



RESTORING THE ROOKERY BAY ESTUARY

A PROJECT CONNECTING PEOPLE AND SCIENCE FOR LONG-TERM COMMUNITY BENEFIT

Rookery Bay National Estuarine Research Reserve

A Compilation of Proposed Watershed Improvement Projects within the Rookery Bay Watershed Collier County, Florida



Prepared by
Rookery Bay National Estuarine Research Reserve
Naples, Florida
Updated October 2014



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Funding for this project was provided to the Rookery Bay National Estuarine Research Reserve in 2011-2015 by the National Estuarine Research Reserve System's (NERRS) Science Collaborative which is a cooperative agreement between the National Oceanic and Atmospheric Administration (NOAA) and the University of New Hampshire under NOAA grant NA09NOS4190153. The NERRS Science Collaborative puts Reserve-based science to work for coastal communities by engaging the people who need the science in the research process—from problem definition and project design through implementation of the research and use of its results in coastal decisions.

For more information about this project please visit www.rookerybay.org/restoreRB or contact Principal Investigator Tabitha Whalen Stadler at the Rookery Bay National Estuarine Research Reserve in Naples, Florida at 239-530-5940.



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About the Project

A multidisciplinary team led by Florida's Rookery Bay National Estuarine Research Reserve received an \$815,000 grant for a three-year project to help local communities manage freshwater flows in the Rookery Bay watershed. In consultation with an advisory group consisting of hydrologic engineers, social science researchers, resource managers, and community stakeholders, the team produced science to better understand the freshwater flows needed to maintain the health of the watershed's Rookery Bay Estuary and the perspectives of water users and decision makers (see map, page 5 for study site information). As part of this project, investigators created a framework that stakeholders can use to collaborate and make decisions about water issues into the future.

About this Document

In order to understand the proposed watershed management projects within the study area (see map, page 5 for study site information), project team members Tabitha Stadler from Rookery Bay Reserve and Emilio Robau from RWA and Robau & Associates researched information from the Collier County Watershed Plan, the Belle Meade Stormwater Master Plan and summarized the projects in this document. These projects are intended to address the quality, quantity and timing of freshwater inflow to the estuary, as well as, prevent flooding and recharge the aquifer. Knowledge of these projects may help stakeholders make more informed decisions about water resources in the region.

Why is this Important?

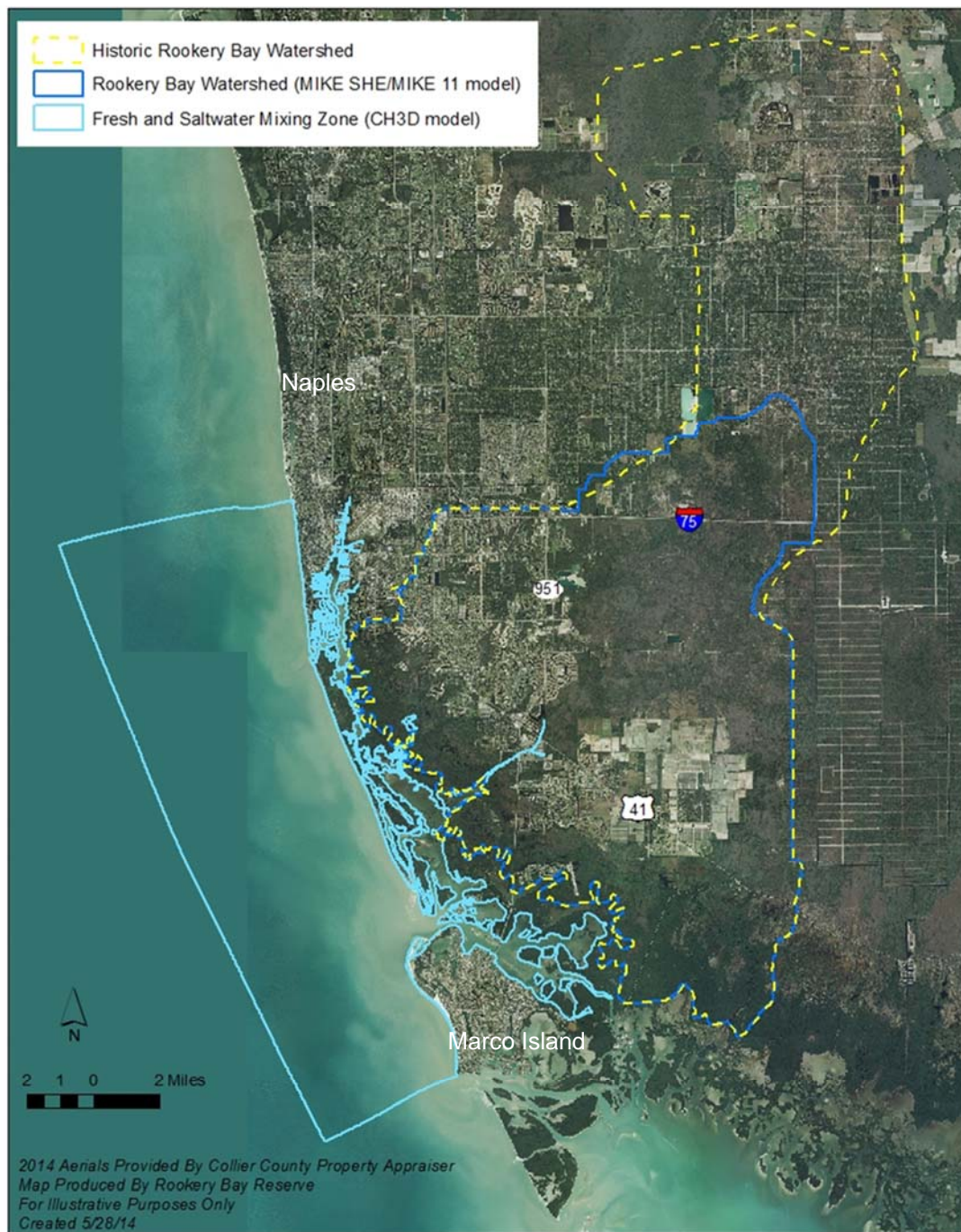
One of the few pristine, mangrove-forested estuaries in the U.S., the Rookery Bay Estuary is a recognized breeding ground for commercial and recreational fisheries like blue crab, stone crab, snook, tarpon and snapper. Each year, thousands of tourists are drawn to its vast expanses of natural space, where they fish, swim, kayak and experience manatees, dolphins, and coastal birds in their native surroundings. The health of the Estuary and its wildlife depend on seasonally appropriate flows of freshwater. These freshwater flows also sustain communities in surrounding Collier County and on nearby Marco Island. Population growth and saltwater intrusion of community and government wells (an increasingly common event in southern Florida) are placing further stress on available freshwater. Compounding the situation are the area's highly managed water control structures and canals that mitigate flooding, but also disrupt the natural sheet flow conditions necessary for estuarine health. Balancing the water needs of people with those of the natural systems on which they depend for jobs and recreation is becoming an increasing challenge as communities grow and sea levels rise. This project aims to address this challenge of increasing knowledge of the water flow parameters necessary for estuarine health in the Rookery Bay.



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The study site for the project is the Rookery Bay watershed located in Collier County between the cities of Naples and Marco Island in southwestern Florida.

The current Rookery Bay Watershed is shown in dark blue and encompasses 167 square miles. The historic watershed is shown by a yellow dotted line and includes an additional 80 square miles. The light blue depicts the fresh and saltwater mixing zone called the Rookery Bay Estuary.

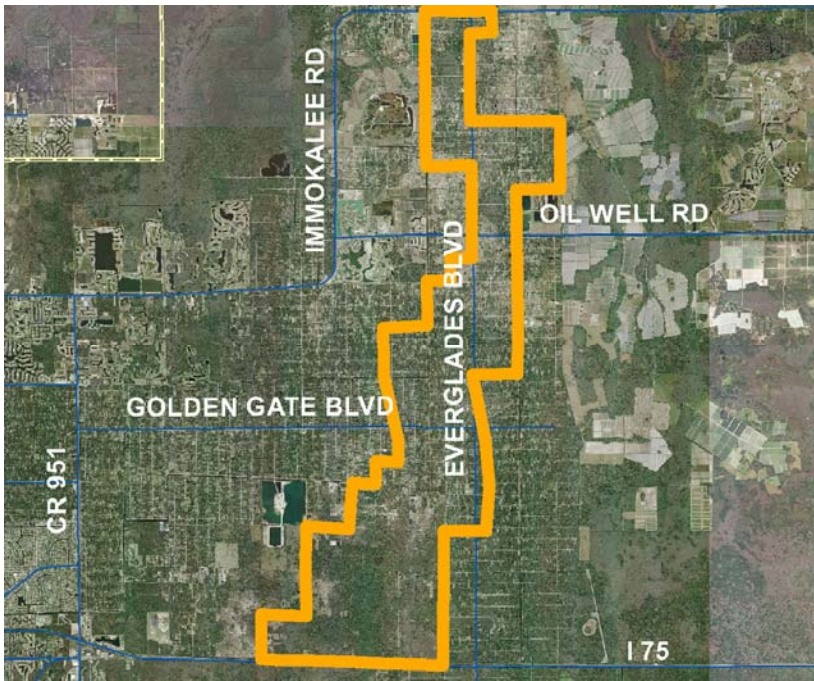


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1.0 Northern Golden Gate Estates Flow-way Restoration



