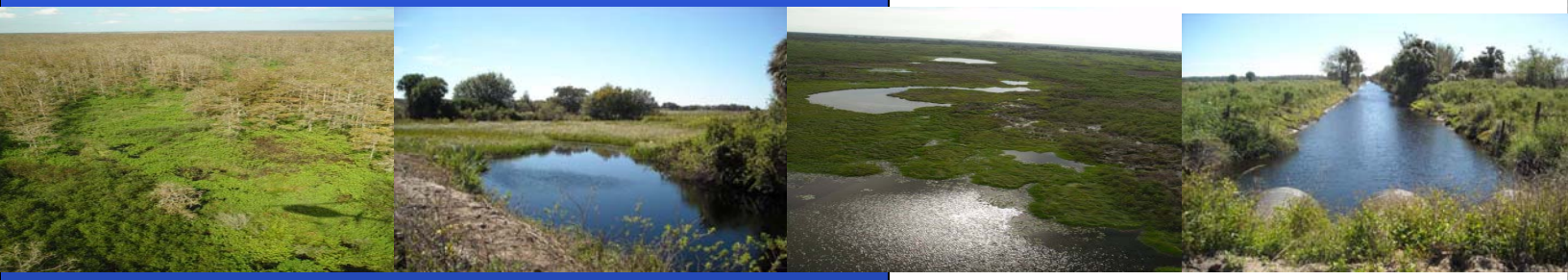
FISHEATING CREEK SUB-WATERSHED FEASIBILITY STUDY PHASE I

(Contract No. 4600000912-WO01)



DOCUMENT&DATA SUMMARY REPORT (FINAL)

March 2009

Submitted by:

13450 West Sunrise Blvd.
Suite 200
Sunrise, Florida 33323
T 954 745 7200
F 954 945 7299
www.aecom.com

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PHASE 1

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DOCUMENT/DATA SUMMARY REPORT

(Final)

MARCH 2009

Prepared for:

Prepared by:

METCALF & EDDY | AECOM

ZFI

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ACRONYMS

BHC	Benzene Hexachloride
BMP	Best Management Practices
BODR	Basis of Design Report
BSIR-STA	Brighton Seminole Indian Reservation Stormwater Treatment Area
C&SF	Central and Southern Florida
CDV	Cattle Dip Vat
CERP	Comprehensive Everglades Restoration Plan
CR	County Road
DBHYDRO	SFWMD Database
DDT	Dichlorodiphenyltrichloroethane
DO	Dissolved Oxygen
EMA	Emergent Macrophyte
EPA	Environmental Protection Agency
ES	Endangered Species
F.A.C.	Florida Administrative Code
FCWMA	Fisheating Creek Wildlife Management Area
FAWN	Florida Automated Weather Network
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FWC	Florida Fish and Wildlife Conservation Commission
FWCC	Florida Fish and Wildlife Conservation Commission
FRESP	Florida Ranchlands Environmental Services Project
GIS	Geographical Information System
GPS	Global Positioning System

IWHRS	Integrated Wildlife Habitat Ranking System
LOPA	Lake Okeechobee Protection Act
LOPP	Lake Okeechobee Protection Plan
LOP2TP	Lake Okeechobee Watershed Phase II Technical Plan
LOW	Lake Okeechobee Watershed
LOWP	Lake Okeechobee Watershed Project
M&E	Metcalf & Eddy | AECOM
M&E Team	Metcalf & Eddy | AECOM and ZFI Engineering
MPMP	Master Project Management Plan
mt	metric ton
NES	Nadic Engineering Services, Inc
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NRHP	National Register of Historical Places
NWI	National Wetland Inventory
OCHP	Office of Cultural and Historical Preservation
PAA	Planning Area Alternatives
PEM	Palustrine emergent
PIR	Lake Okeechobee Project Implementation Report
PL-566	Public Law Assessment – 566
ppb	parts per billion (µg/l)
PSS/PFO	Palustrine scrub-shrub/forested wetland
QA/QC	Quality Assurance / Quality Control
RASTA	Reservoir Assisted Stormwater Treatment Area
RCRA	US EPA Resource Conservation and Recovery Act
RESTUDY	Central and Southern Florida Project Comprehensive Review Study

RV	Recreational Vehicle
SAV	Submerged Aquatic Vegetation
SFWMD	South Florida Water Management District
SWFWMD	Southwest Florida Water Management District
SHCA	Strategic Habitat Conservation Area
SPT	Standard Penetration Test
SR	State Road
SSC	Species of Special Concern
STA	Stormwater Treatment Area
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TS	Threatened Species
UF/IFAS	University of Florida / Institute of Food and Agricultural Sciences
UMAM	Uniform Mitigation Assessment Method
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
WIMS	Water Information Management System
WMA	Water Management Area
WOD	Lake Okeechobee Works of the District Basins
ZFI	ZFI Engineering
SBIO	Sampling Stations from Statewide Biological Database
COMET	Compliance & Enforcement Tracking Facilities
ERPpa	Environmental Resource Program's Permitting Application facilities (subset of PA)
HRS	metadata does not state what HRS means
PA	Permit Application Tracking System
PWS	Potable Water System Plants

STCM	Metadata does not state what STCM means
STORET	Storage Retrieval Sampling Stations

SECTION 1 INTRODUCTION

Lake Okeechobee Watershed Construction Project Phase II Technical Plan (LOP2TP) was developed by the South Florida Water Management District (SFWMD) in coordination with the Florida Department of Environmental Protection (FDEP) and Florida Department of Agricultural and Consumer Services (FDACS) as required by the Florida legislature under the Northern Everglades and Estuaries Protection Program. The LOP2TP provided recommendations on how to reduce the phosphorus loading to Lake Okeechobee to achieve water quality targets for the Lake. The Plan also suggested the evaluation of additional water storage alternatives to improve the Lake's operating levels to more ecologically desirable ranges and to be able to avoid undesirable discharges to the estuaries (SFWMD Scope of Work, 2008).

The above feasibility study recommendations are suggested to be performed at the sub-watershed level. Throughout the Plan nine sub-watersheds were evaluated within the study area including Fisheating Creek (FEC) Sub-watershed. The FEC sub-watershed has been determined as one of the most significant sources of phosphorus loading to Lake Okeechobee among the other sub-watersheds evaluated (SFWMD, 2008).

Based on the recommendations of the Lake Okeechobee Watershed Construction project Phase II Technical Plan, SFWMD has taken the initiative to conduct a more detailed feasibility study to further define the best mix of surface storage and water quality improvement features that are most suitable in FEC sub-watershed; to identify locations for siting these features; and to develop preliminary engineering design and cost estimates for the identified features. This report represents the Phase I of the Fisheating Creek Sub-Watershed Feasibility Study and summarizes conditions of the Study Area.

1.1 Background

Fisheating Creek is the only tributary that flows into Lake Okeechobee with its natural flow regime with an average gradient of 0.5 foot per mile. The FEC sub-watershed is located in both Highlands and Glades County. A small area of the sub-watershed on its southwest part is located in Charlotte County. The entire sub-watershed covers approximately an area of 440 square miles (mi^2). FEC, which is about 56 miles, originates in western Highlands County and flows south through Cypress Swamp into the Glades County. The Creek turns to east around 1 mile north of County Road (CR) 731 and flows into Lake Okeechobee through the Cowbone Marsh (**Figure 1**) (SFWMD Scope of Work, 2008).

The sub-watershed provides many benefits both to its residents and the natural ecosystem in its surroundings. The northern part of the sub-watershed within the Highlands County limits is mostly utilized for agricultural purposes. Smaller percentage of wetlands and forests are also observed in this part of the area. The southern part of the basin located in Glades County and partly Charlotte County is occupied with forests, conservation areas, wetlands and agricultural land use.

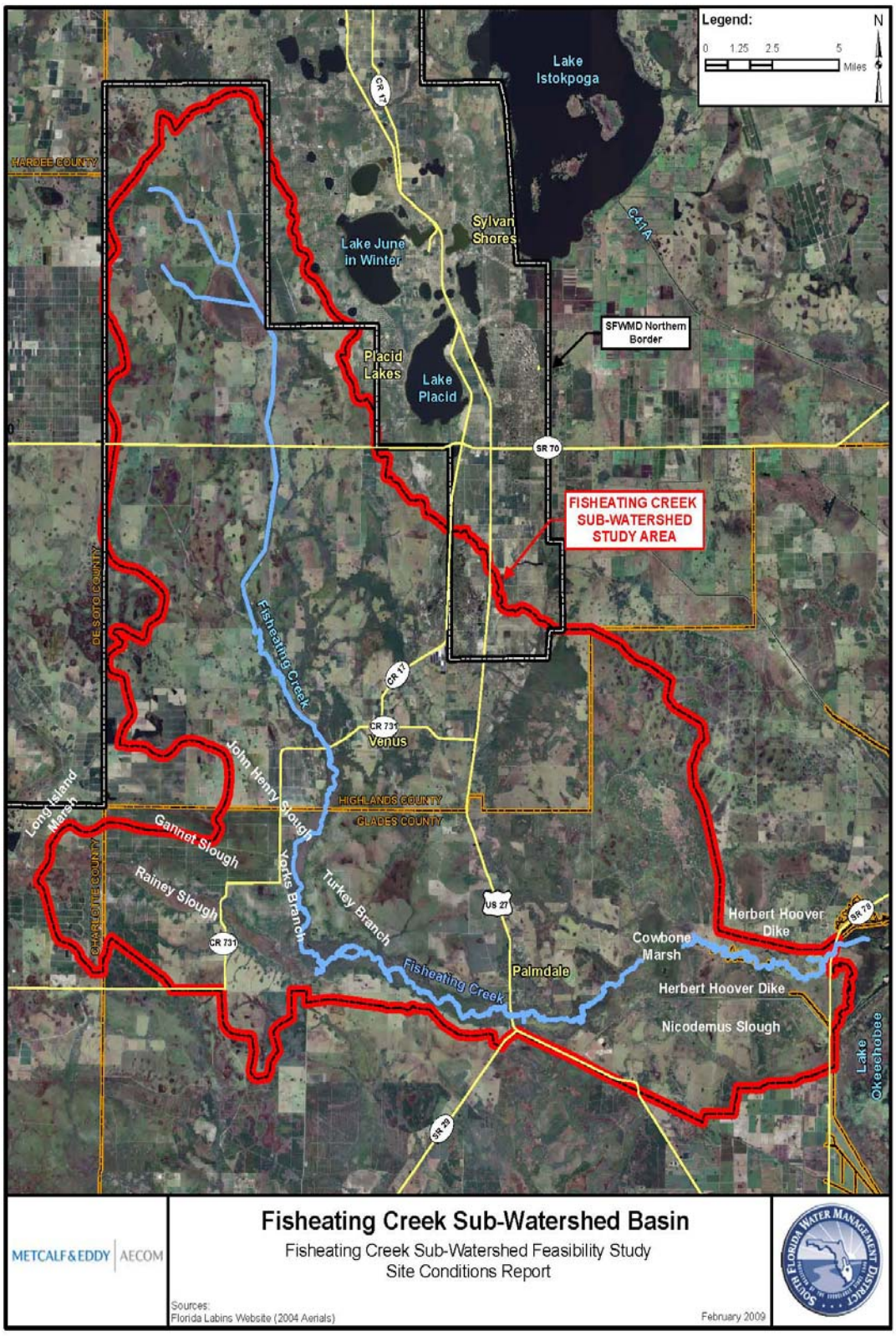


Figure 1. Fisheating Creek Sub-Watershed Study Area

Representatives of the SFWMD, Metcalf & Eddy | AECOM and ZFI Engineering (M&E Team) flew over the Study Area on October 08, 2008. Cowbone Marsh was visited on October 22, 2008. The M&E Team visited the Study Area through October 27 and 29, 2008. The Study Team also attended to two field trips that were organized to introduce the Florida Ranchlands Environmental Services Project (FRESP) to the stakeholders and other relevant parties. The first field trip took place on October 29, 2008, and the second trip was held on January 27, 2009. **Table 1** shows the ground truthed locations during these site visits.

Table 1. Ground Truthed Locations within the Study Area

Site Location	Date	Latitude	Longitude
Culvert Discharging to FEC Downstream of Drop Spillway No.1 Structure	Oct 27 2008	27.27513 N	81.47126 W
FEC - US 27 Intersection (Looking NW)	Oct 27 2008	26.93241N	81.31520W
View of Pasture Land from CR 731 (Looking NW)	Oct 27 2008	27.07277N	81.37945W
View of FEC from CR 731 (Looking S)	Oct 27 2008	26.98478N	81.49188W
View of Pasture land from Farabee Road	Oct 27 2008	26.97078N	81.51617W
View of Tasmania Road	Oct 27 2008	26.97690N	81.49090W
View from Intersection of CR 74 and CR 731	Oct 28 2008	26.94492N	81.48886W
Fisheating Wildlife Management Campground Entrance on US 27	Oct 28 2008	26.93930N	81.31952W
View of Private Land Entrance Heading to FEC	Oct 28 2008	26.94574N	81.31789W
View of FEC from Clark Road (Looking N)	Oct 28 2008	27.32236N	81.48840W
Discharge Point of FEC to Lake Okeechobee	Oct 28 2008	26.96220N	81.12110W
Cowbone Marsh	Oct 22 2008	-	-
Lykes Marsh Reservoir	Oct 29 2008	-	-
Buck Island Ranch	Oct 29 2008	-	-
Payne Ranch	Jan 27 2009	-	-
Blue Head Ranch	Jan 27 2009	-	-

1.2 Purpose and Scope

The main objective of the Fisheating Creek Sub-Watershed Feasibility Study is to prepare a Feasibility Report that will identify the most feasible alternative(s) for the water storage and P-load reduction within the Fisheating Creek Sub-Watershed Study Area. The feasibility report will not only define the most feasible alternatives but also conduct alternative analysis and selection, including preliminary design and cost estimates of identified features in the preferred alternative

This report as a part of the Phase 1 of the Fisheating Creek Sub-Watershed Feasibility Study presents the historic and existing Site Conditions of the Fisheating Creek Sub-Watershed Study Area in order to depict its overall characteristics that are important to provide a through evaluation in development of the Feasibility Report. Therefore climate, land use, topography, geology and soils, hydraulics and hydrology, water quality, land ownership, vegetation, wetlands and floodplains, fish and wildlife, threatened and endangered species, recreational resources, aesthetics, ecological, cultural and archaeological resources, hazardous waste sites, existing utilities as well as the previous studies and reports conducted for the study area are described herein.

SECTION 2 PREVIOUS STUDIES AND REPORTS

This section provides an overall review of existing studies from the Lake Okeechobee Watershed Protection Program (LOWP) that geographically and hydrologically relate to the Fisheating Creek (FEC) sub-watershed, Lake Okeechobee Basin. Please note that many other documents were reviewed for the preparation of the Data/Document Summary Report. Reports of the LOWP were provided by the SFWMD, counties, and other entities within this water management region. Most existing studies address water resource issues within the Lake Okeechobee Basin and its major sub-watersheds, however, there are limited studies related to the FEC sub-watershed. The hierarchical structure of most of the reviewed reports in this section is shown in **Figure 2**. A list of studies is presented as follows:

- Central and Southern Florida Project Comprehensive Review Study (RESTUDY)
- Master Project Management Plan (MPMP)
- Lake Okeechobee Protection Plan
- Lake Okeechobee Watershed Construction Project – Phase II Technical Plan (LOP2TP)
- Fisheating Creek Alternative Plan Evaluation Document, February 2006
- Fisheating Creek Basin Water Quality Survey, July 26, 2001

2.1 Central and Southern Florida Project Comprehensive Review Study (RESTUDY)

The Central and Southern Florida (C&SF) Project was established during the past 50 years, extending from south of Orlando to the Florida Keys. The authorized purposes of the project included flood control, regional water supply for agricultural and urban areas, prevention of salt water intrusion, water supply to Everglades National Park for the preservation of fish and wildlife, recreation and navigation. The original C&SF Project included some construction work within the FEC sub-watershed. Major improvement work consisted of creating Canal 22 and Structure 69. However, these two structures were withdrawn from the C&SF Project recommendations in 1959 because flood protection in the area could not be economically justified. Since then, the FEC sub-watershed has not been significantly altered by regional level construction projects such as canalization, and impoundment.

The Central and Southern Florida Project Comprehensive Review Study (RESTUDY) was created based on the requirements of the Water Resources Development Act of 1992 and 1996

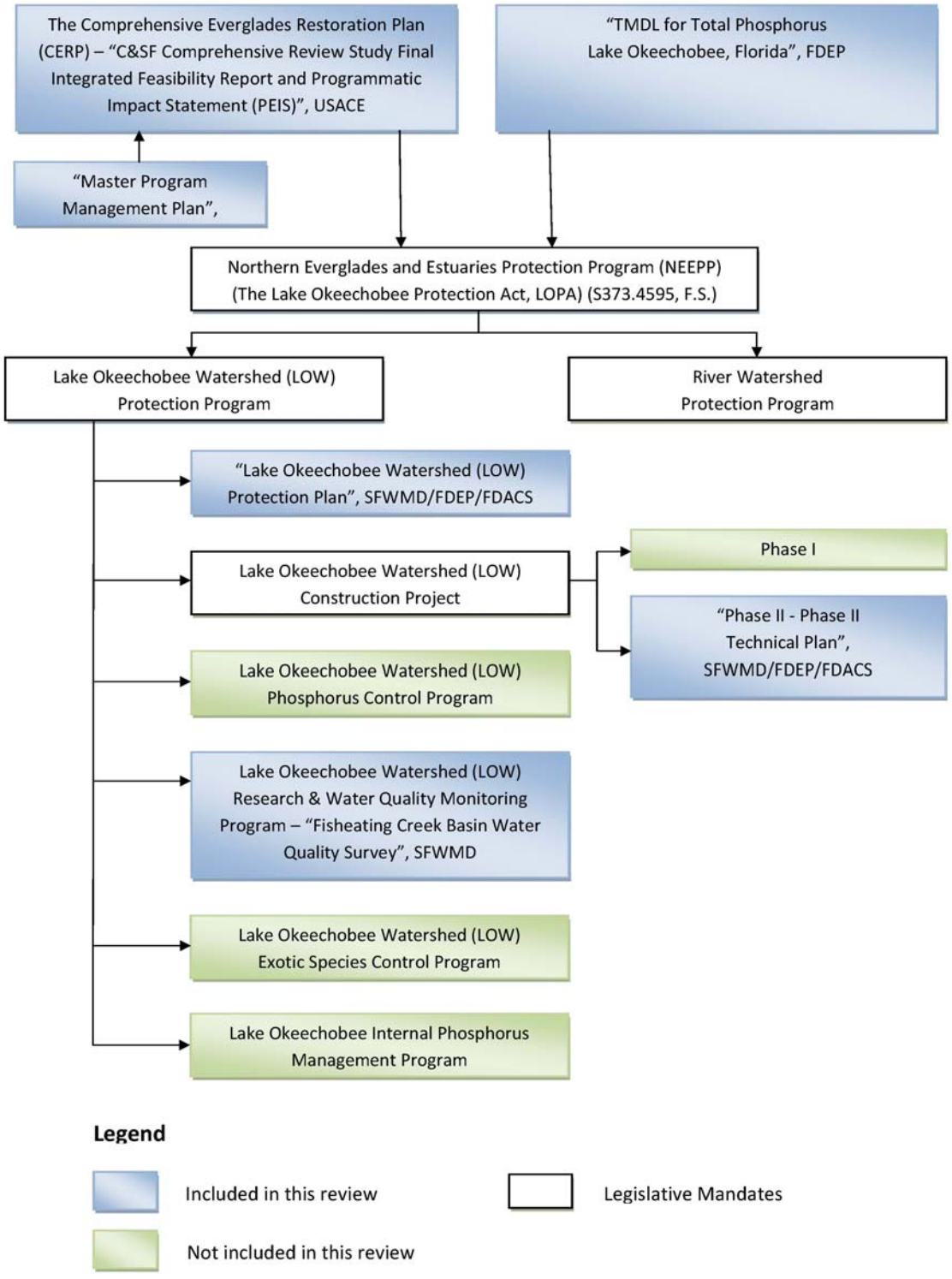


Figure 2. Hierarchy of Relevant Studies Reviewed

to re-examine the environmental and water resource impacts of the C&SF Project on the Everglades and the C&SF ecosystem. The RESTUDY planned water-related needs such as urban and agricultural water supply requirements and flood protection within the Everglades Ecosystem including the Lake Okeechobee Watershed. The RESTUDY established a set of objectives to achieve falling under general goals of enhancing ecologic values, and enhancing economic values and social well being.

The RESTUDY recognized adverse environmental impacts due to channelization of the Kissimmee River Watershed which occurred under the C&SF Project. A restoration plan was developed to repair the river and its floodplain by increasing water storage in the upper Kissimmee Watershed and physically modifying the lower watershed.

The watershed north to Lake Okeechobee, including the FEC sub-watershed, was considered as a sub-area in the C&SF project. The RESTUDY characterized overall watershed conditions that existed in the south Florida ecosystem prior to drainage and development activities. Prior to drainage, the north region of Lake Okeechobee was characterized by a complex wetland system, as the dominant woody species being oaks. All landscape in the FEC sub-watershed used to be interconnected with ecotones with slight topographic gradients. The Fisheating Creek drains into the lake's littoral zone in the west. Interconnected landscapes are now dominated by pine flatlands, pine rocklands, tropical hardwood hammocks, and xeric hammocks.

Nowadays, Lake Okeechobee water levels are regulated by a multifaceted system of pumps, spillways and locks. The creek flows through vast prairies and flatlands and discharges freely to the broad littoral zone of Lake Okeechobee at the northwest corner. Water level of the creek is controlled downstream by the lake's control structures.

Surface water draining and agricultural land use are described as the major activities impacting the water quality in Lake Okeechobee. Total phosphorus concentrations in Lake Okeechobee were as low as 50 ppb in the late 1960's. Currently total phosphorus concentrations in the lake have been measured in the range of 100 ppb and above. The FEC sub-watershed was described as a pollutant source contributing a significant phosphorus load to the lake in the RESTUDY report.

Restoration plan for Lake Okeechobee water quality improvement focused on the vast contribution of phosphorus from the Kissimmee River and Taylor Creek/Nubbin Slough sub-watersheds. The area was characterized in the RESTUDY report as highly productive agricultural regions and rapidly growing urban areas. However, when compared with other major sub-watersheds of the region, FEC's hydrology and land uses have experienced the least human impact, containing many natural, undeveloped areas suitable for preservation. Land uses within FEC sub-watershed are dominated by agricultural practices such as cattle grazing and dairy and citrus farming but also have a large percentage of forested lands and wetlands.

The major water quality problems in the FEC sub-watershed are elevated nutrient levels expressed as chlorophyll a and low dissolved oxygen (DO). Elevated nutrient levels can most likely be attributed to agriculture activities; but low DO may be caused by either agricultural nutrient loading or natural occurrences in the swamp water. Within the FEC sub-watershed, there is one wastewater treatment facility discharging treated flow to groundwater and one permitted landfill. Irrigation/discharge canals and pumping operations throughout the watershed collect contaminated surface runoff and discharges into the creek.

The RESTUDY formulated and developed a comprehensive restoration plan that includes a set of sixty-eight (68) construction projects covering the entire study area. According to the plan, 49 construction projects, including 5 construction pilot projects and 44 construction projects, should be completed before 2010. Within the Kissimmee River region where the FEC sub-watershed is located, the RESTUDY identified six (6) projects including four (4) construction projects for water quality improvement and two projects to improve the operation of water management practices. However, no project has been proposed to restore the FEC Ecosystem in the FEC sub-watershed. It should be noted that although RESTUDY depicts it different, the FEC Study Area for this project does not associate with the Kissimmee River Region or the Sub-Watershed.

2.2 Master Project Management Plan

The purpose of this Master Program Management Plan (MPMP) was to describe the framework and process to be used by the U.S. Army Corps of Engineers (USACE) and the SFWMD for managing and monitoring the implementation of the Comprehensive Everglades Restoration Plan (CERP).

The MPMP specified the large regional scope of CERP management and control framework, including program level management and coordination, program management and control requirements, program activities and project activities.

No detailed information regarding planning, assessment and engineering related to the FEC sub-watershed were included in this report.

2.3 Lake Okeechobee Protection Plan

In 2000, the Florida legislature passed the Lake Okeechobee Protection Act (LOPA) in Section 373.4595, Florida Statutes (F.S.), which requires state water quality standards to be achieved no later than January 1, 2015 (Section 373.4595(4)(c)(3), F.S., 2000). LOPA also requires the coordinating agencies to work together to address total phosphorus loading and exotic species control. LOPA was amended by the legislature in 2007 to include the St. Lucie and Caloosahatchee River Watershed Protection Program, and was renamed the

Northern Everglades and Estuaries Protection Program (NEEPP) (Section 373.4595, F.S., 2007). As specified by LOPA, the SFWMD, FDEP, and FDACS submitted the Lake Okeechobee Protection Plan (LOPP) to the Florida legislature in January 2004 (SFWMD et al., 2004). The LOPA requires that the protection plan be reevaluated every three years to determine if further TP load reductions are needed to achieve the TMDL. A three-year reevaluation report was submitted to the legislature in March 2007 (SFWMD et al., 2007). In April 2007, the Florida legislature substantially expanded the LOPA to include protection and restoration of the Lake Okeechobee Watershed and the Caloosahatchee and St. Lucie rivers watersheds and estuaries. At the same time, the legislature also extended the Save Our Everglades Trust Fund for 10 years, providing a dedicated state funding source for the restoration through 2020. As noted before, the newly expanded program was named as the Northern Everglades and Estuaries Protection Program (NEEPP) (Section 373.4595, F.S., 2007). Consequently, the Lake Okeechobee and Estuary Recovery (LOER) Plan, announced by the former Governor Bush in October 2005, was migrated into this program.

The Lake Okeechobee Protection Plan (LOPP) (2004) identified alternative plans, schedules and costs to meet the total phosphorus TMDL requirement. To achieve the goal of restoration and protection of Lake Okeechobee, the LOPP proposed an integrated management strategy which combines different levels of the phosphorous source control efforts, including Best Management Practices (BMPs) at the parcel level; projects of source control and flow attenuation at the sub-basin and regional level; and remediation within the lake.

The preferred phosphorous source control and flow attenuation plan was formulated in the LOPP by considering a number of assumptions related to regional hydrology, lake functions, performance of projects/BMPs on phosphorous reduction, water storage volumes in various land uses, time lag effects, and overall schedule and funding. This study recognized uncertainties introduced by the study assumptions, and applied conservative estimates to formulate the Plan.

The LOPP's study area includes the entire Lake Okeechobee Watershed that contributes surface water flow and phosphorous load to the Lake Okeechobee. LOPP consists of nine sub-watersheds: Eastern Lake Okeechobee, Lake Istokpoga, Northern Lake Okeechobee (including FEC, Taylor Creek/Nubbin Slough, Lower Kissimmee and Indian Prairie basins), Southern Lake Okeechobee (EAA basins), Upper Kissimmee and Western Lake Okeechobee. The FEC area lies within the Northern Lake Okeechobee sub-watershed.

The LOPP suggested using treatment alternatives for those sub-watersheds of low flow but high phosphorous concentration, while using storage alternatives for those sub-watersheds of high flow but low phosphorous concentration. Within each sub-watershed, different water control and treatment facilities may be used interactively. Combinations of treatment alternatives and storage increase alternatives were specially investigated to develop effective solutions for phosphorous reduction and flow attenuation.

The Lake Okeechobee total phosphorous TMDL of 140 mt (metric tons) was adopted by the State in May 2001 (Chapter 62-304.700, F.A.C.). To describe the recent water quality conditions within the study area, LOPP defined the baseline condition using the monitored total phosphorous data (load and concentration) collected spatially within the watershed during the period from 1991 to 2000. The LOPP listed FEC and Nicodemus Slough as separate drainage basins which contribute inflows and P-loads to Lake Okeechobee. The data analysis results are shown in **Table 2**.

Table 2 . Contribution of Inflows and P Loads from FEC and Nicodemus Slough to LO (LOPP) (1991 – 2000)

Basin Name	Watershed Area (acre)	Average Annual Discharge (acre-ft)	Average Annual P Loads (mt)
Fisheating Creek	289,366	200,766	40.97
Nicodemus Slough	25,641	3,371	0.25
Lake Okeechobee. Total	3,451,086	2,246,336	433.09
	(%)	(%)	(%)
FEC / Lake Okeechobee	8.38	8.94	9.46
Nicodemus. Slough / Lake Okeechobee	1.00	0.002	0.06

The LOPP identified the FEC to be a problematic sub-watershed requiring restoration efforts and recommended the use of local projects within the sub-watershed; such as owner implemented BMPs, funded cost-share BMPs, and cost-share BMPs, in order to achieve phosphorous source control objectives. No regional level projects within the FEC sub-watershed were suggested by LOPP.

In addition to the current watershed activities that define restoration measures of owner-implemented BMPs, funded BMPs, other phosphorous reduction projects, and regional public works projects; the LOPP developed two future implementation alternatives. Alternative I consisted of typical cost-share BMPs that require future funding, other regional projects, and the Lake Okeechobee Watershed Project (LOWP). Alternative II consisted of all items of Alternative I plus additional agricultural practices which are activities that are implemented in addition to the typical cost-share BMPs (e.g., edge of farm chemical treatment, or modifying the internal work of a farm to achieve nutrient balance on individual parcels) (SWFWMD, 2004). Based on the evaluation criteria, public comments and SFWMD Governing Board directions, Alternative I was selected as the preferred plan. The components of the preferred plan included implementation of current activities, execution of typical cost-share BMPs that require future funding, and construction of regional projects and the LOWP. Alternative II was not considered as preferred plan due to its large capital investment and high operation & maintenance cost.

Both Alternatives I and II assume regional projects will be designed to address the remaining load reduction necessary to meet the TMDL once the State implements components that fall outside of the scope of the LOWP. Excluding the LOWP, the total

phosphorous load reductions estimated from the implementation of Alternatives I and II are 60% and 72%, respectively, of the total reduction needed to meet the TMDL. Alternative I assumes a greater P-load reduction from the regional treatment facilities in the LOWP as compared to Alternative II. Alternative II has more reductions associated with source control from the implementation of Additional Agricultural Practices.

Most phosphorous source control activities within the FEC sub-watershed are owner-implemented BMPs without cost sharing for agriculture lands. The FEC sub-watershed has not identified future cost-sharing projects or Regional Public Works projects.

2.4 Lake Okeechobee Watershed Project

In 2004, the SWFWMD and Jacksonville District of the Army Corps documented the process followed for the formulation of alternative plans for wetland restoration for the Lake Okeechobee Watershed Project. The process focused on identifying and screening alternative plans for restoring wetlands in the project study area which included Fisheating Creek Sub-Watershed. An Ecological Subgroup led by representatives from the U.S. Fish and Wildlife Service evaluated and screened potential wetland restoration sites.

Initial steps include determining the amount of wetland restoration necessary in the project study area to achieve project benefits. That determination would depend upon which watershed-wide ecological function could be predicted depending on differing degrees of anthropogenic disturbance. In addition the functionality of existing wetlands in the project area is important to determine to further identify the level of wetland and associated upland restoration that would be needed to truly have an ecologically functioning watershed. The document explains that in order to determine the threshold of ecosystem functionality, one or more appropriate indicators of wetland restoration would be needed. Additional data that should be collected are: historic conditions of the selected indicator; existing conditions of the selected indicator, and appearance or functional losses that would be characteristic of a “broken” wetland ecosystem.

Quantifying restoration benefits are required for the U.S. Army Corps of Engineers’ (USACE) planning process. Both quantity and quality are important so it is inadequate to simply use “acres of wetlands restored”. This study for LOWP, used habitat units as the indicator of wetland restoration (and associated upland restoration), as well as the overall means of assessing alternative wetland restoration plans. The report explains that habitat units represent combination of habitat quality (expressed as a score on a scale of 0.01 to 1.00) and habitat quantity (acres) within a given wetland system at a given time (existing or future conditions).

2.5 Lake Okeechobee Watershed Construction Project – Phase II Technical Plan

The Phase II Technical Plan (LOP2TP) was prepared by SFWMD, FDEP and Florida Department of Agriculture and Consumer Services (FDACS) to assess the technical issues and developed/evaluated solutions of water quality, quantity, and water distribution within the northern Everglades region. To develop a set of preferred construction projects, the up-to-date available land use information, flow data and water quality data were used to identify existing flows and phosphorus loads from the lake's northern watersheds. A review of current programs and projects was performed in order to identify potential constraints for the proposed new development and to ensure compatibility with all ongoing and/or planned initiatives and legal mandates (SFWMD, 2008).

The Lake Okeechobee watershed studied in the LOP2TP encompasses a drainage area of over 3.5 million acres, spanning ten counties in Florida, and is dominated by agricultural land uses. Based on hydrologic and geographic boundaries, the watershed is generally delineated into nine sub-watersheds. The LOP2TP focused on the northern sub-watersheds to Lake Okeechobee that contributes most surface water flow and phosphorus load to the Lake. This includes lands that drain by gravity (controlled or uncontrolled) to the lake, as well as areas that are drained by pumps into the lake. The distinct tributary systems to the lake include the Kissimmee River Valley, Lake Istokpoga-Indian Prairie/Harney Pond, Fisheating Creek, and Taylor Creek/Nubbin Slough. Only Fisheating Creek flows into the Lake by uncontrolled gravity flow; other inflows are controlled by gravity-fed or pump-driven water control structures.

The FEC sub-watershed drains into Lake Okeechobee starting in western Highlands County and flows south through Cypress Swamp and into Glades County. Water leaves the creek channel from central Glades County, and flows east through Cowbone Marsh into Lake Okeechobee. More than 60,000 acres of land adjacent to the lower reaches of the creek is covered under a State controlled conservation easement. The State plans to acquire additional lands for conservation in the area. According to John Outland from Florida Department of Protection (FDEP) "The Florida State acquired interest in submerged lands, and adjacent land through a settlement agreement, fee simple acquisition and conservation easements (FWC, 2003, Glades County, 1999). The conservation easement land has been classified into Natural Easement and Impacted Easement Areas and each have certain activities that are allowed and are specified under the Phase I Conservation Area agreement. He noted that if any facility is proposed in the easement area approval from the Board of Trustees must be asked". Major land use in the upper reaches of Fisheating Creek is agriculture, such as cattle farming, tree plantations, and citrus growth. These land uses are the main contribution to water quality conditions in the creek. LOP2TP recognized various types of BMPs under LOPP were planned and under implementation, and recommended to continue the BMP implementation for water quality reduction. No additional structures were recommended in the sub-catchment.

The LOP2TP developed a set of four alternatives that would increase water storage and reduce phosphorus loading to the lake. Alternative 1 characterizes the TP load reduction and storage that would be provided by the Level 1 and Level 2 MMs (Management Measures). It also includes certain Level 3 and Level 4 MMs. Alternative 1 was used as a base for other alternatives. Alternative 2 was intended to maximize storage capacity in the LOW. Alternative 3 was intended to maximize TP load reduction in the LOW. Alternative 4 was intended to optimize storage capacity and reduce TP loads in the study area. Alternative 4 which consist of integrating the optimal combination of storage increase and phosphorus load reduction to achieve the desirable average phosphorus load reduction and storage capacity increase was considered the basis for the preferred Construction Plan.

The LOP2TP identified that "the Indian Prairie, Taylor Creek/Nubbin Slough and Fisheating Creek sub-watershed contribute disproportionately high phosphorus loads to Lake Okeechobee relative to their flow contributions". In the 1991 – 2005 period of record, for example, the average annual total phosphorus concentration of FEC Study Area contributing to the TP load to the Lake Okeechobee was 199 ppb, much higher than the average annual total phosphorous concentration value of the upper Kissimmee sub-watershed (78 ppb) and the lower Kissimmee sub-watershed (166 ppb). During the same period, the average annual total phosphorus loading from FEC was approximately 55 mt as indicated in **Table 3**. The LOP2TP requires additional water quality measures to be applied for these three sub-watersheds to control the phosphorus loadings to the Lake.

Table 3. Summary of Average Annual Flows and TP Loads to LOP2TP (1991-2005)

Sub-Watershed	Area (acre)	Aver. Annual Discharge (ac-ft)	Average Annual P Load (mt)	Average Annual P Concentration (ppb)
Total LOW	3,451,087	2,558,279	514	163
FEC Study Area	315,007	224,368	55	199
	(%)	(%)	(%)	(%)
Comparison FEC vs. LOW	9.1	8.8	10.7	122

The Study Area, which includes FEC sub-watershed and Nicodemus Slough, discharging to the Lake through Culvert 5, covers 9.01% of the total Lake Okeechobee Watershed, and contributes 8.8% of annual flow to the Lake. However, the FEC sub-watershed contributes 10.7% of averaged annual total phosphorus load to the Lake. The phosphorus concentration is considerably higher than the averaged Annual P concentration within LOW.

In 2001, the FDEP established a TMDL for phosphorus loads to Lake Okeechobee as 140 mt including 35 mt of total phosphorous loading estimated for atmospheric deposition. The FDEP TMDL requirement calls for significant reduction of total phosphorous load to Lake

Okeechobee from the entire LOW including the FEC sub-watershed. As indicated in the LOPP, most phosphorous control projects within FEC sub-watershed are owner-implemented BMPs. Only one fund-matching BMP project, but no regional phosphorous control project is located within the FEC sub-watershed.

The target total phosphorous load reduction for the FEC sub-watershed is projected to be 33 mt/yr, as established by the LOP2TP. The current level of LOPP project implementation will generate a reduction of 15 mt of total phosphorus from FEC to Lake Okeechobee. This reduction is not enough to achieve the TMDL goal established for this sub-watershed. Other improvement projects beyond the scope of LOPP will need to be implemented.

The LOP2TP established a set of additional projects and grouped those projects into four alternatives and requested that the combined effect of all LOP2TP projects reach the water quality goal for Lake Okeechobee Restoration. Alternative 4 was selected by the LOP2TP as the Preferred Plan. This plan targeted the overall cost effective function of total phosphorous reduction and flow attenuation to Lake Okeechobee. It was created as a cost-effective hybrid between Alternative Plans 2 and 3 and would reach the required total phosphorous load reduction from FEC by only building necessary storage capacity within the sub-watershed. Additional projects to be implemented within the FEC sub-watershed would include:

- FEC Reservoir Assisted Stormwater Treatment Area (RASTA) I would provide 39,000 ac-ft of storage capacity in the upper reaches of the FEC Sub-watershed. It consists of a 9,000 acre. 1-ft deep STA, and a 3,000 acre, 10-ft deep reservoir. This RASTA would reduce total phosphorous loads by approximately 28-29 mt.

- FEC RASTA II would provide 15,000 ac-ft of storage capacity in the lower reaches of the FEC sub-watershed. It consisted of a 1,350 acre, 12-ft deep reservoir and a 450 acre STA. This RASTA would reduce TP loads by approximately 2-3 mt

- Nicodemus Slough RASTA – This proposed feature would provide approximately 168,000 ac-ft of storage capacity and reduce TP loads by up to 33 mt in the lower reaches of the Fisheating Creek Sub-watershed. The RASTA complex consists of a 6,500 acre STA coupled with an 11,000 acre, 16-ft deep reservoir. Because of its proximity to the Lake Okeechobee, it could also be used to store and treat lake waters, if necessary

2.6 Fisheating Creek Alternative Plan Evaluation Document, February 2006

This document was prepared by the SFWMD, assisted by HDR Engineering Inc, to be incorporated to the Lake Okeechobee Project Implementation Report (PIR). This document includes results and recommendations from six planning steps that were undertaken on the

Fisheating Creek (FEC) Planning Area Alternatives (PAA) in order to improve the water quality and better management of Lake Okeechobee water levels and releases to the estuaries. These six planning steps consisted of identifying problems and opportunities, inventory and forecast, formulation of alternative plans, evaluation alternative plans, comparing alternative plans, and selecting a plan.

According to this document, reservoirs were considered the preferred option for water storage, and Stormwater Treatment Areas (STAs) were the preferred option for phosphorus loading reduction within the FEC sub-watershed. A combination of both, called Reservoir Assisted Stormwater Treatment Areas (RASTA's) could also be effective when storage and water quality improvement would be required.

Two areas within the FEC sub-watershed and a 21,000 acre parcel located in the Nicodemus Slough area were identified to be potentially suitable to this study. These two areas within the FEC sub-watershed were located upstream of the creek and preliminary assessments indicated that a significant change in flow patterns could occur; therefore, these two areas were eliminated from further studies.

In addition to flow, several other significant hurdles could not be overcome as Paul Gray of Audubon noted. Mr. Gray identified the following issues:

1. *There are Indian mound complexes in Nicodemus Slough, similar to those at Ft. Center, that could be negatively impacted if flooded.*

2. *The Swallow-tailed Kite roost near Cowbone Marsh appears dependent on the wetlands of Cowbone and taking water from the creek for treatment might upset their needs. The Kites are not endangered, but have relatively low populations (perhaps 5000 in the US, with more than half using Fisheating Creek) and are charismatic, thus the team was cautious of their protection.*

3. *Taking all the water from the creek would upset the riverine nature of the Creek itself, thus creating some level of harm to the last free-flowing creek into Okeechobee.*

4. *One strategy to funnel the creek water to storage and treatment required putting a barrier across the creek (dam or weir of some sort) which could impeed navigation. The Fisheating Creek corridor was established out of litigation over navigation and such a structure could renew the conflict.*

5. *And oddly to us, the Hoover dike in this area has a National Historical designation (or something similar) that would have to be dealt with to alter it.*

However, the Nicodemus Slough area was recommended in the FEC document as the preferred site for further consideration. The following configurations were selected for future studies:

- FEC PAA1: 6,300 acres STA, consisting of 75% Emergent Macrophyte (EMA) and 25% of Submerged Aquatic Vegetation (SAV). Estimated reduction of approximately 40 mt of phosphorus.

- FEC PAA 2: 6,300 acres STA, consisting of 100% Emergent Macrophyte's. Estimated reduction of approximately 20 to 25 mt of phosphorus.

2.7 Fisheating Creek Basin Water Quality Survey, July 2001

This document was prepared by Paul Ritter, from the SFWMD Okeechobee Service Center, to provide an overview of the FEC sub-watershed, focusing on the Total Phosphorus concentrations. Soil information, Lake Okeechobee Works of the District Basins (WOD) Compliance Monitoring Sites, Land Use Map, and Historical Total Phosphorus Concentration Annual Average from 1973 to 2001 were included in this document.

