4,4'-DDD	0.050 U	0.050 U	µg/L
Endosulfan II	0.050 U	0.050 U	µg/L
4,4'-DDT	0.050 U	0.050 U	µg/L
Endrin aldehyde	0.050 U	0.050 U	µg/L
Endosulfan sulfate	0.050 U	0.050 U	µg/L
Methoxychlor	0.10 U	0.10 U	µg/L
Endrin Ketone	0.050 U	0.050 U	µg/L
Chlordane (Total)	1.0 U	1.0 U	µg/L
Toxaphene	2.0 U	2.0 U	µg/L
PCB-1016/1242	1.0 U	1.0 U	µg/L
PCB-1221	1.0 U	1.0 U	µg/L
PCB-1232	1.0 U	1.0 U	µg/L
PCB-1248	1.0 U	1.0 U	µg/L
PCB-1254	1.0 U	1.0 U	µg/L
PCB-1260	1.0 U	1.0 U	µg/L

Surrogate:	% RECOV	% RECOV	LIMITS
2,4,5,6-TCMX	100	102	30-150
DBC	80	86	27-167
Date Extracted	01/29/99	01/29/99	
Date Analyzed	02/04/99	02/04/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 614 - **ORGANOPHOSPHORUS PESTICIDES**	**SW-5**	**LAB BLANK**	**Units**
Demeton	1.0 U	1.0 U	µg/L
Diazinon	1.0 U	1.0 U	µg/L
Disulfoton	1.0 U	1.0 U	µg/L
Methyl Parathion	1.0 U	1.0 U	µg/L
Malathion	1.0 U	1.0 U	µg/L
Ethyl Parathion	1.0 U	1.0 U	µg/L
Ethion	1.0 U	1.0 U	µg/L
Azinphos methyl	1.0 U	1.0 U	µg/L
Chlorpyrifos	1.0 U	1.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
Tributyl Phosphate	72	53	65-137
Triphenyl Phosphate	73	43	61-127
Date Extracted	01/29/99	01/29/99	
Date Analyzed	02/04/99	02/04/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 615 - CHLORINATED HERBICIDES	SW-5	LAB BLANK	Units
Dalapon	1.0 U	1.0 U	µg/L
Dicamba	1.0 U	1.0 U	µg/L
MCPP	50 U	50 U	µg/L
MCPA	50 U	50 U	µg/L
Dichloroprop	1.0 U	1.0 U	µg/L
2,4-D	1.0 U	1.0 U	µg/L
2,4,5-TP (Silvex)	1.0 U	1.0 U	µg/L
2,4,5-T	1.0 U	1.0 U	µg/L
2,4-DB	1.0 U	1.0 U	µg/L
Dinoseb	1.0 U	1.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
2,4-DCAA	76	140	10-218
Date Extracted	02/03/99	02/03/99	
Date Analyzed	02/05/99	02/05/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5212
DATE REPORTED: February 5, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	SW-5	LAB BLANK	Units
Aluminum	202.1	1.0 U	1.0 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Antimony	204.2	0.0050 U	0.0050 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Arsenic	206.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Barium	208.1	0.50 U	0.50 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Beryllium	210.2	0.0010 U	0.0010 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Boron *	200.7	0.100 U	0.100 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Cadmium	213.2	0.0020 U	0.0020 U	mg/L
Date Analyzed		01/31/99	01/31/99	
Chromium	218.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/30/99	01/30/99	
Copper	220.2	0.0010 U	0.0010 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Iron	236.1	**0.20**	0.10 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Lead	239.2	0.0050 U	0.0050 U	mg/L
Date Analyzed		01/31/99	01/31/99	
Manganese	243.1	0.050 U	0.050 U	mg/L
Date Analyzed		01/28/99	01/28/99	

* Subcontract laboratory FL DHRS #83331 and #E83012.
U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	SW-5	LAB BLANK	Units
Mercury	245.1	0.00020 U	0.00020 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Nickel	249.1	0.10 U	0.10 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Selenium	270.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Silver	272.2	0.00050 U	0.00050 U	mg/L
Date Analyzed		02/01/99	02/01/99	
T. .lium	279.2	0.0020 U	0.0020 U	mg/L
Date Analyzed		01/29/99	01/29/99	
Zinc	289.1	0.050 U	0.050 U	mg/L
Date Analyzed		01/28/99	01/28/99	

U - Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

MISCELLANEOUS	METHOD	SW-5	LAB BLANK	Units
Alkalinity (as CaCO3)	310.1	**22**	2.0 U	mg/L
Date Analyzed		01/30/99	01/30/99	
Ammonia-N	350.1	**0.12**	0.030 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Unionized Ammonia	DRAFT	0.030 U	NA	mg/L
Date Analyzed		02/04/99		
Specific Cond.	120.1	**93**	1.0 U	µmhos/cm
Date Analyzed		01/30/99	01/30/99	
Hexavalent Chromium	SM 3500 CR D	0.050 U	0.050 U	mg/L
Date Analyzed		01/27/99	01/27/99	
Cyanide, Total	335.2	0.010 U	0.010 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Fluoride	340.2	**0.22** I	0.20 U	mg/L
Date Analyzed		02/01/99	02/01/99	
MBAS	425.1	**0.18**	0.010 U	mg/L
Date Analyzed		01/27/99	01/27/99	
Nitrate-N	353.1	0.020 U	NA	mg/L
Date Analyzed		01/29/99		
Nitrogen, Total	351.2/353.1	**0.98**	NA	mg/L
Date Analyzed		02/03/99		

NA = Not applicable
U = Compound was analyzed for but not detected to the level shown.
I Analyte detected; value is between the Method Detection Level (MDL) and the Practical Quantitation Level (PQL).

RESULTS OF ANALYSIS

MISCELLANEOUS	METHOD	SW-5	LAB BLANK	Units
Phosphorus, Total	365.4	**0.45**	0.020 U	mg/L
Date Analyzed		02/02/99	02/02/99	
pH	150.1	**6.8**	NA	S.U.
Date Analyzed		01/27/99		
Phenols	420.1	0.050 U	0.050 U	mg/L
Date Analyzed		01/28/99	01/28/99	
Oil and Grease	413.1	1.0 U	1.0 U	mg/L
Date Analyzed		01/29/99	01/27/99	
Fecal Coliform *	SM9222D	**12** B	<1	cols/100ml
Date Analyzed		01/26/99	01/26/99	
Total Coliform *	SM9222B	**3300**	<1	cols/100ml
Date Analyzed		01/26/99	01/26/99	
Gross Alpha **	900.0	0.8 ± 0.5	NA	pCi/l
Date Analyzed		01/31/99		

* = Subcontract laboratory FL DHRS #83331 and #E83012.
** = Subcontract laboratory FL DHRS #83141.
B = The total number of coliform colonies exceeds the metho indicated ideal ranges: Total Coliforms (20-80 colonies), Fecal Coliforms (20-60 colonies).
N = Not applicable
U = Compound was analyzed for but not detected to the level shown.

QUALITY CONTROL DATA

Parameter	% RECOVERY MS/MSD/LCS	ACCEPT LIMITS	% RPD MS/MSD	ACCEPT LIMITS
EPA Method 8270				
Phenol	14/ 13/ 42	29-102	7	44
2-Chlorophenol	14/ 12/ 69	58-124	15	41
1,4-Dichlorobenzene	63/ 62/ 45	10-127	2	43
N-Nitrosodi-N-Propylamine	90/ 83/ 79	72-118	8	22
1,2,4-Trichlorobenzene	98/107/ 55	18-129	9	43
4-Chloro-3-methylphenol	73/ 80/ 79	75-126	9	22
Acenaphthene	65/ 68/ 60	63-122	4	28
4-Nitrophenol	4/ 3/ 52	10-168	28	52
2,4-Dinitrotoluene	64/ 70/ 64	81-151	9	21
P tachlorophenol	32/ 34/ 89	27-154	6	42
Pyrene	60/ 62/ 71	54-146	3	32
EPA Method 608				
gamma-BHC (Lindane)	90/100/ 90	39-118	10	25
Heptachlor	121/100/100	22-184	19	33
Aldrin	75/100/ 70	14-164	28	95
Dieldrin	125/152/100	38-168	19	20
Endrin	120/130/ 70	28-182	8	35
4,4'-DDT	100/100/ 90	35-149	<1	32

Environmental Conservation Laboratories Comprehensive QA Plan #960038

< = Less Than
MS = Matrix Spike
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Standard
RPD = Relative Percent Difference

QUALITY CONTROL DATA

Parameter	% RECOVERY MS/MSD/LCS	ACCEPT LIMITS	% RPD MS/MSD	ACCEPT LIMITS
EPA Method 614				
Dichlorvos	87/ 67/ 60	49-95	26	40
Ethoprop	127/ 93/ 93	88-113	31	22
Dimethoate	113/100/ 93	22-100	12	40
Ronnel	80/ 67/ 67	82-116	18	6
Dursban	57/ 47/ 48	82-115	19	6
EPA Method 615				
Dalapon	72/ 60/ 92	37-161	18	45
Dicamba	88/ 80/108	36-232	10	45
2 -D	104/104/ 80	43-180	<1	46
2,4,5-TP (Silvex)	112/108/ 68	64-168	4	42
2,4-DB	120/124/ 52	15-126	3	45

Environmental Conservation Laboratories Comprehensive QA Plan #960038

< = Less Than
MS = Matrix Spike
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Standard
RPD = Relative Percent Difference

QUALITY CONTROL DATA

Parameter	% RECOVERY MS/MSD/LCS	ACCEPT LIMITS	% RPD MS/MSD	ACCEPT LIMITS
Total Metals				
Aluminum, 202.1	94/ 92/ 90	65-125	2	15
Antimony, 204.2	102/ 93/105	45-152	9	15
Arsenic, 206.2	112/112/105	56-125	<1	15
Barium, 7080	100/102/ 91	68-120	2	12
Beryllium, 210.2	99/101/101	67-145	2	15
Cadmium, 213.2	95/ 97/ 96	40-126	2	15
Chromium, 218.2	102/ 82/137	75-137	22	15
Copper, 220.2	119/131/103	65-140	10	12
Iron, 236.1	99/ 94/ 95	63-129	5	15
Le , 239.2	105/103/101	66-140	2	17
Manganese, 243.1	106/106/ 94	75-115	<1	10
Mercury, 245.1	106/104/102	70-136	2	12
Nickel, 249.1	93/ 95/ 96	75-115	2	10
Selenium, 7740	105/105/111	50-135	<1	15
Silver, 272.2	98/ 96/ 61	47-141	2	34
Thallium, 279.2	104/103/101	69-153	<1	15
Zinc, 289.1	104/101/104	75-125	3	10

Environmental Conservation Laboratories Comprehensive QA Plan #960038

< = Less Than
MS = Matrix Spike
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Standard
RPD = Relative Percent Difference

QUALITY CONTROL DATA

Parameter	% RECOVERY MS/MSD/LCS	ACCEPT LIMITS	% RPD MS/MSD	ACCEPT LIMITS
MISCELLANEOUS				
Alkalinity (as CaCO3), 310.1	94/ 94/ 95	80-119	<1	4
Ammonia-N, 350.1	101/104/104	75-122	3	16
Specific Cond., 120.1	NA/ NA/120	-	NA	
Hexavalent Chromium, SM 3500 CR D	97/ 99/103	56-131	2	5
Cyanide, Total, 335.2	81/ 79/104	49-131	2	21
Fluoride, 340.2	93/ 98/101	76-127	5	16
MBAS, 425.1	110/110/ 84	45-149	<1	16
Phosphorus, Total, 365.4	103/100/103	74-121	3	11
pH. 150.1	NA/ NA/100	-	NA	
Pl .ols, 420.1	77/ 79/ 99	80-113	2	14
Oil and Grease, 413.1	96/ 96/ 97	63-127	<1	13

Environmental Conservation Laboratories Comprehensive QA Plan #960038

< = Less Than
MS = Matrix Spike
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Standard
RPD = Relative Percent Difference

QSARF # [illegible]

ENCO

ENVIRONMEN L CONSERVATION LABORATORIES

4810 Executive Park Court, Suite 211, Jacksonville, Florida 32216-6069, Ph. (904) 296-3007 • Fax (904) 296-6210

10207 General Drive, Orlando, Florida 32824, Ph. (407) 826-5314 • Fax (407) 850-6945

ENCO CompQAP No.: 960038G/0

CHAIN OF CUSTODY RECORD

PROJECT REFERENCE: DEP - Tenoroc | PROJECT NO.: 479657 | P.O. NUMBER:

PROJECT LOC. (State): FL | SAMPLER(s) NAME: T. Shaw | PHONE (941) 667-2345 | FAX (941) 667-2662

CLIENT NAME: BCI Engineers + Scientists | CLIENT PROJECT MANAGER: Tom Shaw

CLIENT ADDRESS (CITY, STATE, ZIP): P.O. Box 5467, Lakeland FL 33807-5467

PAGE ___ OF ___

☐ STANDARD REPORT DELIVERY

☐ EXPEDITED REPORT DELIVERY (surcharge)

Date Due: ___

REQUIRED ANALYSIS: SEE QUOTE #09154

	STATION	DATE	TIME	GRAB	COMP	SAMPLE IDENTIFICATION	SURFACE WATER	GROUND WATER	WASTEWATER	DRINKING WATER	SOIL/SOLID/SEDIMENT	NONAQUEOUS LIQUID (oil, solvent, etc.)	AIR	SLUDGE	OTHER	NUMBER OF CONTAINERS SUBMITTED	REMARKS
1	1	1-26-99		X		SW-1	X									12	
2	2	↓		X		SW-2	X									12	
3	3	↓		X		SW-3	X									12	
4	4	↓		X		SW-4	X									12	
5	5	↓		X		SW-5	X									12	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	

SAMPLE KIT PREPARED BY: ☐ JACKSONVILLE ☒ ORLANDO	DATE	TIME	RELINQUISHED BY: (SIGNATURE) K. Armstrong	DATE 1/25/99	TIME 5:50	RECEIVED BY: (SIGNATURE) Kim Casey	DATE 1/26/99	TIME 6:15pm
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE) Thomas L. Shaw	DATE 1-26-99	TIME 10:20	RELINQUISHED BY: (SIGNATURE) Thomas L. Shaw	DATE 1-26-99	TIME 6:15
RECEIVED BY (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	ENCO LOG NO.	REMARKS
Kim Casey ☐ Jacksonville ☒ Orlando	1/26/99	6:15pm	☐ YES ☐ NO	OE5212	

Environmental Conservation Laboratories
10207 General Drive
Orlando, Florida 32824-8529
407 / 826-5314
ax 407 / 850-6945
www.encolabs.com

ENCO Laboratories

DHRS Certification No. E83182

CLIENT : Bromwell & Carrier, Inc.
ADDRESS: P.O. Box 5467
Lakeland, FL 33807-5467

REPORT # : OR5240
DATE SUBMITTED: January 28, 1999
DATE REPORTED : February 2, 1999

ATTENTION: Tom Shaw

SAMPLE IDENTIFICATION

Samples submitted and
identified by client as:

PROJECT #: 979657

DEP-Tenoroc

01/28/99

#1	- SW-1	@ 15:00
#2	- SW-2	@ 15:10
#3	- SW-3	@ 15:20
#4	- SW-4	@ 15:25
#5	- SW-5	@ 15:40
#6	- TRIP BLANK	

PROJECT MANAGER ______________________
Marcia C. Terlep

ENCO LABORATORIES
REPORT # : OR5240
DATE REPORTED: February 2, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 624 - VOLATILE ORGANICS	SW-1	SW-2	Units
Dichlorodifluoromethane	1.0 U	1.0 U	µg/L
Chloromethane	1.0 U	1.0 U	µg/L
Vinyl Chloride	1.0 U	1.0 U	µg/L
Bromomethane	2.0 U	2.0 U	µg/L
Chloroethane	2.0 U	2.0 U	µg/L
Acrolein	10 U	10 U	µg/L
Trichlorofluoromethane	1.0 U	1.0 U	µg/L
1,1-Dichloroethene	1.0 U	1.0 U	µg/L
Methylene Chloride	3.0 U	3.0 U	µg/L
Acrylonitrile	10 U	10 U	µg/L
t-1,2-Dichloroethene	1.0 U	1.0 U	µg/L
Methyl tert-butyl ether	6.0 U	6.0 U	µg/L
1,1-Dichloroethane	1.0 U	1.0 U	µg/L
c-1,2-Dichloroethene	1.0 U	1.0 U	µg/L
Chloroform	1.0 U	1.0 U	µg/L
1,1,1-Trichloroethane	1.0 U	1.0 U	µg/L
Carbon tetrachloride	1.0 U	1.0 U	µg/L
Benzene	1.0 U	1.0 U	µg/L
1,2-Dichloroethane	1.0 U	1.0 U	µg/L
Trichloroethene	1.0 U	1.0 U	µg/L
1,2-Dichloropropane	1.0 U	1.0 U	µg/L
Bromodichloromethane	1.0 U	1.0 U	µg/L
2-Chloroethyl vinyl ether	2.0 U	2.0 U	µg/L
c-1,3-Dichloropropene	1.0 U	1.0 U	µg/L
Toluene	1.0 U	1.0 U	µg/L
t-1,3-Dichloropropene	1.0 U	1.0 U	µg/L
1,1,2-Trichloroethane	1.0 U	1.0 U	µg/L
Tetrachloroethene	2.0 U	2.0 U	µg/L
Dibromochloromethane	1.0 U	1.0 U	µg/L
Chlorobenzene	1.0 U	1.0 U	µg/L

U Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5240
DATE REPORTED: February 2, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 624 (cont.) - VOLATILE ORGANICS	SW-1	SW-2	Units
Ethylbenzene	1.0 U	1.0 U	µg/L
m-Xylene & p-Xylene	2.0 U	2.0 U	µg/L
o-Xylene	1.0 U	1.0 U	µg/L
Styrene	1.0 U	1.0 U	µg/L
Bromoform	1.0 U	1.0 U	µg/L
1,1,2,2-Tetrachloroethane	1.0 U	1.0 U	µg/L
1,3-Dichlorobenzene	1.0 U	1.0 U	µg/L
1,4-Dichlorobenzene	1.0 U	1.0 U	µg/L
1,2-Dichlorobenzene	1.0 U	1.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
Di omofluoromethane	68	68	81-133
D8-Toluene	75	76	78-119
Bromofluorobenzene	72	70	78-122
Date Analyzed	01/30/99	01/30/99	

U - Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5240
DATE REPORTED: February 2, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 624 - VOLATILE ORGANICS	SW-3	SW-4	Units
Dichlorodifluoromethane	1.0 U	1.0 U	µg/L
Chloromethane	1.0 U	1.0 U	µg/L
Vinyl Chloride	1.0 U	1.0 U	µg/L
Bromomethane	2.0 U	2.0 U	µg/L
Chloroethane	2.0 U	2.0 U	µg/L
Acrolein	10 U	10 U	µg/L
Trichlorofluoromethane	1.0 U	1.0 U	µg/L
1,1-Dichloroethene	1.0 U	1.0 U	µg/L
Methylene Chloride	3.0 U	3.0 U	µg/L
Acrylonitrile	10 U	10 U	µg/L
t-1.2-Dichloroethene	1.0 U	1.0 U	µg/L
Me /l tert-butyl ether	6.0 U	6.0 U	µg/L
1,1-Dichloroethane	1.0 U	1.0 U	µg/L
c-1,2-Dichloroethene	1.0 U	1.0 U	µg/L
Chloroform	1.0 U	1.0 U	µg/L
1,1,1-Trichloroethane	1.0 U	1.0 U	µg/L
Carbon tetrachloride	1.0 U	1.0 U	µg/L
Benzene	1.0 U	1.0 U	µg/L
1,2-Dichloroethane	1.0 U	1.0 U	µg/L
Trichloroethene	1.0 U	1.0 U	µg/L
1,2-Dichloropropane	1.0 U	1.0 U	µg/L
Bromodichloromethane	1.0 U	1.0 U	µg/L
2-Chloroethyl vinyl ether	2.0 U	2.0 U	µg/L
c-1,3-Dichloropropene	1.0 U	1.0 U	µg/L
Toluene	**8.6**	1.0 U	µg/L
t-1,3-Dichloropropene	1.0 U	1.0 U	µg/L
1,1,2-Trichloroethane	1.0 U	1.0 U	µg/L
Tetrachloroethene	2.0 U	2.0 U	µg/L
Dibromochloromethane	1.0 U	1.0 U	µg/L
Chlorobenzene	1.0 U	1.0 U	µg/L

U - Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5240
DATE REPORTED: February 2, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 624 (cont.) - VOLATILE ORGANICS	SW-3	SW-4	Units
Ethylbenzene	1.0 U	1.0 U	μg/L
m-Xylene & p-Xylene	2.0 U	2.0 U	μg/L
o-Xylene	1.0 U	1.0 U	μg/L
Styrene	1.0 U	1.0 U	μg/L
Bromoform	1.0 U	1.0 U	μg/L
1,1,2,2-Tetrachloroethane	1.0 U	1.0 U	μg/L
1,3-Dichlorobenzene	1.0 U	1.0 U	μg/L
1,4-Dichlorobenzene	1.0 U	1.0 U	μg/L
1,2-Dichlorobenzene	1.0 U	1.0 U	μg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
D[illegible]omofluoromethane	67	64	81-133
D8-Toluene	71	72	78-119
Bromofluorobenzene	70	66	78-122
Date Analyzed	01/30/99	01/30/99	

U Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5240
DATE REPORTED: February 2, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 624 - **VOLATILE ORGANICS**	**SW-5**	**TRIP BLANK**	**Units**
Dichlorodifluoromethane	1.0 U	1.0 U	µg/L
Chloromethane	1.0 U	1.0 U	µg/L
Vinyl Chloride	1.0 U	1.0 U	µg/L
Bromomethane	2.0 U	2.0 U	µg/L
Chloroethane	2.0 U	2.0 U	µg/L
Acrolein	10 U	10 U	µg/L
Trichlorofluoromethane	1.0 U	1.0 U	µg/L
1,1-Dichloroethene	1.0 U	1.0 U	µg/L
Methylene Chloride	3.0 U	3.0 U	µg/L
Acrylonitrile	10 U	10 U	µg/L
t-1,2-Dichloroethene	1.0 U	1.0 U	µg/L
Methyl tert-butyl ether	6.0 U	6.0 U	µg/L
1,1-Dichloroethane	1.0 U	1.0 U	µg/L
c-1,2-Dichloroethene	1.0 U	1.0 U	µg/L
Chloroform	1.0 U	1.0 U	µg/L
1,1,1-Trichloroethane	1.0 U	1.0 U	µg/L
Carbon tetrachloride	1.0 U	1.0 U	µg/L
Benzene	1.0 U	1.0 U	µg/L
1,2-Dichloroethane	1.0 U	1.0 U	µg/L
Trichloroethene	1.0 U	1.0 U	µg/L
1,2-Dichloropropane	1.0 U	1.0 U	µg/L
Bromodichloromethane	1.0 U	1.0 U	µg/L
2-Chloroethyl vinyl ether	2.0 U	2.0 U	µg/L
c-1,3-Dichloropropene	1.0 U	1.0 U	µg/L
Toluene	1.0 U	1.0 U	µg/L
t-1,3-Dichloropropene	1.0 U	1.0 U	µg/L
1,1,2-Trichloroethane	1.0 U	1.0 U	µg/L
Tetrachloroethene	2.0 U	2.0 U	µg/L
Dibromochloromethane	1.0 U	1.0 U	µg/L
Chlorobenzene	1.0 U	1.0 U	µg/L

U Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5240
DATE REPORTED: February 2, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 624 (cont.) - VOLATILE ORGANICS	SW-5	TRIP BLANK	Units
Ethylbenzene	1.0 U	1.0 U	µg/L
m-Xylene & p-Xylene	2.0 U	2.0 U	µg/L
o-Xylene	1.0 U	1.0 U	µg/L
Styrene	1.0 U	1.0 U	µg/L
Bromoform	1.0 U	1.0 U	µg/L
1,1,2,2-Tetrachloroethane	1.0 U	1.0 U	µg/L
1,3-Dichlorobenzene	1.0 U	1.0 U	µg/L
1,4-Dichlorobenzene	1.0 U	1.0 U	µg/L
1,2-Dichlorobenzene	1.0 U	1.0 U	µg/L
Surrogate:	% RECOV	% RECOV	LIMITS
Dibromofluoromethane	64	68	81-133
D_8-Toluene	73	72	78-119
Bromofluorobenzene	70	66	78-122
Date Analyzed	01/30/99	01/30/99	

Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD 624 - VOLATILE ORGANICS	LAB BLANK	Units
Chloromethane	2.0 U	µg/L
Vinyl Chloride	2.0 U	µg/L
Bromomethane	2.0 U	µg/L
Chloroethane	2.0 U	µg/L
Trichlorofluoromethane	2.0 U	µg/L
1,1-Dichloroethene	2.0 U	µg/L
Methylene Chloride	2.0 U	µg/L
Acrylonitrile	20 U	µg/L
t-1,2-Dichloroethene	1.0 U	µg/L
1,1-Dichloroethane	4.0 U	µg/L
c-1,2-Dichloroethene	1.0 U	µg/L
Chloroform	1.0 U	µg/L
1,1,1-Trichloroethane	1.0 U	µg/L
Carbon tetrachloride	1.0 U	µg/L
Benzene	1.0 U	µg/L
1,2-Dichloroethane	1.0 U	µg/L
Trichloroethene	1.0 U	µg/L
1,2-Dichloropropane	1.0 U	µg/L
Bromodichloromethane	1.0 U	µg/L
c-1,3-Dichloropropene	1.0 U	µg/L
Toluene	1.0 U	µg/L
t-1,3-Dichloropropene	1.0 U	µg/L
1,1,2-Trichloroethane	1.0 U	µg/L
Tetrachloroethene	2.0 U	µg/L
Dibromochloromethane	1.0 U	µg/L
Chlorobenzene	1.0 U	µg/L

U - Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR5240
DATE REPORTED: February 2, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD 624 (cont.) - VOLATILE ORGANICS	LAB BLANK	Units
Ethylbenzene	1.0 U	μg/L
m-Xylene & p-Xylene	3.0 U	μg/L
o-Xylene	1.0 U	μg/L
Styrene	1.0 U	μg/L
Bromoform	2.0 U	μg/L
1,1,2,2-Tetrachloroethane	1.0 U	μg/L
1,4-Dichlorobenzene	1.0 U	μg/L
1,2-Dichlorobenzene	1.0 U	μg/L
Surrogate:	**% RECOV**	**LIMITS**
Dibromofluoromethane	55	91-141
D8 Toluene	75	80-120
Bromofluorobenzene	76	90-115
Date Analyzed	01/28/99	

U Compound was analyzed for but not detected to the level shown.

QUALITY CONTROL DATA

Parameter	% RECOVERY MS/MSD/LCS	ACCEPT LIMITS	% RPD MS/MSD	ACCEPT LIMITS
EPA Method 624				
1,1-Dichloroethene	94/ 90/ 82	56-136	4	33
Benzene	109/ 94/104	66-115	15	17
Trichloroethene	95/ 90/ 89	68-110	5	6
Toluene	121/ 95/109	68-110	24	13
Chlorobenzene	98/ 95/ 92	50-131	3	12

Environmental Conservation Laboratories Comprehensive QA Plan #960038

< = Less Than
MS = Matrix Spike
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Standard
RPD = Relative Percent Difference

QSARF #___

ENVIRONMENTAL CONSERVATION LABORATORIES

4810 Executive Park Court, Suite 211
Jacksonville, Florida 32216-6069
Ph. (904) 296-3007 • Fax (904) 296-6210

10207 General Drive
Orlando, Florida 32824
Ph. (407) 826-5314 • Fax (407) 850-6945

ENCO CompQAP No.: 960038G/0

CHAIN OF CUSTODY RECORD

PROJECT REFERENCE: DEP - Tenoroc
PROJECT NO.: 979657
P.O. NUMBER:
PAGE 1 OF 1

PROJECT LOC. (State): FL
SAMPLER(s) NAME: T. Shaw
PHONE: (941) 667-2345
FAX: (941) 667-2662

CLIENT NAME: BCI Engineers + Scientists, Inc.
CLIENT PROJECT MANAGER: Tom Shaw
CLIENT ADDRESS (CITY, STATE, ZIP): P.O. Box 5467 Lakeland, FL 33807-5467

☐ STANDARD REPORT DELIVERY
☐ EXPEDITED REPORT DELIVERY (surcharge)
Date Due: ___

REQUIRED ANALYSIS: 624 (HCl)

	STATION	DATE	TIME	GRAB	COMP	SAMPLE IDENTIFICATION	SURFACE WATER	GROUND WATER	WASTEWATER	DRINKING WATER	SOIL/SOLID/SEDIMENT	NONAQUEOUS LIQUID (oil, solvent, etc.)	AIR	SLUDGE	OTHER	624 HCl (NUMBER OF CONTAINERS SUBMITTED)								REMARKS
1	1	1-28-99	1500	X		SW-1	X									3								
2	2	↓		X		SW-2	X									3								
3	3			X		SW-3	X									3								
4	4			X		SW-4	X									3								
5	5			X		SW-5	X									3								
6																								
7																								
8																								
9																								
10																								
11																								
12																								
13																								
14																								

	DATE	TIME		DATE	TIME		DATE	TIME
SAMPLE KIT PREPARED BY: ☐ JACKSONVILLE ☒ ORLANDO			RELINQUISHED BY: (SIGNATURE) K Armstrong	1/28/99	11:35	RECEIVED BY: (SIGNATURE) Thomas L. Shaw	1-28-99	10:30
RELINQUISHED BY: (SIGNATURE) Thomas L. Shaw	1-28-99	1640	RECEIVED BY: (SIGNATURE) [signature]	1/28/99	1640	RELINQUISHED BY: (SIGNATURE)		
RECEIVED BY (SIGNATURE)			RELINQUISHED BY: (SIGNATURE)			RECEIVED BY: (SIGNATURE)		