Project Type:

- Regional flow-way restoration

Project Elements:

- Restore historic flow patterns
- Provide stormwater attenuation and treatment
- Enhance flood protection
- Enhance water quality treatment
- Habitat restoration and protection

Watershed Location:

Faka-Union, N Golden Gate, Golden Gate, Naples Bay, Rookery Bay

Status: Design development

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan

This project entails the restoration of a historic wetland flow-way known as the Horse Pen Strand (also sometimes referred to as the Northern Golden Gate Estates Flow-way Restoration) which is located within Northern Golden Gate Estates at the uppermost reach of the Rookery Bay watershed. Critical elements of the restoration include an emphasis on stormwater treatment, stormwater conveyance, and habitat protection together with maintaining existing and/or restoring historic overland sheet flow. The project would result in the protection and enhancement of water quality in canals, lakes, and wetlands and also recharge groundwater. The flows from this area to the South Belle Meade area may only occur during high water wet season events.

The Horse Pen Area Restoration Plan was developed in 2008 with funding from the Collier Soil and Water Conservation District and it assessed the hydrology and vegetation characteristics of a 34-square-mile area through historic and current aerial interpretation and vegetation mapping. This report supported the idea that this area could be connected to downstream areas and meet project objectives. A “Phase II” study is currently underway and will assist in a future stormwater master plan. Plan elements may include culverts, swales, control structures, and land acquisition as part of retrofits to the Northern Golden Gate Estates subdivision.

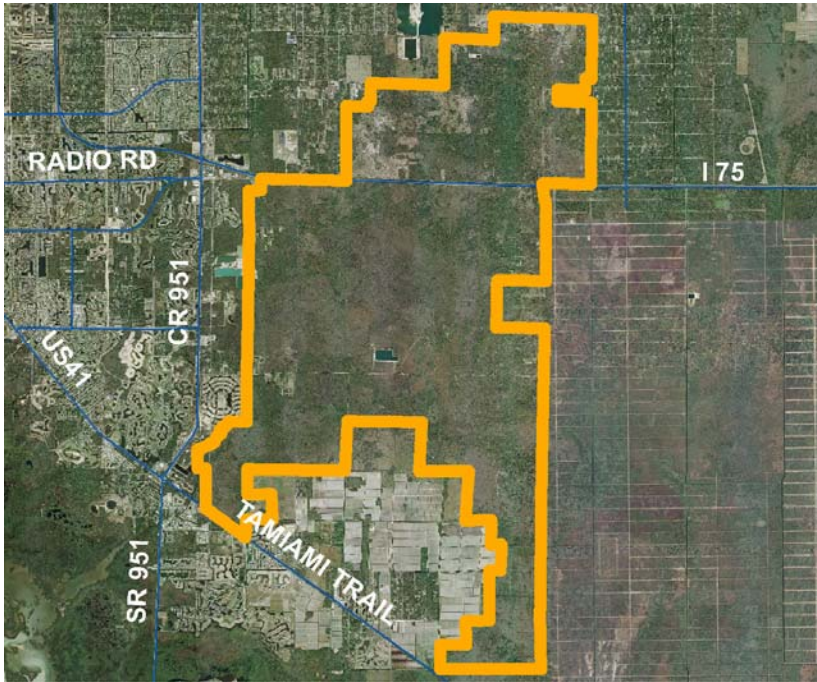


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2.0 South Belle Meade Flow-way Master Project



Project Type:

- Regional flow-way restoration outlined in projects 2.1 through 2.6

Project Elements:

- Divert water from Golden Gate Canal
- Restore historic flow patterns
- Install culverts
- Provide stormwater storage and treatment reservoirs
- Enhance flood protection
- Enhance water quality treatment
- Habitat restoration and protection

Watershed Location: Faka-Union, Golden Gate, Naples Bay, Rookery Bay

Status: Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Master Plan

South Belle Meade is an undeveloped region bounded on the north by I-75, and on the east by the Picayune Strand Comprehensive Everglades Restoration Plan project, and on the south by US 41/Tamiami Trail where an active agricultural area exists. This is in the middle of the Rookery Bay watershed. South Belle Meade is ecologically connected to North Belle Meade, which is located north of I-75, but is hydrologically separated due to the I-75 corridor and its associated borrow canals. This area is part of the Collier County Transfer of Development Rights (TDR) program as an area where development rights can be transferred. Both North and South Belle Meade have been severely impacted by over-drainage from a variety of canals including the Golden Gate Canal, County Road 951/Henderson Creek Canal, and the I-75 canal. Sheet flow from the north is captured by the canal that is north of, and parallel to, the I-75 highway and water is diverted east or west and then runs south through culverts under the highway. These culverts are spaced at several-thousand-foot intervals and they deliver surface water to the South Belle Meade region. That water, however, is diverted around most of Belle Meade through a series of ditches that dump water into the Miller Canal on the east and the County Road 951/Henderson Creek Canal to the west. The area continues to support over 50 listed plants and 30 listed animals that may benefit from hydrologic restoration of flow-ways and water quality protection. This is also relevant because adjacent public lands include Picayune Strand State Forest, Rookery Bay National Estuarine Research Reserve, and Collier-Seminole State Park. Hydrologic restoration would also support public water supplies since the City of Marco Island has a surface water withdrawal facility along the County Road 951/Henderson Creek Canal. This master project includes activities necessary to provide additional sheet flows to Belle Meade with a potential area of influence involving 5,000 to 6,000 acres. This includes redirection of surface water from north of I-75 and from the Golden Gate Canal to minimize flows into Naples Bay, and to rehydrate and store water. This series of projects would include culverts, an elevated reservoir, wetland retention areas, and potentially land acquisition or agricultural restoration. Projects 2.1 through 2.7 are pieces of this overall flow-way project concept.

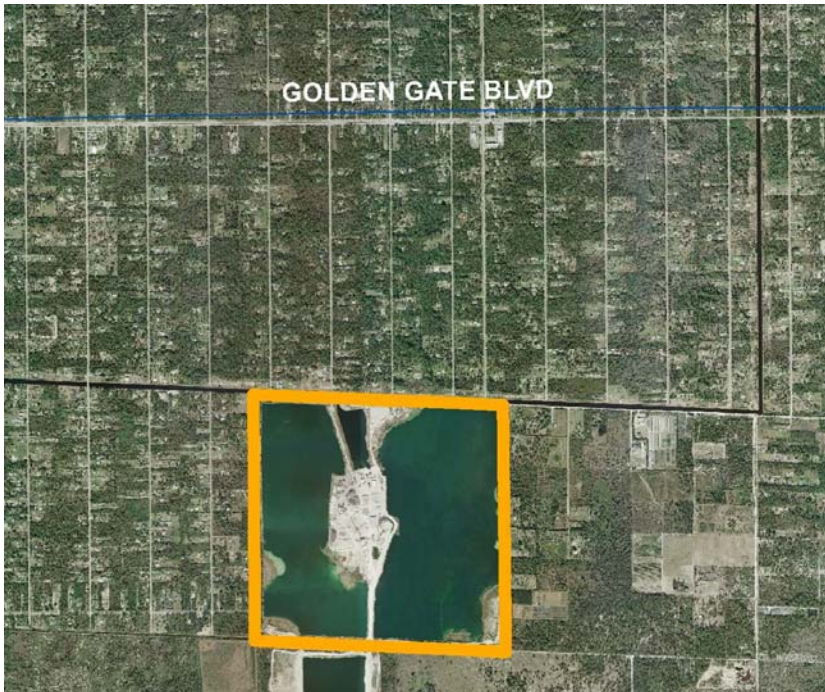


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2.1 North Belle Meade Storage Reservoir



Project Type:

- Elevated water conservation storage reservoir

Project Elements:

- Capture wet season canal flows from for water quality treatment, storage, aquifer recharge, and other multiple downstream uses
- Construct a containment berm
- Construct pump station facilities
- Construct gravity discharge facilities and modify discharge to emulate natural seasonal patterns

Watershed Location: Golden Gate, Naples Bay, Rookery Bay

Status: Conceptual

Project Conceptualized on:

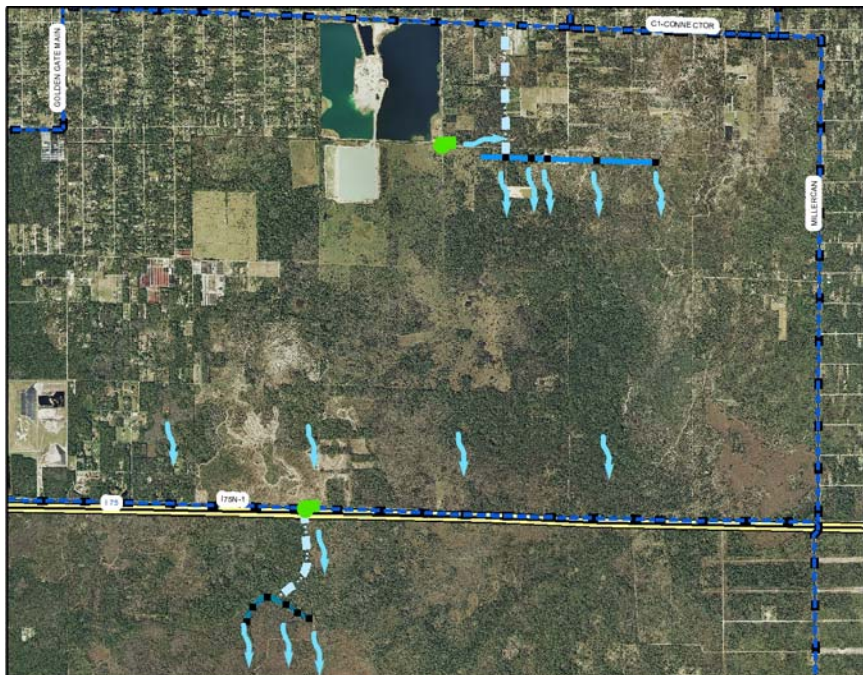
- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

The proposed project is to convert an existing quarry to an above-ground reservoir along the Golden Gate Canal to store wet period excess flows and to provide supplemental dry period flows to downstream flowways. This would be accomplished through construction of a containment berm surrounding the existing quarry pit and a pump station to pump water from the canal into the reservoir. In addition, the project would include the construction of a gravity discharge facility, perhaps a crested weir, to allow flows from the reservoir into the proposed Project 2.2 which is a lower elevation area that is mostly existing wetlands, and intended to store water, at grade, over a larger area.

This project is designed to capture wet season canal flows from the Golden Gate Canal and areas to the north for storage, aquifer recharge, consumptive water uses, and potential release during the dry season to better mimic predevelopment flows. The main objective, however, is to hydrate the Belle Meade region to the south. Additional analysis would be necessary to determine if this project could potentially reduce freshwater pulse discharges to Naples Bay and redirect fresh water to the downstream waters of the Rookery Bay National Estuarine Research Reserve.



2.2 North Belle Meade Rehydration



Project Type:

- Non-elevated wetland conservation area

Project Elements:

- Capture wet season canal flows for water quality treatment, storage, aquifer recharge, and other multiple downstream uses
- Construct a containment berm
- Construct gravity discharge facilities and modify discharge to mimic natural seasonal patterns
- Construct culverts under I-75

Watershed Location:

Golden Gate, Naples Bay, Rookery Bay

Status: Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

This project represents the downstream alterations required to accept flows from the elevated water conservation reservoir described in project 2.1. It is also located north of I-75 and is therefore within the area known as North Belle Meade. It involves creating a large surface water impoundment within existing wetlands south of the reservoir by containing the wetland area using existing or new berms, and also constructing culverts under I-75. This project would rehydrate the North and South Belle Meade areas.

The additional water storage that could result from this project would extend the hydroperiod by discharging flows into the early dry season and more closely mimicking historic conditions. Implementation of this element will incrementally restore wetlands and reduce flow in the Golden Gate Canal.

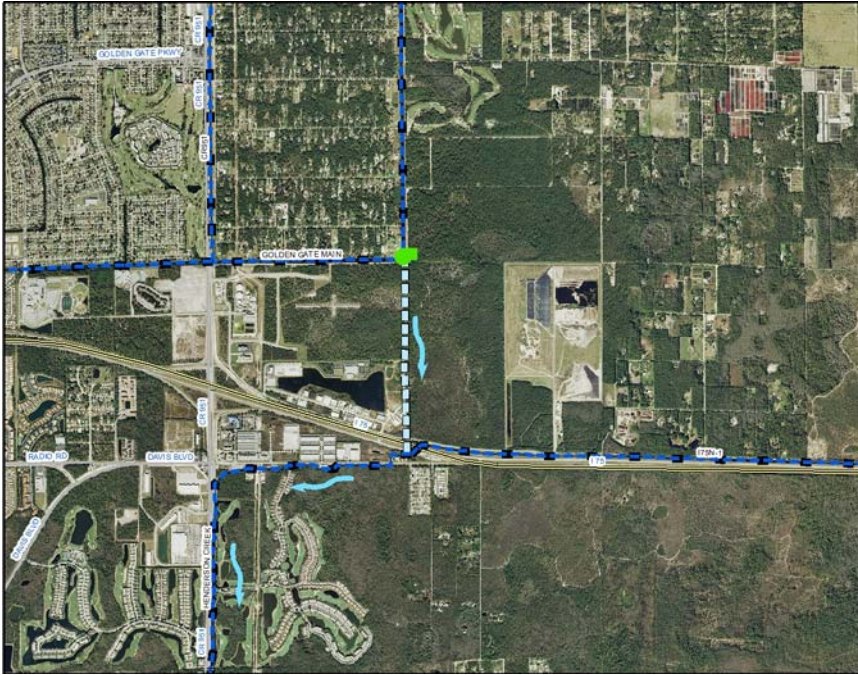


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2.3 Golden Gate Canal Diverter Structure



Project Type:

- Diverter structure and pump station

Project Elements:

- Capture wet season canal flows from the Golden Gate Canal and discharge the flows into the Henderson Creek Canal for downstream hydration and multiple uses
- Construct pump station facilities
- Construct gravity discharge facilities and modify discharges to mimic natural seasonal patterns
- Construct a canal that connects the Golden Gate Canal with the Henderson Creek Canal

Watershed Location: Golden Gate, Naples Bay, Rookery Bay

Status: Design Development

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

This project seeks to divert water from the Golden Gate Canal into the County Road 951/Henderson Creek Canal. The project plans call for the construction of a 100 cubic feet per second (cfs) pump station to divert flows south from the Golden Gate Canal into a new 5,200-linear-foot dredged canal, that would be 30 feet wide and ten feet deep. After land acquisition, the water would flow into County Road 951/Henderson Creek Canal through an existing box culvert under I-75. Additional channel and culvert improvements would also be necessary in the County Road 951/Henderson Creek Canal area that is downstream of I-75 to convey the additional flows.

This project could have the benefit of reducing flows into Naples Bay and increasing flows into Rookery Bay with a main objective to better mimic historic flows into both estuarine systems.

This project is currently being modeled by Big Cypress Basin South Florida Water Management District and has potential funding available during 2015.

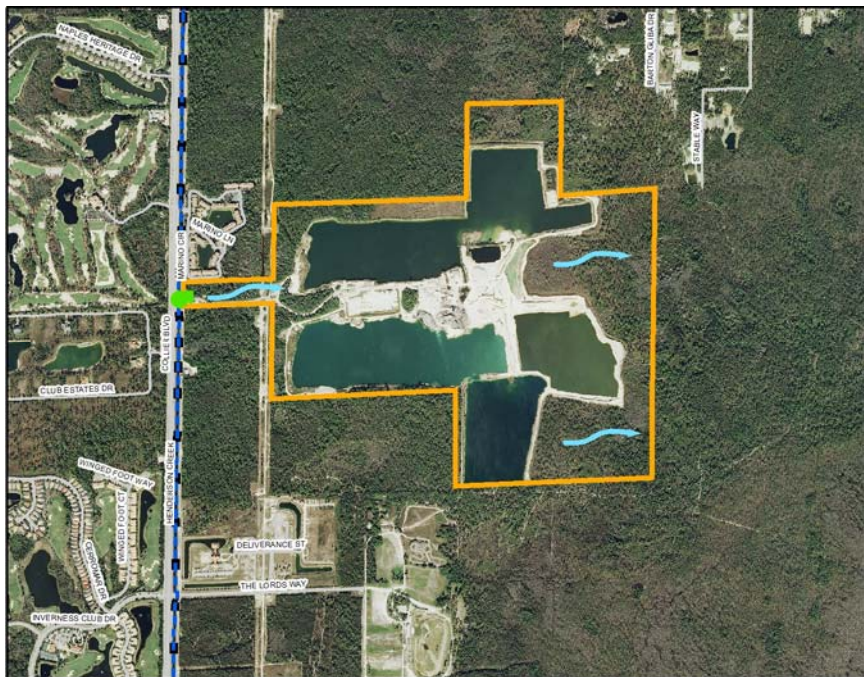


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2.4 Henderson Creek Off-line Storage Reservoir