High phosphorus concentration locations were identified and further study was recommended. The Total Phosphorus concentration was above 500 ppb in the upper and lower reaches of the creek.

The following areas were recommended for further studies due to the high phosphorus concentrations:

- Platt Branch Creek

- Upstream of culverts at Farabee Rd and Hwy 731

- Headwaters of Gopher Slough at Site 69

- Headwaters of Gator Slough (under Hwy 27)

- East of FEC and north of Hwy 70.

It should be noted that, while the FEC Basin Water Quality Survey report included the historical monitoring data from 1973, the mentioned 500 ppb total phosphorus concentration was based on a one (1) day snap shot and was not flow weighted. Steffany Gornak from SFWMD Okeechobee Service Center, mentioned that the purpose of these surveys were to provide information on areas of concern not to provide a precise phosphorus concentration from a particular area. She also provided the following background information for SFWMD's monitoring programs.

The District has three tiers of monitoring within the Northern Lake Okeechobee watershed. The District has monitored the inflows to Lake Okeechobee at District-operated control structures and has maintained an extensive tributary or ambient water quality monitoring

network for sub-watersheds within the Lake Okeechobee watershed since 1972. The Lake Okeechobee structure monitoring network is used to evaluate the phosphorus loading to the lake. The tributary monitoring network is used to evaluate phosphorus concentrations of discharges from the sub-watersheds. The District also conducts surface water quality monitoring upstream of the sub-watershed monitoring as part of the Lake Okeechobee Watershed Assessment (LOWA) network.

The upstream LOW A surface water monitoring network evolved from the Lake Okeechobee Works of the District (WOD) monitoring network which was established as part of the phosphorus source control regulatory program in 1989. The WOD network was an edge of property network consisting of bi-weekly grab samples analyzed for phosphorus (collected regardless of flow) and was used to determine compliance with permitted discharge limits. This WOD monitoring network became known as LOWA in 2003 and now consists of phosphorus sampling at various frequencies (seasonal, quarterly, and bi-weekly when flow is detected) and is used to identity, prioritize, and direct resources to areas of water quality concern within the sub-watershed.

Currently there are 21 active LOW A monitoring sites in the Fisheating Creek basin. The LOW A monitoring network is a dynamic network with the capability of dropping and adding sites within the Lake Okeechobee Watershed as needed. For example, if monitoring at a LOWA site indicates good water quality, that site may be dropped and a new site started in another area of the watershed where there had previously been no monitoring.

2.8 Discussion on the Period of Record

The following text was provided by Paul Gray of Audubon:

The CERP Lake Okeechobee Watershed Project (LOWP) used a period of record from 1965-2000. That period included the relatively-dry decades of the 1970s and 1980s. The Lake O Protection Plan (LOPP, 2004) used a period of record from 1991-2000. The update of that plan in 2007 used the same period of record and concluded previous plans were still on track to meet the TMDL for the lake. The Northern Everglades Plan in 2007 (~Phase II Construction Project) used a period of record of 1991-2005 and concluded the LOPP plans were not on track to meet the TMDL

The reason the Northern Everglades concluded plans to meet the TMDL by 2015 were no longer on track was that by adding the years 2001-2005 to the period of record, they included some very wet, high phosphorus-loading years to the lake, thereby increasing the annual average P load by about 80 tons. Similarly, the LOWP project's period of record included more dry years than the Northern Everglades period of record and concluded that about 300,000 acre-feet of storage should meet most, or at least many, Lake Okeechobee goals (including water level control). Northern Everglades, with its wetter period of record, recommended much greater water storage was needed (900k-1.3 M).

The variations in periods of record, and conclusions reached, stem from climate variability over the decades. One hypothesis is that the Atlantic Ocean oscillates between warmer and cooler phases, over the period of decades, and when warm creates about twice the annual net inflow to Lake Okeechobee, than when cool (Atlantic Multi-decadal Oscillation, AMO). Other hypotheses have been proposed, but whatever the cause, one can clearly see significantly different weather patterns over the past decades, that might require different restoration strategies. Audubon wrote a report that explains these issues further that is at (http://www.audubonofflorida.org/PDFs/pubs_policydocs-LakeOReport_1-07.pdf).

SECTION 3 ON-GOING PROGRAMS and STUDIES IN THE STUDY AREA

3.1 Lake Okeechobee Interim Water Storage Assessment Study

The Lake Okeechobee Interim Water Storage Assessment (LOIWSA), together with the LOP2TP, is the follow-up investigation of publicly owned parcels, identified by the SFWMD, for potential water storage within Lake Okeechobee watershed. The purpose of the LOIWSA is to assess the potential for interim water storage and develop cost estimates for the interior water storage strategies at each of these sites. Interim water storage facilities (i.e. temporary ditch blocks, minor berming, and minimal earthwork) are being considered as enhancement of long-term stormwater treatment areas planned at some of the investigated sites. In addition, the LOISWA also considers the potential for wetlands restoration, and options for the diversion of water to sites with temporary pump facilities.

Three sites were identified in Fisheating Creek sub-watershed in the Lake Okeechobee Interim Water Storage Report. These sites were designated as FEC East 1, FEC East 3, and Fisheating Creek. The Fisheating creek site was categorized as a priority site for further investigation for purposes of the report. Below is a table describing the different parameters at each site.

Table 4. Parameters for Identified Sites within Fisheating Creek Watershed in the LOIWSA.

Site	Total Site Area (acres)	Total Wetlands (acres)	% poor	% fair	% good	Land Use	Total Upland (acres)
FEC East 1	5.1	1.6	100	0	0	vacant	3.5
FEC East 3	25.9	25.7	100	0	0	vacant	0
Fisheating Creek	608.2	83.9	12	28	0	vacant	519.4

Site	Total Surface Water (acres)	Initial Estimate of Effective Water storage Capacity (acre-ft)	Maximum water storage capacity (acre-ft)	Diversion potential
FEC East 1	-----	3	5	Rim Canal
FEC East 3	0.2	0	25	Rim Canal
Fisheating Creek	4.9	578	578	Fisheating Creek

(Source: SFWMD, LOIWSA, 2008d)

One of the seven priority sites in the study was a fallow agriculture field in Fisheating Creek, bordered by Banana Grove Road and SR 78. This site identified as Fisheating Creek in **Table 4**, contained poor quality wetlands and was used as a low quality pasture for cattle. The site investigation showed that drainage to the site was limited to the site footprint, but

that there was potential to divert water to the site from Fisheating creek, which lies immediately north. The LOISWA explains the hydrology and hydraulics of Fisheating Creek based on gages located in Lakeport and Palmdale. The study showed that the stage in Fisheating Creek is mainly controlled by the elevation in Lake Okeechobee. Over a fifteen year period, 1991-2008, the stage exceeded the proposed interim water storage site average elevation less than 20 percent of the time. Based on the data, the design objectives were to create pocket wetlands by using creek waters reaching the site during flood events. An evaluation of alternatives was completed to divert water to the site by gravity during flood events and contain water on-site. Results of the evaluation identified a maximum of 50 acres for wetlands restoration and diversion of water from Fisheating Creek, by manually controlled gates during extreme flood events.

3.2 Alternative Water Storage/Disposal

Alternative Water Storage/Disposal is a cost sharing partnership on public, private and tribal lands. It was originated as a Lake Okeechobee and Estuary Recovery (LOER) initiative in October 2005. The primary goals of this program is water retention, load reduction and/or hydrologic restoration. There are several locations identified in the Lake Okeechobee watershed for siting AWSD including the following:

Fisheating Creek Marsh Watershed Project- This project would provide between 11,000 to 22,000 ac-ft of storage. It will evaluate, engineer, and rehabilitate PI 566 water control structures in the Fisheating Creek Marsh Watershed to more effectively store and manage water and reduce phosphorus runoff from more than 50,000 acres in the headwaters of Fisheating Creek. This project is currently in planning phase.

Lykes Nicodemus Slough- This project will have the potential to store 13,000 to 26,000 ac-ft of water from Lake Okeechobee. It includes design, engineering and implementation of a water storage area on 15,129 acres of which a flowage easement exists on the southern most 2,000 acres in a area surrounding Nicodemus Slough near Fisheating Creek.

South Florida Water Management District has recently initiated a study under the AWSD program to determine engineering and cost estimating of water management alternatives of five private lands (Carlton Carrion ranch, Carlton Darroh ranch, Waldron ranch, XL ranch and Circle 5 ranch) in Fisheating Creek sub-watershed. The study will include site assessments, review of existing information on these sites and conceptual design drawings with cost estimates of the proposed water management alternatives for final design plans, permitting and construction.

3.3 Florida Ranchlands Environmental Service Program

Florida Ranchlands Environmental Service Program (FRESP) has launched in 2005 to provide a mechanism by which landowners can sell environmental services related to water retention and phosphorus load reduction to State agencies and other willing buyers. The purpose of FRESP is to design and field test a payment for environmental services program

whereby agencies of the state and other willing buyers would pay landowners for the documented provision of water. FRESP is in the third year of a 5 year pilot phase and is field testing program design elements and service documentation methods on 8 ranches in total. Four ranches were constructed and operational in 2007, three were constructed in 2008 and one will be completed in early 2009. FRESP has two on-ranch water management projects located in the Fisheating Creek Watershed.

C.M. Payne's FRESP water management project located at the headwaters of FEC is to retain both on-site and off-site storm water runoff within a 466 acre site of improved pasture surrounded by a dike. This project involves operating six water control structures and monitoring water stage at five shallow groundwater wells and five surface water monitoring locations. The surface monitoring stations will include auto samplers, and will be used to estimate surface flows of water and nutrients into and out of the site. The second FRESP ranch site is Lightsey Cattle Company's XL Ranch. This water management project entails installing water control structures (culvert risers and ditch weirs) in 14 existing ditches to retain water in a 350 acre pasture area draining into a 580 acre wetland impoundment. Groundwater stage is being monitored at 3 locations in the project site and at the discharge from the impoundment. Manual grab sample are being collected quarterly for nutrient analysis at the impoundment discharge and in the creek downstream of the impoundment (FRESP June 2008)

The FRESP team is currently developing a model to estimate the potential water retention of each of the 8 ranch water management projects. This information will be used to estimate the potential water retention of a payment for environmental services program if scaled up to the Northern Everglades watershed. Conservative preliminary planning level estimates suggest that on-ranch dispersed water storage acquired through a payment for environmental services program could retain a significant amount of acre feet of water during a rain year. Retaining water throughout the watershed in dispersed smaller-scale water management projects on ranchlands has a potential to reduce the volume as well as phase and timing of water reaching Lake Okeechobee while contributing to the attainment of the phosphorus TMDL for the Lake and tributaries.

There also are two federal initiatives in the Study Area to be considered for alternative water storage provided to the Study Team by John Winfree from The Nature Conservancy (TNC) as follows:

3.4 Federal Grant Programs

3.4.1 Wetland Reserve Program (WRP)

A voluntary program offering private landowners and Tribes financial and technical assistance to restore and protect wetlands and associated uplands through permanent easements, 30-year easements, and long-term restoration agreements. This is a Farm Bill program administered by the USDA Natural Resources Conservation Service (NRCS).

Eligible land includes wetlands cleared or drained for farming, pasture, or timber production; certain adjacent lands that contribute significantly to wetland functions and values; previously restored wetlands that need long-term protection; upland areas needed to provide an adequate buffer or that contribute to creating a manageable boundary; drained wooded wetlands; existing or restorable riparian habitat corridors that connect protected wetlands; and certain lands substantially altered by flooding. The land must be restorable and be suitable for providing wildlife benefits. Participants retain private ownership subject to the easement. Easements for the WRP are shown in **Figure 3**.

3.4.2 Wetland Reserve Enhancement Program (WREP)

A program under the new Farm Bill that authorizes federal partnership with states, Tribes, and nongovernmental organizations on special WRP projects in designated watersheds. As part of WREP, a pilot program is authorized for the landowner's reservation of grazing rights. WREP will have a separate allocation but drawn from the nationwide funding for WRP. The Nature Conservancy and NRCS are working within the Fisheating Creek sub-watershed to identify qualified landowners expressing an interest in WREP. This would be a pilot program that may be approved for implementation, and is currently in the planning phase, but would protect additional wetlands in the watershed, while allowing landowners to retain their grazing rights if it progresses to implementation. So far approximately 19,207 acres of ranches interested in this program have been identified within the FEC,(pers. comm. with John Winfree, TNC), as shown in **Figure 4.**

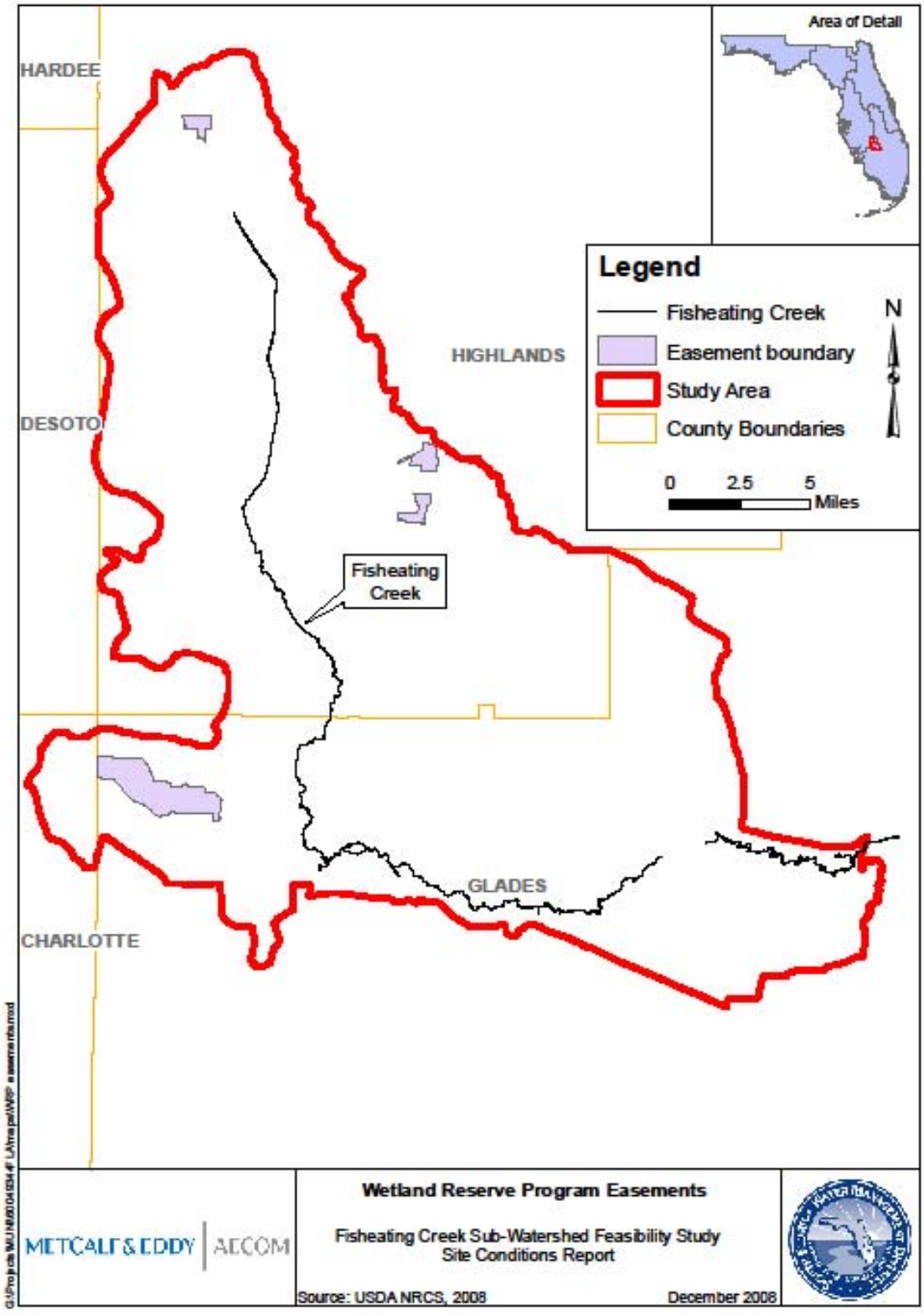


Figure 3. Wetland Reserve Program Easements in the Study Area

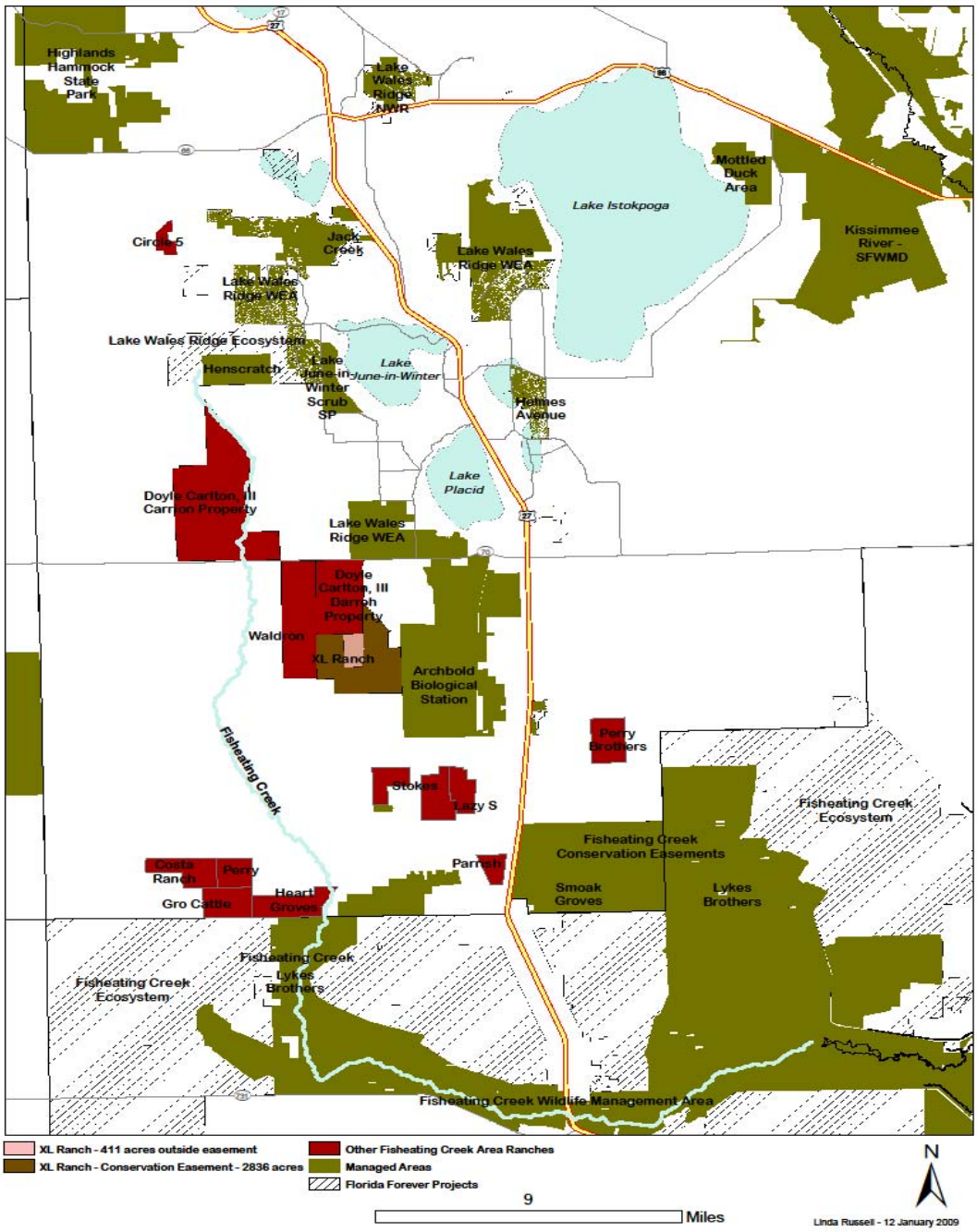


Figure 4. Identified Lands within the FEC under the Wetlands Reserve Enhancement Program

3.4.3 Total Maximum Daily Loads

A Total Maximum Daily Load [Section 62-304.700(10, Florida Administrative Code (F.A.C.)] for total phosphorus (TP) for Lake Okeechobee was adopted by the FDEP in 2001. The TMDL is based on a five-year rolling average of 140 mt/yr which include atmospheric deposition of 35 mt/yr. the TMDL is allocated to the sum of all non-point sources and includes all direct inflows into Lake Okeechobee.

US. Environmental Protection Agency (USEPA) recently adopted a phosphorus TMDL for tributaries in the Lake Okeechobee watershed based on a phosphorus concentration of 113 ppb. However, Fisheating Creek itself does not have any established TMDLs yet but is listed by FDEP to have a in-stream TMDL developed by 2011. The Fisheating Creek also listed as impaired per the state's Impaired Waters Rule for nutrients, dissolved oxygen, and iron. **Figure 5** shows the ongoing 2009 FDEP TMDL monitoring site locations (provided by Jennifer Thera, FDEP) .

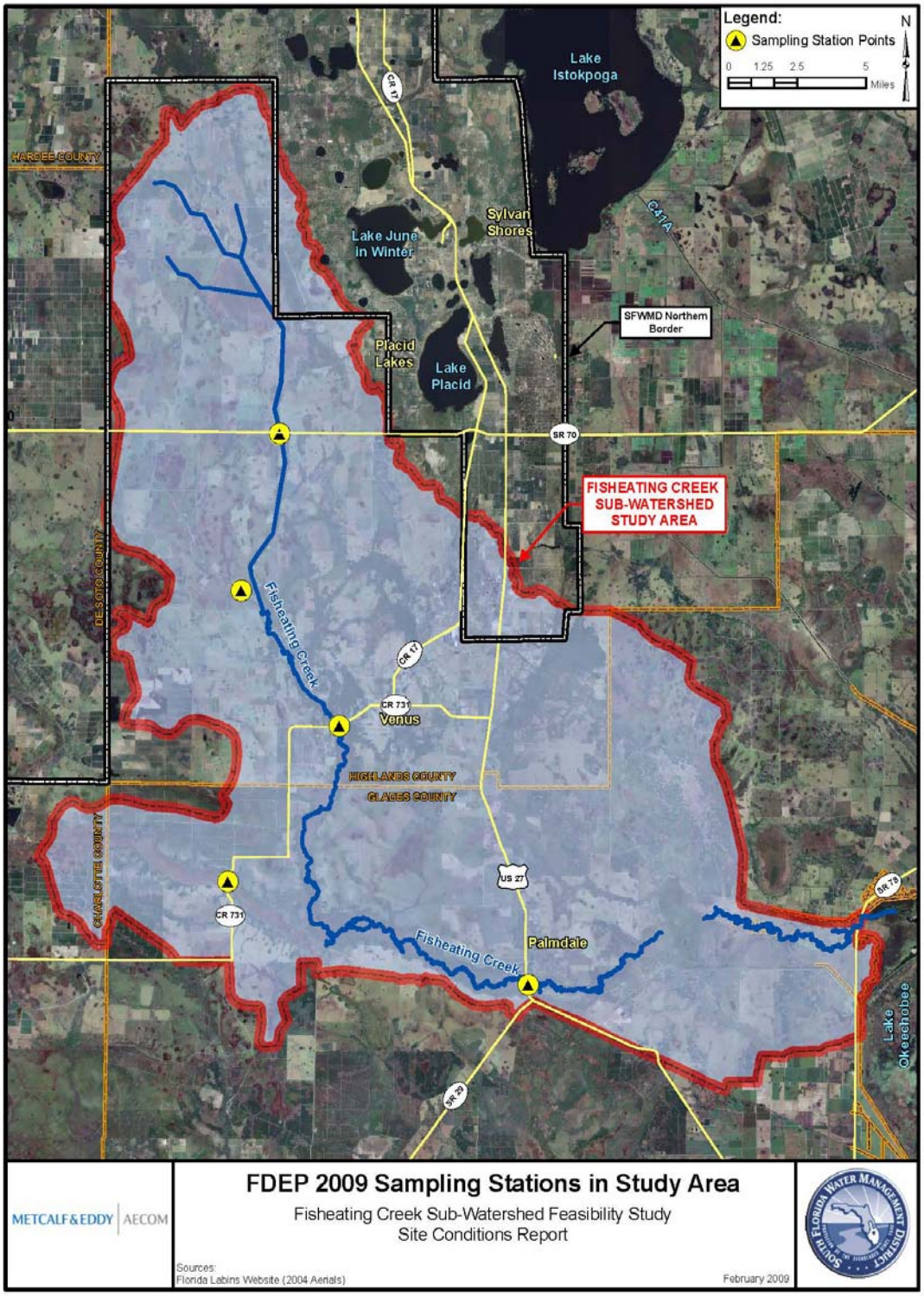


Figure 5. FDEP 2009 Sampling Stations in the Study Area

SECTION 4 HISTORICAL CONDITIONS

According to the Florida Fish and Wildlife Conservation Commission (FWC), the time of the first settlement which took place along the banks of the FEC goes back to between 1000 and 500 BC. The Creek's name comes from the Creek Thlothlopopka-hatchee which means "the creek where fish are eaten." Belle Glad People who are known as the early inhabitants of the area are the first residents known to build mound and other earthworks. They survived by netting fish, harvesting turtles, snakes and alligators. In addition to its use as a food and water source, the creek was also used for transportation by means of canoe since it was possible to travel to Lake Okeechobee and other settlements on both of its east and west (FWC, 2008). Fort Center site, an archaeological site in the Fisheating Creek Sub-Watershed Study Area, includes over at least 2000 year old mounds, ponds, circular ditches and linear embankments. **Figure 6** shows a painting of the Fort Center (FWC, 2008).

The Fort Center Site is listed in the National Register of Historic Places. It is noted that the site had residents at the time of the arrival of European's in the 16th and 17th centuries. However, no evidence of agricultural use of the land was found for this time period through the archaeological researches.

Based on the information found on FWC website, it was very hard to travel on the creek due to its twisted shape and changing width according to the descriptions of a US Navy officer traveled on the creek in 1842. **Figure 7** depicts residents traveling on FEC with a canoe (FWC, 2008). According to the observations of another US Navy office from 1855, the Fort Center area then was too hot, full of mosquitoes and snakes. It is also written on the website that as a result of research conducted for five areas for the US Government in 1881, 37 families used to live in 22 campsites in five areas and one of these areas was Fisheating Creek. This shows the FEC area was not highly populated at that time.

Figure 6. A Historical View of Fort Center

Figure 7. Residents Traveling on Fisheating Creek, 1842

Above historical information represents mostly the southern part of the Study Area within Glades County. Based on the data available only historical knowledge about the northern part of the Area in Highland County pertains to two (2) man made structures located in the Public Law Assessment – 566 (PL-566) Area. These structures, named as Check Dam No.1 and Drop Spillway No.1, were built for flood prevention and agricultural water management purposes (HSDH, 1957). More information regarding these structures will be contained in the report by M&E by May 2009.

Figure 8 and **Figure 9** show the aerial view of these structures on the FEC Study Area.

SECTION 5 EXISTING CONDITIONS

5.1 Site Overview

The Fisheating Creek Sub-watershed Study Area is mostly covered with pasture lands through which canals are discharging to the Fisheating Creek. Fisheating Creek (FEC) originates in Highlands County, and flows south through the Glades County. From Glades County it turns to the east about one mile north of the CR 74. The creek flows to the east until it drains to the Lake Okeechobee through Cowbone Marsh.

Existing conditions within the Study Area were observed through site visits in addition to literature research. A fly-over on the Study Area took place on October 08, 2008 with the representatives of the SFWMD. A three (3) day site visit through October 27 and 29, 2008 was also conducted by Metcalf & Eddy (M&E) and ZFI Engineering representatives. This section presents the site visit observations along with the site pictures. The Global Positioning System (GPS) locations of the sites visited are also presented for some of the areas along with their pictures taken during these visits.

Almost all of the Study Area is owned by private landowners. Therefore, site visits were mostly conducted on the publicly accessible areas. The Public Law Assessment – 566 (PL-566) structures (Check Dam No.1 and Drop Spillway No.1) were accessed via special permission obtained from the landowners by FDACS and SFWMD representatives. **Figure 8** and **Figure 9** show the aerial view of these two structures on the FEC. These two (2) structures located on the northern part of the creek within the PL-566 area were built for flood prevention and agricultural water management purposes (HSDH, 1957). The surroundings of the PL-566 area was observed to be occupied mostly with pasture lands and cattle ranches. Many culverts were observed around these structures (**Figure 11** and **Figure 12**). Although pasture lands and cattle ranches were observed to be very dominant in the area, dense cypress swamp were also observed around the creek in the southern watershed where it intersects with US 27 and SR 731 **(Figure 14** and **15)**. **Figure 18** shows a view of a pasture land on CR 731 located about 3 miles west of the US 27. **Figure 19** shows a view of Fisheating Creek passing under the CR 731. There are several sloughs located at the southern parts of the Study Area. Views of the Rainey Slough from the CR 731 is shown on **Figure 20** and **Figure 21**. **Figure 24** shows a view of the Tasmania road. **Figure 27** and **Figure 28** show pictures of Fisheating Wildlife Management Area (FWMA) entrance through the Campground located at Palmdale, FL. **Figure 33** shows the discharge point of FEC to the Lake Okeechobee.

Representatives of SFWMD and M&E Team attended to a site visit on October 22, 2008 to Cowbone Marsh. **Figures 34** through **39** show pictures from this site visit.

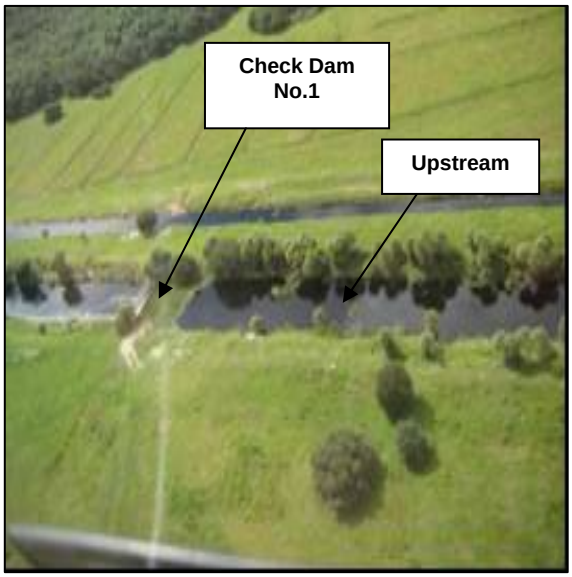


Figure 8. PL-566 Check Dam No.1 Structure on FEC (Looking W)

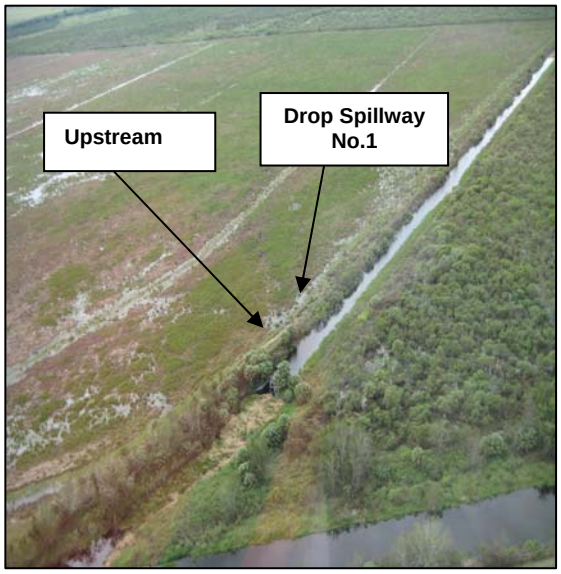


Figure 9. PL-566 Drop Spillway No.1 Structure on FEC (Looking SW)

Figure 10. A View of Check Dam No.1 Structure from Downstream

Figure 11. Culvert Located at the Upstream of Check Dam No1 (27.27513 N, 81.47126 W)

Figure 12. A Culvert Discharging to FEC at the Upstream of Check Dam No.1 Structure (27.27513 N, 81.47126 W)

Figure 13. Wetland in the Vicinity of Drop Spillway No.1 (27.27758 N, 81.47368 W)

Figure 14. FEC – US 27 Intersection (Looking SE)

Figure 15. FEC – CR 731 Intersection (Looking South)

Figure 16. FEC – US 27 Intersection (Looking NW) (26.93241N, 81.31520W)

Figure 17. FEC – US 27 Intersection (Looking NE)

Figure 18. A View of a Pasture Land from CR 731 (27.07277N, 81.37945W) (Looking N)

Figure 19. A View of FEC from CR 731 (Looking S) (26.98478N, 81.49188W)

Figure 20. Rainey Slough from Tasmania Road (Looking SW)

Figure 21. Rainey Slough (Looking W)

Figure 22. Pasture Land View on FEC (26.97610N, 81.51333W)

Figure 23. A View of Tree Line on Pasture from Farabee Road (26.97078N, 81.51617W)

Figure 24. A View of Tasmania Road (26.97690N, 81.49090W)

Figure 25. A View from Intersection of CR 74 and CR 731 (26.94492N, 81.48886W)

Figure 26. A View of Cattle on the Study Area (26.94116 N, 81.37667 W)

Figure 27. Fisheating Wildlife Management Campground Entrance on US 27 (26.93930 N, 81.31952 W)

Figure 28. FWMA - Fisheating Creek Campground

Figure 29. Another View from the Study Area (26.99999 N, 81.45618 W)

Figure 30. A View of a Private Land Entrance Heading to the FEC (26.94574 N, 81.31789 W)

Figure 31. FEC Basin from CR 731 (Looking SW)

Figure 32. A View of FEC from Clark Road (27.32236 N, 81.48840 W) (Looking S)

Figure 33. Discharge Point of FEC to the Lake Okeechobee (26.96220 N, 81.12110 W)

Figure 34. Cowbone Marsh (1)

Figure 35. Cowbone Marsh (2)

Figure 36. Cowbone Marsh (3)

Figure 37. Cowbone Marsh (4)

Figure 38. Cowbone Marsh (5)

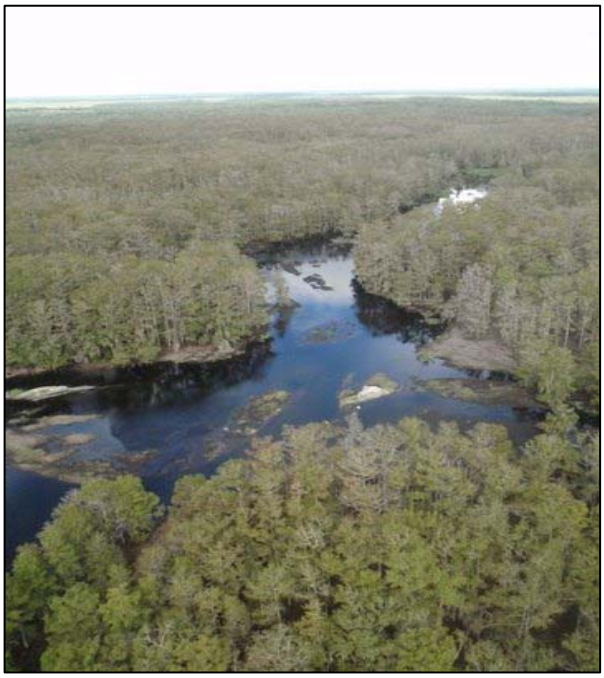


Figure 39. Cowbone Marsh (6)

Figure 40 and **Figure 41** show pictures from the Florida Ranchlands Environmental Services Project Areas site visit which took place on October 29, 2008.

Figure 40. Lykes Marsh Reservoir

Figure 41. Buck Island Ranch

Figure 42 shows the approximate location of the FEC Sub-watershed Study Area on an aerial map along with some of its important details.

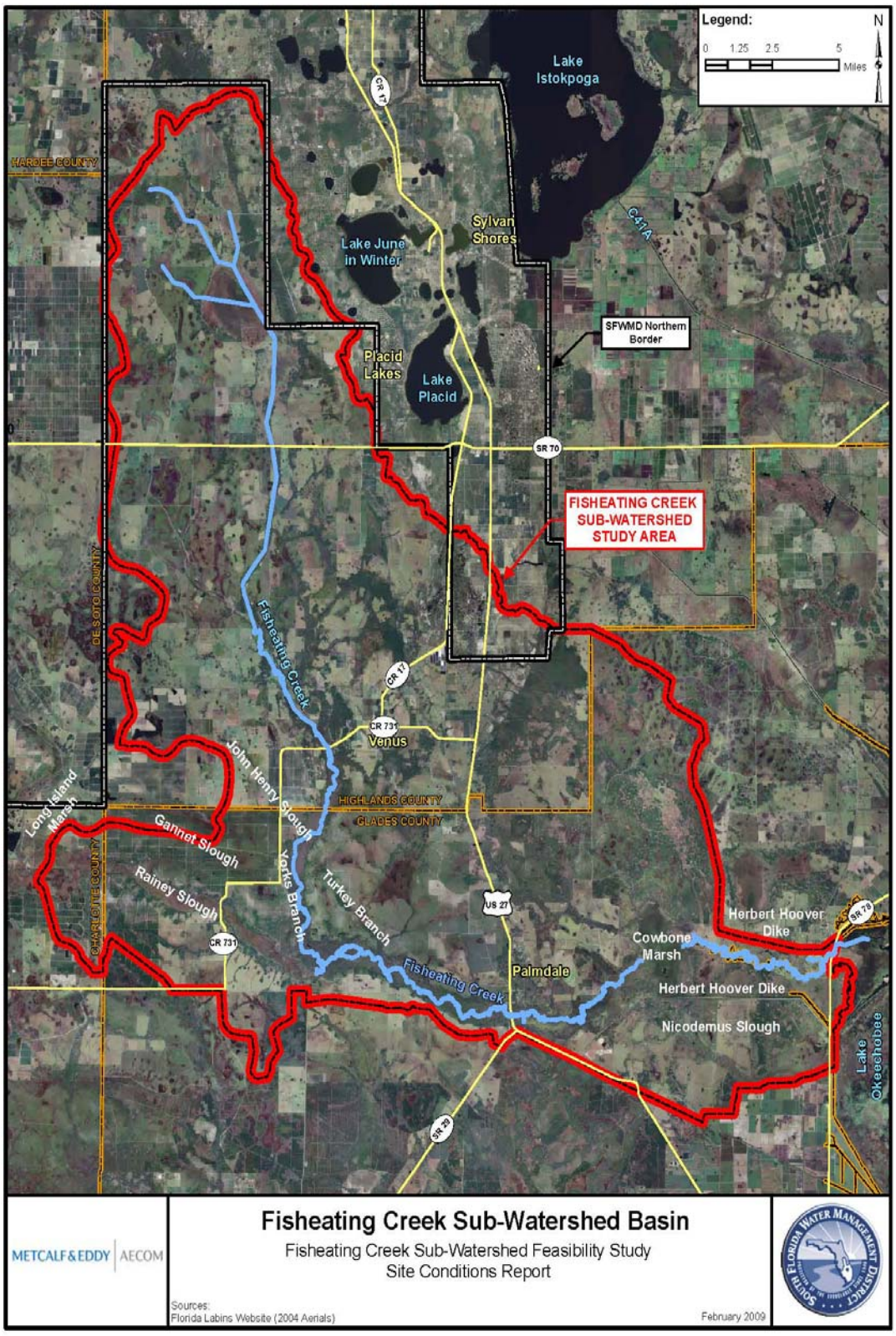


Figure 42. Fisheating Creek Sub-Watershed Basin Aerial View

5.1.1 Fisheating Creek (FEC)

The Fisheating Creek (FEC) flows into Lake Okeechobee by gravity through a broad littoral swamp in the northwest direction. Among all inflow canals to the lake, the FEC is the only uncontrolled, gravity driven free-flow creek. The creek starts in western Highlands County and flows south through the Cypress Swamp and into Glades County. Water leaves the creek channel from central Glades County, and flows east through the Cowbone Marsh into Lake Okeechobee.

To the North of State Road 70, the creek is a regular open channel, developing from a confined open channel to a swamp water course with dendritic tributaries between State Road 70 (SR 70) and County Road 731 (CR 731). The creek becomes a wide cypress swamp with a broad floodplain flowing south towards CR 731. Since 1982, the maximum water level recorded at the United States Geological Survey (USGS) Palmdale station (USGS Station 02256500 / South Florida Water Management District (SFWMD) Station FISHP (DBKEY 00088)) is 8.24 feet NGVD (SFWMD, 2004) and the minimum water level recorded was -0.45 feet NGVD (SFWMD, 2008c) (Datum of gage: 27.19 feet NGVD). Landscapes over interconnected swamp, wetlands and water course are dominated by pine flatlands, pine rocklands, tropical hardwood hammocks, and xeric hammocks. The creek lies within the FEC sub-watershed, and the main stream course flows into the boundary of Lake Okeechobee under the State Road 78 (SR 78) Bridge.

5.1.2 Fisheating Creek Sub-Watershed Study Area

The SFWMD Basin Atlas (Guardo, 1992 with 2004 SFWMD updates) was used to specify the boundary of the Study Area. The Basin Atlas was derived from ongoing field investigations and other updates of watershed boundaries. In general, boundaries of the Study Area specified in the Basin Atlas have been accepted as the “best” boundary delineations unless there is compelling evidence from other sources to modify the boundaries. It was also noted by Hilary Swain from Archbold Biological Station that west side of the Study Area boundary is very weakly delineated. It is our understanding that this sub-watershed network is from the Basin Atlas, which was initialized in 1992, and continuously evolved to cover more and more areas as defined by the District. Although SFMWD Basin Atlas depicts it different, FEC Study Area for this project does not associate with the Kissimmee River Region or the Sub-Watershed.

The Study Area extends from west-central Highlands County southward into the Glades County, and runs eastward to connect the northwest boundary of Lake Okeechobee. The Study Area for this report includes the FEC Sub-watershed and Nicodemus Slough which is not currently in the FEC basin. The FEC sub-watershed covers about 440 square miles (mi^2) of area and the Nicodemus Slough covers 27 mi^2 of area.

The FEC sub-watershed and Nicodemus Slough are surrounded by the adjacent sub-watersheds of Josephine Creek, C-41, L-61E, L-61W, L-41, L-42, C-19, Meander Ditch, Upper Citrus Center, Upper Linden Pen Marsh, Upper Cypress Branch, Jacks Branch, Cow Slough SWF, Gannet Slough and Prairie Creek (**Figure 51**). The southeast end of the FEC sub-watershed connects with the littoral zone of the Lake Okeechobee. The sub-watershed may receive inflow from the Highlands Hammock state forest at its northern-most end, and possibly from other creeks, ditches and wetland water courses. The surface water drainage system of the sub-watershed may also receive groundwater recharge from the Lake Wales Ridge area. Surface water connections between the FEC sub-watershed and other surrounding sub-watersheds need to be further identified during this study.

