
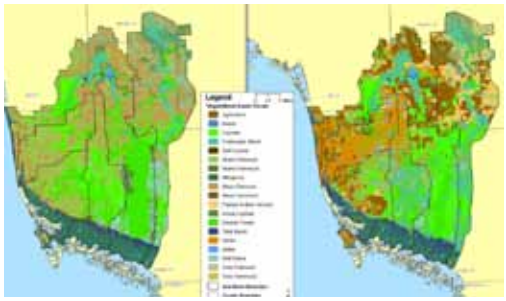

Collier County watershed management plan

Final Report Volume 2:

Analysis of Alternatives and Structural Recommendations

01022-12

Collier County

Prepared by: ATKINS

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FINAL REPORT

COLLIER COUNTY WATERSHED MANAGEMENT PLAN COLLIER COUNTY, FLORIDA

VOLUME 2: ANALYSIS OF ALTERNATIVES AND STRUCTURAL RECOMMENDATIONS

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Acronyms and Abbreviations

ECM	Existing Conditions Model
EMC	Event Mean Concentration
ET	Evapotranspiration
FDEP	Florida Department of Environmental Protection
FLUCCS	Florida Land Use, Land Cover Classification System
FLUE	Future Land Use Element
IWR	Impaired Waters Rule
LID	Low Impact Development Techniques
NEXRAD	High Resolution Radar
NGGEFRA	North Golden Gate Estates Flowway Restoration Area
NGGEFRP	North Golden Gate Estates Flowway Restoration Program
NSM	Natural Systems Model
RFMU	Rural Fringe Mixed Use
RWCA	Recyclable Water Containment Areas
SFWMD	South Florida Water Management District
SWFFS	Southwest Florida Feasibility Study
TDR	Transfer of Development Rights
TMDL	Total Maximum Daily Load
TTI	Ten Thousand Islands
URF	Urban Residential Fringe
USACE	United States Army Corps of Engineers
WBID	Water body Identification Number

1.0 Introduction

Watershed Management recommendations provide the means by which to protect natural resources, restore critical ecosystem functions, and implement stormwater solutions that integrate the developed and natural environments in Collier County.

Watershed Stressors

Watershed stressors are driven by population growth and the needs of urban development. The Collier Interactive Growth Model (CIGM) (Van Buskirk, 2008) predicts that the population of Collier County at full build-out will be approximately 950,000. The additional development will occur primarily east of Collier Boulevard and north of I-75. The Van Buskirk model suggests that the Golden Gate Estates area will be the first area to be more densely developed. Properties that are currently designated as Rural Lands Stewardship Areas are also predicted to convert to highly urbanized areas in the next 50–60 years.

The Lower West Coast Water Supply Plan (LWCWSP) (SFWMD, 2005-2006) evaluated issues related to water supply and environmental issues based on projections out to the year 2025. According to the LWCWSP, there are three primary issues to be considered when planning for the future in Collier County:

- Saltwater intrusion, wetland protection, and interference with existing land uses will significantly limit increased usage of existing groundwater and surface water supplies.
- Freshwater high-flow discharges from altered surface water systems in the planning area are impacting coastal resources and estuaries. Capturing some of the excess surface and storm water for water supply purposes would improve water supply availability and benefit the environment.
- Additional water storage is needed to create opportunities to fully use reclaimed water and seasonal surface water resources to meet urban irrigation needs.

In addition, further stress to Collier County's environmental system will result from sea level rise. At this time, scientists have only developed potential future scenarios of the magnitude of that impact. They range from minimum to significant. Actual impacts will have to be tracked in the coming years.

Recommended Structural Recommendations

Recommendations for structural and non-structural means of watershed management and improvement are the core of the CCWMP and provide the means by which to protect natural resources, restore critical ecosystem functions, and implement stormwater solutions that integrate the developed and natural environments in Collier County. Volume 2 is a stand-alone report that describes the structural best management

practices (BMPs) recommended for implementation. This document, along with three other project reports, comprises the final documents for the Collier County Watershed Management Plan (CCWMP). Volume 1 presents a summary of existing conditions in the watersheds and estuaries and the performance measures developed for evaluating potential projects. Volume 3 describes the non-structural initiatives recommended for implementation as part of the watershed management plan. Volume 4 is a compilation of the individual technical memoranda completed to address existing conditions in the watershed and estuaries and presents the details of the analyses conducted as part of this project.

The proposed structural projects will help address the impacts of the watershed stressors. Volume 2 was prepared as a stand-alone document. This volume presents a list of recommendations for implementation of specific watershed management projects and initiatives for both the watersheds and estuaries. Recommendations were developed based on differences in historical and existing conditions in the watersheds and estuaries and then examining the changes necessary to help restore the natural function of a system to the extent practical. The differences in historical and existing conditions and the development of performance measures against which to evaluate the success of projects were described in Volume 1.

The proposed structural improvement projects have been prioritized for implementation based on cost and benefits, but the final implementation strategy will depend on several other factors such as availability of resources and public support. It is noted that the structural improvements provide only partial solutions to the water resource issues facing the county. They are complemented by non-structural, policy based, initiatives that are described in Volume 3.

2.0 Identification of Potential Structural Projects

The approach for analyzing previously identified projects was to provide definition to define their implementation feasibility.

This section addresses the method used to identify potential projects in Collier County. The process is divided into the steps described in detail below. These steps include the following:

1. Review completed studies to identify previously proposed projects.
2. Identify new improvement projects
3. Initial Screening

Review Completed Studies to Identify Previously Proposed Projects

Many studies have been completed to identify potential projects within specific areas of Collier County. Because the descriptions of the projects vary widely from specific details to general concepts, our approach was to provide definition to the projects that so require so as to be able to define their implementation feasibility. Following is a description of the identified projects.

Picayune Strand Restoration Project

The Picayune Strand Restoration Project (PSRP) was designed by the USACE and the SFWMD to restore the wetlands of the Picayune Strand located in Collier County south of I-75. The projects calls for the installation of ditch blocks in four (4) canals and the construction of three (3) pump stations to move water into the overland flow plain. Figure 2-1 shows the components of the PSRP. This project is under construction and will be included in the "with project" evaluation as part of the alternative scenarios.

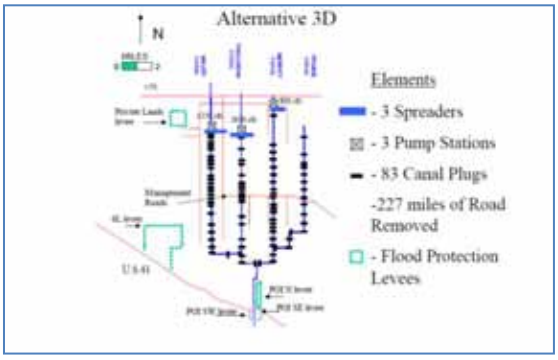

Figure 2-1. Components of the Picayune Strand Restoration Project

Southwest Florida Feasibility Study

The SWFFS is an ongoing project funded by the USACE and the SFWMD. This project considers projects that will improve water quality, restore wetland habitat, improve estuary systems, and remove exotic species in the Cocohatchee, Estero, and Big Cypress Basins. Several projects were recommended in Collier County. These are described below:

- Okaloacoochee Flowway Restoration – This project provides little detail in the SWFFS documentation. The concept is to improve the wetland system by improving the flowway by removing man-made impediments. Specific projects to support this concept have been proposed.
- Camp Keais Strand Flowway Restoration – This project provides little detail in the SWFFS documentation. The concept is to improve the

wetland system by improving the flowway by removing man-made impediments. The Rural Lands Stewardship Area program provides incentives to restore the Camp Keais Flowway Stewardship Area. The designation of most of the flowway as Stewardship Sending Areas has already been accomplished.

- Corkscrew Swamp Flowway Restoration – This project provides little detail in the SWFFS documentation. The concept is to improve the wetland system by improving the flowway by removing man-made impediments. PBS&J has proposed specific projects to support this concept.
- Off-Line Storage Reservoirs – The SWFFS identified several potential off-line storage reservoir locations in the Golden Gate-Naples Bay, and Faka Union watersheds. These proposed projects are described in more detail in the watershed specific projects section.
- SR-29 Flowway Restoration – This project calls for the SR-29 Canal to be plugged with ditch blocks at regular intervals. Culverts underneath SR-29 will be used to divert water to the west into Fakahatchee Strand. Other components include the construction of spreader canal and pump stations to divert water into wetland systems north of I-75.

Belle Meade Stormwater Management Master Plan

The Belle Meade Stormwater Management Plan was completed in 2006 and describes a number of projects to rehydrate wetlands and restore historical flow patterns to Rookery Bay. These projects are shown in Figure 2-2. Conditions have changed since this report was published; however, most proposed projects are still relevant. Updates and details have been added as needed. For example, a series of flow way restoration projects were identified through the agricultural area in the southeast portion of the Rookery Bay watershed. These lands are now part of the "Receiving Areas" for development credits, which limits current restoration opportunities. Recommendations are made to facilitate restoration of the flowways when urban development occurs in the future.

Figure 2-2. Components of the Belle Meade Stormwater Management Master Plan

North Golden Gate Estates Flowway Restoration Project

This project is sponsored by the Collier Soil and Water Conservation District. The concept is to link the wetland systems in the Northern Golden Gates Estates that were fragmented by construction of the Golden Gate Canal network and the residential

road network. PBS&J will coordinate with the Collier Soil and Water Conservation District and will include projects defined as part of the project in the alternative scenario simulations.

Lely Area Stormwater Improvement Project

This project focused primarily on stormwater management issues in the Lely area of the Rookery Bay watershed. Projects include, but are not limited to, culvert and structure upgrades, spreader swales, removal of exotic species, and expansion of stormwater ponds. Many of the projects have been built and are included in the ECM. Other components are scheduled for construction over the next 3–5 years and all will be included in the alternative scenarios simulations.

Immokalee Stormwater Master Plan

This project focused primarily on stormwater management issues in the Immokalee area of the Okaloacoochee–SR 29 watershed. Projects include, but are not limited to, culvert and structure upgrades, rapid infiltration trenches, and spreader swales. It is assumed that all of the projects will be constructed and they will be included in the alternative scenario simulations.

Gordon River Improvements

This project focused on stormwater and wetland restoration projects in the Gordon River Extension. Projects included culvert upgrades along the Gordon River corridor and the development of water quality parks. The parks have been built and it is assumed that the upgraded culverts will be installed in the near future. All will be included in the alternative scenario simulations.

Other South Florida Water Management District (SFWMD) Projects

The SFWMD has several projects in process. Most of the projects include redesign of existing structures to improve management capability. The redesigned GG-3 structure is now operational in a new location. In addition, the SFWMD plans to replace the GG-6, GG-7, and Miller3 structures in the near future. The SFWMD is also considering a project to divert water from the Golden Gate Main Canal to the Henderson Creek Canal. Specific conceptual characteristics of this project have been identified and were used to assess its potential benefits and disadvantages.

New Projects

Atkins conducted desktop and field level investigations to refine potential projects identified by others and to identify potential new improvements. To complete this task, Atkins considered several key factors when identifying potential project locations:

Estuary Freshwater Surplus/Deficit

The status of the receiving estuary is important in determining the types of projects to be identified. If the estuary receives a surplus, it is necessary to identify projects that will store or divert, or otherwise reduce the volume of flow released to the estuary. Similarly, if the estuary has a flow deficit, projects must be identified that will increase flow to the estuary at the appropriate time.

Changes in Hydrology

If the hydrologic analysis indicates that the hydrology of a wetland area has changed, then the projects' objective will be to restore the hydroperiod or depth of water to a more desirable condition.

Future roadway improvements

This issue will help determine the location of future projects or how a project will be configured to accommodate the footprint of future roadways.

Property Ownership

Projects can be implemented on publicly owned lands more readily and at less cost that on privately owned lands. Publicly owned lands include properties that have existing conservation easements or are within the Rural Fringe Sending Areas. Properties that fall within the "Receiving Areas" are assumed to be unavailable for implementation of specific projects.

Initial Project Screening

During the initial screening process, more than 100 potential projects were identified. Many of those projects were eliminated from further consideration because they did not support the water quantity and water quality goals of the Watershed Management Plans. The types of projects that were eliminated from further consider include:

- Wildlife road crossing
- Exotic species removal
- Local flood control projects
- Projects that fall within designated Rural Fringe Receiving Areas. It is expected that wetland protection activities in these areas would be managed through changes in the Land Development Code.
- Berm removal projects that cannot be adequately represented at the regional scale.
- Urban *BMPs designed to provide water quality treatment.*
- *Project*s that have been recommended for implementation or are scheduled for construction. This includes projects located at sites with active permits.

Table 2-1 lists each of the projects identified during this task and offers comment about the potential application of each to the regional watershed assessment process.

A total of 27 individual projects were identified for further evaluation. These include

- One project in the Cocohatchee-Corkscrew watershed
- Ten projects in the Golden Gate – Naples Bay watershed
- Six projects in the Rookery Bay watershed, and
- Ten projects in the Faka Union, Fakahatchee, and Okaloacoochee-SR29 watersheds.

Watershed	Project Name	Comment
Cocohatchee-Corkscrew	Bird Rookery Swamp Hydrologic Improvement	Permitted
	Candlewood Lane Culvert Improvements	Local Flood Control
	Cocohatchee Slough	Project defined
	Corkscrew Watershed Agricultural Containment Area	Incentive Based Program
	CREW Acquisition and Management	CREW managed lands
	East Bird Rookery Swamp Upland Habitat Restoration	Replanting with xeric pine
	LivingstonE/W Drainage Outfall	Local Flood Control
	Madison Creek	Local Flood Control
	Northern Golden Gate Estates Unit 53 Restoration and Acquisition	Project defined
	Slough Cross Drains	Local Flood Control

Table 2-1. Projects Identified during the Initial Screening by Watershed

Table 2-1. Projects Identified during the Initial Screening by Watershed (Cont'd)

Watershed	Project Name	Comment
Golden Gate - Naples Bay	4th Street NE Ditch Blocks	Project defined
	Channel Excavation along Goodlette Rd.	Local Flood Control
	Channel Excavation under Royal Poinciana Bridge	Local Flood Control
	Cypress Canal Storage Reservoir	Project defined
	Golden Gate Canal Storage Reservoir	Project defined
	Golden Gate City Master Plan - Northeast Quadrant	Local Flood Control
	Golden Gate City Master Plan - Northwest Quadrant	Local Flood Control
	Golden Gate City Master Plan - Southwest Quadrant	Local Flood Control
	Golden Gate City Master Plan - Southeast Quadrant	Local Flood Control
	Henderson Creek Diversion	Project defined
	Horsepen Strand	Projects defined
	Northern Golden Gate Estates Canal/Weir Improvements	Project defined
	Orange Tree Canal	Project defined
	Outfall for Royal Palm Estates	Local Flood Control
	Pine Ridge Outfall	Local Flood Control
	Pine Ridge Rd (North Side)	Local Flood Control
	Replace existing pipe along GG Pkwy	Local Flood Control
	Replace existing pipe along Goodlette Rd	Local Flood Control
	Replace existing pipe along Goodlette Rd	Local Flood Control
	Replace existing pipe under 26th Ave.	Local Flood Control
	Replace existing pipe under Creech Rd	Local Flood Control
	Replace existing pipe under Ohio Dr.	Local Flood Control
	Replace existing pipe under Pompei Ln.	Local Flood Control
	Replace existing pipe under Ridge Rd	Local Flood Control
	Replace existing pipe under Solana Rd.	Local Flood Control
	Weir Replacement Pine Ridge # 1	Local Flood Control
	Widen existing cross-sections along Reach 3	Local Flood Control
	Wolfe Rd Water Quality Treatment	Project defined

Table 2-1. Projects Identified during the Initial Screening by Watershed (Cont'd)

Watershed	Project Name	Comment
Rookery Bay	Belle Meade	Check individual components
	Belle Meade Flow-way South of I-75	Project defined
	Belle Meade Flow-way south of Tamiami Trail	Agricultural land within Rural Fringe Neutral area. LDC will define restoration activities
	Belle Meade Flow-way south of Tamiami Trail	Agricultural land within Rural Fringe Neutral area. LDC will define restoration activities
	Belle Meade Stormwater Master Plan	Check individual components
	Belle Meade Stormwater Master Plan/Central Flow-way Restoration	Within Rural Fringe Receiving Lands. LDC will define restoration activities
	Belle Meade WQ Treatment Area	Within Rural Fringe Receiving Lands. LDC will define restoration activities
	Bone Fish Springs Acquisition	Land Acquisition
	CR 92 Culverting	Local Flood Control
	CR 951 Culverting	Local Flood Control
	Fiddlers Creek Spreader System	Conflicts with Marco Island Facility
	Griffin road	Design is on-going
	Henderson Creek MAPS	Algal Scrubber for WQ
	Henderson Creek Storage Reservoir	Project defined
	Lely Area Stormwater Improvement Project	Construction program underway
	Manatee Road Area Improvements	Local Flood Control
	North Belle Meade Rehydration	Project defined
	North Belle Meade WQ Treatment Area	Permit pending for mining activity
	Road regrading	Projects defined
	Sabal Palm Spreader System	Cannot be represented at regional scale
	Shell Island Rd. Culvert Installation	Flowway Restoration (project completed)
	South Belle Meade Flow-way	Evaluate individual components
	Stormwater Treatment Area - Tamiami Canal and Manatee Rd.	Project defined
	Tomato Road Diversions	Cannot be represented at regional scale

Table 2-1. Projects Identified during the Initial Screening by Watershed (Cont'd)

Watershed	Project Name	Comment
Faka Union	Faka Union Hydrologic Restoration	Berm Removal
	Picayune Strand at I-75 WQ Treatment Area	Part of Northern Golden Gate Estates Flowway
Fakahatchee	Camp Keais Extensions (Multiple)	Projects defined
	Camp Keais Strand Agricultural Containment Area (multiple)	Incentive Based Program
	Camp Keais Water Quality Treatment Area (multiple)	Incentive Based Program
	CREW/Camp Keais Marsh Restoration	Projects defined
	CREW/Camp Keais Marsh Restoration	Projects defined
	CREW/Pepper Ranch Acquistion	Water Containment Areas/exotic species
	Fakahatchee Strand/Ten Thousand Islands Connector	Berm Removal ; Airboat trail restoration
	Florida Panther NWR Okaloacoochee Slough Hydrologic Restoration	Recommended in SWFFS
	Florida Panther NWR Wetland	Recommended in SWFFS
	Florida Panther NWR Wetland	Recommended in SWFFS
	I-75 Panther NWR Canal Plugs	Evaluated in SWFFS
	Janes Scenic Drive Culverts	Local Flood Control
	Lake Trafford	Dredging is complete; urban BMPs
	Mud Lake Strand	WQ treatment is flowway
	Route 41 Culvert Emplacement West of the Tamiami Trail Culverts Project	Local Flood Control
	Rural Lands R2 Other listed species	In Rural Lands Stewardship
	Rural Lands R2 Wading Bird	In Rural Lands Stewardship
	Shaggy Cypress addition to Camp Keais Strand (multiple)	Land purchase; project considered
	Wildlife Crossing/Oil Well Road East	Wildlife Crossing
	Wildlife Crossing/Oil Well Road West	Wildlife Crossing

Table 2-1. Projects Identified during the Initial Screening by Watershed (Cont'd)

Watershed	Project Name	Comment
Okaloacoochee Slough/SR29	Bear Island Road Network	Outside Model Domain
	Downtown Immokalee	Local Flood Control
	Half Circle L Ranch	Biological conservation
	Immokalee Drive	Local Flood Control
	Immokalee Stormwater Master Plan	Local Flood Control
	Immokalee Connector	Exotics Removal and Local Flood Control
	Okaloacoochee Slough Agricultural Containment Area	Incentive Based Program
	Okaloacoochee Slough Agricultural Containment Area (Multiple)	Incentive Based Program
	Okaloacoochee Slough Flowway from the Caloosahatchee to the Big Cypress Swamp	Projects defined
	Okaloacoochee Slough Wildlife Management Area Hydrologic Restoration	Projects defined
	Palm Tree Farm Restoration	Restore natural vegetation
	Rural Lands R1 Wading Bird	In Rural Lands Stewardship
	SR 29/Barron River Flow-way Restoration	Recommended in SWFFS
	SR 29/Barron River Flow-way Restoration	Recommended in SWFFS
	SR29/Barron River Flow-way Restoration	Recommended in SWFFS
	SR29/Barron River Water Control	Recommended in SWFFS
	SR29/Barron River Water Control	Recommended in SWFFS
	Wildlife Crossing/SR29 South	Wildlife Crossing
	Wildlife Crossing/Immokalee Road East	Wildlife Crossing
	Wildlife Crossing/Immokalee Road West	Wildlife Crossing
	Wildlife Crossing/SR 29 North	Wildlife Crossing

3.0 Alternative Analysis

The purpose of the non-structural initiatives is to formulate recommendations that would allow for the implementation of an environmentally sustainable management program to will guide future land development activities in Collier County.