Project Type:

- Water conservation storage reservoir

Project Elements:

- Capture wet season canal flows from County Road 951/Henderson Creek Canal system for storage, aquifer recharge, and other multiple downstream uses
- Construct a containment berm
- Construct pump station facilities
- Construct gravity discharge facilities and modify discharges to mimic natural seasonal patterns

Watershed Location: Rookery Bay

Status: Conceptual

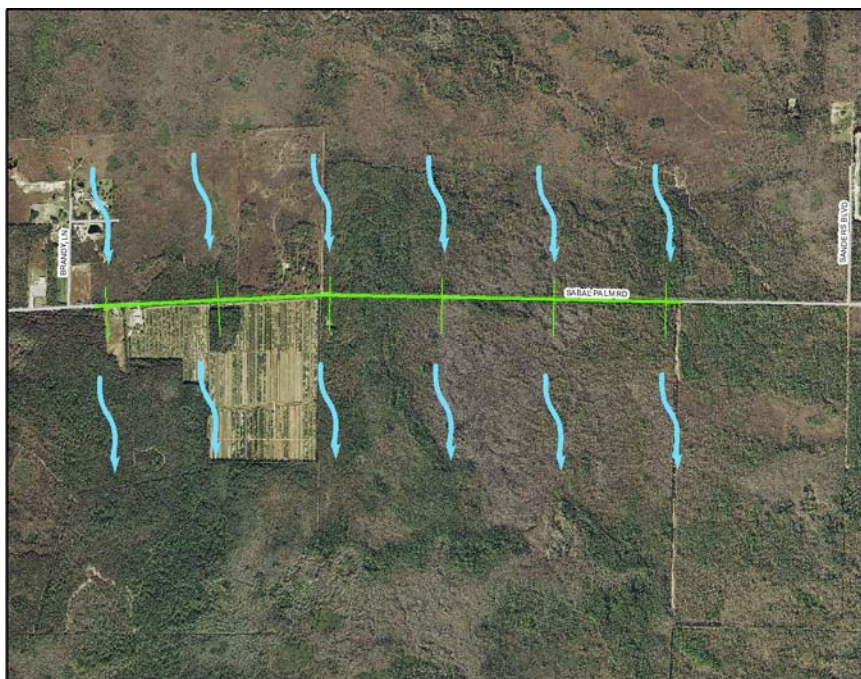
Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

This project focuses on an existing quarry, accessed from County Road 951/Collier Boulevard, and converting it to an elevated water conservation storage reservoir. The project goals are to capture wet season canal flows in the reservoir for release to the southeast to hydrate the South Belle Meade area in a manner that mimics the seasonal natural discharge patterns. This project includes land acquisition, the construction of a containment berm, a stormwater lift station, and gravity control structure discharge facilities to the east and west for multiple downstream uses.



2.5 Sabal Palm Road Spreader System



Project Type:

- Culvert connections, berm elimination, flow-way construction

Project Elements:

- Culvert installation
- Berm removal
- Flow-way identification and construction enhancements
- Construct a containment berm
- Construct gravity discharge facilities and modify discharge to mimic natural seasonal patterns

Watershed Location: Rookery Bay

Status: Partially constructed

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

This project includes the installation of culverts under a segment of Sabal Palm Road. This roadway, which was not properly designed and permitted, blocks north/south surface water flows in the center of the South Belle Meade flow-way. The project also proposes the removal of the road to the east of an existing quarry, the removal of berms on the south side of the road, and enhancements to the north-to-south ditches in the area in order to restore historic flows.

This project includes the installation of culverts in clusters, or series, so that water flows through three sets of flow-ways. The first flow-way is approximately 15,000 feet long and 1,000 feet wide and the second flow-way is 18,000 feet long and 1,000 feet wide. Several culverts, encompassing two of the flow-ways on the western portion of the road, have already been installed as part of mitigation plans for adjacent development. The proposed flow-ways are intended to enhance historic north-to-south flows and to reduce flood elevations in nearby areas.

In addition, the berm on the south side of Sabal Palm Road appears to run about one-half the length of the proposed project area. The berm is approximately four or five feet high and does not appear to contain any breaches in the area. This berm would be partially removed to enhance potential surface water sheet flow. The creation of shallow scrapes beside the remaining roadbed would also help to retain standing water during dry periods and could provide valuable foraging for wading birds if the road is ever graded to historic contours. In addition, low speed limits would mitigate wildlife mortality from vehicle collisions.

2.6 Tamiami Trail & Manatee Road Stormwater Treatment



Project Type:

- Water quality treatment area

Project Elements:

- Capture wet season canal flows from the US-41 Canal and areas to the north for water quality treatment, storage, and other multiple downstream uses
- Construct a containment berm
- Construct pump station facilities
- Construct gravity discharge facilities and modify discharge to emulate natural seasonal patterns

Watershed Location: Rookery Bay

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

This plan element would capture and divert some peak flows from the County Road 951/Henderson Creek Canal and also the US 41/Tamiami Trail Canal and divert them into a 66.1 acre triangular-shaped land parcel north and immediately adjacent to the Tamiami Canal and just to the west of Naples Reserve Boulevard. This would divert water that would otherwise flow more directly downstream into Henderson Creek and the Rookery Bay Estuary during the rainy season. In addition, this plan element would rehydrate historic wetlands on a parcel of land that was acquired in 1997 by the State of Florida and is managed by the Rookery Bay National Estuarine Research Reserve. The site, with the exception of the Tamiami Canal spoil berm and some lands on the eastern side of the property, is considered jurisdictional wetlands by state and federal regulatory agencies. The parcel contains a mosaic of wetlands, cypress strands, and hydric pine uplands. The quality of the wetlands varies from higher, in the eastern two-thirds of the parcel, to lower in the six-acres of parcel's western corner. The lower quality wetlands are attributed to decreased hydrology and invasion by melaleuca. The northeast corner is a mixed canopy of slash pine and pond cypress with a normal pool elevation of about six inches above existing grade and seasonal high of about 22 inches above natural grade. A spoil berm on the north side of the Tamiami Canal runs along the north side of US 41 with cuts that occur at intervals of approximately 100 feet providing hydrological connections between the parcel and the canal. Upstream of each berm cut is a flow-way (or flow-ways) that extends into the parcel for varying distances. The canal banks are heavily utilized as a wildlife travel corridor and possibly a forage area for several species including the Florida panther, as evidenced by tracks left along the water's edge.

The Tamiami Canal likely contributes to decreased hydroperiods in the eastern one-third of the parcel. Given the land elevation relative to the Tamiami Canal, design issues mandate a pump inflow structure, while the outfall would be a gravity discharge weir. The construction of levees around the parcel perimeter would also be required. The intent of this plan element is to provide a more natural hydrologic regime by managing the rainfall/regional flow-driven scheme, and allowing for a recession drawdown over a relative short duration. The hydrologic and hydraulic impact area near the stormwater detention area is a reduction in the flood elevation and peak flow rates in the Tamiami Canal, rehydration of wetlands, and improved of water quality.

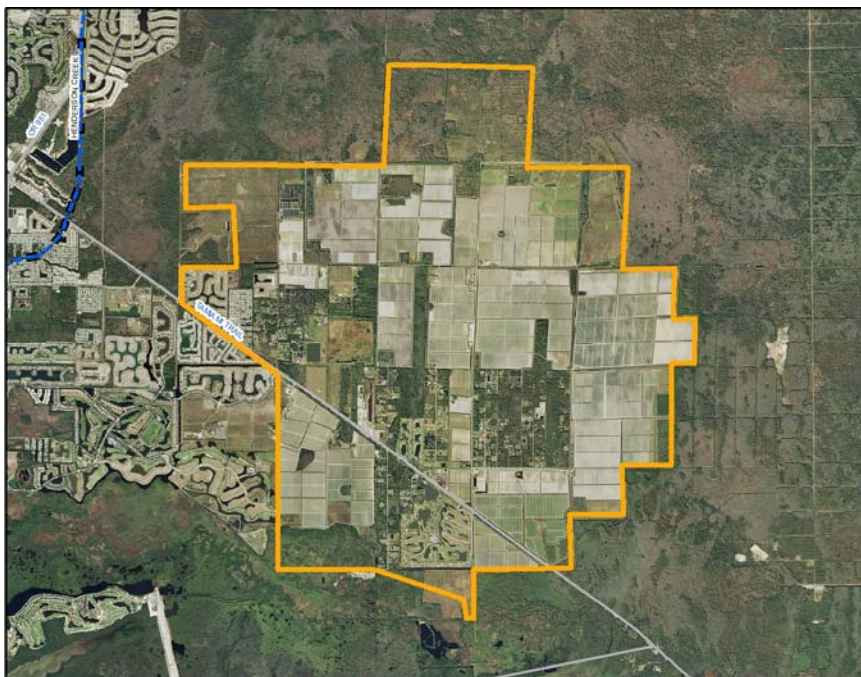


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3.0 Belle Meade Agricultural Area Flow-ways Restoration Master Project



Project Type:

- Regional flow-way restoration which is an overview of projects 3.1 through 3.6

Project Elements:

- Proposed stormwater retention and detention
- Water quality treatment
- Three proposed flow-ways
- Install culverts
- Enhance flood protection
- Enhance water quality treatment
- Habitat restoration and protection

Watershed Location: Rookery Bay

Status: Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

Master Project 3 focuses on a large area in the south-central portion of South Belle Meade which is primarily being used for agriculture, although some older housing areas are included. The main purpose of the project would be to establish three flow-ways (west, middle, east) through this area and also allow for the appropriate associated water storage and treatment areas. The project involves land acquisition, the installation of flow-ways and culverts, restoration of agricultural land to native landscapes, berm and road removal, spreader swale construction, and invasive exotic plant removal. Sub-projects of this overall master project are depicted in projects 3.1 through 3.6. The goals of this project would be realized through continued implementation of agricultural best management practices under the current land-use scenario or through planning or permitting efforts if agricultural land-uses convert to development.

