Feasibility Study

Picayune Watershed Water Quality Feasibility Study

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EXECUTIVE SUMMARY

The Picayune Strand Restoration Project (PSRP), a component of the Comprehensive Everglades Restoration Plan (CERP) is currently under construction north of the proposed water quality feasibility study area discussed herein. The PSRP is expected to increase flows from north of US 41 to Outstanding Florida Waters (OFWs) within Collier-Seminole State Park, Rookery Bay Estuarine Research Reserve, and the Ten Thousand Islands National Wildlife Refuge. These areas will also continue to receive existing surface water flows from other portions of the greater Picayune Watershed, including Belle Meade and agricultural and urban areas north of US 41 and west of the general focus area of this study. While the new flows to be discharged south of US 41 are expected to have lower nutrient concentrations than existing flows, the overall flows are projected to increase. The purpose of this study is to examine the feasibility of several water quality treatment options to improve water quality in existing and future flows prior to discharge to OFWs.

This study includes a discussion of challenges, opportunities, and constraints associated with the increased flows and potential water quality treatment solutions. Water quality data in the region of the project area is presented to provide an overview of where nutrients, copper, iron, and turbidity are at their highest concentrations and subsequently, where a treatment system may be of the greatest benefit. Additionally, an expansion of existing water quality monitoring and the inclusion of monitoring the effectiveness of the chosen treatment system are discussed below.

A significant impediment to implementing solutions for treatment of water quality is identifying the land on which treatment systems may be constructed. There are few upland areas south of US 41 and upstream of the OFWs, significantly limiting treatment opportunities. Several of these upland areas include State-owned, agriculturally zoned, and other privately owned parcels further west. The State-owned opportunity, while not without its own challenges, is presented within this study and reflects what is currently accessible today. Future efforts to partner with private entities or obtain access to privately owned parcels may provide additional opportunities.

Technologies chosen for inclusion in water quality treatment systems have limitations in both the amount and type of treatment that may be performed, and costs may vary widely depending on the treatment type and the amount of land available for treatment system construction. Impacts to the selected treatment system from future development or new source control measures may also affect the long-term performance and operation and maintenance cost. Identification of locations for source control are not included in this study; however, parallel efforts to begin that work are recommended.

Funding sources for construction of treatment systems must also be identified and a wide array of potential funding sources are provided below with descriptions and rankings assigned to indicate suitability for this effort. Funding sources identified for this effort include federal and state grants and loans, including sources that require local, private, or other matching funds. Public-Public and Public-Private Partnerships will be critical mechanisms to leverage funding for the maximum benefit to improve area water resources and to achieve a sense of ownership of any project to be implemented.

Permitting requirements and existing conditions, such as topography, soils, and/or the presence of threatened or endangered species or cultural resources, may provide additional challenges for the implementation of water quality treatment systems. These and the factors described above have been taken into consideration in the development of this feasibility study and the recommendations provided below.

1.0 INTRODUCTION / BACKGROUND

On January 10, 2019, Florida Governor Ron DeSantis signed Executive Order 19-12, calling for greater protection of Florida's environment and water quality. The Executive Order directed the state agencies to take a more aggressive approach to address some of the environmental issues plaguing the state, with a significant emphasis on south Florida and water quality. The Picayune Strand Restoration Project (PSRP), currently under construction north of the proposed water quality feasibility study area as shown in **Appendix A**, is expected to increase flows from north of US 41 to Outstanding Florida Waters (OFWs[1]) within Collier-Seminole State Park, Rookery Bay Estuarine Research Reserve, and the Ten Thousand Islands National Wildlife Refuge. These areas will also continue to receive surface water flows from other portions of the greater Picayune Watershed, including Belle Meade and agricultural and urban areas north of US 41 and west of the general focus area of this study. Given the importance of the State Park and OFWs, this water quality feasibility study is being conducted to develop recommendations for water quality treatment systems that may be implemented to mitigate the migration of nutrient impacted flows to the State Park and OFWs. Although it is recognized that overall nutrient concentrations in inflow waters will likely decrease with dilution from implementation of the PSRP, the additional flows may still result in an overall increase in total nutrient loads (primarily Total Phosphorus (TP) and secondarily Total Nitrogen (TN)).

Prior to making recommendations, numerous documents and other information provided by the Working Group (**Table 1-1**) regarding existing water quality treatment technologies in use, or being considered for use, in South Florida were reviewed for applicability to this project. A summary of the information reviewed is included in the previously submitted Information Collection Summary Report (Report)[2] developed for Task 2 (**Appendix B**). Following an initial review of information provided by the working group, comments provided on the draft Report, and considering comments received during public meetings held on August 31st, October 20th and December 15th in 2020 (**Appendix C**), additional technologies were reviewed and further details regarding the technologies were researched in order to develop a more complete overview of available treatment options.

Table 1-1: Work Group Organizations

SFWMD	Conservancy of SW FL
FDEP	FL Wildlife Federation
FDACS	Nat. Audubon Society
USFWS	Stantec (Consultant)
Lipman Family Farms	QCA (Consultant)
Collier County	Lago (Consultant)

[1] https://floridadep.gov/dear/water-quality-standards/content/outstanding-florida-waters
[2] Please note that the Ten Thousand Islands National Wildlife Refuge was incorrectly referred to as the Ten Thousand Islands Aquatic Preserve in the Information Collection Summary Report.

Introduction / Background

The Report identified eight primary water quality treatment technologies as the most likely solutions to be implemented to address nutrient removal in the study area based on proven success in the South Florida environment at a scale similar to the anticipated treatment area available for this project. These technologies, including spreader berms/swales, polishing ponds, sedimentation basins, constructed treatment wetlands, media filters, restored wetlands, air diffusion systems and periphyton, are the focus of further review in this Feasibility Study (Study), the first five of which are discussed in detail as treatment train[3] components below. Potential alternatives for treatment trains using the various technologies are also further described within this Study.

[3] A treatment train is a series of water quality treatment technologies through which water flows in an established direction for water quality treatment purposes.

2.0 CHALLENGES, OPPORTUNITIES AND CONSTRAINTS

Development of water quality treatment solutions for discharges from culverts crossing under US 41 from the PSRP, particularly the existing BR36 culvert, the PRSP proposed culvert, and from the existing BR37 culvert, is constrained by a number of natural, technological, and anthropological factors (see map **Appendix A**). The most significant challenges for the project are described below followed by potential resolutions where appropriate.

2.1 WATER QUALITY

2.1.1 Water Quality Summary for Regional Sampling Locations

Under current conditions, water flowing south of US 41 likely exceeds OFW water quality standards for TN, TP and is above state water quality standards for iron and copper at several stations **(Table 2-1 and 2-2)**. Any treatment system proposed will need to address these exceedances to the maximum extent practicable. Additional water quality monitoring is recommended to verify the upstream sources of nutrients and metals in order to identify supplemental projects which may be implemented to treat sources prior to entry into surface waters flowing south of US 41. These supplemental projects could complement the proposed treatment system to further treat flows and potentially reduce long term operation and maintenance costs for the system.

The tables below present both arithmetic and geometric mean concentrations for TP, TN, turbidity, copper, iron, and salinity for selected water quality sample locations in the vicinity of the project area compared to applicable water quality standards. Concentrations are largely calculated using data from the total period of record (POR) collected from the FDEP WBID Run 59 and SFWMD DBHYDRO database. TN and TP arithmetic and geometric means for stations BR36, BR37, BR49, FAKA, BC9, BC10, and BC11 were sourced from summary tables found in the SFWMD PSRP Water Quality Projections With “Southeastern Protective Levee” Feature Report[4]. Although standard concentrations are referenced corresponding with each station and parameter, these criteria apply to values calculated over varying time periods (e.g., annually or monthly). Since the measures of central tendency were calculated using data from the total period of record, exceedances of water quality standards do not directly indicate the station is out of compliance. These comparisons are intended to identify areas of interest for potential watershed improvement projects. Standards vary depending on if the site is freshwater or saltwater and whether the sample location is within an OFW. Water quality data were not evaluated for tidal influence. Detailed sample data and maps are provided in **Appendix D**.

[4] South Florida Water Management District, 2020. Picayune Strand Restoration Project (PRSP) Water Quality Projections With “Southwestern Protective Levee” Feature. 2020. 37 pp.

Table 2-1: POR Arithmetic Mean Concentrations for Water Quality Sample Locations

Station ID	Station Location Description	TP	TN	Turbidity	Copper	Iron	Salinity
		mg/L	mg/L	NTU	µg/L	µg/L	PSU
BR36	In Tamiami Canal at US 41	0.362[A]	1.71[C]	24.31[E]	33.45[F]	1105.6[I]	-
BR37	Tamiami Canal Spur transports water from west under US 41	0.314[A]	1.34[C]	-	-	-	-
BR39	Tamiami Canal north of US 41	0.162[A]	-	1.23[E]	-	-	-
BC20	Culvert under US 41 west of Faka Union Canal	0.058[A]	1.34[C]	2.36[E]	1.13[F]	186.9[I]	5.49
BR49	Culvert/canal under US 41 1.2 miles west of FakaUnion Canal	0.013[A]	1.03[C]	-	-	-	-
TT175C	OFW south of project	0.064[B]	0.60[D]	9.82[E]	-	-	32.29
FAKA	Large canal at US 41 east of project	0.013[A]	0.50[C]	1.84[E]	0.67[F]	112.3[I]	1.52
Faka Union Canal	Large canal south of US 41 east of project	0.027[A]	0.60[C]	3.22[E]	2.57[F]	246.7[I]	16.28
Blackwater River	OFW south of project	0.072[B]	0.60[D]	7.89[E]	-	-	31.12
TT175B	OFW south of project	0.057[B]	0.54[D]	8.93[E]	-	-	32.11
BC9	Canal under -75 at north end of Picayune State Forest	0.011[A]	0.57[C]	2.39[E]	0.75[G]	350.7[I]	0.29
BC10	Canal under -75 at north end of Picayune State Forest	0.022[A]	0.52[C]	2.00[E]	0.59[H]	264.6[I]	0.25
BC11	Canal under -75 at north end of Picayune State Forest	0.021[A]	0.61[C]	1.06[E]	1.12[H]	189.6[I]	0.24