This section describes the methodology used to evaluate each of the 27 projects that were found to be potentially feasible during the initial screening process. The objective was to evaluate the identified projects in more detail, select those that are recommended for implementation, and rank the projects based on expected benefits and costs.

General Methodology

The process included three evaluation steps:

a) Assessment of the project's feasibility based on permittability and constructability

b) Evaluation of project benefits based on the application of performance measures.

c) Cost estimating

d) Calculation of the benefit versus cost (B/C) ratio

Permittability and Constructability

The permittability review considered potential environmental impacts that would make a project difficult to obtain the necessary permits from the regulatory agencies, namely the South Florida Water Management District (SFWMD), Florida Department of Environmental Protection (FDEP), and the Corps of Engineers (USACOE). The constructability evaluation considered project location, property ownership and land acquisition needs, site characteristics, technical limitations such as infiltration capacity or tidal influences, difficulty of installing project components, public acceptance, and operation and management issues. A total of 7 of the original 27 projects were eliminated from further consideration based on these criteria. Two or the projects were merged with other projects. The projects are listed in Table 2-2, along with related comments.

Types of Feasible Structural Projects

The projects that passed the permittability and constructability assessment were grouped in two categories; publicly funded projects that could be implemented by Collier County, the SFWMD, or other public entity; and privately funded projects that could be implemented by private property owners through existing incentive programs.

Recommended Public Structural Projects

A total of 10 projects have been identified that may be implemented through public funding. Following are brief descriptions of those projects. Full project descriptions are included in **Appendix 2-A**.

Table 2-2. Comments on Permittability and Constructability

Watershed	Project ID	Project Name	Comments
Cocohatchee-Corkscrew	CC-3	Corkscrew Regional Ecosystem Watershed	Alternative Analysis
Golden Gate - Naples Bay	GG-1	Upper Golden Gate Operable Weir	Alternative Analysis
	GG-2	NGGE Flowway Restoration	Alternative Analysis
	GG-3	Corkscrew Regional Ecosystem Watershed - Area 4	Merged with CC-3
	GG-4	4th Street NE - Ditch Block	Provides no benefit; area is part to roadside stormwater management area
	GG-5	Wolfe Road Wetland Treatment System	Alternative Analysis
	GG-6	Cypress Canal Off-line Reservoir	The location conflicts will Collier County wellfield. Reservoir would drain quickly back to adjacent canal.
	GG-7	Orange Tree Canal Operable Weir	Alternative Analysis
	GG-8	Golden Gate Canal Off-line Reservoir	Reservoir would drain quickly back to Golden Gate Canal via baseflow and provides no benefit as a stand-alone project.
	GG-9	Golden Gate Canal Water Supply Reservoir	Insufficient storage volume for water supply source
	GG-10	Henderson Creek Diversion	Alternative Analysis
Rookery Bay	RB-1	North Belle Meade Spreader Swale	Alternative Analysis
	RB-2	South I-75 Canal Spreader Swale	Alternative Analysis
	RB-3	Henderson Creek Off-line Reservoir	Alternative Analysis
	RB-4	Picayune Strand Natural Grade Restoration - Area 1	Provides no benefit
	RB-5	Picayune Strand Natural Grade Restoration - Area 2	Provides no benefit
	RB-6	Henderson Creek Spreader Swale	Location conflicts with Marco Island facility
	RB-7	US Highway 41 Stormwater Treatment Area	Alternative Analysis
Faka Union	FA-1	Winchester Head Rehydration	Merged with GG-2
Fakahatchee	FH-1	Fakahatchee Wetland Restoration - Area 1	Alternative Analysis
	FH-3	Fakahatchee Wetland Restoration - Area 3	Alternative Analysis
Okaloacoochee/SR29	OK-1	Upper Okaloacoochee SloughWetland Restoration	Alternative Analysis
	OK-2	Middle Okaloacoochee SloughWetland Restoration	Alternative Analysis
	OK-3	Lower Okaloacoochee Slough Wetland Restoration	Alternative Analysis
	OK-4	Okaloacoochee Wetland Restoration - Area 1	Alternative Analysis
	OK-5	Okaloacoochee Wetland Restoration - Area 2	Alternative Analysis
	OK-6	Okaloacoochee Wetland Restoration - Area 3	Alternative Analysis

Project 1: North Belle Meade Rehydration

This project includes a constructed spreader swale to rehydrate wetland areas north of I-75, south of the Golden Gate Main Canal, and west of the Miller Canal. A pump station would be constructed to divert water from the Golden Gate Main Canal into the spreader swale and thus increase the volume of fresh water delivered to Rookery Bay, which experiences a water deficit. The project is predicted to reduce the volume of discharge to Naples Bay by 10 percent and will provide treatment of the diverted water in the wetland systems. Full design would need to consider the conveyance capability of the culverts under I-75.

Project 2: Northern Golden Gate Estates Northern Golden Gate Estates Flowway Restoration

The purpose of this project is to restore wetland flow paths and reconnect isolated wetlands in the Northern Golden Gate Estates between the Golden Gate and Faka Union Canals. Implementation of this project would reduce the volume of water entering the canals and provide water quality treatment of runoff. The project would also provide groundwater recharge to benefit the

potable water supply wellfield in the area. One of the recommended non-structural initiatives to incentivize project implementation is to a) designate this area as a mitigation bank and b) implement a Transferrable Development Rights (TDR) program to help acquire residential property rights.

Project 3: Henderson Creek Diversion

This project would utilize a 100 cfs pump station constructed near the new GG-3 structure to divert water from the Golden Gate Main Canal to the Henderson Creek Canal. The project is predicted to reduce the volume of discharge to Naples Bay by about 10 percent. The project will also increase the volume of water entering Rookery Bay. This project's benefits are strictly about water quantity. Pollution removal potential is limited.

Project 4: South I-75 Spreader Swale

This conceptual project focuses on rehydration of wetland areas in the Rookery Bay portion of the Picayune Strand State Forest. A spreader swale would be constructed to facilitate movement of water out of the canals that parallel I-75 and direct the water south via overland flow. This would provide water quality and wetland hydrology benefits. The project is also predicted to affect the timing of flows to Rookery Bay, although it is unlikely to have a significant effect on the volume of water reaching the estuary.

Project 5: Corkscrew Regional Watershed Improvements

This proposed project consists of constructing ditch blocks to restore wetland hydrology in lands located adjacent to the Corkscrew Regional Ecosystem Watershed. The project is predicted to affect the timing of flows to the Wiggins Pass Estuary and to provide improvements in wetland habitat and water quality treatment in the area.

Project 6: Henderson Creek Off-line Storage Reservoir

This is a future project that relies upon acquisition of an active mining operation after the mine reaches the end of its economic life. The mine pit would be used to store water pumped from Henderson Creek during the wet season. Recharge from the mine pit to the Water Table aquifer is predicted to have no effect on the nearby wellfield that draws from the Mid-Hawthorne aquifer; however, it may augment the available groundwater flow at the Marco Island water intake near US-41. The operation of this off-line reservoir is expected to reduce wet season discharge from Henderson Creek and be used to supplement dry season flows to the Rookery Bay estuary.

Project 7: US 41 Stormwater Treatment Area

This conceptual project involves construction of a Stormwater Treatment Area adjacent to the US-41 canal in the Rookery Bay watershed. The project will provide water quality treatment and off-line storage of runoff from the highway.

Project 8: Wolfe Road Wetland Treatment Area

This proposed project would utilize existing pond features at the western end of Wolfe Road to treat runoff that is currently directed into the Island Walk Subdivision. The project is predicted to reduce the volume of water entering the Island Walk stormwater management system, reduce the

incoming nutrient load, and provide additional groundwater recharge in the area.

Project 9: Upper Golden Gate Canal Weir Construction

The canal on the north side of the Collier County Fairgrounds currently discharges to the Golden Gate Canal without restraint. It is recommended that an operable weir structure be constructed near the outlet of the canal. The weir structure will allow more runoff to be stored in the canal network and can also be used to reduce baseflow between storm events. The project is predicted to contribute to the reduction of flow to Naples Bay.

Project 10: Orange Tree Canal Weir Construction

The Orange Tree Canal currently discharges to the Golden Gate Canal. No water control features exists along this system. This project involves construction of an operable weir structure near the Orange Tree canal outlet. The operable weir could be operated to store more runoff in the canal during storm events and also to reduce baseflow between storm events. The project is predicted to contribute to reduced flows to Naples Bay.

Incentive Based Projects

Several feasible projects may be constructed within Stewardship Sending Areas (SSAs) or within Flowway Stewardship Areas. Implementation of these, and other similar types of projects, should be encouraged through existing incentive programs. Full descriptions of these conceptual projects are included in Appendix 2-B

Five of the conceptual projects identified in the SSAs involve restoration of isolated wetland areas that have been drained for agricultural or logging purposes. The concept is to utilize existing dredge spoil to backfill or to create blocks within the ditches that were dug to drain the wetlands. Two (2) of these projects are located in the Fakahatchee watershed and three (3) in the Okaloacoochee watershed. These projects would provide significant local scale benefits to wetland hydrology and water quality treatment, but are unlikely to have a significant effect on discharges to the Ten Thousand Islands estuary.

Other, more significant feasible wetland restoration projects are located within the Okaloacoochee Slough Flowway Protection Area. Ditches exist that provide preferential flow paths through the slough area and speed delivery of runoff to the estuary. It is recommended that ditch blocks or other similar methods be used to restore the historic overland flow pattern. These conceptual projects may require public –private partnerships to implement.

4.0 Estimated Project Benefits

The purpose of the non-structural initiatives is to formulate recommendations that would allow for the implementation of an environmentally sustainable management program to will guide future land development activities in Collier County.

Methods

The method used to estimate project benefits evaluated each project individually. Benefits were defined as the increase in watershed score resulting from each of the previously-defined performance measures: water quantity, pollution load, wetland hydrology, and groundwater recharge. The process consisted of first conducting an assessment of project benefits, as described below and subsequently applying weighting factors that considered both the special characteristics of each watershed and the relative importance of the watershed issues for watershed management purposes. It is noted that flood protection was also initially considered as a performance measure, but it was determined that none of the proposed projects would have a negative impact on flood elevations because project operation would be such that water diversion structures, including pump stations, that may have the potential of affecting the conveyance capacity of the drainage network would cease operations during periods when large storm events are anticipated.

Water Quantity Benefits

The benefit of a project was measured based on the effect it would have on the volume of fresh water discharged to the estuarine systems.

The post-project score was determined by comparing the monthly fresh water discharges to the natural system condition. Changes in monthly discharge patterns were estimated for each project based on water pumping rates and corresponding water diversion volumes. Subsequently the post project scores were compared to those for the existing condition. The project benefit was defined as the "lift" in watershed score due to project implementation.

Pollutant Load Reduction Benefits

The water quality benefits were measured in terms of the anticipated anthropogenic pollutant load reduction. This evaluation focused on total nitrogen and total phosphorus because those are the pollutants of primary concern in Collier County and Florida in general. The predicted post-project pollutant load removed was calculated based on typical removal rates associated with runoff treatment processes associated with a project. For the most part proposed projects would remove pollutants through created/restored wetland systems. Based on available literature values, it was assumed that removal efficiencies would be 30 and 65 percent for total nitrogen and total phosphorus, respectively. Once the pollutant load reduction benefits were quantified for each specific project, the overall watershed impact was determined by calculating the post-project pollutant loading score. As with the water quantity benefits, the

project benefit was defined as the "lift" in watershed score compared to existing conditions.

Wetland Hydrology Benefits

Each project was evaluated to consider the potential change in hydroperiod and average wet season water depth. The predicted hydroperiod and water depth were then used to generate post project performance measure scores in the area affected by the project. These new scores were then averaged with the scores in the remainder of the watershed to determine the average post-project hydrologic performance measure score for the watershed. As with the other evaluation criteria, the project benefit was defined as the "lift" in watershed score compared to existing conditions.

Groundwater Recharge Benefits

Each project was evaluated to consider the potential change in aquifer water level. The predicted groundwater levels in the Water Table and Lower Tamiami aquifers were used to generate post project watershed scores, which were then compared to the existing conditions scores. As with the other evaluation criteria, the project benefit was defined as the "lift" in watershed score compared to existing conditions.

General Description of Project Costs

The cost item in the calculation of the B/C ratio was cost of construction. It is recognized that project implementation also includes operation and management (O&M) costs. However, for project evaluation purposes, it was considered that O&M costs are generally proportional to the size of the project and weigh equally for all projects. Therefore, it is not necessary to include them for project prioritization purposes.

Detailed Evaluation of Project Benefits

As described previously, the identified feasible projects were evaluated to determine expected benefits based on each performance measure. Project benefits were defined as the "lift" in watershed performance measure score associated with discharge to estuaries, pollutant load removal, wetland hydrology, and groundwater recharge. **Table 2-3** shows the calculated score "lift" for each project. This first assessment of benefits was then modified by the application of weighting factors, as described later in this section, to prioritize project implementation.

It is noted that the scoring for all categories was based on a scale of 0 to 10 for all performance items. For example, if the existing conditions score for a given performance measure is 5 and the anticipated lift is 1.25, it means that the project is expected to raise the score to 6.25. As expected, large projects have a larger impact on watershed conditions, as opposed to local projects that may improve the characteristics of the immediate project area, but are not significant at the watershed level.

Project Benefit Weighting Factors

Two types of weighting factors were applied to further assess project benefits, a) watershed-based factor, and b) issue-based factor. The methodology is described below.

Table 2-3. Calculated Performance Measure Lift

Project Name	Discharge to Estuary Benefit	Water Quality Benefit	Wetland Hydrology/Habitat	Groundwater Benefit
	Performance Lift	Performance Lift	Performance Lift	Performance Lift
Corkscrew Regional Ecosystem Watershed	0.0000	0.0000	0.0314	0.000
North Golden Gate Estates Flowway Restoration Project	0.0095	0.6822	0.1177	0.1/0.1
North Belle Meade Spreader Swale[1]	0.89/1.25	0.4354	0.0358	0.200
South I-75 Canal Spreader Swale	0.0385	0.1759	0.1035	0.100
Henderson Creek Diversion [1]	0.89/1.67	0.0000	0.0000	0.000
Wolfe Road Wetland Treatment System	0.0000	0.0076	0.0000	0.050
Middle Okaloacoochee Slough Wetland Restoration	0.0000	0.2779	0.0154	0.000
Henderson Creek Off-Line Storage Reservior	0.3169	0.0237	0.0000	0.005
Lower Okaloacoochee Slough Wetland Restoration	0.0000	0.0588	0.0024	0.000
Upper Golden Gate Estates Canal Weir Constuction	0.0001	0.0000	0.0000	0.010
Orange Tree Canal Control Structure Installation	0.0001	0.0000	0.0000	0.010
Fakahatchee Wetland Restoration - Area 1	0.0000	0.0415	0.0001	0.000
US HWY 41 Stormwater Treatment Area	0.0000	0.0058	0.0015	0.000
Fakahatchee Wetland Restoration - Area 2	0.0000	0.0309	0.0001	0.000
Upper Okaloacoochee Slough Wetland Restoration	0.0000	0.0023	0.0004	0.000
Okaloacoochee Wetland Restoration - Area 2	0.0000	0.0000	0.0002	0.000
Okaloacoochee Wetland Restoration - Area 3	0.0000	0.0000	0.0002	0.000
Okaloacoochee Wetland Restoration - Area 1	0.0000	0.0000	0.0002	0.000

(1) Includes change in benefit score for multiple watersheds

Watershed-Based Weighting Factors

The calculated project benefit (lift of performance measure score) was modified by applying a watershed-based weighting factor that considers the differences in the extent of each watershed and the corresponding a) discharge to the receiving estuary, b) anthropogenic load, c) natural wetland systems and d) water demand for public supply and irrigation. This approach allowed project comparisons across watersheds and helped better represented the risk associated with each watershed. The weighting factors are described below.

Discharge to Estuary Weighting Factor

This factor is based on the assumption that runoff from a watershed will have more effect on the receiving estuary if the estuary is small in comparison to the drainage area. The equation used to define this weighting factor is as follows:

Discharge to Estuary WF = 10 - (10 x (Receiving Estuary Area / Watershed Area))

Pollution Load Weighting Factor

This factor considers the percentage of urban and agricultural lands in a watershed. The higher the percentage of these land use types, the greater the anthropogenic load, and the larger the weighting factor. The equation used to define this weighting factor is as follows:

Pollution Load WF = 10 x (Urban + Agricultural Area / Watershed Area)

Wetland Hydrology/Habitat Weighting Factor

This factor is based on the premise that it is more important to preserve and restore wetland habitat in watersheds with few wetland systems relative to the total watershed area. Therefore, the watersheds with the lowest percentage of wetland

habitat will have the highest weighting factor. In addition, it was considered that the natural system in the County has been impacted in a way that wetlands with short hydroperiods currently provide the most valuable and must receive an additional level of protection and restoration effort. The general equation used to determine this weighting factor is shown below. The final weighting factor for this parameter was derived as a weighted average of the factor value calculated for short hydroperiod wetlands and the factor value for long hydroperiod wetlands.

Wetland Hydrology/Habitat WF = 10 - (10 x (Short HP Wetland Area/Watershed Area))

Groundwater Demand Weighting Factor

This factor is based on the premise that it is more important to promote recharge in watersheds where water demand is higher. Therefore, watersheds with the highest demand for groundwater would have the highest weighting factor. This was calculated as the model predicted total volume of water pumped from the aquifer systems averaged over the watershed area.

Table 2-4 shows the calculated weighting factors for each watershed and performance measure.

Table 2-4. Evaluation Criteria Weighting Factors

Watershed	Weighting Factor			
	Discharge to Estuary	Water Quality	Wetland Hydrology/Habitat	Groundwater
Golden Gate/Naples Bay	9.75	6.06	7.85	5.86
Rookery Bay	6.55	2.45	6.98	1.21
FU-FA-OK/Ten Thousand Islands	7.27	1.81	3.82	2.91
Cocohatchee-Corkscrew/Wiggins Pass	9.75	4.01	5.92	3.88

Once the lift in performance measure score was modified by the weighting factors, they were normalized using a 0 to 10 scale. In this manner all scores were measured using the same scale. The normalized project scores by project are listed in **Tables 2-5** and 2**-6.**

Detailed Description of Project Costs

Conservative cost estimates were prepared for each of the publically funded projects such that a Benefit to Cost (B/C) ratio can be used as the basis for project prioritization. These estimates assumed no land acquisition costs if projects are located on publically owned lands, within Rural Fringe Sending Lands, within Stewardship Sending Areas, or within designated flowway protection areas. Table 2-7 lists the estimated construction cost by recommended capital project. Cost estimates, including estimates for engineering and construction, are also shown on the individual project sheets found in Appendix 1-A. Detailed cost estimates are included in Appendix 1-C. As shown, the total estimated construction cost for all Capital Improvement Projects included in the management plan amount to $24,322,000.