Sheet flow in the overall region is disrupted by the largely bermed-off and isolated agricultural production area. However, the proposed three flow-ways running north and south in this agricultural area are partially intact since they empty into existing canals associated with the farm fields and are contiguous to forested areas, probably cypress trees, that are not being farmed. In summary, master Project 3 involves planning for, and the installation of, a series of projects to allow the sheet flow moving from north to south to go through the Belle Meade agricultural area with water quality treatment and water quantity discharges that mimic the natural seasonal pattern.

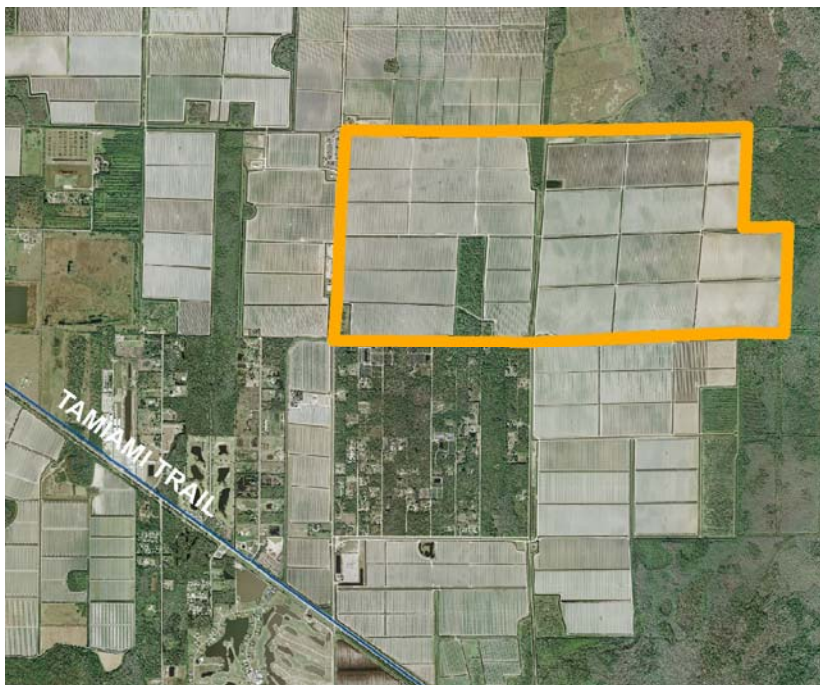


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3.1 Belle Meade Agricultural Flow-ways Water Quality Treatment Area



Project Type:

- Water Quality Treatment Area on Belle Meade flow-way east somewhere within area shown.

Watershed Location: Rookery Bay

Status: Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

The project area above is intended to depict the potential location of a water quality treatment area, or areas, located adjacent to three proposed South Belle Meade agricultural area flow-ways, described in project 3.0. Since the Belle Meade Agricultural area generally suffers from nutrient pollution from the existing land uses, and has a lack of adequate treatment facilities, the need for current or future water quality treatment is necessary. The exact location for these facilities has not yet been determined.

The project consists of the creation of wet or dry detention facilities, and the associated discharge control structures, to provide additional water quality treatment. This project could be implemented as part of the ongoing implementation of agricultural best management practices, or could occur if agricultural land-uses convert to development and would then be implemented during planning or permitting efforts.



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3.2 US 41 Reconstruction and Culvert Replacement



Project Elements:

- Culvert installation for strategic flow-way restoration
- Berm removal
- Evaluate and modify existing weirs to better distribute quantity discharges
- Construct gravity discharge facilities and modify discharges to mimic natural seasonal patterns

Watershed Location: Rookery Bay

Status: Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

This project involves reconstructing existing culverts as part of the future reconstruction of the US 41/ Tamiami Trail road improvement project to better accommodate upstream, existing, and planned flows from north to south under the roadway. This is necessary to accommodate other proposed upstream flow improvements and moves flows closer to the coast and the Rookery Bay National Estuarine Research Reserve. These flows must be effectively collected and transmitted under the road, and at strategic locations, to mimic natural conditions while accommodating existing uses. Proposed project activities include installing culverts, and spreader swales, as well as some limited berm removal.

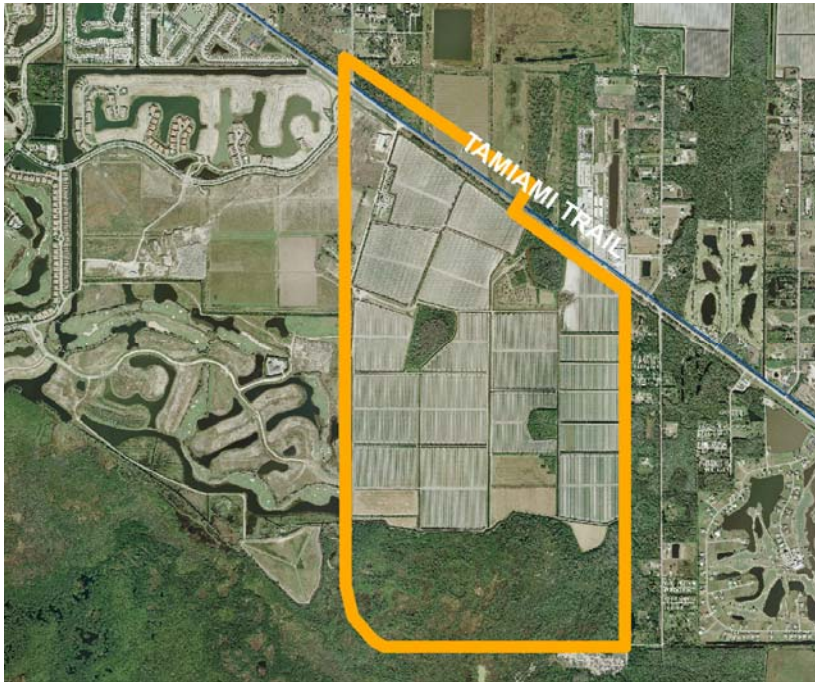


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3.3 Belle Meade Agricultural Flow-way South of US 41—A



Project Type:

- Protect and restore habitat
- Continuation of flow-ways to estuarine interface
- Proposed water level control devices to drainage canals

Watershed Location: Rookery Bay

Status: Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

This project is located immediately south of US 41/Tamiami Trail and to the east of the Fiddler's Creek Development. The natural hydrology of the area has been heavily impacted by agricultural activities, road construction, and other development activities. This project involves the creation or restoration of a flow-way focused on accepting flows from the south side of US 41/Tamiami Trail and transmitting them to the estuarine interface outfalls. The project would include planning for, and the installation of culverts, spreader swales, and control structures, as well as removing berms and roadways at strategic locations in order to re-establish flows from north to south. The project can be implemented as part of ongoing agricultural best management practices or could occur if agricultural land-uses convert to development and would then be implemented during planning or permitting efforts.