Table 2-2: POR Geometric Mean Concentrations for Water Quality Sample Locations

Station ID	Station Location Description	TP	TN	Turbidity	Copper	Iron	Salinity
		mg/L	mg/L	NTU	µg/L	µg/L	PSU
BR36	In Tamiami Canal at US 41	0.303[A]	1.61[C]	19.68[E]	23.21[F]	1003.6[I]	-
BR37	Tamiami Canal Spur transports water from west under US 41	0.274[A]	1.23[C]	-	-	-	-
BR39	Tamiami Canal north of US 41	0.147[A]	-	1.21[E]	-	-	-
BC20	Culvert under US 41 west of Faka Union Canal	0.044[A]	1.23[C]	1.73[E]	0.82[F]	143.3[I]	2.52
BR49	Culvert/canal under US 41 1.2 miles west of FakaUnion Canal	0.012[A]	1.01[C]	-	-	-	-
TT175C	OFW south of project	0.050[B]	0.57[D]	6.58[E]	-	-	31.81
FAKA	Large canal at US 41 east of project	0.012[A]	0.47[C]	1.46[E]	0.43[F]	80.9[I]	0.63
Faka Union Canal	Large canal south of US 41 east of project	0.022[A]	0.56[C]	3.04[E]	2.01[F]	146.3[I]	6.52
Blackwater River	OFW south of project	0.068[B]	0.57[D]	7.42[E]	-	-	30.58
TT175B	OFW south of project	0.046[B]	0.48[D]	6.45[E]	-	-	31.59
BC9	Canal under -75 at north end of Picayune State Forest	0.010[A]	0.52[C]	1.99[E]	0.44[G]	252.4[I]	0.29
BC10	Canal under -75 at north end of Picayune State Forest	0.018[A]	0.47[C]	1.57[E]	0.41[H]	187.6[I]	0.24
BC11	Canal under -75 at north end of Picayune State Forest	0.019[A]	0.54[C]	0.95[E]	0.58[H]	168.9[I]	0.23

Standard Water Quality Criteria

[A] **TP Standard = No numeric threshold, narrative criterion in paragraph FAC 62-302.530(47(b) apply** (South Florida Standard Concentrations [FAC 62-302.531(c)(2)]). Waters in this area are impaired for nutrients, including TP (https://fdep.maps.arcgis.com/home/webmap/viewer.html?webmap=1b4f1bf4c9c3481fb2864a415fbeca77)

[B] **TP Standard = 0.053 mg/L** (Estuary-Specific Numeric Interpretations of the Narrative Nutrient Criterion table Blackwater River ENRE8 [FAC 62-302.532(1)(e)(8)])

[C] **TN Standard = No numeric threshold, narrative criterion in paragraph FAC 62-302.530(47(b) apply** (South Florida Standard Concentrations [FAC 62-302.531(c)(2)]). Waters in this area are impaired for nutrients, especially TN (https://fdep.maps.arcgis.com/home/webmap/viewer.html?webmap=1b4f1bf4c9c3481fb2864a415fbeca77)

[D] **TN Standard = 0.41 mg/L** (Estuary-Specific Numeric Interpretations of the Narrative Nutrient Criterion table Blackwater River ENRE8 [FAC 62-302.532(1)(e)(6)])

[E] **Turbidity Standard = 29 NTU** (Surface Water Quality Criteria table [FAC 62-302.530 (70])

[F] **Copper Standard = 30 µg/L** (Surface Water Quality Criteria table [FAC 62-302.530(23)])

[G] **Copper Standard = 23 µg/L** (Surface Water Quality Criteria table [FAC 62-302.530(23)])

[H] **Copper Standard = 21 µg/L**: Surface Water Quality Criteria table [FAC 62-302.530(23)])

[I] **Iron Standard = 1000 µg/L** (Surface Water Quality Criteria table [FAC 60-302.530 (38)])

2.1.2 Water Quality Criteria for Treatment Systems Discharging to OFWs

OFWs are waters that have been designated by the state as worthy of special protection due to their natural attributes and protecting and improving the quality of water entering these features is essential to preserving the natural attributes and functional value of these waters. In general, it should be noted that projects implemented upstream of OFWs must not lower the “background ambient water quality” of the OFW.[5] Background ambient water quality is defined as “the water quality a year prior to OFW designation or the year before a complete permit application, whichever water quality is better.” Implementation of OFW protections is conducted through regulatory permitting programs and the specific requirements of those programs.

2.1.2.1 Permitting Considerations for OFWs

Permitting of stormwater treatment systems is regulated by the State of Florida through the Environmental Resource Permit (ERP) process. As further described in the Environmental Resource Permit Applicant’s Handbook Volume II (Handbook), for use within the geographic limits of the South Florida Water Management District[6], additional design criteria apply to water treatment systems discharging to OFWs. Pertinent Sections of the Rules that apply to ERPs are described in the Handbook, including:

- **Section 4.1.3**: Direct Discharges to Outstanding Florida Waters Systems (i.e. which do not flow through non-OFW waters prior to entering an OFW), must provide an additional fifty percent of the required treatment. It has not yet been determined whether any conceptual project will discharge directly to an OFW and will not be determined until a project location can be identified.

- **Section 4.1.4:** Projects Discharging to Impaired Waters or to Outstanding Florida Waters Systems discharging to a waterbody that has been identified as impaired by the Department of Environmental Protection pursuant to 403.067, F.S., or to an Outstanding Florida Water, shall be designed in accordance with the procedures in **Appendix E**.

- **Appendix E**: Existing ERP Water Quality Requirements and Evaluation - The design requirements in Section 4, Stormwater Quality, of Volume II are applied in conjunction with the water quality requirements in Section 8, Criteria for Evaluation and Section 10, Environmental Criteria, Volume I. State surface water quality standards are outlined in Chapter 62-302, F.A.C., and require that reasonable assurances be provided to ensure that proposed discharges do not cause or contribute to violations of State water quality standards. As a part of the review of ERP applications, the state permitting agency evaluates whether discharges from a project will be directed to OFWs, directly or indirectly, and requires that water quality standards be met for the project in accordance with criteria outlined in the Handbook effective: MAY 22, 2016.

- If a proposed project discharges to an OFW or an impaired water body, the state regulatory agency will require that that additional protective measures be incorporated into the project’s

[5] https://floridadep.gov/sites/default/files/OFW_factsheet.pdf
[6] https://www.sfwmd.gov/sites/default/files/documents/swerp_applicants_handbook_vol_ii.pdf

design and operation to provide reasonable assurance that the proposed discharge will not cause or contribute to violations of State water quality standards. The additional protective measures shall include a site-specific pollutant loading analysis and an additional 50% water quality treatment volume above the amounts required pursuant to Section 4.2.1, Volume II. Best management practices (BMPs), source controls or protective measures shall be considered as discussed below.

- **Section 4.1, Volume II** requires that "projects shall be designed and operated so that offsite discharges will meet State water quality standards."
- **Section 4.1.3, Volume II**, states that "systems which have a direct discharge to an OFW, must provide an additional fifty percent of the required treatment."
- **Section 4.9.1, Volume II** specifies a more detailed evaluation for new developments which outfall to sensitive receiving waters. Such sensitive receiving waters include all OFWs as well as other water bodies specifically named in this rule. Section 10.2.4, Volume I states: An applicant must provide reasonable assurance that the regulated activity will not violate water quality standards. Reasonable assurance regarding water quality must be provided both for the short term and the long term…The following requirements are in addition to the water quality requirements found in Sections 8.2.3 and 8.3.1 through 8.3.3.
- **Water Quality Monitoring Section 4.9.1(b), Volume II** of the Environmental Resource Permit Applicant's Handbook Volume II: For Use within the Geographic Limits of the South Florida Water Management District, incorporated by reference in Rule 40E-4.091, F.A.C., contains the rule on water quality monitoring.
- **4.9.1b (b)** New developments which plan to utilize sensitive areas for disposal of stormwater will be given more detailed evaluation by the Agency Staff. In addition, new projects entailing a more intensified land use, such as industrial parks, and planning to discharge to a sensitive receiving water, directly or indirectly, shall be required to institute a water quality monitoring program if the applicant is unable to provide adequate assurances (by such means as routing drainage of areas where polluting materials would be located away from the stormwater management system; developing restrictive covenants, or similar documents, which would have the effect of prohibiting polluting materials on the project site; or proposing other methods of assurance that degradation of the receiving body water quality will not occur. The following listing of land use intensity is in ascending order. 1. Wetlands (including transition zones adjacent thereto) 2. Forested lands 3. Rangeland 4. Agricultural 5. Urban and built-up land
- In cases where a project will discharge to a water body that does not meet standards, Section 10.2.4.5, Volume I requires that: The applicant must demonstrate that the proposed activity will not contribute to the existing violation.
- In addition, where the applicant is unable to meet water quality standards because existing ambient water quality does not meet standards, Section 373.414(1)(b)3, F.S., states that the

Governing Board shall consider mitigation measures proposed by or acceptable to the applicant that cause net improvement of the water quality in the receiving body of water for those parameters which do not meet standards.

- Required Analysis The applicant must submit the following for each project:
  - Construction Phase Pollution Prevention Plan - A Stormwater Pollution Prevention Plan for construction activities resulting in greater than 1 acre of land clearing, soil disturbance, excavation, or deposition of dredge material. The plan shall be prepared in accordance with recognized design practices and shall identify the potential sources of pollution that shall reasonably be expected to affect the quality of stormwater discharge associated with the construction activity.
  - Operation Phase Pollution Prevention Plan - A Post-construction Pollution Prevention Plan to be submitted as part of the permit application, which provides details of controls and practices to be implemented after construction is completed to reduce or eliminate the generation and accumulation of potential stormwater runoff contaminants at or near their source. A Post-construction Pollution Prevention Plan shall include plans for surface water management system operation and maintenance, nutrient and pesticide management, solid waste management, and/or animal/livestock waste storage and disposal, if applicable. Records of maintenance, operation and inspection shall be kept by the permittee and shall be available for inspection and copying by the District staff upon request.
  - Site-Specific Water Quality Evaluation - In order to demonstrate that the proposed activities will not contribute to an existing impairment of a water body, will not degrade an OFW, or will provide a “net improvement,” an applicant shall provide reasonable assurance based on site specific information to demonstrate that discharges of the parameter or parameters which have caused the impairment do not have the potential to cause or contribute to water quality violations in the basin. This demonstration shall be accomplished through the use of a site-specific water quality evaluation. Additional Source Controls, BMPs and Other Protective Measures In addition to the extra 50% water quality treatment volume for discharges to OFWs or impaired water bodies, a site-specific water quality analysis is required.

    Before submitting an application, the applicant shall perform an initial site-specific water quality analysis. The initial analysis must demonstrate that the proposed project’s stormwater management system will not degrade an OFW or will provide a net improvement in an impaired water body for any parameters which are impaired. If the site-specific water quality analysis does not demonstrate that an OFW will not be degraded or a net improvement will occur in an impaired water body, then additional protective measures are required. These protective measures shall consist of source controls, BMPs or other protective measures. The applicant must then submit a site-specific water quality analysis to the District that demonstrates that an OFW will not be degraded or that a net improvement will occur in an impaired water body of any parameter which is impaired.

- Treatment Efficiency of BMPs in Series: If a stormwater treatment system is designed in series as part of a BMP treatment train to increase the pollutant removal efficiency of the overall system, the treatment efficiencies of BMPs in series must account for the reduced loading transferred to subsequent downstream treatment devices as well as irreducible concentrations of certain pollutants. After treatment occurs in the first system, a load reduction occurs, which is a function of the type of treatment provided. After migrating through the initial treatment system, the remaining load consists of pollutant mass which was not removed in the initial system. This mass is then acted upon by the second treatment system with an efficiency associated with the particular type of BMP used until the irreducible concentration level is met. Attention must be paid to the treatment efficiency used for each downstream BMP to account for the diminishing "treatability" of stormwater as concentrations are reduced.