Table 2-5. Normalized Project Scores

Project Name	Discharge to Estuary Benefit				Water Quality Benefit			
	Performance Lift	Watershed Weighting	Weighted Score	Normalized Score	Performance Lift	Watershed Weighting	Weighted Score	Normalized Score
Corkscrew Regional Ecosystem Watershed	0.0000	9.75	0.0000	0.0000	0.0000	4.0062	0.0000	0.000
North Golden Gate Estates Flowway Restoration Project	0.0095	9.75	0.0927	0.0472	0.6822	6.0585	4.1330	10.000
North Belle Meade Spreader Swale[(1)]	0.89/1.25	9.75/6.55	16.865	8.5976	0.4354	2.4475	1.0658	2.579
South I-75 Canal Spreader Swale	0.0385	6.55	0.2525	0.1287	0.1759	2.4475	0.4304	1.041
Henderson Creek Diversion [(1)]	0.89/1.67	9.75/6.55	19.616	10.000	0.0000	6.0585	0.0000	0.000
Wolfe Road Wetland Treatment System	0.0000	9.75	0.0000	0.0000	0.0076	6.0585	0.0462	0.112
Henderson Creek Off-Line Storage Reservior	0.3169	6.55	2.0768	1.0587	0.0237	2.4475	0.0581	0.141
Upper Golden Gate Estates Canal Weir Constuction	0.0001	9.75	0.0006	0.0003	0.0000	6.0585	0.0000	0.000
Orange Tree Canal Control Structure Installation	0.0001	9.75	0.0005	0.0003	0.0000	6.0585	0.0000	0.000
US HWY 41 Stormwater Treatment Area	0.0000	6.55	0.0000	0.0000	0.0058	2.4475	0.0143	0.035

(1) Weighting considers benefits to two (2) watersheds.

Table 2-6. Normalized Project Scores

Project Name	Wetland Hydrology/Habitat Benefit				Groundwater Benefit			
	Performance Lift	Watershed Weighting	Weighted Score	Normalized Score	Performance Lift	Watershed Weighting	Weighted Score	Normalized Score
Corkscrew Regional Ecosystem Watershed	0.0314	5.9200	0.186	2.011	0.000	3.88	0.000	0.000
North Golden Gate Estates Flowway Restoration Project	0.1177	7.8500	0.924	10.000	0.1/0.1	5.86/2.91	0.877	10.000
North Belle Meade Spreader Swale[(1)]	0.0358	6.9800	0.250	2.703	0.200	1.21	0.242	2.759
South I-75 Canal Spreader Swale	0.1035	6.9800	0.722	7.814	0.100	1.21	0.121	1.380
Henderson Creek Diversion [(1)]	0.0000	6.9800	0.000	0.000	0.000	1.21	0.000	0.000
Wolfe Road Wetland Treatment System	0.0000	7.8500	0.000	0.000	0.050	5.86	0.293	3.341
Henderson Creek Off-Line Storage Reservior	0.0000	6.9800	0.000	0.000	0.005	1.21	0.006	0.069
Upper Golden Gate Estates Canal Weir Constuction	0.0000	7.8500	0.000	0.000	0.010	5.86	0.059	0.668
Orange Tree Canal Control Structure Installation	0.0000	7.8500	0.000	0.000	0.010	5.86	0.059	0.668
US HWY 41 Stormwater Treatment Area	0.0015	6.9800	0.011	0.117	0.000	1.21	0.000	0.000

(1) Weighting considers benefits to two (2) watersheds.

Table 2-7. Total Normalized Project Scores

Project Name	Discharge to Estuary Benefit Normalized Score	Water Quality Benefit Normalized Score	Wetland Hydrology/Habit Normalized Score	Groundwater Benefit Normalized Score	Total Normalized Project Score	ESTIMATED PROJECT COST Cost (In Millions of Dollars)	Benefit-to-Cost Ratio
North Golden Gate Estates Flowway Restoration Project	0.0472	10.000	10.000	10.000	30.094	$2.368	**12.71**
North Belle Meade Spreader Swale[1]	8.5976	2.579	2.703	2.759	25.236	$7.026	**3.59**
Henderson Creek Diversion [1]	10.000	0.000	0.000	0.000	20.000	$5.708	**3.50**
South I-75 Canal Spreader Swale	0.1287	1.041	7.814	1.380	10.493	$3.131	**3.35**
Wolfe Road Wetland Treatment System	0.0000	0.112	0.000	3.341	3.453	$1.416	**2.44**
Corkscrew Regional Ecosystem Watershed	0.0000	0.000	2.011	0.000	2.011	$0.096	**20.95**
Upper Golden Gate Estates Canal Weir Constuction	0.0003	0.000	0.000	0.668	0.669	$0.552	**1.21**
Orange Tree Canal Control Structure Installation	0.0003	0.000	0.000	0.668	0.669	$0.552	**1.21**
Henderson Creek Off-Line Storage Reservior	1.0587	0.141	0.000	0.069	2.327	$2.929	**0.79**
US HWY 41 Stormwater Treatment Area	0.0000	0.035	0.117	0.000	0.152	$0.544	**0.28**

(1) Weighting considers benefits to two (2) watersheds.

Project Priorities Results

The B/C ratios calculated for all 10 publicly-funded projects found to be feasible for implementation are also shown in Table 2-7. The table lists the projects in the order that Atkins recommends for implementation. The wetland restoration project in the Corkscrew Regional Ecosystem Watershed area is predicted to provide the most benefit for the dollars spent. This is attributed to the low cost to implement this project. However, the project is expected to only provide a lift in wetland hydrology for a localized wetland area and does not address the more important issues facing the county. Therefore this project was moved to a lower priority for implementation.

Atkins recommends that the Northern Golden Gate Estates Flowway Restoration Project be implemented first although it places second on the benefit to cost scale. It does place first on the benefits based scale. This project provides a lift for each of the four performance criteria used to evaluate the projects. The project provides minimal lift in the Discharge to Estuary criteria, but provides the most lift for each of the other evaluation criteria.

The second project recommended for implementation (the North Belle Meade Spreader Swale) also provides a lift in each of the four performance criteria. For this project, the primary benefit is a significant lift in the Discharge to Estuary performance measure in the Golden Gate and Rookery Bay watersheds. This project has the potential to reduce flows to Naples Bay by 10 percent annually while increasing the volume of flow reaching Rookery Bay. This project also provides a moderate lift for each of the other performance measures.

The Henderson Creek Diversion project is considered the third most important project to implement and ranks fourth in the benefit to cost ratio. Similar to the North Belle Meade Spreader Swale, this project provides a significant lift in the Discharge to Estuary performance measure for the Golden Gate and Rookery Bay watersheds. However, it provides no benefit for the other evaluation criteria.

Conclusions

The implementation of all proposed projects will require a very significant commitment by the County, SFWMD, and possibly the federal government. It is recognized that project implementation will also result in lost efficiencies because of the overlapping of project functions.

As an example, two projects are recommended that divert water from the Golden Gate Main Canal into the Rookery Bay watershed. Individually, each of these projects has the potential to divert as much as 10 percent of the excess water discharging to Naples Bay. However, both projects would potentially draw from the same segment of the Golden Gate Main Canal which would limit the total volume of water that could be transferred. If both were implemented, it may only be possible to divert 15 percent of the excess water discharging to Naples Bay. **Table 2-8** shows the combined benefits of the recommended publically funded projects in terms of a cumulative score lift achieved as projects are implemented.

Results also show that, although the recommended projects are valuable steps towards protecting the ecological conditions in Collier

County, watershed conditions cannot consider solely construction of capital projects. Watershed management plans must also include a substantial non-structural component based primarily on regulatory controls and incentive programs to encourage better land management practices for new development and for the retrofit and modification of management practices on lands that are currently developed or used for agricultural purposes.

Table 2-8. Cumulative Benefit and Cost of Projects

Project Name	Cocohatchee-Corkscrew Cumulative Lift				Golden Gate - Naples Bay Cumulative Lift				Rookery Bay Cumulative Lift				Cumulative Cost (Millions of Dollars)
	Discharge to Estuary	Water Quality	Hydrology	Groundwater	Discharge to Estuary	Water Quality	Hydrology	Groundwater	Discharge to Estuary	Water Quality	Hydrology	Groundwater	
Corkscrew Regional Ecosystem Watershed	0.000	0.000	0.031	0.000									$0.096
North Golden Gate Estates Flowway Restoration Project					0.010	0.682	0.118	0.002					$2.464
North Belle Meade Spreader Swale[(1)]					0.900	0.682	0.118	0.002	1.250	0.435	0.036	0.200	$9.490
South I-75 Canal Spreader Swale									1.289	0.523	0.088	0.250	$12.621
Henderson Creek Diversion [(1)]					1.345	0.682	0.118	0.002	2.124				$18.329
Wolfe Road Wetland Treatment System					1.345	0.690	0.118	0.007					$19.745
Henderson Creek Off-Line Storage Reservior									2.282	0.547	0.088	0.255	$22.674
Upper Golden Gate Estates Canal Weir Constuction					1.345	0.690	0.118	0.008					$23.226
Orange Tree Canal Control Structure Installation					1.345	0.690	0.118	0.009					$23.778
US HWY 41 Stormwater Treatment Area									2.282	0.553	0.089	0.255	$24.322
Total Benefit or Cost	0.000	0.000	0.031	0.000	1.345	0.690	0.118	0.009	2.282	0.553	0.089	0.255	$24.322

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Appendix 2-A

Capital Improvement Program
Recommended Projects

Collier County Watershed Management Plan

Corkscrew Regional Ecosystem Watershed

Cocohatchee Watershed

ATKINS

Collier County

STATEMENT OF PROBLEM

These lands are partially located within the Corkscrew Regional Ecosystem Watershed. Development of residential areas included construction of drainage ditches and swales. These ditches and swales interconnect with stormwater management systems in downstream sub-divisions before discharging into the Cocohatchee Canal.

The man-made ditches and swales contribute to a modified wetland system with shorter hydroperiod.

PROJECT BENEFITS

(1) The project provides local benefits in restoring wetland hydrologic characteristics. The improvement is predicted to provide an average annual watershed wetland hydrology performance measure lift of 0.03.

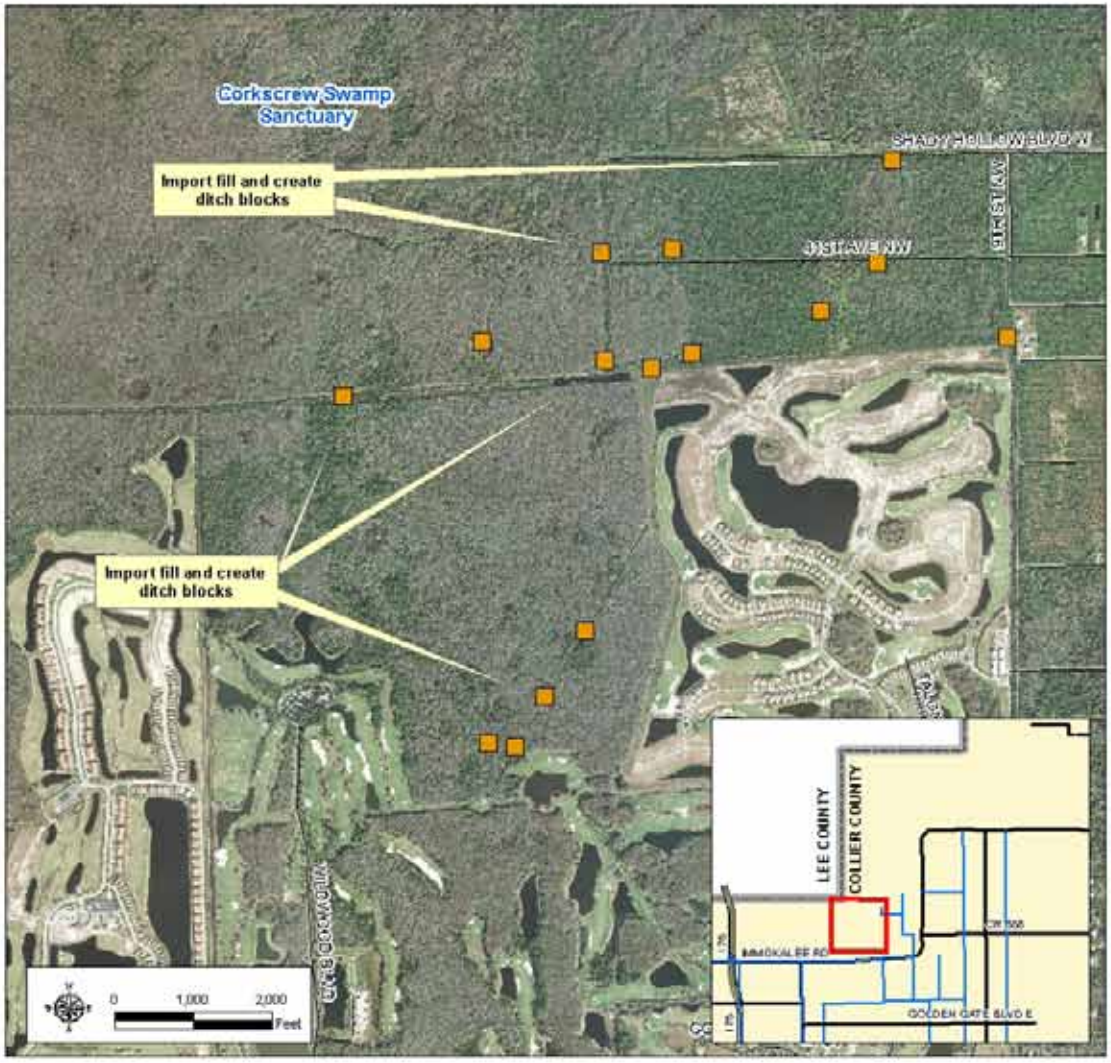
(3) Increased groundwater recharge.

PROJECT DISADVANTAGES

(1) Local improvements provide little benefit to the watershed as a whole.

(2) Changed depth of overland water could affect golf courses and residential communities.

(3) Portions of project area along 41st Ave NW are privately held and outside Rural Fringe Sending Area.



SOLUTION

- Southern portion of project is located within existing Rural Fringe Sending Area. Use incentive programs to encourage property owner to implement local wetland restoration activities.

- Import material and backfill man-made drainage ditches at wetland outfall locations.

DESIGN CONSIDERATIONS

- Coordination with CREW.

- Potential impacts to golf courses and surrounding residential communities.

- Potential presence of exotic species.

- Equipment access.

- Investigate availability of potential onsite material.

North Golden Gate Estates Flowway Restoration Project

ATKINS

Collier County Watershed Management Plan

Collier County

Golden Gate and Faka Union Watersheds

STATEMENT OF PROBLEM

Construction of the Golden Gate Main Canal network and construction of residential roads fractured the connectivity of wetland systems in the north Golden Gate Estates areas. Roadside drainage swales, coupled with a lack of culverts underneath the roads now divert runoff directly into the canal system.

The result is a loss of wetland hydrology and an increased volume of discharge to Naples Bay. The effect also includes less recharge to the surficial aquifer system that is a primary source of drinking water in the northern Golden Gate Estates.

PROJECT BENEFITS

(1) Improves wetland hydrology in the proposed flowway. Predicted to provide an average annual watershed performance measure lift of 0.12.

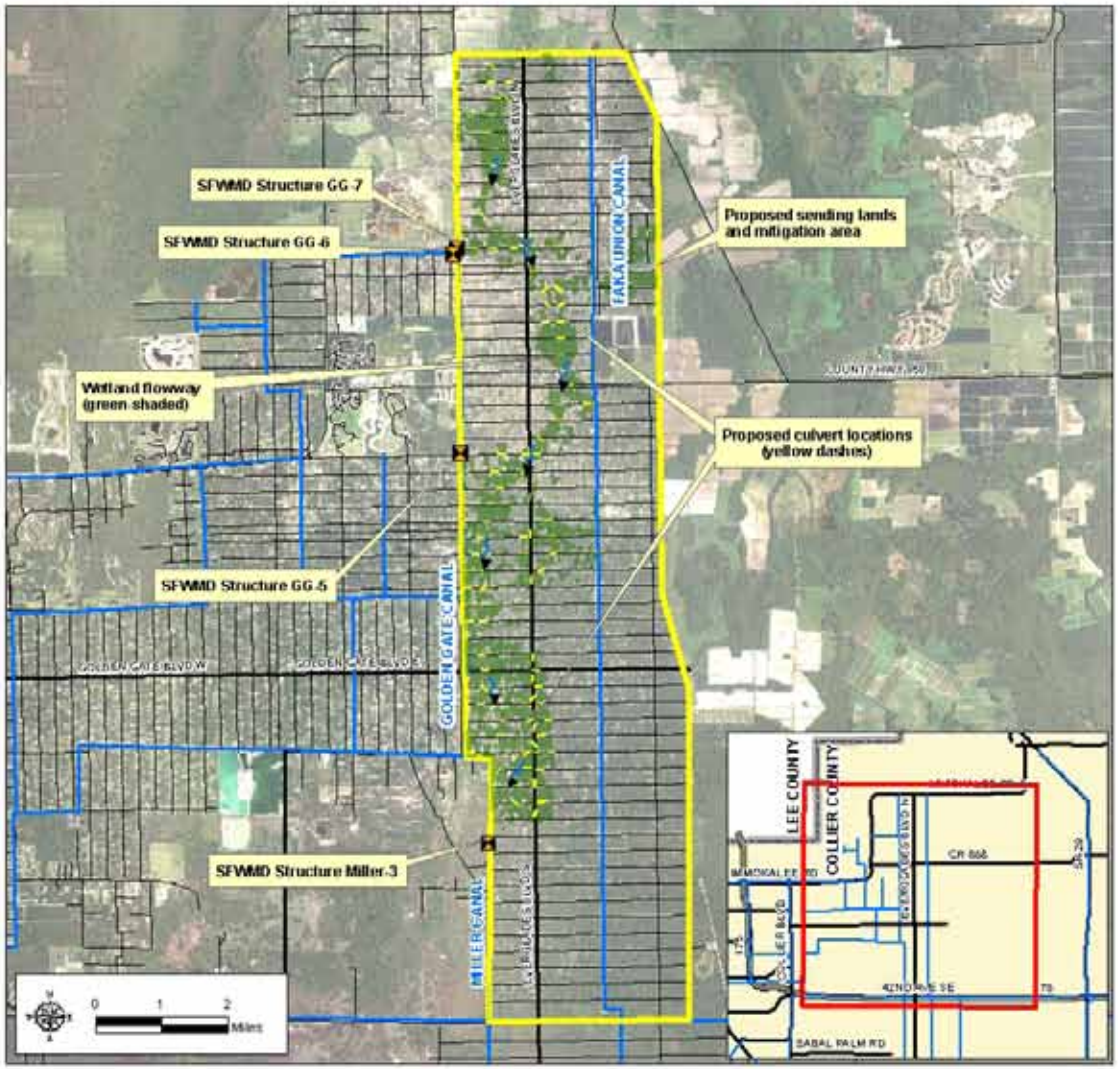
(2) Provides additional water quality treatment resulting in a annual average performance measure lift of 0.68 across the watershed.