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	ENCO LOG NO.	REMARKS
Kevin Casey ☐ Jacksonville ☒ Orlando	1/28/99	5:30PM	☐ YES ☐ NO	OR5240	Report results concurrently with results for Class III samples collected on 1-26-99

Environmental Conservation Laboratories, Inc.
10207 General Drive
Orlando, Florida 32824-8529
·07 / 826-5314
Fax 407 / 850-6945
www.encolabs.com

ENCO
Laboratories

DHRS Certification No. E83182

CLIENT : Bromwell & Carrier, Inc.
ADDRESS: P.O. Box 5467
Lakeland, FL 33807-5467

REPORT # : OR6755
DATE SUBMITTED: May 26, 1999
DATE REPORTED : June 8, 1999

ATTENTION: Tom Shaw

SAMPLE IDENTIFICATION

Samples submitted and
identified by client as:

PROJECT #: 979657

Coliform Samples

05/26/99

#1 - SW-1 (S#1) 09:44
#2 - SW-2 (S#2) 10:10
#3 - SW-3 (S#3) 10:26
#4 - SW-4 (S#4) 10:32
#5 - SW-5 (S#5) 11:55

PF⁻JECT MANAGER ______________________
Marcia C. Terlep

ENCO LABORATORIES
REPORT # : OR6755
DATE REPORTED: June 8, 1999
REFERENCE : 979657
PROJECT NAME : Coliform Samples

RESULTS OF ANALYSIS

MISCELLANEOUS *	METHOD	SW-1 (S#1)	SW-2 (S#2)	Units
Fecal Coliform	SM9222D	330 Q	96	Col/100mL
Date Analyzed		05/26/99	05/26/99	
Total Coliform	SM9222B	470	2500	Col/100mL
Date Analyzed		05/26/99	05/26/99	

MISCELLANEOUS *	METHOD	SW-3 (S#3)	SW-4 (S#4)	Units
Fecal Coliform	SM9222D	145 B	17 B	Col/100mL
Date Analyzed		05/26/99	05/26/99	
Total Coliform	SM9222B	7200	2500	Col/100mL
Date Analyzed		05/26/99	05/26/99	

MISCELLANEOUS *	METHOD	SW-5 (S#5)	METHOD BLANK	Units
Fecal Coliform	SM9222D	64	<2	Col/100mL
Date Analyzed		05/26/99	05/26/99	
Total Coliform	SM9222B	440	<10	Col/100mL
Date Analyzed		05/26/99	05/26/99	

* = Subcontract laboratory FL DHRS #83331 and #E83012.
< = Less Than
Q = Sample was received and analyzed out of acceptable hold time.
B = The total number of coliform colonies exceeds the method indicated ideal ranges: Fecal Coliforms: 20-60 colonies.

Environmental Conservation Laboratories Comprehensive QA Plan #960038

QSARF #09714

ENVIRONMENTAL CONSERVATION LABORATORIES

4810 Executive Park Court, Suite 211
Jacksonville, Florida 32216-6069
Ph. (904) 296-3007 • Fax (904) 296-6210

10207 General Drive
Orlando, Florida 32824
Ph. (407) 826-5314 • Fax (407) 850-6945

ENCO CompQAP No.: 960038G/0

CHAIN OF CUSTODY RECORD

PROJECT REFERENCE:
PROJECT NO.: 979657
P.O. NUMBER:
PROJECT LOC. (State):
SAMPLER(s) NAME: Fernando Banda
PHONE: (941) 667-2345
FAX:
CLIENT NAME:
CLIENT PROJECT MANAGER: Tom Sholl
CLIENT ADDRESS (CITY, STATE, ZIP):

PAGE 1 OF 1

☐ STANDARD REPORT DELIVERY
☐ EXPEDITED REPORT DELIVERY (surcharge)

Date Due:

MATRIX TYPE: SURFACE WATER, GROUND WATER, WASTEWATER, DRINKING WATER, SOIL/SOLID/SEDIMENT, NONAQUEOUS LIQUID (oil, solvent, etc.), AIR, SLUDGE, OTHER

REQUIRED ANALYSIS — NUMBER OF CONTAINERS SUBMITTED

#	STATION	DATE	TIME	GRAB	COMP	SAMPLE IDENTIFICATION	SURFACE WATER	GROUND WATER	WASTEWATER	DRINKING WATER	SOIL/SOLID/SEDIMENT	NONAQUEOUS LIQUID	AIR	SLUDGE	OTHER	REMARKS
1	SW-1	5-26	9:44			S# 1	✓									
2	SW2	5-26	10:10			S# 2	✓									
3	SW3	5-26	10:26			S# 3	✓									
4	SW4	5 26	10:32			S# 4	✓									
5	SW-5	5-26	11:55			S# 5	✓									
6																
7																
8																
9																
10																
11																
12																
13																
14																

SAMPLE KIT PREPARED BY: ☐ JACKSONVILLE ☒ ORLANDO	DATE	TIME	RELINQUISHED BY: (SIGNATURE) K. Armstrong	DATE 5-13-99	TIME 1:00	RECEIVED BY: (SIGNATURE) Fernando Banda	DATE 5-26	TIME 12:20
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	DATE	TIME	RELINQUISHED BY: (SIGNATURE) Fernando Banda	DATE 5-26	TIME 12:20
RECEIVED BY: (SIGNATURE) [signature]	DATE 5/26/99	TIME 12:20	RELINQUISHED BY: (SIGNATURE) [signature]	DATE 5/26/99	TIME 1315	RECEIVED BY: (SIGNATURE)	DATE	TIME

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	ENCO LOG NO.	REMARKS
Keri C ☐ Jacksonville ☒ Orlando	5/26/99	1:15PM	☐ YES ☒ NO	OR6755	

Environmental Conservation Laboratories, Inc.
10207 General Drive
Orlando, Florida 32824-8529
407 / 826-5314
Fax 407 / 850-6945
www.encolabs.com

ENCO Laboratories

DHRS Certification No. E83182

CLIENT : Bromwell & Carrier, Inc.
ADDRESS: P.O. Box 5467
Lakeland, FL 33807-5467

REPORT # : OR7017
DATE SUBMITTED: June 12, 1999
DATE REPORTED : June 28, 1999

ATTENTION: Tom Shaw

SAMPLE IDENTIFICATION

Samples submitted and
identified by client as:

PROJECT #: 979657

DEP-Tenoroc

06/11/99

#1	- T-1	@ 09:50
#2	- T-2	@ 13:45
#3	- T-3	@ 12:55
#4	- EB-1	@ 09:30

PROJECT MANAGER ______________________
Marcia C. Terlep

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8260 - VOLATILE ORGANICS	**T-1**	**T-2**	**Units**
Dichlorodifluoromethane	2.0 U	2.0 U	µg/L
Chloromethane	1.0 U	1.0 U	µg/L
Vinyl Chloride	1.0 U	1.0 U	µg/L
Bromomethane	2.0 U	2.0 U	µg/L
Chloroethane	2.0 U	2.0 U	µg/L
Trichlorofluoromethane	1.0 U	1.0 U	µg/L
Acrolein	100 U	100 U	µg/L
1,1-Dichloroethene	2.0 U	2.0 U	µg/L
Acetone	50 U	50 U	µg/L
Iodomethane	2.0 U	2.0 U	µg/L
Carbon Disulfide	50 U	50 U	µg/L
Acetonitrile	10 U	10 U	µg/L
3-Chloropropene	6.0 U	6.0 U	µg/L
Methylene Chloride	3.0 U	3.0 U	µg/L
Acrylonitrile	6.0 U	6.0 U	µg/L
t-1,2-Dichloroethene	1.0 U	1.0 U	µg/L
1,1-Dichloroethane	4.0 U	4.0 U	µg/L
Vinyl Acetate	2.0 U	2.0 U	µg/L
Chloroprene	6.0 U	6.0 U	µg/L
2-Butanone	20 U	20 U	µg/L
Propionitrile	30 U	30 U	µg/L
Methacrylonitrile	3.0 U	3.0 U	µg/L
Chloroform	1.0 U	1.0 U	µg/L
1,1,1-Trichloroethane	1.0 U	1.0 U	µg/L
Carbon tetrachloride	1.0 U	1.0 U	µg/L
Isobutyl Alcohol	60 U	60 U	µg/L
Benzene	1.0 U	1.0 U	µg/L
1,2-Dichloroethane	1.0 U	1.0 U	µg/L
Trichloroethene	1.0 U	1.0 U	µg/L
1,2-Dichloropropane	1.0 U	1.0 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8260 - VOLATILE ORGANICS	T-1	T-2	Units
Dibromomethane	1.0 U	1.0 U	μg/L
1,4-Dioxane	60 U	60 U	μg/L
Methyl Methacrylate	2.0 U	2.0 U	μg/L
Bromodichloromethane	1.0 U	1.0 U	μg/L
4-Methyl-2-pentanone	20 U	20 U	μg/L
Toluene	1.0 U	1.0 U	μg/L
t-1,3-Dichloropropene	1.0 U	1.0 U	μg/L
Ethyl Methacrylate	2.0 U	2.0 U	μg/L
1,1,2-Trichloroethane	1.0 U	1.0 U	μg/L
Tetrachloroethene	3.0 U	3.0 U	μg/L
c-1,3-Dichloropropene	1.0 U	1.0 U	μg/L
2-Hexanone	20 U	20 U	μg/L
Dibromochloromethane	1.0 U	1.0 U	μg/L
1,2-Dibromoethane	1.0 U	1.0 U	μg/L
Chlorobenzene	1.0 U	1.0 U	μg/L
1,1,1,2-Tetrachloroethane	1.0 U	1.0 U	μg/L
Ethylbenzene	1.0 U	1.0 U	μg/L
m-Xylene & p-Xylene	2.0 U	2.0 U	μg/L
o-Xylene	1.0 U	1.0 U	μg/L
Styrene	1.0 U	1.0 U	μg/L
Bromoform	1.0 U	1.0 U	μg/L
1,1,2,2-Tetrachloroethane	1.0 U	1.0 U	μg/L
1,2,3-Trichloropropane	2.0 U	2.0 U	μg/L
t-1,4-Dichloro-2-Butene	2.0 U	2.0 U	μg/L
1,2-Dibromo-3-chloropropane	2.0 U	2.0 U	μg/L

Surrogate:	% RECOV	% RECOV	LIMITS
Dibromofluoromethane	91	86	52-149
D8-Toluene	81	76	70-132
Bromofluorobenzene	85	83	60-135
Date Analyzed	06/17/99	06/17/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR7017
DATE REPORTED: June 28, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	**T-1**	**T-2**	**Units**
Acenaphthene	10 U	10 U	µg/L
Acenaphthylene	10 U	10 U	µg/L
Acetophenone	10 U	10 U	µg/L
2-Acetylaminofluorene	10 U	10 U	µg/L
4-aminobiphenyl	10 U	10 U	µg/L
Aniline	10 U	10 U	µg/L
Anthracene	10 U	10 U	µg/L
Aramite	10 U	10 U	µg/L
Benzo(a)anthracene	10 U	10 U	µg/L
Benzo(g,h,i)perylene	10 U	10 U	µg/L
Benzo(k)fluoranthene	10 U	10 U	µg/L
Benzyl alcohol	10 U	10 U	µg/L
Benzo(b)fluoranthene	10 U	10 U	µg/L
Benzo(a)pyrene	10 U	10 U	µg/L
Bis(2-chloroethoxy)methane	10 U	10 U	µg/L
Bis(2-chloroethyl)ether	10 U	10 U	µg/L
Bis(2-chloroisopropyl)ether	10 U	10 U	µg/L
Bis(2-ethylhexyl)phthalate	10 U	10 U	µg/L
4-Bromophenylphenyl ether	10 U	10 U	µg/L
Benzylbutyl phthalate	10 U	10 U	µg/L
Dinoseb	10 U	10 U	µg/L
4-Chloroaniline	10 U	10 U	µg/L
4-Chloro-3-methylphenol	10 U	10 U	µg/L
2-Chloronaphthalene	10 U	10 U	µg/L
2-Chlorophenol	10 U	10 U	µg/L
4-Chlorophenyl phenyl ether	10 U	10 U	µg/L
Chrysene	10 U	10 U	µg/L
3 & 4-Methylphenol	20 U	20 U	µg/L
2-Methylphenol	10 U	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	T-1	T-2	Units
Diallate	10 U	10 U	μg/L
Dibenzo(a,h)anthracene	10 U	10 U	μg/L
Dibenzofuran	10 U	10 U	μg/L
Di-n-butyl phthalate	10 U	10 U	μg/L
1,2-Dichlorobenzene	10 U	10 U	μg/L
1,3-Dichlorobenzene	10 U	10 U	μg/L
1,4-Dichlorobenzene	10 U	10 U	μg/L
3,3'-Dichlorobenzidine	10 U	10 U	μg/L
3,3'-Dimethylbenzidine	10 U	10 U	μg/L
2,4-Dichlorophenol	10 U	10 U	μg/L
2[illegible]-Dichlorophenol	10 U	10 U	μg/L
Diethyl phthalate	10 U	10 U	μg/L
p-(dimethylamino)azobenzene	10 U	10 U	μg/L
7,12-Dimethylbenz(a)Anthracene	10 U	10 U	μg/L
a,a-Dimethylphenethylamine	10 U	10 U	μg/L
2,4-Dimethylphenol	10 U	10 U	μg/L
Dimethyl phthalate	10 U	10 U	μg/L
m-Dinitrobenzene	10 U	10 U	μg/L
2-Methyl-4,6-Dinitrophenol	10 U	10 U	μg/L
2,4-Dinitrophenol	10 U	10 U	μg/L
2,4-Dinitrotoluene	10 U	10 U	μg/L
2,6-Dinitrotoluene	10 U	10 U	μg/L
Di-n-octyl phthalate	10 U	10 U	μg/L
Diphenylamine	10 U	10 U	μg/L
Ethyl methanesulfonate	10 U	10 U	μg/L
N-Nitrosodi-N-Propylamine	10 U	10 U	μg/L
Fluoranthene	10 U	10 U	μg/L
Fluorene	10 U	10 U	μg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	**T-1**	**T-2**	**Units**
Hexachlorobenzene	10 U	10 U	µg/L
Hexachlorobutadiene	10 U	10 U	µg/L
Hexachlorocyclopentadiene	10 U	10 U	µg/L
Hexachloroethane	10 U	10 U	µg/L
Hexachlorophene	2000 U	2000 U	µg/L
Hexachloropropene	10 U	10 U	µg/L
Indeno(1,2,3-cd)pyrene	10 U	10 U	µg/L
Isophorone	10 U	10 U	µg/L
Isosafrole	10 U	10 U	µg/L
Methapyrilene	10 U	10 U	µg/L
3-Methylcholanthrene	10 U	10 U	µg/L
4 itroquinoline-1-oxide	10 U	10 U	µg/L
Methyl methanesulfonate	10 U	10 U	µg/L
2-Methylnaphthalene	10 U	10 U	µg/L
Naphthalene	10 U	10 U	µg/L
1,4-Naphthoquinone	10 U	10 U	µg/L
1-Naphthylamine	10 U	10 U	µg/L
2-Naphthylamine	10 U	10 U	µg/L
2-Nitroaniline	10 U	10 U	µg/L
3-Nitroaniline	10 U	10 U	µg/L
4-Nitroaniline	10 U	10 U	µg/L
Nitrobenzene	10 U	10 U	µg/L
2-Nitrophenol	10 U	10 U	µg/L
4-Nitrophenol	10 U	10 U	µg/L
N-nitrosodi-n-butylamine	10 U	10 U	µg/L
N-nitrosodiethylamine	10 U	10 U	µg/L
N-nitrosomethylethylamine	10 U	10 U	µg/L
N-Nitrosodiphenylamine	10 U	10 U	µg/L
N-Nitrosodimethylamine	10 U	10 U	µg/L
N-Nitrosomorpholine	10 U	10 U	µg/L
N-Nitrosopiperidine	10 U	10 U	µg/L
N-Nitrosopyrrolidine	10 U	10 U	µg/L
5-Nitro-o-toluidine	10 U	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR7017
DATE REPORTED: June 28, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	T-1	T-2	Units
Pentachlorobenzene	10 U	10 U	µg/L
Pentachloroethane	10 U	10 U	µg/L
Pentachloronitrobenzene	10 U	10 U	µg/L
Pentachlorophenol	10 U	10 U	µg/L
Phenacetin	10 U	10 U	µg/L
Phenanthrene	10 U	10 U	µg/L
Phenol	10 U	10 U	µg/L
p-Phenylenediamine	10 U	10 U	µg/L
2-Picoline	10 U	10 U	µg/L
Pronamide	10 U	10 U	µg/L
Pyrene	10 U	10 U	µg/L
Pyridine	10 U	10 U	µg/L
Safrole	10 U	10 U	µg/L
1,2,4,5-Tetrachlorobenzene	10 U	10 U	µg/L
2,3,4,6-Tetrachlorophenol	10 U	10 U	µg/L
o-Toluidine	10 U	10 U	µg/L
1,2,4-Trichlorobenzene	10 U	10 U	µg/L
2,4,5-Trichlorophenol	10 U	10 U	µg/L
2,4,6-Trichlorophenol	10 U	10 U	µg/L
o,o,o-Triethyl phosphorothioate	10 U	10 U	µg/L
1,3,5-Trinitrobenzene	10 U	10 U	µg/L