2.1.2.2 Project Benefits and Monitoring

A variety of technologies may be installed to improve water quality in discharges from the three culverts, focusing on the most upstream culvert in the Tamiami Canal (BR36). Water quality sampling at BR36 has demonstrated the most elevated concentrations of TP and TN within the canal. Flows recorded at BR36 are also significantly lower than the downgradient culverts and are expected to decrease further with implementation of the PSRP. Implementation of water quality treatment systems to intercept and treat flow through BR36 can potentially result in an overall net benefit to both the water quality in the downgradient canal culverts as well as the downstream receiving systems compared to current conditions. Utilization of nature-based treatment solutions may also provide an ecologic benefit to water quality as well as to water-dependent wildlife in the region. Additional ecological benefits may be offered through the incorporation of wetland enhancement and/or restoration via the removal of nuisance and exotic species and/or the restoration of the appropriate hydrology to historic wetland areas. These benefits complement the primary purpose of treating water quality and may facilitate implementation of a project.

Additional monitoring will assist with source identification for the excess nutrients and may provide the basis to support and facilitate the creation of Public-Private Partnerships. As further described under funding options section, partnerships can create a path to creative, cost and benefit sharing as well as access to more potential source control solutions. These potential source control solutions may reduce the overall size or need for downstream treatment, which may result in significant cost savings. Public-Private Partnerships also increase a sense of ownership among stakeholders in the region of the project, generally resulting in better public education regarding environmental concerns and a greater desire among the public to ensure that the implemented solutions succeed.

As an additional note, stakeholders involved in providing review and guidance on this document have indicated that there are three bays in the region referred to 'Goldilocks' bays: one had higher than 'natural' salinity levels (Fakahatchee Bay), one had salinity levels below what would be expected in a non-impacted condition (Faka Bay), and one had salinity levels that were at desirable levels (Pumpkin Bay). After further investigation, it was determined that these bays are too far to the east and south to be substantially impacted or improved by the project proposed in this study, as shown in **Figure 2-1** below. Therefore, investigation of these areas has not been pursued further.

Figure 2-1: Approximate Project Location with Proximity to Fakahatchee, Faka, and Pumpkin Bays

2.2 WATER QUANTITY

The volume of water discharged south of US 41 through existing culverts BR37, and a new proposed culvert is expected to increase due to a future southwest protection feature being constructed as part of the PSRP project. Conversely, flow at BR36 is anticipated to decrease due to increased conveyance and higher flow capacity through the downgradient and new culverts. While BR36 currently discharges to the state park, most likely intermittently during high flow events, there is no evidence of treatment or detention/retention of the inflow waters under existing conditions. Development of treatment and attenuation technologies, and appropriately placed outlets, can result in a net overall improvement of freshwater flows, particularly to the Collier Seminole State Park and the subsequent Ten Thousand Islands National Wildlife Refuge. This may partially restore historic freshwater flows to receiving areas south of US 41 and west of CR 92 that were interrupted with the construction of Tamiami Trail in 1928.

Beneficial freshwater flows to Ten Thousand Islands will also increase due to the PSRP although the water quality concerns through existing conveyance features are less for sites located east of CR 92.

Based on modeled results, the increased/restored flows would also be substantially comprised of water from the Picayune Strand State Forest (~41% of total) and are expected to have lower nutrient concentrations than those currently observed at the culverts under US 41. These increased flows with improved water quality may result in an overall decrease in concentrations of TP, TN, copper, and iron. However, as flows are anticipated to increase with the PSRP, even decreased constituent concentrations may contribute to an overall increase in total loads of these parameters. A flow monitoring program should be developed to fully understand the source of flows under current conditions and impact to flows once the PSRP is fully constructed.

2.3 LAND AVAILABILITY

The primary constraint to constructing a water quality treatment system to treat water discharging to the south from culverts under US 41 is land availability. There are both public and private lands located in the study area as shown on the parcel map in **Appendix A**. Availability of these land areas for use as a treatment area are currently unknown for several reasons; however, there are paths to determine availability. Public-Public Partnerships and Public-Private Partnerships will be critical in funding, operating, and maintaining any water quality treatment systems that are constructed following evaluation of this completed feasibility study. Public-Private Partnerships will be especially critical in implementing water quality treatment solutions because remaining uplands in the vicinity of the project is at a premium in terms of availability.

2.3.1 Public Lands

Public land located immediately south of the discharge points is comprised of Collier-Seminole State Park property. Some of this property near US 41 consists of wetlands that are unlikely to be permitted for impacts associated with a water quality treatment system unless the wetlands are already in very poor condition or overrun with exotic vegetation. Some upland areas are known to include areas with gopher tortoise burrows, a state listed species for which habitat impacts must be avoided. Additionally, the state park has already assigned uses to areas within the park and therefore it cannot be presumed that any given area might be available for use as a water quality treatment area. Discussions with park staff have occurred throughout the development of this study; however, further conversations and potential partnerships between stakeholders and the park should be pursued. Due to the proximity of the Collier-Seminole State Park to the culverts under US 41, select areas of the park would provide an ideal location for a treatment solution and potentially improve this area from its current condition.

At times, public lands are purchased with funding sources that restrict the use of the lands, potentially prohibiting use for water quality treatment; however, it appears that the state has owned Collier-Seminole State Park since the 1940s prior to the likely existence of these restrictions. Stantec discussed potential restrictions associated with the state park with Jay Sircy with the Division of State Lands and Mr. Sircy was not aware of any restrictions for land uses in the park. Furthermore, a review of public land documents found in the Board of Trustees Land Documents System did not reveal any restrictions on use of the state park lands for implementation of water quality treatment systems. Use of public lands will require coordination with and approval from additional state departments and delay implementation of the project.

It is unknown whether public access to the treatment areas would be restricted, which would be dictated by the specific funding source used if a land purchase is required as discussed in Section 6. In addition to meeting water quality requirements of the CWA, any discharge from a project designed as a result of this effort must also meet the standards of the OFW receiving waters as described above.

The excerpts from the Collier Seminole State Park Management Plan (Plan, **Appendix F**) provided below are related to the potential use of the park as a potential location for a water quality treatment project. To summarize the items below, the Plan discourages but does not explicitly prohibit the use of the park for a water quality project; the Plan prohibits such a project in 96% of the park, but this prohibition does not cover an area in the north that has been the subject of discussion; and there are management goals that may be met by implementation of a water quality treatment project, including restoration of hydrology to historically drained areas and improvement of water quality.

As an example, an upland area of the park with limited habitat function may be converted to a wetland treatment system similar to Freedom Park in the City of Naples, providing not only water quality treatment, but also habitat value for aquatic wildlife and wading birds, as well as trails and boardwalks consistent with the recreational goals of the park. Discharge water may then be directed to dispersed flow to an area identified as hydrologically altered where pine trees are replacing wetland species to facilitate hydrologic restoration in accordance with management goals for the park.

Collier Seminole State Park Management Plan – Excerpts Regarding Permittable Land Uses

- The land was donated by Barron Collier following construction of the Tamiami Trail with the intent that the land would be used as a state park.
  - Page 1:
    - Public recreation and conservation is the designated single use of the property.
    - There are no legislative directives or executive orders that constrain the use of this park (see addendum 1 of the management plan).
    - For this park, it was determined that no secondary purposes could be accommodated in a manner that would not interfere with the primary purpose of resource-based outdoor recreation and conservation. Uses such as water resource development projects, water supply projects, stormwater management projects, linear facilities and sustainable agriculture and forestry (other than those forest management activities specifically identified in this plan) are not consistent with this plan or the management purposes of the park and will be discouraged.
  - Page 4:
    - Goal of restoring hydrology to pre-drainage conditions as possible – find funds for hydrological study to identify corrective measures and eliminate pine trees where they have invaded hydric communities (this does relate to hydrology).

   - Monitor and use activities outside the park that may impact park resources or the visitor experience.
- Page 11:
   - All permanent water bodies within the park boundaries have been designated as Outstanding Florida Waters, pursuant to Chapter 62-302 Florida. Surface Waters in this unit are also classified as Class II waters by FDEP. “Surface waters” includes wetlands.
- Page 15:
   - As noted above, there are several man-made canals within, and adjacent to, the park. They were originally built to facilitate draining the roads, an agricultural site and residential areas. These canals have lowered the water table, accelerated runoff during the rainy season and reduced hydroperiods. Drainage has also contributed to saltwater intrusion in the park (and in the surrounding countryside). The Golden Gate Estates Redevelopment Study (1976) states: “We have noted, with special concern, the strong inland flow of tidewater through the Blackwater culvert under the Tamiami Trail. During low groundwater stages, this is a serious point of contamination of sand-filled basin storage in the southeastern Belle Meade (drainage) Basin as well as the southern end of the Picayune Strand. Finally, although while not within the confines of the Golden Gate Estates, some measure of control should be established on the Blackwater River at Collier Seminole State Park. A control structure (C11) should be considered at the US Highway 41 bridge to prevent over-drainage of the southeastern Belle Meade Basin. This and other control measures should be investigated to restore hydroperiods in the park.”
- Page 23:
   - Drainage canals near the park have reduced the residence time for standing water. The most obvious effect is an increase in pine trees in natural communities where they were absent or less numerous. Other changes may be less visible. The need is to restore the original flow and periodicity of surface water as much as possible. A surface water problem of another kind is the pumping of water from an adjacent agricultural field onto the park. The diked field is west of US 41. Excess water is vented through a large pipe during periods of heavy rainfall.
- Page 24:
   - The objective for hydrological restoration is just that – to restore the hydrological regime as nearly as possible to its original state, and to reverse and obliterate all biological changes brought on by hydrological disruption that can be identified.
- Page 25:
   - Canals in and around the park have led to the encroachment of slash pines into communities that would not normally have them in high proportions. Strand swamps, for example, currently have greater numbers of slash pines growing among cypress than in times past, as early aerial photographs show. Furthermore, the slash pines are presently stunted in appearance that suggests that they are not in their optimum habitat. These ‘slash pine infested’ cypress stands no longer have water standing long enough to prevent the establishment of pine seedlings.
   - Before any remedial hydrological measures are attempted, baseline hydrological data, as called for in the 1988 Collier County Comprehensive Plan, are needed on hydrodynamics, topography, flow volumes and other physical characteristics. In addition, as indicated above, the South Florida Water Management District should be a part of any actions affecting the hydrology.