(3) The project also increases groundwater recharge and helps maintain groundwater elevations in the Collier County well field.

PROJECT DISADVANTAGES

(1) Elevated groundwater level may affect septic leach fields or increase flood risk for residential properties near the project.

(2) May require purchase of private properties within the primary flowway.



SOLUTION

- The Northern Golden Gates Estates Flowway Restoration Project would utilize ditch blocks and equilization culverts to provide connectivity within the wetland system and help re-establish historical flow patterns.

- Recommend designation of area as a mitigation area and use TDR incentive programs to obtain properties and to generate funds to implement the project.

DESIGN CONSIDERATIONS

- Evaluate the presence of roadside berms that restrict sheet flow.

- Determine the maximum groundwater elevation that is allowed for proper function of septic systems in the immediate vicinity.

- Consider the affects of increased sheetflow on downstream properties.

- Evaluate flow rates and storage capacities within the system and size culverts accordingly.

COST ESTIMATE

Construction:	$1,891,000
Land Acquisition:	$0
Engineering and Contingency:	$677,000
TOTAL:	$2,388,000

North Belle Meade Spreader Swale

ATKINS

Collier County Watershed Management Plan

Collier County

Rookery Bay Watershed

STATEMENT OF PROBLEM

Construction of the Golden Gate Main Canal significantly increased the size of the watershed draining to Naples Bay and reduced the size of the watershed flowing to Rookery Bay. As a result, Naples Bay receives significantly too much water and Rookery Bay receives too little water, negatively affecting both receiving estuary systems.

Additionally, the reduction of stormwater runoff to the south has decreased wetland hydroperiods in areas where sheetflow used to occur.

PROJECT BENEFITS

(1) Predicted to reduce freshwater discharges to Naples Bay by 10 percent resulting in an annual performance measure lift of 0.69.

(2) Predicted to increase freshwater discharge to Rookery Bay by 19 percent, resulting in an annual performance measure lift of 1.25.

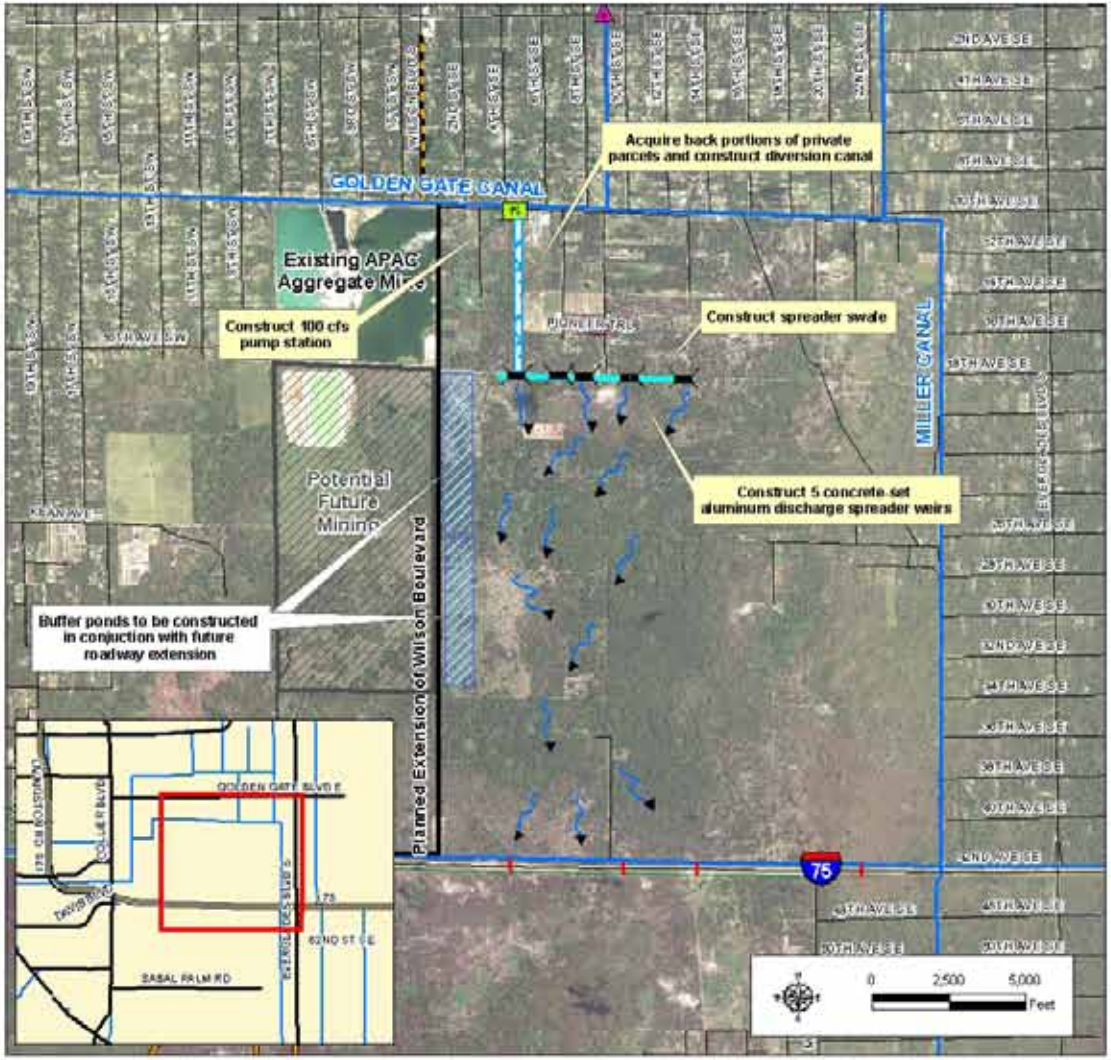
(3) Increases wetland hydrology in North Belle Meade with predicted performance measure lift of 0.04.

(4) Project reduces nutrient load to Naples Bay but does not significantly increase load to Rookery Bay.

PROJECT DISADVANTAGES

(1) Primary concept is dependant on acquisition of privately-owned property for the diversion canal construction.

(2) Project implementation may be tied to construction of Wilson Boulevard Extension or to proposed mining permits in the area.



SOLUTION

- Construct a 100 cfs pump station to divert water south from the Golden Gate Main Canal.

- Construct a spreader swale with weir structure to promote overland flow into wetland areas in North Belle Meade.

DESIGN CONSIDERATIONS

- An alternative design would be to build the diversion canal in conjunction with and adjacent to the Wilson Blvd extension. Water would be pumped from the diversion canal to the spreader swale.

- Flows north of the constructed spreader swale may need to be graded slightly east to the constructed finger canal.

- Project discharge area lies with a Rural Fringe Sending area, the development rights for this area would need to be obtained prior to construction. This could be tied to the proposed mining permits in the area.

COST ESTIMATE

Construction:	$4,788,000
Land Acquisition:	$322,000
Engineering and Contingency:	$1,916,000
TOTAL:	$7,026,000

South I-75 Canal Spreader Swale

ATKINS

Collier County Watershed Management Plan

Collier County

Rookery Bay Watershed

STATEMENT OF PROBLEM

Construction of the Golden Gate Main Canal interrupted the historical sheet flow pattern to the south toward Rookery Bay. The water is now diverted west toward the Naples Bay estuary. Due to the redirection of flow and the impedence to overland flow caused by I-75, the wetland area south of I-75 in the Rookery Bay watershed has a decreased hydroperiod and a change in wetland habitat.

PROJECT BENEFITS

(1) Increases hydrology of the wetland areas in the Rookery Bay portion of the Picayune Strand State Forest. Predicted to provide an annual average watershed performance measure lift of 0.10.

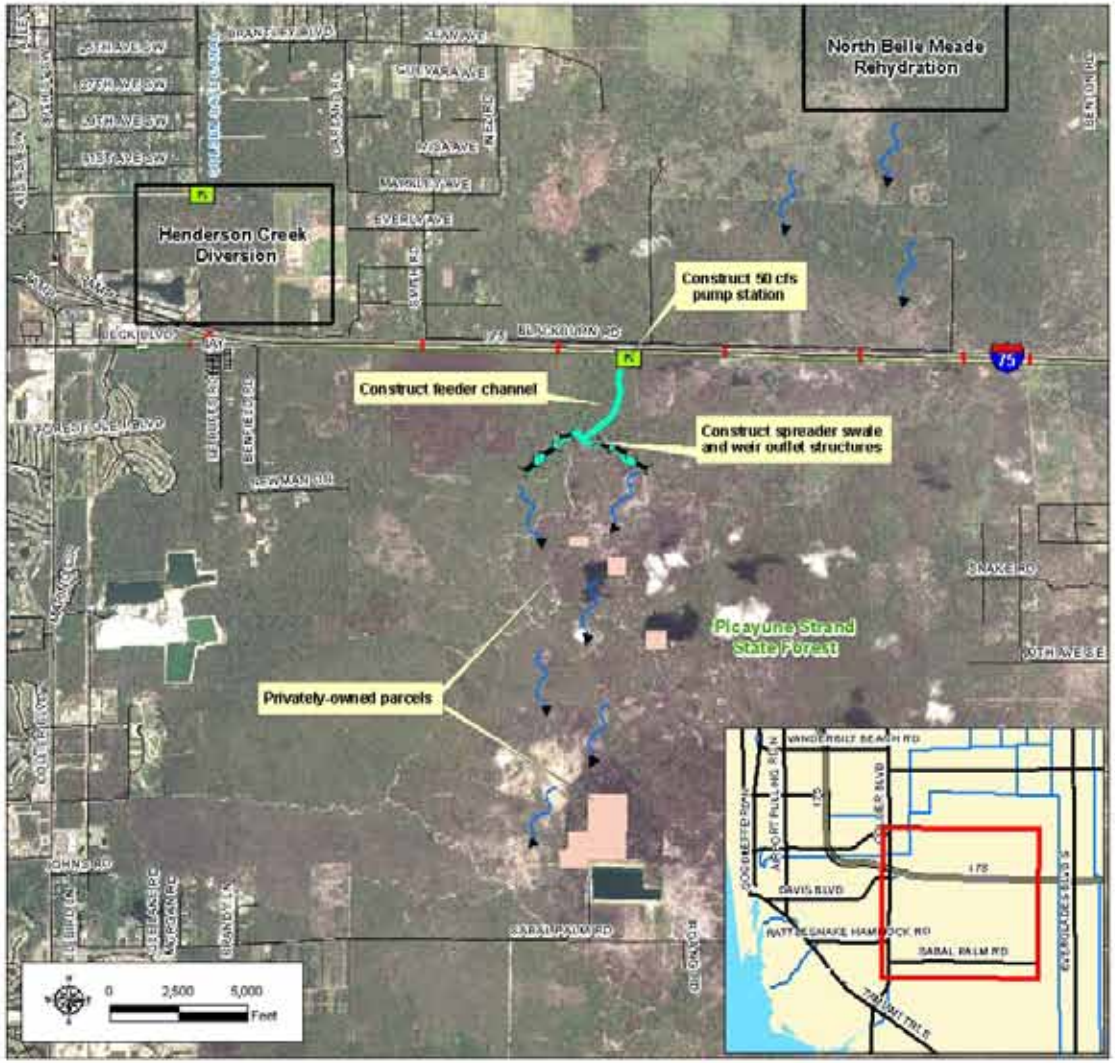
(2) Provides water quality treatment to diverted flows. The average annual watershed performance measure lift is predicted to be 0.18.

PROJECT DISADVANTAGES

(1) Project implementation would depend on agreement with the managers of the Picayune Strand State Forest.

(2) Additional culverts or other crossing would likely be required under Sabal Palm Rd.

(3) Privately owned out-parcels exist in the Picayune Strand State Forest. Conservation easements may be required, or the properties may have to be purchased.



SOLUTION

- Construct a 50 cfs Pump Station to pump water from the interconnected I-75 Canal Network into the to feeder channel.

- Construct spreader swale with outfall weirs that discharge at topographic lows.

DESIGN CONSIDERATIONS

- Consider the effect of increased sheet flow on out-parcels in the Picayune Strand State Forest.

- Availability of water to divert to the spreader system may be dependent upon contributions from other recommended projects.

- Culverts under I-75 will require regular maintenance to convey water from areas north of I-75.

- Culverts and crossings under Sable Palm Rd may not have capacity to manage additional flow.

COST ESTIMATE

Construction:	$2,328,000
Land Acquisition:	$0
Engineering and Contingency:	$932,000
TOTAL	$3,131,000

Henderson Creek Diversion Pump Station

ATKINS

Collier County Watershed Management Plan

Collier County

Golden Gate Watershed

STATEMENT OF PROBLEM

Construction of the Golden Gate Main Canal significantly increased the size of the watershed draining to Naples Bay and reduced the size of the watershed draining to Rookery Bay. As a result, Naples Bay receives significantly too much water and Rookery Bay receives too little water, negatively affecting both receiving water estuary systems.

PROJECT BENEFITS

(1) Predicted to reduce freshwater discharges to Naples Bay by 10 percent resulting in an annual performance measure lift of 0.89.

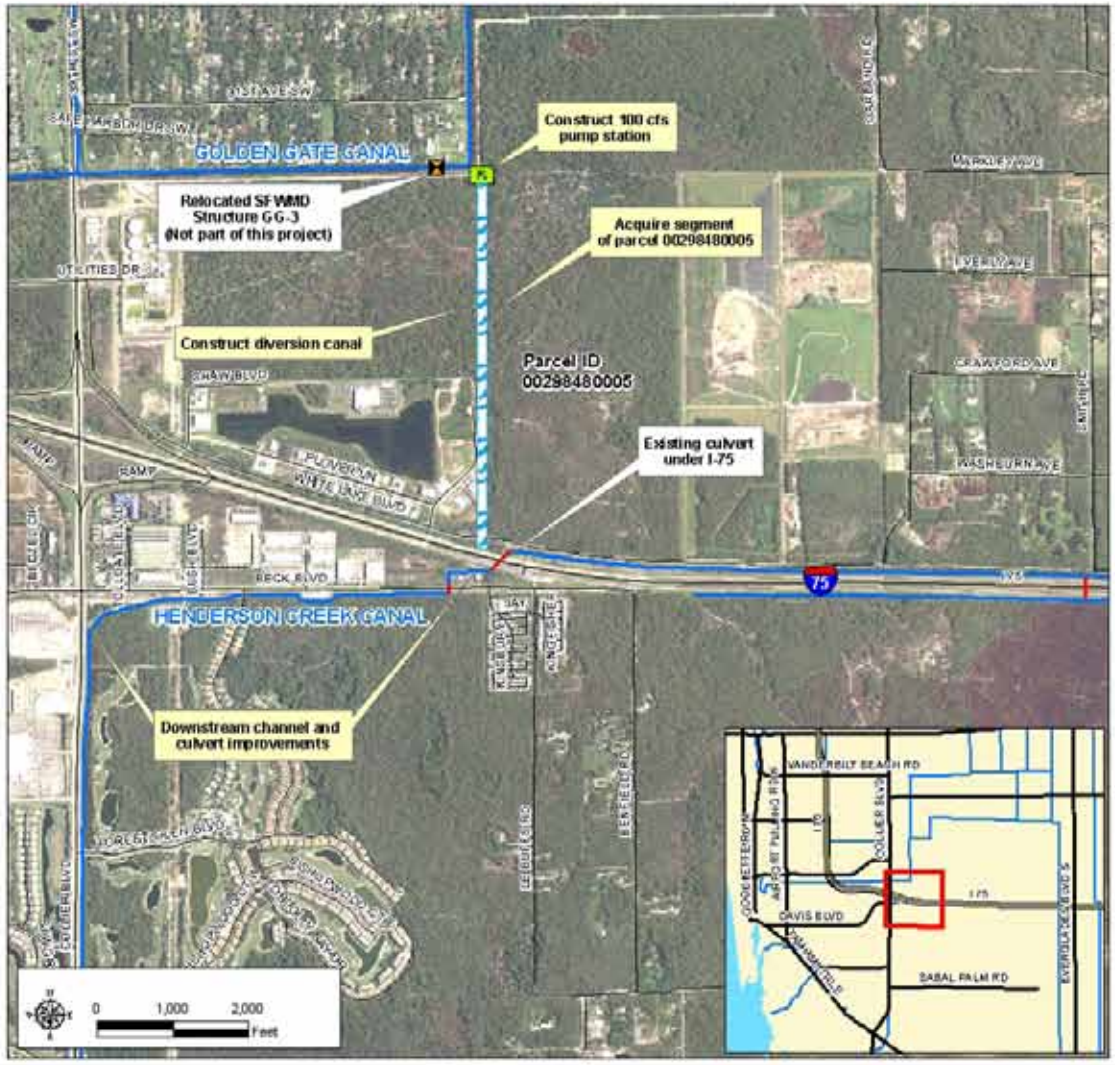
(2) Predicted to increase freshwater discharge to Rookery Bay by 33 percent, resulting in an annual performance measure lift of 1.67.

(3) Provides additional water to Henderson Creek that may be available to augment future supply needs for the Marco Island Water Treatment Plant.

PROJECT DISADVANTAGES

(1) The project would be dependant on the purchase of a portion of private property required to construct diversion canal.

(2) Project reduces total nutrient load to Naples Bay, but potentially increases total load to Rookery Bay.



SOLUTION

This project has been conceptualized by the South Florida Water Management District and seeks to divert water from the Golden Gate Main Canal into Henderson Creek.

- Plans call for construction of a 100 cfs pump station to divert flows from the Golden Gate Canal to the Henderson Creek Canal.

- Diverted water will move south through a new 5200 LF dredged canal, 30' wide and 10' deep and water will flow into Henderson Creek through an existing box culvert under I-75.

- Channel and Culvert improvements will be required in Henderson Creek downstream I-75 to convey the additional flows.

DESIGN CONSIDERATIONS

- Evaluate alternative pumping strategies to determine optimal operation.

- Inclusion of a water quality treatment system would reduce the potential increase in total pollutant load to Rookery Bay.

COST ESTIMATE

Construction	$4,065,000
Land Acquisition	$423,000
Engineering and Contingency	$1,220,000
TOTAL	$5,708,000

Atkins Light Blue Horizontal Logo.png

Wolfe Road Wetland Treatment System

ATKINS

Collier County Watershed Management Plan

Collier County

Golden Gate Watershed

STATEMENT OF PROBLEM

Urban runoff and pollutant loading to stormwater ponds. In this area, runoff from upstream areas is routed through the Island Walk subdivision and contributes to elevated nutrient concentrations in the stormwater ponds.

PROJECT BENEFITS

(1) The project utilizes existing features.