Surrogate:	% RECOV	% RECOV	LIMITS
Nitrobenzene -D5	82	101	44-135
2-Fluorobiphenyl	84	101	48-127
Terphenyl -D14	92	95	47-168
Phenol -D5	61	75	6-125
2-Fluorophenol	70	85	27-121
2,4,6-Tribromophenol	103	116	58-144
Date Extracted	06/14/99	06/14/99	
Date Analyzed	06/21/99	06/21/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR7017
DATE REPORTED: June 28, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8080 - ORGANOCHLORINE PESTICIDES	T-1	T-2	Units
alpha-BHC	0.050 U	0.050 U	µg/L
beta-BHC	0.050 U	0.050 U	µg/L
gamma-BHC (Lindane)	0.050 U	0.050 U	µg/L
Heptachlor	0.050 U	0.050 U	µg/L
delta-BHC	0.050 U	0.050 U	µg/L
Aldrin	0.050 U	0.050 U	µg/L
Heptachlor Epoxide	0.050 U	0.050 U	µg/L
Chlordane (Total)	1.0 U	1.0 U	µg/L
Kepone	0.10 U	0.10 U	µg/L
Endosulfan I	0.050 U	0.050 U	µg/L
4,4'-DDE	0.050 U	0.050 U	µg/L
Dieldrin	0.050 U	0.050 U	µg/L
Endrin	0.050 U	0.050 U	µg/L
4,4'-DDD	0.050 U	0.050 U	µg/L
Endosulfan II	0.050 U	0.050 U	µg/L
4,4'-DDT	0.050 U	0.050 U	µg/L
Endrin aldehyde	0.050 U	0.050 U	µg/L
Endosulfan sulfate	0.050 U	0.050 U	µg/L
Methoxychlor	0.10 U	0.10 U	µg/L
Isodrin	0.050 U	0.050 U	µg/L
Chlorobenzilate	0.10 U	0.10 U	µg/L
Toxaphene	2.0 U	2.0 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8080 (cont.) - ORGANOCHLORINE PESTICIDES	T-1	T-2	Units
PCB-1016/1242	1.0 U	1.0 U	µg/L
PCB-1221	1.0 U	1.0 U	µg/L
PCB-1232	1.0 U	1.0 U	µg/L
PCB-1248	1.0 U	1.0 U	µg/L
PCB-1254	1.0 U	1.0 U	µg/L
PCB-1260	1.0 U	1.0 U	µg/L
Surrogate:	% RECOV	% RECOV	LIMITS
2,4,5,6-TCMX	50	50	30-150
DBC	86	86	37-128
Date Extracted	06/17/99	06/17/99	
Date Analyzed	06/23/99	06/23/99	

EPA METHOD APPENDIX IX, 8141 - ORGANOPHOSPHORUS PESTICIDES	T-1	T-2	Units
Dimethoate	2.0 U	2.0 U	µg/L
Disulfoton	2.0 U	2.0 U	µg/L
Famphur	2.0 U	2.0 U	µg/L
Parathion ethyl	2.0 U	2.0 U	µg/L
Parathion methyl	2.0 U	2.0 U	µg/L
Phorate	2.0 U	2.0 U	µg/L
Sulfotep	2.0 U	2.0 U	µg/L
Thionazin	2.0 U	2.0 U	µg/L
Dichlorofenthion	2.0 U	2.0 U	µg/L
Surrogate:	% RECOV	% RECOV	LIMITS
Tributyl Phosphate	54	105	61-143
Triphenyl Phosphate	55	118	58-143
Date Extracted	06/17/99	06/17/99	
Date Analyzed	06/23/99	06/23/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8150 - CHLORINATED HERBICIDES	T-1	T-2	Units
2,4-D	1.0 U	1.0 U	µg/L
2,4,5-TP (Silvex)	1.0 U	1.0 U	µg/L
2,4,5-T	1.0 U	1.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
2,4-DCAA	88	94	9-127
Date Extracted	06/19/99	06/19/99	
Date Analyzed	06/25/99	06/25/99	

EPA METHOD 504	T-1	T-2	Units
Ethylene Dibromide	0.020 U	0.020 U	µg/L
Dibromochloropropane	0.020 U	0.020 U	µg/L
Date Extracted	06/16/99	06/16/99	
Date Analyzed	06/16/99	06/16/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR7017
DATE REPORTED: June 28, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	T-1	T-2	Units
Antimony	7041	0.0050 U	0.0050 U	mg/L
Date Analyzed		06/19/99	06/19/99	
Arsenic	6010	0.010 U	0.010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Barium	6010	0.10 U	0.10 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Beryllium	6010	0.0010 U	0.0010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Cadmium	6010	0.0010 U	0.0010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Chromium	6010	0.010 U	0.010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Cobalt	6010	0.050 U	0.050 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Copper	6010	0.050 U	0.050 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Lead	6010	0.0050 U	0.0050 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Mercury	7470	0.00020 U	0.00020 U	mg/L
Date Analyzed		06/16/99	06/16/99	
Nickel	6010	0.010 U	0.010 U	mg/L
Date Analyzed		06/18/99	06/18/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	T-1	T-2	Units
Selenium	6010	0.010 U	0.010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Silver	6010	0.010 U	0.010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Thallium	7841	0.0020 U	0.0020 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Tin	6010	0.10 U	0.10 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Vanadium	6010	0.010 U	0.010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Zinc	6010	0.10 U	0.10 U	mg/L
Date Analyzed		06/18/99	06/18/99	

MISCELLANEOUS	METHOD	T-1	T-2	Units
Cyanide, Total	335.2	0.010 U	0.010 U	mg/L
Date Analyzed		06/15/99	06/15/99	
Sulfide, Total	376.1	1.0 U	1.0 U	mg/L
Date Analyzed		06/14/99	06/14/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR7017
DATE REPORTED: June 28, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8260 - VOLATILE ORGANICS	T-3	EB-1	Units
Dichlorodifluoromethane	2.0 U	2.0 U	µg/L
Chloromethane	1.0 U	1.0 U	µg/L
Vinyl Chloride	1.0 U	1.0 U	µg/L
Bromomethane	2.0 U	2.0 U	µg/L
Chloroethane	2.0 U	2.0 U	µg/L
Trichlorofluoromethane	1.0 U	1.0 U	µg/L
Acrolein	100 U	100 U	µg/L
1,1-Dichloroethene	2.0 U	2.0 U	µg/L
Acetone	50 U	50 U	µg/L
Iodomethane	2.0 U	2.0 U	µg/L
Carbon Disulfide	50 U	50 U	µg/L
Acetonitrile	10 U	10 U	µg/L
3-Chloropropene	6.0 U	6.0 U	µg/L
Methylene Chloride	3.0 U	3.0 U	µg/L
Acrylonitrile	6.0 U	6.0 U	µg/L
t-1,2-Dichloroethene	1.0 U	1.0 U	µg/L
1,1-Dichloroethane	4.0 U	4.0 U	µg/L
Vinyl Acetate	2.0 U	2.0 U	µg/L
Chloroprene	6.0 U	6.0 U	µg/L
2-Butanone	20 U	20 U	µg/L
Propionitrile	30 U	30 U	µg/L
Methacrylonitrile	3.0 U	3.0 U	µg/L
Chloroform	1.0 U	1.0 U	µg/L
1,1,1-Trichloroethane	1.0 U	1.0 U	µg/L
Carbon tetrachloride	1.0 U	1.0 U	µg/L
Isobutyl Alcohol	60 U	60 U	µg/L
Benzene	1.0 U	1.0 U	µg/L
1,2-Dichloroethane	1.0 U	1.0 U	µg/L
Trichloroethene	1.0 U	1.0 U	µg/L
1,2-Dichloropropane	1.0 U	1.0 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8260 - VOLATILE ORGANICS	**T-3**	**EB-1**	**Units**
Dibromomethane	1.0 U	1.0 U	µg/L
1,4-Dioxane	60 U	60 U	µg/L
Methyl Methacrylate	2.0 U	2.0 U	µg/L
Bromodichloromethane	1.0 U	1.0 U	µg/L
4-Methyl-2-pentanone	20 U	20 U	µg/L
Toluene	1.0 U	1.0 U	µg/L
t-1,3-Dichloropropene	1.0 U	1.0 U	µg/L
Ethyl Methacrylate	2.0 U	2.0 U	µg/L
1,1,2-Trichloroethane	1.0 U	1.0 U	µg/L
Tetrachloroethene	3.0 U	3.0 U	µg/L
c ,3-Dichloropropene	1.0 U	1.0 U	µg/L
2-Hexanone	20 U	20 U	µg/L
Dibromochloromethane	1.0 U	1.0 U	µg/L
1,2-Dibromoethane	1.0 U	1.0 U	µg/L
Chlorobenzene	1.0 U	1.0 U	µg/L
1,1,1,2-Tetrachloroethane	1.0 U	1.0 U	µg/L
Ethylbenzene	1.0 U	1.0 U	µg/L
m-Xylene & p-Xylene	2.0 U	2.0 U	µg/L
o-Xylene	1.0 U	1.0 U	µg/L
Styrene	1.0 U	1.0 U	µg/L
Bromoform	1.0 U	1.0 U	µg/L
1,1,2,2-Tetrachloroethane	1.0 U	1.0 U	µg/L
1,2,3-Trichloropropane	2.0 U	2.0 U	µg/L
t-1,4-Dichloro-2-Butene	2.0 U	2.0 U	µg/L
1,2-Dibromo-3-chloropropane	2.0 U	2.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
Dibromofluoromethane	86	88	52-149
D8-Toluene	78	78	70-132
Bromofluorobenzene	82	84	60-135
Date Analyzed	06/17/99	06/17/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR7017
DATE REPORTED: June 28, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	T-3	EB-1	Units
Acenaphthene	10 U	10 U	µg/L
Acenaphthylene	10 U	10 U	µg/L
Acetophenone	10 U	10 U	µg/L
2-Acetylaminofluorene	10 U	10 U	µg/L
4-aminobiphenyl	10 U	10 U	µg/L
Aniline	10 U	10 U	µg/L
Anthracene	10 U	10 U	µg/L
Aramite	10 U	10 U	µg/L
Benzo(a)anthracene	10 U	10 U	µg/L
Benzo(g,h,i)perylene	10 U	10 U	µg/L
Benzo(k)fluoranthene	10 U	10 U	µg/L
Benzyl alcohol	10 U	10 U	µg/L
Benzo(b)fluoranthene	10 U	10 U	µg/L
Benzo(a)pyrene	10 U	10 U	µg/L
Bis(2-chloroethoxy)methane	10 U	10 U	µg/L
Bis(2-chloroethyl)ether	10 U	10 U	µg/L
Bis(2-chloroisopropyl)ether	10 U	10 U	µg/L
Bis(2-ethylhexyl)phthalate	10 U	10 U	µg/L
4-Bromophenylphenyl ether	10 U	10 U	µg/L
Benzylbutyl phthalate	10 U	10 U	µg/L
Dinoseb	10 U	10 U	µg/L
4-Chloroaniline	10 U	10 U	µg/L
4-Chloro-3-methylphenol	10 U	10 U	µg/L
2-Chloronaphthalene	10 U	10 U	µg/L
2-Chlorophenol	10 U	10 U	µg/L
4-Chlorophenyl phenyl ether	10 U	10 U	µg/L
Chrysene	10 U	10 U	µg/L
3 & 4-Methylphenol	20 U	20 U	µg/L
2-Methylphenol	10 U	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	T-3	EB-1	Units
Diallate	10 U	10 U	µg/L
Dibenzo(a,h)anthracene	10 U	10 U	µg/L
Dibenzofuran	10 U	10 U	µg/L
Di-n-butyl phthalate	10 U	10 U	µg/L
1,2-Dichlorobenzene	10 U	10 U	µg/L
1,3-Dichlorobenzene	10 U	10 U	µg/L
1,4-Dichlorobenzene	10 U	10 U	µg/L
3,3'-Dichlorobenzidine	10 U	10 U	µg/L
3,3'-Dimethylbenzidine	10 U	10 U	µg/L
2,4-Dichlorophenol	10 U	10 U	µg/L
2,6-Dichlorophenol	10 U	10 U	µg/L
Diethyl phthalate	10 U	10 U	µg/L
p-(dimethylamino)azobenzene	10 U	10 U	µg/L
7,12-Dimethylbenz(a)Anthracene	10 U	10 U	µg/L
a,a-Dimethylphenethylamine	10 U	10 U	µg/L
2,4-Dimethylphenol	10 U	10 U	µg/L
Dimethyl phthalate	10 U	10 U	µg/L
m-Dinitrobenzene	10 U	10 U	µg/L
2-Methyl-4,6-Dinitrophenol	10 U	10 U	µg/L
2,4-Dinitrophenol	10 U	10 U	µg/L
2,4-Dinitrotoluene	10 U	10 U	µg/L
2,6-Dinitrotoluene	10 U	10 U	µg/L
Di-n-octyl phthalate	10 U	10 U	µg/L
Diphenylamine	10 U	10 U	µg/L
Ethyl methanesulfonate	10 U	10 U	µg/L
N-Nitrosodi-N-Propylamine	10 U	10 U	µg/L
Fluoranthene	10 U	10 U	µg/L
Fluorene	10 U	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	**T-3**	**EB-1**	**Units**
Hexachlorobenzene	10 U	10 U	µg/L
Hexachlorobutadiene	10 U	10 U	µg/L
Hexachlorocyclopentadiene	10 U	10 U	µg/L
Hexachloroethane	10 U	10 U	µg/L
Hexachlorophene	2000 U	2000 U	µg/L
Hexachloropropene	10 U	10 U	µg/L
Indeno(1,2,3-cd)pyrene	10 U	10 U	µg/L
Isophorone	10 U	10 U	µg/L
Isosafrole	10 U	10 U	µg/L
Methapyrilene	10 U	10 U	µg/L
3-Methylcholanthrene	10 U	10 U	µg/L
4-Nitroquinoline-1-oxide	10 U	10 U	µg/L
Methyl methanesulfonate	10 U	10 U	µg/L
2-Methylnaphthalene	10 U	10 U	µg/L
Naphthalene	10 U	10 U	µg/L
1,4-Naphthoquinone	10 U	10 U	µg/L
1-Naphthylamine	10 U	10 U	µg/L
2-Naphthylamine	10 U	10 U	µg/L
2-Nitroaniline	10 U	10 U	µg/L
3-Nitroaniline	10 U	10 U	µg/L
4-Nitroaniline	10 U	10 U	µg/L
Nitrobenzene	10 U	10 U	µg/L
2-Nitrophenol	10 U	10 U	µg/L
4-Nitrophenol	10 U	10 U	µg/L
N-nitrosodi-n-butylamine	10 U	10 U	µg/L
N-nitrosodiethylamine	10 U	10 U	µg/L
N-nitrosomethylethylamine	10 U	10 U	µg/L
N-Nitrosodiphenylamine	10 U	10 U	µg/L
N-Nitrosodimethylamine	10 U	10 U	µg/L
N-Nitrosomorpholine	10 U	10 U	µg/L
N-Nitrosopiperidine	10 U	10 U	µg/L
N-Nitrosopyrrolidine	10 U	10 U	µg/L
5-Nitro-o-toluidine	10 U	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	T-3	EB-1	Units
Pentachlorobenzene	10 U	10 U	µg/L
Pentachloroethane	10 U	10 U	µg/L
Pentachloronitrobenzene	10 U	10 U	µg/L
Pentachlorophenol	10 U	10 U	µg/L
Phenacetin	10 U	10 U	µg/L
Phenanthrene	10 U	10 U	µg/L
Phenol	10 U	10 U	µg/L
p-Phenylenediamine	10 U	10 U	µg/L
2-Picoline	10 U	10 U	µg/L
Pronamide	10 U	10 U	µg/L
Pyrene	10 U	10 U	µg/L
Pyridine	10 U	10 U	µg/L
Safrole	10 U	10 U	µg/L
1,2,4,5-Tetrachlorobenzene	10 U	10 U	µg/L
2,3,4,6-Tetrachlorophenol	10 U	10 U	µg/L
o-Toluidine	10 U	10 U	µg/L
1,2,4-Trichlorobenzene	10 U	10 U	µg/L
2,4,5-Trichlorophenol	10 U	10 U	µg/L
2,4,6-Trichlorophenol	10 U	10 U	µg/L
o,o,o-Triethyl phosphorothioate	10 U	10 U	µg/L
1,3,5-Trinitrobenzene	10 U	10 U	µg/L