    - The pumping of excess water from an adjacent agricultural field onto the park, as described above under Management Needs and Problems, was grandfathered by permitting agencies and thus does not present and obvious solution to this problem.
- Page 29
    - As pointed out under the section on “Management Measures for Natural Resources – Hydrology”, baseline hydrological data need to be established in accord with the type of proposal called for in the 1998 Collier County Comprehensive Plan, in which hydrodynamics, topography, flow volumes, and other physical characteristics will be considered. In addition, as indicated earlier, the South Florida Water Management District should be part of any actions affecting hydrology.
- Page 33
    - Protected Zones – A protected zone is an area of high sensitivity or outstanding character from which most types of development are excluded as a protective measure. Generally, facilities requiring extensive land alteration or resulting in intensive resource use, such as parking lots, camping areas, shops or maintenance areas, are not permitted in protected zones. Facilities with minimal resource impacts, such as trails, interpretive signs, and boardwalks are generally allowed. All decisions involving the use of protected zones are made on a case-by-case basis after careful planning and site analysis.
    - At Collier Seminole State Park, the coastal berm, rockland hammock, marl prairie, slough, strand swamp, wet flatwoods, marine tidal marsh, marine tidal swamp, and marine unconsolidated substrate have been designated as protected zones as delineated on the Conceptual Land Use Plan. These lands cover over 96% of the park.
- Addendum 1
    - According to this lease, the Division [of State Lands] manages the property only for the conservation and protection of natural, historical, and cultural resources and for resource-based public outdoor recreation compatible with the conservation and protection of the property.
    - Collier Seminole State Park is designated single-use to provide resource-based public outdoor recreation and other park related uses. Uses such as water resource development projects, water supply projects, stormwater management projects, and linear facilities and sustainable agriculture and forestry (other than those forest management activities specifically identified in the unit management plan of this park) are not consistent with the management purposes of this park.

2.3.2 Private Lands

There are limited private lands that include uplands located south of US 41 in this area (**Appendix A**) and it is still unknown whether the landowners of the adjacent and undeveloped private lands would be willing to sell or otherwise make their land available (e.g. through a conservation easement) for water quality treatment use. There are no apparent conservation easements currently associated with private lands in the general project area that might prohibit land use for water quality treatment systems. A portion of one property is apparently designated for Florida panther habitat mitigation, which would need to be relocated if the property involved were to be used. Correspondence with U.S. Fish and Wildlife Service staff indicates that relocation of the panther habitat credits is a possibility and discussions with the private landowners are ongoing to determine whether adjacent private lands may be available for use. An additional constraint with the use of private lands is the cost associated with land purchase or other agreements that may be required to use the land, depending upon funding source requirements. Purchasing private land may also delay implementation of the project.

2.4 LAND SUITABILITY

Based on current land uses and soil survey data, as shown in **Appendices E and G**, not all of the adjacent land is suitable for the development of water quality treatment systems. Several areas should be excluded from treatment system location:

- Areas that are currently moderate to high quality wetlands, which would require not only mitigation, but adequate justification to cause an impact to these features to address agency reduction and elimination/avoidance and minimization policies. See further information under Permitting Constraints below.
- Areas located in organic "mucky" soils. The incorporation of these areas into a treatment system is likely to be counterproductive because the organic soils themselves are likely to release nutrients at a rate greater than they are removed by the treatment technology, resulting in a net increase in nutrient levels in discharge waters.
- Areas with Seasonal High Groundwater Tables (SHGWT) at or near the ground surface. These areas may not provide sufficient treatment volume as they will already be filled with water once excavated; most upland soils in this area have a water table depth of 6 to 18 inches. The importance of the SHGWT level will vary by technology. In addition, sea-level rise may impact the effectiveness of the treatment facility and vegetation required for removal of nutrients.
- Presence of federally or state listed threatened or endangered species or state listed Species of Special Concern, such as the gopher tortoise. It is known that there are gopher tortoises in some areas of the state park and these areas should be excluded from consideration and new inundation of these areas must be avoided.
- Areas with intact native and/or rare native habitats should be avoided.
- Areas with cultural resources should be avoided.

Any project proposed on public or private lands will be required to be permitted through the state Environmental Resource Permitting program (either SFWMD or the FDEP, depending on project location, funding sources, and other potential considerations unknown at this time), the issuance of which provides the water quality certification to satisfy requirements of the Clean Water Act. Depending on the location and details of any proposed projects, Section 404 permitting may also be required. It uncertain whether the state or the USACE will process the Section 404 application because there is a mix of state assumed and federal retained waters in the area. Jurisdiction will be determined once project location and design are known. An extensive review of potential impacts of the project on wildlife will be conducted by the Florida Fish and Wildlife Conservation Commission during ERP review and by the U.S. Fish and Wildlife Service during the Section 404 review. Since a project location has not been identified at this time, it cannot be stated whether threatened and endangered wildlife species exist within the project area; however, areas with listed species should be excluded from consideration. The USFWS Information for Planning and Consultation application lists the following federally threatened or endangered species as potentially located in the general project region:

- Florida Bonneted Bat
- Florid Panther
- Everglades Snail Kite
- Red Cockaded Woodpecker
- Wood stork
- American Alligator
- American Crocodile
- Eastern Indigo Snake
- Gopher Tortoises are known to live in some upland areas of the state park; however, these are state listed as Threatened and are not included in the federal listing but would require relocation or “take permits” if impacted by the project. Project design is expected to avoid impacting any areas currently occupied by gopher tortoises.

The project should avoid habitat of known listed species and may create additional habitat for these species through the conversion of uplands to open water and marsh areas. An updated listed species survey for both plant and animal species should be conducted for areas potentially affected by the project once a conceptual project and location have been identified.

2.5 TECHNOLOGY LIMITATIONS

The water quality treatment technologies themselves have several types of limitations:

- Some technologies only treat either TN or TP but not both. Media filters in particular will likely treat one nutrient to a much greater extent than the other.
- The technologies may require a much larger footprint than available land to fully treat inflow waters to water quality standards, or to function properly. For example, spreader berms and swales require a long linear area for construction as well as an appropriate downstream receiving area to accept discharge waters.
- It is unlikely that any single technology will provide adequate treatment by itself, requiring treatment trains of multiple linked technologies.

- Technologies that are designed to remove TP and TN may or may not also remove turbidity, iron, and copper.

2.6 PERMITTING CONSTRAINTS

All regulatory agencies, including the U.S. Army Corps of Engineers, Florida Department of Environmental Protection and South Florida Water Management District require that wetland impacts for any project be avoided and/or minimized to the greatest extent practicable in order to meet permitting criteria. In addition, an alternatives analysis to show what other sites were considered and descriptions of why the other sites cannot be used must be provided. Furthermore, the state has reduction and elimination criteria that also must be addressed to reduce wetland impacts to the greatest extent practicable. Conversion of an existing wetland area to a water quality treatment system would be considered a wetland impact, even if the treatment system was a constructed wetland. These considerations are generally most easily addressed if the wetland proposed for impact is currently of poor quality due to nuisance/exotic species infestations and/or past hydrological alterations that have reduced wetland function.

If reduction and elimination and avoidance and minimization were successfully addressed to the satisfaction of both agencies, wetland mitigation would need to be provided. This is most easily accomplished through the purchase of mitigation bank credits, which are currently $130,000 per credit at the Panther Island Expansion Mitigation Bank. If a large wetland is impacted, a large number of credits may be needed, though the number of credits will also depend on the current quality and function of the wetland proposed for impact.

Additional permitting constraints associated with design and construction of a project that discharges to OFWs are described further above in Section 2.1.2.1.

2.7 AVAILABLE FUNDING CONSTRAINTS

Several constraints related to obtaining funding to construct and implement water quality treatment technologies include, but are not limited to:

- Restrictions on use of funding sources to only public or private lands.
- The need to plan months or a year or more in advance to obtain funding for projects, particularly when funding must be approved through government budget cycles.
- Some funding may require cost share funds be contributed by other stakeholders.
- Limited funding may be available and water quality treatment systems may need to be constructed in stages rather than complete system construction in one phase.
- Funding should not be limited due to environmental impacts as extensive wetland impacts are not contemplated, and wetland restoration is a proposed component of potential treatment trains.

2.8 ADDITIONAL OPPORTUNITIES

Implementation of the technologies proposed below may result in additional opportunities not directly related to water quality treatment, but which may enhance the overall benefits of this project. Educational efforts and informational signage may enhance public knowledge and awareness of Florida's water resources, regional water resource issues, the importance of preventing excess nutrients from entering natural waters (including from urban and residential areas), the importance of OFWs, factors that may adversely impact water quality, and methods of treatment of impacted waters.

Other opportunities include the potential for creation of Public Private Partnerships (PPPs) to work towards a common goal of environmental enhancement and restoration. These partnerships often have a greater net benefit than when a single entity conducts the work. The involvement of representatives from many interest areas in the development process typically enhances the sense of ownership of a project throughout a community. In addition, coordination of state and federal efforts can be leveraged to provide funding sources to conduct the proposed work.

Parallel efforts to the potential water quality treatment project include the investigation of nutrient, copper and iron sources and treatment of those sources. While this study is focused on developing a water quality treatment system to treat discharges flowing through culverts south of US 41, it is recognized that the amount of treatment may be reduced, possibly substantially, through addressing source control of the parameters of interest. It is recommended that a separate parallel effort be conducted concurrently with the development of a water quality treatment system design to optimize the reduction in nutrients, iron and copper being discharged south of US 41 and into OFWs. These parallel efforts to identify and treat sources of water quality degradation should be conducted on both urban and agricultural lands upstream of BR36.

In the face of climate uncertainty, solutions must also be able to withstand a range of potential conditions. Nature-based solutions have an inherent resilience because they are comprised of multiple, heterogeneous species, allowing some to thrive, others to die back. Nature-based solutions have the capacity to self-heal, adapt, and evolve with changing conditions. As water levels rise, vegetation seeds itself and moves upland.

3.0 ALTERNATIVE FORMULATION

3.1 EXISTING AND PLANNED CONDITIONS

Prior to considering construction of water quality treatment options, it is necessary to understand the current conditions of water inflow as well as the planned conditions associated with construction of the Picayune Strand Restoration Project. Please refer to the Area Parcel Ownership Map in **Appendix A**, which includes locations of existing and planned culverts.