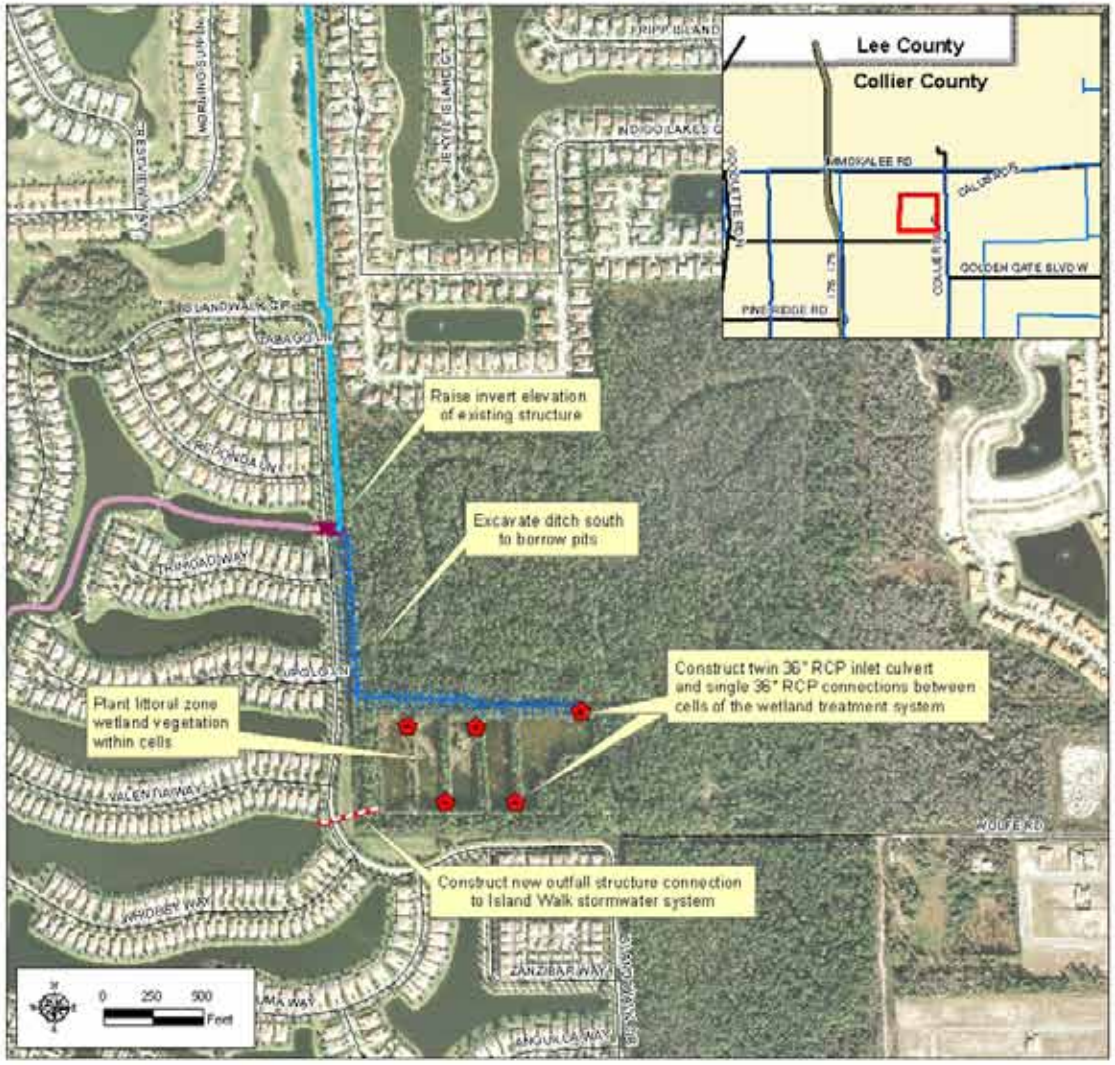
(2) The project will reduce the volume of outside flow entering the Island Walk stormwater management system.

(3) The project will provide water quality treatment of runoff before it enters the Island Walk system. The average annual watershed performance measure lift is predicted to be 0.008.

PROJECT DISADVANTAGES

(1) The required property (approximately 20 acres) is privately owned and permits have been requested for urban development.

(2) The existing permit for the Island Walk Subdivision would have to be modified to change the inflow characteristics.



SOLUTION

- Raise the invert of the existing structure that controls discharge from the drainage ditch into the Island Walk stormwater system.

- Extend the drainage ditch south and to the east into the series of existing borrow pits.

- Install culverts to convert the borrow pits into interconnected wetlands with sediment sumps and littoral shelf planting.

- Construct new control structure to release treated stormwater back into the Island Walk stormwater system.

DESIGN CONSIDERATIONS

- Evaluate stage and volume of stormwater flowing through the existing structure into Island Walk.

- Determine maximum volume that can be treated in the proposed wetland treatment system.

- Consider requirements to change the Island Walk permit.

COST ESTIMATE

Construction	$353,000
Land Acquisition	$921,000
Engineering and Contingency	$142,000
TOTAL	$1,416,000

Henderson Creek Off-Line Storage Reservior

ATKINS

Collier County Watershed Management Plan

Collier County

Rookery Bay Watershed

STATEMENT OF PROBLEM

The Henderson Creek Canal discharges to the south, directly to Rookery Bay. Rookery Bay experiences a freshwater inflow surplus during the wet season (June -September) and freshwater deficit during the dry season. These flow deficits/surpluses have a negative impact on the salinity levels within the receiving water estuary.

PROJECT BENEFITS

(1) Project is used to modify the timing of flow to Rookery Bay. The reservoir would capture excess wet season flow that may be released water during the dry season.

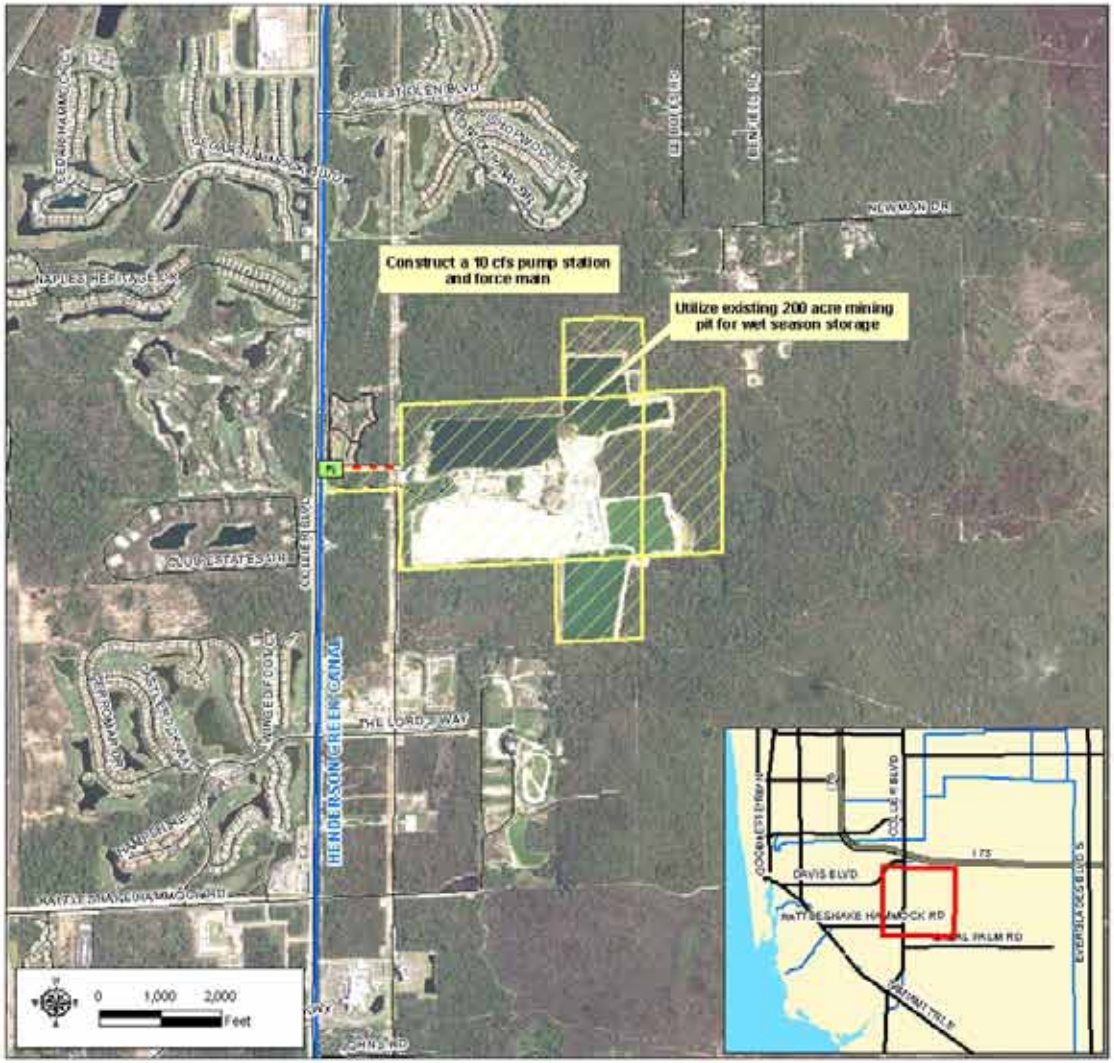
(2) Would increase groundwater recharge from the mining pit which would affect the timing of flows from the watershed.

(3) Predicted to provide average annual performance measure lift of 0.32 in the discharge to estuary scores.

PROJECT DISADVANTAGES

(1) Property is currently private-owned and is actively mined. Project may not be viable for many years.

(2) A large portion of diverted water would likely be lost to groundwater recharge. If the rock is fractured, groundwater may rapidly migrate back into the canal as baseflow.



SOLUTION

- Obtain the rights to the mining property after the mine is closed.

- Utilize storage volume in the abandoned mine by constructing a 10 cfs pump station to divert excess wet season flows (August-September) into the reservoir.

DESIGN CONSIDERATIONS

- Pumping operation will be based on stage and flow in the Henderson Creek Canal.

- Determine the leakage rate through the bed of the mining pit to the canal.

- Re-evaluate storage/pump capacity when mining operations are completed.

- Consider potential affects on private or public potable water supply wells in the vicinity of the project site.

COST ESTIMATE

Construction	$671,000
Land Acquisition	$1,999,000
Engineering and Contingency	$269,000
TOTAL	$2,929,000

Upper Golden Gate Estates Canal Operable Weir Installation

ATKINS

Collier County Watershed Management Plan

Collier County

Golden Gate Watershed

STATEMENT OF PROBLEM

Construction of the Golden Gate Main Canal significantly increased the size of the watershed draining to Naples Bay. The result is that the discharge to Naples Bay is more than five times the historic volume. This has negatively affected the Naples Bay estuary system.

In additional, the canal network and use of shallow groundwater sources for potable water supply has contributed to lower groundwater elevations in the Golden Gate Estates.

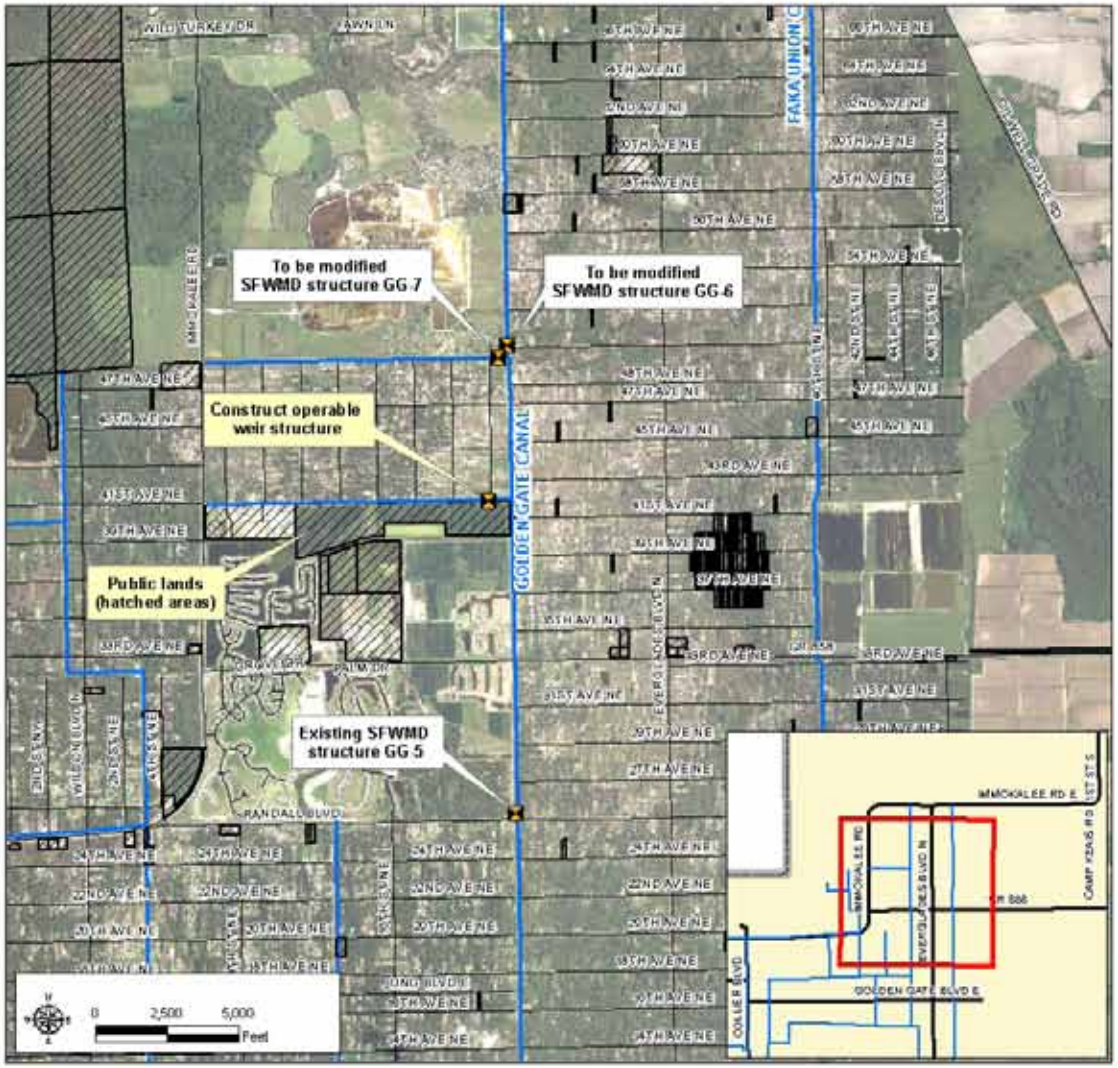
PROJECT BENEFITS

(1) Provides more flexibility to increase the volume of runoff stored, and decrease the volume of water released during storm events. The direct benefit is a lift in the Discharge to Estuary performance measure score of 0.0001.

(2) The proposed operable weir provides flexibility to manage groundwater and surface water elevations effectively. Indirect benefits includee reduced baseflow and an increase in available groundwater.

PROJECT DISADVANTAGES

(1) Increased groundwater elevations may affect septic leach fields or increase flood risk for residential areas near the canal.



SOLUTION

- In conjuction with SFWMD projects to replace GG-6 and GG-7 with operable structures, construct an additional operable structure on the finger canal south of the GG-7 canal. The structure will allow the canal to be used as water storage feature and to reduce baseflow in the Golden Gate Canal network.

DESIGN CONSIDERATIONS

- Design and operational protocol would be coordinated with SFWMD projects to replace the GG-6 and GG-7 structures.

- Construction and operational access may require construction easement on the north side of the canal.

- Permits for upstream water detention facilty may have to be modified.

COST ESTIMATE

Construction	$394,000
Land Acquisition	$0
Engineering and Contingency	$158,000
TOTAL	$552,000

Orange Tree Canal Control Structure Installation

ATKINS

Collier County Watershed Management Plan

Collier County

Project GG-7 Golden Gate Watershed

STATEMENT OF PROBLEM

Construction of the Golden Gate Main Canal significantly increased the size of the watershed draining to Naples Bay. The result is that the discharge to Naples Bay is now more than five times the historic volume. This has negatively affected the Naples bay estuary system.

In addition, the canal network and use of shallow groundwater sources for potable water supply has contributed to lower groundwater elevations in the Golden Gate Estates.

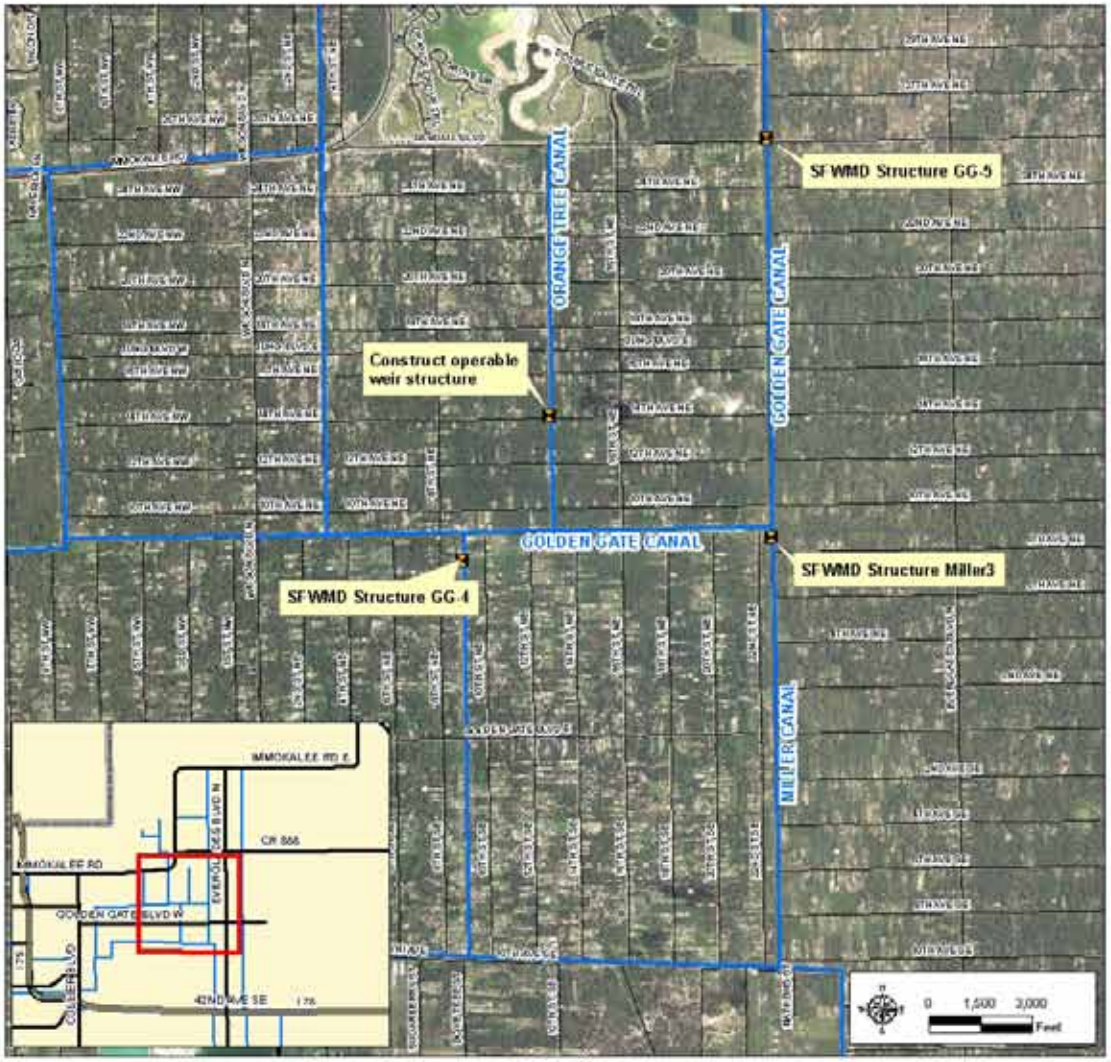
PROJECT BENEFITS

(1) Provides more flexibility to increase the volume of runoff stored, and decreases the volume of water released during storm events. The direct benefit is a lift of 0.0001 in the Discharge to Estuary annual average performance measure score.

(2) The proposed operable weir provides flexibility to manage groundwater and surface water elevations effectively. Indirect benefits include reduced baseflow and an increase in available groundwater.