Surrogate:	% RECOV	% RECOV	LIMITS
Nitrobenzene -D5	85	72	44-135
2-Fluorobiphenyl	92	75	48-127
Terphenyl -D14	94	103	47-168
Phenol -D5	68	60	6-125
2-Fluorophenol	76	71	27-121
2,4,6-Tribromophenol	104	105	58-144
Date Extracted	06/14/99	06/14/99	
Date Analyzed	06/21/99	06/21/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8080 - ORGANOCHLORINE PESTICIDES	T-3	EB-1	Units
alpha-BHC	0.050 U	0.050 U	µg/L
beta-BHC	0.050 U	0.050 U	µg/L
gamma-BHC (Lindane)	0.050 U	0.050 U	µg/L
Heptachlor	0.050 U	0.050 U	µg/L
delta-BHC	0.050 U	0.050 U	µg/L
Aldrin	0.050 U	0.050 U	µg/L
Heptachlor Epoxide	0.050 U	0.050 U	µg/L
Chlordane (Total)	1.0 U	1.0 U	µg/L
Kepone	0.10 U	0.10 U	µg/L
Endosulfan I	0.050 U	0.050 U	µg/L
4 '-DDE	0.050 U	0.050 U	µg/L
Dieldrin	0.050 U	0.050 U	µg/L
Endrin	0.050 U	0.050 U	µg/L
4,4'-DDD	0.050 U	0.050 U	µg/L
Endosulfan II	0.050 U	0.050 U	µg/L
4,4'-DDT	0.050 U	0.050 U	µg/L
Endrin aldehyde	0.050 U	0.050 U	µg/L
Endosulfan sulfate	0.050 U	0.050 U	µg/L
Methoxychlor	0.10 U	0.10 U	µg/L
Isodrin	0.050 U	0.050 U	µg/L
Chlorobenzilate	0.10 U	0.10 U	µg/L
Toxaphene	2.0 U	2.0 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8080 (cont.) -

ORGANOCHLORINE PESTICIDES	T-3	EB-1	Units
PCB-1016/1242	1.0 U	1.0 U	µg/L
PCB-1221	1.0 U	1.0 U	µg/L
PCB-1232	1.0 U	1.0 U	µg/L
PCB-1248	1.0 U	1.0 U	µg/L
PCB-1254	1.0 U	1.0 U	µg/L
PCB-1260	1.0 U	1.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
2,4,5,6-TCMX	62	70	30-150
DBC	84	106	37-128
D ؜e Extracted	06/17/99	06/17/99	
Date Analyzed	06/24/99	06/24/99	

EPA METHOD APPENDIX IX, 8141 -

ORGANOPHOSPHORUS PESTICIDES	T-3	EB-1	Units
Dimethoate	2.0 U	2.0 U	µg/L
Disulfoton	2.0 U	2.0 U	µg/L
Famphur	2.0 U	2.0 U	µg/L
Parathion ethyl	2.0 U	2.0 U	µg/L
Parathion methyl	2.0 U	2.0 U	µg/L
Phorate	2.0 U	2.0 U	µg/L
Sulfotep	2.0 U	2.0 U	µg/L
Thionazin	2.0 U	2.0 U	µg/L
Dichlorofenthion	2.0 U	2.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
Tributyl Phosphate	117	113	61-143
Triphenyl Phosphate	125	136	58-143
Date Extracted	06/17/99	06/17/99	
Date Analyzed	06/23/99	06/23/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8150 - CHLORINATED HERBICIDES	T-3	EB-1	Units
2,4-D	1.0 U	1.0 U	µg/L
2,4,5-TP (Silvex)	1.0 U	1.0 U	µg/L
2,4,5-T	1.0 U	1.0 U	µg/L
Surrogate:	**% RECOV**	**% RECOV**	**LIMITS**
2,4-DCAA	112	112	9-127
Date Extracted	06/19/99	06/19/99	
Date Analyzed	06/25/99	06/25/99	

EPA METHOD 504	T-3	EB-1	Units
Ethylene Dibromide	0.020 U	0.020 U	µg/L
Dibromochloropropane	0.020 U	0.020 U	µg/L
Date Extracted	06/16/99	06/16/99	
Date Analyzed	06/16/99	06/16/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	T-3	EB-1	Units
Antimony	7041	0.0050 U	0.0050 U	mg/L
Date Analyzed		06/19/99	06/19/99	
Arsenic	6010	0.010 U	0.010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Barium	6010	0.10 U	0.10 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Beryllium	6010	0.0010 U	0.0010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
C[illegible]ium	6010	0.0010 U	0.0010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Chromium	6010	0.010 U	0.010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Cobalt	6010	0.050 U	0.050 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Copper	6010	0.050 U	0.050 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Lead	6010	**0.0050** I	0.0050 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Mercury	7470	0.00020 U	0.00020 U	mg/L
Date Analyzed		06/16/99	06/16/99	
Nickel	6010	0.010 U	0.010 U	mg/L
Date Analyzed		06/18/99	06/18/99	

U = Compound was analyzed for but not detected to the level shown.
I Analyte detected; value is between the Method Detection Level (MDL) and the Practical Quantitation Level (PQL).

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	T-3	EB-1	Units
Selenium	6010	0.010 U	0.010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Silver	6010	0.010 U	0.010 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Thallium	7841	0.0020 U	0.0020 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Tin	6010	0.10 U	0.10 U	mg/L
Date Analyzed		06/18/99	06/18/99	
Vanadium	6010	**0.010**	0.010 U	mg/L
Date Analyzed		06/25/99	06/18/99	
Zinc	6010	0.10 U	0.10 U	mg/L
Date Analyzed		06/18/99	06/18/99	

MISCELLANEOUS	METHOD	T-3	EB-1	Units
Cyanide, Total	335.2	0.010 U	0.010 U	mg/L
Date Analyzed		06/15/99	06/15/99	
Sulfide, Total	376.1	1.0 U	1.0 U	mg/L
Date Analyzed		06/14/99	06/14/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR7017
DATE REPORTED: June 28, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8260 -

VOLATILE ORGANICS	LAB BLANK	Units
Dichlorodifluoromethane	2.0 U	µg/L
Chloromethane	1.0 U	µg/L
Vinyl Chloride	1.0 U	µg/L
Bromomethane	2.0 U	µg/L
Chloroethane	2.0 U	µg/L
Trichlorofluoromethane	1.0 U	µg/L
Acrolein	100 U	µg/L
1,1-Dichloroethene	2.0 U	µg/L
Acetone	50 U	µg/L
Iodomethane	2.0 U	µg/L
Carbon Disulfide	50 U	µg/L
Acetonitrile	10 U	µg/L
3-Chloropropene	6.0 U	µg/L
Methylene Chloride	3.0 U	µg/L
Acrylonitrile	6.0 U	µg/L
t-1,2-Dichloroethene	1.0 U	µg/L
1,1-Dichloroethane	4.0 U	µg/L
Vinyl Acetate	2.0 U	µg/L
Chloroprene	6.0 U	µg/L
2-Butanone	20 U	µg/L
Propionitrile	30 U	µg/L
Methacrylonitrile	3.0 U	µg/L
Chloroform	1.0 U	µg/L
1,1,1-Trichloroethane	1.0 U	µg/L
Carbon tetrachloride	1.0 U	µg/L
Isobutyl Alcohol	60 U	µg/L
Benzene	1.0 U	µg/L
1,2-Dichloroethane	1.0 U	µg/L
Trichloroethene	1.0 U	µg/L
1,2-Dichloropropane	1.0 U	µg/L
Dibromomethane	1.0 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR7017
DATE REPORTED: June 28, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8260 - VOLATILE ORGANICS	LAB BLANK	Units
1,4-Dioxane	60 U	µg/L
Methyl Methacrylate	2.0 U	µg/L
Bromodichloromethane	1.0 U	µg/L
4-Methyl-2-pentanone	20 U	µg/L
Toluene	1.0 U	µg/L
t-1,3-Dichloropropene	1.0 U	µg/L
Ethyl Methacrylate	2.0 U	µg/L
1,1,2-Trichloroethane	1.0 U	µg/L
Tetrachloroethene	3.0 U	µg/L
c-1,3-Dichloropropene	1.0 U	µg/L
2-Hexanone	20 U	µg/L
Dibromochloromethane	1.0 U	µg/L
1,2-Dibromoethane	1.0 U	µg/L
Chlorobenzene	1.0 U	µg/L
1,1,1,2-Tetrachloroethane	1.0 U	µg/L
Ethylbenzene	1.0 U	µg/L
m-Xylene & p-Xylene	2.0 U	µg/L
o-Xylene	1.0 U	µg/L
Styrene	1.0 U	µg/L
Bromoform	1.0 U	µg/L
1,1,2,2-Tetrachloroethane	1.0 U	µg/L
1,2,3-Trichloropropane	2.0 U	µg/L
t-1,4-Dichloro-2-Butene	2.0 U	µg/L
1,2-Dibromo-3-chloropropane	2.0 U	µg/L

Surrogate:	% RECOV	LIMITS
Dibromofluoromethane	76	52-149
D8-Toluene	73	70-132
Bromofluorobenzene	79	60-135
Date Analyzed	06/17/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	LAB BLANK	Units
Acenaphthene	10 U	μg/L
Acenaphthylene	10 U	μg/L
Acetophenone	10 U	μg/L
2-Acetylaminofluorene	10 U	μg/L
4-aminobiphenyl	10 U	μg/L
Aniline	10 U	μg/L
Anthracene	10 U	μg/L
Aramite	10 U	μg/L
Benzo(a)anthracene	10 U	μg/L
Benzo(g,h,i)perylene	10 U	μg/L
Benzo(k)fluoranthene	10 U	μg/L
B[illegible]zyl alcohol	10 U	μg/L
Benzo(b)fluoranthene	10 U	μg/L
Benzo(a)pyrene	10 U	μg/L
Bis(2-chloroethoxy)methane	10 U	μg/L
Bis(2-chloroethyl)ether	10 U	μg/L
Bis(2-chloroisopropyl)ether	10 U	μg/L
Bis(2-ethylhexyl)phthalate	10 U	μg/L
4-Bromophenylphenyl ether	10 U	μg/L
Benzylbutyl phthalate	10 U	μg/L
Dinoseb	10 U	μg/L
4-Chloroaniline	10 U	μg/L
4-Chloro-3-methylphenol	10 U	μg/L
2-Chloronaphthalene	10 U	μg/L
2-Chlorophenol	10 U	μg/L
4-Chlorophenyl phenyl ether	10 U	μg/L
Chrysene	10 U	μg/L
3 & 4-Methylphenol	20 U	μg/L
2-Methylphenol	10 U	μg/L

U - Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	**LAB BLANK**	**Units**
Diallate	10 U	µg/L
Dibenzo(a,h)anthracene	10 U	µg/L
Dibenzofuran	10 U	µg/L
Di-n-butyl phthalate	10 U	µg/L
1,2-Dichlorobenzene	10 U	µg/L
1,3-Dichlorobenzene	10 U	µg/L
1,4-Dichlorobenzene	10 U	µg/L
3,3'-Dichlorobenzidine	10 U	µg/L
3,3'-Dimethylbenzidine	10 U	µg/L
2,4-Dichlorophenol	10 U	µg/L
2.6-Dichlorophenol	10 U	µg/L
I thyl phthalate	10 U	µg/L
p-(dimethylamino)azobenzene	10 U	µg/L
7,12-Dimethylbenz(a)Anthracene	10 U	µg/L
a,a-Dimethylphenethylamine	10 U	µg/L
2,4-Dimethylphenol	10 U	µg/L
Dimethyl phthalate	10 U	µg/L
m-Dinitrobenzene	10 U	µg/L
2-Methyl-4,6-Dinitrophenol	10 U	µg/L
2,4-Dinitrophenol	10 U	µg/L
2,4-Dinitrotoluene	10 U	µg/L
2,6-Dinitrotoluene	10 U	µg/L
Di-n-octyl phthalate	10 U	µg/L
Diphenylamine	10 U	µg/L
Ethyl methanesulfonate	10 U	µg/L
N-Nitrosodi-N-Propylamine	10 U	µg/L
Fluoranthene	10 U	µg/L
Fluorene	10 U	µg/L

= Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR7017
DATE REPORTED: June 28, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	LAB BLANK	Units
Hexachlorobenzene	10 U	µg/L
Hexachlorobutadiene	10 U	µg/L
Hexachlorocyclopentadiene	10 U	µg/L
Hexachloroethane	10 U	µg/L
Hexachlorophene	2000 U	µg/L
Hexachloropropene	10 U	µg/L
Indeno(1,2,3-cd)pyrene	10 U	µg/L
Isophorone	10 U	µg/L
Isosafrole	10 U	µg/L
Methapyrilene	10 U	µg/L
3-Methylcholanthrene	10 U	µg/L
4-Nitroquinoline-1-oxide	10 U	µg/L
Methyl methanesulfonate	10 U	µg/L
2-Methylnaphthalene	10 U	µg/L
Naphthalene	10 U	µg/L
1,4-Naphthoquinone	10 U	µg/L
1-Naphthylamine	10 U	µg/L
2-Naphthylamine	10 U	µg/L
2-Nitroaniline	10 U	µg/L
3-Nitroaniline	10 U	µg/L
4-Nitroaniline	10 U	µg/L
Nitrobenzene	10 U	µg/L
2-Nitrophenol	10 U	µg/L
4-Nitrophenol	10 U	µg/L
N-nitrosodi-n-butylamine	10 U	µg/L
N-nitrosodiethylamine	10 U	µg/L
N-nitrosomethylethylamine	10 U	µg/L
N-Nitrosodiphenylamine	10 U	µg/L
N-Nitrosodimethylamine	10 U	µg/L
N-Nitrosomorpholine	10 U	µg/L
N-Nitrosopiperidine	10 U	µg/L
N-Nitrosopyrrolidine	10 U	µg/L
5-Nitro-o-toluidine	10 U	µg/L

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8270 - BASE/NEUTRAL-ACID SVOAS	LAB BLANK	Units
Pentachlorobenzene	10 U	µg/L
Pentachloroethane	10 U	µg/L
Pentachloronitrobenzene	10 U	µg/L
Pentachlorophenol	10 U	µg/L
Phenacetin	10 U	µg/L
Phenanthrene	10 U	µg/L
Phenol	10 U	µg/L
p-Phenylenediamine	10 U	µg/L
2-Picoline	10 U	µg/L
Pronamide	10 U	µg/L
Pyrene	10 U	µg/L
Pyridine	10 U	µg/L
Safrole	10 U	µg/L
1,2,4,5-Tetrachlorobenzene	10 U	µg/L
2,3,4,6-Tetrachlorophenol	10 U	µg/L
o-Toluidine	10 U	µg/L
1,2,4-Trichlorobenzene	10 U	µg/L
2,4,5-Trichlorophenol	10 U	µg/L
2,4,6-Trichlorophenol	10 U	µg/L
o,o,o-Triethyl phosphorothioate	10 U	µg/L
1,3,5-Trinitrobenzene	10 U	µg/L
Surrogate:	**% RECOV**	**LIMITS**
Nitrobenzene -D5	87	44-135
2-Fluorobiphenyl	85	48-127
Terphenyl -D14	112	47-168
Phenol -D5	63	6-125
2-Fluorophenol	78	27-121
2,4,6-Tribromophenol	119	58-144
Date Extracted	06/14/99	
Date Analyzed	06/21/99	

U = Compound was analyzed for but not detected to the level shown.

ENCO LABORATORIES
REPORT # : OR7017
DATE REPORTED: June 28, 1999
REFERENCE : 979657
PROJECT NAME : DEP-Tenoroc

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8080 - ORGANOCHLORINE PESTICIDES	LAB BLANK	Units
alpha-BHC	0.050 U	µg/L
beta-BHC	0.050 U	µg/L
gamma-BHC (Lindane)	0.050 U	µg/L
Heptachlor	0.050 U	µg/L
delta-BHC	0.050 U	µg/L
Aldrin	0.050 U	µg/L
Heptachlor Epoxide	0.050 U	µg/L
Chlordane (Total)	1.0 U	µg/L
Kepone	0.10 U	µg/L
Endosulfan I	0.050 U	µg/L
4,4'-DDE	0.050 U	µg/L
Dieldrin	0.050 U	µg/L
Endrin	0.050 U	µg/L
4,4'-DDD	0.050 U	µg/L
Endosulfan II	0.050 U	µg/L
4,4'-DDT	0.050 U	µg/L
Endrin aldehyde	0.050 U	µg/L
Endosulfan sulfate	0.050 U	µg/L
Methoxychlor	0.10 U	µg/L
Isodrin	0.050 U	µg/L
Chlorobenzilate	0.10 U	µg/L
Toxaphene	2.0 U	µg/L

U - Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8080 (cont.) - ORGANOCHLORINE PESTICIDES	LAB BLANK	Units
PCB-1016/1242	1.0 U	µg/L
PCB-1221	1.0 U	µg/L
PCB-1232	1.0 U	µg/L
PCB-1248	1.0 U	µg/L
PCB-1254	1.0 U	µg/L
PCB-1260	1.0 U	µg/L
Surrogate:	**% RECOV**	**LIMITS**
2,4,5,6-TCMX	84	30-150
DBC	140	37-128
Date Extracted	06/17/99	
Date Analyzed	06/23/99	

EPA METHOD APPENDIX IX, 8141 - ORGANOPHOSPHORUS PESTICIDES	LAB BLANK	Units
Dimethoate	2.0 U	µg/L
Disulfoton	2.0 U	µg/L
Famphur	2.0 U	µg/L
Parathion ethyl	2.0 U	µg/L
Parathion methyl	2.0 U	µg/L
Phorate	2.0 U	µg/L
Sulfotep	2.0 U	µg/L
Thionazin	2.0 U	µg/L
Dichlorofenthion	2.0 U	µg/L
Surrogate:	**% RECOV**	**LIMITS**
Tributyl Phosphate	108	61-143
Triphenyl Phosphate	126	58-143
Date Extracted	06/19/99	
Date Analyzed	06/24/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

EPA METHOD APPENDIX IX, 8150 - CHLORINATED HERBICIDES	LAB BLANK	Units
2,4-D	1.0 U	µg/L
2,4,5-TP (Silvex)	1.0 U	µg/L
2,4,5-T	1.0 U	µg/L
Surrogate:	**% RECOV**	**LIMITS**
2,4-DCAA	114	9-127
Date Extracted	06/19/99	
Date Analyzed	06/24/99	

E METHOD 504	LAB BLANK	Units
Ethylene Dibromide	0.020 U	µg/L
Dibromochloropropane	0.020 U	µg/L
Date Extracted	06/16/99	
Date Analyzed	06/16/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	LAB BLANK	Units
Antimony	7041	0.0050 U	mg/L
Date Analyzed		06/19/99	
Arsenic	6010	0.010 U	mg/L
Date Analyzed		06/18/99	
Barium	6010	0.10 U	mg/L
Date Analyzed		06/18/99	
Beryllium	6010	0.0010 U	mg/L
Date Analyzed		06/18/99	
Cadmium	6010	0.0010 U	mg/L
Date Analyzed		06/18/99	
Chromium	6010	0.010 U	mg/L
Date Analyzed		06/18/99	
Cobalt	6010	0.050 U	mg/L
Date Analyzed		06/18/99	
Copper	6010	0.050 U	mg/L
Date Analyzed		06/18/99	
Lead	6010	0.0050 U	mg/L
Date Analyzed		06/18/99	
Mercury	7470	0.00020 U	mg/L
Date Analyzed		06/16/99	
Nickel	6010	0.010 U	mg/L
Date Analyzed		06/18/99	

U = Compound was analyzed for but not detected to the level shown.

RESULTS OF ANALYSIS

TOTAL METALS	METHOD	LAB BLANK	Units
Selenium Date Analyzed	6010	0.010 U 06/18/99	mg/L
Silver Date Analyzed	6010	0.010 U 06/18/99	mg/L
Thallium Date Analyzed	7841	0.002 U 06/18/99	mg/L
Tin Date Analyzed	6010	0.10 U 06/18/99	mg/L
V adium Date Analyzed	6010	0.010 U 06/18/99	mg/L
Zinc Date Analyzed	6010	0.10 U 06/18/99	mg/L

MISCELLANEOUS	METHOD	LAB BLANK	Units
Cyanide, Total Date Analyzed	335.2	0.010 U 06/15/99	mg/L
Sulfide, Total Date Analyzed	376.1	1.0 U 06/14/99	mg/L

U = Compound was analyzed for but not detected to the level shown.

QUALITY CONTROL DATA

Parameter	% RECOVERY MS/MSD/LCS	ACCEPT LIMITS	% RPD MS/MSD	ACCEPT LIMITS
EPA Method APPENDIX IX, 8260				
1,1-Dichloroethene	82/ 84/ 85	36-185	2	34
Benzene	81/ 91/ 89	65-143	12	25
Trichloroethene	74/ 69/ 72	51-152	7	28
Toluene	77/ 91/ 88	62-144	17	24
Chlorobenzene	81/ 78/ 79	64-140	4	23
EPA Method APPENDIX IX, 8270				
Phenol	76/ 60/ 48	29-102	24	44
2-Chlorophenol	108/ 84/ 84	58-124	25	41
1,4-Dichlorobenzene	112/ 85/ 82	10-127	27	43
N-Nitrosodi-N-Propylamine	110/ 90/ 84	72-118	20	22
1,2,4-Trichlorobenzene	113/ 93/ 87	18-129	19	43
4-Chloro-3-methylphenol	122/116/ 96	75-126	5	22
Acenaphthene	108/102/ 86	63-122	6	28
4-Nitrophenol	106/104/ 64	10-168	2	52
2,4-Dinitrotoluene	136/133/103	81-151	2	21
Pentachlorophenol	138/138/104	27-154	<1	42
Pyrene	108/ 95/ 87	54-146	13	32

Environmental Conservation Laboratories Comprehensive QA Plan #960038

< = Less Than
MS = Matrix Spike
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Standard
RPD = Relative Percent Difference

QUALITY CONTROL DATA

Parameter	% RECOVERY MS/MSD/LCS	ACCEPT LIMITS	% RPD MS/MSD	ACCEPT LIMITS
EPA Method APPENDIX IX, 8080				
gamma-BHC (Lindane)	95/ 65/ 85	44-105	38	40
Heptachlor	90/ 60/ 75	58-109	40	17
Aldrin	100/ 60/ 80	35-103	50	51
Dieldrin	100/ 90/ 85	54-139	10	35
Endrin	135/ 85/ 95	57-123	45	26
4,4'-DDT	135/ 80/120	11-153	51	25
EPA Method APENDIX IX, 8141				
Dimethoate	138/138/145	49-95	<1	40
E'	135/121/140	88-113	11	22
Malathion	120/124/132	22-100	3	40
Monocrotophos	88/ 90/ 92	82-116	3	6
Parathion	95/ 94/105	82-115	<1	6
Sulfotep	88/ 90/ 92	82-115	3	6
TEPP	110/ 97/ 87	82-115	12	6
EPA Method 8151				
Dalapon	67/ 14/ 88	37-161	131	45
Dicamba	119/ 18/111	36-232	147	45
2,4-D	109/ 38/110	43-180	96	46
2,4,5-TP (Silvex)	140/ 21/120	64-168	148	42
2,4-DB	124/ 42/ 72	15-126	99	45

Environmental Conservation Laboratories Comprehensive QA Plan #960038

< = Less Than
MS = Matrix Spike
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Standard
RPD = Relative Percent Difference

QUALITY CONTROL DATA

Parameter	% RECOVERY MS/MSD/LCS	ACCEPT LIMITS	% RPD MS/MSD	ACCEPT LIMITS
EPA Method 504				
Ethylene Dibromide	116/120/ 56	66-137	3	14
Total Metals				
Antimony, 7041	113/111/112	45-152	2	15
Arsenic, 6010	118/116/115	64-126	2	12
Barium, 6010	116/118/118	74-119	2	11
Beryllium, 6010	118/116/116	76-126	2	12
Cadmium, 6010	116/115/120	68-121	<1	12
Chromium, 6010	118/117/119	73-120	<1	10
Cobalt, 6010	116/114/117	76-120	2	17
Copper, 6010	119/116/116	75-123	2	11
Lead, 6010	115/114/118	68-126	<1	19
Mercury, 7470	109/108/103	70-136	<1	12
Nickel, 6010	111/109/112	64-126	2	12
Selenium, 6010	119/118/119	65-129	<1	10
Silver, 6010	104/105/105	69-121	<1	12
Thallium, 7841	78/ 80/101	69-153	2	15
Tin, 6010	106/104/100	81-124	2	18
Vanadium, 6010	131/128/122	82-115	2	16
Zinc, 6010	116/113/115	63-131	3	24
MISCELLANEOUS				
Cyanide, Total, 335.2	80/ 99/ 75	49-131	21	21
Sulfide, Total, 376.1	NA/ NA/100	14-155	NA	9

Environmental Conservation Laboratories Comprehensive QA Plan #960038

< = Less Than
MS = Matrix Spike
MSD = Matrix Spike Duplicate
LCS = Laboratory Control Standard
RPD = Relative Percent Difference

QSARF #

ENVIRONMEN AL CONSERVATION LABORATORIES

4810 Executive Park Court, Suite 211
Jacksonville, Florida 32216-6069
Ph. (904) 296-3007 • Fax (904) 296-6210

10207 General Drive
Orlando, Florida 32824
Ph. (407) 826-5314 • Fax (407) 850-6945

ENCO CompQAP No.: 960038G/0

CHAIN OF CUSTODY RECORD

PROJECT REFERENCE: DEP - Tenoroc | PROJECT NO.: 979657 | P.O. NUMBER:

PROJECT LOC. (State): FL | SAMPLER(s) NAME: T.L. Shaw | PHONE: (941) 667-2345 | FAX: (941) 667-2662

CLIENT NAME: BCI Eng. + Sci., Inc. | CLIENT PROJECT MANAGER:

CLIENT ADDRESS (CITY, STATE, ZIP): P.O. Box 5467, Lakeland, FL, 33807-5467

PAGE 1 OF 1

☒ STANDARD REPORT DELIVERY
☐ EXPEDITED REPORT DELIVERY (surcharge)

Date Due:

MATRIX TYPE: SURFACE WATER, GROUND WATER, WASTEWATER, DRINKING WATER, SOIL/SOLID/SEDIMENT, NONAQUEOUS LIQUID (oil, solvent, etc.), AIR, SLUDGE, OTHER

REQUIRED ANALYSIS / NUMBER OF CONTAINERS SUBMITTED

STATION	DATE	TIME	GRAB	COMP	SAMPLE IDENTIFICATION	SURFACE WATER	GROUND WATER	WASTEWATER	DRINKING WATER	SOIL/SOLID/SEDIMENT	NONAQUEOUS LIQUID	AIR	SLUDGE	OTHER	8260 (HCl)	504 (Ice)	8270 (Ice)	8080 (Ice)	8141 (Ice)	8151 (Ice)	17 Metals (HNO_3)	Cyanide (NaOH)	(NaOH + Zn Ac)	REMARKS
1	6-11-99	0950	X		T-1		X								3	2	1	1	1	1	1	1	1	
2	↓	1345	X		T-2		X								3	2	1	1	1	1	1	1	1	
3	↓	1255	X		T-3		X								3	2	1	1	1	1	1	1	1	Filter 8260's, 8270's
4	↓	0930	X		EB-1		X								3	2	1	1	1	1	1	1	1	and EDB's
5																								
6																								
7																								
8																								
9																								
10																								
11																								
12																								
13																								
14																								

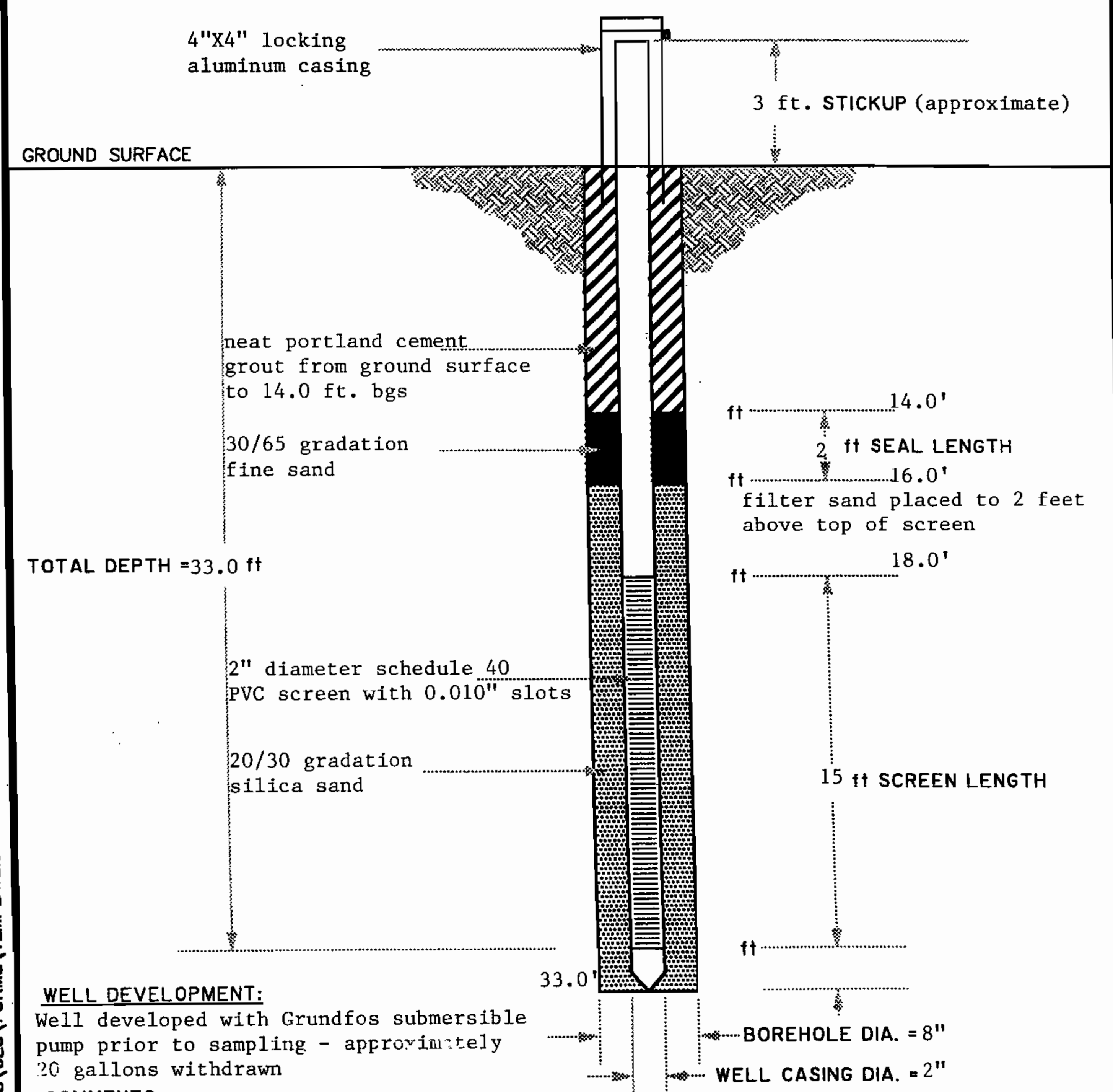
	DATE	TIME		DATE	TIME		DATE	TIME
SAMPLE KIT PREPARED BY: ☐ JACKSONVILLE ☒ ORLANDO			RELINQUISHED BY: (SIGNATURE) J. Armstrong	6-7-99	12:35	RECEIVED BY: (SIGNATURE) Thomas L. Shaw	6-8-99	08:30
RELINQUISHED BY: (SIGNATURE) Thomas L. Shaw	6-11-99	1430	RECEIVED BY: (SIGNATURE) [signature]	6-11	1430	RELINQUISHED BY: (SIGNATURE) [signature]	6/12	1015
RECEIVED BY (SIGNATURE)			RELINQUISHED BY: (SIGNATURE)			RECEIVED BY: (SIGNATURE)		

RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	CUSTODY INTACT	ENCO LOG NO.	REMARKS
M. Pichon ☐ Jacksonville ☑ Orlando	6-12-99	09:00	☑ YES ☐ NO	OR7017	Samples iced upon pickup and delivery SE

BCI
BROMWELL & CARRIER, INC.

WELL COMPLETION RECORD

CLIENT: FDEP
PROJECT: Tenoroc Fish Management Area
PROJECT NO.: 979657.14
WELL I.D.: T-1
DATE INSTALLED: 1-15-99
BCI INSPECTOR: T.L. Shaw
CONTRACTOR/DRILLER: Huss Drilling, Inc.
SITE COORDINATES: N: 1363640.18 E: 706537.85 (FL State Plane Coordinate System)
ELEVATION: TOP OF CASING - 145.34 feet NGVD
GROUND SURFACE - 142.3 feet (approximate)
AQUIFER OF COMPLETION: Surficial



WELL DEVELOPMENT:
Well developed with Grundfos submersible pump prior to sampling - approximately 20 gallons withdrawn

COMMENTS:
Water level = 24.5 ft. BTOC
6-4-99

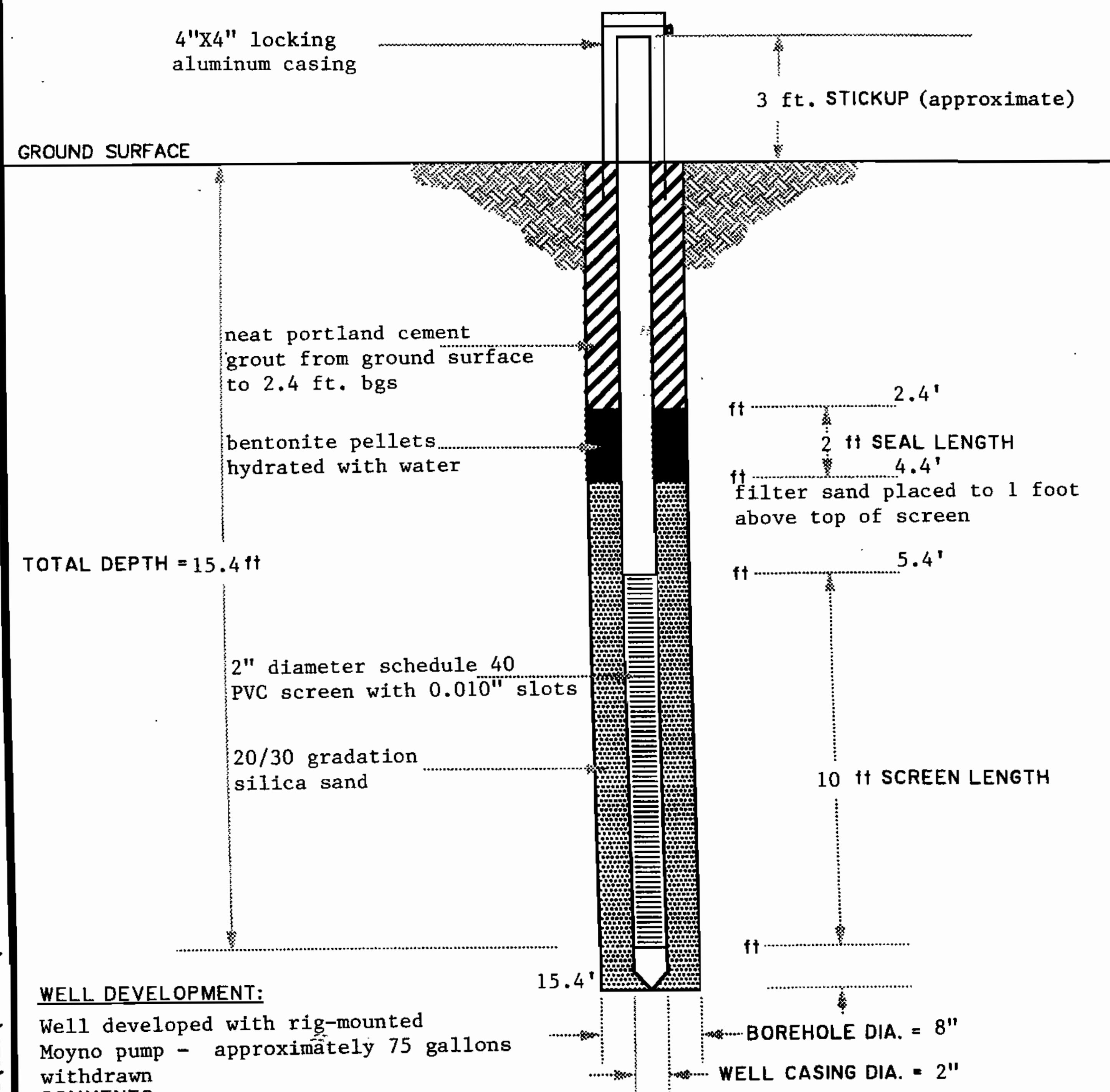
DATE PLOTTED... -29-98

N:\DETAILS\GEO\FORMS\TEMPLATE.DWG

BCI BROMWELL & CARRIER, INC.

WELL COMPLETION RECORD

CLIENT: FDEP
PROJECT: Tenoroc Fish Management Area
PROJECT NO.: 979657.14
WELL I.D.: T-2
DATE INSTALLED: 1-15-99
BCI INSPECTOR: T.L. Shaw
CONTRACTOR/DRILLER: Huss Drilling, Inc.
SITE COORDINATES: N: 1364761.91 E: 706205.67 (FL State Plane Coordinate System
ELEVATION: TOP OF CASING - 129.14 feet NGVD
GROUND SURFACE - 126.0 feet (approximate)
AQUIFER OF COMPLETION: Surficial



WELL DEVELOPMENT:

Well developed with rig-mounted Moyno pump - approximately 75 gallons withdrawn

COMMENTS:

Water level = 7.3 ft. BTOC
6-4-99

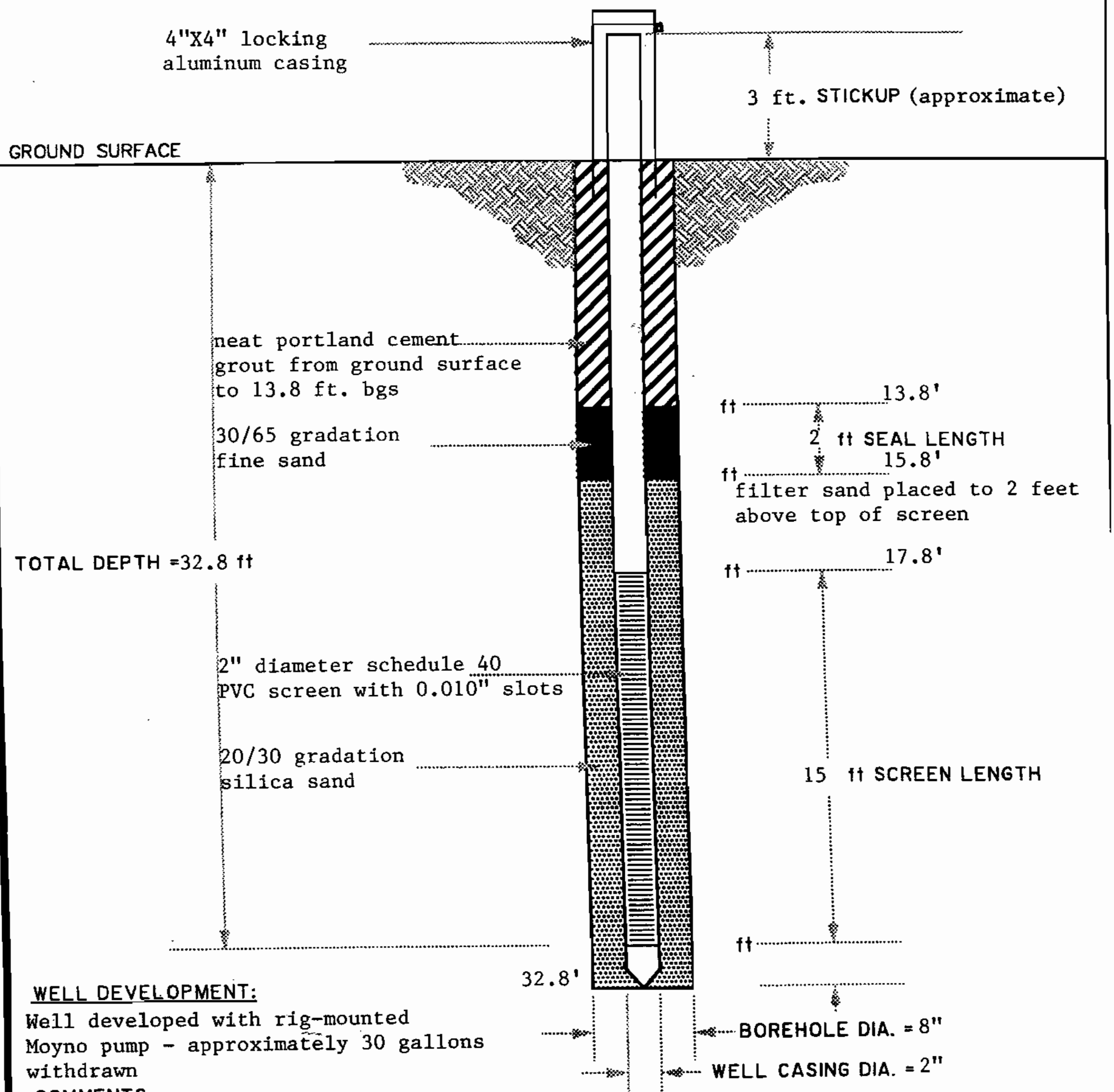
DATE PLOTTED:9-29-98

N:\DETAILS\GEO\FORMS\TEMPLATE.DWG

BCI — BROMWELL & CARRIER, INC.