3.1.1 Existing Conditions

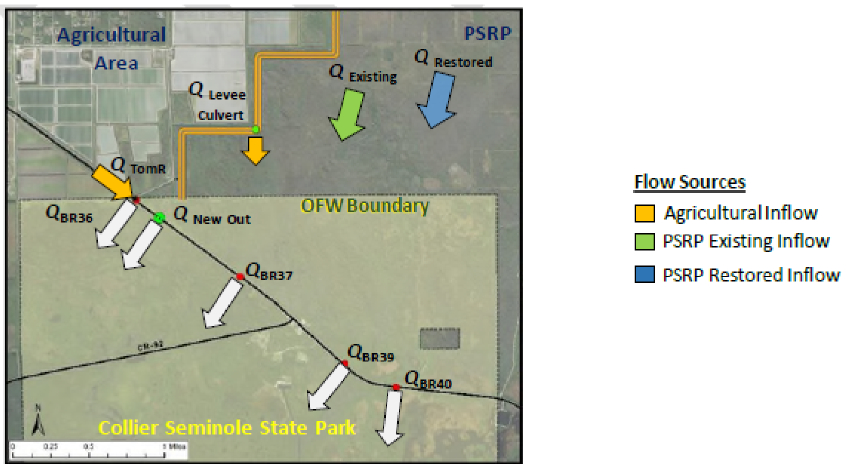
In the existing condition, water that discharges upstream of the project area, from both urban and agricultural lands, enters a canal that runs southeast along the north side of US 41. The first culvert that this water encounters within the study area is BR 36, which flows under US 41, but in relatively low quantities. The new culvert shown on the map does not exist at this time and therefore any water bypassing BR36 continues to flow southeast to BR37, where much of the water turns south to flow under a bridge through a canal. The remaining water continues to travel southeast through a smaller and unmaintained ditch along the north side of US 41 towards BR39 and BR40; however, it appears that the majority of water flowing under the bridges at BR39 and BR40 may be derived primarily from sheetflow from the north through undeveloped lands and the water quality data indicates much lower nutrient levels at these culverts compared to BR36 and BR37.

3.1.2 Proposed Conditions Without Water Quality Treatment Project

Based on the modeling effort for the PSRP, the volume of flow will increase at BR37, and at the new culvert that has not been constructed yet, all of which discharge to Collier Seminole State Park. Modeling conducted during the design of the PSRP indicates that less water will flow under US 41 at BR36 likely resulting in increased concentrations of both nutrients and metals, while additional water will flow under US 41 via the new culvert and BR37, with the remaining water flowing to downgradient culverts BR39 and BR40 as stated above. In the existing condition, flow under US 41 at BR36 is limited, resulting in a small wet area of cattails and Carolina willow in a low area near the highway. Water will also enter the park at the new culvert in the same manner as at BR36, which will occur as water stages up to a higher elevation north of US 41 than the elevation south of US 41. This new water will then rise above any low area associated with the culverts to sheetflow across the north end of the state park at this location without treatment, except for some nutrient uptake by plants. There will likely be sedimentation associated with BR36 and the new culvert that will require periodic maintenance in addition to an increase in nuisance and exotic vegetation with the higher nutrient load.

Water that does not make the turn to flow through BR36 and the new culvert can be primarily expected to discharge under the bridge at BR37 and then through the canal and Blackwater Creek. This ultimately discharges to Blackwater Bay in the Ten Thousand Island National Wildlife Refuge and will be without treatment beyond that which is provided in the canal. The general flow of water is depicted in **Figure 3-1** below.

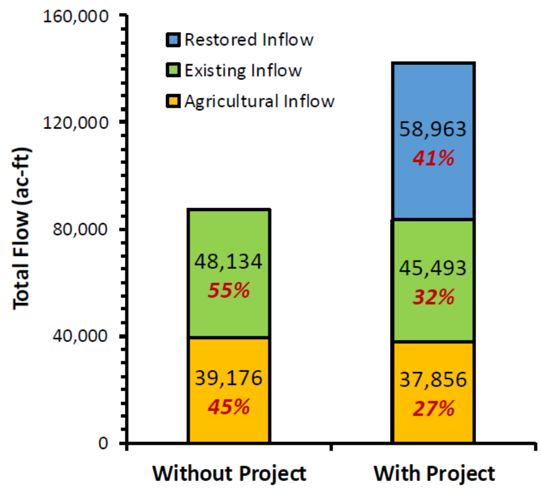
Figure 3-1: Projected Inflow Sources to Collier-Seminole State Park with the PSRP[7]



The water contributing to the increase in flows to BR36, the new culvert and BR37 will have lower nutrient concentrations than the existing water flowing through BR36 and BR37 because this water is primarily derived from the westward sheetflow of water to the west in the PSRP across natural areas. This sheetflow water will be intercepted and diverted south by the new levee located east of the new borrow/conveyance canal and existing agricultural spreader ditch. These flows will mingle with the agricultural discharges from the Levee Culvert shown in **Figure 3-1** and then continue south-southwest through the Picayune State Forest until the levee ends north of US 41 at the Park boundary where additional agricultural run-off is discharged from the new borrow/conveyance canal and existing agricultural ditch. The surface water will continue to sheetflow south across the northern portion of the Collier-Seminole State Park towards the three new conveyance culverts. In summary, more water is expected to reach the culverts and increase nutrient loading to the receiving areas. Overall, flows are projected to increase by approximately 16,790 acre-feet per year from water with lower nutrient concentrations that is currently discharging through the two existing culverts/bridges (BR36 and BR37) as shown in **Figure 3-2**.

[7] South Florida Water Management District, 2020. Picayune Strand Restoration Project (PRSP) Water Quality Projections With "Southwestern Protective Levee" Feature. 2020. 37 pp.

Figure 3-2: Comparison of Aggregated Monthly Total Volumes for the Different Inflow[8]



3.2 TREATMENT MECHANISMS

The primary constituents of concern requiring treatment are predominately nutrients and sediment. Additional constituents (i.e. metals) may inhibit treatment efficiency and therefore should be considered in the overall design and management for water quality improvement. The following sections provide an overview of the various treatment mechanisms for the anticipated constituents of concern available within a natural treatment system environment.

Table 3-1: Treatment Mechanism Matrix

Technology	Water Storage	Sediment	Particulate Phosphorus	Dissolved Phosphorus	Particulate Nitrogen	Dissolved Nitrogen	Particulate Metals	Dissolved Metals
Spreader Swale/Canal/ Berm	X	X	X		X		X	
Sedimentation Basin	X	X	X		X		X	
Treatment Wetlands	X	X	X	X	X	X	X	X
Polishing Ponds	X	X	X		X		X	
Media Filters		X	X	X	X	X	X	X

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8 South Florida Water Management District, 2020. Picayune Strand Restoration Project (PRSP) Water Quality Projections With "Southwestern Protective Levee" Feature. 2020. 37 pp.

3.2.1 Sediment

The predominant physical mechanisms for suspended solids/sediment removal in natural systems are sedimentation and filtration. The velocity through the natural system, particle size, and turbulence directly influences the efficiency of particulate settling; therefore, the most efficient technology for sediment removal is a large sedimentation basin. Available water quality data indicates high concentrations of nutrients are associated with the particulate phase (at BR36 approximately 48% of total phosphorus and 79% of total nitrogen). Therefore, in addition to removal of suspended solids through sedimentation, nutrients and other potential contaminants could be significantly reduced through sedimentation processes.

In addition to the morphology of open water ponds, the incorporation of vegetation within a treatment design can promote ideal settling conditions (i.e., sheetflow) across the system, thus attenuating runoff velocities and further promoting sedimentation. Particulates (i.e., trash, debris, and other floatables) are also filtered mechanically as water passes through vegetation. The vegetation and its root system additionally help to stabilize the sediment and decrease the potential for resuspension of settled particles. Sedimentation basins require periodic maintenance to remove sediments to an offsite, upland location to maintain functional capacity of the system. Frequency of maintenance will be determined during the design process and refined during initial operations.

3.2.2 Phosphorus

A variety of mechanisms contribute to the removal/reduction of phosphorus in natural treatment systems: sedimentation, adsorption, consumption, and burial. Sedimentation of suspended sediment, which may contain elevated levels of phosphorus, will result in a rapid removal of phosphorus from runoff waters. Particulate forms may also become trapped in sediment and vegetation. Most soils have sorptive capacity for phosphorus; however, this storage can be quickly saturated and thereby removal via adsorption will decrease over time. Systems designed to promote sedimentation will require routine maintenance (e.g., sediment removal) to minimize potential phosphorus release.

Phosphorous is an essential macronutrient for growth of plants and organisms. Biological processes at several scales utilize and convert phosphorus, ranging from microorganisms and algae to macrophytes. Plants will uptake phosphorus for growth; however, some of the phosphorus taken up by plants is also released as soluble reactive phosphorus in the winter dry season as the vegetation senesces and decomposes. As little flow will be expected during the winter dry season, phosphorus release during senescence will be limited and not likely an impact to downgradient receptors.

Long-term phosphorus removal is achieved through accretion and burial within sediments. New sediments and soils are formed as residuals from the biogeochemical pathways, a process termed bio-accretion. Such new solid accretions are a long-term sink for phosphorus in the wetland; however, periodic removal of the accumulated sediment and/or decomposing plant matter may be required to maintain proper treatment volume and functions of the treatment system.

3.2.3 Nitrogen

Nitrogen, a major component of stormwater runoff, is potentially toxic to aquatic organisms and plays a role in eutrophication. Particulate nitrogen can be easily removed through sedimentation processes.

Numerous biological and physiochemical processes can transform nitrogen between its various oxidation states. In addition to the physical translocation of nitrogen compounds, the processes involved in nitrogen transformation include ammonification, nitrification, denitrification, nitrogen fixation, and nitrogen assimilation. Ammonification is the microbial conversion of organic nitrogen to ammonia. Removal of ammonia nitrogen in a natural system is a two-step process. First, ammonia is oxidized to nitrate via a microbially mediated process termed nitrification. Nitrification is an aerobic process in which ammonia converted to nitrate by bacteria during microbial respiration. After the ammonia has been nitrified, it can then be denitrified, or converted to atmospheric nitrogen through anaerobic microbial respiration processes. The combination of open water pond and shallow marshes of wetlands (both natural and treatment) create alternating reduced (anaerobic) and oxidized (aerobic) conditions which can maximize nitrogen removal rates.

Similar to phosphorus, nitrogen is also an essential nutrient that may be removed through plant uptake followed by accretion and burial. The ammonium and/or nitrate molecules taken up by plants are stored in organic form. Periodic removal of decomposing plant matter may be required to maintain optimal nitrogen treatment capacity of the system.

3.2.4 Metals

Metals entering these natural systems are commonly associated with suspended solids and are removed via similar mechanisms (i.e., sedimentation and filtration). Following these physical processes, metals are buried and sequestered in sediments via sorption and chemical precipitation reactions. As noted in previous sections, periodic removal of accumulated sediment will be required to ensure sedimentation ponds function efficiently. Any metal absorbed to the sediment will likely contribute to elevated disposal and management costs.

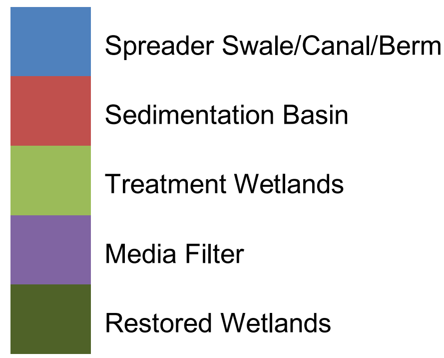
Organic matter is abundant in wetland substrates, particularly in the surficial detritus layer. Within the wetland substrates, anaerobic conditions promote the growth of sulfate-reducing bacteria. Wetland substrates designed to be rich in organic matter and sulfates promote the reduction of sulfate to sulfide and the generation of hydrogen sulfides. Divalent metals (e.g., iron, silver, copper, zinc, manganese, and lead) chemically react with available hydrogen sulfide to readily form highly insoluble and non-biologically available metal sulfides.