PROJECT DISADVANTAGES

(1) Elevated groundwater level may affect septic leach fields or increase flood risk in developed areas near the canal.



SOLUTION

- Construct an operable weir structure near the intersection of the Orange Tree Canal and 14th Avenue NE to increase storage capacity and better manage baseflow.

- Properties on either side of the canal near the structure location may be required to provide construction and maintenance access.

DESIGN CONSIDERATIONS

- Coordinate operational protocols with SFWMD Structure GG-4.

- Evaluate the effect of increased stage in the canal upstream of the structure. Evaluation should include changes in groundwater elevation and potential changes in flood risk.

COST ESTIMATE

Construction:	$394,000
Land Acquisition:	$0
Engineering and Contingency:	$158,000
TOTAL:	$552,000

US Highway 41 Stormwater Treatment Area

ATKINS

Collier County Watershed Management Plan

Collier County

Rookery Bay Watershed

STATEMENT OF PROBLEM

The Rookery Bay watershed is identified as impaired for nutrients and dissolved oxygen. In addition, this wetland area was identified as having a reduced hydroperiod relative its pre-development condition

PROJECT BENEFITS

(1) The project will provide water quality treatment to remove nutrients from the US Highway 41 canal system. Watershed average performance measure list is predicted to be 0.035

(2) The project will rehydrate this wetland area during the wet season by extending the depth and length of the hydroperiod. Watershed average performance measure list is predicted to be 0.11

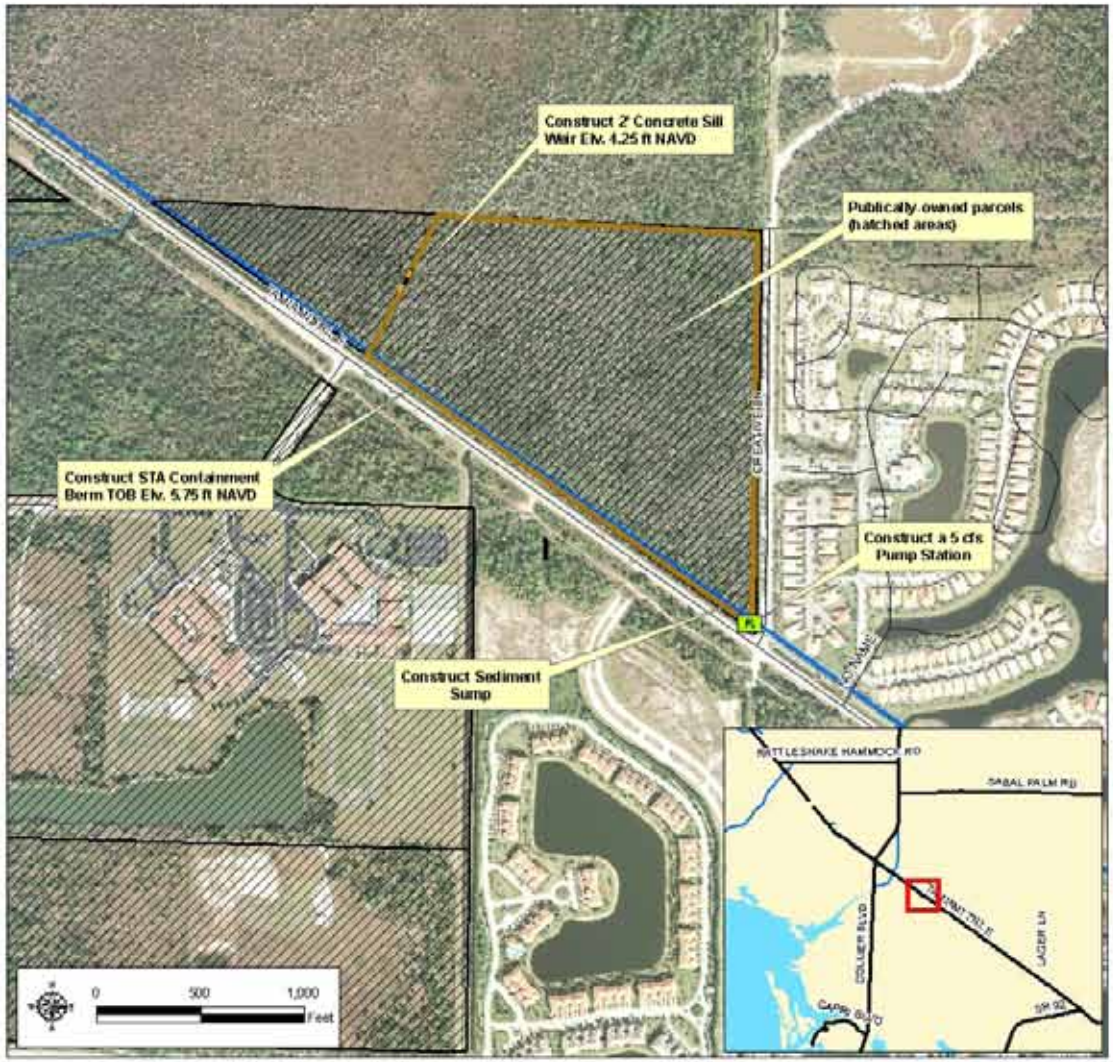
(3) The lands are publically-owned

PROJECT DISADVANTAGES

(1) The project is relatively small and may not provide a large water quality benefit.

(2) Flow analysis in the US41 Canal suggests that the operational period for the system would likely be limited to a three month period during the wet season.

(3) The increased groundwater elevations could affect adjacent residential areas.



SOLUTION

- Construct a 52-acre wetland stormwater treatment area (STA) on publicly owned land on the north side of US Highway 41. A pump station will divert water from the US 41 canal into the STA for treatment during the wet season.

- The STA will include a sediment sump.

- Treated water would be released into the wetland downstream via gravity flow over a concrete spillway to optimize detention time.

DESIGN CONSIDERATIONS

- Determine wetland characteristics to determine final wetland inundation depth.

- The location of the outfall from the STA must be carefully selected to ensure that treated water is drawn back into the wetland system.

- Consider installing a manual stop-log structure on the concrete sill to retain the last pumped cycle and further extend the STA wetland hydroperiod.

COST ESTIMATE

Construction:	$388,000
Land Acquisition:	$0
Engineering and Contingency:	$156,000
TOTAL:	$544,000

Appendix 2-B

Incentive Based Program
Recommended Projects

Fakahatchee Wetland Restoration - Area 1

ATKINS

Collier County Watershed Management Plan

Collier County

Fakahatchee Watershed

STATEMENT OF PROBLEM

During agricultural development, many isolated wetlands were drained for logging or planting. Historically, this wetland stored more water and maintained a longer hydroperiod.

This canal dredging also negatively impacted the ecology of the wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

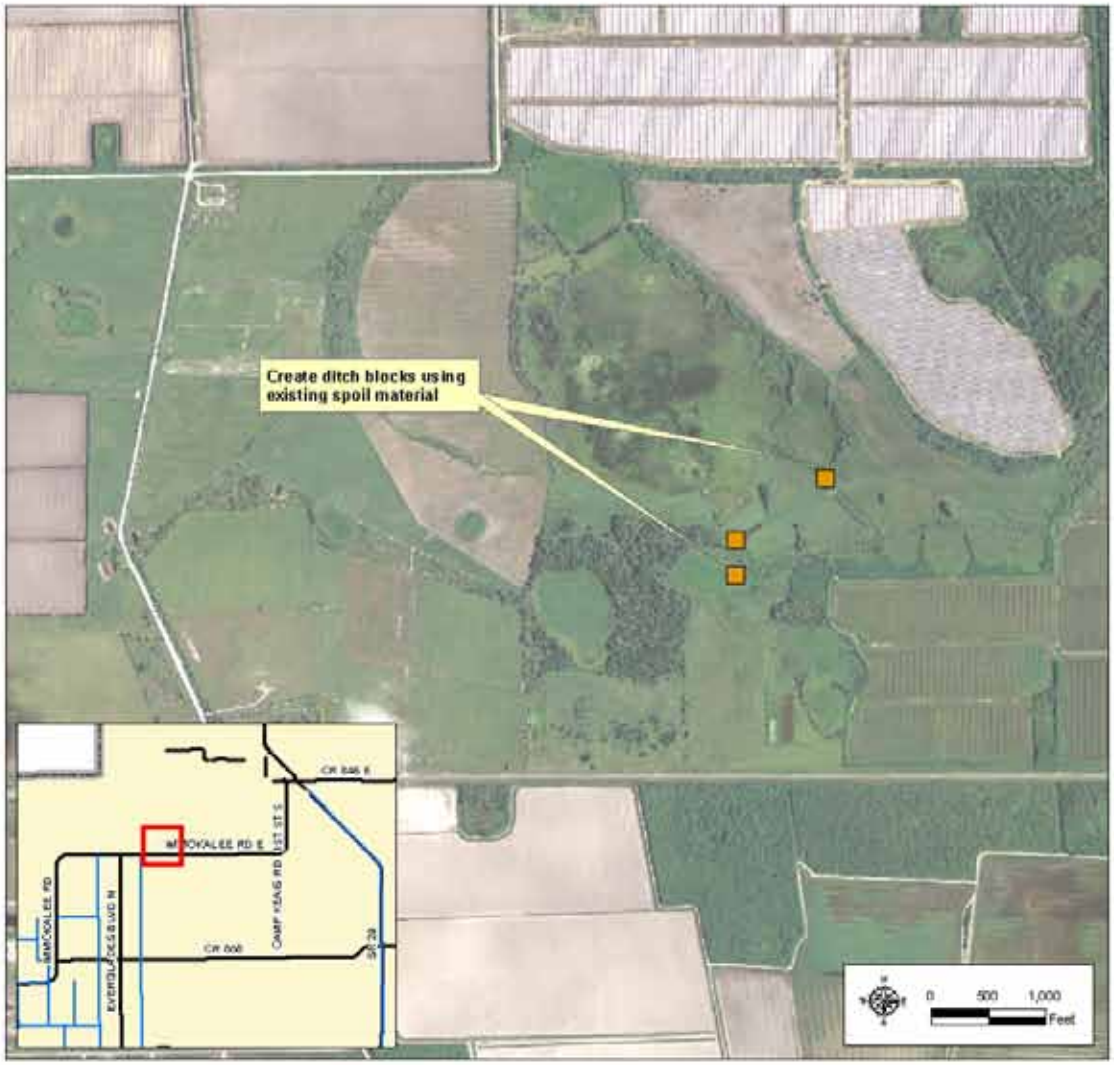
(1) The projects is predicted to improved the hydrology of these isolated wetland systems by blocking ditches and reducing artificial drainage.

(2) The project serves a local area (120 acres) and provides a lift in average wetland hydrology score for the combined watersheds of 0.0001.

(3) Provides storage and water quality treatment.

PROJECT DISADVANTAGES

(1) Changes in groundwater and surface water elevations may affect adjacent farming activities.



SOLUTION

- Project is located within existing Stewardship Sending Area. Use incentive programs to encourage property owner to implement local wetland restoration activities.

- Use existing dredge spoil material on the canal banks to backfill drainage ditches and create ditch blocks at the wetland outfall locations to allow wetlands to discharge via overland flow.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

- Potential presence of exotic species

- Equipment access

Fakahatchee Wetland Restoration - Area 2

ATKINS

Collier County Watershed Management Plan

Collier County

Fakahatchee Watershed

STATEMENT OF PROBLEM

During agricultural development, many isolated wetlands were drained for logging or planting. Historically, these wetlands stored more water and had a longer hydroperiod.

The canal dredging also negatively impacted the ecology of the wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

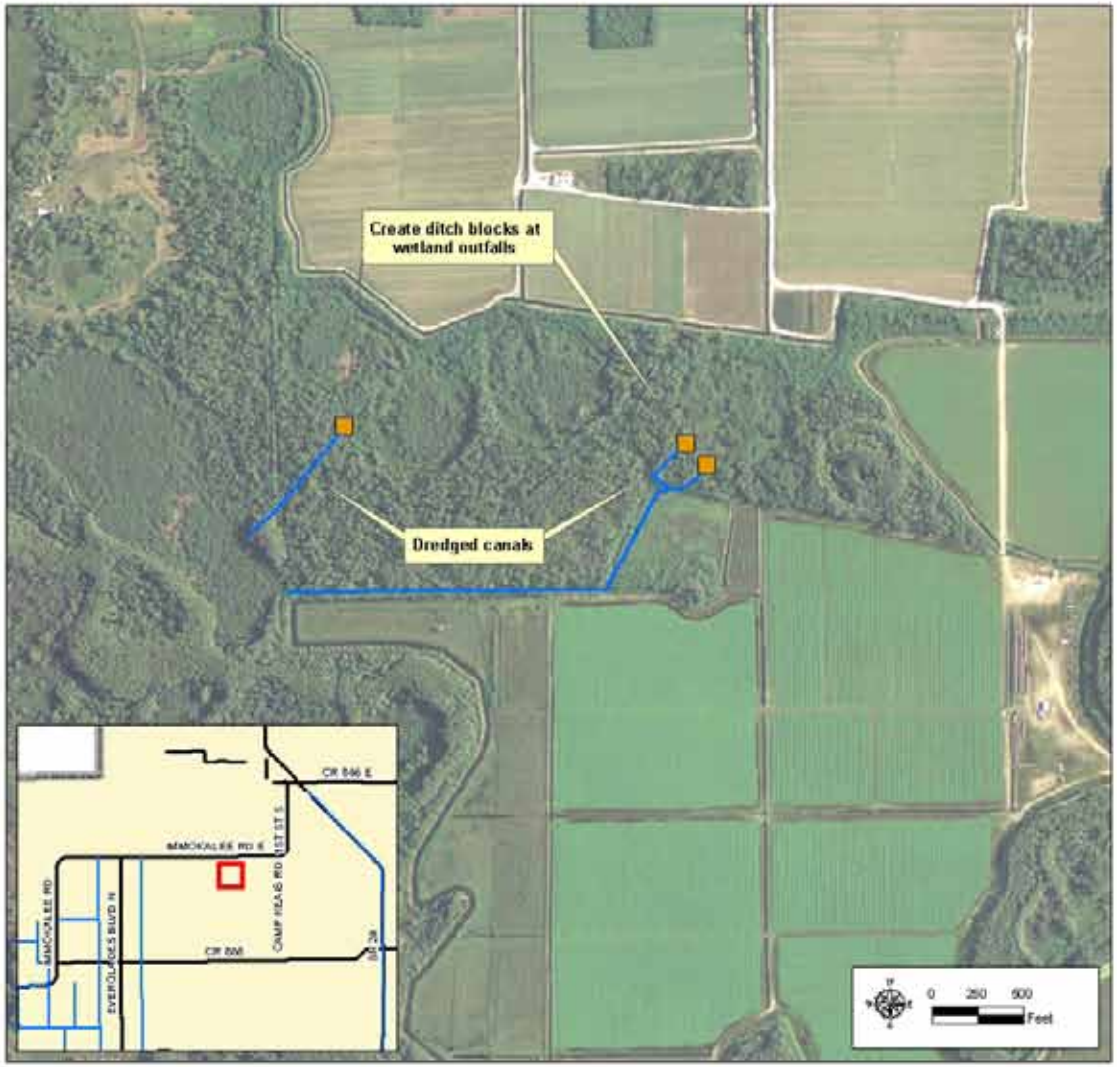
(1) The project is predicted to improve the wetland hydrology of these isolated wetland systems by blocking ditches.

(2) The project serves a local area (37 acres) and provides a lift in average wetland hydrology for the combined watersheds of 0.0001.

(3) Provides on-site storage and water quality treatment.

PROJECT DISADVANTAGES

(1) Changes in groundwater and surface water elevations may affect adjacent farming activities.



SOLUTION

- Project is located within existing Habitat Stewardship Area. Use incentive programs to encourage property owner to implement local wetland restoration activities.

- Use existing dredge spoil material or import material to backfill drainage ditches and create ditch blocks at the wetland outfall locations and allow wetlands to discharge via overland flow.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

Upper Okaloacoochee Slough Wetland Restoration

ATKINS

Collier County Watershed Management Plan

Collier County

Okaloacoochee Watershed

STATEMENT OF PROBLEM

This portion of the Okaloacoochee Slough was dredged to drain the upstream wetland areas for farming activities. This resulted in shorter wetland hydroperiods and less groundwater recharge. The dredged canal also negatively impacted the ecology of the surrounding wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

(1) Re-establishes wetland hydroperiods by reducing drainage. Lift in annual watershed performance measure is predicted to be 0.0004.

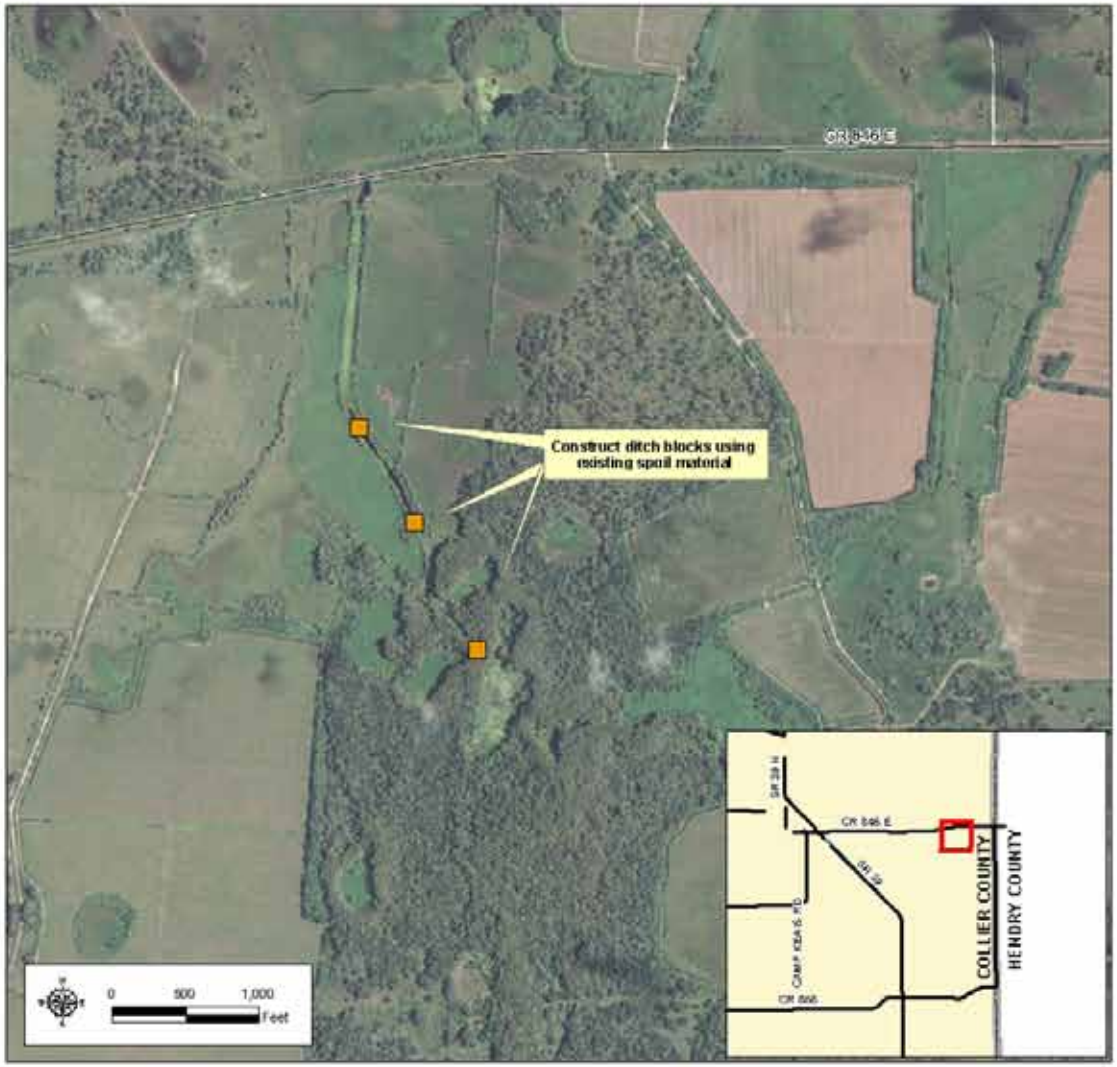
(2) Provides additional water quality treatment in the wetland area. Lift in annual watershed performance measure is predicted to be 0.002.