5.1.3 Sub-Watershed Settings

Agricultural, natural forest and wetlands are predominant landscapes within the FEC sub-watershed. The combined agricultural and ranch land uses occupy 58 percent of land within the sub-watershed; and the combined forest, swamp and wetlands cover nearly 40 percent of the total land within the sub-watershed. The dominant agricultural land uses include cattle grazing and citrus growth. Urban and commercial developments are minimal within the sub-watershed. No industry or commercial land uses are found within the sub-watershed.

More than 60,000 acres of land around the lower reaches of the creek are protected under a State controlled conservation easement. The rural undisturbed natural lands are adequate for wildlife habitat protection, restoration and natural conservation. The State plans to acquire additional lands for conservation in the area (SFWMD, 2008).

The hydrologic system of the FEC sub-watershed forms a part of the interconnected Kissimmee River ecosystem, which lies at the northern end of the Everglades Ecosystem. Historically, water from both the Kissimmee River tributary system and the Fisheating Creek meandered slowly into Lake Okeechobee. Construction of the Herbert Hoover Dike around Lake Okeechobee and channelization within the upper and lower Kissimmee River basins significantly altered the surface water resources and drainage hydrology in the region north to Lake Okeechobee.

However, the hydrologic system of the FEC sub-watershed has endured the least human impact. The sub-watershed is quite rural comparing with other south-central Florida regions. In the early stages of the Central and Southern Florida (C&SF) Project development, some regional water improvement work, including construction of Canal 22 and Structure 69, was planned within the FEC sub-watershed. However, these two structures were withdrawn from the C&SF Project in 1959 as flood protection in the area could not be economically justified. Since then, the FEC sub-watershed has not received any regional flood control and ecosystem restoration modifications. Only local channelization and drainage network

have been implemented in the northern section of the sub-watershed along with agricultural land development.

The water quality of the FEC has been adversely affected by agricultural activities in the upper reaches of the creek. Phosphorous loadings from non-point sources associated with cattle farming, dairy production, tree and vegetation plantation, and citrus growth directly result in degradation of the creek water quality and consequently increase the eutrophication rate in the Lake Okeechobee. Long term and extensive water quality monitoring results for the Kissimmee River region indicate that the FEC sub-watershed is a pollutant source contributing significant phosphorus loads to Lake Okeechobee (FDEP, 2004). In the Florida Department of Environmental Protection (FDEP) 1998 303(d) list of impaired water bodies in Florida (FDEP, 1998), approximately 25 water bodies/segments were identified as impaired surface water bodies in the Central and South Florida regions. Excessive nutrients, low levels of dissolved oxygen, and high concentrations of iron and chlorides, as well as coliform bacteria are being discharged into the Lake Okeechobee through the FEC.

Regional planning on the Lake Okeechobee water quality improvement and the Everglades Ecosystem restoration has been focused on the vast contribution of phosphorus from the Kissimmee River and the Taylor Creek/Nubbin Slough sub-watersheds. These areas are characterized as highly productive agricultural regions and rapidly growing urban areas. Currently water quality improvement Best Management Practices (BMPs) within the FEC sub-watershed are limited to owner self- funded agricultural BMPs and grant funded BMPs. In recent planning studies, two regional Reservoir Associated Stormwater Treatment Areas (RASTAs) have been evaluated and planned within the FEC sub-watershed (Lake Okeechobee Protection Plan (LOPP), 2004 and SFWMD 2008).

5.2 Climate

The climate in the proximity of the Fisheating Creek Sub-Watershed Study Area is presented in this section. Temperature and precipitation information was obtained from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) which has several meteorological stations in Florida (NCDC, 2004). Rainfall and evapotranspiration data at the Palmdale Station was obtained from SFWMD DBHYDRO, Arcadia, Sebring and Clewiston through FAWN.

5.2.1 Temperature and Precipitation

The climate in South Florida is subtropical and humid. The summers are long, humid, and warm, and the winters are mild with temperatures rarely below freezing. The warmest months are July and August, and January and February are the coolest months.

Climate information was obtained from two National Climatic Data Stations – Moore Haven Lock 1 Station and Archbold Bio Station. In addition, rainfall data was also obtained from

the Hicoria Romp 14 station through the Water Management Information System (WMIS) maintained by SWFWMD, and Palmdale station maintained by the Florida Automated Weather Network (FAWN). Moore Haven Lock 1 Station, Palmdale station are located in Glades County and Archbold Bio Station and the Hicoria Romp Station are located in Highlands County as indicated in **Figure 43.**

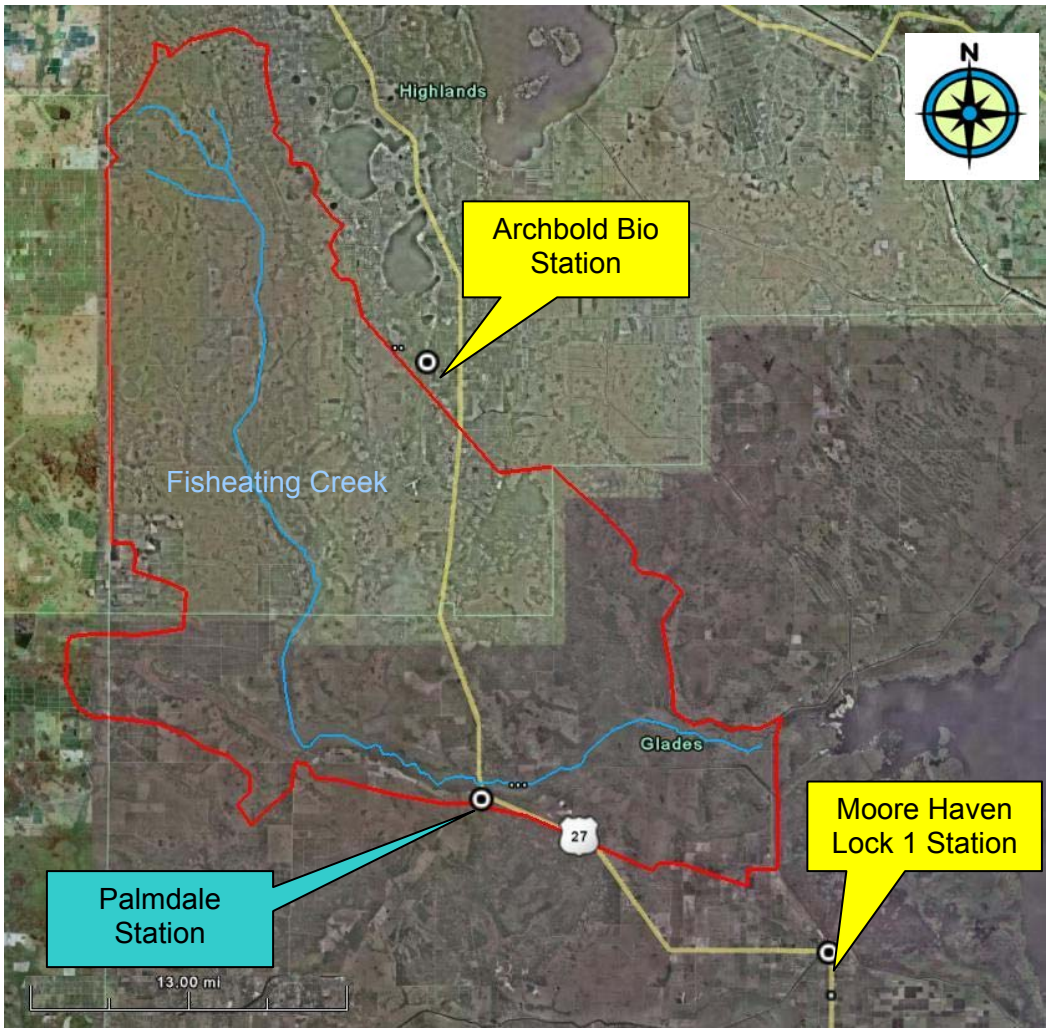


Figure 43. Temperature and Precipitation Stations Location Map for the Study Area

The daily maximum temperatures in the project areas range between 74 ºF and 94 ºF. Average temperatures are in the low 70's ºF, ranging from about 60ºF in midwinter to about 82ºF in summer. The daily minimum temperatures range between 46 ºF and 73 ºF. Maximum, mean, and minimum temperatures for 1971-2000 at Moore Haven Lock 1 Station and Archbold Bio Station are listed in **Table 5.**

There are two distinct periods of rainfall in South Florida, wet season and dry season. The wettest months occur during June through September. November, December, January, and February typically have the lowest rainfall. Annual and seasonal rainfalls, however, vary

from year to year and may have major contributions from tropical storms and hurricanes in some years. Annual precipitation from 1971 to 2000 averages 46 inches at the Moore Haven Lock 1 Station and 51 inches at the Archbold Bio Station. According to the rainfall monitoring data from Archbold Biological Station the average annual rainfall was approximately 51 inches between years 1981-1993. Evapotranspiration rates are high in South Florida and may equal or exceed precipitation rates. Mean monthly precipitation values over varying time periods at Moore Haven Lock 1 Station, Archbold Bio Station, the Hicoria Romp 14 station, and Palmdale station are listed in **Table 6**.

Table 5. Moore Haven and Archbold Temperatures (1971 to 2000)

Month	Max Temp (ºF)		Mean Temp (ºF)		Min Temp (ºF)	
	Moore Haven, FL	Archbold, FL	Moore Haven, FL	Archbold, FL	Moore Haven, FL	Archbold, FL
Jan	73.6	74.8	62.7	60.4	51.7	46.0
Feb	75.1	76.8	63.8	61.6	52.4	46.4
March	79.2	81.5	67.9	66.0	56.6	50.5
April	83.0	85.7	71.8	69.5	60.5	53.2
May	87.5	90.4	76.7	75.1	65.8	59.8
June	90.0	92.6	80.4	79.2	70.8	65.8
July	91.1	93.7	81.6	80.5	72.1	67.2
Aug	90.5	93.5	81.6	80.6	72.6	67.7
Sept	88.7	91.6	80.5	79.2	72.2	66.8
Oct	84.4	87.1	75.7	73.8	67.0	60.5
Nov	79.4	81.4	70.0	68.1	60.6	54.7
Dec	74.8	76.0	64.5	62.4	54.1	48.7
Annual	**83.1**	**85.4**	**73.1**	**71.4**	**63**	**57.3**

(Source: NCDC, 2004)

Table 6. Moore Haven, Archbold, Hicoria and Palmdale Precipitation

Month	Mean Precipitation (inches)				
	Moore Haven, FL (1971-2000)	Archbold, FL (1971-2000)	Archbold, FL (1931-2008)	Hicoria (2000-2008)	Palmdale (2004-2008)
Jan	2.04	2.32	1.96	1.06	0.75
Feb	2.05	2.38	2.43	1.97	2.71
Mar	2.93	3.25	3.07	2.02	2.76
Apr	2.35	2.33	2.41	2.78	2.33
May	3.7	3.98	3.87	3.02	2.29
Jun	6.98	7.74	8.42	8.76	8.13
Jul	6.67	7.66	8.48	7.68	7.62
Aug	6.8	7.42	8.01	9.32	9.73
Sep	6.42	6.5	7.55	6.71	4.83
Oct	2.95	3	3.79	2.23	3.33
Nov	1.91	2.07	1.75	1.34	1.31
Dec	1.64	1.95	1.74	1.86	1.35
Annual	**46.44**	**50.6**	**53.49**	**48.75**	**47.14**

Sources: (NCDC, 2004; FAWN, 2009; WMIS, 2009)

According to the 2007 South Florida Environmental report, the annual average rainfall on the entire SWFWMD region is 52.8 Inches (Ali and Abtew, 1999). The SWFWMD region encompasses a much larger area than the FEC project boundary and the areal rainfall statistics were based on data from 1900-1995. As seen in **Table 7**, the average annual rainfall at the Palmdale station from 1980-1984 exceeded the average by 7.02 inches.

The average annual rainfall over the time period from 1970-1993 was also calculated from data recorded at the Archbold Biological Station. The average was 50.6 inches which did not differ from the average rainfall data calculated from the same station between year 1971-2000. It should be noted that the rainfall data shown for the 1931-2008 time period was provided by Archbold Biological Station to the Study Team.

5.2.2 Rainfall versus Evapotranspiration

Average evaporation and rainfall for 1980-1984 at SFWMD Station Palmdale located at the intersection of Fisheating Creek with US 27 **(Figure 43)** are listed in **Table 7**. Evaporation is close to the "potential evapotranspiration", which is the evapotranspiration that would occur from vegetated land surface if water were fully available. Evapotranspiration from vegetated

land surfaces depends on meteorological conditions, the water availability and the type of vegetation. For this study, it was assumed that the evaporation was the same as the evapotranspiration for the data shown in **Table 7**. The data in table shows that evaporation was greater than rainfall, however, rainfall, and evapotranspiration exhibit large seasonal fluctuations. These fluctuations tend to be similar, with higher rainfall and evapotranspiration from May to September. An important factor is that both evapotranspiration and more significantly rainfall vary from year to year.

Table 7. Lake Okeechobee Evapotranspiration and Rainfall

Month	Palmdale Evaporation (inches)	Rainfall (inches)	Net Removal (inches)
January	3.38	2.48	0.90
February	4.10	5.02	-0.92
March	5.87	4.54	1.33
April	5.57	3.32	2.25
May	6.97	6.14	0.83
June	10.28	8.40	1.88
July	8.89	8.78	0.11
August	8.52	6.82	1.70
September	6.62	6.88	-0.26
October	4.60	2.84	1.76
November	4.57	2.86	1.71
December	2.35	1.74	0.61
Total	**71.72**	**59.82**	**11.90**

(Source: SFWMD, 2008c)

Rainfall and evapotranspiration data were also obtained for Palmdale through FAWN. Palmdale had negative net removal showing that evapotranspiration was less than the rainfall over the time period of 2004-2008 (**Table 8**).

Table 8. Palmdale (2004-2008) Evapotranspiration and Rainfall

Month	Palmdale Rainfall (inches)	ET (inches)	Net Removal (inches)
Jan	0.75	1.8	1.1
Feb	2.71	2.4	-0.3
Mar	2.76	3.3	0.6
Apr	2.33	4.1	1.7
May	2.29	5.1	2.8
Jun	8.13	4.6	-3.6
Jul	7.62	4.7	-2.9
Aug	9.73	4.4	-5.3
Sep	4.83	3.4	-1.4
Oct	3.33	3.1	-0.3
Nov	1.31	2.0	0.6
Dec	1.35	1.4	0.0
Total	**47.14**	**40.2**	**-6.9**

(Source: FAWN, 2009)

Evapotranspiration data was also searched through SWFWMD WMIS Archbold station. However, there was no evapotranspiration data available through this station. Instead just evaporation and there was no associated rainfall. If in the next phases of the Study it is needed, the evaporation data from this station could also be used.

In order to provide a general overview of the region where the Study Area is located following rainfall and evapotranspiration data from various stations in the vicinity of the Study Area were also analyzed and presented in **Tables 9** through **12**.

Arcadia had a net removal of 1.4 inches showing that the evapotranspiration was greater than the rainfall, however Sebring and Clewiston had negative net removal showing that evapotranspiration was less than the rainfall for the time periods data were available.

Data from four stations obtained from DBHYDRO can be compared for Average annual evapotranspiration in **Table 12**. The highest amount of evapotranspiration was observed to occur from March through August. The data for each station is recorded for varying time periods, however the annual amounts are all similar.

Table 9 . Arcadia (2006-2008) Evapotranspiration and Rainfall

Month	Arcadia Evapotranspiration (inches)	Arcadia Rainfall (inches)	Net Removal (Inches)
Jan	1.86	1.38	0.49
Feb	2.24	2.29	-0.05
Mar	3.13	1.43	1.69
Apr	3.85	1.04	2.81
May	4.83	2.30	2.53
Jun	4.66	5.18	-0.52
Jul	4.88	6.02	-1.14
Aug	4.98	8.18	-3.20
Sep	4.16	3.80	0.35
Oct	3.09	1.65	1.43
Nov	1.87	0.47	1.40
Dec	1.41	1.41	-0.01
Total	**40.94**	**35.15**	**5.78**

(Source: FAWN, 2009)

Table 10. Sebring (2004-2008) Evapotranspiration and Rainfall

Month	Sebring Evapotranspiration (inches)	Sebring Rainfall (inches)	Net Removal (Inches)
Jan	**1.80**	1.06	0.74
Feb	2.48	2.81	-0.33
Mar	3.45	2.13	1.32
Apr	4.12	2.02	2.11
May	5.17	1.94	3.23
Jun	4.66	8.52	-3.86
Jul	5.01	9.49	-4.48
Aug	4.45	8.51	-4.05
Sep	3.97	6.03	-2.06
Oct	2.89	3.47	-0.58
Nov	1.96	1.13	0.83
Dec	1.40	1.62	-0.23
Total	**41.37**	**48.73**	**-7.36**

(Source: FAWN, 2009)

Table 11. Clewiston (2008) Evapotranspiration and Rainfall

Month	Clewistown Evapotranspiration (inches)	Clewistown Rainfall (inches)	Net Removal (Inches)
Jan	2.06	1.24	0.82
Feb	2.97	2.00	0.96
Mar	3.53	4.19	-0.66
Apr	4.74	2.45	2.29
May	5.70	1.65	4.05
Jun	5.27	12.45	-7.18
Jul	5.29	8.25	-2.95
Aug	4.47	16.15	-11.67
Sep	4.61	4.02	0.59
Oct	3.22	2.24	0.98
Nov	2.22	0.27	1.95
Dec	1.89	1.33	0.57
Total	**45.98**	**56.22**	**-10.25**

(Source: FAWN, 2009)

Table 12. Evapotranspiration for the indicated stations over varying time periods

Month	Glades County Station S78W (1992-2008)	Palm Beach County Station L006 (2001-2008)	Okeechobee County Station S65DWX (2000-2008)	Okeechobee County Station S65CW (1992-2008)
Jan	2.72	2.75	2.87	2.67
Feb	3.11	3.34	3.40	3.27
Mar	4.00	4.08	4.09	4.03
Apr	4.66	4.92	4.90	4.67
May	4.81	5.01	5.06	4.85
Jun	4.29	4.13	4.31	4.50
Jul	4.24	4.15	4.41	4.43
Aug	4.08	3.87	4.27	4.28
Sep	3.66	3.53	3.84	3.70
Oct	3.40	3.38	3.52	3.37
Nov	2.92	2.77	2.99	2.82
Dec	2.32	2.36	2.51	1.19
Annual	**44.21**	**44.29**	**46.17**	**43.78**

(Source: SWFWMD DBHYDRO, 2009)

5.3 Land Use

The current land use distribution within the FEC sub-watershed is shown in **Figure 44**. Land use data applied in the assessment was obtained from the SFWMD's GIS database (SFWMD GIS Data Catalog). The boundary delineation of the FEC sub-watershed was taken from the SFWMD's Basin Atlas (SFWMD, 2004). Land uses within the sub-watershed are grouped into 8 main categories and over 50 more detailed sub-categories, some of which are shown in Table 9, among which the agriculture, rangeland, forest land and wetlands occupy more than 96 percent of the total land. The total land within the FEC Sub-watershed is approximately 440 square miles.

From 1984 to 2006, more than 72 square miles (46,080 acres) of rangelands, which by definition represents unimproved grass land with native vegetation, were converted to agricultural land use for farming, citrus growth and cattle production.. This conversion of land use resulted in a significant increase on phosphorous loading to the creek.

Most farmland is distributed in the upper portion of the sub-watershed within Highlands County. Some agricultural land is also located around the downstream end of the FEC. Most state forest conservation, wetlands, and undeveloped ranch land are located in the lower portion of the sub-watershed within Glades County. Agricultural land uses indicate the distribution and intensity of non-point source pollution within the sub-watershed.

The detailed categories in **Table 14**, show that in 2006 improved pastureland made up over 29% of the land. A significant contribution to land use is also the upland forests. Upland Coniferous Forest and Upland Hardwood Forests combine to contribute 15% and an additional 5.9% is contributed by Tree plantations (**Table 14, Figure 46**).

A majority of wetlands within the area are vegetated non-forested wetlands and Wetland Hardwood Forests contributing to more than 13% and 5% of the land use, respectively (**Table 14**, **Figure 46**). Besides the creek water course and wetlands, the sub-watershed contains a limited area of surface water bodies. Water bodies contribute 0.3% of land use, and they include isolated lakes and agricultural ponds (**Table 14, Figure 46**).

In the past 20 years, land use for urban development within the FEC sub-watershed varied from 1.3% in 1988 to 1.4% in 2006. Scattered urban developments with a low suburban population density are found at the north end and the central portion of the sub-watershed. However, urban town and residential build-ups have been established around Lake Placid and Placid Lakes over the highland of the Lake Wales Ridge (in the Josephine Sub-watershed according to the SFWMD's Basin Atlas, 2004). The Ridge is highly vulnerable to leaching of surface runoff contaminated by chemicals such as pesticides and fertilizers received from the urban development across the sub-watershed boundary. The sandy soils on the Ridge are well drained therefore surface water and groundwater resources within the FEC sub-watershed may be affected by the urban development over the Ridge..

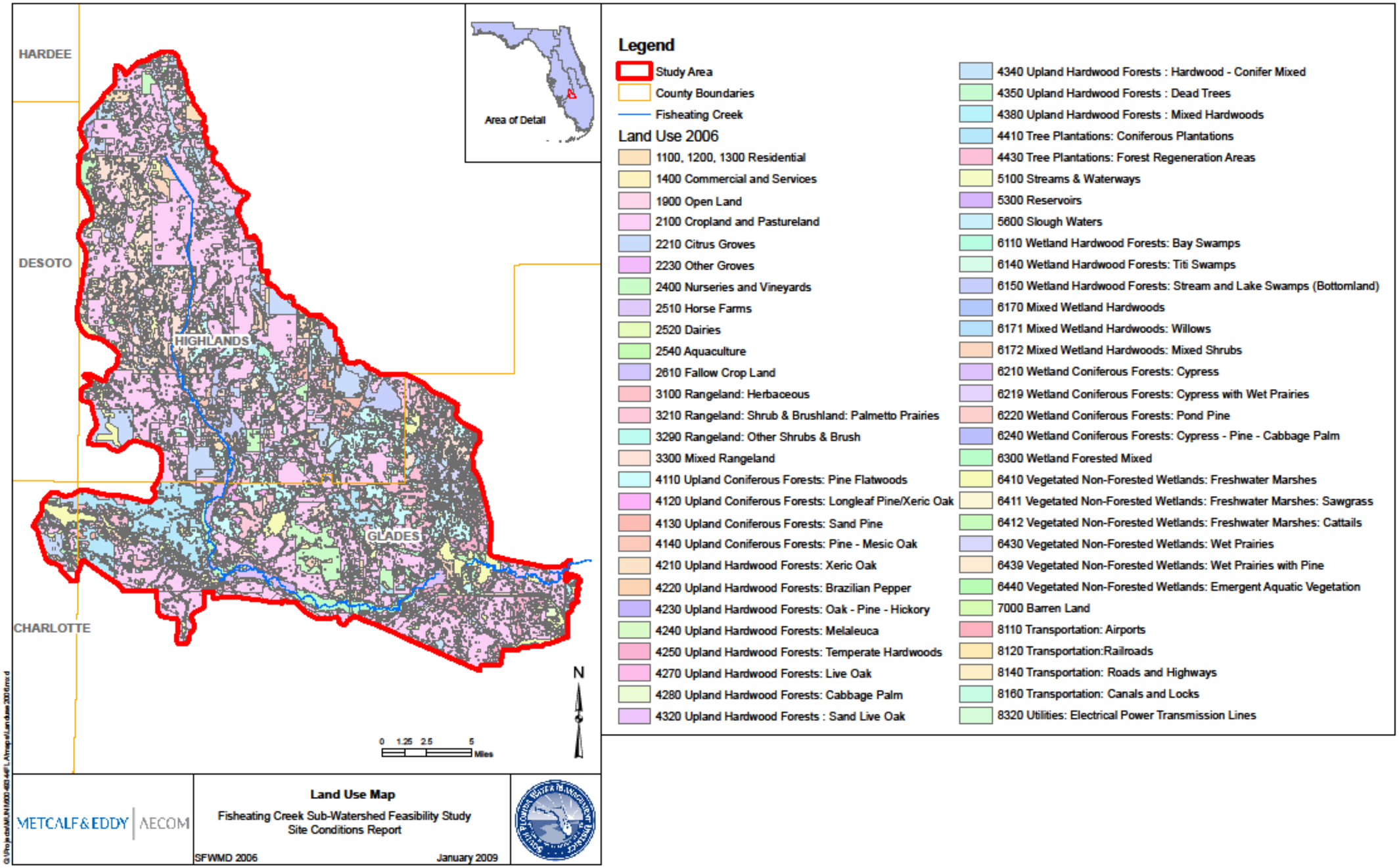
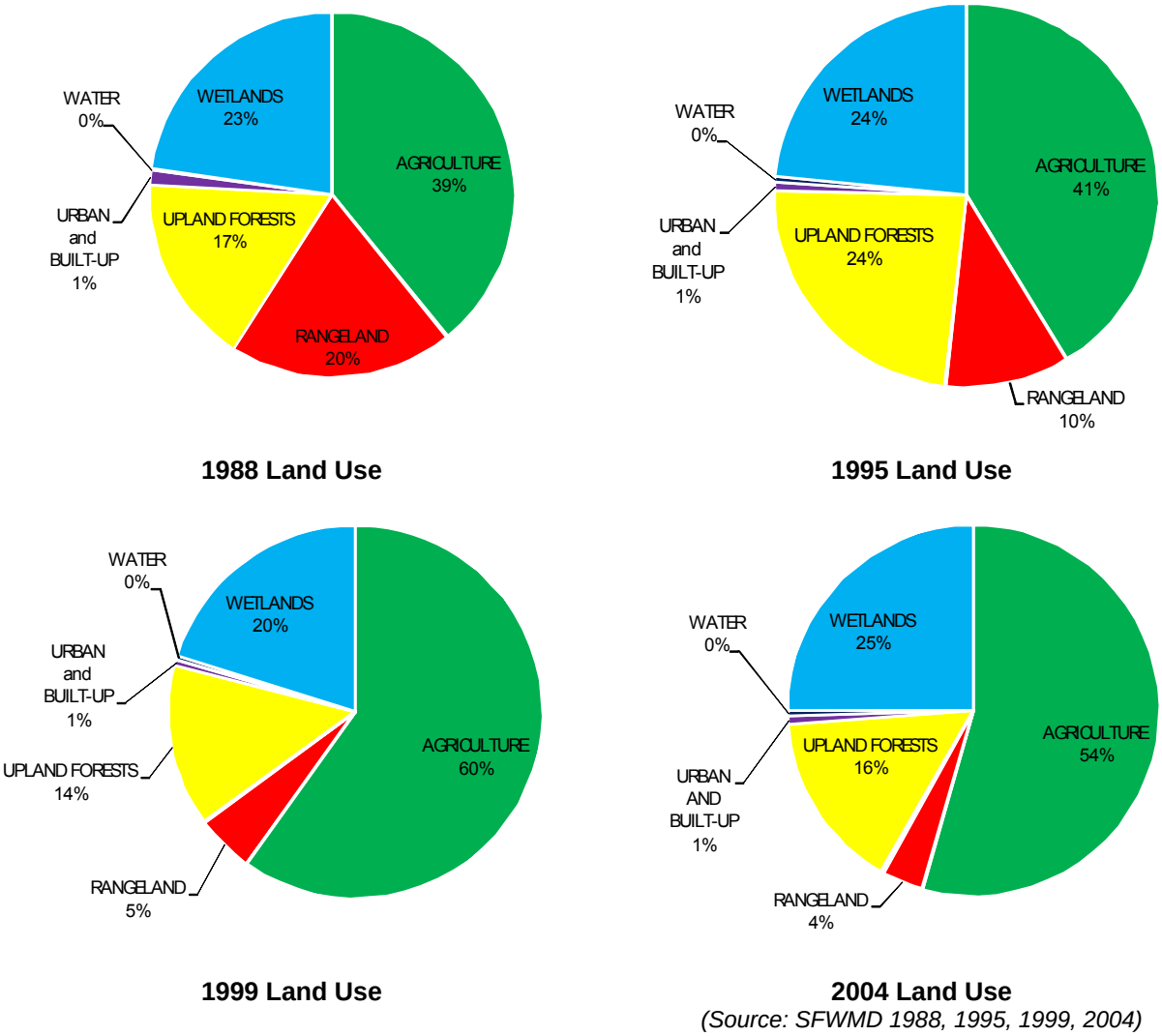


Figure 44. Land Use Condition for Fisheating Creek (2006)

Table 13. Study Area Land Use Distribution

Land Use Categories	1988	1995	1999	2004	2006
AGRICULTURE	39.1%	41.3%	59.8%	54.3%	44.2%
BARREN LAND	0.1%	0.0%	0.1%	0.2%	0.1%
RANGELAND	19.9%	10.3%	4.9%	3.6%	9.0%
TRANSPORTATION, COMMUNICATION AND UTILITIES	N/A	0.2%	0.2%	0.2%	0.4%
UPLAND FORESTS	16.8%	23.5%	14.0%	15.6%	20.9%
URBAN AND BUILT-UP	1.3%	0.8%	0.5%	0.7%	1.4%
WATER	0.1%	0.4%	0.3%	0.5%	0.3%
WETLANDS	22.7%	23.5%	20.1%	25.0%	23.7%



(Source: SFWMD 1988, 1995, 1999, 2004)

Figure 45. Study Area Land Use Categories, Distributions and Variations (1988-2004)

Table 14: Study Area Land Use Distribution – 2006 data

Land Use Category	% of Total
Improved Pastures	29.42%
Vegetated Non-Forested Wetlands	13.21%
Rangeland	9.04%
Upland Hardwood Forests	7.65%
Upland Coniferous Forests	7.33%
Unimproved Pastures	6.54%
Tree Plantations	5.89%
Wetland Hardwood Forests	5.13%
Citrus Groves	4.29%
Wetland Forested Mixed	3.23%
Wetland Coniferous Forests: Cypress	1.99%
Residential	1.38%
Woodland Pastures	1.34%
Nurseries and Vineyards	1.34%
Sod Farms	0.80%
Transportation	0.32%
Fallow Crop Land	0.18%
Streams & Waterways	0.18%
Barren Land	0.14%
Wetland Coniferous Forests: Cypress - Pine - Cabbage Palm	0.14%
Reservoirs	0.13%
Field Crops	0.13%
Row Crops	0.07%
Utilities	0.03%
Aquaculture	0.02%
Commercial and Services	0.02%
Slough Waters	0.01%
Dairies	0.01%
Horse Farms	0.01%
Wetland Coniferous Forests: Pond Pine	0.01%
Tree Crops	0.00%
Total	**100.00%**

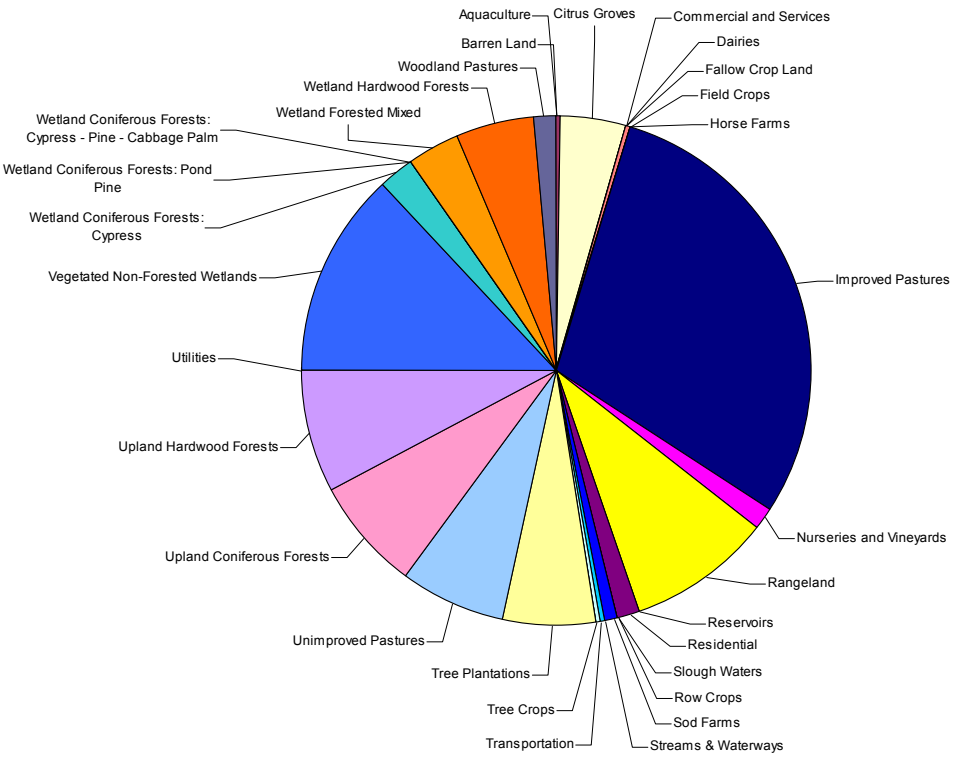


Figure 46. Study Area Land Use Categories, Distributions and Variations (2006)

5.4 Geology and Soils

5.4.1 Surficial Soil Survey Mapping

The predominant surficial soil types in Fisheating Creek Sub-watershed basin are Immokalee sand, Myakka fine sand, Basinger fine sand and Valkaria fine sand, among others (**Figure 47**).

Table 15 shows all of the soil types with their relevant distribution areas on the Fisheating Creek Sub-watershed Study Area. Soil types determined in the sub-watershed mainly fall under the hydrologic groups B/D (77.92%) and D(15.52%). The rest of the soil in the sub-watershed classified under group A (2.08%), B (0.07%) and C (4.14%) (NRCS-USDA 2006, 2007) (**Figure 48**).

Hydrologic Soil Group A have a high rate of water transmission. They have a low runoff potential when completely wet. This group of soils consist of deep, well drained to excessively drained sands or gravelly sands. Group B soils have a moderate rate of water transmission. When they are thoroughly wet they have moderate infiltration capacity. This group of soil mainly consists of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. Group C soils have a slow infiltration capacity even when they are thoroughly wet. Therefore, they have a slow rate of water transmission, with a layer that slows down the downward movement of water or soils of moderately fine texture or fine texture. Group D soils mainly consist of clays that have a high shrink-swell potential, high water table, a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow infiltration and water transmission rate. Group B/D soil shows that the parts of the area covered with drained soil falls under the Group B while the undrained parts of area soil falls under the Group D (NRCS-USDA, 2006, 2007). It should be noted that 77.92% of the Fisheating Sub-watershed basin falls under this group.

The soil type in the sub-watershed is also classified according to its hydric property. Hydric soils are defined as soils that are formed under conditions of saturation, flooding, or ponding long enough during the growth season to develop anaerobic conditions in the upper part of the soil. It is reported that soils formed under such conditions would support the growth and reproduction of the hydrophtic vegetation. Use of hydric soils along with the published soils survey series is extremely useful for land use planning. However, an on-site test is always required to determine the extent of the hydric soils on a specific site via field identification of the presence of one or more of the hydric soil indicators (FDEP, 2008d) . Such property may be a useful criterion in determination of a wetland area. In general, wetland soils are supposed to be in muck, peat etc. However, loam, clay and sandy soils could be used as wetland soils if it is known that they are frequently saturated or inundated (MDEQ, 2008).

Table 15. Fisheating Creek Sub-Watershed Study Area Surficial Soil Distribution

Soil Type	Hydrologic Group	Hydric	Area (Acre)	% of Total Area
Anclote sand, depressional	D	All hydric	126	0.04
Anclote-Basinger fine sand, frequently flooded	D	All hydric	2118	0.70
Archbold sand, 0 to 5 percent slopes	A	Not hydric	1289	0.43
Arents, very steep	A	Not hydric	520	0.17
Astatula sand, 0 to 8 percent slopes	A	Not hydric	1078	0.36
Astor fine sand, depressional	B/D	All hydric	4346	1.44
Basinger fine sand	B/D	Partially hydric	30209	9.99
Basinger fine sand, depressional	D	All hydric	6812	2.25
Basinger, St. Johns, and Placid soils	B/D	Partially hydric	8283	2.74
Boca fine sand	B/D	Partially hydric	657	0.22
Bradenton fine sand	B/D	All hydric	1724	0.57
Brighton muck	B/D	All hydric	230	0.08
Chobee fine sandy loam, depressional	D	All hydric	474	0.16
Chobee loamy fine sand, depressional	D	All hydric	106	0.04
Daytona sand	B	Partially hydric	24	0.01
Daytona sand, 0 to 5 percent slopes	B	Not hydric	193	0.06
Duette sand, 0 to 5 percent slopes	A	Not hydric	159	0.05
EauGallie fine sand	B/D	Not hydric	3212	1.06
EauGallie sand	D	Partially hydric	106	0.04
Felda fine sand	B/D	All hydric	9538	3.16
Felda fine sand, depressional	D	All hydric	745	0.25
Floridana fine sand, depressional	D	All hydric	6159	2.04
Floridana sand, depressional	D	All hydric	994	0.33
Floridana, Astor, and Felda soils, frequently flooded	D	All hydric	13910	4.60
Ft. Drum fine sand	C	Partially hydric	1057	0.35
Gator muck	D	All hydric	4143	1.37
Gator muck, depressional	D	All hydric	1222	0.40
Hallandale fine sand	B/D	Partially hydric	55	0.02
Hallandale fine sand, slough	B/D	All hydric	7	0.00
Hallandale-Pople complex	B/D	Partially hydric	423	0.14
Hicoria mucky sand, depressional	D	All hydric	2846	0.94
Hontoon muck	B/D	All hydric	114	0.04
Immokalee fine sand	B/D	Not hydric	55	0.02
Immokalee sand	B/D	Partially hydric	70728	23.40
Kaliga muck	B/D	All hydric	2672	0.88
Malabar fine sand	B/D	All hydric	5338	1.77
Malabar fine sand, depressional	D	All hydric	17	0.01

Soil Type	Hydrologic Group	Hydric	Area (Acre)	% of Total Area
Malabar fine sand, high	B/D	Partially hydric	3537	1.17
Malabar sand, depressional	D	All hydric	1208	0.40
Myakka fine sand	B/D	Partially hydric	42433	14.04
Myakka fine sand, depressional	D	Partially hydric	154	0.05
Okeelanta muck, depressional	B/D	All hydric	3926	1.30
Oldsmar fine sand	B/D	Not hydric	1115	0.37
Oldsmar sand	B/D	Not hydric	2054	0.68
Orsino sand, 0 to 5 percent slopes	A	Not hydric	423	0.14
Paola sand, 0 to 8 percent slopes	A	Not hydric	1707	0.56
Pineda fine sand	B/D	All hydric	3116	1.03
Pineda fine sand, depressional	D	All hydric	44	0.01
Pineda sand	B/D	All hydric	3465	1.15
Placid fine sand, depressional	D	All hydric	4990	1.65
Pomello fine sand	C	Not hydric	3108	1.03
Pomello sand, 0 to 5 percent slopes	C	Not hydric	1634	0.54
Pople fine sand	B/D	Partially hydric	5339	1.77
Punta fine sand	B/D	Not hydric	155	0.05
Samsula muck	B/D	All hydric	1814	0.60
Samsula muck, depressional	D	All hydric	0.93	0.00
Sanibel muck	B/D	All hydric	486	0.16
Sanibel muck, depressional	D	All hydric	660	0.22
Satellite fine sand	C	Partially hydric	15	0.01
Satellite sand	C	Partially hydric	6696	2.214
Smyrna fine sand	B/D	Partially hydric	4042	1.34
Smyrna sand	B/D	Partially hydric	6825	2.26
St. Lucie sand, 0 to 8 percent slopes	A	Not hydric	1074	0.36
Tavares sand, 0 to 5 percent slopes	A	Not hydric	52	0.02
Tequesta muck	B/D	All hydric	1026	0.34
Terra Ceia muck, drained	B/D	All hydric	9	0.00
Valkaria fine sand	B/D	All hydric	18434	6.1
Valkaria fine sand, depressional	D	All hydric	13	0.00
Wabasso sand	B/D	Partially hydric	170	0.056
Water		-	827	0.27
Winder sand, depressional	D	Partially hydric	54	0.02

(Source: NRCS-USDA 2006,2007)