3.3 ALTERNATIVE SEQUENCING

Natural treatment system designs are determined based upon flowrate, influent concentrations, effluent discharge criteria, and contaminant mass loading. Each system must be designed to accommodate these parameters, as well as factors such as climate, available land area, and topography, while consistently achieving effluent standards as required by the applicable regulatory permit(s).

The following sections provide an overview of three potential treatment sequences to improve water quality. Each option is predominantly driven by potential land availability. Please note, additional land restrictions are likely within the candidate treatment locations as per the limitations previously discussed in Section 2.0 (e.g., property ownership, topography, jurisdictional wetlands, soils, and water conveyance).

Figure 3-3: Treatment Technology Legend



Flows assumptions are based upon future conditions reported for BR36, the New Culvert and BR37 in the *Picayune Strand Restoration Project (PSRP) Water Quality Projections With "Southwestern Protective Levee" Feature* as prepared by the SFWMD. In addition, hourly flow at BR36 and BR37 was modeled under existing conditions to determine average daily flow as well as peak flow conditions.

Table 3-2: Summary of Modeled Flow Rates Under Existing Conditions[9]

	BR36	**BR37**
Average Daily Flow (cfs)	2.08	11.01

Based upon existing conditions model for estimated hourly flow from July through October 2008.

As noted in the table above, during the wet season average daily flow is estimated to be 2.08-cfs at BR36 and 11.01-cfs at BR37. These are preliminary estimates and additional modeling will be necessary to estimate future flows resulting from the PSRP and to determine potential capture and treatment of flow through the new culvert. Any treatment solution will be designed to intercept and treat all flows below a specific wet weather event. For the purpose of preliminary sizing, solutions were sized based upon the average daily flow at BR36 and BR37 as summarized in **Table 3-2**. While flow during the dry season is anticipated to be limited, solutions will need to be designed to capture and treat these flows as water quality will likely be more degraded due to less dilution.

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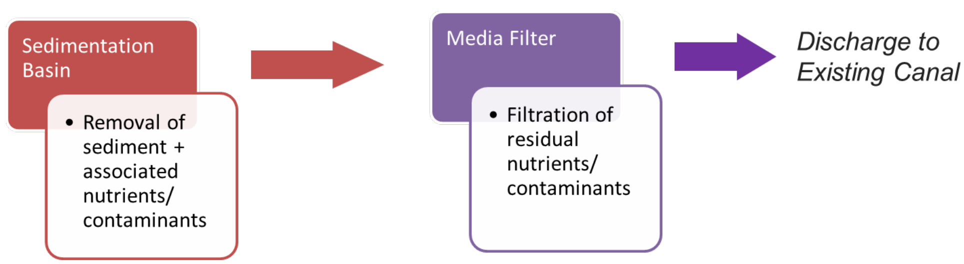
[9] South Florida Water Management District, 2020. Picayune Strand Restoration Project (PRSP) Water Quality Projections With "Southwestern Protective Levee" Feature. 2020. 37 pp.

Identifying a location, for the treatment solution, within close proximity to the canal is critical. All alternatives have been situated within the State-owned land located immediately adjacent and downgradient to the Tamiami Canal. Siting the alternatives in these locations would both minimize the need for transporting flow long distance (i.e., need for pumping) and offer flexibility to either discharge back to the canal or to restore freshwater flow and improved water quality to downgradient resources. This State-owned area opportunity reflects what is currently accessible today. Future efforts to partner with private entities or obtain access to privately owned parcels, also immediately adjacent to the canal, may provide additional opportunities.

Two candidate locations have been preliminary identified immediately west and adjacent to Tamiami Trail East/US 41 and north of San Marco Road (County Road 92) (**Appendix A**). The land in these locations is State-owned (Curcie Road – Collier County Property). Candidate Area 1 is approximately 55 acres, of which approximately 42 acres is likely buildable land for implementation of treatment practices. Candidate Area 2 is approximately 53 acres, of which approximately 40 acres is likely buildable land.

3.3.1 Option A

Figure 3-4: Option A Treatment Sequence



Option A only considers treatment of flow through BR36 up to 2.08-cfs for an estimated treatment area of 11.25 acres. Option A would be constructed entirely within land owned by the State of Florida (Curcie Road – Collier County Property). The candidate location for Option A is approximately 55-acres located immediately west and adjacent to Tamiami Trail East/US 41 and north of San Marco Road (County Road 92) (**Appendix A**).

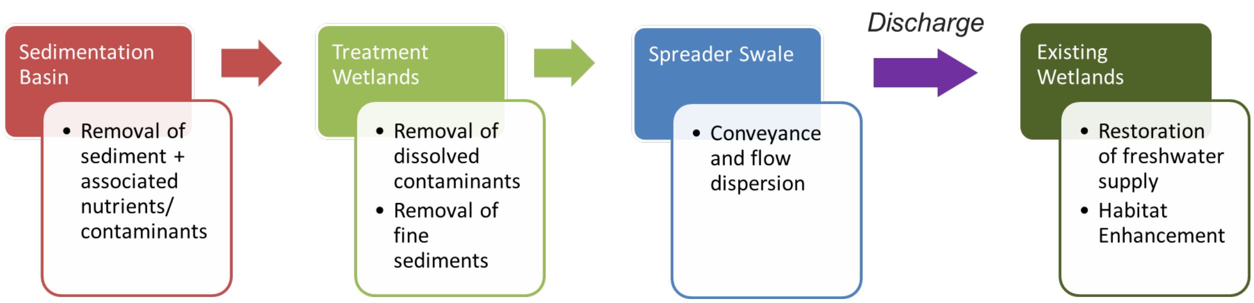
Water would be intercepted at BR36 and diverted into a sedimentation basin for removal of suspended solids and the contaminants adsorbed to those suspended particles. Review of available data indicate that at sampling location BR36, approximately 48% of total phosphorus and 79% of total nitrogen is associated with suspended solids and thus influent concentrations could be significantly reduced through sedimentation processes. The sedimentation basin will reduce velocities and provide quiescent conditions that enhance the removal of suspended solids. Heavier sediments will drop out as water passes through the basin, while lighter sediments will settle out as the runoff is retained in the permanent pool.

The sedimentation basin would additionally provide attenuation of a storm event through temporary detention and provide flood storage detention and reduce the impact of storm flows on downgradient resources. Initial sedimentation in the basin will enhance treatment performance, reduce maintenance, and increase the longevity of the subsequent media filter. Due to the high potential of fouling with these filters, the sedimentation basin has been sized based upon lower areal loading rates compared to Option B.

Effluent from the sedimentation basin would flow to a downflow media filter for final polishing. Residual dissolved constituents would be removed with passage through a media filter designed for the efficient removal of any residual nutrients of concern (e.g., iron enhanced sands for phosphorus removal or compost-based bioreactor for nitrogen and metal removal). Media filters would be designed specifically to address the anticipated nutrient and/or metal load. Effluent from the media filter would then flow directly back to the Tamiami Canal upgradient of BR37.

3.3.2 Option B

Figure 3-5: Option B Treatment Sequence



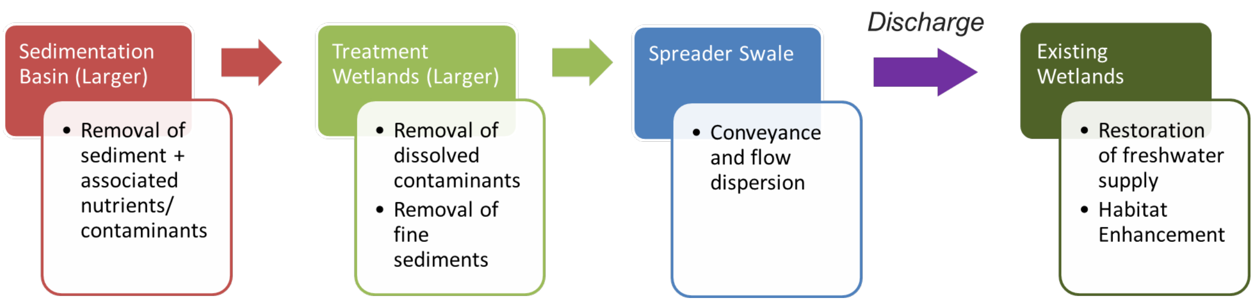
Similar to Option A, Option B considers treatment of flow only through BR36 (up to 2.08-cfs) for an estimated total treatment area of 14.6-acres. Option B would be constructed in the same 55-acre State owned lot as Option A.

Water would be intercepted at BR36 then diverted into a sedimentation basin for removal of suspended solids and the contaminants adsorbed to those suspended particles. However, unlike Option A, instead of a media filter, effluent from the sedimentation basin would flow into treatment wetlands designed for further removal of suspended sediments plus removal of dissolved contaminants (e.g., orthophosphate, ammonia/ammonium, nitrate) through filtration, adsorption, and biological degradation processes. The treatment wetlands would be designed with a combination of open water ponds and shallow marshes. Fine sediment will settle out in the open water ponds while dissolved contaminants will be removed in the shallow marshes through the filtering and trapping of fine particles and soluble pollutants (i.e., metals, organics, and nutrients). The shallow marshes are typically designed with two planting zones (low and high marshes) of varying water depths to maximize treatment efficiency. The marsh plants will also stabilize the sediments and prevent scouring and resuspension during high flows, with the added benefit of providing wildlife habitat for aquatic species and wading birds.

Effluent from the treatment wetlands would be diverted into a 1-ac spreader swale for conveyance and dispersion of flow to the existing wetlands located south of County Road 92. Discharge of treated water from BR36 to the existing wetlands will help restore freshwater flows which were previously interrupted with the construction of Tamiami Trail in 1928.

3.3.3 Option C

Figure 3-6: Option C Treatment Sequence



Option C considers treatment of flow through BR36 and BR37. Similar to Option B, water from BR36 would be intercepted and treated as discussed in Option B. Water from BR37 would then be intercepted and treated within a second 53-acre triangular parcel of State-owned land immediately southeast of BR37. Option C would require 79.1 acres to fully capture and treat flow from BR36 (up to 2.08-cfs; 13.6-ac) and BR37 (up to 11.01-cfs; 65.5-ac). While the average daily flow may be captured and treated within Candidate Area 1, Candidate Area 2 is too small to fully detain and treat flow from BR37. Therefore, the maximum flow which may be intercepted and treated within Candidate Area 2 is estimated to be 6.7 cfs for a treatment area of approximately 40 acres. The updated design basis for Option C would require 55.2-ac to treat average daily flow from BR36 (up to 2.08-cfs; 13.6-ac) and partial flow from BR37 (up to 6.7-cfs; 40-ac).