3.4 Belle Meade Agricultural Flow-way South of US 41—B



Project Type:

- Protect and restore habitat
- Continuation of flow-ways to estuarine interface
- Proposed water level control devices to drainage canals

Watershed Location: Rookery Bay

Status: Conceptual

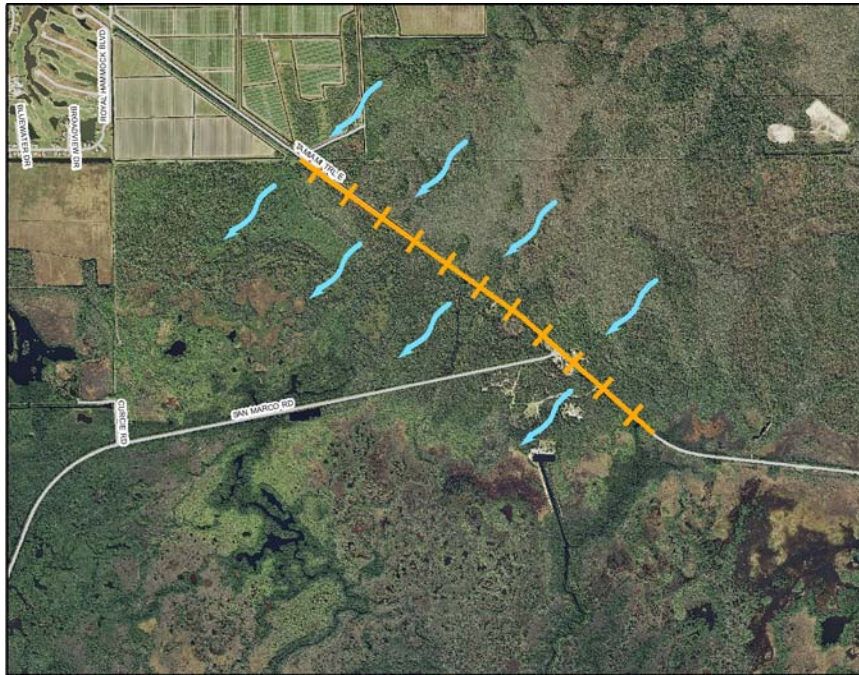
Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

This project is located immediately south of US 41/Tamiami Trail and east of the Royal Palm Estates Development. The natural hydrology of the area has been heavily impacted by agricultural activities. This project involves the creation or restoration of a flow-way focused on accepting flows from the south side of US 41/Tamiami Trail and transmitting them to the estuarine interface outfalls and into adjacent public lands such as the Rookery Bay National Estuarine Research Reserve and Collier-Seminole State Park. The project would include agricultural land restoration and planning for, and the installation of culverts, spreader swales, and control structures, as well as removing berms and roadways at strategic locations in order to re-establish flows from north to south. The project could be implemented as part of ongoing agricultural best management practices or could occur if agricultural land-uses convert to development and would then be implemented during planning or permitting efforts.



3.5 Tomato Road Diversions



Project Type:

- Stormwater diversion to reconnect historic flows

Project Elements:

- New swale construction

Watershed Location: Rookery Bay

Status:

Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

The intent of this project is to redirect stormwater runoff and sheet flow from the north and west in Tamiami Canal to the east and reconnect historic flow-ways southeast from US 41/Tamiami Trail and the Tamiami Canal towards Collier-Seminole State Park. Presently, stormwater runoff from Tamiami Canal is directed primarily westward to the confluence of the Henderson Creek Canal and the Tamiami Canal to culverts which direct flow to the south.

The project involves the construction of a new swale south of US 41/Tamiami Trail and then connecting the swale to existing culverts under US 41 within the approximate vicinity of Tomato Road in order to increase the efficiency of the culverts to carry flow to the south and east. Prior studies of the area revealed a north-to-south creek that intercepts stormwater and natural sheet flow as it flows southeasterly within the Tamiami Canal. This creek directs the water south. The cypress swamp has a dense shrub layer indicative of impacted hydrology. The interface of the pine flatwoods/cypress swamp and creek to the south contains an elevated jeep trail which is also known as the original "Road to Marco." The jeep trail is approximately 20 feet wide and two to three feet above the wetland's natural grade therefore it impedes flow to the south and adversely impacts water flows in the area. An historic agricultural ditch discharges south into a degraded 24 inch corrugated steel culvert under the jeep trail at the apparent low-point in the cypress swamp. It appears that the road is overtopped during flood events and these facilities need to be reconstructed.

This project includes the construction of a new 50-foot-wide, 500-foot-long natural swale at 0.5% slope that would be connected to the culverts under US 41/Tamiami Trail. The outfall and associated control structures would be at the downstream end of the swale. The cumulative effect of the project in the vicinity of Tomato Road would result in more natural sheet flows from the northwest towards the south and southeast.

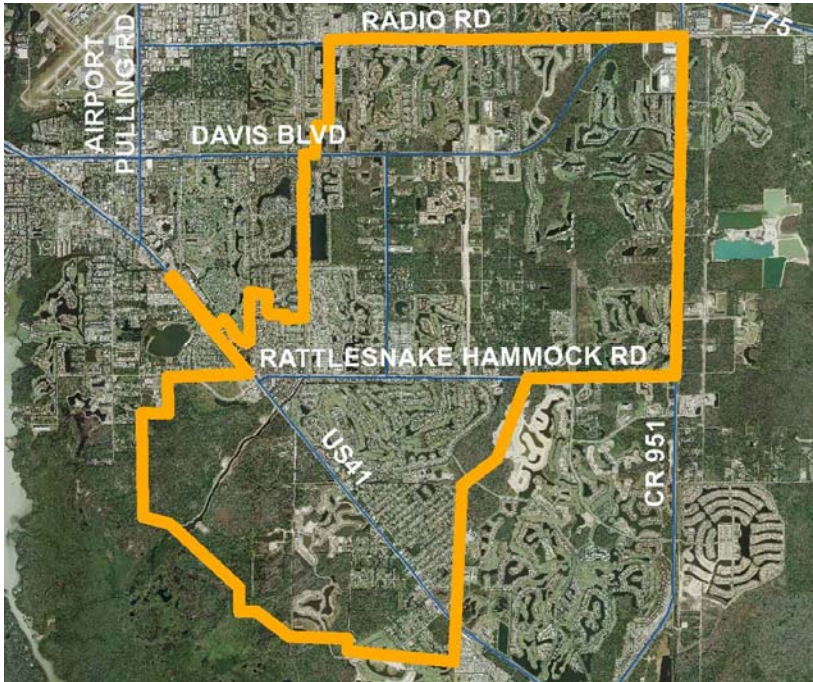


RESTORING THE ROOKERY BAY ESTUARY

A PROJECT CONNECTING PEOPLE AND SCIENCE FOR LONG-TERM COMMUNITY BENEFIT

Rookery Bay National Estuarine Research Reserve

4.0 Lely Area Stormwater Improvement Project (LASIP)



Project Type:

- Regional master planned surface water management, flooding remediation, and water quality improvement

Project Elements

- Canal expansion and construction
- Weir construction and reconstruction
- Spreader swale construction
- Culvert installation
- Berm removal
- Older development stormwater facility retrofits

Watershed Location: Rookery Bay

Status: Construction (10 year project approximately 90% complete)

Project Conceptualized on:

- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

The Lely Area Stormwater Improvement Master Project (LASIP) is a long-term, ongoing water management project encompassing approximately 11,135 acres in southeast Naples. The purpose of the project was to provide a comprehensive stormwater drainage outfall system for the area of East Naples, which has experienced an increasing level of drainage-related problems as development has continued in the area.

The LASIP project area is divided up into two sub-basins known as the Lely Canal Basin system and the Lely Manor Basin system. The Lely Canal Basin system discharges into an estuarine coastal zone along the intercoastal waterway near Dollar Bay, within the Rookery Bay National Estuarine Research Reserve, primarily through the Lely Main Canal. The Lely Manor Basin System discharges into an estuarine coastal zone near the headwaters of Sandhill Bay, and eventually into Rookery Bay National Estuarine Research Reserve through the Lely Manor Canal. The system also has discharge facilities located within Treviso Bay. The project consists of 27 components. By the end of 2013, 24 components had been completed, with ongoing design and permitting on all remaining segments. Construction completion is anticipated in 2015.

The project historically included planning for, and the installation of culverts, spreader swales, berm removal, road removal, retrofits of best management practices within the basin, and discharge facility construction. Several public/private partnerships were used to implement the overall plan as the development of the area proceeded and land was converted to residential land-uses occurred.