(3) Increases groundwater recharge.

PROJECT DISADVANTAGES

(1) Reduced drainage capacity could increase flood risk of SR 848 and upstream lands.

(2) Changes in depth of surface water could affect surrounding agricultural areas.



SOLUTION

- Project is located within an approved Stewardship Sending Area and within the Okaloacoochee Flowway Stewardship Area. Use incentive programs to encourage property owner to implement local wetland restoration activities.

- Use existing dredge spoil material on the canal banks to backfill ditches and create ditch blocks at the wetland outfall locations. The ditch blocks created within the slough will re-hydrate wetlands and provide natural sedimentation in the dredged canal to raise the slough profile and promote the natural restoration of the waterway.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

- Verify no flooding impacts are generated at SR 848 and the lands to the north of SR 848.

Middle Okaloacoochee Slough Wetland Restoration

ATKINS

Collier County Watershed Management Plan

Collier County

Okaloacoochee Watershed

STATEMENT OF PROBLEM

This portion of the Okaloacoochee Sough was dredged to drain the upstream wetland area for farming activities. This resulted in shorter wetland hydroperiods and less groundwater recharge. The dredged canal also negatively impacted the ecology of the upstream wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

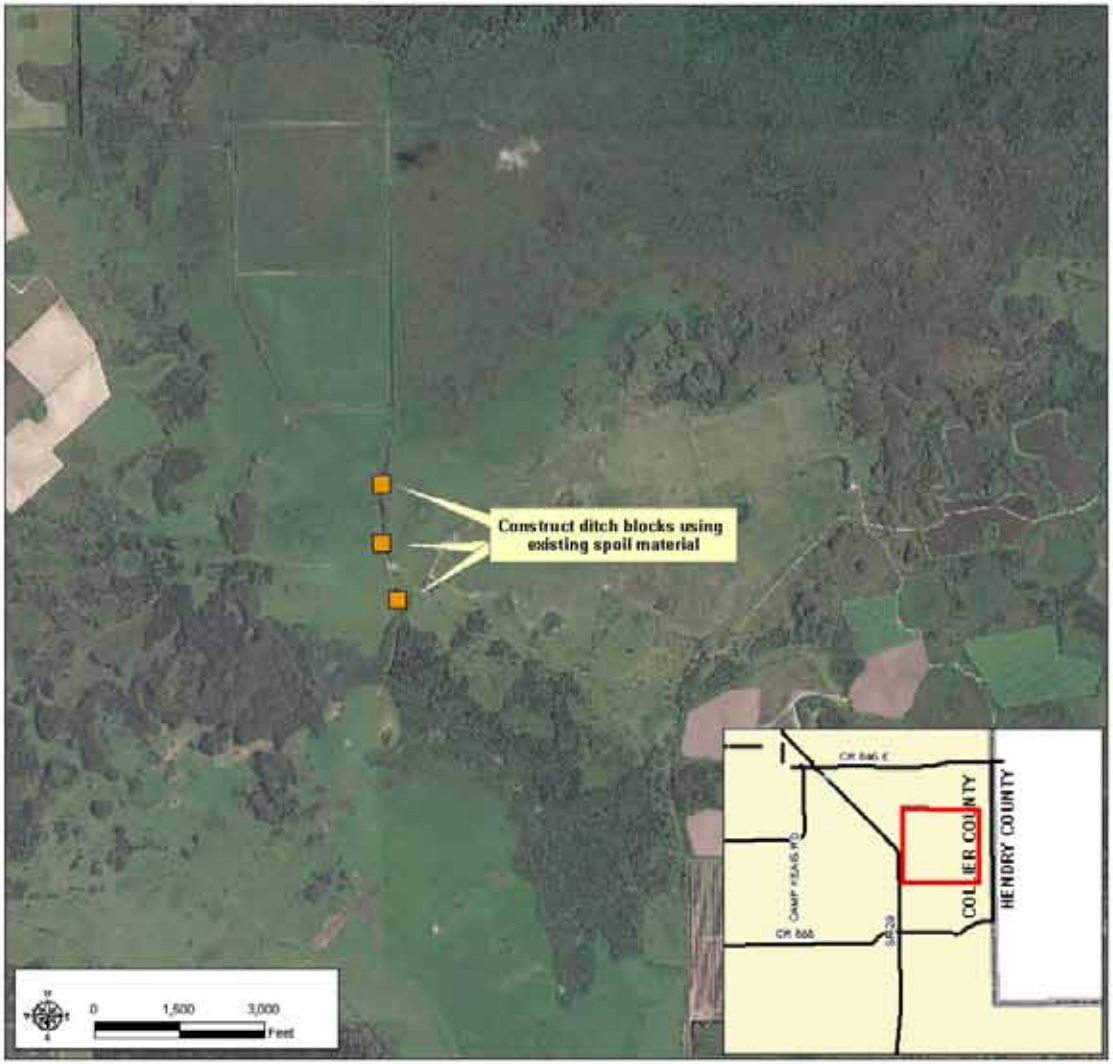
(1) Re-establishes historic wetland hydroperiod by containing inflows which are artificially drained. Predicted to provide an average annual watershed performance measure lift of 0.015.

(2) Predicted to increase water quality treatment in the wetland area. An annual average watershed performance measure lift of 0.20 is predicted.

(3) Increases groundwater recharge.

PROJECT DISADVANTAGES

(1) Change in depth of water could negatively impact surrounding agricultural activities.



SOLUTION

- Project is located within the Okaloacoochee Flowway Stewardship Area. Use incentive programs to encourage property owner to implement local wetland restoration activities.

- Use existing dredge spoil material on the canal banks to backfill man-made ditches and create ditch blocks at the wetland outfall locations. The ditch blocks created within the slough will provide natural sedimentation in the canal to raise the slough profile and promote the natural restoration of the waterway.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

Lower Okaloacoochee Slough Wetland Restoration

ATKINS

Collier County Watershed Management Plan

Collier County

Okaloacoochee Watershed

STATEMENT OF PROBLEM

This portion of the Okaloacoochee Sough was dredged to drain the upstream wetland areas for farming activities. This resulted in shorter wetland hydroperiods and less groundwater recharge. The dredged canal also negatively impacted the ecology of the surrounding wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

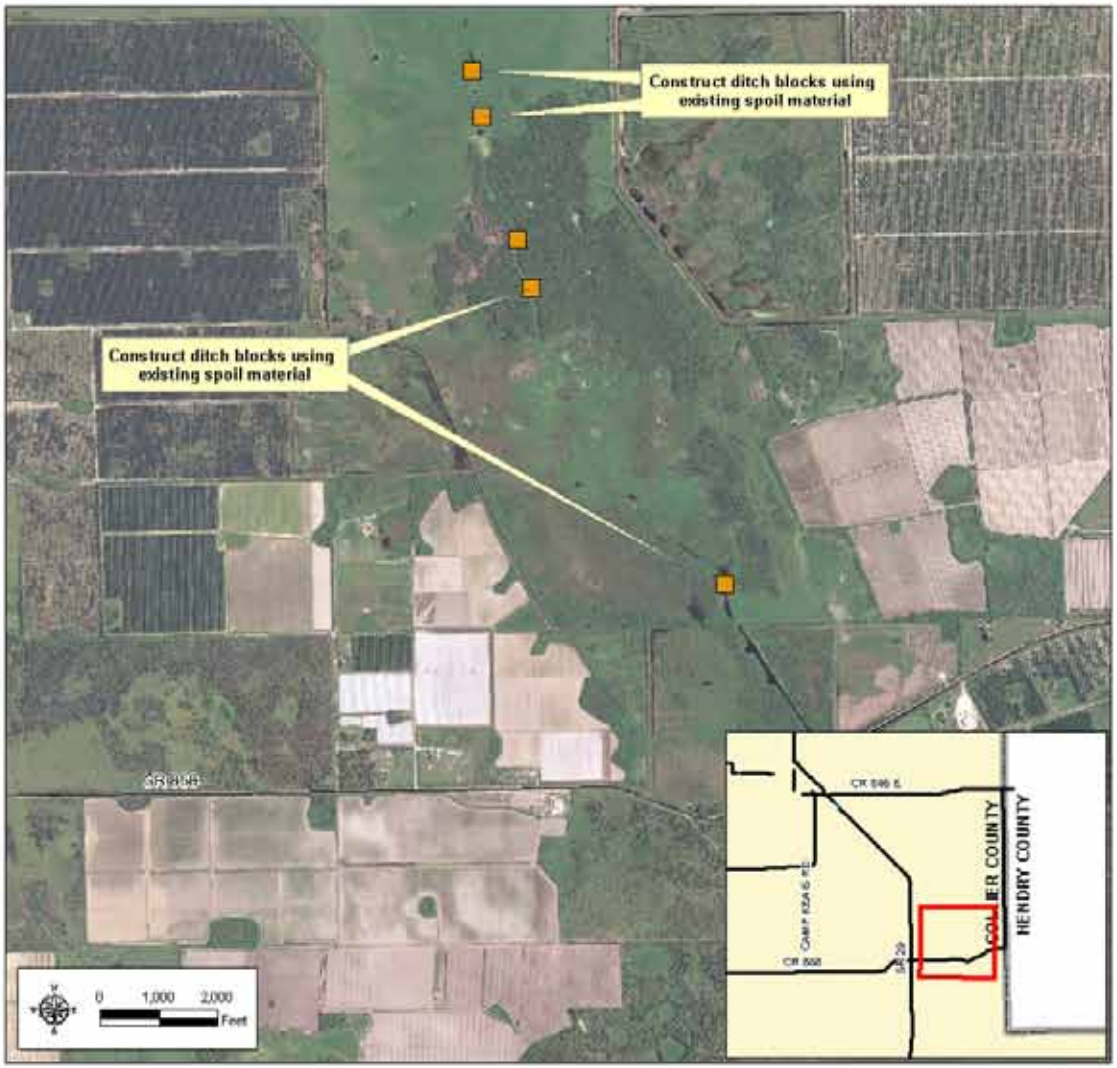
(1) Improves wetland hydrology and habitat by reducing drainage. Predicted to provide an average annual watershed performance measure lift of 0.002.

(2) Provides improved water quality treatment in wetland areas. An average annual performance measure lift of 0.059 is predicted.

(3) Increases groundwater recharge.

PROJECT DISADVANTAGES

(1) Changes in depth of surface water could increase flood risk of surrounding agricultural areas.



SOLUTION

- Project is located within existing Okaloacoochee Flowway Stewardship Area. Use incentive programs to encourage property owner to implement local wetland restoration activities.

- Use existing dredge spoil material on the canal banks to backfill man-made ditches and create ditch blocks. The ditch blocks created within the slough will rehydrate wetlands and provide natural sedimentation to raise the ditch profile and promote the natural restoration of the waterway.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

Okaloacoochee Wetland Restoration - Area 1

ATKINS

Collier County Watershed Management Plan

Collier County

Okaloacoochee Watershed

STATEMENT OF PROBLEM

During agricultural development, many isolated wetlands were drained for logging or planting. Historically, these wetlands discharged at higher stages via a natural slough or overland flow.

These drained wetlands currently have a shorter hydroperiod and provide less groundwater recharge than previously. The wetland dredging also negatively affected the ecology of the wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

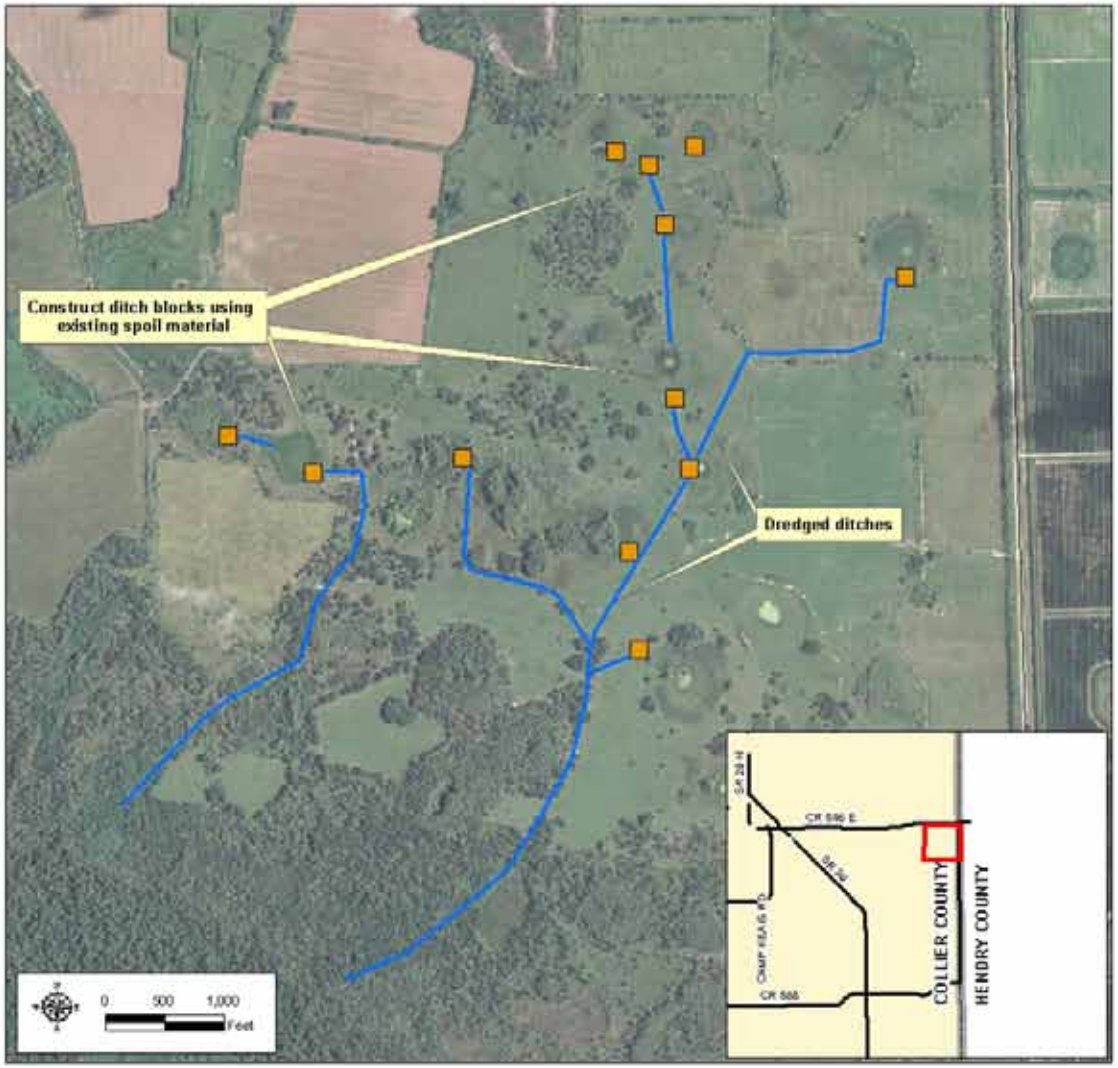
PROJECT BENEFITS

(1) Improves wetland hydrology/habitat in isolated wetland areas. The average annual lift in performance measure for the watershed is predicted to be 0.0002.

(2) Increases groundwater recharge.

PROJECT DISADVANTAGES

(1) Changes in groundwater and surface water elevation may affect adjacent agricultural lands.



SOLUTION

- Project is located within approved Stewardship Sending Area and existing Habitat Stewardship Area. Use incentive programs to encourage property owner to implement local wetland restoration activities.

- Use existing dredge spoil material on the canal banks to backfill man-made ditches and create ditch blocks at the wetland outfall locations. The ditch blocks created within the canals will contain the wetland inflows which will increase the hydroperiods and groundwater recharge in the area.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

Okaloacoochee Wetland Restoration - Area 2

ATKINS

Collier County Watershed Management Plan

Collier County

Okaloacoochee Watershed

STATEMENT OF PROBLEM

During agricultural development, many isolated wetlands were drained for logging or planting. Historically, these wetlands discharged at higher stages via a natural slough or overland flow.

These drained wetlands currently have a shorter hydroperiod and provide less groundwater rechage than previously. The wetland dredging also negatively affected the ecology of the wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

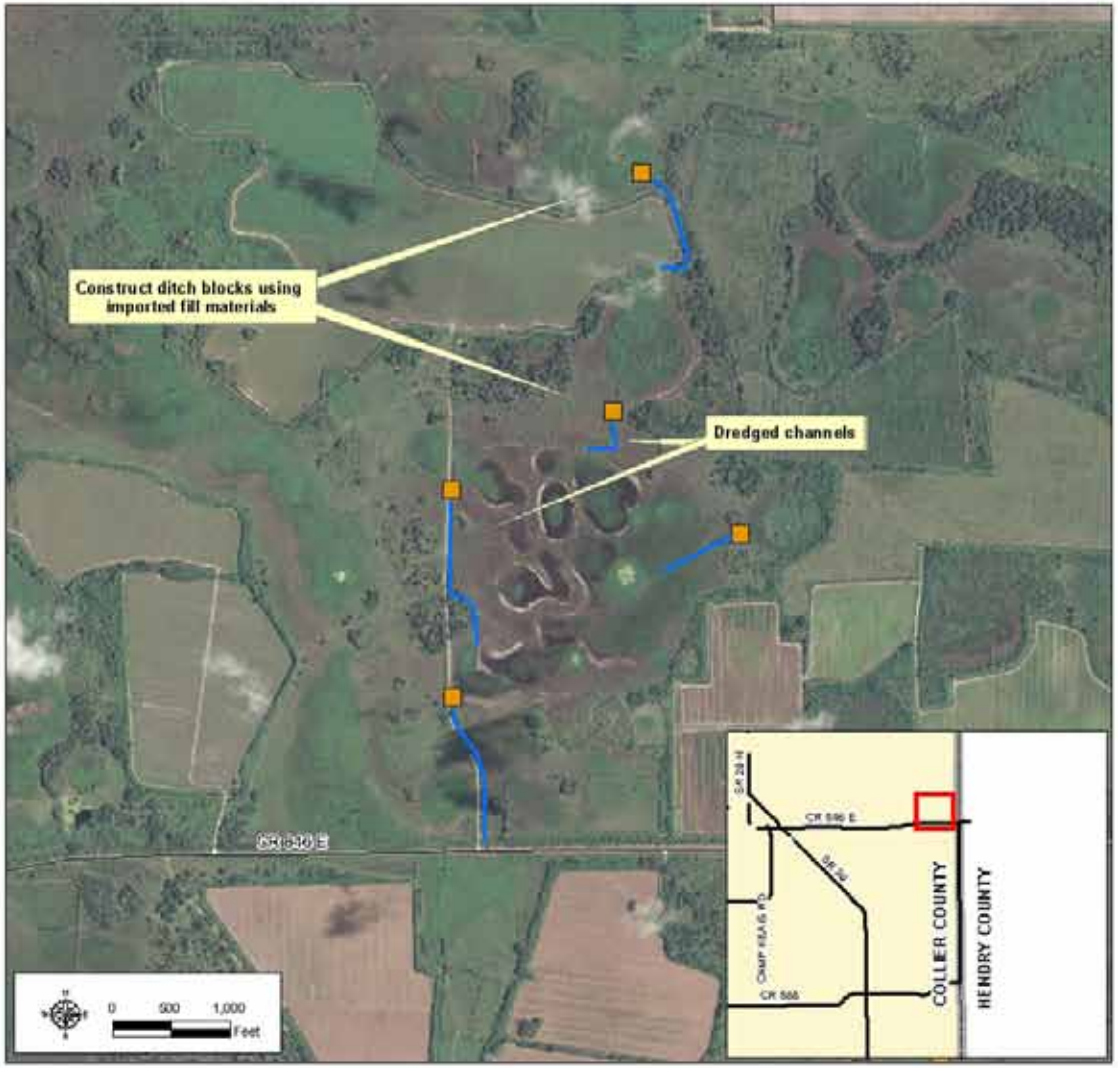
PROJECT BENEFITS

(1) Improves wetland hydrology and habitat by blocking ditches that artificially drain these isolated wetlands. Predicted to provide an average annual watershed performance measure lift of 0.0002.