Similar to the treatment sequence of Option B, water from the flow at BR37 would flow initially into a sedimentation basin for removal of suspended solids and the contaminants adsorbed to those suspended particles. Effluent from the sedimentation basin would flow into treatment wetlands designed for further removal of suspended sediments plus removal of dissolved contaminants. Effluent from the treatment wetlands would be combined with the treated effluent from BR36 and diverted into a 1.5-ac spreader canal/swale for conveyance and dispersion of flow to the existing wetlands located south of County Road 92.

4.0 ALTERNATIVE EVALUATION

Each alternative was evaluated based on the following six evaluation criteria:

- Treatment Performance
- Area Requirements
- Operation and Maintenance Requirements
- Cost/Funding Need
- Implementation Schedule/Time
- Longevity

Each of the criteria is further described below.

4.1 TREATMENT PERFORMANCE

Most nature-based water quality practices are effective at removing particulate related pollutants. Some solutions, primarily those with vegetative components, can also reduce dissolved constituents. Many factors govern pollutant removal capabilities including the specific removal mechanisms, the type of contaminant to be removed, the characteristics of the volume treated, and treatment efficiency factors.

Table 4-1: Treatment Performance

Treatment	Total Suspended Solids	Total P	Total N
Sedimentation Basin/Wet Pond	>70%	45 to 70%	30 to 50%
Bold & Gold CTS Filter Medium	>90%	95%	75%
Iron Enhanced Sands	>90%	>70%	NA
Sand Filter	50 to 90%	50 to 80%	30 to 45%
Surface Flow Treatment Wetlands	50 to 75%	50 to 75%	25 to 55%

Some treatment units evaluated are contaminant dependent. Media filters can be designed to remove specific contaminants by selecting media mixtures (e.g., compost, peat, sawdust, or wood chips for nitrate removal and iron enhanced sands for phosphorus removal). Media filters are designed to sequester materials and solids in the filter.

In addition to evaluating the anticipated performance of individual treatment unit in each sequence, the amount of water captured and treated by each option was assessed to determine overall impacts on downstream water quality. The greater the flow intercepted and treated; the higher ranking was assigned.

4.2 AREA REQUIREMENTS

Nature based solutions to improve water quality are typically land intensive, thus adequate area must be available at the candidate location for construction. Area required is proportional to the volume of water captured as well as the time (i.e., hydraulic retention time) required to ensure contaminants are removed to the desired discharge standard. Longer residence times are typically required for biological removal mechanisms and thus require more land area. Conversely, media filters process water faster than treatment wetlands and thus filters typically require less land area.

Table 4-2: Treatment Area Requirements

Treatment Area (acres)	Option A	Option B	Option C
Source Treated	BR36	BR36	BR36 + BR37
Design Flow (cfs)	2.08	2.08	8.78
Sedimentation Basin(s) (acres)	10.5	4.4	18.7
Media Filter (acres)	0.75	--	--
Treatment Wetland(s) (acres)	--	9.2	35.0
Spreader Swale(acres)	--	1	1.5
Total Area Required (acres)	11.25	14.6	55.2

Additional modeling will be necessary to estimate future flows resulting from the PSRP and to determine potential capture and treatment of flow through the new culvert.

4.3 OPERATION AND MAINTENANCE REQUIREMENTS

Nature based solutions are not no maintenance but are low maintenance. Maintenance is necessary for a nature-based system to operate as designed on a long-term basis. Typical O&M activities are summarized in the following table.

Table 4-3: Summary of O&M Requirements

Sedimentation Ponds	Media Filters	Treatment Wetlands
• Routine water quality monitoring Water level inspections • Removal of trash/debris/floatables • Embankment inspections and mowing • Sediment removal • Mosquito and vector control	• Routine water quality monitoring • Filter surface inspections for accumulated sediment • Structure/cleanout inspection/cleaning • Solids removal • Media replacement	• Routine water quality monitoring • Water level inspections • Removal of trash/debris/floatables • Structure inspections/cleaning • Embankment inspections and mowing • Sediment removal • Invasive species control • Mosquito and vector control

Pond and treatment wetland maintenance activities range widely in terms of the level of effort and expertise required to perform them. Routine pond and wetland maintenance, such as mowing and removing debris or trash, is needed multiple times each year, but can be performed by citizen volunteers. More significant maintenance such as removing accumulated sediment is needed less frequently but requires more skilled labor and special equipment. Inspection and repair of critical structural features, such as embankments and risers, needs to be performed by a qualified professional (e.g., structural engineer) that has experience in the construction, inspection, and repair of these features.

Clogging poses the greatest operational and maintenance challenge of all media filters. Pretreatment, in the form of a sedimentation basin or forebay, can increase effectiveness, reduce maintenance, and extend the life of media filter. Proper maintenance is critical to the successful operation of a filtration practice. Without regular maintenance, filtration system media can become clogged, losing its ability to conduct water at the designed rate. This can lead to stagnant water, mosquito breeding habitat, and reduction or elimination of pollutant removal capacity.

4.4 COST

Options which treat more flow and require more land area will cost more to construct. Capital cost items may include the following:

- Site preparation such as clearing and grubbing
- Levee construction and cell grading
- Pump station and transmission main
- Water supply and distribution (pump station, internal piping, water control structures, outfall structure)
- Custom media (typically costs more than locally available material)
- Contingencies

Table 4-4: Summary of Estimated Implementation Costs

	Option A	Option B	Option C
Capital Construction	$ 2,360,000	$ 4,800,000	$ 16,750,000
Additional Testing, Permitting, Engineering Design and Construction Oversight	$ 590,000	$ 1,680,000	$ 5,870,000
Land Acquisition	$ 3,000,000	$ 3,000,000	$ 10,950,000
TOTAL Estimated Implementation Costs	**$ 5,950,000**	**$ 9,480,000**	**$ 33,570,000**

In addition to construction costs, costs will include design and permitting, land acquisition, and operation, inspection, monitoring and maintenance costs. Systems which require more O&M will contribute to higher costs. Design and permitting costs are typically estimated to be 25 to 35 percent of the base construction cost, depending on the geographic area and the experience of the designer. Capital costs for installation and construction of nature-based treatment systems vary depending on land costs, weather patterns, construction methods, and site-specific conditions. Operation, inspection, and maintenance are crucial elements in maintaining design integrity, a relative cost of these elements has been estimated as a percent of the capital cost. Additional operational costs may include energy costs for pump stations.

4.5 IMPLEMENTATION SCHEDULE/TIME

Larger systems will generally require a longer time to implement for several reasons:

- Large systems may need to be implemented in phases as funding becomes available, assuming that larger systems are more costly than smaller systems.

- Construction of large treatment systems will generally require a longer construction duration.
- Larger systems may also require more extensive permitting than smaller systems, although, depending on specifics, this is not a certainty.

Other Considerations:

- Any proposed system that would adversely impact wetlands and/or wildlife resources would also require a longer permitting time and may not meet ERP rule criteria without changes in design. This applies to all project sizes.
- It is possible that water quality studies of receiving systems may be required in the permitting process to ensure that any proposed project will not result in a degradation of ambient conditions.
- Construction of any system may be limited to work conducted only during the dry season depending on the location and site-specific conditions of the proposed project.
- Smaller systems and/or treatment systems that are located entirely in uplands may qualify for minor permits, or even exemptions, which generally have a shorter processing time.
- Close coordination with permitting agency staff, including the U.S. Fish and Wildlife Service, should be conducted early in the design process to ensure the most efficient permitting process possible.

4.6 LONGEVITY

Long-term effectiveness will generally depend on proper operation and maintenance of the entire system. The more passive the technology, the longer the treatment performance. Treatment wetlands are typically designed for a minimum lifespan of 25-30 years. Incorporation of pretreatment (e.g., sedimentation) will decrease the accumulation of sediments within a treatment wetland and will increase the wetland's longevity.

The lifespan of filtration media is dependent on the target nutrients. Nitrogen removal is a biological process and therefore does not have a lifespan permitting sufficient carbon is available. However, phosphorus removal is primarily via adsorption and thus media filters for phosphorus removal do have a lifespan, which is influenced by concentration and flow rate. Once the media is exhausted, replacement will be required.

5.0 ALTERNATIVE COMPARISON

Options were ranked according to 6 evaluation criteria: Treatment Performance, Area Requirements, O&M Requirements, Overall Costs/Funding Required, Time Required for Planning and Implementation, and overall System Lifespan/Longevity. A higher ranking reflects better performance, smaller area, less O&M, lower cost, shorter timeframe, and longer lifespan. Lower ranking reflects lower performance, larger area, higher O&M, higher cost, longer timeframe, and shorter lifespan.

Table 5-1: Alternative Comparison

Evaluation Parameter	Option A	Option B	Option C (Larger Footprint)
Sequence	1. Sedimentation Basin 2. Media Filter 3. Existing Canal	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands
Treatment Performance	4	3	5
Area Requirements	5	4	1
O&M Requirements	2	4	3
Cost/Funding Need	3	4	1
Implementation Schedule/Time	3	2	1
Longevity	1	3	3
Ranking	**18**	**20**	**14**

As noted in the above table, Option B ranked the highest while Option C ranked the lowest. The combination of a sedimentation basin, treatment wetlands, and spreader canal with discharge to an existing wetland maximizes treatment into available land by capturing and treating the higher sediment and nutrient concentrated flow from BR36. Interception and diverging of flow from the Tamiami Canal at BR36 to a treatment system may alleviate the migration of contaminant loads to downgradient resources, thereby potentially eliminating the need for additional treatment at locations down canal (i.e., BR37 via Option C).

Pond and wetland systems require less O&M and offer a more sustainable solution for the improvement of water quality compared to more O&M intensive systems such as media filters. While media filters provide efficient treatment of dissolved constituents, they often foul easily and thus require more O&M. Media filters also may have a shorter lifespan once adsorptive surfaces are exhausted, thus resulting in an overall lower longevity score due to the potential need for complete system replacement.

While Option C would capture and treat the largest flow from the Tamiami Canal, the area requirements necessary to construct this system are greatest and thus the costs to implement such a system are significantly larger. In addition, it is unclear if there is a need to capture and treat flow from BR37 if the most nutrient rich water from BR36 is fully captured and treated. Additional water quality modeling is necessary to make this determination.

6.0 FUNDING OPTIONS

6.1 FUNDING SOURCES

There are several applicable funding sources to assist with the design, permitting and construction phases for this project. Funding sources typically fall into three main categories: grants, loans, and partnerships. Grants often require a local funding match ranging from 25 to 50-percent of the project amount. Loans must be repaid within a certain term period and can often be obtained with lower than market interest rates specifically for governmental entities. Partnerships between Public-Public and Public-Private entities were previously rare but are becoming more prevalent as solutions are continually identified that benefit both parties. Creative funding scenarios are becoming commonplace as communities look for new ways to fund water quality treatment systems, both at the source and downstream, to address water quality issues and provide the greatest ecological benefit to downstream water bodies.