ROBAU & ASSOCIATES

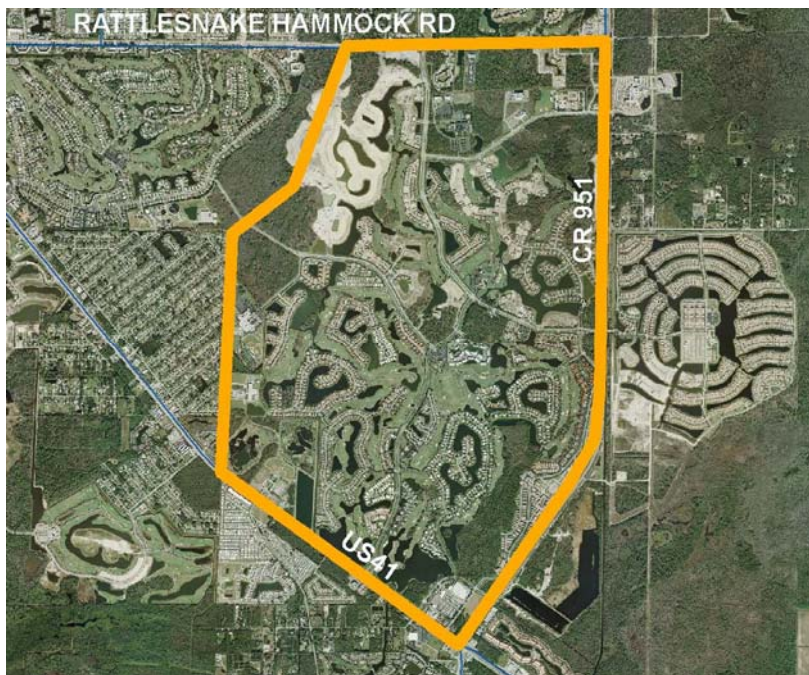


RESTORING THE ROOKERY BAY ESTUARY

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Rookery Bay National Estuarine Research Reserve

5.0 Lely Resort West Outfall/Price Street Weir/Tower Road Weir



Project Type:

- Water quality treatment
- Water quantity attenuation
- Implementation of urban best management practices

Project Elements:

- Weir replacement

Watershed Location: Rookery Bay

Status: Conceptual

Project Conceptualized on:

- Collier County Watershed Plan

The Lely Resort Community is a 3,200 acre residential master planned community located in East Naples. The project was constructed in the mid-1980's and is in compliance with current regulatory standards. The aging, downstream Price Street outfall weir is the primary control structure that manages water discharging from the Lely Resort Community and it may not be functioning properly. Part of this project is to reconstruct the weir for the improvement of water quality treatment and to also implement best management practices, which are appropriate Countywide, but are specifically recommended in this area due to the immediate upstream proximity to sensitive receiving water bodies such as the Rookery Bay National Estuarine Research Reserve. The intent is to install any combination of new infrastructure, or retrofit existing infrastructure in an urban area, with more than one best management practice implemented. Stormwater quality and quantity treatment improvements are desired. These features are generally designed to further trap particulate pollutants (suspended solids and trace metals), organic particulates, promote infiltration, and reduce the flow velocity of stormwater runoff to receiving water bodies from a largely urbanized drainage basin.

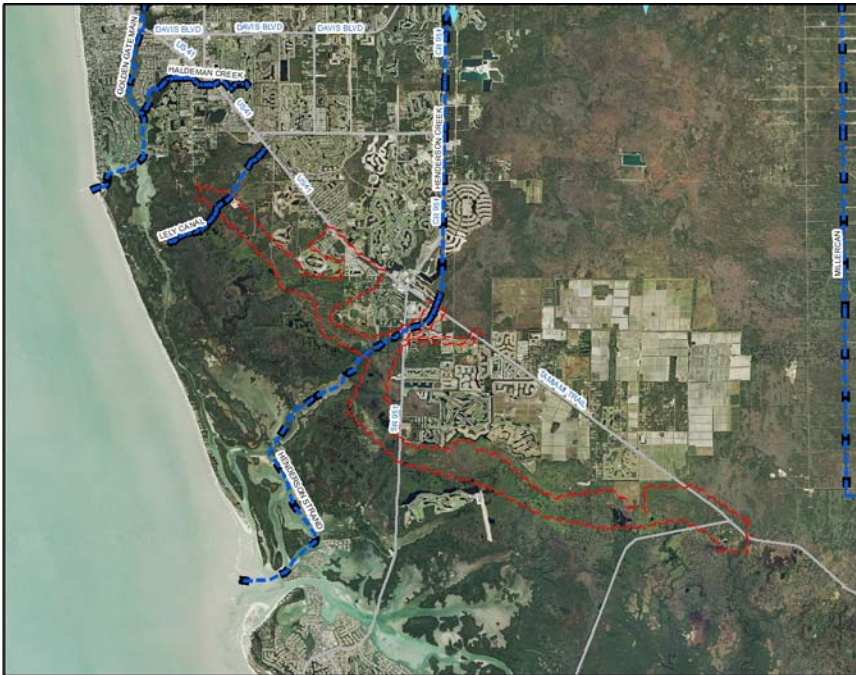


RESTORING THE ROOKERY BAY ESTUARY

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Rookery Bay National Estuarine Research Reserve

6.0 Outfall and Equalizer Culverts Master Project



Project Type:

- Water quality treatment
- Water quantity attenuation
- Implementation of urban best management practices
- General improvements to flow-ways where they discharge to the estuary

Project Elements:

- Construct filter marshes
- Construct and reconstruct weirs
- Construct berms and spreader swales
- Public education
- Fertilizer and pesticide management and use reduction

Watershed Location: Rookery Bay

Status: Conceptual

Project Conceptualized on:

- Collier County Watershed Plan

This master project consists of several incremental phased projects that are focused on improving the water quality, quantity, and discharge timing characteristics of the locations where the upstream flows meet the estuary. In addition, this master project also proposes additional culverts under the two major access roadways to Marco Island that are intended to further equalize tidal flows underneath the roadways. The incremental projects are described in projects 6.1 through 6.8.

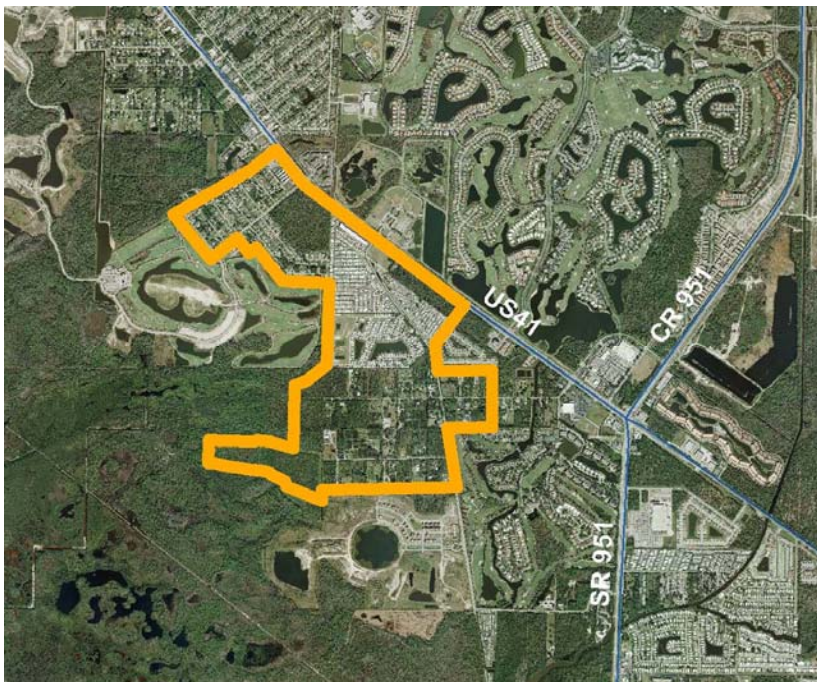


RESTORING THE ROOKERY BAY ESTUARY

A PROJECT CONNECTING PEOPLE AND SCIENCE FOR LONG-TERM COMMUNITY BENEFIT

Rookery Bay National Estuarine Research Reserve

6.1 Griffin Road Filter Marsh and Outfall



Project Type:

- Water quality treatment
- Water quantity attenuation
- Implementation of urban best management practices

Project Elements:

- Filter marsh construction

Watershed Location: Rookery Bay

Status:

Design

Project Conceptualized on:

- Collier County Watershed Plan
- Collier County Stormwater Department

The Griffin Road Stormwater Improvement Project is located near the southwestern end of Griffin Road in East Naples near the intersection of US 41/Tamiami Trail and Barefoot Williams Road. The project includes construction of a water quality treatment area on Rookery Bay National Estuarine Research Reserve property that would accept flows from the largely urbanized land identified within the drainage basin exhibit above.

The focus of this project would be to provide water quality treatment facilities and an adequate stormwater outfall for the area, which would also prevent flooding. The project would include improvements to a system of ditches and a small canal that is currently discharging without water quantity and quality discharge controls. These facilities would serve older established neighborhoods that were constructed prior to the current water management regulatory controls and the use of associated best management practices. The project is a collaborative effort between Rookery Bay National Estuarine Research Reserve, Big Cypress Basin South Florida Water Management District, Friends of Rookery Bay, Griffin Road Homeowner’s Association, and Collier County.