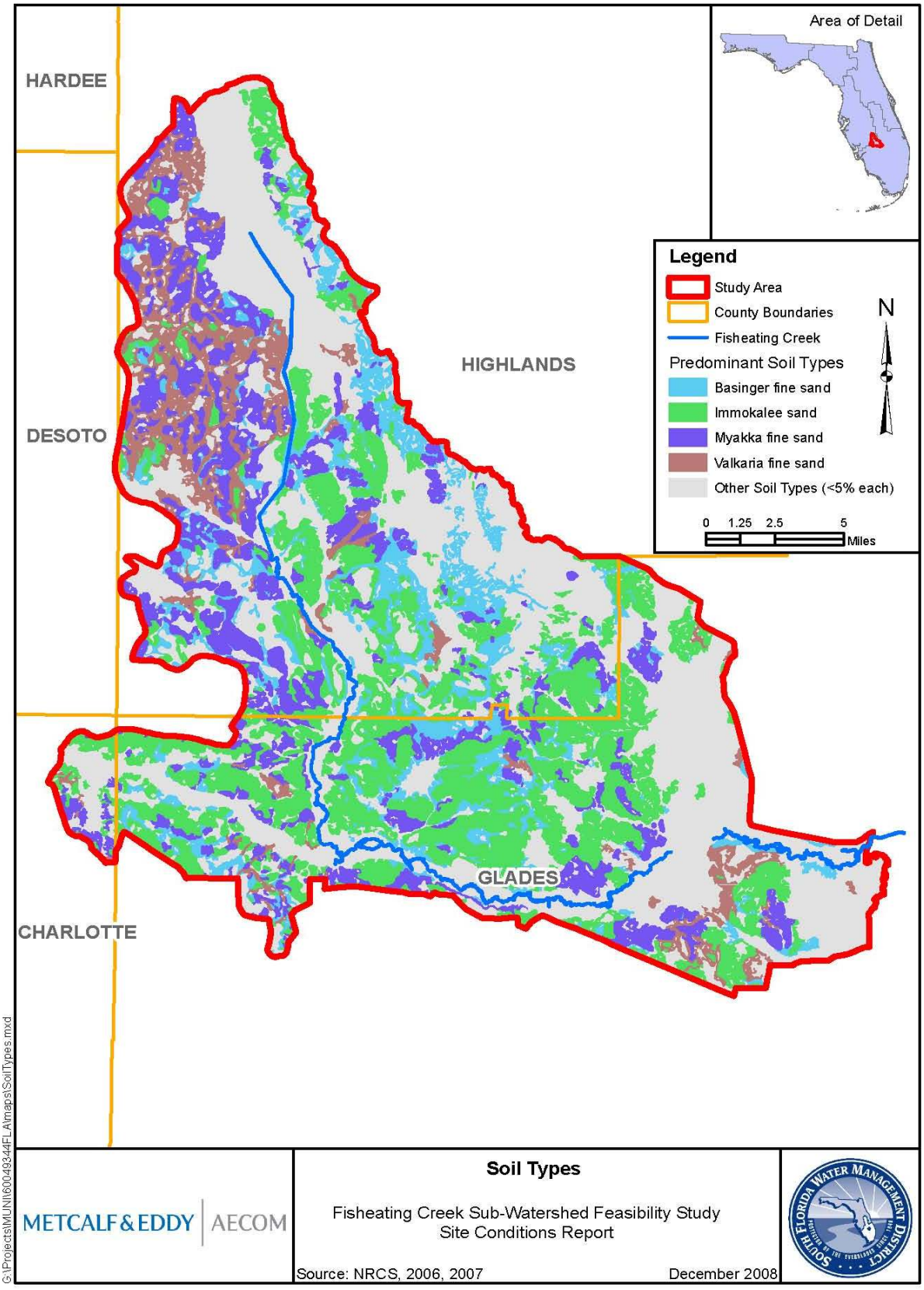


Figure 47. Soil Types in the Fisheating Creek Sub-Watershed Study Area

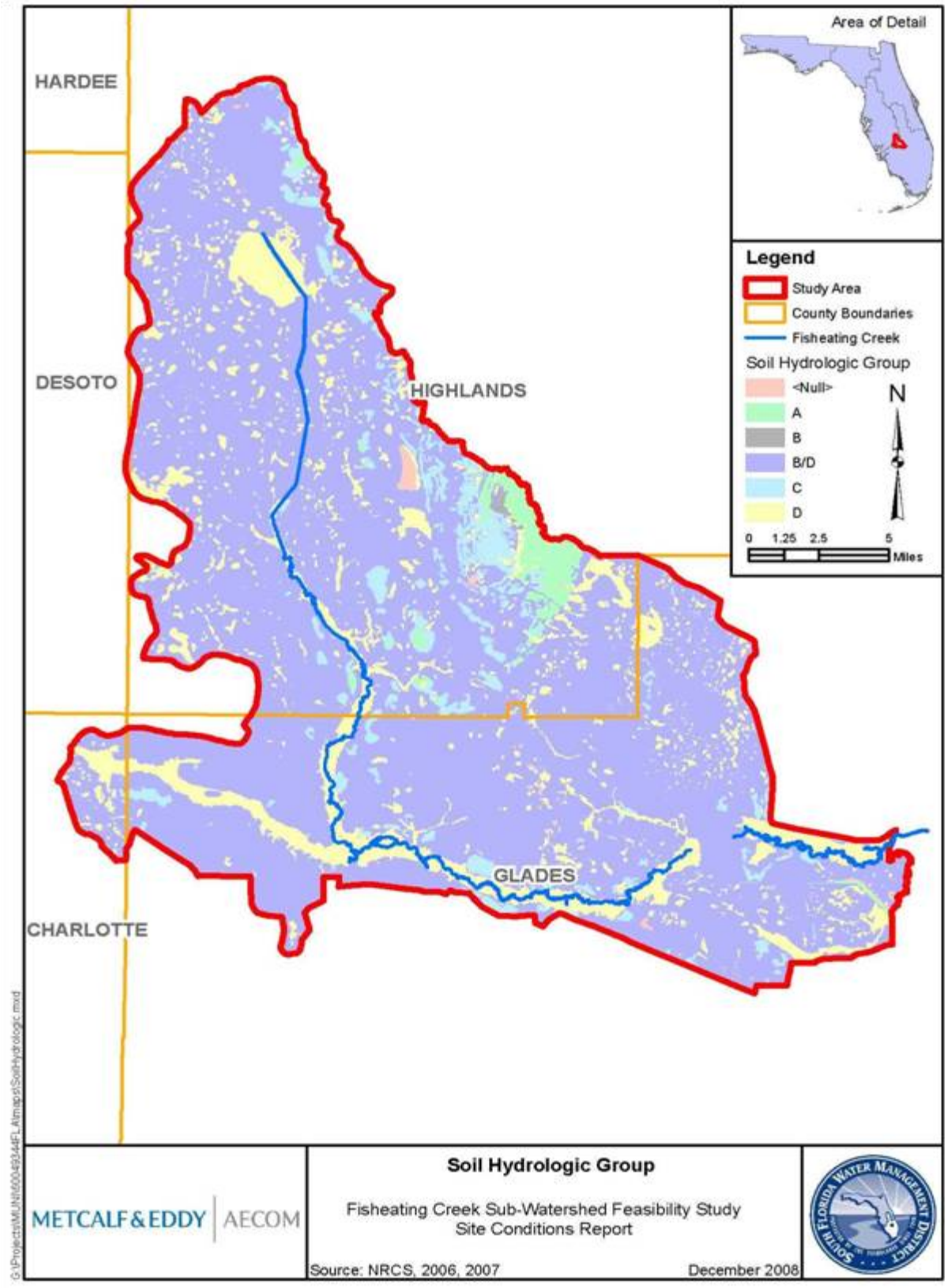


Figure 48. Hydrologic Soil Groups in the FEC Sub-Watershed Study Area

5.4.2 Subsurface Investigation

Investigation conducted for the subsurface properties did not reveal any information for the Fisheating Creek Sub-watershed basin area. However, information for the study area was located for the vicinity of Nicodemus Slough area (USACE, 1982). The purpose of the geotechnical study was to identify the subsurface materials and determine their characteristics as they relate to engineering construction (USACE, 1982). According to the results of the study, sand is the predominant material in the project area together with lesser amounts of clay, silt, and shells. Local pockets of muck are present at ground surface. A 6-foot thick layer of limestone was found at one boring at elevation -2.1 feet NGVD, approximately 22.5 feet deep. **Table 16** lists the geotechnical findings at these five core borings drilled in 1955. **Figure 49** shows the geotechnical study boundary for the Nicodemus Slough area.

Table 16. Core Borings Stratigraphy (1955)

Boring No.	Elevation (ft NAVD)	Material Description
1	+20.7 to +18.2	SP-SM-SAND, slgt silty, org, fine
	+18.2 to +10.7	SP-SAND, fine. (+15.7 to +14.7 very shelly and +14.7 to +10.7 shelly, few consol. frags.)
	+10.7 to -0.1	SP-SC-SAND, slgt clayey, very fine, shelly
	-0.1 to -2.8	SP-SAND, very fine (-1.7 to -2.8 very shelly)
	-2.8 to -4.8	SC-SAND, clayey
	-4.8 to -9.3	SP-SAND, shelly, fine SW above -5.3
2	+19.3 to +15.3	SM-SAND, silty, very org, fine
	+15.3 to +12.3	SP-SM-SAND, slgt silty, fine
	+12.3 to -1.2	SP-SAND, clean above +3.3, fine
	-1.2 to -3.2	SP-SC-SAND, slgt clayey
	-3.2 to -8.2	SP-SAND, fn/med, few silt lens
	-8.2 to -10.7	SP-SM-SAND, slgt silty, fn/md
3	+21.6 to +21.1	SP-SM-SAND, slgt silty, fine, org
	+21.1 to +14.6	SP-SAND, fine slgt org.
	+14.6 to +13.1	SP-SM-SAND, slgt silty, org.
	+13.1 to +9.6	SP-SAND, clean, fine
	+9.6 to -0.9	SC-SAND, clayey, fine, shelly (+1.6 to -0.9 very clayey)
	-0.9 to -2.1	LIMESTONE, hard
	-2.1 to -7.0	LIMESTONE, med-hard

Boring No.	Elevation (ft NAVD)	Material Description
	-7.0 to -8.4	SP-SAND, 10% consol.
4	+19.6 to +13.6	SP-SM-SAND, slgt silty, very org. above +19.1
	+13.6 to +9.1	SP-SAND, shelly, clean, to +11.7 (+11.7 to +9.1 some slgt silty lenses, no shell)
	+9.1 to +1.6	SP-SC-SAND, slgt clayey, 50% small consol. frags
	+1.6 to -0.4	SC-SAND, very clayey, very fine, few shelly lenses
	-0.4 to -5.4	CL-CLAY, sandy
	-5.4 to -10.4	SC-SAND, very clayey, shelly
5	+19.5 to +17.0	SP-SM-SAND, slgt silty, fine
	+17.0 to -0.5	SP-SAND, shelly, fine (+13.5 to -0.5 clean, slgt shelly)
	-0.5 to -5.5	SP-SC-SAND, slgt clayey
	-5.5 to -10.5	CL-CLAY, shelly few thin lenses of consol. shell

(Source: USACE, 1982)

5.4.3 Other Relevant Geotechnical Studies

Aquaflorida Project, Highlands County, Ardaman & Associates, Inc.

A report entitled "Subsurface Exploration and Geotechnical Engineering Evaluation", for the "Aquaflorida" Lake Okeechobee Water Quality Improvement Project, Highlands County, Florida, prepared by Ardaman & Associates, Inc. (Ardaman), dated as January 13, 2003, was provided by Lykes Bros Inc. This report pertains to an area located approximately 17 miles away from the center of the Fisheating Creek Sub-watershed basin (**Figure 49**). The soil information was considered appropriate for this phase of the project.

Ardaman evaluated the subsurface conditions for supporting 8 to 10 feet high earthen levee construction and water distribution structures. A total of 91 Standard Penetration Test (SPT) borings were performed to depths between 15 and 100 feet below the existing ground surface in the period between July 31, 2002 and October 26, 2002. Moreover, a total of 19 permanent 2-inch diameter monitoring wells were installed at selected locations throughout the site followed by 19 field permeability tests performed at varying depths in the installed wells. The measured hydraulic conductivities varied from 0.057 ft/day to 6.520 ft/day with an average of 1.47 ft/day. Based on the tests results, the soils throughout the site consist of clean, slightly silty, slightly clayey to clayey fine sands from the existing ground surface to depths of about 35 to 50 feet,

followed by slightly sandy, low to medium plasticity clays to high plasticity clays reaching depths of 85 to 95 feet, in turn followed by clean fine sands to slightly clayey fine sands reaching the termination depths of the deepest borings. The groundwater was generally encountered above 3 feet. This geotechnical study recommended levees to be constructed in some parts of the site using slightly silty sands borrowed from within the property without removing the encountered surficial organics or the use of synthetic reinforcement, provided that a staged construction technique consisting of 3 to 4 lifts is used. In other parts of the site, levees can be constructed using well compacted 18-inch lifts of slightly silty sands borrowed from within the property, with only conventional clearing operations prior to the start of the filling.

The soils of this study were considered adequate to support a pump station construction on a conventional mat or raft foundation, with a bearing pressure of 2,500 pounds per square foot (psf) or less.

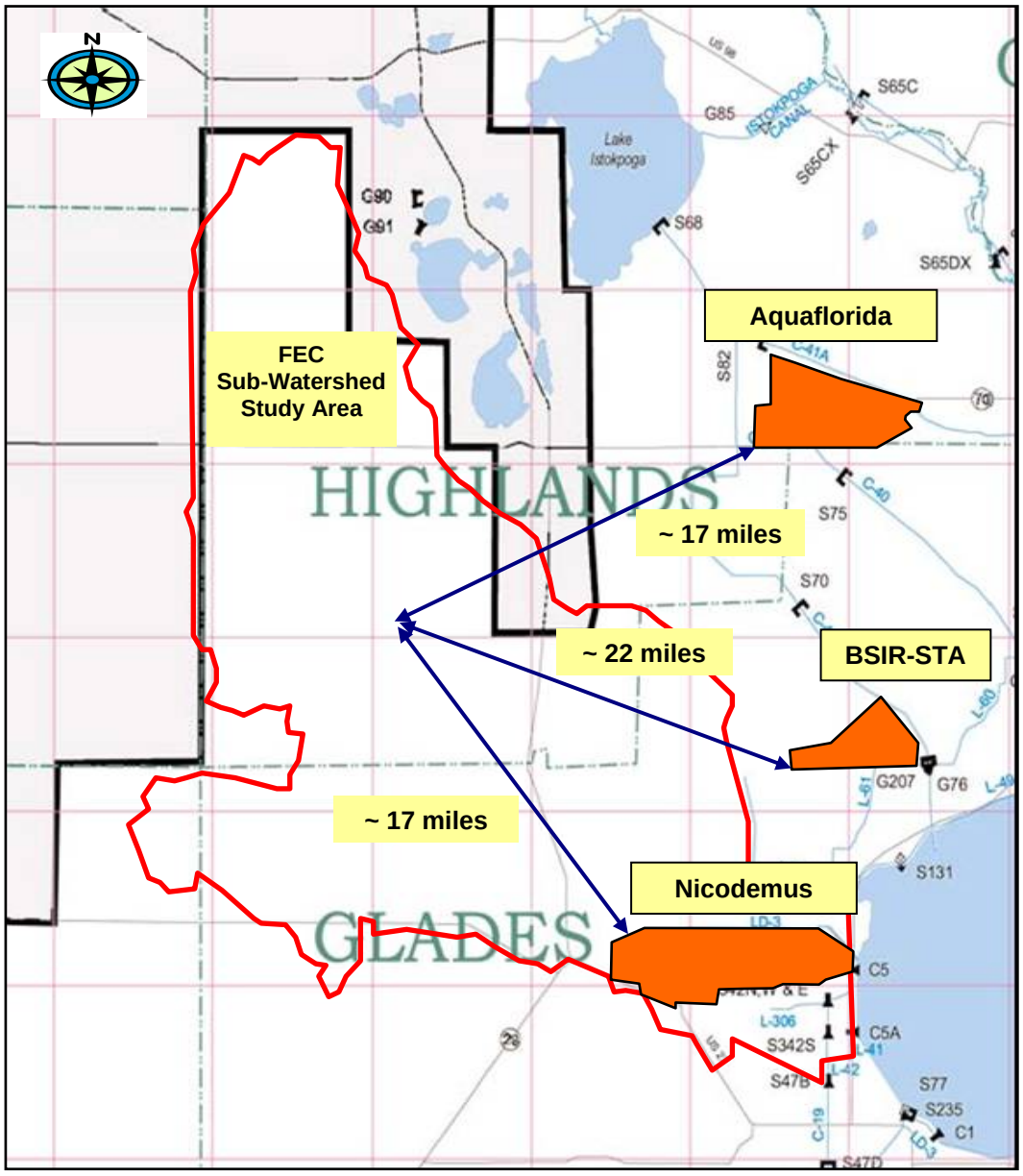
BSIR-STA Project, Glades County, Nadic Engineering Services, Inc.

A report entitled "Preliminary Geotechnical Report", for the Brighton Seminole Indian Reservation Stormwater Treatment Area (BSIR-STA) Project, Glades County, Florida, prepared by Nadic Engineering Services, Inc. (NES), dated as September 21, 2007, was provided by the SFWMD. This report pertains to an area located approximately 22.25 miles away from the center of the Fisheating Creek Sub-watershed basin (**Figure 49**). The soil information was considered appropriate for this phase of the project.

NES evaluated the subsurface conditions for the design and construction of stormwater treatment areas (STAs) and water control structures. A total of 35 Standard Penetration Test (SPT) borings were performed to depths of about 25 feet below the existing ground surface in the period between January 02, 2007 and March 08, 2007. The borings generally encountered fine sand with varying amount of silt and occasionally clay and trace shell from the existing ground surface to a depth of about seven feet follow by fine sand with silt and trace shells to abundant shells to boring termination depths of about 25 feet below existing grade. Isolated 5-foot layer of clayey sand was encountered in 5 borings at depths between 7 and 17 feet below existing grade. Limestone layer approximately 5-foot thick was encountered in 2 borings at a depth of about 13 feet below existing grade. The near surface sandy soils are generally very loose to medium dense with isolated very dense soils. Below a depth of about 10 feet, the encountered soils are generally medium dense to very dense. The groundwater was generally encountered from about 2.5 to 6.5 feet, at approximate +14 to +17.5 feet NGVD.

This geotechnical study stated that embankment construction materials can be generated from on-site excavations, except in isolated areas where highly compressible organic soils and peat

are present at the ground surface. These excavations may take the form of seepage collection canal(s) as well as several borrow sites from within the property.



(Source: SFWMD, 2005)

Figure 49. Geotechnical Study Site Locations Map

The soils of this study were considered suitable to support a pump station and other structures construction on a variety of foundation types, including shallow foundations, driven piles or drilled shafts, with a bearing pressure of 3,000 pounds per square foot (psf) for dead load plus live loads.

5.5 Topography

Topography map of the FEC Sub-watershed Study Area is shown on **Figure 50** with 5 ft contours (FGDL, 1997). The northwestern portion of the sub-watershed is bounded by the south extension of the Lake Wales Ridge. The topography of the sub-watershed slopes gradually from about 85 feet NGVD in the northwest section to about 20 feet NGVD in the southeast section as identified in the 5-feet topographic map. A bend of low-lying wetland near the southern boundary of the sub-watershed forms the swamp water course of the creek.

5.6 Existing Watershed Hydrology

5.6.1Data Resources

The applied hydrological data is collected from the SFWMD's DBHYDRO database. Hydrologic datasets include:

- Rainfall data monitored at 2 rain stations (ARCHBO & VENUS_R) within the sub-watershed
- Flow and stage data collected at the SFWMD's FISHP station (USGS Station 02256500)
- Groundwater data collected at two monitoring wells south of the sub-watershed
- Water quality data monitored at multiple stations. Total phosphorous concentration data measured at Station FECSR78 is used in this report to estimate the total phosphorous loads.

Locations of the above measurement stations are shown in **Figure 51**, and available data periods at those stations are listed in **Table 17**. Within the 440 square mile study area, there exists only one active SFWMD flow and stage monitoring station, two active rainfall monitoring stations, and no active groundwater monitoring wells. The flow data measured at the US 27 bridge (SFWMD Station FISHP / USGS Station 02256500) is registered in the DBHYDRO database with a Preferred DBKey (DBKey 15627), indicating that raw data collected at this station has gone through the required QA/QC process. The stage data recorder located at the same station is owned by USGS and therefore is named as "unknown" in DBHYDRO. Both rainfall and groundwater well data are raw data.

In order to assess the recent hydrologic conditions in the FEC, datasets of rainfall, flow/stage, and groundwater level and water quality data for the period of January 1991 - October 2008 were extracted from available data recorded at the above stations. The extracted datasets during this period were examined for data quality in terms of missing measurements, abnormal spikes, recording consistency, and data error flags. The data quality is generally satisfactory.

Table 17. Available Data Periods

Dbkey	Station	Data Type	Freq	Stat	Recorder	Agency	Start Date	End Date
15627	FISHP	Flow	Day	Mean	PREF	WMD	1/1/72	6/30/08
00088	FISHP	STG	Day	Mean	Unknown	USGS	1/5/31	5/11/08
06205	ARCHBO	Rain	Day	SUM	OMD	WMD	1/8/91	11/10/08
VN418	VENUS_R	Rain	Day	SUM	NRG	WMD	10/1/07	3/01/08
	CRS02NM	GrdW						
	MUSE W	GrdW						

Although all data recording frequencies are daily, monthly data (maximum, minimum, monthly cumulative values and monthly averaged values) are used to support the hydrologic assessment.

The distance between FISHP and FECSR78 is about 12 miles. The distance between USGS02255600 and FE36382811 is about 5 miles. These stations are shown in **Figure 51**.

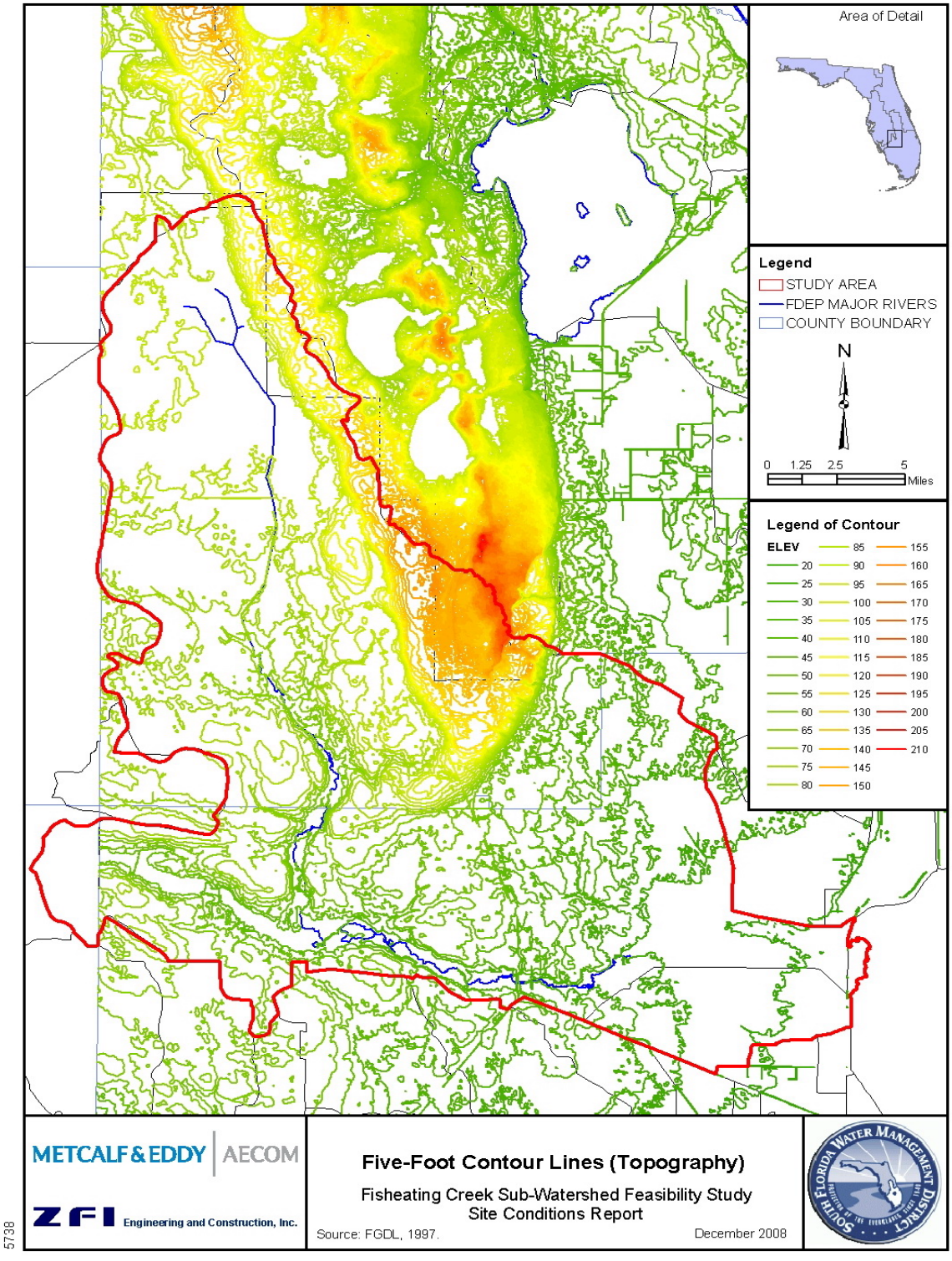


Figure 50. Five-Foot Contour Lines (Topography)

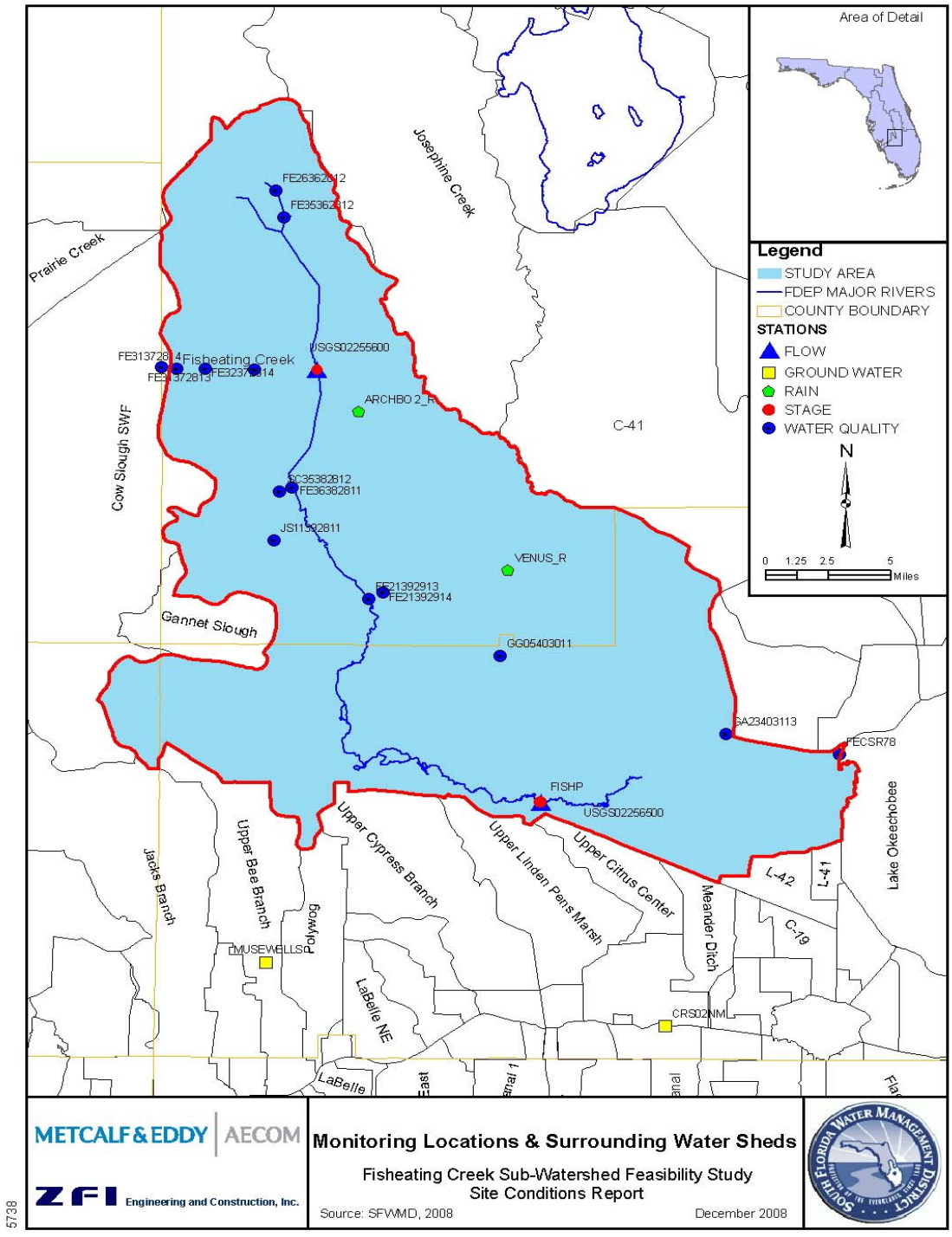


Figure 51. Monitoring Locations & Surrounding Watersheds

5.6.2 Hydrological Characteristics

Rainfall

The general rainfall distribution for the Study Area is assessed using the annually averaged monthly rainfall for the period from 1991 to 2008. The monthly averaged rainfall volumes of a specified month are extracted from all years of the data period, and are averaged to generate the annually averaged rainfall data for the specified month. The result, as shown in, demonstrates a typical central Florida rainfall distribution pattern: the dry season lasts from November to April; the rainy season ranges from June to September; and the transition months between the dry and wet seasons are May and October. In average, more than 40% of annual precipitation is generated during rainy season months (**Figure 52**).

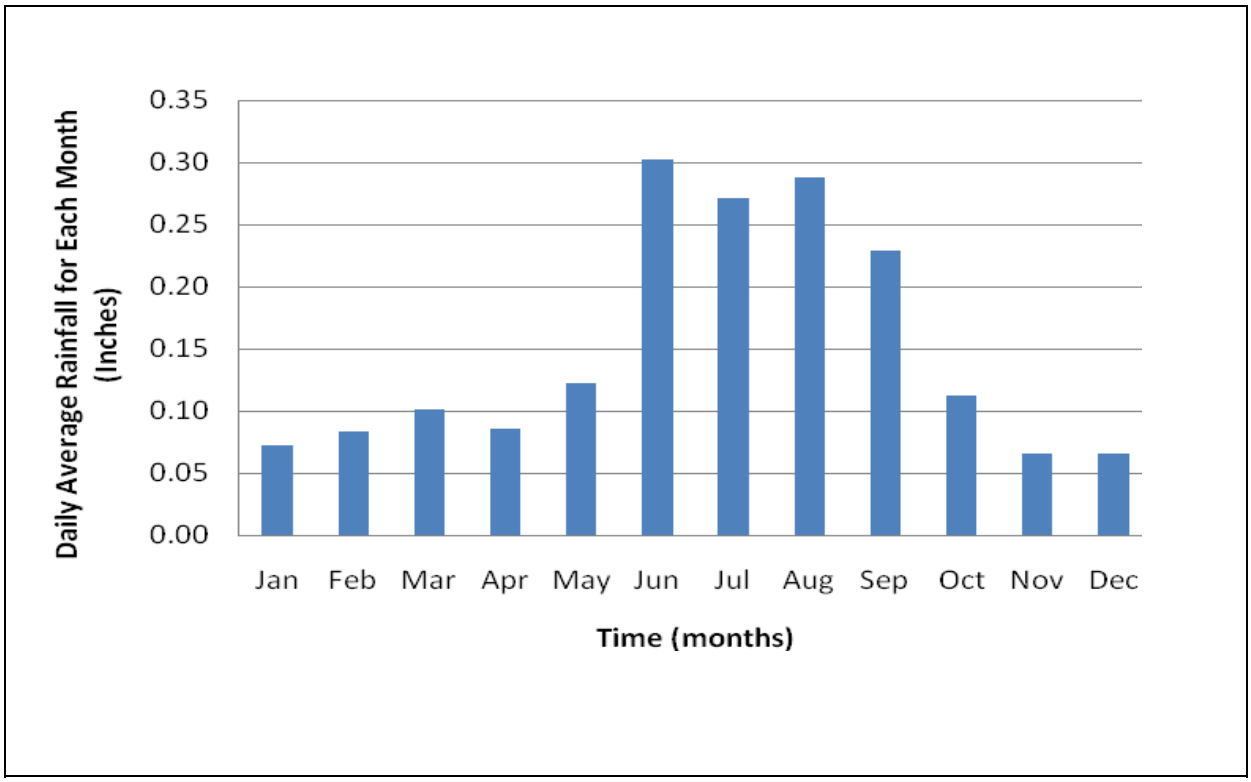


Figure 52. Annually Averaged Monthly Rainfall (SFWMD DBHYDRO (DBKey 16604) 1991-2008)

Stage

Figure 53 shows the monthly averaged creek water level recorded at the SFWMD FISHP station from Year 1991 to Year 2008. The stage data depicted a strong seasonal variation pattern during summer/autumn months. During most years, the creek water level was observed to reach its peak value during July and August. Water level was observed to gradually decrease from October through March and reach an annual low during April or May.

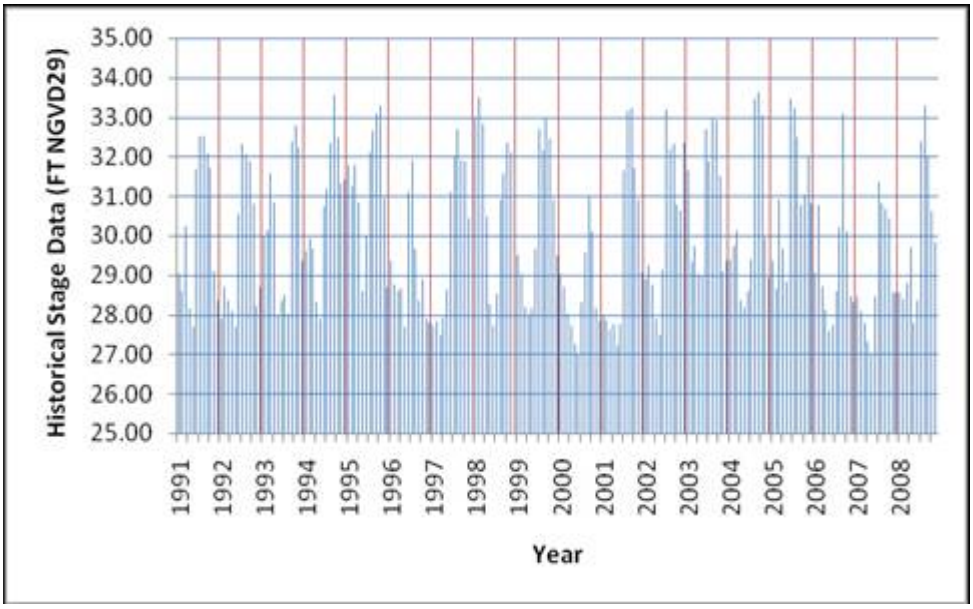


Figure 53. Monthly Averaged Stage Data Measured at FISHP Station (SFWMD DBHYDRO (DBKey 00088) 1991-2008)

The patterns of water levels in the creek were observed to be inconsistent from year to year. Water levels in winter/spring months for some years (e.g., years 1993, 1995, 1998 and 2003) were significantly higher than the winter/spring water levels in other years (e.g. years 1997, 2001 and 2007). Swamps and wetlands near the southern boundary of the sub-watershed play an important role of controlling water level and its temporal variation along the creek water course. Analysis of the relationship between FEC rainfall and stage indicates a well-correlated response during its ascending process, but poor correlation in the stage recession process. Hydrologic characteristics of wetlands, such as duration/frequency of hydro-periods and level of inundation affect the water level fluctuation of the FEC.

The FEC reached its extreme low water level stage in June 2000, May 2001 and May 2007. Given the datum of Station FISHP to be 27.19 feet NGVD, the monthly averaged water levels at the monitoring station were 27.02 feet NGVD, or 0.17 feet below the datum, in June 2000; 27.22 feet NGVD in May 2001; and 27.00 feet NGVD in May 2007. The occurrence of the FEC's 2007 drought is consistent with that of the Lake Okeechobee drought as water levels of both water

bodies reached their extreme lows in the same year. Year 2007 was a historically dry year in the whole Central and South Florida region. The two recorded low water level stages of FEC (2000 and 2001) also corresponded to extreme low water levels in Lake Okeechobee for the same calendar years.

High stage values at FISHP will result in flooding over the low-lying area. At stage elevation of 33 feet NGVD, a large swamp area downstream to FISHP (including Nicodemus Slough Area) will be flooded as shown in **Figure 55.** The topographic map indicates that the upstream section of the FEC sub-watershed is not as susceptible to flooding as the southern section of the sub-watershed.

Stage measurement at the USGS stage and flow monitoring station USGS 02255600 is plotted in **Figure 54**. The station, located at the intersect of the FEC and SR 70, is operated by the USGS. The monitoring data have not been stored in the District DBHYDRO, but are posted by USGS.

The seasonal variation pattern of stage can be observed from the plot although the data span is limited. The averaged stage level in 2007 is considerably lower than comparing with other years, indicating the drought year occurred over the whole sub-watershed. Weak correlations of stage variation between the upstream monitoring station and the downstream FISHP can be observed by comparing the magnitude of stage variations. The wetlands marshes in downstream reaches of the FEC may attenuate high flows and prolong water level variation.

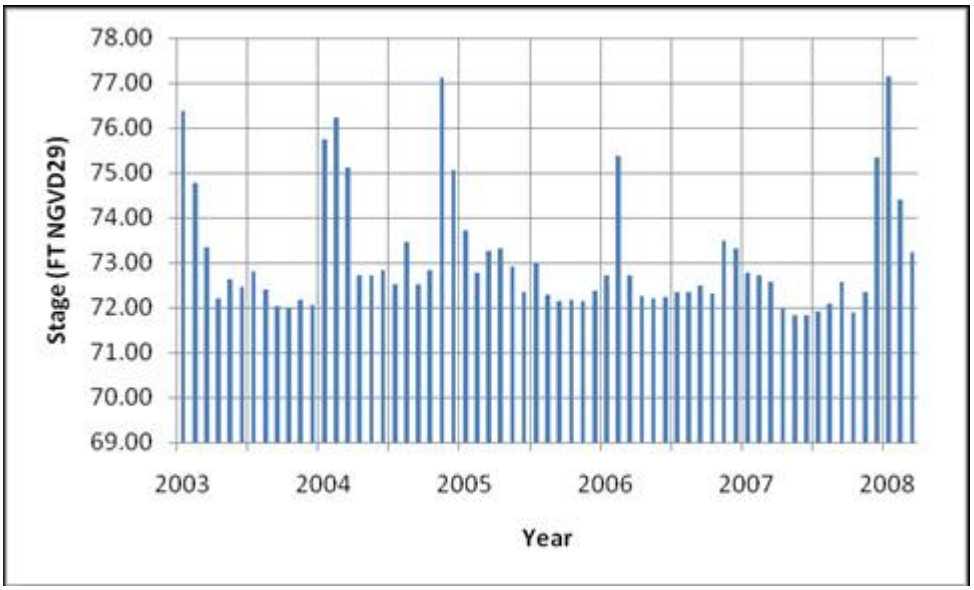


Figure 54. Monthly Averaged Stage Data Measured at USGS02255600 (USGS, 2008)

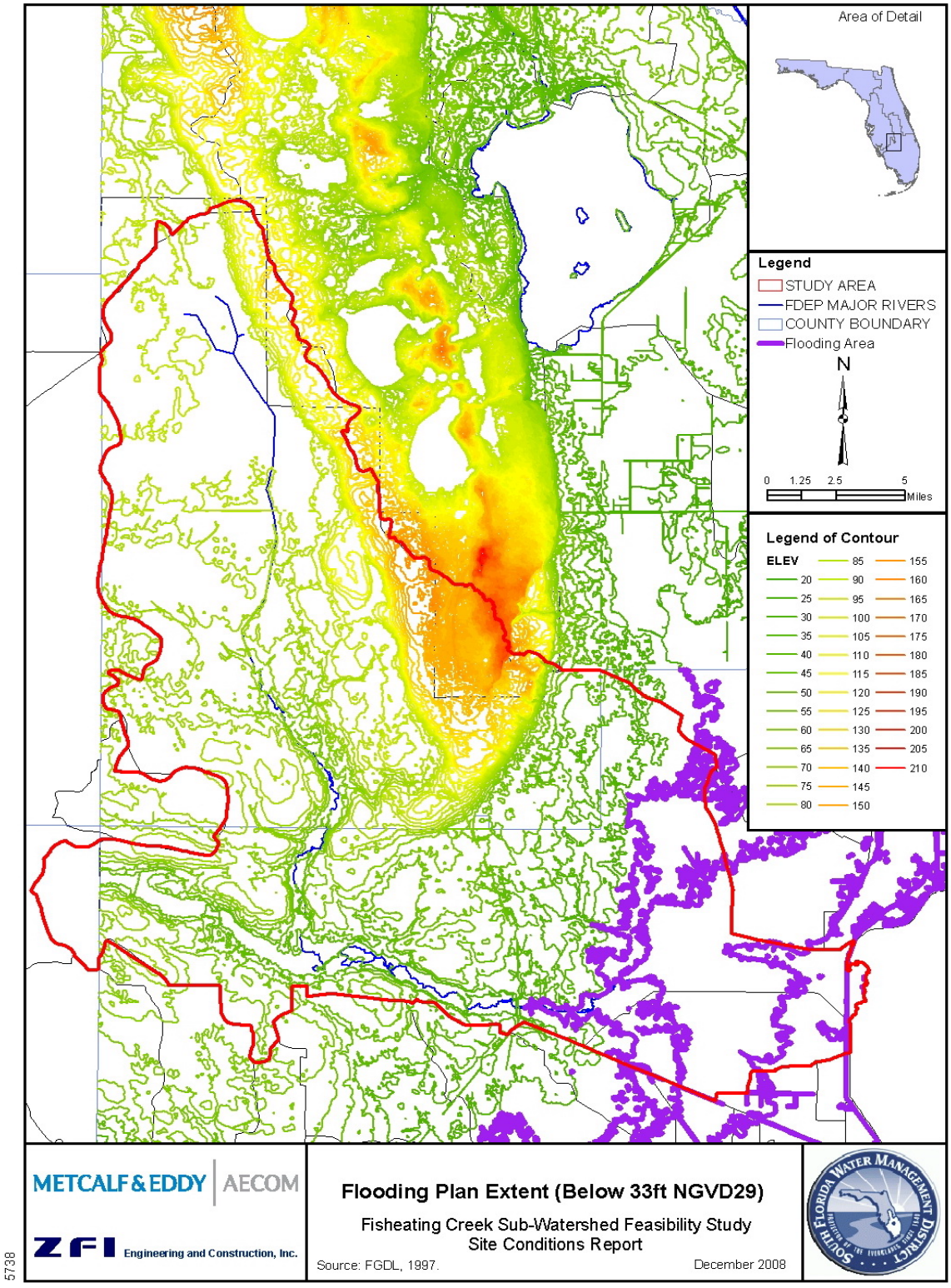


Figure 55. Flooding Plan Extent

Flow

The monthly averaged flow rate recorded at FISHP station is plotted in **Figure 56**. During many winter/spring months, water flow along the FEC was low and undetected. However, in January, February, and March of 1998, high flows occurred together with abnormally high stage levels. During this winter/spring period, a series of heavy rain events were recorded within the FEC sub-watershed. The maximum event rainfall volume during this period ranged from 2.21 inches to 3.25 inches, which is considered to be high precipitation in Central Florida during winter/spring months.

Year 2000 and Year 2007 were two drought years for the FEC sub-watershed. Both monthly flow distribution and the cumulative total water volume reached an extreme low. Flow and stage distributions are consistent in these two years.