(2) Increases groundwater recharge.

PROJECT DISADVANTAGES

(1) Changes in groundwater and surface water elevations may affect adjacent agricultural lands.



SOLUTION

- Project is located within approved Stewardship Sending Area. Use incentive programs to encourage property owner to implement local wetland restoration activities.

- Use existing dredge spoil material or import material to backfill drainage ditches and create ditch blocks at the wetland outfall locations to allow wetlands to discharge via overland flow. The ditch blocks created within the canals will contribute to an increase in hydroperiod and groundwater recharge in the area.

DESIGN CONSIDERATIONS

- Determine if any on-site dredge spoil material is available for backfill requirements.

Okaloacoochee Wetland Restoration - Area 3

ATKINS

Collier County Watershed Management Plan

Collier County

Okaloacoochee Watershed

STATEMENT OF PROBLEM

During agricultural development, many isolated wetlands were drained for logging or planting. Historically, these wetlands discharged at higher stages via a natural slough or overland flow.

These drained wetlands currently have a shorter hydroperiod and provide less groundwater recharge. The wetland dredging also negatively affected the ecology of the wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

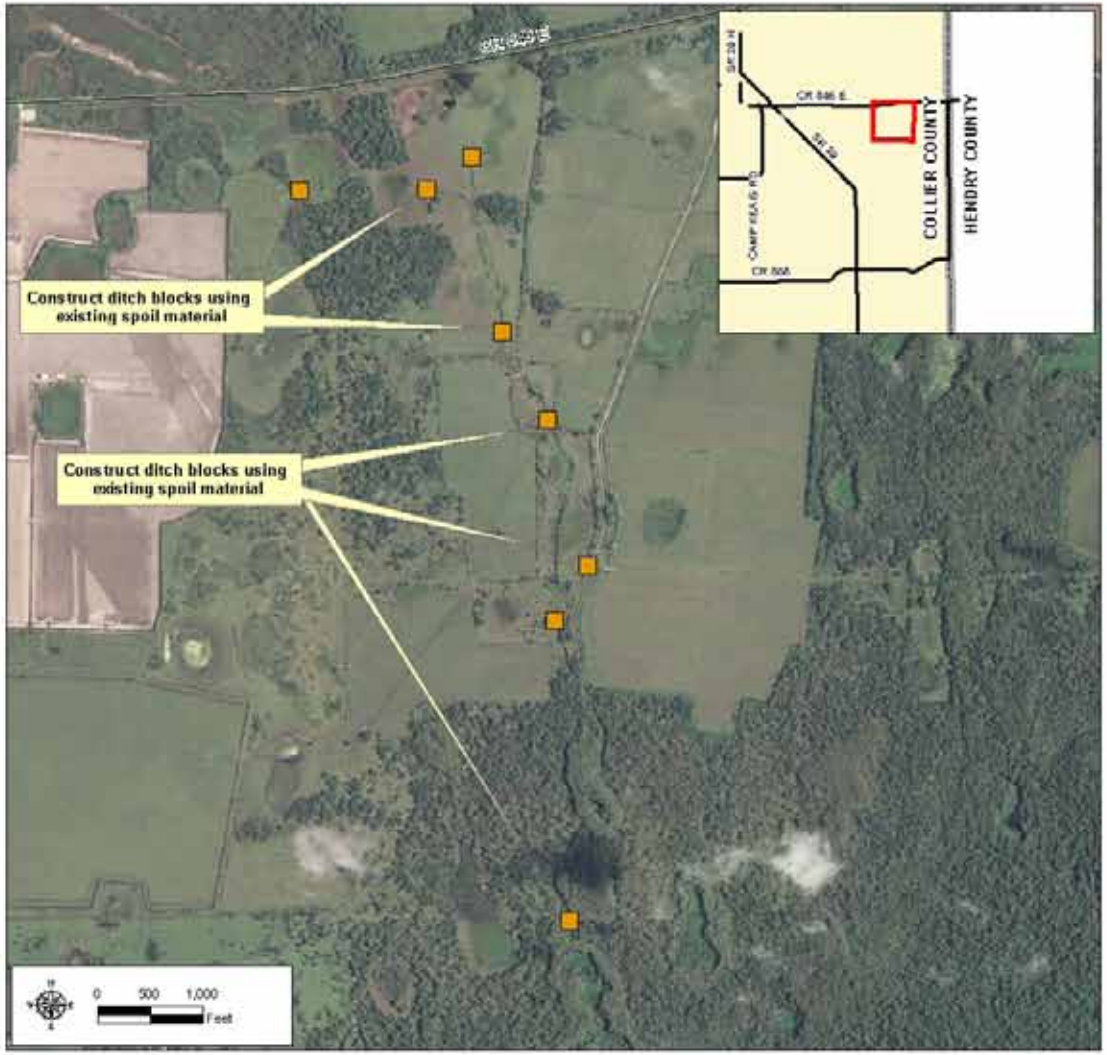
PROJECT BENEFITS

(1) Improves wetland hydrology and habitat by blocking ditches that artificially drain these isolated wetlands. Predicted to provide an annual average watershed performance measure lift of 0.0002.

(2) Increases groundwater recharge.

PROJECT DISADVANTAGES

(1) Changes in groundwater and surface water elevation may affect adjacent agricultural lands.



SOLUTION

- Project is located within approved Stewardship Sending Area and existing Habitat Stewardship Area. Use incentive programs to encourage property owner to implement local wetland restoration activities.

-Use existing dredge spoil material on the canal banks to backfill man-made ditches and create ditch blocks at the wetland outfall locations. The ditch blocks created within the isolated wetlands and slough will provide natural sedimentation in the canal to raise the slough profile and promote the natural restoration of the waterway.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

Appendix 2-C

Capital Improvement Program
Recommended Project Cost Estimates

Cost Estimate
Collier County Watershed Management Plan

CC-3
Cocohatchee Watershed
CORKSCREW REGIONAL ECOSYSTEM WATERSHED

Item	Unit	Quantity	Unit Price	Total Price*
Site Demolition/Removal				
Clearing & Grubbing	AC	0.25	$15,000	$3,800
Erosion Control (coir logs)	LF	900	$5	$4,500
				$8,300
Grading & Earthwork				
Ditch Bottom excavation	CY	500	$10	$5,000
Ditch Backfill Placement and Compaction	CY	2,438	$20	$48,800
				$53,800
Subtotal				**$63,000**
Mobilization & Demobilization (5%, minimum $5,000)				**$5,000**
		Estimated Construction Cost		**$68,000**
Land Acquisition				
Partial Property Acquisition	N/A	-	N/A	**$0**
Engineering & Contingency (40% of Construction, minimum $15,000)				**$28,000**
	ESTIMATED TOTAL COST =			**$96,000**

Cost Estimate
Collier County Watershed Management Plan

GG-2
Golden Gate Watershed
NORTH GOLDEN GATE ESTATES FLOWWAY RESTORATION PROJECT

Item	Unit	Quantity	Unit Price	Total Price*
Site Demolition/Removal				
Land Clearing & Grubbing	AC	1	$15,000	$15,000
				$15,000
Storm Structure & Pipes				
MES 24" RCP	EA	212	$1,800	$381,600
24" RCP	LF	8,240	$100	$824,000
				$1,205,600
Grading & Earthwork				
Sodding	SY	3,533	$1.75	$6,200
Miscellaneous Onsite Grading	CY	1,060	$10.00	$10,600
				$16,800
Paving and Roadway				
Pavement Restoration	SY	4,240	$70	$296,800
				$296,800
Miscellaneous				
Septic Tank Upgrades	EA	100	$750	$75,000
				$75,000
Subtotal				**$1,610,000**
Mobilization & Demobilization (5%)				**$81,000**
		Estimated Construction Cost		**$1,691,000**
Engineering and Contingency (40% of Construction)				**$677,000**
	ESTIMATED TOTAL COST =			**$2,368,000**

*Rounded to the nearest $1000

Cost Estimate
Collier County Watershed Management Plan

RB-1
Rookery Bay Watershed
NORTH BELLE MEADE SPREADER SWALE

Item	Unit	Quantity	Unit Price	Total Price*
Site Demolition/Removal				
Clearing & Grubbing (Spreader swale only)	AC	25	$15,000	$372,000
				$372,000
Storm Structures & Pipes				
5 - 75' Concrete-Set Aluminum Spreader Weirs	LF	375	$500	$188,000
4' x 8' RCBC	LF	40	$850	$34,000
4' x 8' RCBC Headwall	EA	2	$18,000	$36,000
				$258,000
Grading & Earthwork				
1 Mile Diversion Canal (30' wide, 10' Deep & 2:1 SS)	LS	1	$1,000,205	$1,000,000
Spreader Swale Excavation and Construction	CY	47,111	$10	$471,100
Sodding	SY	66,667	$1.75	$116,700
				$1,587,800
Miscellaneous				
100 cfs Pump Station	LS	1	$2,342,068	$2,342,000
				$2,342,000
Subtotal				**$4,560,000**
Mobilization & Demobilization (5%)				**$228,000**
			Estimated Construction Cost	**$4,788,000**
Land Acquisition				
100, Wide Segment of 5 Parcels (5300 LF total)	AC	12	$10,000	$122,000
150' Wide Segement of Parcels for Spreader (6000 LF)	AC	20	$10,000	$200,000
			Land Cost Total	**$322,000**
Engineering and Contingency (40% of Construction)				**$1,916,000**
			ESTIMATED TOTAL COST =	**$7,026,000**

*Rounded to the nearest $100

Cost Estimate
Collier County Watershed Management Plan

RB-2
Rookery Bay Watershed
SOUTH I-75 CANAL SPREADER SWALE

Item	Unit	Quantity	Unit Price	Total Price*
Site Demolition/Removal				
Clearing & Grubbing (Spreader swale only)	AC	16	$15,000	$234,000
				$234,000
Storm Structures & Pipes				
Concrete-Set Aluminum Spreader Weirs	LF	190	$500	$95,000
				$95,000
Grading & Earthwork				
Channel & Swale Excavation and Construction	CY	27,111	$10	$271,100
Sodding	SY	16,000	$1.75	$28,000
				$299,100
Miscellaneous				
50 cfs Pump Station	LS	1	$1,500,000	$1,500,000
				$1,500,000
Subtotal				**$2,129,000**
Mobilization & Demobilization (5%)				**$107,000**
			Estimated Construction Cost	**$2,236,000**
Land Acquisition				
	AC	0	$0	$0
			Land Cost Total	**$0**
Engineering and Contingency (40% of Construction)				**$895,000**
			ESTIMATED TOTAL COST =	**$3,131,000**

*Rounded to the nearest $100

Cost Estimate
Collier County Watershed Management Plan

GG-10
Golden Gate Watershed
HENDERSON CREEK DIVERSION

Item	Unit	Quantity	Unit Price	Total Price*
Site Demolition/Removal				
	AC	0	$15,000	$0
				$0
Storm Structure & Pipes				
	LF	0	$80	$0
				$0
Grading & Earthwork				
	LF	0	$1,200	$0
				$0
Paving and Roadway				
	SY	0	$70	$0
				$0
Miscellaneous				
100 cfs Pump Station	LS	1	$2,144,704	$2,144,800
Diversion Canal	LS	1	$919,826	$919,900
Diversion Canal DS Connection Improvements	LS	1	$1,000,000	$1,000,000
Subtotal				**$4,065,000**
		Estimated Construction Cost		**$4,065,000**
Land Acquisition		Porportional Value	MARKET	
100' Wide Section of PARCEL #00298120608	LS		$422,170	$423,000
		Estimated land Acquisition		**$423,000**
Engineering and Contingency (30% of Construction)				**$1,220,000**
			ESTIMATED TOTAL COST =	**$5,708,000**

*Rounded to the nearest $100

Cost Estimate
Collier County Watershed Management Plan

GG-5
Golden Gate Watershed
WOLFE ROAD WETLAND TREATMENT SYSTEM

Item	Unit	Quantity	Unit Price	Total Price*
Site Demolition/Removal				
Land Clearing & Grubbing	AC	2	$15,000	$22,500
				$23,000
Storm Structure & Pipes				
Modify Existing Control Structure	LS	1	$2,500	$2,500
FDOT Type E Inlet Modified	EA	2	$3,500	$7,000
Double 36" RCP Headwall	EA	3	$3,600	$10,800
36" RCP Headwall	EA	8	$3,000	$24,000
36" RCP	LF	930	$150	$139,500
				$184,000
Grading & Earthwork				
Channel Excavation and Grading	CY	3,684	$10	$36,900
Riprap	TN	110	$100	$11,000
Sodding	SY	8,933	$1.75	$15,700
				$64,000
Paving and Roadway				
Sidewalk Restoration	LS	1	$500	$500
Pavement Restoration	SY	60	$70	$4,200
				$5,000
Miscellaneous				
Littoral Shelf Planting	AC	4.00	$15,000	$60,000
Subtotal				**$336,000**
Mobilization & Demobilization (5%)				**$17,000**
		Estimated Construction Cost		**$353,000**
Land Acquisition			MARKET	MARKET
PARCEL #00204360009	N/A		$910,660	$910,660
Easement purchace PARCEL #00203720006	LS		$10,000	$10,000
		Estimated land Acquisition		**$921,000**
Engineering and Contingency (40% of Construction)				**$142,000**
	ESTIMATED TOTAL COST =			**$1,416,000**

*Rounded to the nearest $100

Cost Estimate
Collier County Watershed Management Plan

RB-3
Rookery Bay Watershed
HENDERSON CREEK OFF-LINE STORAGE RESERVIOR

Item	Unit	Quantity	Unit Price	Total Price*
Site Demolition/Removal				
Land Clearing & Grubbing (force main only)	AC	0	$15,000	$1,500
				$1,500
Storm Structure & Pipes				
24" Force Main	LF	1,700	$144	$244,800
				$244,800
Paving and Roadway				
Pavement Restoration	SY	55	$70	$3,900
				$3,900
Miscellaneous				
10 cfs Pump Station	LS	1	$400,000	$400,000
				$400,000
Subtotal				**$405,400**
Mobilization & Demobilization (10%)				**$20,300**
		Estimated Construction Cost		**$671,000**
Land Acquisition			MARKET	MARKET
PARCEL #00411800006	LS		$1,740,506	$1,740,506
PARCEL #00417040006	LS		$45,844	$45,844
PARCEL#00412240005	LS		$155,648	$155,648
PARCEL #00411160005	LS		$46,182	$46,182
		Estimated land Acquisition		**$1,989,000**
Engineering and Contingency (40% of Construction)				**$269,000**
	ESTIMATED TOTAL COST =			**$2,929,000**

*Rounded to the nearest $100

Cost Estimate
Collier County Watershed Management Plan

GG-7
Golden Gate Watershed
UPPER GOLDEN GATE ESTATES CANAL WEIR CONSTRUCTION

Item	Unit	Quantity	Unit Price	Total Price*
Description				
Land Clearing & Grubbing	AC	0.1	$15,000	$1,500
Turbidity Barrier	LF	160	$18	$2,900
Backfill and Reshape Canal slope	CY	444	$5	$2,300
Sheetpile with concrete Cap	SF	3,200	$44	$140,800
Install self-contained slide gate/weirs	EA	4	$24,000	$96,000
Rip Rap	CY	296	$90	$26,700
H Beam to support walkway	LF	400	$102	$40,800
Floor grating steel, panels, handrails and cross bars	SF	180	$48	$8,700
Security fence	LF	120	$38	$4,600
Swing Gate	EA	2	$1,200	$2,400
Fine clearing and grading	LS	1	$1,200	$1,200
Subtotal				**$327,900**
Markup (15%)				**$49,200**
Mobilization & Demobilization (5%)				**$16,400**
		Estimated Construction Cost		**$394,000**
Land Acquisition			MARKET	MARKET
	LS		$0	$0
		Estimated land Acquisition		**$0**
Engineering and Contingency (40% of Construction)				**$158,000**
	ESTIMATED TOTAL COST =			**$552,000**

*Rounded to the nearest $1000

Cost Estimate
Collier County Watershed Management Plan

GG-7
Golden Gate Watershed
ORANGE TREE CANAL CONTROL STRUCTURE INSTALLATION

Item	Unit	Quantity	Unit Price	Total Price*
Description				
Land Clearing & Grubbing	AC	0.1	$15,000	$1,500
Turbidity Barrier	LF	160	$18	$2,900
Backfill and Reshape Canal slope	CY	444	$5	$2,300
Sheetpile with concrete Cap	SF	3,200	$44	$140,800
Install self-contained slide gate/weirs	EA	4	$24,000	$96,000
Rip Rap	CY	296	$90	$26,700
H Beam to support walkway	LF	400	$102	$40,800
Floor grating steel, panels, handrails and cross bars	SF	180	$48	$8,700
Security fence	LF	120	$38	$4,600
Swing Gate	EA	2	$1,200	$2,400
Fine clearing and grading	LS	1	$1,200	$1,200
Subtotal				**$327,900**
Markup (15%)				**$49,200**
Mobilization & Demobilization (5%)				**$16,400**
		Estimated Construction Cost		**$394,000**
Land Acquisition			MARKET	MARKET
	LS		$0	$0
		Estimated land Acquisition		**$0**
Engineering and Contingency (40% of Construction)				**$158,000**
	ESTIMATED TOTAL COST =			**$552,000**

*Rounded to the nearest $1000

Cost Estimate
Collier County Watershed Management Plan

RB-1
Rookery Bay Watershed
US Highway 41 Stormwater Treatment Area

Item	Unit	Quantity	Unit Price	Total Price*
Site Demolition/Removal				
Clearing & Grubbing	AC	3	$15,000	$45,000
				$45,000
Storm Structures & Pipes				
2' Concrete Sill Weir	EA	1	$8,000	$8,000
				$8,000
Grading & Earthwork				
STA Bank Construction	CY	4,815	$10	$48,100
Sodding	SY	10,111	$1.75	$17,700
				$65,800
Miscellaneous				
5 cfs Pump Station	LS	1	$250,000	$250,000
				$250,000
Subtotal				**$369,000**
Mobilization & Demobilization (5%)				**$18,500**
		Estimated Construction Cost		**$388,000**
Land Acquisition			MARKET	
			Land Cost Total	**$0**
Engineering and Contingency (40% of Construction)				**$156,000**
	ESTIMATED TOTAL COST =			**$544,000**

*Rounded to the nearest $100

Collier County
Watershed Management Plan

Collier County

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