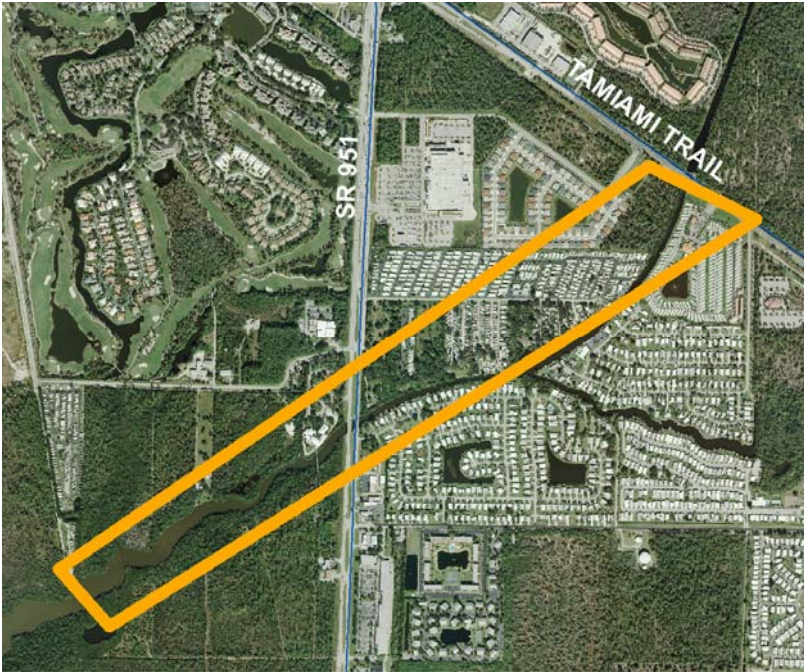


RESTORING THE ROOKERY BAY ESTUARY

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Rookery Bay National Estuarine Research Reserve

6.2 Henderson Creek Development Best Management Practices Retrofit



Project Type:

- Water quality treatment
- Water quantity attenuation
- Implementation of urban best management practices

Project Elements:

- Education
- Swale construction
- Rain gardens

Watershed Location: Rookery Bay

Status:

Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan

This project consists of the implementation of best management practices which are appropriate Countywide but are specifically recommended in this area due to the immediate upstream proximity to sensitive receiving water bodies of the Rookery Bay National Estuarine Research Reserve. The general projects are small-scale water quality treatment, best management practices implementation for redevelopment, and water quantity attenuation that can be incorporated into an urban setting. The intent is to install any combination of new infrastructure, or retrofit existing infrastructure, in an urban area with more than one best management practice implemented to achieve cumulative pollutant reduction or water quantity attenuation. Stormwater quality and quantity treatment train improvements are desired. These features are generally designed to further trap particulate pollutants (suspended solids and trace metals) and organic particulates, promote infiltration, and reduce the flow velocity of stormwater runoff to receiving water bodies from a largely developed drainage basin.



RESTORING THE ROOKERY BAY ESTUARY

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Rookery Bay National Estuarine Research Reserve

6.3 Henderson Creek Water Quality Treatment Area



Project Type:

- Water quality treatment
- Algal Turf Scrubbers for water quality treatment

Project Elements:

- Unknown or unclear

Watershed Location: Rookery Bay

Status:

Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

The area has been listed as impaired for nutrients and Henderson Creek Canal is listed as impaired for DO. The component entails the construction of an Algal Turf Scrubber (ATS).

{NOTE TO PAG: This project requires further discussion and little is known about whether it is still under consideration by government entities.}



6.4 Manatee Road Area Improvements



Project Type:

- Water quality treatment
- Flood protection
- Habitat restoration

Project Elements:

- Drainage outfall spreader system
- Stormwater treatment facility
- Construction of culverts, ditches and swales

Watershed Location: Rookery Bay

Status:

Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

This project consists of enlarging an existing ditch that receives water from the US 41/Tamiami Canal and lands to the north of the US 41/Tamiami Trail, and installing proper water quantity and quality weirs. The nearly abandoned ditch currently discharges into a tributary of Henderson Creek and to roadside swales on the north side of Manatee Road from Rouse Road to State Road 951/Collier Boulevard.

The project includes the construction of culverts under County Road 951/Collier Boulevard and spreader swales downstream that would direct freshwater flows to the west and into the Rookery Bay National Estuarine Research Reserve. The wetlands located adjacent to the aforementioned ditch, south of US 41, have been disturbed with over-drainage during the dry season, as evidenced by groundwater that is below natural grade by several inches to a foot. Seasonal high water indicators show shallow inundation through much of the wetland area during the wet season. The downstream area between the wetlands and the outfall is urbanized.

The plan calls for the construction of a 5,500 ft. long trapezoidal ditch, approximately three feet deep with a one-foot bottom width and three-to-one-foot, horizontal-to-vertical side slopes. The shallow swale adjacent to Manatee Road would connect westward under State Road 951/Collier Boulevard. This projects control structures and weirs may serve to rehydrate a portion of the wetlands adjacent to US 41, to attenuate flows to Henderson Creek, and improve water quality treatment prior to discharge.



RESTORING THE ROOKERY BAY ESTUARY

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Rookery Bay National Estuarine Research Reserve

6.5 Fiddler's Creek Spreader System



Project Type:

- Drainage outfall spreader system

Project Elements:

- Breaching an old road bed
- Installing crested weirs
- Exotic vegetation removal

Watershed Location: Rookery Bay

Status:

Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan

This project is located on an abandoned railroad grade on property managed by the Rookery Bay National Estuarine Research Reserve and located south of the Fiddler's Creek development and agricultural lands. The area receives varying flows from land to the north. The purpose of this project is to reduce peak flow discharges to the estuary by redistributing flows along various points across the existing abandoned railroad grade, rehydrating wetlands to the south, and improving surface water quality discharges to the estuary.

This project includes breaches or gaps, in the form of broad crested weirs, throughout the abandoned railroad grade to accept and redirect point-source discharges to spreader swales. Water level indicator evidence (elevated lichen lines) shows that the berm is seasonally breached with two to six inches of water along the length of the berm and could be re-shaped to allow a better discharge pattern. The only existing breach in the berm is a 30-foot-wide excavated area west of the City of Marco Island's Reuse Water Facility.

Overall, the project would provide water quality treatment and attenuate flows into the Rookery Bay National Estuarine Research Reserve. Additional ecological benefits could be gained by identifying and preserving existing significant vegetation areas and removing exotic invasive Brazilian Pepper that has invaded the area. Project planning efforts should take into account the value of the pine trees and other existing native vegetation established on the southern shoulder of the railroad grade, so as to promote native re-colonization and minimize future potential exotic vegetation from becoming established.



RESTORING THE ROOKERY BAY ESTUARY

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6.6 Royal Palm Estates and Auto Ranch Road Outfall



Project Type:

- Water quality treatment
- Water quantity attenuation
- Implementation of urban best management practices

Project Elements:

- Berm removal
- Culvert replacement
- Spreader swale construction

Watershed Location: Rookery Bay

Status: Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study
- Collier County Watershed Plan
- Belle Meade Stormwater Management Master Plan
- Collier County Stormwater Department

During the wettest part of the rainy season, the Royal Palm Estates (formerly known as Boyne South) development experiences a high water elevation in the farthestmost downstream stormwater detention lake. This lake is constructed along the south side of the development and runs east and west along the majority of the nearly one-mile long property line and is adjacent to undeveloped land close to the boundary of the Rookery Bay National Estuarine Research Reserve. The outfall is working poorly and the discharge path downstream of the receiving lake is undefined and unmaintained, and likely discharges into a series of partially abandoned agricultural ditches.

This project includes installing a properly designed outfall with spreader swale facilities necessary to allow water discharges at the permitted rate, to prevent excessively high water surface elevation in the Royal Palm Estates lakes, and to prevent downstream adverse impacts to the receiving waters. This project would also abate seasonal flooding on Auto Ranch Road, which is an older development area that experiences high water levels.



RESTORING THE ROOKERY BAY ESTUARY

A PROJECT CONNECTING PEOPLE AND SCIENCE FOR LONG-TERM COMMUNITY BENEFIT

Rookery Bay National Estuarine Research Reserve

6.7 County Road 951 Cross Drain Culverts



Project Type:

- Hydrologic restoration
- Culvert installation

Project Elements:

- New culvert installation

Watershed Location:

Rookery Bay

Status:

Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study

Natural surface water flows are interrupted by State Road 951/Collier Boulevard. Although the roadway construction and hydraulic design had been improved during earlier phases of prior construction, there still exists a significant impediment to flow from east to west across the road. This project proposes to install additional culverts under State Road 951/Collier Boulevard and provide spreader swales and berms along the length of the roadway at the culvert crossings to return surface water flows to a more natural regime that existed prior to the construction of the road.



6.8 State Road 92 Cross Drain Culverts



Project Type:

- Hydrologic restoration
- Culvert installation

Watershed Location:

Rookery Bay, Ten Thousand Islands

Status:

Conceptual

Project Conceptualized on:

- Southwest Florida Feasibility Study

On the eastern edge of the Rookery Bay Watershed is State Road 92 which connects Marco Island and the areas called Goodland and San Marco with US 41/Tamiami Trail. This road and its associated canal system interrupts the natural hydrology and sheet flow of the adjacent mangrove and wetland systems. This project would involve the construction of additional culverts under the road to improve tidal exchange, but may also include plugging or back-filling portions of the canal.