The monthly averaged flow rate recorded at USGS02255600 is plotted in **Figure 57**. Although the flow data indicates that all recorded heavy runoff events occurred in wet season months (in 2005 and 2008), meaningful seasonality of flow variation is not depicted due to the length of data period and drought years of 2006 and 2007.

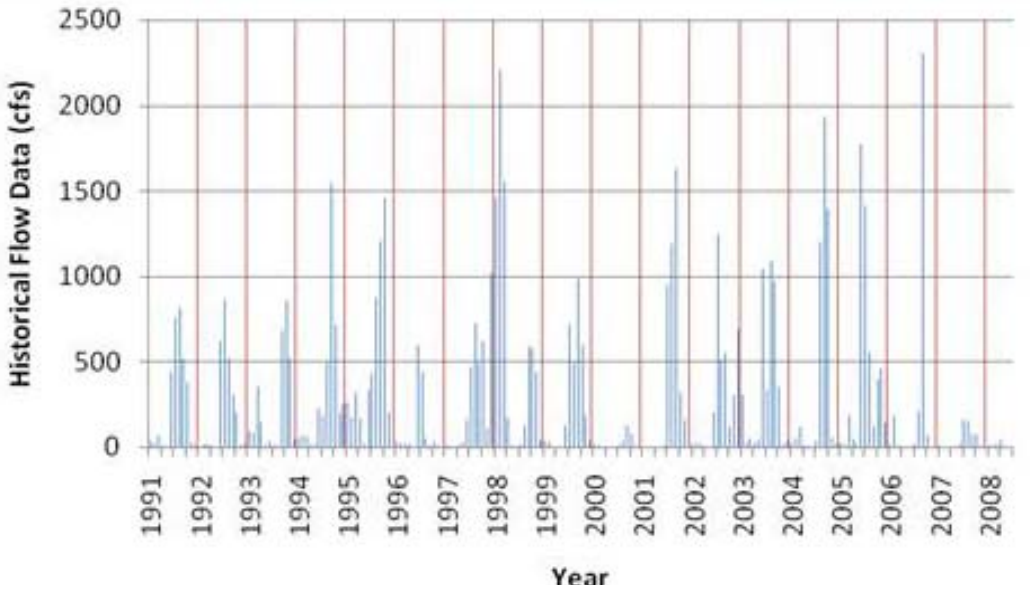


Figure 56. Monthly Averaged Flow Data Measured at FISHP Station (SFWMD DBHYDRO (DBKey 15627) 1991-2008)

Also because of the length of data span, correlation of flow rates between the USGS 02255600 station and the FISHP station cannot be clearly observed. In 2005, the maximum monthly average flow rate recorded at the USGS station was 500cfs, which is approximately one-third of flow rate recorded at FISHP (1750cfs) in the same month. However, the maximum flow at the

USGS 02255600 recorded in 2006 (200cfs) is less than one-tenth of the maximum flow recorded at FISHP (2300 cfs).

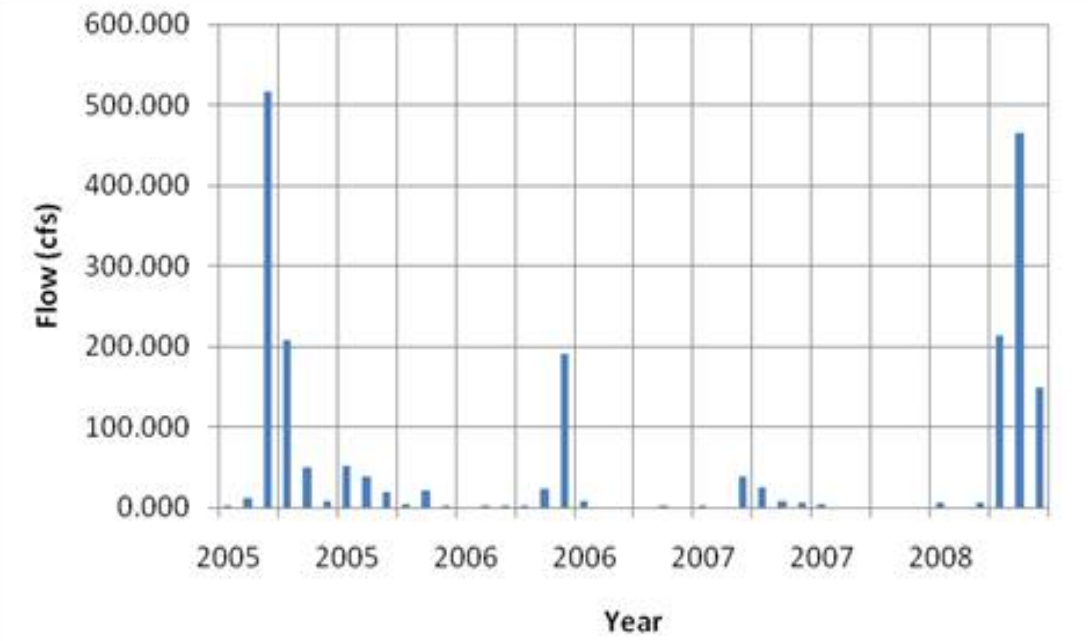


Figure 57. Monthly Averaged Flow Rate Recorded at the USGS02255600 Station (USGS, 2008)

Groundwater

The aquifer systems underneath the FEC sub-watershed consist of surficial, intermediate, and Floridan aquifers.

The thickness of surficial aquifers in the region is generally less than 100 feet. Surface water and groundwater interactions may happen in the surficial aquifers where groundwater continuously moves along the hydraulic gradient from areas of recharge to places of discharge. Surficial aquifers are recharged locally, and the water-table fluctuates in response to drought or rainfall. Affected by highlands of Lake Wales Ridge and broad wetlands marshes, surface drainage conditions such as canal base-flow and surface water retention of the FEC sub-watershed may be influenced considerably by groundwater movement in surficial aquifers. In the northern section of the sub-watershed, groundwater recharge from the Lake Wales Ridge would affect the canal base-flow and agriculture water use; while in the southern section, groundwater flow and water table fluctuation control wetland hydrology such as duration, frequency, and extent of inundation.

The Floridan aquifer is a portion of the principal artesian aquifer which covers the southeast United States and extends into Florida. Groundwater in the Floridan aquifer is contained under pressure by a confining bed of impermeable sediments. When the water pressure is high enough, the groundwater breaks to the surface and forms spring flows. Although fresh water from the Floridan aquifer supplies water needs to numerous towns and rural communities, deep wells in Floridan aquifer are not found in the FEC sub-watershed in the study area. Most wells used for agricultural irrigation are shallow wells in the surficial aquifer.

Intermediate aquifers are comprised of limestone beds and lie between the surficial and Floridan aquifers. Approximately 10 % of fresh water is stored in intermediate aquifers.

A groundwater monitoring network has not been established in the FEC sub-watershed. For other water supply and groundwater quality studies, the SFWMD and other state and municipal agencies have established a number of groundwater wells in the Lake Wales Ridge area and in other surrounding sub-watersheds. Groundwater level series collected at 3 stations (CRS02 NW (DBKey L7449), Musewells (DBKey15239 and 15240)) located south of the FEC sub-watershed, are plotted in **Figure 58**, and demonstrate groundwater variation in areas close to the sub-watershed. **Figure 51** shows the location of these stations.

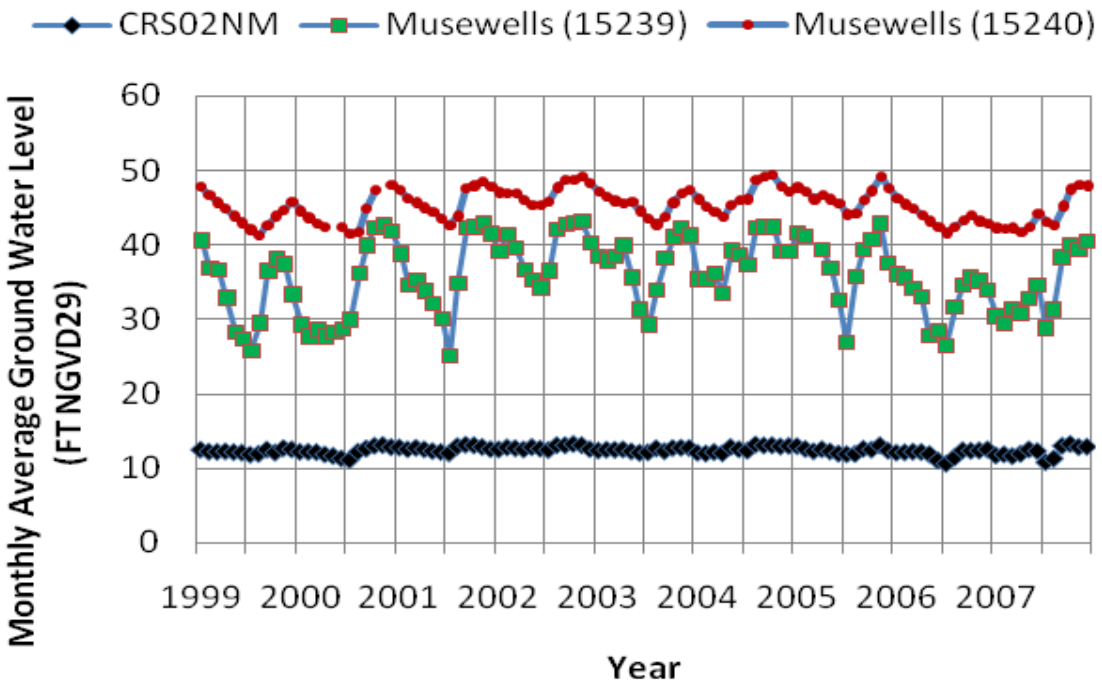


Figure 58. Monthly Average Groundwater Levels Recorded at Monitoring Wells South to the Sub-Watershed

The three monthly averaged groundwater level series show consistent fluctuation patterns, but with different magnitudes depending on well locations. In most years, groundwater levels dropped to their annual low in the months of June to July while reaching their annual high in August to October. The groundwater level variation recorded at the Musewells Station may represent the agricultural water supply pattern, as both wells are located in agriculture land. Groundwater pumping for irrigation in dry-season months and surface recharge due to rainfall in wet season resulted in water table fluctuations.

Similar water table variation patterns may occur over the agricultural areas of the FEC sub-watershed. However, the groundwater resources in the northern portion of the FEC sub-watershed may also be affected by surficial aquifer recharge from the Lake Wales Ridge. Groundwater levels over wetlands, swamps and forest lands in the southern portion of the sub-watershed are most likely different from areas containing Musewells Station. Further groundwater analysis within the FEC sub-watershed would require the installation of both deep and shallow monitoring wells at different FEC sub-watershed locations.

In addition to the above statement, Hilary Swain of Archbold Biological Station mentioned that the SWFWMD has new series of wells along SR 70 and more information on these wells could be useful for the Study. Therefore, during the next phases of this Study this data will be investigated through Dave Arnold of SWFWMD.

The Southwest Florida Water Management Districts established a Regional Observation Monitoring Program (ROMP) to evaluate seasonal and long-term changes in ground-water levels and quality, and the interaction and connectivity between ground water and surface-water bodies. Elevation data was obtained from four monitoring wells within the ROMP14 district. For most years, from 1995 to 2008, fluctuations are within a 1 foot, however there are some yearly averages that change 4 feet. Further analysis can be completed within each year to analyze seasonal variations and short-term events that could affect increased fluctuation (**Table 18**).

Table 18. Water Elevation Recorded by ROMP 14 Established by the SWFWMD

Year	Lower Hawthorn Station ID:23820	Surficial Stratographic Station ID:23821	Avon Park Station ID:23822	Suwannee Station ID:23823
	Average water elevation (ft)	Average water elevation (ft)	Average water elevation (ft)	Average water elevation (ft)
1995	--------	138.2	--------	50.6
1996	--------	137.4	48.4	48.8
1997	--------	135.8	48.2	49.2
1998	110.5	140.0	50.9	49.8
1999	110.2	141.0	49.1	48.1
2000	109.6	138.0	45.1	45.7
2001	108.3	136.6	46.4	46.6
2002	109.7	138.7	48.2	48.2
2003	110.5	156.0	49.5	49.5
2004	111.5	140.4	49.1	49.1
2005	112.7	141.0	50.3	50.6
2006	112.6	139.9	48.2	48.2
2007	111.8	138.5	47.4	47.4
2008	111.0	137.5	48.2	48.3
Average over time period	**110.8**	**139.9**	**48.4**	**48.6**

(Source: SWFWMD WMIS, 2009)

5.6.3 Water Quality Analysis

The Lake Okeechobee total phosphorous total maximum daily load (TMDL) of 140 mt was adopted by the State of Florida in May 2001 (Chapter 62-304.700, F.A.C.). In 2002, the annual measured phosphorous load to Lake Okeechobee was 543 mt. The five-year moving average phosphorous load monitored from 1998 to 2002 was 554 mt, which exceeded the Lake Okeechobee TMDL by 414 mt. This five-year moving average included the lowest measured historical load (169 mt in 2000), due to the worst drought in recent history; and the largest measured load in the past decade (780 mt in 1998) during a very wet year. The water quality data applied for the above analysis in the Lake Okeechobee Protection Plan (LOPP) is an aggregate dataset comprised of multi-point spatial data to present the regional water quality conditions.

The Study Area (FEC sub-watershed and Nicodemus Slough) is listed as problematic source of total phosphorous to Lake Okeechobee. As summarized in the LOPP using water quality data collected from 1991 to 2000, the FEC contributes approximately 9.4% of the Total P load received by the Lake (**Table 19**).

Table 19. Contribution of Inflows and P Loads from FEC and Nicodemus Slough to the Lake Okeechobee (LOPP) Period of Record of Data (1991 – 2000)

Basin Name	Watershed Area (acre)	Average Annual Discharge (acre-ft)	Ave. Annual P Load (mt)
Fisheating Creek	289,366	200,766	40.97
Nicodemus Slough	25,641	3,371	0.25
Lake Okeechobee Total	3,451,086	2,246,336	433.09
FEC / Lake Okeechobee %	8.38%	8.94%	9.46%
Nicodemus Slough / Lake Okeechobee %	1.00%	0.002	0.06%

Table 19 shows the averaged annual P loads (40.97 mt for Fisheating Creek 0.25 mt for Nicodemus Slough) under the baseline conditions (year 1991-2000) of LOPP. The base period is determined to present the historical conditions right before the start of LOPA in 2000 (LOPP, FDEP, 2004). These averaged annual P loads do not represent the annual variation of the P loads which may be much higher than the averaged annual loads. For example, P loads of the dry year of 2000 (less than 5 mt) are significantly different from the wet year of 2001 (about 100 mt) due to the variation of surface runoffs. For the restoration and planning purpose, consideration of P loads of individual years would be more important than averaged annual P loads over a period of multiple years as rainfall and evapotranspiration in the region shows fluctuations from year to year.

Phosphorous loads of a sub-watershed are usually estimated by flow measurements and water quality sampling data taken at the outlet structure of that sub-watershed. At most major structures discharging to Lake Okeechobee and at selected tributary flow/stage monitoring stations, the SFWMD has installed integrated water quality monitoring systems and flow meters. However, a water quality monitoring station has not been installed at the hydrologic station FISHP where both flow and stage values are recorded. The estimate of total phosphorous loads from the FEC sub-watershed to Lake Okeechobee is herein developed by using water quality data monitored at the creek's outlet, at the SFWMD's Station FECSR78. The annual total phosphorous loads are provided in **Figure 59**. P Loads are estimated using the FISHP flow data and the FECSR78 water quality data.

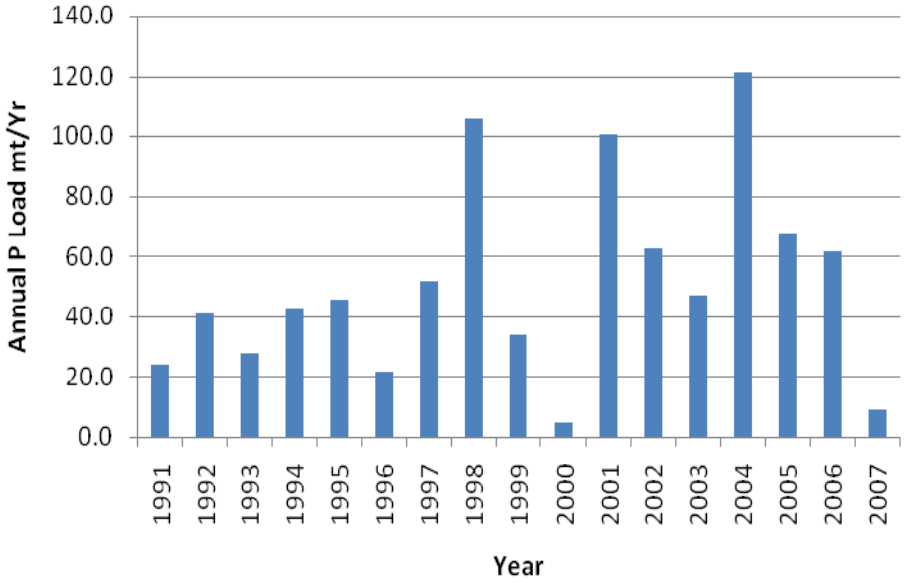
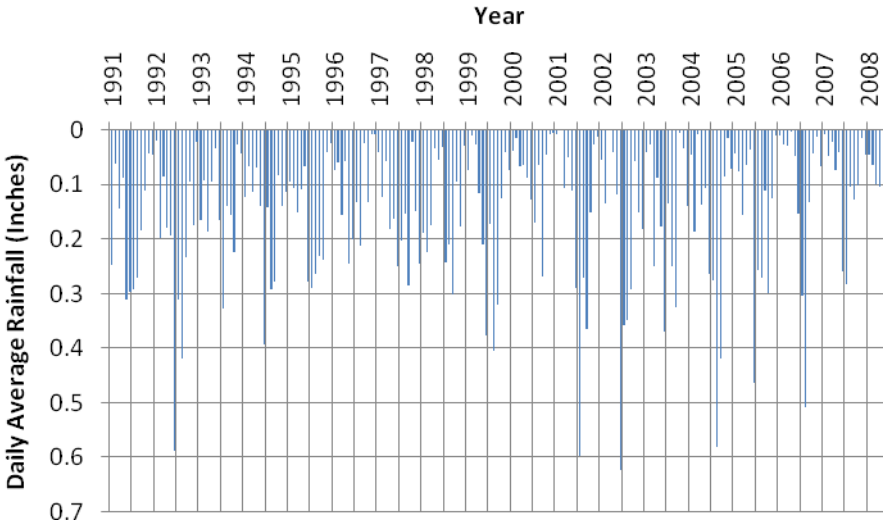


Figure 59. Annual Total Phosphorous Loads from the FEC Sub-Watershed to Lake Okeechobee (SFWMD DBHYDRO (Station FECSR78 and FISHP) 1991-2007)

The phosphorous loads from the FEC sub-watershed are correlated with the discharge flow rates. Low levels of phosphorous loads occurred in drought years 2000 and 2007, while high levels of phosphorous loads happened in wet years of 1998 and 2004. Phosphorous loads in the sub-watershed are primarily generated at non-point sources due to agricultural land uses. Surface water runoff and agricultural discharge are major means of phosphorous load generation.



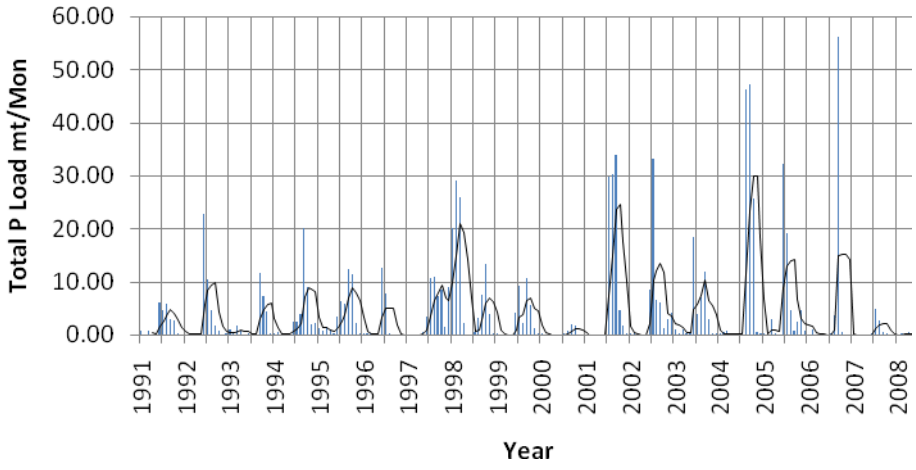


Figure 60. Monthly Averaged Rainfall and Phosphorous Loads Around FISHP Station
(SFWMD DBHYDRO (Station ARCHBO 2_R, FECSR78 and FISHP) 1991-2008)

The correlation between phosphorous loadings and hydrological conditions also exists in the relation of rainfall and phosphorous loads. **Figure 60** presents monthly averaged rainfall and phosphorous loads around FISHP station for the period from 1991 to 2008. As shown in the 12-month moving average on the P load series, in years with higher rainfall higher phosphorus loads are observed. This is due to more phosphorus being flushed from the sub-watershed during these higher rainfall events. Peak values of phosphorous loads occurring slightly later than the rainfall peaks is also observed on **Figure 60**.

The phosphorous loads generated from the agricultural non-point sources in the upstream section of the FEC sub-watershed are estimated by using the flow measurement data at USGS02255600 station and water quality data sampled at FE36382811 Station. The results are plotted in **Figure 601**.

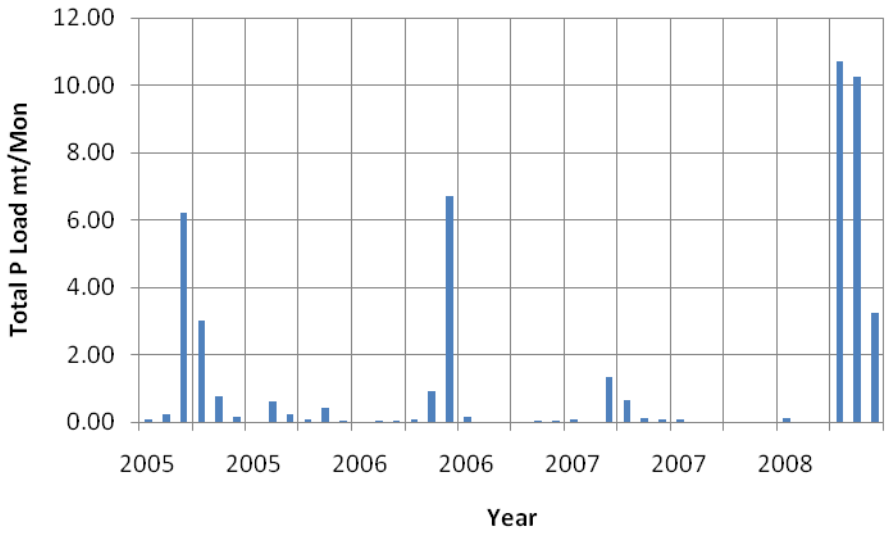


Figure 61. Total Phosphorous Loads in the Upstream Stream Section (SFWMD DBHYDRO (Station FE36382811) and USGS (Station 02255600) 1991-2008)

5.7 Land Ownership and Water Use Permit

The land ownership and current water use permits within the Fisheating Creek Sub-Watershed Area and Nicodemus Slough (Study Area) are presented in this Section. Land ownership information for Glades County was obtained from the 2001 Plat Maps and for Highlands County was obtained from 2003 Plat Maps and the Highlands County Property Appraiser Website (Highlands Property Appraiser, 2008). Water Use information was obtained from the SFWMD website through the "Application & Permit Information Database" (SFWMD, 2008a).

5.7.1 Land Ownership

Figure 62 presents the approximate location of properties and identifies the names of the owners with areas equal or greater than 640 acres (1 sq. mi.) within the Study Area. The landowners that have less than one square mile within the Study Area are identified as "Other Landowners" on the figure. Lykes Brothers Inc. is the major owner of the southern portion of the Study Area (43%); and Blue Head Ranch is the major owner of the northwestern portion of the Study Area (18%). State, FDEP, SFWMD are also shown in **Figure 62**, and they represent 2% of the Study Area. **Table 20** lists all the owners that possess land areas equal or greater than one square mile within the Study Area and their respective percentage.

Table 20. FEC Landownership Map

Landowner	Ownership Percentage (%)
Atlantic Blue (Blue Head Ranch)	18.36
Baker	0.33
Braha	0.33
Bullrich	0.25
CFI USA	0.52
Carlton	2.72
Florida Game	0.40
Heart Groves	0.31
Henscratch (Highland Farms)	0.68
J&D Hendrie	0.48
J&J Hendrie	1.81
Lykes Brothers, Inc.	42.93
Pella	0.42
Perry Brothers	0.31
Smoak	2.78
Southern Farms	0.90
Trochet	0.40
Waldron Daphne	0.77
Westby	3.25
XL	0.29
TIITF and SFWMD	1.67
Other Land Owners	14.64
Not Available	5.47

5.7.2 Water Use Permit

Landowners are required to obtain a Water Use Permit from the SFWMD to withdraw a specified amount of water, either from the ground, a canal, a lake or a river.

The water can be withdrawn for a public water supply; for agriculture, nursery plants or golf courses; or for industrial processes. Certain users are not required to obtain a water use permit,

such as, single family homes or duplexes, fire fighting water wells, salt water use or reclaimed water use (SFWMD, 2008b).

Information on water permits awarded by the SFWMD from 1978 to 2008 was gathered, summarized and analyzed. The complete data obtained from the SFWMD water use permit database is provided in **Appendix A**, including expired permits.

These data are for Township/ Range blocks located within the Fisheating Creek Sub-Watershed and Nicodemus Slough (Study Area). For those blocks that are partially within the study area, all the sections in the block are included in this study, therefore, some of the water use permits are outside of the study area.

There are 88 active water use permits within the Study Area, with their total project area estimated in approximately 50,000 acres. Since the water use permit area analyzed has a total area of approximately 510,000 acres; the active water use permits represent serving 10% of the total area. The water use permits data obtained from the SFWMD website do not list the allowed withdrawal for every permit; therefore, the permitted withdrawal daily flow is not presented in this report.

Most of the project areas that obtain water use permits are designated to agricultural use (64%); followed by livestock (26%). The remaining 10% of the project areas are used for public water supply, landscape, nurseries, and industrial uses among others.

The Floridan Aquifer seems to be the main source of water within the Study Area (47%), followed by Onsite and SFWMD Canals with 28% of the project area being served by them; however due to the lack of permitted flow information for all the water use permits, this statement may be confirmed when this information is made available.

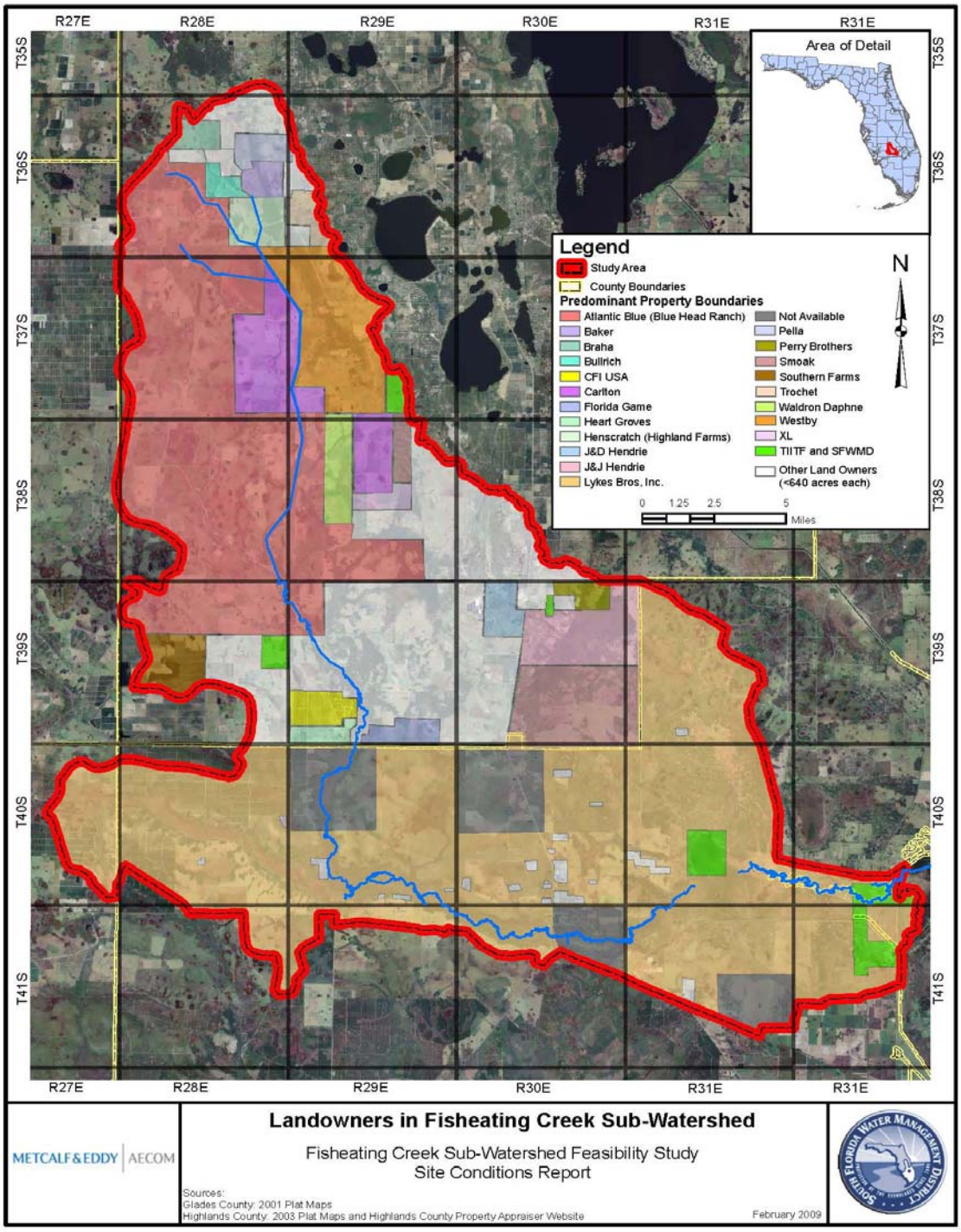


Figure 62. Landownership Map of FEC Study Area

5.8 Vegetation, Wetlands and Floodplains

The sections below discuss vegetation, wetlands, and floodplains located in the Fisheating Creek watershed. These resources were identified based on the following:

- US Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) data layers;
- USGS topographic mapping
- Results of the aerial flyover of the site on October 7, 2008;
- A reconnaissance survey to some of the publicly accessible portions of the watershed on October 28, 29, and 30, 2008;
- Flood elevation data from FEMA online FIRM maps;
- Information available on the Florida Fish and Wildlife Conservation Commission (FWC), Florida DEP (FDEP), and USFWS websites;
- Previous SFWMD Reports discussing natural resource conditions in the watershed

The Fisheating Creek watershed includes a combination of pristine natural vegetation areas as well as areas with vegetation substantially altered due to cattle ranching, pine plantations, and citrus production. Vegetation types present include freshwater marsh, upland hammock, wet prairie and grazed ranchland in the upper reaches of the watershed, and a mosaic of floodplain forest, freshwater marsh, wet and dry prairie, upland tree hammocks and pine/palmetto upland in the lower reaches of the watershed (FWC, undated and 2008a; FDEP, 2008; Audubon, 2002). Ranchland and citrus production areas are also located in the lower reaches of the watershed.

The headwaters of Fisheating Creek are located in Highlands County, approximately 40 miles to the northwest of Lake Okeechobee **(Appendix B).** The creek flows south through Highlands County, crossing under State Route (SR) 70 before it enters Glades County. Approximately 5 miles south of the county line, the creek crosses SR 731 and then makes a sharp turn to the east and continues towards SR 27. Rainey Slough enters Fisheating Creek from the west in the general area where the creek turns to the east towards SR 27. Approximately five miles east of SR 27, Fisheating Creek enters Cowbone Marsh and then discharges to Lake Okeechobee.

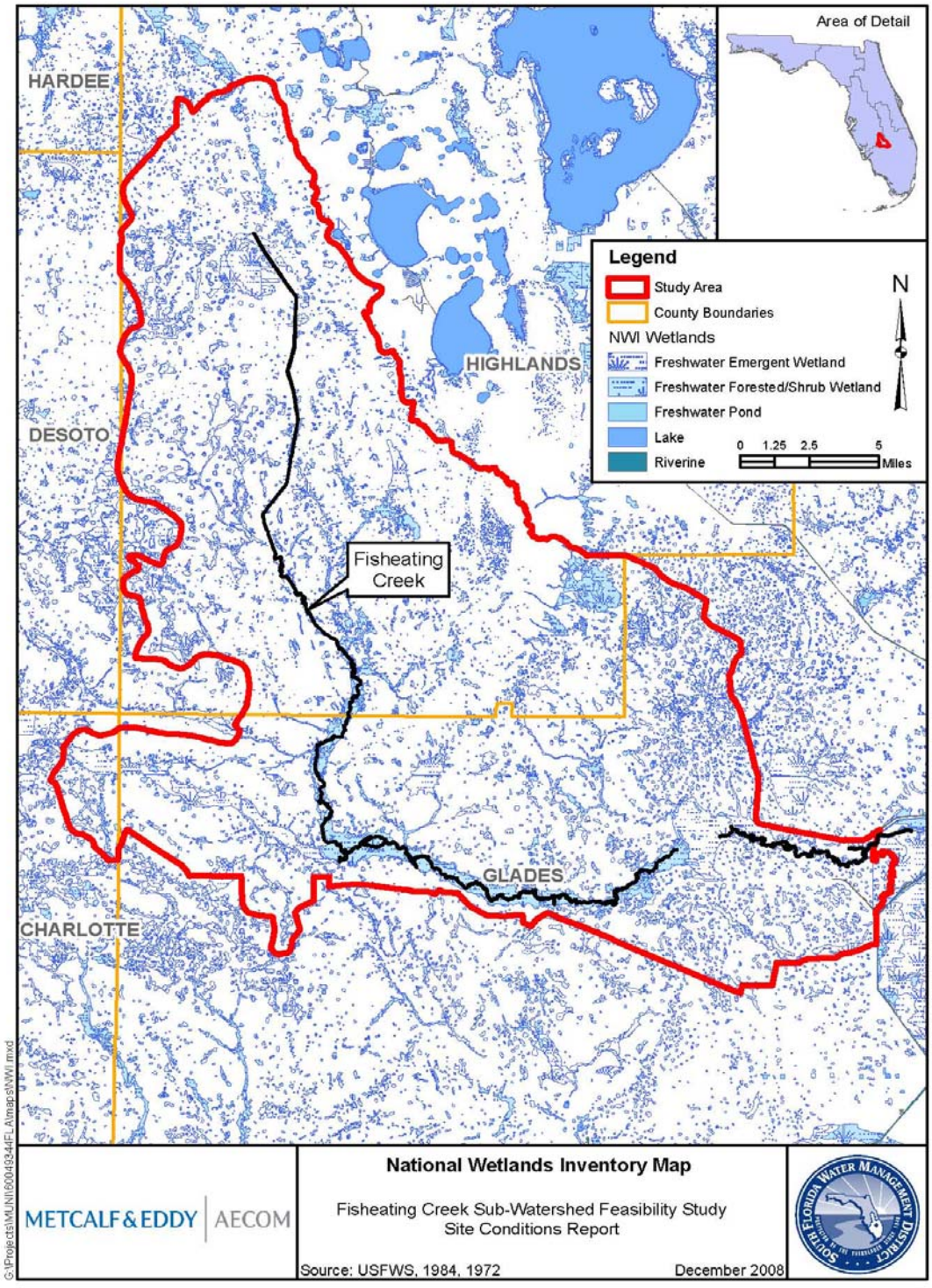


Figure 63. FEC Sub-Watershed Study Area Wetland Map

Fisheating Creek itself is classified as riverine from just below its headwaters to approximately two miles south of SR 70; at the locations where it crosses SR 731 and SR 27; and in a few other sporadic locations between SR 731 and Cowbone Marsh. The NWI indicates no discernible channel or riverine characteristics present within Cowbone Marsh, and that the channel returns on the western side of the marsh and continues to Lake Okeechobee **(Figure 63 and Appendix C)**.

The USGS topographic map indicates that the far northern areas of the watershed, where the headwaters of the creek are located, include vast areas of marsh bisected by a system of drainage ditches and canals **(Appendix B).** The NWI map identifies this area as predominantly upland, with a mosaic of small palustrine emergent wetlands and a linear ridge of forested wetland along the eastern side of the watershed **(Figure 63 and Appendix C)**. The USGS maps were created in 1953, with some updates incorporated based on aerial photographs and local knowledge gathered in 1984, but not field verified. The NWI data layer was created from 1984 data. It is likely that a more extensive marsh system existed in the upstream headwaters of Fisheating Creek in 1953 than were present in 1984 or in the current time. The extensive network of drainage ditches has likely served to effectively drain much of a previously larger marsh area to reduce it to an area now intermingled with wet and dry prairie and upland forest.

The NWI and USGS topographic maps both show a large palustrine emergent wetland area over 600 acres in size adjacent to either side of the beginning of the stream channel known as Fisheating Creek. This area was observed in October 2008 and a variety of wetland plants were evident, including pickerelweed (*Pontederia cordata*), cattail (*Typha* spp.), rush (*Juncus* spp.) and sedge (*Carex* spp) species (**Figure 64)**. All these are typical of South Florida marshes and expected to represent the species present in many of the smaller emergent wetlands identified by the NWI as scattered throughout the watershed. It is within this marsh that the stream channel identified as Fisheating Creek is first noted. Within this marsh and further south the channel of Fisheating Creek has been channelized, and is bordered on either side by relatively high banks of presumably dredged material ranging up to heights of ten feet or greater above the creek bed **(Figure 635).** Much of the water surface of Fisheating Creek in this area is vegetated by water hyacinth (*Eichornia crassipes*) **(Figure 646).**

The area immediately south of the creek headwaters and adjacent marshes is dominated by cattle ranches on which vegetation has been altered by historic ditching and draining as well as current cattle grazing **(Figure 67).** These land cover types extend south throughout much of the lower watershed in its outer portions away from the channel and floodplain wetlands along Fisheating Creek. Large tracts within this portion of the watershed consist predominantly of grazed grasses and dog fennel (*Eupatorium capillifolium*) intermingled with numerous interspersed pockets of emergent marsh and wet prairie. The NWI map characterizes these

Figure 64. Large Marsh Adjacent to Upstream Portion of Fisheating Creek, View to the North

Figure 65. FEC South Intercept, Looking NW

Figure 66. Water Hyacinth in Fisheating Creek Channel, View to the North from Check Dam No.1

Figure 67. Cattle Grazing, View Towards the East

portions of the watershed as predominantly upland, with a mosaic of both large and small palustrine emergent wetlands present throughout. Species observed in these pocket wetlands included pickerelweed, cattail, sedge and rush species. Other species characteristic of marshes and wet prairies that may be present would include sawgrass (*Cladium jamaicense*), spikerush (*Eleocharis* spp.), starrush whitetop (*Rhynchospora colorata*), beak sedges (*Rhynchospora* spp.), and wetland grasses (*Panicum* spp.)(Lodge, 2005). Stands of upland forest are also sporadically present along the margins and interiors of ranch fields, including oak (*Quercus* spp.) and pine (*Pinus* spp.), palmetto (*Serenoa repens*), cabbage palm (*Sabal palmetto*), and frequent Spanish moss (*Tillandsia usneoides*).

In the general vicinity of where Fisheating Creek crosses CR 731, the creek returns to a more natural, unchannelized condition. The portion of Fisheating Creek between the county line and Cowbone Marsh is part of a Florida Fish and Wildlife Conservation Commission (FWC) Wildlife Management Area. This area is dominated by native vegetation, although FWC reports that invasive plants are present in some areas, including climbing fern (*Lygodium microphyllum*) and wetland nightshade (*Solanum tampicense*; FWC, undated). The NWI classifies the area within a one-half to one-mile width adjacent to the creek as palustrine scrub-shrub/forested wetland (PSS/PFO) along this entire stretch of the creek until it reaches Cowbone Marsh east of SR 27 (**Figure 68**). The vegetation adjacent to Fisheating Creek in this area includes an extensive and majestic cypress swamp **(Figure 69).** Dominant species in the floodplain forest along the creek include bald cypress (*Taxodium distichum*), willow (*Salix caroliniana*), red maple (*Acer rubrum*), sweet bay (*Magnolia virginiana*), wax myrtle (*Myrica cerifera*), and cabbage palm. The WMA includes substantial populations of three plants endemic to central Florida Edison's ascyrum (*Hypericum edisonianum*), cutthroat grass (*Panicum abscissum*), and nodding pinweed (*Lechea cernua*) (FDEP, 2008).

Numerous sloughs and smaller tributary creeks are present throughout the lower half of the watershed, between approximately SR 731 and SR 27, including Rainey Slough, Joe Slough, John Henry Slough, Gannett Slough, and Clay Slough, all of which enter Fisheating Creek from the west **(Appendix B).** Rainey Slough is the largest of these, originating in Charlotte County and covering an area of over 14 miles in length and approximately 0.5 miles in width. A variety of wetland plants were observed in this area on the day of the reconnaissance visit, including cattail, sawgrass, pickerelweed, and alligator flag (*Thalia geniculata*) **(Figure 70)**. This area is characterized by features associated with a typical slough, including slow moving, relatively shallow water lacking a well defined channel. Each of the smaller sloughs throughout the watershed was not observed, but would be expected to have similar hydrology and vegetation characteristics.

Bootleg Creek and the Platt Branch both enter Fisheating Creek from the east in the vicinity of SR 731 **(Appendix B).** Bootleg Creek drains an extensive forested wetland

Figure 68. Fisheating Creek Crossing at SR 731, View to the North

Figure 69. Cypress Swamp Along Lower Reaches of Fisheating Creek, View to the North

Figure 70. Rainey Slough, View to the West

complex in the mid-eastern portion of the watershed between Fisheating Creek and SR 17. This area was not accessible during the site visit, but would be expected to include tree and shrubs typical of forested wetlands throughout South Florida, including many of those described above in the floodplain forest adjacent to Fisheating Creek.