WELL COMPLETION RECORD

CLIENT: FDEP
PROJECT: Tenoroc Fish Management Area
PROJECT NO.: 979657.14
WELL I.D.: T-3
DATE INSTALLED: 1-15-99
BCI INSPECTOR: T.L. Shaw
CONTRACTOR/DRILLER: Huss Drilling, Inc.
SITE COORDINATES: N: 1365030.88 E: 708749.15 (FL State Plane Coordinate System
ELEVATION: TOP OF CASING - 143.83 feet NGVD
GROUND SURFACE - 140.8 feet (approximate)
AQUIFER OF COMPLETION: Surficial



WELL DEVELOPMENT:
Well developed with rig-mounted Moyno pump - approximately 30 gallons withdrawn

COMMENTS:
Water level = 20.1 ft. BTOC
6-4-99

DATE PLOTTED:9-29-98

N:\DETAILS\GEO\FORMS\TEMPLATE.DWG

WATER QUALITY MONITORING PROGRAM
FOR THE TENOROC FISH MANAGEMENT AREA

Introduction

The Tenoroc Fish Management Area (TFMA) is a public recreation area and fisheries research facility owned by the State of Florida and managed by the Florida Fish and Wildlife Conservation Commission (FFWCC). Lands within the TFMA and the surrounding Upper Saddle Creek Sub-basin (USCSB) have been heavily impacted by previous phosphate mining and reclamation activities within the region. In addition, a parcel of land adjoining the southeastern portion of the site was formerly utilized as an unlined landfill (the former Tri-City Landfill).

Surface waters within phosphate mine sites generally contain naturally-occurring high levels of phosphorous that can contribute to the potential for nuisance blooms of algae. In addition, deep mine-pit lakes may contain undesirably low levels of dissolved oxygen in the lower strata. At operating mine sites, these problems are typically addressed by means of an active water recirculation system. However, at old mines sites such as Tenoroc, these recirculation systems no longer exist.

The former Tri-City Landfill was operated during the early 1970's, prior to the development of existing environmental regulations governing the construction of landfill sites. A majority of the landfill was reportedly constructed below grade in the mine pits created during prior mining activities. Therefore, the area is suspect with regard to the potentially contaminated soils, surface water and/or ground water on or near the property, and the possible migration of these contaminants onto the TFMA site.

As a result of the 1995 Memorandum of Understanding (MOU) between the U.S. Army Corps of Engineers (USACOE), the Florida Department of Environmental Protection (FDEP), the Florida Department of Transportation (FDOT), the Florida Game and Fresh Water Fish Commission (now known as the FFWCC), and the Southwest Florida Water Management District (SWFWMD), restoration plans for areas within the boundaries of the TFMA include the reclamation of formerly mined lands located within several non-mandatory reclamation program areas at the site, and the construction of new mitigation wetlands intended to replace wetland areas that were destroyed or impacted as a result of construction of the Polk County Parkway.

Construction work associated with reclamation and mitigation activities has the potential to create surface water quality impacts, due to the mobilization of stagnant water and sediment within the work zones. Preliminary investigations conducted as part of Task 1 of this restoration project indicate that relatively high levels of bacterial pathogens have been found in several surface water bodies within the specified work areas.

Regional development activities to the north and east of the site (at the proposed Bridgewater and Saddle Creek Developments and the City of Auburndale's new wastewater effluent disposal area) pose a potential threat to surface water and ground water quality, both in and around the TFMA. Stormwater runoff from residential yards, roadways and parking areas, as well as leachates from retention areas associated with large developments, can contaminate surface water and ground water, and the sediments at the bottom of lakes and streams. In addition, high levels of nutrients (particularly nitrates) can be introduced into ground water systems in the vicinity of wastewater effluent disposal areas.

The FFWCC has worked diligently to establish the TFMA as a premiere public fishing and recreation area, and therefore a primary consideration of this restoration effort must be to protect and maintain the quality of waters entering and flowing through the fishing lakes system. Based on all of these considerations, a plan must be developed to:

- evaluate the baseline water quality characteristics of surface water and ground water entering, residing within, and exiting the TFMA, before significant restoration and development activities are initiated;

- assess potential changes in water quality that may occur as a result of these activities; and,

- monitor existing and future inflow and outflow sources for compliance with applicable water quality standards.

Monitoring Approach and Sampling Strategy

The following Water Quality Monitoring Program (WQMP) has been developed to establish the protocols and procedures necessary to achieve the objectives stated above. The plan has been designed in a phased approach to achieve the stated objectives in an efficient and organized manner. The following lists the various phases of the WQMP in sequential order.

Phase 1 – Establish Background/Baseline Conditions Prior to Restoration

In order to evaluate potential changes in water quality at the TFMA in the future, a thorough understanding of the current background/baseline conditions must be established. This evaluation will provide critical information necessary to assess the existing health and viability of the fishery and the associated wildlife habitats. The effort will result in a better understanding of the mechanisms of potential ecological effects, and guidance for management of the site on both a short-term and long-term basis. As part of this initial evaluation, the following tasks must be completed:

1. Determine existing watershed hydrology to establish surface water routings and Surficial Aquifer ground water flow into, through and out of the TFMA site. Appropriate samples locations are to be selected based on the review of existing watershed hydrology.
2. Collect surface and ground water samples for field and/or laboratory analysis for selected Class III Surface Water Standards (Fresh Water) referenced in Section 62-

302.530 of the Florida Administrative Code (FAC), and Florida's Primary and Secondary Drinking Water Standards referenced in Section 62-550, FAC.

The first task in Phase 1 was completed by reviewing data generated by the University of South Florida (USF) during their hydrologic investigation of the USCSB in 1999. In April 2000, representatives of FDEP, the FFWCC and BCI Engineers and Scientists, Inc. (BCI) utilized this information to select appropriate surface water sampling locations during a field reconnaissance of the site. A total of six sample locations were selected, based on the hydrologic data provided by USF and the findings obtained during the reconnaissance. The positional coordinates of each location were recorded on a hand-held Global Positioning System (GPS) unit maintained by the FFWCC.

In June 1999, BCI completed a preliminary assessment of Surficial Aquifer ground water quality in the vicinity of the former Tri-City Landfill (see Section 2.9 of the Task 1 Final Report). Three ground water monitor wells were installed at the locations shown on the map included as Attachment B. Ground water samples were collected from each of the three wells and analyzed for the Appendix IX water quality parameters listed in Title 40, Chapter 1, Part 264 of the Code of Federal Regulations (CFR). The analytical results obtained during this preliminary assessment indicated that ground water in the Surficial Aquifer within portions of the TFMA adjoining the landfill area did not appear to have been impacted by potential contaminant migration from the landfill site.

These three monitor wells will be used to establish the background/baseline ground water quality data required as part of this task. Additionally, it is anticipated that these three wells will continue to provide data to evaluate whether potential ground water contamination from the landfill area is migrating toward the TFMA property during subsequent post restoration monitoring. Therefore, no other monitor wells are believed to be necessary to complete the requirements of Phase 1 and Phase 3 of this WQMP.

The second task involves the collection and analysis of ground water and surface water samples for laboratory analysis. All sampling activities should be conducted under the auspices of a Comprehensive Quality Assurance Program (CompQAP) approved by the FDEP's Quality Assurance Section. BCI's CompQAP Identification Number is 930109. Samples will be collected on three occasions, at least one month apart, to provide a statistical database of background/baseline conditions before significant restoration and development activities are initiated.

Surface water samples will be collected at the locations shown on the attached map and submitted to an FDEP-approved laboratory for analysis of the Class III Surface Water (Fresh Water) parameters listed below. Additional water samples will be collected at each location and analyzed with portable meters and/or probes to determine the general water quality characteristics of pH, specific conductance, temperature and turbidity.

Laboratory Analyses

Nutrients

Nitrate, Total Nitrogen, and Total Phosphorous

Metals

Aluminum, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Silver, Thallium and Zinc

Miscellaneous

Coliforms (Fecal and Total), Dissolved Oxygen, Oils and Greases, Total Suspended Solids

During each of the sampling events, the three previously mentioned monitor wells will be utilized to collect ground water samples for analysis of the following parameters listed in Florida's Primary and Secondary Drinking Water Standards (Section 62-550, Florida Administrative Code). As noted above, additional water samples will be collected at each location and analyzed to determine the general water quality characteristics of pH, specific conductance and temperature.

Primary Inorganic Compounds (includes both metals and nutrients)

Arsenic, Barium, Beryllium, Cadmium, Chromium, Lead, Mercury, Nickel, Nitrate, Nitrite, Selenium, Sodium, Thallium and Zinc

Secondary Compounds (metals)

Aluminum, Copper, Iron, Manganese, Silver and Zinc

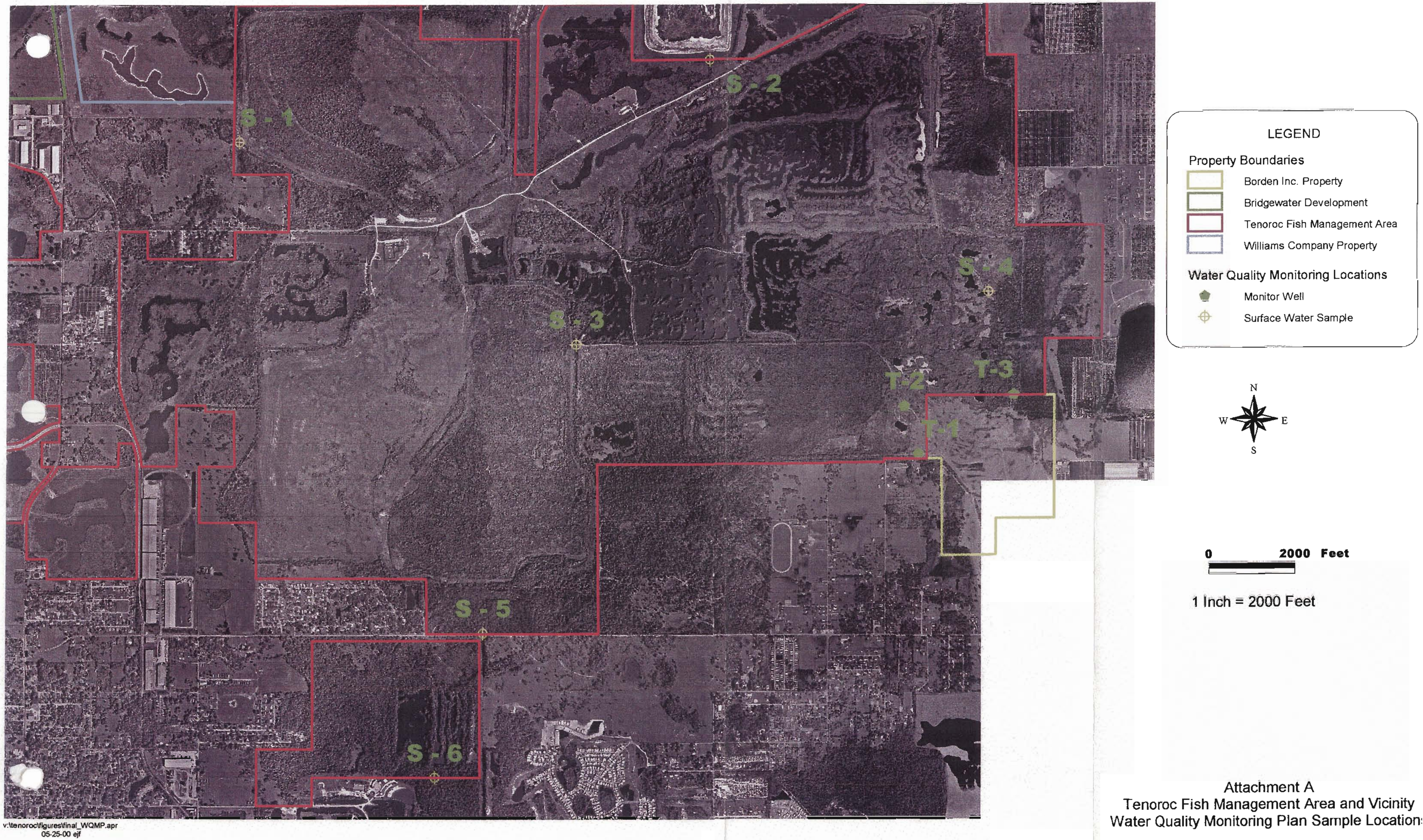
Phase 2 - Data Reporting and Analysis

In order to facilitate comparisons between background/baseline analytical data and long-term post restoration monitoring data collected in the future, a clear, concise reporting strategy must be developed as part of this WQMP. Data resulting from the background/baseline studies will be analyzed by both statistical and graphical methods. The results of the analyses will be expressed as measures of central tendency and the spread of the distribution (mean, median and standard deviation), the distribution shape (histogram), and seasonal variation (time-series plots).

The compiled data will be utilized in the development of the Task II Restoration Alternatives, and will be stored in a master WQMP database. The master database will serve as the historical record of pre-restoration baseline data collection and mapped sampling locations, and as a repository for post-restoration data and evolutionary changes to the WQMP. Periodic reporting of data collected to-date will be made via end-of-task reports (such as the Task 1 Final Report). Data specifically required for mitigation areas will be reported pursuant to the Restoration Monitoring and Management Plan (Task 6), as approved by the Selection Committee.

Phase 3 – Post Restoration Monitoring

Due to the dynamic nature of the various activities occurring in the USCSB, both now and in the future, the post-restoration monitoring plan must be tailored to accommodate changes resulting from the selection of a specific restoration plan, approved off-site development plans and permits, and the results of baseline data collected during Phase 1 of this task. Some monitoring locations and methodologies may remain constant, while others may be added, relocated, or modified to suit post restoration changes in hydrology and land use. The post-restoration monitoring plan, as well as the actual restoration planning, will be coordinated with management plans developed by the FFWCC, and off-site planning, permitting, and/or construction/maintenance activities by private developers, the Central Florida Regional Planning Council (CFRPC), SWFWMD, Polk County, the FDOT, and the FFWCC.



Attachment A
Tenoroc Fish Management Area and Vicinity
Water Quality Monitoring Plan Sample Locations