Much of the outer margins of the lower watershed away from the Fisheating Creek channel and adjacent floodplain forest is similar to that described above for the upper reaches, and contains numerous small, interspersed wetlands identified as palustrine emergent wetlands by the NWI **(Figure 63** and **Appendix C).** These are wet prairie and freshwater marsh wetlands similar to those described above, and are interspersed with grazed and ungrazed dry prairie as described above for the upper reaches of the watershed. Other vegetation cover types present in the outer margins of the watershed in its lower reaches include upland hammock forest vegetated by live oak (*Quercus virginiana*) and cabbage palm and pine/palmetto upland, vegetated by slash pine (*Pinus elliotti*), cabbage palm, and palmetto.

Once entering Cowbone Marsh, no discernible channel for Fisheating Creek is denoted on the USGS or NWI map. Cowbone Marsh is classified as PEM by the NWI and is over 600 acres in size. Species typical of a Florida marsh are present, including cattail, sedges, rushes, pickerelweed, and others (**Figure 71**). The watershed in the vicinity of Cowbone Marsh narrows considerably as the creek nears Lake Okeechobee, due to the presence of the Herbert Hoover

Dike along the northern and southern boundaries of Cowbone Marsh. After exiting Cowbone Marsh, the creek crosses underneath Route 78 in multiple channels and continues towards Lake Okeechoobee. Vegetation east of Route 27 along the floodplain associated with the creek includes scrub-shrub species, including willow and wax myrtle (**Figure 72**).

Floodplains are located along the length of Fisheating Creek, along Rainey Slough, and along the smaller tributaries and sloughs entering Fisheating Creek and throughout the marsh and ditched areas forming the creek headwaters (**Figure 73**). The Federal Emergency Management Agency (FEMA) has not established an elevation for the 100-year floodplain in the watershed. Areas predicted to flood typically follow the topography of the creek and bordering wetlands and sloughs, and form an extensive network throughout the entire watershed. The northeastern portion of the watershed in Highlands County in the vicinity of SR27 and SR17 are the only areas lacking extensive floodplains.

There are several sites in the Fisheating Creek Watershed where degraded wetlands have been restored as part of the USDA Wetland Reserve Program. Information regarding the locations of these sites has been requested via a Freedom of Information Act Request. Once this information is received, it will be used as part of the subsequent phases of the project

Figure 71. Cowbone Marsh Emergent Wetland Vegetation East of SR 78, View to the West

Figure 72. Fisheating Creek Channel Downstream of Cowbone Marsh, with Scrub-Shrub Wetland Habitat in Background, View to the East

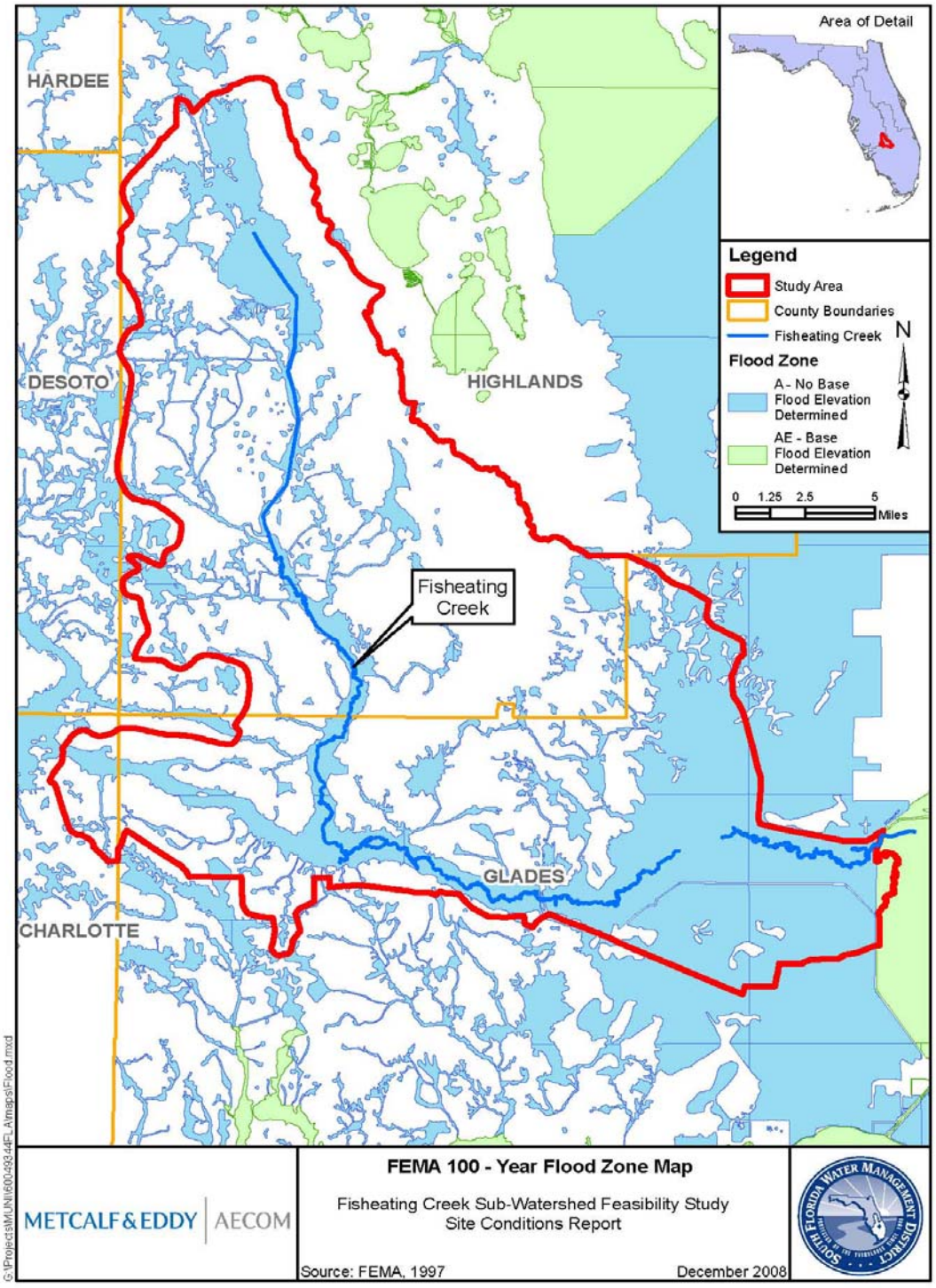


Figure 73. FEC Sub-Watershed Study Area 100-year Flood Zone Map

5.9 Fish and Wildlife

The Fisheating Creek watershed supports a diverse and abundant array of fish and wildlife species, including many endangered and threatened species (see **Section 5.10**). There is no single comprehensive published document describing the fish and wildlife resources, although many state and federal agencies and local experts have extensive knowledge of the fish and wildlife resources present. The information describing the faunal resources of the watershed is summarized below based on information available from the following sources:

- A reconnaissance survey to some of the accessible portions of the watershed on October 28, 29, and 30, 2008;
- Information available on the Florida Fish and Wildlife Conservation Commission (FWC), Florida DEP (FDEP), and U.S. Fish and Wildlife Service (USFWS) websites;
- Previous SFWMD Reports discussing natural resource conditions in the watershed

5.9.1 Fisheries Resources

Stream habitat along the length of Fisheating Creek, Bootleg Creek, Platt Branch and the many sloughs present in the watershed provide a high diversity of aquatic habitat for fish. Freshwater fishes are able to occupy several habitats in the watershed, including marshes, stream channels, sloughs, oxbows, submerged hardwood forests, and seasonal ponds during flooding events. Fish species occurring in the watershed include a variety of resident native species such as largemouth bass, crappie, catfish, and bream in addition to introduced species such as armored catfish and tilapia (FWC, undated; **Table 21**). Although few published data regarding fish species present in the watershed are available, many other common freshwater fish that are known to occur in Lake Okeechobee and throughout the Everglades would also be expected to occur in the habitats of the Fisheating Creek watershed, including gar, sunfishes and a variety of other fish species such as those listed in **Table 21**. Forage species are likely abundant in the watershed, including minnows, such as the golden shiner and pugnose minnow, sailfin molly, golden topminnow, flagfish, and mosquitofish (**Table 21**; Lodge, 2005). These species are extremely important as they form the base of the food chain that supports higher tropic levels (Lodge, 2005).

5.9.2 Wildlife Resources

Abundant and diverse wildlife resources are present within the Fisheating Creek watershed including many species of reptiles, mammals, and bird species. The lower portion of the

Table 21. Fish Species Potentially Present in the Fisheating Creek Sub-Watershed Study Area

Common Name	Scientific Name
Florida Gar	*Lepisosteus platyrhincus*
Bowfin (mudfish)	*Amia calva*
Golden shiner	*Notemigonus crysoleucas*
Coastal shiner	*Notropis petersoni*
Lake chubsucker	*Erimyzon sucetta*
Yellow bullhead (butter cat)	*Ameiurus natalis*
Tadpole madtom	*Noturus gyrinus*
Walking catfish	*Clarias batrachus*
Chain pickerel	*Esox niger*
Banded topminnow	*Fundulus cingulatus*
Sheepshead minnow	*Cyprinodon variegatus*
Golden topminnow	*Fundulus chrysotus*
Marsh killifish	*Fundulus confluentus*
Seminole killifish	*Fundulus seminolis*
flagfish	*Jordanella floridae*
Bluefin killifish	*Lucania goodei*
Pike killifish	*Belonesox belizanus*
Eastern mosquitofish	*Gambusia holbrooki*
Least killifish	*Heterandria formosa*
Sailfin molly	*Poecilia latipinna*
Everglades pygmy sunfish	*Elassoma evergladei*
Bluespotted sunfish	*Enneacanthus gloriosus*
Warmouth	*Lepomis gulosus*
Bluegill (bream)	*Lepomis macrochirus*
Dollar sunfish	*Lepomis marginatus*
Redear sunfish (shellcracker)	*Lepomis microlophus*
Spotted sunfish (stump-knocker)	*Lepomis punctatus*
Largemouth bass	*Micropterus salmoides*
Swamp darter	*Etheostoma fusiforme*

(Source: Lodge, 2005)

watershed is largely within the FWC's Fisheating Creek Water Management Area (WMA) (**Figure 74**).

The watershed is known to provide habitat for a variety of snake species, including cottonmouth (*Agkistrodon piscivorous conanti*) , dusky pygmy rattlesnake (*Sistrurus miliarius barbour*), eastern diamond rattlesnake (*Crotalus adamanteus*), and eastern indigo snake (*Drymarchon corais couperi*) (FWC, 2008a; FDEP, 2005).

Alligators (*Alligator mississippiensis*) are abundant in the watershed, and a crocodile (*Crocodylus acutus*) has been documented in the Fisheating Creek WMA. During the reconnaissance survey two alligators were observed in Fisheating Creek in the WMA near the junction with US 27, and are likely abundant throughout the watershed's creeks, marshes, sloughs, and hammocks. Numerous invertebrate and amphibian species are likely present throughout the watershed, including snails, crayfish, grass shrimp, dragonflies, frogs, tree frogs, and toads (Lodge, 2005).

A variety of both large and small mammals inhabit the watershed, including black bear (*Ursus americanus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), white-tailed deer (*Odocoileus virginianus*), river otter (*Lutra canadensis*), armadillo (*Dasypus novemcinctus)*, raccoon (*Procyon lotor*), and opossum (*Didelphis virginiana*)(FWC, 2008a). Numerous other small mammal species are likely present, including short-tailed shrew (*Blarina brevicauda*), rabbit (*Sylvilagus* spp.), squirrel (*Sciurus* spp.), cotton mouse (Peromyscus gossypinus), skunk (*Mephitis mephitis*), mink (*Mustela vison mink*), and others (Lodge, 2005). Florida panther (*Felis concolor coryi*) has also been documented in the watershed (FWC, 2008a). Although the primary habitat areas are currently located to the south **(Figure 74)**, the area near Fisheating Creek is thought to provide habitat important for the recovery of the panther in Florida (FDEP, 2008d) The FWC designated primary and secondary range for black bear both extend into the watershed north and east of Fisheating Creek **(Figure 74)**. Feral boar (*Sus scrofa)*, an introduced species, is also present in the watershed (FWC, undated) and was observed during the reconnaissance survey.

Fisheating Creek and its watershed supports an extremely high diversity of bird species, including those listed in **Table 22**, and has been designated as an Important Bird Area by the Audubon Society (Audubon, 2002). The WMA is a key location for swallow-tailed kites migrating to their wintering locations in South America; half of the U.S. population is reported to utilize the habitat here during their migration (FWC, 2008a; USACE/SFWMD/HDR, 2006). Their communal roosting area is located in the vicinity of Cowbone Marsh (FWC, undated). Numerous other species are common in the area, including Florida scrub jay, crested carcara, snail kite, ducks, hawks, bald eagle, warblers, herons, egrets, wood storks, osprey, wild turkey and many others **(Table 22)**. Numerous bald eagle nests have been recorded in and around the WMA, as well as in the upper watershed **(Figure 74)**. Although much of the high value wildlife

habitat in the watershed is concentrated in the WMA centered on the creek itself, many of the species discussed above occur throughout the watershed. Wood storks, herons, egrets, and other bird species were also observed in the upper reaches of the watershed in the vicinity of ranchland during the reconnaissance survey.

In 2008 the FWC developed a GIS tool to assist planners and decision-makers in identifying important wildlife habitat throughout the state of Florida (FWC, 2008b). This tool ranks land areas in terms of their relative importance for wildlife within the state based on a number of factors, including land uses, potential wildlife habitat for listed and non-listed species with known habitat requirements, greenway data, and existence of land under conservation protection or in need of such protection. The resulting data ranks land areas on a scale from 1, least important, to 10, most important, in terms of their value for wildlife. The results for the Fisheating Creek watershed are shown in **Figure 75.** and indicate that much of the watershed is extremely valuable for wildlife, which received ranking predominantly higher than a value of 5 throughout its boundaries. The lower watershed in the vicinity of the WMA was ranked with values of 9 and 10, indicating that this area is extremely valuable for wildlife. Although the upper reaches generally received lower rankings, they were still primarily over 5, indicating that much of the watershed, including managed ranchland, has very high wildlife value.

The Nicodermus Slough is an important area within Fisheating Creek Sub-watershed for Swallow-tailed Kites (Elanoides forficatus). Documented in a letter written by the Avian Research and Conservation Institute in 2005, observations during 18 years of monitoring at the Fisheating Creek site had indicated that human disturbance is a serious threat to roosting Swallow-tailed Kites. The largest known pre-migration communal roost of Swallow-tailed Kites in North America forms annually within a small portion of what became the Fisheating Creek Wildlife Management Area (FCWMA). Restoring or protecting many areas in the Fisheating Creek region would benefit Kites by providing buffers from disturbance, alternate roost locations if present sites are harmed, and ensuring natural communities would continue to provide a reliable food supply. Because Nicodemus Slough is adjacent to the present roost, its function for these purposes is more important than any other unprotected Fisheating Creek locations and improving the Slough's future should be the number one priority for North American Swallow-tailed Kite conservation. A strong recommendation was given to restore the wetland/upland mosaic in Nicodemus Slough, as the habitat restoration and protection for the greater area would help secure the future not only of Swallow-tailed Kites but the impressive biological diversity of the region (Avian Research and Conservation Institute, 2005).

A Conceptual Management Plan for Fisheating Creek Wildlife Management Area 2003-2008 was written for Glades County by the FWC in 2003. The plan addresses an area of 18, 272 acres along the Fisheating Creek corridor, known as the 'expanded corridor' leased FWC through the Conservation and recreation Lands (CARL) Program to be operated as the Fisheating Creek Wildlife Management Area (FCWMA). For many years the land was part of the

Lykes Bros., Inc. ranch lands managed for cattle grazing, eucalyptus and pine silviculture and a number of recreational activities including hunting, fishing, camping and canoeing. The report acknowledges the current condition of the land ranging from poor to excellent with regard to the natural community, and the low intensity use as a "working ranch" resulted in relatively low intensity uses leaving habitats of many rare and endangered species in good condition. The primary objectives for purchasing the Fisheating Creek Project as conservation and protection of the natural communities along the shores of the creek, was to enable the maintenance and improvement of the status of rare plant and animal communities. Other goals and objectives developed for the FCWMA are outlined in the management plan representing ideas of FWC personnel in charge of managing and protecting the leased area, as well as those of cooperative managers, user groups and other stakeholders from outside the FWC (FWC, 2003).

A settlement agreement between the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida, Save our Creeks, Inc., Environmental Confederation of Southwest Florida, Inc. (ECOSWF) and Lykes Bros. Inc. was established on May 25, 1999. Immediate possession determining the title of Fisheating Creek in Glades County up to the ordinary high water boundary was granted to the Board of Trustees on June 2, 1997. The Lykes Brothers, Inc. asserted their ownership of the land and appealed the ruling because the location of the ordinary high water boundary was not determined. The objectives of the settlement agreement were to end the continued litigation which was costly and time consuming; provide the State with immediate fee title to certain lands; provide the state with immediate conservation easement over adjacent areas; allows public to continue traditional use of Fisheating Creek and allows Lykes Bros Inc. to continue its traditional uses of the conservation easement lands while ensuring preservation of its natural resources; and does not determine the ordinary high water line as it is a complex, and strongly disputed. The settlement agreement involved the State of Florida purchasing a corridor along the Creek consisting of Lykes Bros., Inc. lands lying above the "25% exceedance line". In contrast, the Lykes Bros., Inc. provided a quitclaim deed to company lands below the exceedance line. Resulting from the settlement agreement, the Trustees acquired clear title to 18, 272 acres along the Creek Corridor, referred to as the "Expanded Corridor" in the Fisheating Creek Settlement Agreement (FWC, 2003).

A Conservation Easement was granted from the Lykes Bros. Inc.(Landowner) to the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida (Easement Owner) on December 2nd 1999. A mutual recognition of the natural, scenic, and special characteristics of the property were the common purpose for conserving natural values and character of the property as conveyed and accepted by the Perpetual Conservation Easement. As monitored by the Florida Game and Fresh Water Fish Commission, and its successor, the Florida Fish and Wildlife Conservation Commission, the objectives were to conserve the value, character, ecological integrity, and hydrological integrity, conserve and protect the animal and plant populations and prohibit certain further development activity. The property has been divided into approximately 35, 000 acres of Natural Easement Areas containing habitats and natural

communities that do not show substantial human-induced disturbance and have maintained their ecological integrity, and 6,500 acres of Impacted Easement areas that do show human-induced disturbance. The Landowner has rights to certain uses and activities while they are prohibited from disturbing the existing land cover, administering any management activity which would adversely impact a threatened or endangered species, any construction activity, or various other activities as outlined in the easement regarding agricultural practices, water resources etc. The easement owner has rights to conduct research, monitor for conservation, and maintain the protected property.

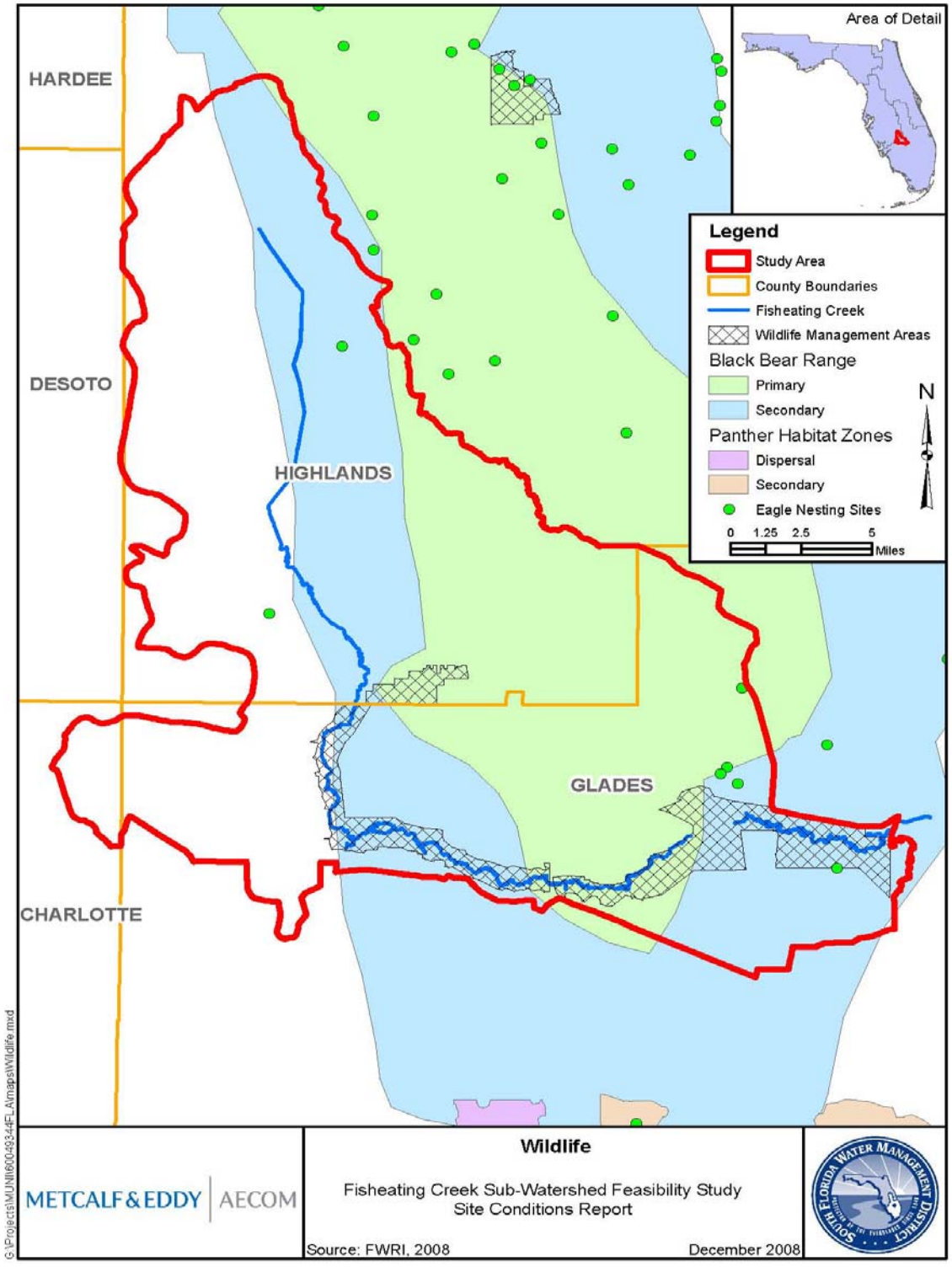


Figure 74. Wildlife in FEC Sub-Watershed Study Area

Table 22. Bird Species Present in the Fisheating Creek Watershed Study Area

Common Name	Scientific Name
Common Loon	*Gavia immer*
Pied-billed Grebe	*Podilymbus podiceps*
Double-crested Cormorant	*Phalacrocorax auritus*
American White Pelican	*Pelecanus erythrorhynchos*
Anhinga	*Anhinga anhinga*
American Bittern	*Botaurus lentiginosus*
Least Bittern	*Ixobrychus exilis*
Great White Heron	*Ardea herodias*
Great Blue Heron	*Ardea herodias*
Great Egret	*Ardea alba*
Snowy Egret	*Egretta thula*
Little Blue Heron	*Egretta caerulea*
Tricolored Heron	*Egretta tricolor*
Cattle Egret	*Bubulcus ibis*
Green Heron	*Butorides virescens*
Black-crowned Night Heron	*Nycticorax nycticorax*
Yellow-Crowned Night Heron	*Nyctanassa violacea*
White Ibis	*Eudocimus albus*
Glossy Ibis	*Plegadis falcinellus*
Black Vulture	*Coragyps atratus*
Turkey Vulture	*Cathartes aura*
Snow Goose	*Chen caerulescens*
Wood Duck	*Aix sponsa*
Mottled Duck	*Anas fulvigula*
Bluewinged Teal	*Anas discors*
Ring-necked Duck	*Aythya collaris*
Hooded Merganser	*Lophodytes cucullatus*
Osprey	*Pandion haliaetus*
Swallow-tailed Kite	*Elanoides forficatus*
White-tailed kite	*Elanus leucurus*
Snail Kite	*Rostrhamus sociabilis*

Table 22. Bird Species Present in the Fisheating Creek Watershed Study Area

Common Name	Scientific Name
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Broad-winged Hawk	*Buteo platypterus*
Short-tailed Hawk	*Buteo brachyurus*
Red-shouldered Hawk	*Buteo lineatus*
Red-tailed Hawk	*Buteo jamaicensis*
American Kestrel	*Falco sparverius*
Wild Turkey	*Meleagris gallopavo*
Northern Bobwhite	*Colinus virginianus*
Purple Gallinule	*Porphyrio martinica*
Common Moorhen	*Gallinula chloropus*
American Coot	*Fulica americana*
Limpkin	*Aramus guarauna*
Sandhill Crane	*Grus canadensis*
Killdeer	*Charadrius vociferus*
Spotted Sandpiper	*Actitis macularius*
Solitary Sandpiper	*Tringa solitaria*
Wilson's Snipe	*Gallinago delicata*
American Woodcock	*Scolopax minor*
Greater Yellowlegs	*Tringa melanoleuca*
Mourning Dove	*Zenaida macroura*
Common Ground-Dove	*Columbina passerine*
Eurasian Collared Dove	*Streptopelia decaocto*
White-winged Dove	*Streptopelia reichenowi*
Yellow-billed Cuckoo	*Coccyzus americanus*
Barn Owl	*Tyto alba*
Eastern Screech Owl	*Megascops asio*
Great Horned Owl	*Bubo virginianus*
Barred Owl	*Strix varia*
Common Nighthawk	*Chordeiles minor*

Table 22. Bird Species Present in the Fisheating Creek Watershed Study Area

Common Name	Scientific Name
Chuck-will's-widow	*Caprimulgus carolinensis*
Whip-poor-will	*Caprimulgus vociferus*
Chimney swift	*Chaetura pelagica*
Ruby-throated Hummingbird	*Archilochus colubris*
Belted Kingfisher	*Megaceryle alcyon*
Red-headed Woodpecker	*Melanerpes erythrocephalus*
Red-cockaded Woodpecker	*Picoides borealis*
Red-bellied Woodpecker	*Melanerpes carolinus*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Downy Woodpecker	*Picoides pubescens*
Hairy Woodpecker	*Picoides villosus*
Northern Flicker	*Colaptes auratus*
Pileated Woodpecker	*Dryocopus pileatus*
Eastern Wood-Pewee	*Contopus virens*
Acadian Flycatcher	*Empidonax virescens*
Eastern Phoebe	*Sayornis phoebe*
Great Crested Flycatcher	*Myiarchus crinitus*
Eastern Kingbird	*Tyrannus tyrannus*
Gray Kingbird	*Tyrannus dominicensis*
Loggerhead shrike	*Lanius ludovicianus*
White-eyed Vireo	*Vireo griseus*
Yellow-throated Vireo	*Vireo flavifrons*
Blue-Headed Vireo	*Vireo solitarius*
Red-eyed Vireo	*Vireo olivaceus*
Blue Jay	*Cyanocitta cristata*
American Crow	*Corvus brachyrhynchos*
Fish Crow	*Corvus ossifragus*
Purple Martin	*Progne cryptoleuca*
Tree Swallow	*Tachycineta bicolor*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Barn Swallow	*Hirundo rustica*

Table 22. Bird Species Present in the Fisheating Creek Watershed Study Area

Common Name	Scientific Name
Florida Scrub-Jay	*Aphelocoma coerulescens*
Tufted Titmouse	*Baeolophus bicolor*
Carolina Wren	*Thryothorus ludovicianus*
House Wren	*Troglodytes aedon*
Marsh Wren	*Cistothorus palustris*
Ruby-crowned Kinglet	*Regulus calendula*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Eastern Bluebird	*Sialia sialis*
American Robin	*Turdus migratorius*
Swainson's Thrasher	*Catharus ustulatus*
Hermit Thrasher	*Catharus guttatus*
Gray Catbird	*Dumetella carolinensis*
Northern Mockingbird	*Mimus polyglottos*
Brown Thrasher	*Toxostoma rufum*
European Starling	*Sturnus vulgaris*
Northern parula	*Parula americana*
Cedar Waxwing	*Bombycilla cedrorum*
Orange-Crowned Warbler	*Vermivora celata*
Yellow Warbler	*Dendroica petechia*
Cape May Warbler	*Dendroica tigrina*
Black-throated Blue Warbler	*Dendroica caerulescens*
Yellow- rumped Warbler	*Dendroica coronata*
Yellow-throated Warbler	*Dendroica dominica*
Pine Warbler	*Dendroica pinus*
Prairie Warbler	*Dendroica discolor*
Palm Warbler	*Dendroica palmarum*
Black-and-white Warbler	*Mniotilta varia*
Blackpoll Warbler	*Dendroica striata*
American Redstart	*Setophaga ruticilla*
Prothonotary Warbler	*Protonotaria citrea*
Ovenbird	*Seiurus aurocapilla*

Table 22. Bird Species Present in the Fisheating Creek Watershed Study Area

Common Name	Scientific Name
Northern Waterthrush	*Seiurus noveboracensis*
Common Yellowthroat	*Geothlypis trichas*
Summer Tanager	*Piranga rubra*
Eastern Towhee	*Pipilo erythrophthalmus*
Bachman's Sparrow	*Aimophila aestivalis*
Savannah Sparrow	*Passerculus sandwichensis*
Swamp Sparrow	*Melospiza Georgiana*
Chipping Sparrow	*Spizella passerina*
Field Sparrow	*Spizella pusilla*
Vesper Sparrow	*Pooecetes gramineus*
Grashopper Sparrow	*Ammodramus savannarum*
Florida Grasshopper Sparrow	*Ammodramus savannarum*
Northern Cardinal	*Cardinalis cardinalis*
Bobolink	*Dolichonyx oryzivorus*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Indigo Bunting	*Passerina cyanea*
Red-winged Blackbird	*Agelaius phoeniceus*
Eastern Meadowlark	*Sturnella magna*
Common Grackle	*Quiscalus quiscula*
Boat-tailed Grackle	*Quiscalus major*
Brown-headed Cowbird	*Molothrus ater*
Baltimore Oriole	*Icterus galbula*
American Goldfinch	*Carduelis tristis*
Crested Caracara	*Caracara cheriway*
Wood Stork	*Mycteria Americana*
Ring-billed Gull	*Larus delawarensis*
Rock Pigeon	*Columba livia livia*

(Source: FWC, 2006, FWC 2007, FDEP 2008 and Audubon 2002, Archbold Biological Station, August 2007)

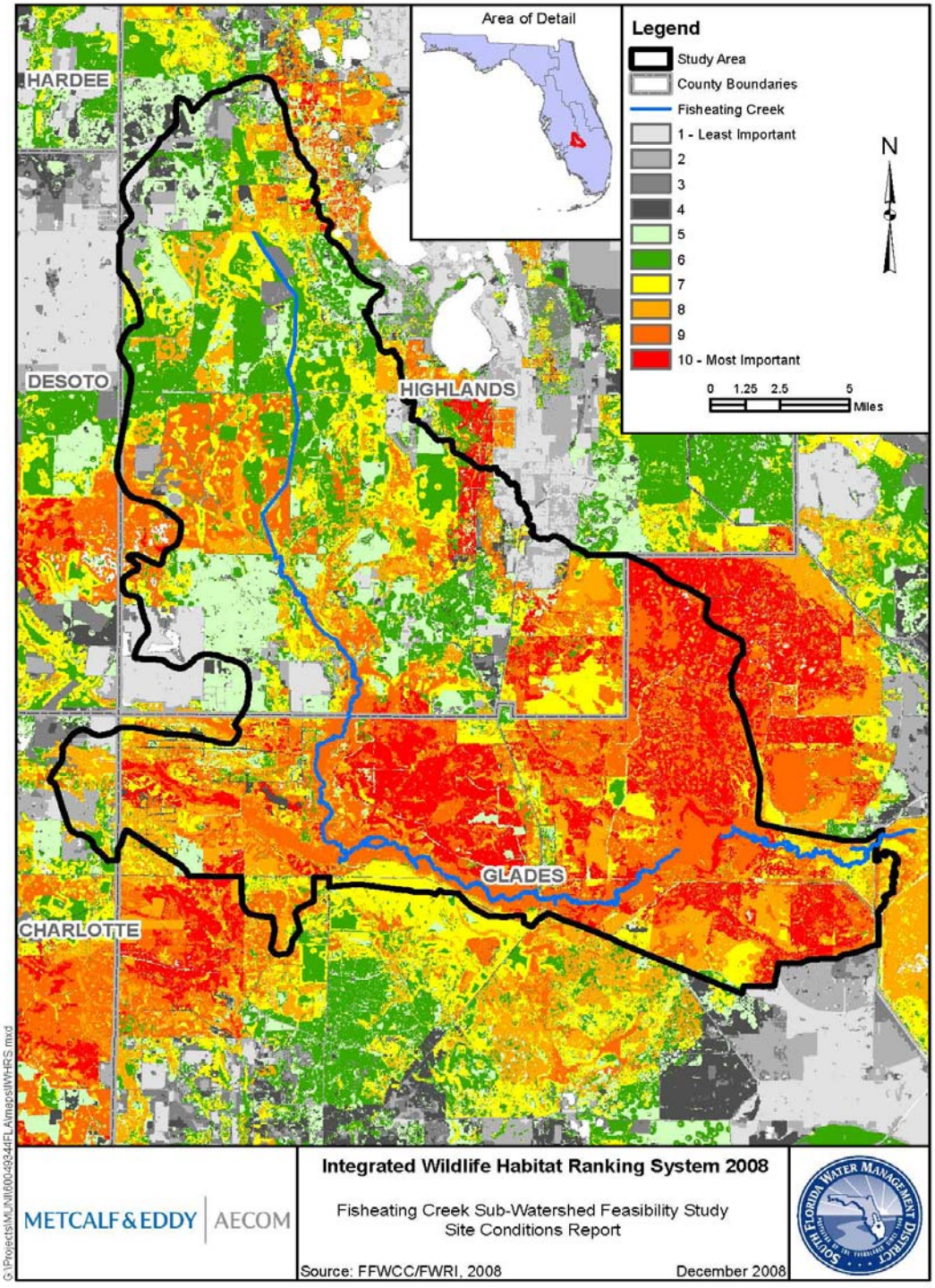


Figure 75. Integrated Wildlife Habitat Ranking System (IWHRS) for FEC Sub-Watershed Study Area

5.10 Threatened and Endangered Species

A large number of federally designated threatened and endangered plant and animal species are present in South Florida, and many are known to be, or have the potential to be, present in the Fisheating Creek watershed (**Table 213 and Table 24**). Initial consultation with USFWS and FWC (2009) has assisted in the development of **Tables 23** and **24**. The number of species listed in **Table 23** highlights the high value of the habitat for threatened and endangered species and the importance of siting any facilities in areas that avoid or minimize impacts to these species to the extent possible. The Florida Panther is one of the most endangered large mammals in the world. There are only an estimated 87 individuals in South Florida, which represents the only wild population of panther that once thrived throughout most of the southeastern United States (Mazourek 2007). Further consultation with USFWS is needed to ascertain the presence of federally listed species within particular locations that may be considered for stormwater storage and treatment facilities. USFWS (2009) has indicated that they can review the detailed Land Use map and provide comments on particular types of land cover codes that should be avoided when siting any facilities. USFWS further indicated that similar review by FWC, Audubon, Lykes Brothers, The Nature Conservancy, and Archbold Biological Station would provide useful information regarding potential locations of protected species.

Land use cover maps identifying where protected species may be located were prepared with guidance from the USFWS (**Figure 76**). The maps can be further developed in Phase II based on number of species present and/or functional group approach as Archbold has previously used. The USFWS will be providing information on previous refinement done of FLUCCS codes for Lake Okeechobee project, and this information will be used in Phase II to refine land use maps used for FEC project.

The Greater Ridge Conservation Planning Tool, a compilation of data layers and GIS analyses, when provided to planners can help reduce impacts of land use changes on the regional biodiversity and conservation lands. The information provided includes existed and planned conservation areas necessary to protect biodiversity and watersheds; methods to adequately buffer conservation areas with other natural areas, agriculture, or low density development to allow needed management; the location of corridors needed for movement of species; and where high intensity land uses will be less likely to compromise the goals of ecological viability. The information and methods used to group protected species by function will be further reviewed during Phase II of this Study to find out if it would be a useful tool in prioritizing sites for consideration.

Table 23. Federally Listed Threatened and Endangered Animal Species in Florida and Potentially in FEC Watershed

Common Name	Latin Name	Status
Caracara, Audubon's crested FL pop.	*Polyborus plancus audubonii*	T
Jay, Florida scrub	*Aphelocoma coerulescens*	T
Kite, Everglade snail FL pop.	*Rostrhamus sociabilis plumbeus*	E
Panther, Florida	*Puma (=Felis) concolor coryi*	E
Skink, bluetail mole	*Eumeces egregius lividus*	T
Skink, sand	*Neoseps reynoldsi*	T
Snake, eastern indigo	*Drymarchon corais couperi*	T
Sparrow, Florida grasshopper	*Ammodramus savannarum floridanus*	E
Stork, wood	*Mycteria americana*	E
Woodpecker, red-cockaded	*Picoides borealis*	E
West Indian manatee	*Trichechus manatus*	E

Source: USFWS, 2008

Table 24. Federally Listed Threatened and Endangered Plant Species in Florida

Common Name	Latin Name	Status
Beargrass, Britton's	*Nolina brittoniana*	E
Blazingstar, scrub	*Liatris ohlingerae*	E
Bonamia, Florida	*Bonamia grandiflora*	T
Buckwheat, scrub	*Eriogonum longifolium var. gnaphalifolium*	T
Cladonia, Florida perforate	*Cladonia perforate*	E
Fringe-tree, pygmy	*Chionanthus pygmaeus*	E
Gourd, Okeechobee	*Cucurbita okeechobeensis ssp. okeechobeensis*	E

Table 24. Federally Listed Threatened and Endangered Plant Species in Florida

Common Name	Latin Name	Status
Harebells, Avon Park	*Crotalaria avonensis*	E
Hypericum, highlands scrub	*Hypericum cumulicola*	E
Lupine, scrub	*Lupinus aridorum*	E
Mint, Garrett's	*Dicerandra christmanii*	E
Mint, scrub	*Dicerandra frutescens*	E
Mustard, Carter's	*Warea carteri*	E
Pigeon wings	*Clitoria fragrans*	T
Plum, scrub	*Prunus geniculata*	E
Polygala, Lewton's	*Polygala lewtonii*	E
Rosemary, short-leaved	*Conradina brevifolia*	E
Sandlace	*Polygonella myriophylla*	E
Snakeroot	*Eryngium cuneifolium*	E
Whitlow-wort, papery	*Paronychia chartacea*	T
Wireweed	*Polygonella basiramia*	E
Ziziphus, Florida	*Ziziphus celata*	E

Source: USFWS, 2008

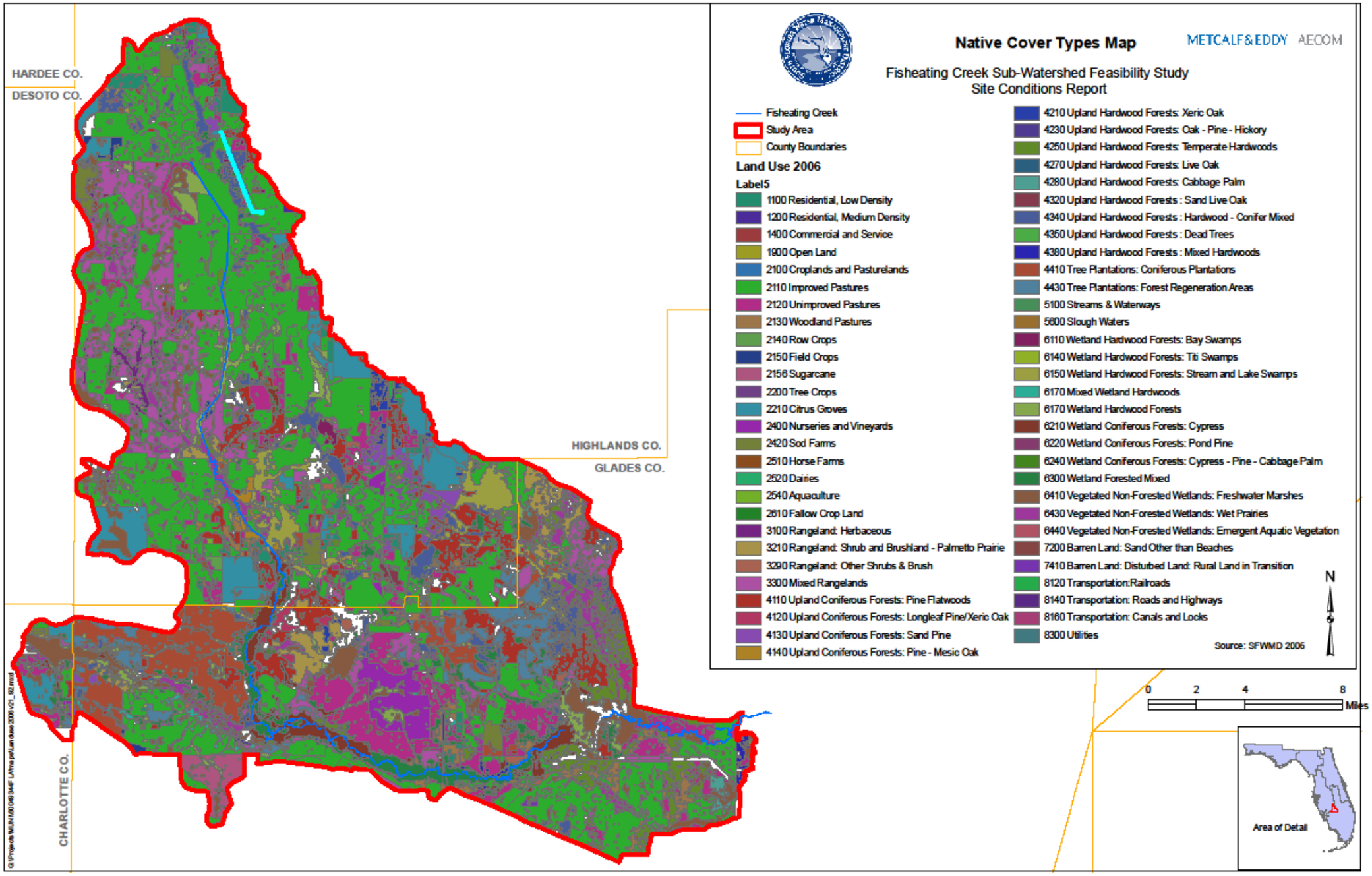


Figure 76. Native Cover Types for Fisheating Creek Sub-Watershed

In addition to the federally listed species, the FWC also designates plants and animal species as endangered, threatened or special concern in accordance with state of Florida laws and regulations. The additional species listed by the FWC that may occur in the Fisheating Creek watershed are identified in **Table 25.** As discussed above for USFWS, additional consultation with FWC is needed to identify the potential presence of particular species in locations throughout the watershed. However, much of the watershed does provide habitat for state-listed species. The FWC has designated much of the watershed as Strategic Habitat Conservation Area (SHCA), which represents habitat areas in need of protection for listed, rare, and imperiled wildlife (FWC, 2008c; **Figure 77**). Information regarding the particular species associated with the SHCA is not available in the FWC's 2008 report describing the recently created Integrated Wildlife Habitat Ranking System (IWHRS), although earlier reports from the Audubon Society (Audubon, 2002) indicate that the SHCAs in the watershed have been designated for swallow-tailed kite and crested caracara. Although the IWHRS does not identify particular species present in various locations, it does identify the number of state-listed species present in the watershed (FWC, 2008c; **Figure 78**). small areas of the watershed are shown has providing habitat for no state-listed species.

Table 25. Additional State – Listed Species Potentially Occurring in FEC Sub-Watershed Study Area[1]

Common Name	Scientific Name
AMPHIBIANS	
Flatwoods salamander	*Ambystoma cingulatum*
Georgia blind salamander	*Haideotriton wallacei*
Pine barrens treefrog	*Hyla andersonii*
Florida bog frog	*Rana okaloosae*
Gopher frog	*Rana capito*
REPTILES	
American alligator	*Alligator mississippiensis*
American crocodile	*Crocodylus acutus*
Key ringneck snake	*Diadophis punctatus acricus*
Red rat snake	*Elaphe guttata*
Florida pine snake	*Pituophis melaneoleucus mugitus*
Short-tailed snake	*Stilosoma extenuatum*
Florida brown snake	*Storeria dekayi victa*
Rim rock crowned snake	*Tantilla oolitica*

Common Name	Scientific Name
Florida ribbon snake	*Thamnophis sauritus sackeni*
Florida Key mole skink	*Eumeces egregius egregius*
Gopher tortoise	*Gopherus polyphemus*
Barbour's map turtle	*Graptemys barbouri*
Alligator snapping turtle	*Macroclemys temminckii*
Striped mud turtle	*Kinosternon baurii*
Suwannee cooter	*Pseudemys concinna suwanniensis*
BIRDS	
Piping plover	*Charadrius melodus*
Snowy plover	*Charadrius alexandrinus*
American oystercatcher	*Haematopus palliatus*
Brown pelican	*Pelecanus occidentalis*
Black skimmer	*Rynchops niger*
Least tern	*Sterna antillarum*
Roseate tern	*Sterna dougalli(Sterna dougallii dougallii)*
Limpkin	*Aramus guarauna*
Reddish egret	*Egretta rufescens*
Snowy egret	*Egretta thula*
Little blue heron	*Egretta caerulea*
Tricolored heron	*Egretta tricolor*
White ibis	*Eudocimus albus*
Florida sandhill crane	*Grus canadensis pratensis*
Whooping crane	*Grus americana*
Wood stork	*Mycteria americana*
Roseate spoonbill	*Platalea ajaja*
Burrowing owl (Florida burrowing owl)	*Athene cunicularia (Athene cunicularia*
Crested caracara (Audubon's crested	*Caracara cheriway (Polyborus plancus*
Peregrine falcon	*Falco peregrinus*
Southeastern American kestrel	*Falco sparverius paulus*
Osprey	*Pandion haliaetus*
Snail kite (Everglades snail kite)	*Rostrhamus sociabilis plumbeus*

Common Name	Scientific Name
Florida scrub jay	*Aphelocoma coerulescens*
Florida grasshopper sparrow	*Ammodramus savannarum floridanus*
White-crowned pigeon	*Columba leucocephala*
Kirtland's warbler	*Dendroica kirtlandii*
Bachman's warbler	*Vermivora bachmanii*
Ivory-billed woodpecker	*Campephilus principalis*
Red-cockaded woodpecker	*Picoides borealis*
Marian's marsh wren	*Cistothorus palustris marianae*
Worthington's marsh wren	*Cistothorus palustris griseus*
Bald Eagle	*Haliaeetus leucocephalus*
MAMMALS	
Florida black bear	*Ursus americanus floridanus*
Everglades mink	*Mustela vison evergladensis*
Big Cypress fox squirrel	*Sciurus niger avicennia*
Sherman's fox squirrel	*Sciurus niger shermani*
Eastern chipmunk	*Tamias striatus*
Florida mouse	*Podomys floridanus*
Florida mastiff bat	*Eumops glaucinus floridanus*
Gray bat	*Myotis grisescens*
Indiana bat	*Myotis sodalis*
Sherman's short-tailed shrew	*Blarina carolonensis*
Homosassa shrew	*Sorex longirostris eionis*
CRUSTACEANS	
Black creek crayfish	*Procambarus pictus*
INSECTS	
Miami blue butterfly	*Cyclargus [=Hermiargus] thomasi*
MOLLUSKS	
Florida tree snail	*Liguus fasciatus*

(Source: FWC, 2008c)

[1]Note that state-listed species that are also federally listed are included in **Table 23**

Two state-listed endangered species are present in the lower reaches of the watershed in the vicinity of the FWC Wildlife Management Area (WMA). Much of the remainder of the watershed is shown as providing habitat for two or more threatened species or one endangered species.

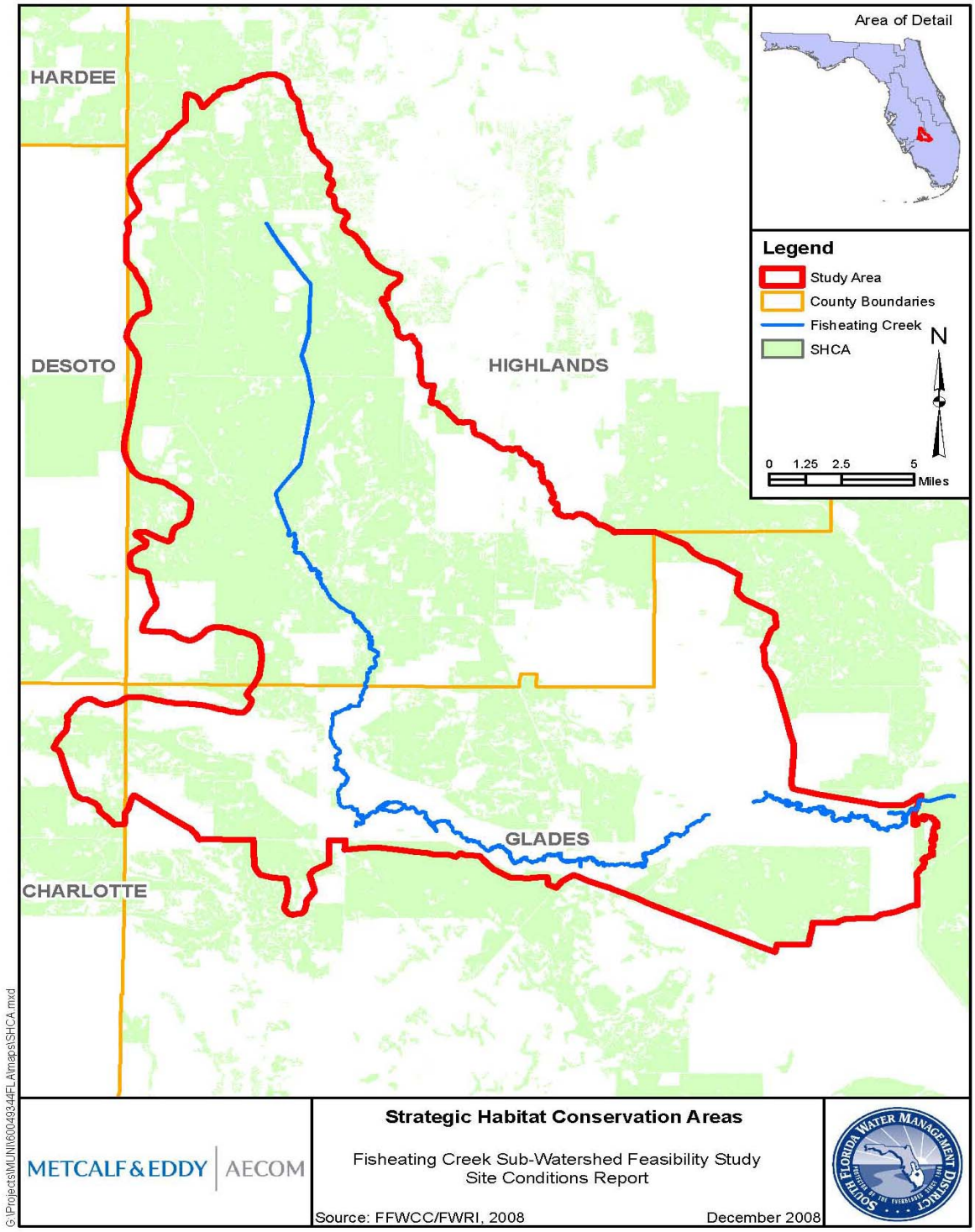


Figure 77. Strategic Habitat Conservation Area (SHCA)

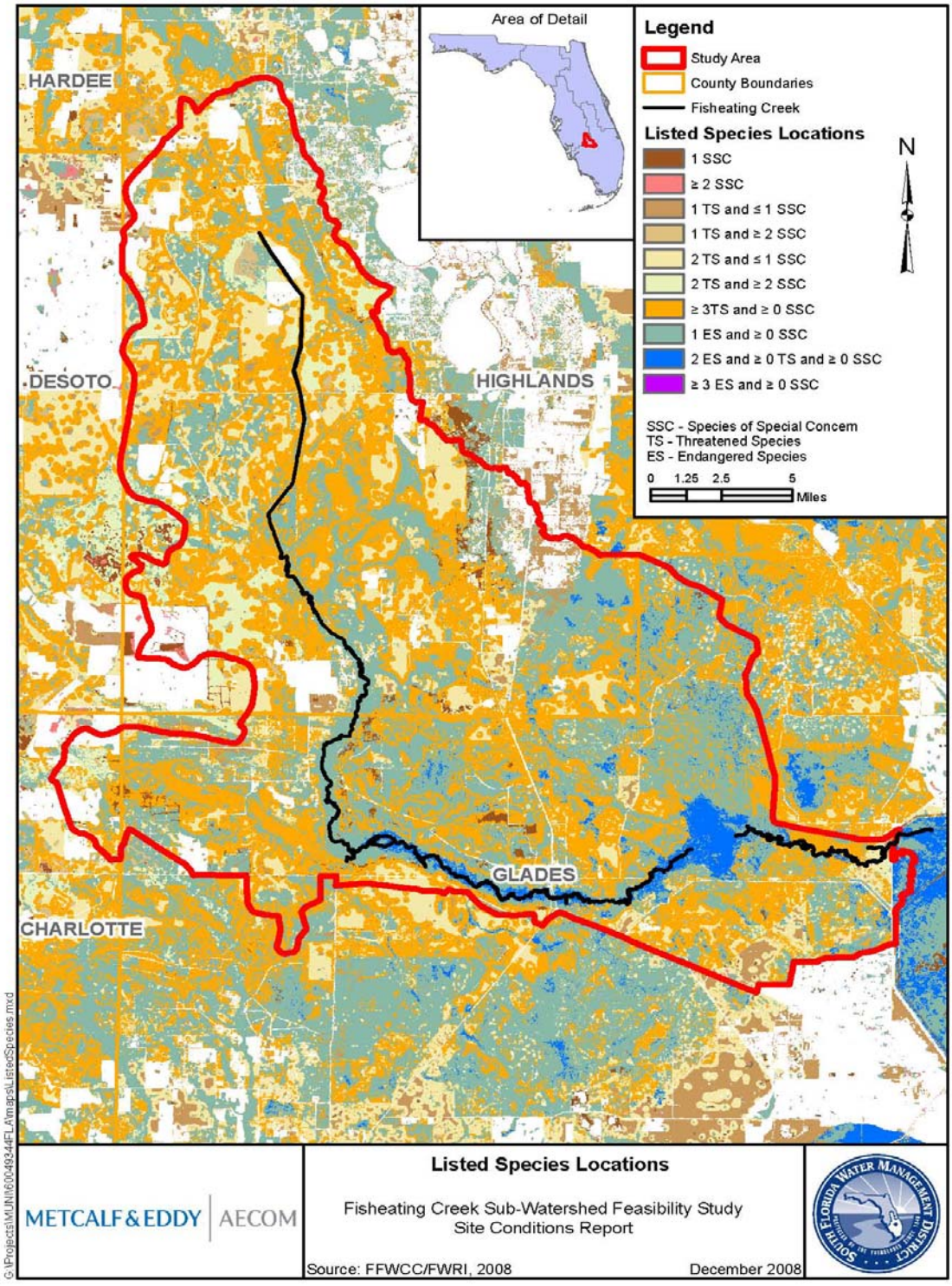


Figure 78. Location of State Listed Species in FEC Sub-Watershed Study Area

5.11 Recreational Resources

The Fisheating Creek Wildlife Management Area (FCWMA) and Gatorama are two (2) recreational places located in the FEC study area.

The FCWMA considers the Fisheating Creek as a very important part of the ecosystem for Florida panthers, Florida black bears, swallow-tailed kites, whooping and sandhill cranes, crested caracara, and a number of other species native to the area. The FCWMA covers an area of 18,272 acres along the Fisheating Creek in the Glades County **(Figure 79)**. Access to the Management Area other than by foot, bicycle or boat is not allowed. Entrance to the area is permitted via designated entrance points around US 27 and SR 78 as shown on **Figure 79**. Only registered and licensed vehicles are allowed to operate within the Camp Ground located at Palmdale. The airboat area between Cowbone Marsh and Lake Okeechobee can only be accessed with a no-cost airboat permission provided by Florida Wildlife Conservation Commission (FWC). This site can be accessed through the boat ramp located 1 mile south of Lakeport at SR 78. Aside from fishing, deer, feral hog and Osceola turkey can also be hunted within the Area. Part of the Management Area located at the east side of the US 27 is used for Turkey hunting. There are several primitive camp sites present along the creek as shown on the **Figure 79** (FCWMA, 2008). The FCWMA Camp Ground, located on US 27 around 1 mile south of Palmdale, offers recreational activities such as recreational vehicle (RV) and tent camping, canoe and kayak rental and daytime use area with pond and picnic tables (FCWMA, 2008).

Gatorama is a roadside attraction park, located at Palmdale, FL on US 27 around half mile north of FCWMA. Visitors of the place can take pictures of the nature which is mostly covered with oak trees and palm trees. The attraction area covers around fifteen acres. The park has 1000 ft long walkway and wooden bridge built in it. Tours through these paths are offered to observe alligators, crocodiles, monkeys, bobcats, raccoons, peacocks, ducks and geese panthers, birds and other Florida Wildlife. Gatorama is home for six species of crocodiles including the American Crocodile. It is also the largest captive breeder of the Acutus Crocodile in North America (Gatorama, 2008).

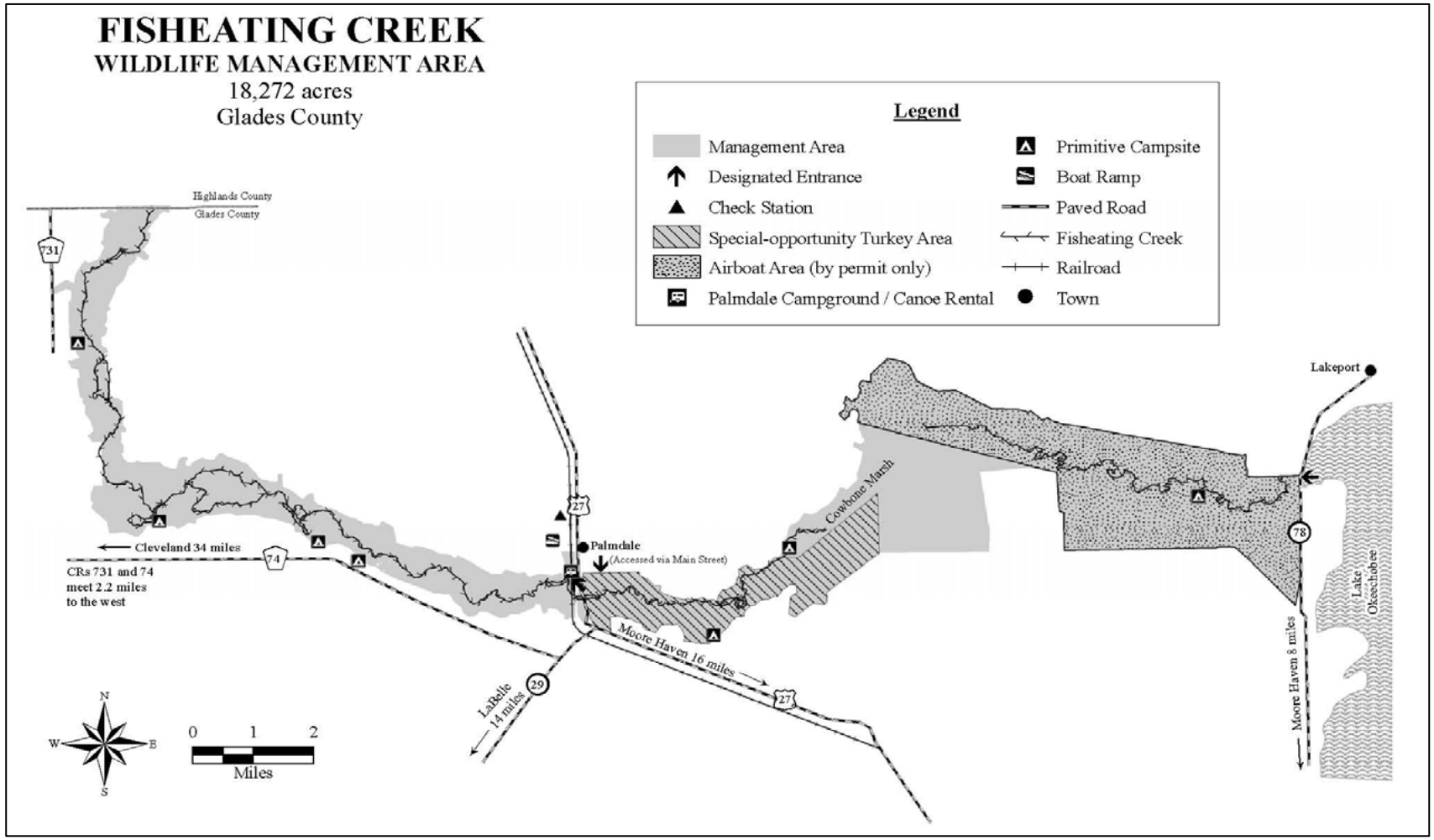


Figure 79. Fisheating Creek Wildlife Management Area

5.12 Aesthetics

The purpose of this section is to characterize the aesthetic quality of the areas surrounding Fisheating Creek, and within the sub-catchment, in order to provide a framework for determining the potential changes that could occur as a result of the project. Access to the watershed via SR 25/US 27 and CR 731 is quite limited; there are only a few scattered residences, and development in general is extremely low. The overall visual aesthetic of the Fisheating Creek sub-watershed is characterized by a divergent range of natural communities that include dry prairies and flatwoods interrupted by numerous freshwater marshes of various kinds, including seepage slopes, wet prairies, and depression marshes. Diverse prairie hammocks occur east of US 27. Hydric hammocks, bottomland forests, and floodplain swamp along Fisheating Creek make up most of the remainder of the natural communities. Large areas of the project area are improved pasture, former eucalyptus plantations, or current pine plantations (DEP, 2008) **(Figure 80** through **Figure 85**). Thus aesthetics in the watershed include a variety of natural settings, such as open fields and marshes, and forests, as well as areas altered and managed by humans such as ranchlands. Much of the managed land occurs in the upper half of the watershed whereas the lower half (Glades County), in the area where Fisheating Creek turns east and then further downstream, contains more of the natural, pristine viewsheds. In this portion of the watershed there is virtually no development and few roads. The majority of the watershed within Highlands County, both north and south of SR 70, consists of ranchland with occasional views of ranch dwellings and out-buildings. Utility lines are visible running adjacent to both state and county roads.

The marshy pasturelands surrounding the upper reaches of the creek are privately held, and therefore are not accessible for public viewing. This portion of the basin is characterized by a fairly extensive system of drainage canals extending west and east of Fisheating Creek. From this area, Fisheating Creek transitions to a channelized waterway which continues for approximately ten miles before again reverting to an open-bank creek. The lower reaches of Fisheating Creek, which flow within the Wildlife Management Area (WMA) between Palmdale and Lakeport (east of U.S. 27), represent the last unaltered tributary to Lake Okeechobee. The portion of the watershed within the WMA offers rustic and pristine views of a natural setting little influenced by humans. In the lower reaches of the WMA, extensive areas of freshwater marsh are associated with the creek for several miles including Cowbone Marsh and Rainey Slough. This area offers expansive marsh views of an undisturbed natural habitat, including many birds and other wildlife that frequent the region. As it approaches the lake, Fisheating Creek passes through open prairie and marshland areas that have been converted to rangeland for cattle.

Figure 80. An Aerial View of the Upper Reaches of FEC, North Lateral to Left

Figure 81. View of Channelized Portion of Fisheating Creek, Looking N

Figure 82. From CR 731 Approximately 3 miles North of SR 25/US 27, Downstream of the Channelized Portion of Fisheating Creek

Figure 83. An Aerial View of Cowbone Marsh

Figure 84. View of Fisheating Creek before it passes under Check Dam No.1 PL-566 Structure

Figure 85. Discharge of Fisheating Creek to Lake Okeechobee

5.13 Cultural and Archaeological Resources

This section describes cultural and archaeological resources with the Fisheating sub-watershed study area based on available data. The National Register of Historical Places website was reviewed online for historic areas in Highlands and Glades counties (NRHP, 2008), and the Office of Cultural and Historical Preservation (OCHP) was contacted in order to obtain access to the Florida Master Site File GIS data for Glades and Highlands Counties.

The project area includes at least 31 archaeological sites, many associated with the important Fort Center Site Complex of the Belle Glades culture (DEP, 2008a). The Fort Center site, located east of Palmdale adjacent to Fisheating Creek consists of mounds, ponds, circular ditches, and linear embankments built over at least 2000 years.

Various archaeological and cultural surveys have been conducted within the study area, particularly within Glades County adjacent to Fisheating Creek. For example, in 2005 an inventory and assessment of cultural and resources in the Fisheating Creek Wildlife Management Area was prepared. The combined extent of these surveys is shown on **Figure 86**. Based on discussion with OCHP staff, it is very likely that a site archaeological survey would be required before any work could be conducted within these areas (OCHP, 2008).

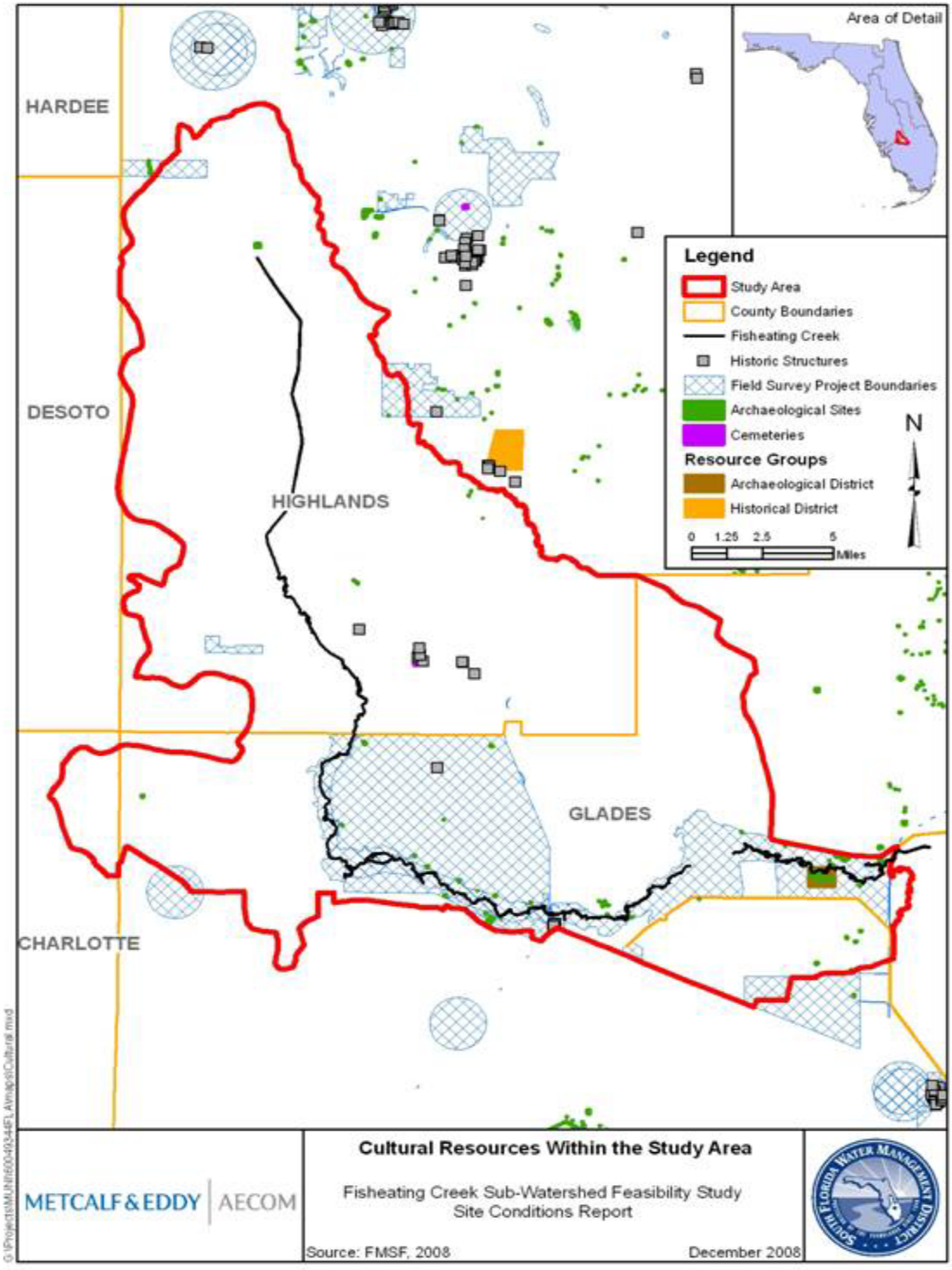


Figure 86. Cultural Resources Within the FEC Sub-Watershed Study Area

5.14 Hazardous Waste Sites

The following section describes current conditions within the Fisheating Creek sub-watershed related to hazardous waste. Spatial hazardous waste data distributed by the Florida Department of Environmental Protection (FDEP) were reviewed (FDEP, 2008a). **Figure 87** presents the results of the data-base search. These data include the following:

- Brownfields Sites, defined as abandoned or underused sites that may require environmental remediation prior to redevelopment (FDEP, 2001)
- Environmental Protection Agency (EPA) National Priorities List (NPL) sites, which includes EPA Superfund sites (FDEP, 2007a)
- Groundwater Contamination Areas (FDEP, 1990)
- US EPA Resource Conservation and Recovery Act (RCRA) Facilities, which includes the locations of hazardous waste handlers regulated under RCRA (EPA, 2008)
- Hazardous Materials Sites in the State of Florida (FDOT, 1997)
- Solid Waste Facilities in the State of Florida (FDEP, 2005)
- Florida DEP State-Funded Hazardous Waste Cleanup Sites (FDEP, 2007b)

There are no Brownfields, EPA NPL, Hazardous Materials, Solid Waste, or Hazardous Waste Cleanup sites located with the Fisheating Creek sub-watershed according to review of FDEP distributed spatial hazardous waste data. However, the data-base search indicated seven EPA RCRA facilities within the study area, and two overlapping regions of groundwater contamination located in Highlands County approximately two miles east of Fisheating Creek.

A siting concern associated with the proposed project is the possible existence of Cattle Dip Vats (CDV's) within the study area. During the early and mid 1900's, more than 3,500 cattle vats were constructed across Florida in order to assist in eradicating the cattle fever tick (Boophilus annulatus) (UF/IFAS, 2000). Livestock was required by state law to be dipped biweekly into these vats, which were concrete-lined channels containing arsenic solution, including synthetic pesticides such as DDT, BHC, chlordane and toxaphene (UF/IFAS, 2000). Although cattle vats are no longer used, soil and groundwater may be contaminated in the vicinity of some vats. To-date only about 120 CDV's have been located state-wide (DOH, 2008). Based on historic records, there are 41 known cattle dipping vat locations in Glades County and 56 within Highlands County (FDEP, 2008b); however, the exact locations of these vats are not known (DOH, 2008). Historically, cattle ranchers typically constructed CDV's in upland areas to avoid flooding (UF, IFAS, 2008); therefore it is unlikely that any vats would be located in the low lying regions adjacent to Fisheating Creek.

5.15 Existing Utilities

According to the information provided by City of Moore Haven both electricity and water is provided by City of Moore Haven to the residents within its limits. The city also provides water to the residents that are within a 2 mile distance to the City limits. The residents in the rest of the Glades County are using their own wells. There are some associations founded by the residents like Lake Port Association that manage the water supply (City of Moore Haven, 2008).

Electricity is provided to the rest of the Glades County by Glades Electric Coop, Inc. According to the conversation with Glades Electric Cooperative, Inc., they provide electricity to the Glades County and rural areas of Highlands County. Glades Electric Coop, Inc. service territory boundaries and power lines are shown on **Figure 88**. The orange color on the figure represents the service territory boundary. The power lines on the FEC study area are shown with circles on the figure. If more detailed information is required such as the details for the power lines, submittal of a formal requisition is required by the company which should be approved by the Company Board of Directors. It was also mentioned by the staff that electricity to the urban areas of Highlands County is provided by Progress Energy (Glades Electric Cooperative, Inc. , 2008).

Progress Energy was also contacted for information regarding their service territory boundary for the Highlands County. A staff from the company contacted with mentioned that they couldn't release such information as it is private but they promised to get in touch with M&E, Inc. However, no respond was provided by them after that conversation. If necessary, further correspondence with this company could be done.

According to the literature as mentioned in **Section 2** presence of one permitted landfill and one wastewater treatment facility discharging treated flow to groundwater within the FEC Sub-Watershed Study Area is known. **Figure 87** provides an illustration of known solid waste facilities and wastewater facilities in the area. Detailed information regarding the wastewater treatment facilities and landfills should be further investigated in the Study Area. However, it does not inhibit moving forward with the project. In addition, information for water treatment facilities, phone line and water service for Highlands County was not available at the time of the report. Additional infrastructure and potential siting constraints within the watershed are illustrated on the Figure in **Appendix D**.

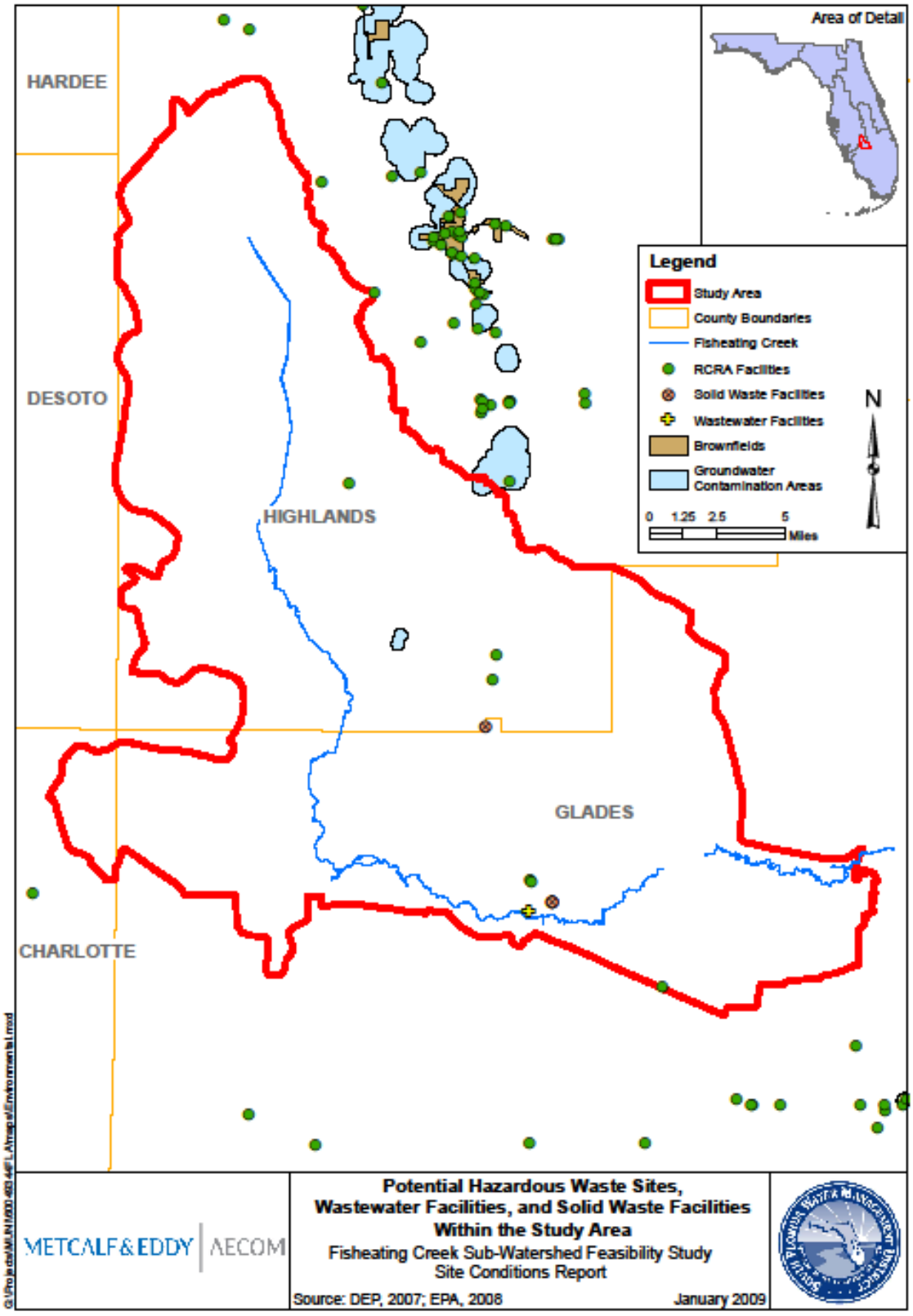
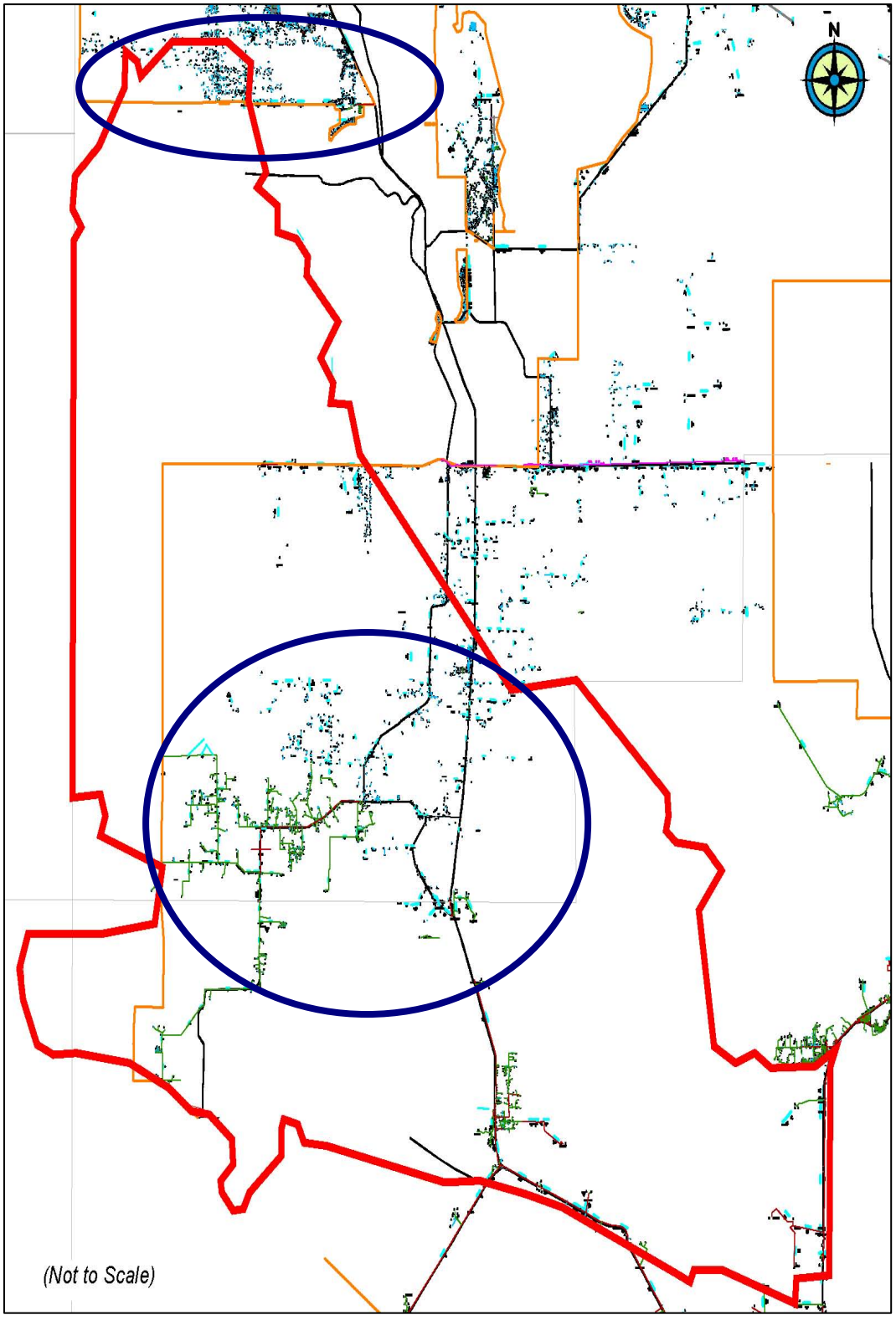


Figure 87. Potential Hazardous Waste Sites, Wastewater Facilities and Solid Wastes Facilities within the FEC Sub-Watershed



(Source: Glades Electric Co., Inc., 2008)

Figure 88. Service Boundary of the Power Utility Map in the Study Area

5.16 Data/Information Gaps

This section below identifies information gaps that may be useful, not critical, for the completion of the Feasibility Report.

During the preparation of this report, discussions with the SFWMD staff and previous consultant HDR indicated that meeting minutes identifying sensitive ecological areas based on local expert knowledge within the watershed were available on the Comprehensive Everglades Restoration Plan (CERP) website on the Lake Okeechobee Restoration Watershed page. A search of the website identified minutes from two meetings, one in June 2003 and one in March 2004 (Everglades, 2008). Neither of these meeting minutes discusses natural resources. If such meeting minutes do exist, obtaining them to provide summaries of previous investigation would be a useful component to include in this document summarizing existing knowledge of the watershed. Similarly, SFWMD staff indicated that a Uniform Mitigation Assessment Method (UMAM) analysis of district-owned lands in the watershed had been conducted and would be provided for summary and inclusion in this report. The UMAM results have not yet been provided, but would also be a valuable element of the existing conditions information that could be added to the report.

The exact location of cattle vats in the watershed, if any, would be another useful piece of information to obtain as part of the baseline information describing the watershed. Although this information was not readily available, direct consultation with landowners may assist in obtaining this data.

More detailed information regarding potential locations of threatened and endangered species would also benefit the project, as this would allow for more refined application of the site selection model during subsequent project phases. Consultation with the USFWS (2009) and the FWC (2009) has narrowed the list of species potentially located in the basin, however USFWS has indicated that additional review of the land use map by the following individuals and agencies would allow identification of specific areas that should be avoided during site selection in order to minimize impacts to protected species:

- US Fish and Wildlife Service
- Florida Fish and Wildlife
- Lykes Brothers
- Archbold Research Station
- Florida Audubon Society
- The Nature Conservancy

It is envisioned that this additional consultation may occur as part of the next public meeting, or as one of the first tasks in Phase II of the project during the application of the Land Suitability Model. Also, the USFWS will be providing information on previous refinement of FLUCCS codes done for the Lake Okeechobee project. This information will be used in Phase II to refine land use maps.

There currently is not enough data to compare the phosphorus loads generated in the upstream portions of the sub-watershed with those generated in its downstream portions. Additional sampling performed through the USGS (Station 02255600) located at where FEC crosses SR 70 to measure the P-load upstream of the FEC could be conducted by the District in parallel with the next phases of the study. In addition, FDEP will provide 2009 TMDL sites data for FEC Sub-Watershed to the Study Team as soon as available.

The permitted water use daily flows and actual water withdrawals would be useful to determine the water availability in the Study Area. However, such information is not considered crucial as the Study Area is not mainly utilized for residential use.

In this regard, information gathered on the existing site conditions is considered to be sufficient to pursue the next phases of the Fisheating Creek Sub-Watershed Feasibility Study.

Action Items for Additional Gap Determinations or Analysis

This part of this section presents the action items planned to be taken into consideration during the next phases of the Study. Action items are classified under three tiers. Tier 1 items represents the highest importance for the Study which may have importance on the determination of the alternative sites and treatment and storage techniques for the Study Area. Tier 2 action items have the secondary importance in comparison to the Tier 1 items. Tier 3 action items contain the reports, documents that were provided to the Study Team while the Phase 1 Data/Document Summary Report was finalized and that will be reviewed as needed during the next phases of the Study. In addition reports that do not fall under any of the above categories were mentioned as Others.

Tier 1

- Water Quality concentrations (not loadings) were reviewed in northern FEC. It would be beneficial to report on perceived shortcomings of existing datasets available and identify the locations where the collection of water quality and/or flow data.

- Jennifer Thera from FDEP provided information for 2009 sampling stations, sampling stations with water quality data, and Impairments shape files and an Excel spreadsheet with FDEP water quality data for years 2004 and 2006. She mentioned that they are sampling for ICP Metals (Calcium, Copper, Iron,

Lead, and Magnesium), Ammonia, Nitrite/Nitrate, Total Kjeldahl Nitrogen, Total Organic Carbon, Total Phosphorous, and Ortho-phosphorous at the 2009 stations. The data in the excel spreadsheet would be utilized during the next phases of this study.

- The four ROMP 14 stations, AVPK, SWNN, LOW HTRN, and SURF were explored for water quality parameters through the Southwest Florida Water Management Information System (WMIS). No intermittent water quality data was found through these wells. Further research would be conducted along with consultation with Hilary Swain from Archbold Biological Station.

- Regarding the Section 5.4.2 Subsurface Investigation in this report, Hilary Swain suggested the Study Team to contact Rich Spechler from USGS who is preparing Groundwater Technical Report for Highlands County. She also suggested to check with Florida Geological Survey and Bureau of Mines. These information would be checked during the next phases of the Study.

- Steffany Gornak from SFWMD forwarded the LOWA 2004 Annual Report along with two maps showing the LOWA monitoring network and monitoring site locations in the Study Area. These files would be further evaluated under her advise during the next phases of the Study.

- The phosphorus budget report prepared by Mock, Roos and Associates, Inc. was provided to the Study Team by Armando Ramirez. This report is an update of its predecessor (published in 1995), which was prepared to estimate the amount of net phosphorus entering the basins that discharge to Lake Okeechobee based on land use practices and hydrologic factors. In this regard, this report addresses the changes in the phosphorus budget due to the different land uses, assesses the effectiveness of the BMPs and strategies that has been used in the area to reduce the P-load to the Lake Okeechobee after 1995. The phosphorus Budget Report as cited below would be utilized in the next phases of this study.

  Phosphorus Budget Update for the Northern Lake Okeechobee Watershed (Final Report) prepared for the SFWMD by MOCK ROOS TEAM Mock, Roos & Associates, Inc. Soil & Water Engineering Technology, Inc. Contract Number C-11683 October 2002 Carolyn Boggess, Ph.D.

Tier 2

- Period of Record was discussed. Paul Gray noted that the Lake Okeechobee Protection Plan (LOPP, 2004) used a period of record from 1991-2000. The

update of that plan in 2007 used the same period of record and concluded previous plans were still on track to meet the TMDL for the lake. The Lake Okeechobee Watershed Construction Project Phase II Technical Plan in 2007 used a period of record of 1991-2005 and concluded the LOPP plans were not on track to meet the TMDL most likely due to the fact that the addition of five years (2000-2005) which has been a much wetter time period. This should be acknowledged in regards to the planning efforts for Fisheating Creek as it caused an increase in annual average phosphorus loading about 80 mt. It should be noted that the period of record heavily influences the phosphorus loadings in the area.

- It was also noted by Hilary Swain from Archbold Biological Station that west side of the Study Area boundary is very weakly delineated. She suggested that this could be followed up with SWFWMD.

- Presence of small dams in the Study Area was brought into attention by Hilary Swain. Although, the Fisheating Creek is mentioned as the only uncontrolled tributary to the Lake Okeechobee in the reports reviewed, the presence of such dams would still be checked in the Study Area during the next phases of the Feasibility Study. M&E|AECOM is currently preparing a report in the PL-566 Area which will be ready May 2009.

- Hilary Swain mentioned about the presence of a series of monitoring wells located in the vicinity of Archbold that have been established by state and federal agencies for either long-term monitoring or in response to specific projects. In regard to this, she also forwarded the following document that describes the USGS Shallow Groundwater Well Network Study on the Lake Wales Ridge. This document would be used to collect pertaining water quality data to the Study Area.

    1. *Design of a Shallow Ground-Water Network to Monitor Agricultural Chemicals, Lake Wales Ridge, Central Florida, 1998. By A.F. Choquette and Agustin A. Sepulveda. USGS Water-Resources Investigations Report* 00-4134. ISBN 1428907084, 9781428907089. More updates could be obtained from the following website: http://fisc.er.usgs.gov/Lake_Wales_Ridge/html/ground-water.html and Anne F. *Choquette of USGS(achoq@usgs.gov).*

    2. *SWFWMD Lake Placid Watershed Study was also suggested to be obtained from Dave Arnold of SWFWMD to gather more information on new set of wells along SR 70. Hilary Swain mentioned that this information could provide the Study Team the basis for well monitoring network from Ridge own to Creek.*

- Personal communication between Bonnie Wolff (FDACS) and Lisa Pietro (M&E Team) via telephone occurred on January 23, 2009. L. Pietro was following up on B. Wolff's comment at the December 8, 2008 meeting at the Glades County Courthouse Commission Chambers in Moore Haven, Florida, proposing that she could provide information regarding 'unused dairy farms' in the area. B. Wolff did not understand the term 'unused dairy farms' but explained that she had information about former dairy farms. She explained that these former dairy farms have lagoons that were not closed off and leach large amounts of phosphorous. L. Pietro asked if there was restoration to any of these former dairy farms and B. Wolff mentioned that the SWFWMD was spending a lot of money to work on the issue. L. Pietro asked about the type of information she can provide and B. Wolff explained that she has not compiled any information yet, but depending on what we needed she could put together a list of general locations, and current ownership. She could also provide maps if necessary. She also said she did not know the condition of all these farms, so it was unclear if any sites have been restored. In this regard, further communication to gather these information would be conducted during the next phases of the Study as needed.

- The Documentation Report for Fisheating Creek Management Area was written in three volumes. Volume 1 was written by the Nature Conservancy, Volume 2 by the Lykes Bros., inc (John Tallen), and Volume 3 by Florida Fish and Wildlife Conservation Commission. Information was requested from Jim Farr at FDEP, but not yet received.

- GIS Shape files for State managed lands of State Managed Lands, which identify state, federally or privately owned managed lands by Hilary Swain from Archbold Biological Station

- The SFWMD was contacted in an attempt to obtain information regarding groundwater data collected along the Lake Wales ridge in the vicinity of the Fisheating Creek sub-watershed. Personal communication via telephone occurred between Shellie Ferraira (SWFWMD, 352-796-7211, ext 4240) and L. Pietro (M&E Team) requesting the information. A study done in Polk County was going to be sent to Zuhal Ozturk (M&E Team), but not yet received. Although there was no groundwater inventory study done for Highlands county, S. Ferraira suggested a discussion with the Highlands County Office. This information will be further investigated in the next phases of the Study as needed.

- Hillary Swain suggested that sloughs on the west of the FEC such as Rainey Slough, John Henry Slough should be taken into consideration during watershed modeling. This suggestion will be taken into consideration during the modeling efforts for the Study.

- USGS 2km grid Evapotranspiration data was suggested to be used during watershed modeling efforts by Hilary Swain. The Study Team has obtained the data and it will be reviewed and utilized as needed during the next phases of the Study.

- Don Chase from TNC was contacted for a report describing nutrient issues in the watershed prepared by Hazen & Sawyer. This report would be attempted to be obtained from him.

- The thesis which is the basis of the following proceeding paper was uploaded to a ftp site by Dr. William Wise of Department of Environmental Engineering Sciences of University of Florida to Steve Schubert's attention. Steve Schubert forwarded the link to the Study Team but we couldn't download the document through the link. This document will be obtained from Steve Schubert and will be reviewed as needed.

  1. Loinaz, M. C., Wise, W. R., Shaw, D. T., James , A. I. Predicting Watershed-Scale Wetland Restoration Potential for Florida's Fisheating Creek Using Models. Proceeding Paper - American Society of Civil Engineers (ASCE), http://cedb.asce.org/cgi/WWWdisplay.cgi?0522403.

- The following literature was suggested by Bonnie Wolff to be located and reviewed to the Study Team. Therefore, it will be searched and reviewed in the next phases of the Study as needed.

  1. Lake Okeechobee tributaries: Kissimmee River, Fisheating Creek and miscellaneous inflow. Tallahassee, State Board of Conservation, 1952. BAN:m01732023; CatSource: JPL JPL AEY. Water Survey and Research Paper, No. 7. Summaries of discharge and stage from beginning of records to include 31 December 1949 is included in this report for the Surface Water of Florida. website: www.corpslibrary.com

Tier 3

- Hilary Swain from Archbold Biological Station provided the GIS shape files and the maps showing the conservation easements in the FEC to SFWMD. These files will be utilized in the next phases of the Study as needed.

- The statistical analysis of the data gathered for stage, rainfall, groundwater etc. may be useful to add to the report in the next phases of the Study according to the suggestion from Hilary Swain.

- Hilary Swain suggested to plot the correlations between the upstream monitoring station and the downstream FISHP in the Study Area as the Study Team found out that they revealed weak correlations.

- Paul Gray made suggestion on following which will be taken into consideration during the next phases of the Study.

  1) More discussion could be provided for CERP LOW Section 2.1 since it did much more detailed work in the watershed than the Restudy did. In this regard, document available through could be used for this section: http://www.evergladesplan.org/pm/pmp/pmp_docs/pmp_01_lake_watershed/pmp_01_lake_o_watershed_final.pdf

  2) Landownership Map of FEC Study Area will be updated with the more recent data if found available during the next phases of the Study and discussed with Paul Gray as he thinks that it does not show the FWC Corridor correctly.

- The following three reports forwarded to the Study Team by Armando Ramirez would be used as needed during the next phases of the Study.

  1) FCWMA Lease Agreement (2003). Board of trustees of the Internal Improvement Trust Fund of the State of Florida

  2) Draft Land Management Review of Fisheating Creek WMA (2008). Prepared by Division of State Lands Staff

- Two examples of western watershed areas of concern or activity where data may be available are listed as follows. These documents would be searched and used as needed, if available

  1) Bluehead Ranch Comp Plan
  2) Tippen Bay (Brian Paul, Owner)

Other Reports

- The following documents were received from Joyce Zhang of SFWMD and will be reviewed during the next phases of this Study as needed.

  1. Hiscock, J.G., Thourot,C.S., Zhang, J. (2003) Phosphorus budget – land use relationships for the Northern Lake Okeechobee watershed, Florida. Ecological Engineering, 21, (63-74)

  2. Peer Review of the Watershed Assessment Model (WAM) - Final Panel Report, January 30, 2009. Prepared by Wendy D. Graham, Anthony S. Donigian, Jr., Rafael Muñoz-Carpena, Wayne Skaggs, Adel Shirmohammadi

3. Future M&E|AECOM PL-566 Structures Data Collection and Evaluation Report will incorporate detailed information for the PL-566 Structures.

5.17 Summary and Preliminary Conclusions

Information presented in this section aims to provide a detailed overview of the most up to date conditions in Fisheating Creek Sub-Watershed Study Area, which will then be used to evaluate and define the potentially feasible sites that could be utilized for water storage and P-load reduction to the Lake Okeechobee using engineering techniques.

In this regard, existing conditions of the Study Area were investigated based on site visits and information gathering from reliable resources such as officially recognized websites and communications with relevant parties. Site visits were conducted to increase familiarity of the Study Team with the Study Area. Data provided in this section of the report was presented for climate, land use, geology and soils, topography, existing watershed hydrology, land ownership and water use permit, vegetation, wetlands and floodplain, fish and wildlife, threatened and endangered species, recreational resources, aesthetics, cultural and archaeological resources, hazardous waste site, existing utilities specific for the Study Area.

Observations based on the preliminary site visits were somewhat limited to the areas that were accessible as the majority of the Study Area is privately owned. Overall the majority of the Study Area visited was occupied with pasture lands, cattle grazing, wetlands and marshes along with the Fish and Wildlife Management Conservation Areas. Although, the site visits were limited to the accessible areas, they were still beneficial to get a better understanding of the Study Area.

Climate in the Study Area was presented in terms of temperature, precipitation and evapotranspiration data gathered from the monitoring stations within and/or in the vicinity of the Study Area. Results suggested that these parameters should be taken into account during the evaluation, decision, planning and conceptual and real design steps of water storage and water treatment technique(s) such as reservoirs and wetlands in the Study Area.

Land use in the Study Area was presented based on the data provided by SFWMD. The most abundant land use cover type in the basin is Cropland and Pastureland, followed by Freshwater Marsh and Wet Prairie. A variety of other land use types comprise the remainder of the watershed, but each represents less than five percent of the watershed.

The soil distribution was classified according to the predominant surficial soil types, soil hydrologic groups and subsurface properties of the Study Area. Main surficial soil types in the Study Area were determined as Immokalee sand, Myakka fine sand, Basinger fine sand and Valkaria fine sand. Investigations showed that approximately 78% of the Study Area

was covered with soils that fall under the hydrologic Group B/D. This implies that the Study area is mainly covered with both drained soil (Group B) and undrained soil (Group D). Subsurface properties were located for the Nicodemus Slough which is located in the southeast part of the Study Area. Results showed that sand is the predominant material in this area together with lesser amounts of clay, silt, and shells. Additional subsurface information to be used was also included in this report for two areas approximately 17 to 22 miles away from the center of the Study Area.

Topography of the Study Area showed slopes gradually from about 85 feet NGVD in the northwest section to about 20 feet NGVD in the southeast section. In addition, the northeast portion of the Study Area is bound by the south extension of the Lake Wales Ridge which showed up to 160 feet NGVD elevation in some parts within the Study Area.

The Hydrology of the sub-watershed was also reviewed and presented in the report. Data showed that for any future restoration and planning purposes including the modeling efforts to reduce the P-loads to the Lake Okeechobee, data belong to individual years should be preferred due to the seasonal fluctuations in the climate of the area. This could help to better evaluate and validate the storage and treatment techniques for the sub-watershed as the change in the rainfall will also affect the P-load contribution to the Lake Okeechobee.

Approximate location of properties and their owners were also identified and presented in the report. It was found that majority of the area is privately owned in the Study Area.

Within the sub-watershed, there are some potentially sensitive sites that should be avoided, including 31 archaeological sites, habitat for threatened and endangered species, the pristine habitats of the Fisheating Creek Wildlife Management Area, and seven EPA RCRA facilities. As discussed above in Section 4.16, further refinement of exact locations of threatened and endangered species habitat is possible in consultation with a variety of state and federal agencies and non-profit organizations knowledgeable about the watershed, and should occur as the project moves forward to identify site locations. Cattle vats may also be present throughout the watershed, although their exact locations are not currently well known. However, these areas tend to be small and contained, and can generally be remediated on a site-specific basis. Their presence at a particular site could be addressed prior to implementation of an alternative at any particular location.

SECTION 6 SUBSEQUENT ACTIONS

The information provided in this report will be used to establish criteria to select alternative sites within the Study Area. Alternative sites will be investigated for their feasibility to identify engineering practices to be used either alone or in combination with other sites to potentially achieve 200,000 acre-feet water storage and 33 mt/yr P-load reduction to the Lake Okeechobee (18 mt/yr reduction from local/regional projects and 15 mt/yr from Best Management Practices). In this regard, different type of storage components and treatment methods that would potentially meet the goals mentioned above will also be evaluated. For this reason, a preliminary decision matrix will be used based on all variables that are of importance on the selection of the method(s). Each variable in the decision matrix will be assigned with a weighting factor so that a thorough ranking could be conducted that will eventually help select the methods to meet the above goals.

Based on the above suggestions, a Feasibility Report Work Plan for Phase 2 and Phase 3 will be provided to the SFWMD. This Work Plan will be structured with a step by step approach that will include the work effort and incremental tasks required to prepare the Report. Detailed schedule for both phases will also be included in the Work Plan. Phases 2 and 3 will then be authorized under a separate work order.

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APPENDIX A

WATER USE PERMIT DATA

Due to the voluminous nature of the Data, the information is only contained in the accompanying CD

APPENDIX B

TOPOGRAPHIC MAP

Topographic Map - North

Fisheating Creek Sub-Watershed
Feasibility Study Site Conditions Report

0 1 2 4 Miles

N

Legend

- Study Area
- County Boundaries
- Fisheating Creek

December 2008

Source: USGS

METCALF & EDDY | AECOM

Area of Detail

HARDEE CO.

DESOTO CO.

HIGHLANDS CO.

GLADES CO.

Headwaters

SR70 Crossing

Fisheating Creek

LAKE PLACID

LAKE JOSEPHINE

LAKE ISTOKPOGA

DESOTO CO.
HIGHLANDS CO.
CHARLOTTE CO.
GLADES CO.
Fisheating Creek
SR731 Crossing
Rainey Slough
SR27 Crossing
Cowbone Marsh

Topographic Map - South

Fisheating Creek Sub-Watershed
Feasibility Study Site Conditions Report

0 1 2 4 Miles

December 2008

Legend

- Study Area
- County Boundaries
- Fisheating Creek

Source: USGS

METCALF & EDDY | AECOM

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

N

Area of Detail

APPENDIX C

NATIONAL WETLANDS INVENTORY MAP

National Wetlands Inventory Map - North

December 2008

Fisheating Creek Sub-Watershed Feasibility Study Site Conditions Report

Legend

- Study Area
- Major Roads
- Minor Roads
- County Boundaries
- Fisheating Creek

NWI Wetlands

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

Source: USFWS, 1984

0 1 2 4 Miles

N

METCALF & EDDY | AECOM

Area of Detail

HARDEE CO.

DESOTO CO.

HIGHLANDS CO.

GLADES CO.

LK JOSEPHINE&LK WOOD

LAKE JUNE ROAD

CLEVELAND ROAD

LAKE CLAY DRIVE

VIRGINIA AVE.

HIGHLANDS LAKE DR.

DAL HALL BLVD

LINCO/JEFF/CAT/DEER

HOLMES AVENUE

LAKE DRIVE

JEFFERSON AVE

PLACID VIEW/LK MIRRO

SR-70

CR 17/OLD SR 8

SR-25/US-27

SR-29

G:\Projects\MUNI\60249344\FLA\maps\NWIMapNorth.mxd

DESOTO CO.
HIGHLANDS CO.
CHARLOTTE CO.
GLADES CO.
CR 17/OLD SR 8
CR 731, OLD VENUS Rd
OLD VENUS RD/CR-731
RAINEY SLOUGH ROAD
CR-74/BERMONT ROAD
CR 74
SR-29
SR 78

National Wetlands Inventory Map - South

December 2008

Fisheating Creek Sub-Watershed Feasibility Study Site Conditions Report

Legend

- Study Area
- Major Roads
- Minor Roads
- County Boundaries
- Fisheating Creek

NWI Wetlands

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

0 1 2 4 Miles

N

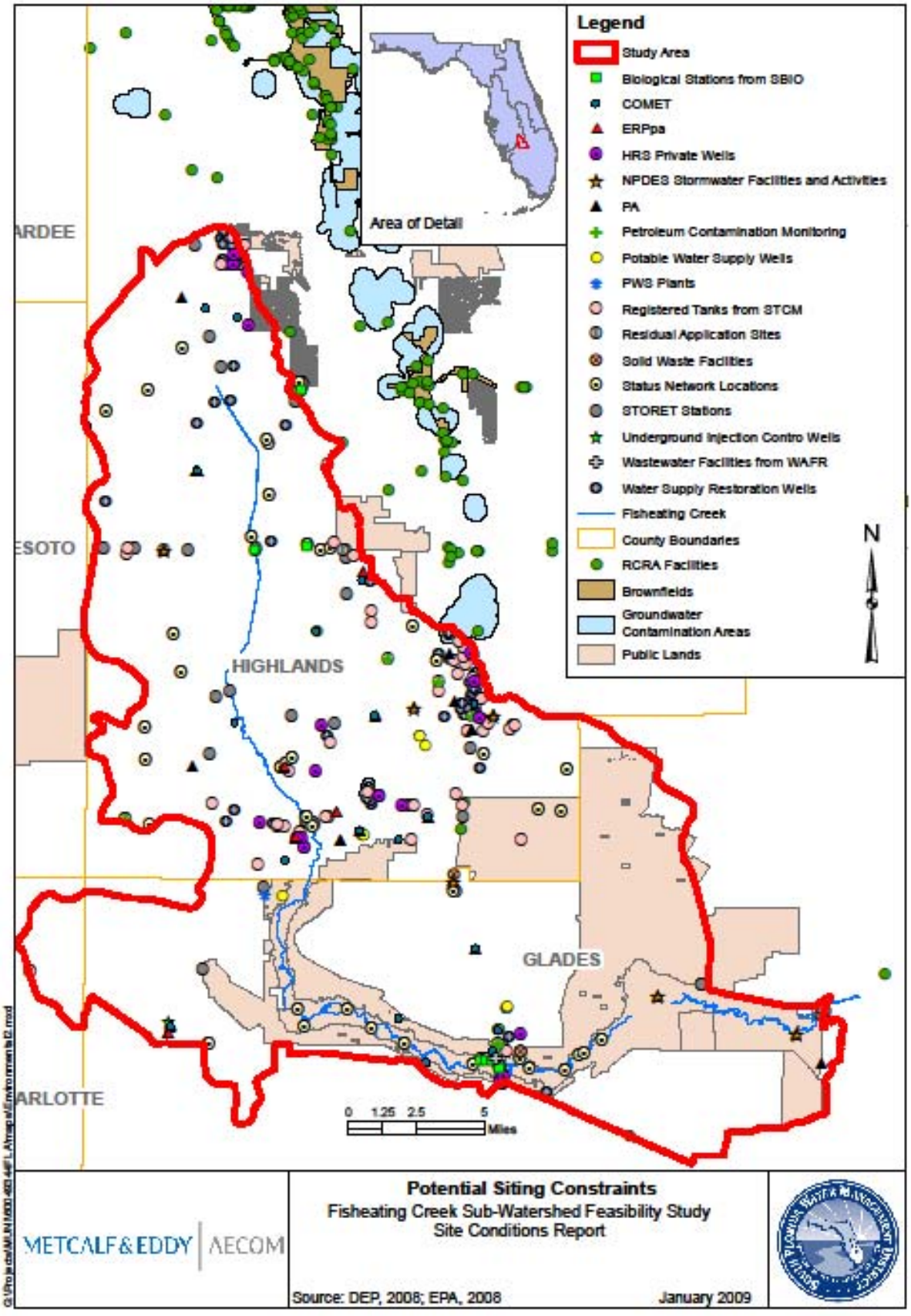
Area of Detail

Source: USFWS, 1984, 1972

METCALF & EDDY | AECOM

APPENDIX D

SITING CONTRAINTS


Legend
Study Area
Biological Stations from SBIO
COMET
ERPpa
HRS Private Wells
NPDES Stormwater Facilities and Activities
PA
Petroleum Contamination Monitoring
Potable Water Supply Wells
PWS Plants
Registered Tanks from STCM
Residual Application Sites
Solid Waste Facilities
Status Network Locations
STORET Stations
Underground Injection Contro Wells
Wastewater Facilities from WAFR
Water Supply Restoration Wells
Fisheating Creek
County Boundaries
RCRA Facilities
Brownfields
Groundwater Contamination Areas
Public Lands
Area of Detail
N
ARDEE
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HIGHLANDS
GLADES
ARLOTTE
0 1.25 2.5 5
Miles
METCALF & EDDY | AECOM
Potential Siting Constraints
Fisheating Creek Sub-Watershed Feasibility Study
Site Conditions Report
Source: DEP, 2008; EPA, 2008
January 2009

APPENDIX E

MEETING NOTES

Fisheating Creek Sub-Watershed Feasibility Study – Phase 1
Feasibility Report Working Team Meeting
December 8, 2008

DATE: December 10, 2008

TO: File

FROM: Metcalf & Eddy | AECOM project team

RE: Meeting Notes #1

Representatives from the South Florida Water Management District (SFWMD), Metcalf & Eddy | AECOM (M&E), and ZFI Engineering, Inc (ZFI) met to discuss project status and planned activities with the Fisheating Creek Stakeholders relevant to M&E's work order and future phases.

The meeting was held on Monday, December 8, 2008 at the Glades County Courthouse Commission Chambers in Moore Haven, Florida. The meeting began at approximately 10:00 AM.

The following items are key notes from the meeting:

Meeting Key Notes

1. Hillary Swain from Archbold Biological Station said that the accuracy of the Study Area boundary should be checked.
2. There is a seepage slope on the eastern boundary of the basin which contributes groundwater to Fisheating Creek and its tributaries. Therefore, soils summary should consider lateral seepage flow from the FEC west ridge in Highlands County.
3. Hillary Swain also mentioned that ridge points go to 145 ft. Therefore they could be concentrated on the areas shown with high elevations like 120 - 160 ft on the topography map. Jim Penkosky from M&E mentioned that a limited survey is currently undergoing in PL-566 area for another project and expected to provide a more detailed understanding on the geography of that specific area. However, detailed surveys are reserved for a future date.
4. Hillary Swain noted that she has more data on precipitation since WW II. She mentioned that between 1981 and 1993 precipitation observed in comparison to the previous years was low and showed small variation. Florida Automated Weather Network (FAWN) could also be used to gather information for precipitation. Dominique Brocard said that changes in climate due to the global warming should also be taken into consideration. Therefore, gathering precipitation data from even earlier years may not represent the future precipitation regime. It was also suggested that for modeling purposes data measured in more frequency should be collected and used.

5. M&E Team needs to re-review flow and stage data with more detail in terms of measurement frequency and period of measurement.
6. M&E Team needs to re-review phosphorus data provided by the SFMWD Okeechobee Service Center. This data may be important when determining the areas of high phosphorus loading as the data in the presentation is limited to the downstream FECSR78 station. However, flow data will also be required at any other stations to determine load rates. Dominique noted the high variability in loading rates for the FECSR78 station from 1991 to 2007 and this will need to be considered when reviewing alternatives' evaluations. Reports authored by Paul Ritter of SFWMD should be reviewed by the M&E Team. Paul Gray mentioned that there may be Phosphorus data available from 3 years ago. (This may be the same data.)
7. The Florida Ranchlands and Environmental Services Project will be collecting water quality and flow data that may be useful for this effort.
8. After discussions, Temperince Morgan from SFWMD said that period of data record that will be used for Phosphorus for the FEC Sub-Watershed Feasibility Study should be consistent with period of data record used in the Phase II Technical Plan (P2TP) which is 1991-2005.
9. One of the attendees from FEC Management Area mentioned that Palmdale Station does not take into consideration the large marshes on its east side. In response, Hillary Swain said that they have some estimation of flow sampling data which they could provide for review.
10. George Guo from ZFI mentioned that groundwater data would be beneficial for the Study. Hillary Swain mentioned the existence of four (4) regional monitoring wells and meteorological station in the Study Area. Well names: ROC or ROMP 14(??), 9400(??) should be located.
11. It was suggested that land use in terms of rangeland, agriculture and wetland utilization should be re-reviewed. Data for the land use provided in the presentation was gathered from the SFWMD Basin Atlas. However, audience mentioned that sometimes wetlands used are reported in the agriculture use, as they are already used for that purpose.
12. It was noted that conservation lands should be shown on the landownership maps.
13. The wildlife determinations should consider other species aside from what was shown in the presentation. M&E has additional information in their Data Summary Report but needs to present the information for more than just a few species.
14. Listed species should be divided into functional groups to provide feedback on the prioritization of the species. Such approach could include groups like endangered species, non-endangered species etc.
15. The pending Development of Regional Impacts (DRIs) for Highlands County projects and USDA Restoration Projects (5 of them) should be documented in the report.
16. The SFWMD will look into setting up a website for data requests and transfers.
17. The LSM will not be used as the primary decision maker but as only a tool in alternative analyses. Items for the Layers (remove the word Constraint) should include Interest Levels for willing land sellers, future or planned infrastructure, and TMDL adoption by 2011. Ecologic value and existing wetlands layer criteria may need to be revised, as the criteria for avoidance may not be appropriate when attempting to site local scale projects such as alternative water storage facilities. Suitability Attributes should also be reviewed

with the constraints which will be carried forward. This will be discussed a bit further (as an update) during the next Working Team Meeting. The possibility of using different criteria for projects of varying scales (local versus regional) was discussed.

18. The diversion of water from the creek, its treatment and return back to the creek is considered an option. It is also known that such attempt may be challenging and potentially unfeasible.
19. Audience (Mr. Godwin) is interested in the next Workshop and the results of the Study. They expressed a desire to contribute in the decision making process…
20. Use of a list of different criteria layers without the term "Constraint" was suggested.
21. The Land Suitability Model application needs to modified for this project, because the same criteria are not applicable to the different types of alternatives. Suggest developing different sets of criteria for different types, such as RASTAs, wetland restoration, distributed water storage.
22. Constraint layers need to be incorporated with TMDL's taken into consideration. For this reason, coordination with DEP was suggested.
23. Wetlands and ditch filling should be added among the "Storage and Treatment Methods".
24. BMPs should be added to the storage and treatment methods list. (It actually falls under the Source Control option, so we should just add this wording on the same line.)
25. Funding mechanism for the design of this study results should be addressed.
26. Bonnie Wolff from FDACS proposed to provide information regarding the unused Dairy Farms in the area…
27. During first work order, need to determine what, if any, information gaps are critical and would need to be addressed in order to move onto the next Phase (i.e. strategic data required).
28. The Atlantic Blue rep (Lisa Jensen) requested that the SFWMD provide an organizational chart showing all agencies involved in this Study.

Adjournment
Meeting adjourned at approximately 12:30 pm.

Fisheating Creek Sub-Watershed Feasibility Study – Phase 1

Feasibility Report Working Team Meeting Sign in Sheet

Name	Representing	Phone Number
1. Jim Penkosky	(Metcalf & Eddy) AECOM	954. 745. 7215
2. Zuhal Öztürk	(Metcalf & Eddy) AECOM	954. 745. 7238
3. Jerry R Joiner	Joiner Consulting Inc.	352-339-6493
4. Beth Morfoy	Ft. Fish + Wildlife	561-722-2188
5. Davies Mtunda	SFWMD	561-686-8800
6. Kevin Carter	" "	561-682-6949
7. Ike Balci	"	561-682-2581
8. David Hasell	"	561-682-6888
9. Temperina Morgan	SFWMD	561-644-7178
10. Armando Ramirez	"	561-629 6974
11. [illegible]	FDACS	863-462-5881
12. Chad Kennedy	FDEP	561-681-6706

December 8, 2008

Attachment A:
Alternatives Workshop Sign-In Sheet

Fisheating Creek Sub-Watershed Feasibility Study – Phase 1

Feasibility Report Working Team Meeting Sign in Sheet

Name	Representing	Phone Number
13. Cloll Fred	Highlands County Natural Resources	863-402-6545
14. George Flinn	ZFI Engineering & Consulting Inc	407-281-1100
15. Wayne Godwin	Westby Corp.	863-699-5411
16. Michelle Pearcy	Metcalf & Eddy	561.670.5477
17. Hilary Swain	Archbold Biological Station	863 465 2571
18. John Winfree	TNC	561 732 6550
19. Mike Izzarone	TNC	561 732-6550
20. Missie Barletto	SFWMD	
21. Steve Schubert	US FWS	(772) 562-3909 x 249
22. Russell Echols	Glades BCC	
23. Lisa Kreiger	SFWMD	863-462-5260
24. Paul Gray	Audubon	863-655-1831

December 8, 2008

Fisheating Creek Sub-Watershed Feasibility Study – Phase 1
Feasibility Report Working Team Meeting #2
February 13, 2009

DATE: February 19, 2009

TO: Armando Ramirez, SFWMD Project Manager

FROM: Metcalf & Eddy | AECOM project team

RE: Meeting Notes #2 and Action Items

Representatives from the South Florida Water Management District (SFWMD) and Metcalf & Eddy | AECOM (M&E) met to discuss project status and planned activities with the Fisheating Creek Stakeholders relevant to M&E's work order and future phases.

The meeting was held on Friday, February 13, 2009 at the Glades County Public Library in Moore Haven, Florida. The meeting began at approximately 10:00 AM with Armando Ramirez's introduction. Attendees introduced themselves prior to the presentation. List of attendees is provided in **Attachment A**.

The following items are key notes from the meeting. Action items are presented following the notes.

Meeting Key Notes

- Armando Ramirez provided dates of completion for reports included under Work Order 1. All reports will be completed by February 20, 2009 with the following week used for project close-out.
- All comments on the draft final Data Document Summary Report to be provided by close of business February 13 so M&E | AECOM can incorporate.
- Steve Schubert mentioned that ground truthing should be conducted on the 2006 Land Use Map. Joyce Zhang and Armando explained the 2006 Land Use Map is ground-truthed and it was also used in the The Lake Okeechobee Watershed Construction Project Phase II Technical Plan. This map is used for consistency (modeling efforts) and is the best information available (Phase I goals). Steve mentioned the 2004 Land Use Map is a level 1 type.
- Steve Schubert has a report on land use (produced by HDR). M&E will obtain the report from Steve.
- Water Quality concentrations (not loadings) were reviewed in northern FEC. It would be beneficial to report on shortcomings of existing datasets available and identify the locations where the collection of water quality and/or flow data would be important to fill the existing data gaps.
- Period of Record was discussed. Paul Gray noted that the Lake O Protection Plan (LOPP, 2004) used a period of record from 1991-2000. The update of that plan in 2007 used the same period of record and concluded previous plans were still on track to meet

the TMDL for the lake. The Lake Okeechobee Watershed Construction Project Phase II Technical Plan in 2007 used a period of record of 1991-2005 and concluded the LOPP plans were not on track to meet the TMDL most likely due to the fact that the addition of five years (2000-2005) which has been a much wetter time period. This should be acknowledged in regards to the planning efforts for Fisheating Creek as it caused an increase in annual average phosphorus loading approximately 80 mtons. It could be mentioned in the Data/Document Summary Report that period of record heavily influences the phosphorus loadings in the area.

- Disparate periods of record in the report need to be referenced:
  Lake Okeechobee Watershed (CERP): 1965 -2000
  Lake Okeechobee Protection Plan: 1991-2000
  Northern Everglades: 1991-2005
- FDEP representative Jennifer Thera provided a hand out summarizing water quality impairments per FDEP Impaired Waters Rule for Fisheating Creek sub-watershed including water quality sampling locations map. Armando to contact her for existing available water quality information.
- Paul mentioned that round-tailed muskrat is missing from the state list of endangered species.
- Hillary Swain mentioned information from Archbold biological Station's website. Habitat modeling of endangered species etc. that could be useful for the study.
- Two examples of western watershed areas of concern or activity where data may be available:
  Bluehead Ranch Comp Plan
  Tippen Bay (Brian Paul, Owner)
- Joyce Zhang made a presentation on Watershed Assessment Model (WAM) and explained why it is being selected as a tool for Fisheating creek feasibility study alternative evaluation and selection. Joyce stated that WAM was developed for Florida applications and was determined by a panel of experts to be the best modeling tool. Her presentation included baseline flow and loads (period 1991-2005), load reduction targets for Fisheating Creek sub-watershed and WAM peer-review comments. She also discussed TMDLs for the loading and concentrations into Lake Okeechobee.
- Hillary Swain suggested that sloughs on the west of the FEC such as Rainey Slough, John Henry Slough should be taken into consideration during watershed modeling. She also mentioned that reference to the Fisheating Creek easement report should be included in this report. M&E will obtain the settlement agreement and conservation easement report from Don Fox whereas Land Management Plan for Wildlife Management Area can be obtained from the website.
- Sarah Lynch asked if WAM capture dispersed water storage, retention period, flow etc? Joyce responded that WAM is cell based and it can capture parcel sized projects as small as one hectare. Joyce also mentioned that the FRESP (Florida Environmental Ranchland Services Project) is considered as DMSTA.
- Landowners/stakeholders are to be included to help P load reduction by the TMDL efforts from FDEP. Kevin Carter provided a brief TMDL discussion.
- Bonnie provided comments on the draft final Data Document Summary Report including written comments about "natural wetland inventory" to add to the report.
- Hilary stated that SWFWMD has Evapotranspiration (ET) data for this basin. As previously noted, the report is missing data on ET and groundwater. Hilary previously provided the link to this data set but M&E team could not locate it through the link. Hilary offered assistance to M&E to locate the data set.

- Steffany Gornak mentioned that Optimization of Water Quality Data network for Lake Okeechobee will be initiated which includes Fisheating creek sub-watershed next year.
- Lisa Jensen of Blue Head suggested that all agencies should collaborate and reduce their efforts in sampling for phosphorus in the Study Area which would also help landowners.
- Paul provided an Audubon document discussing historic and more recent precipitation trends: Audubon of Florida: Lake Okeechobee – Everything in Harmony/Restoration Needs, undated, prepared by Paul (Lake Okeechobee Science Coordinator), Chris Farrell (Everglades Science Coordinator) and Traci Romine (Everglades Policy Director).
- All information to be provided to Armando who will forward to the M&E | AECOM Team.
- Jim Penkosky stated that the Team will do there best to incorporate all information received either directly addressing the information in the text or by providing a summary of information for further evaluation (due to the project deadlines).

The following are **Action Items** for Key Meeting Notes:

- Obtain additional evapotranspiration (ET) and groundwater data if available (refer to SWFWMD). Hillary Swain mentioned that SWFWMD have ET data for FEC for 1982 to 2005 period and offered to assist the M&E | AECOM team locating the data.
- Obtain "Greater Ridge Planning Tool" Report – available on the web, if not M&E | AECOM will contact Hillary Swain.
- Obtain FEC Easement Report, State Lands Management Plan - suggested by Hilary Swain.
- Obtain Documentation Report for the Fisheating Creek Wildlife Management Area – M&E |AECOM to contact Jim Farr of DEP.
- FEC Settlement Agreement - Obtain Settlement Agreement for Fisheating Creek Wildlife Management Area – Hilary indicated that she provided this to Armando.
- Obtain Fisheating Creek Fish and Wildlife Management Plan – available on DEP website according to Hilary Swain.
- Data Summary Report should include some discussion of state (i.e. FRESP) and federal initiatives (i.e USDA/NRCS- Wetlands Restoration Enhancement Program) in FEC. John Winfree has provided Pinar with map of lands that may be preserved through the USDA Wetlands Restoration Enhancement Program. These lands are ones that may have the prospective of being preserved/enhanced, although nothing is yet certain as the project has not been finalized. Pinar indicated that she has this information, and can provide to us. John Winfree has also been requested to forward directly to M&E | AECOM.
- Obtain "Frontiers" article, which describes WWF efforts in FEC watershed to preserve/enhance wetlands - Pinar has indicated that she has this article and will send it to M&E.
- Paul Gray will provide a paragraph explaining the issue on period of record for different planning documents (Lake Okeechobee Protection Plan, Lake Okeechobee Phase II Technical Plan, etc.).
- Paul Gray will also provide a write up on the issue of RaSTAs and the CERP Lake Okeechobee Watershed Project. Armando will post these write-ups on the web communication page. The LOWP included construction of a relatively large structure in the channel of Fisheating Creek that was going to divert water to an off-stream storage site in the Cowbone Marsh area east of the intersection of Fisheating Creek and Route 27. Some of the reasons provided at the meeting for why the previous project did not

proceed and which needs to be incorporated in the data summary report included the following:
    - Indian mounds in this area could not be flooded
    - Flooding in the area would negatively affect swallow-tailed kites
    - Removing water from the creek would change the nature of the ecology of the waterbody and surrounding area
    - Structure in river would hamper navigability of creek
    - Herbert Hoover Dike is a national monument that cannot be altered in any way
- Compilation of what the Nature Conservancy, Sarah Lynch and a listing of alternative storage activities (projects) and objectives to be provided.
- Bonnie Wolff to provide a report prepared for FEC by Army Corp Engineers (USACE) from 1950's to Armando.
- Joyce Zhang, SFWMD, mentioned that a CD exists with water quality data on it for past three years at the junction of SR 70 and Fisheating Creek (Trish Burke is the contact person) –Joyce will provide the data to the M&E team.
- There is a draft report by UF that has some water quality and/or model evaluation in it that we should have. It appeared from the discussion that Joyce may have this report titled "Peer Review of the Watershed Assessment Model (WAM)".
- Joyce Zhang to provide information on the P budget project report by the Mock Roos Team.
- Obtain GIS shape files for State Managed Lands (State, federal and privately managed lands) - Hilary to email this to Pinar and/or Armando.
- M&E will contact Steve Schubert, USFWS to obtain information regarding previous UMAM in watershed and previous fine-tuning of FLUCCS codes coverage in watershed-HDR report (Paul Gray referenced page 116 of our current draft final Data/Document Summary Report regarding this issue).
- Cost-share reference data (not only SFWMD, but other partners) to be provided. This information is presented in the LOP2TP but additional information may be available. M&E | AECOM to add this to the Gap Analysis list.
- USGS is collecting flow and load data (SR 70) should be obtained
- Chad Kennedy will get background of FDEP's position(s) on FEC easement projects
- District to post modeling peer review document for stakeholders

- **Adjournment**

Meeting adjourned at approximately 12:00 pm.

Fisheating Creek Sub-Watershed Feasibility Study – Phase 1

Feasibility Report Working Team Meeting #2
Sign in Sheet

Name	Representing	Phone Number
1. Jim Penkosky	M&E/AECOM WATER	954.745.7215
2. Zuhal Ozturk	M&E/AECOM WATER	954.745.7238
3. Dominique Brocard	M&E/AECOM WATER	781.224.6321
4. Steffany Gornak	SFWMD	863.462-5260
5. Michelle Pearcy	M&E/AECOM	561.670.5477
6. Raulie Raulerson	SFWMD	863-462-5260
7. Steve Schubert	USFWS	772 562-3909x249
8. Armando Ramirez	SFWMD	561.629.6974
9. Larry Brion	SFWMD	561.682.6526
10. Jennifer Thera	DEP-SD	239-332-6975
11. Joyce Zhang	SFWMD	561-682 6341
12. Jennifer Breen	SFWMD	781-224-6474

February 13, 2009

Attachment A:
Alternatives Workshop Sign-In Sheet

Fisheating Creek Sub-Watershed Feasibility Study – Phase 1

Feasibility Report Working Team Meeting #2
Sign in Sheet

Name	Representing	Phone Number
13. John Winsfree	TNC	561 732 6550
14. Vanessa Bessey	FDACS	863-462-5991
15. Mike Izzarone	TNC	561-732-6550
16. Wayne Godwin	Westby Corp.	
17. Brian Wolff Pelaez	FDACS	863-467-5881
18. DONALD FOX	FFWCC	863-462-5024
19. Scott Hefty	SFWMD	239 338-2929
20. Chad Kennedy	FDEP	561-681-6706
21. Sarah Lynch	Florida Ranchlands	
22. LISA JENSEN	ABG	863 679 9595
23. Hilary Swain	Archbold	863 465 2571
24.		

February 13, 2009

Fisheating Creek Sub-Watershed Feasibility Study – Phase 1

Feasibility Report Working Team Meeting #2
Sign in Sheet

Name	Representing	Phone Number
25. Davies Mtandu	SFWMD	561-682-6581
26. Kevin Carter	"	
27. Paul Gray	Audubon	863-655-1831
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February 13, 2009