Each funding program has specific requirements that can be aligned with the final water quality treatment solutions selected and their corresponding benefits. It will be important to estimate the measurable benefits relative to nitrogen and phosphorus removal as many funding programs will rank an application's cost effectiveness on a dollar per pound of reduced nutrient basis, also known as a "cost-benefit analysis".

A high-level funding strategy has been developed to provide options to fund the design, permitting and construction of the project. As this is a feasibility study, there are many unknowns related to the project components, scale, area, costs, and benefits that need to be fully developed before the funding strategy can be finalized. Once the project concept is developed with estimates for the benefits, cost, and timing are identified, the funding options will be further refined and aligned with the recommended solutions. However, even during this feasibility phase, it is beneficial to identify and rank programs that are attractive to pursue to effectively prioritize future efforts to secure funding.

A summary table with the results of the funding strategy including the category (grant, loan or partnership), Program, and a rank of 0-5-10, with 10 having the best alignment with the current project characteristics, is included on the following page. The funding table includes potential funding sources to implement BMPs on agricultural lands, which is to be investigated in an effort to be conducted parallel to this feasibility study. The information included here is for reference purposes; the listed agricultural funding sources are not available for use in the projects proposed in this study, but instead may be used for projects contemplated in a parallel effort being conducted to address nutrient sources outside of the scope of this study.

Table 6-1: Funding Sources

Category	Program	Rank
Grant	Florida House of Representatives and Florida Senate Legislative Appropriations	10
Partnership	Public-Public Partnerships	10
Partnership	Public-Private Partnerships	10
Grant	Florida Department of Environmental Protection Florida Communities Trust Parks and Open Space Florida Forever Grant Program (Acquisition needed)	10
Grant	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE)	10
Grant	Florida Department of Environmental Protection Section 319(h)	10
Grant	National Fish and Wildlife Foundation Gulf Environmental Benefit Fund	5
Grant	Florida Department of Environmental Protection State Water-quality Assistance Grant (SWAG)	5
Loan	Florida Department of Environmental Protection Clean Water State Revolving Fund	5
Grant	Florida Department of Environmental Protection Florida Communities Trust Parks and Open Space Florida Forever Grant Program (No acquisition needed)	1-10
Grant	National Fish and Wildlife Foundation Five Star and Urban Waters Restoration	1
Grant	National Fish and Wildlife Foundation National Coastal Resilience Fund	1
Grant	Army Corps of Engineers Water Resources Development Act	1
Grant	US Fish and Wildlife Service National Coastal Wetlands Grant Program	1
Agricultural BMP Implementation Funding Sources		
Grant	USDA Natural Resources Conservation Service Environmental Quality Incentives Program (EQIP)	10
Grant	Florida Department of Agriculture and Consumer Services Cost Share Funding	10
Grant	USDA Natural Resources Conservation Service Conservation Stewardship Program (CSP)	5

6.2 GRANT PROGRAMS

State Appropriations

Provides funding for priority projects within the state with no funding limit or match requirement. Secure sponsor for any projects that meet criteria and submit via web portals before legislative cycle begins in

March. Promotional fact sheet has been prepared and circulated. This funding source is a good fit. Rank – 10.

Florida Department of Environmental Protection Florida Communities Trust Parks and Open Space Florida Forever Grant Program

Purchase of lands for conservation or recreation purposes by local governments for parks, open space, greenways, and projects supporting Florida's seafood harvesting and aquaculture industries. Application cycle is October 1 through December 15 annually. Rank - 1 if no private land acquisition is needed. Rank - 10 if acquisition is needed and a trail system can be incorporated.

Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE)

The RESTORE Act established the Gulf Coast Ecosystem Restoration Council (Council) to distribute funds to restore and protect natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, coastal wetlands, and the economy of the Guld Coast region. Funding is allocated for large-scale projects and programs that are projected to substantially contribute to restoring and protecting the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast ecosystem. Projects may be included in existing Gulf Coast State comprehensive plans for the restoration and protection of natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast region. Proposals are solicited periodically, approximately every two years. Rank – 10.

Florida Department of Environmental Protection Section 319(h)

Funds projects that address nonpoint source pollution with a 40% local match required. Submit proposals to state for evaluation, including calculations of anticipated nutrient load reductions. Good fit if load reductions are high. Rank – 10.

National Fish and Wildlife Foundation Gulf Environmental Benefit Fund

Goal is to remedy harm to natural resources where there has been injury from the oil spill, including projects that have improvements to freshwater inflows to priority bays. No matching funds are required. Florida solicits project proposals from the public by way of the Project Portal and project selection is conducted yearly with pre-proposals submitted in March, full submittal in June, and selection in November. Rank – 5.

Florida Department of Environmental Protection State Water-quality Assistance Grant (SWAG)

Implementation of best management practices designed to reduce pollutant loads to waters not meeting water quality standards from urban stormwater discharges. No match required but match is encouraged. Applicants can calculate load reductions using the BMPTRAINS model and submit proposals to the state anytime. Proposals are evaluated twice per year. Need to evaluate receiving waterbody water quality criteria but has potential and can be requested anytime. Rank – 1.

National Fish and Wildlife Foundation Five Star and Urban Waters Restoration

Projects should address water quality issues in priority watersheds, pollution from stormwater runoff, and focuses on the stewardship and restoration of coastal, wetland and riparian ecosystems across the country. $50,000 maximum grant with a 50% match. Annual funding cycle beginning in January with application submittal. This funding source is a marginal fit and small funding amount. Rank – 1.

National Fish and Wildlife Foundation National Coastal Resilience Fund

Conservation projects that restore or expand natural features such as coastal marshes and wetlands, dune and beach systems, oyster and coral reefs, forests, coastal rivers and floodplains, and barrier islands that minimize the impacts of storms and other naturally occurring events on nearby communities. Applications submit a pre-proposal first and then if requested submit a full proposal in April. Probably not a good fit because expansion of natural features that will mitigate storm events are not foreseen at this time. Rank – 1.

Army Corps of Engineers Water Resources Development Act

Address flood control, navigation improvements, and watershed and aquatic ecosystem restoration. WRDA is federal legislation that authorizes the US Army Corps of Engineers (USACE) to participate in local and regional water resource projects around the country. Process and funding are not outlined because the USACE is awaiting federal appropriations. Funding from this source may also be unlikely because the USACE is currently funding extensive restoration on adjacent lands through the Comprehensive Everglades Restoration Plan (CERP). Rank – 1.

US Fish and Wildlife Service National Coastal Wetlands Grant Program+

Acquisition of real property interest in coastal lands or waters and the restoration, enhancement, or management of coastal wetlands ecosystems with a 25-50% match requirement. Projects must be coordinated through states and proposals are due from states April – June. This project may not be eligible. Rank – 1.

6.3 LOANS

Florida Department of Environmental Protection Clean Water State Revolving Fund

Low-interest loans to plan, design, and build stormwater and nonpoint source pollution prevention projects. Depends on availability. A Request for Inclusion Form may be submitted any time of the year to request addition to the state priority list, which is used for placement on the funding list at the next quarterly public meeting (second Wednesday of August, November, February and May). Will need to have local government apply. Rank – 5.

6.4 PARTNERSHIPS

Public – Public

Public-Public partnerships could take place between the following entities that are involved in the project: South Florida Water Management District, Florida Department of Environmental Protection, Florida Department of Agriculture and Consumer Services, Collier County, and the U.S. Fish and Wildlife Service. An additional Public-Public partnership between the above entities and the USDA Natural Resources Conservation Service may be possible under specific circumstances, which may or may not apply here. Public-Public partnerships can take various forms, from cost sharing to providing in-kind services, such as land management, or operation of the treatment trains that are ultimately constructed. Cost sharing the required match for grant applications with multiple entities is well received by granting agencies. Rank – 10.

Public – Private

The unique group of stakeholders involved in this project provides an amazing opportunity to form Public-Private partnerships. Private stakeholders that could provide financial support or technical expertise include the Conservancy of Southwest Florida, the National Audubon Society, the Florida Wildlife Federation, and Lipman Family Farms. These partnerships can take various forms such as land conservation, management agreements and cost sharing. These are rare but can be very successful for all parties. Rank – 10.

6.5 AGRICULTURAL BMP IMPLEMENTATION FUNDING SOURCES

USDA Natural Resources Conservation Service Environmental Quality Incentives Program (EQIP)

EQIP provides technical and financial assistance to producers to address natural resource concerns and delivers environmental benefits such as improved water and air quality, conserved ground and surface water, increased soil health and reduced soil erosion and sedimentation, improved or created wildlife habitat, and mitigation against drought and increasing weather volatility. A 50% match requirement is generally required. Applications are continuously accepted, and projects are chosen for funding once per year for all applications submitted by an annual deadline, typically in the fall. Depending on the number of applications and federal funding availability, additional contracts may be considered after the initial funding is allocated. A contract limitation of $450,000 per entity for all USDA programs combined applies for the 2019-2023 Farm Bill term and only participants with an income of less than $900,000, averaged over the previous three years, are eligible for this program. If the land is leased, this income limit applies to the lessee rather than the landowner. Rank – 10.

Florida Department of Agriculture and Consumer Services Cost Share Funding

This grant program is to protect water resources through reduction of water use and improvement of water quality in waters leaving farms. Applicants may sign up throughout the year, generally while signing a Notice of Intent (NOI) to implement BMPs to conserve water and improve water quality. Funding is allocated to be disbursed beginning on July 1 of each year and typically all funds appropriated for the year are obligated soon thereafter. Depending on state budget circumstances, additional funds may be added mid-year. Rank – 10.

USDA Natural Resources Conservation Service Conservation Stewardship Program (CSP)

The goal of this program is to reward farmers for undertaking additional conservation activities and continuing to implement BMPs that they are already using. Applications are ranked and projects are chosen for funding once per year, generally in the fall but timing may vary by year. This program generally does not fund large scale construction projects. Only participants with an income of less than $900,000, averaged over the previous three years, are eligible for this program. If the land is leased, this income limit applies to the lessee rather than the landowner. Rank – 5.

6.6 FUNDING SOURCES MATRIX

A detailed matrix is included in this **Appendix H** encompassing the goals, eligibility, terms, requirements, funding cycle and contact information for each program for further consideration as the project is developed.

6.7 FUNDING SUMMARY AND RECOMMENDATIONS

Grant, loan and partnership funding opportunities were all evaluated to assist with the cost of project implementation. Ultimately, eight grant programs and both types of partnerships rose to the top of the list and are recommended to pursue. Most often, the local governmental entity such as a County or City would be the applicant for these types of grant programs because they have required local match included in their budget and may times have a high level of local knowledge on the project characteristics. In this instance, since there are multiple governmental agencies involved in the feasibility, there may be an opportunity for a joint sponsorship of applications. For the two agricultural grants, the local producer would need to be the grantee and submit the application. A tactical approach is outlined below with the steps and timing to apply for and secure grant funding.

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Jan - Feb — **Florida Senate Legislative Appropriations**

- The County can use the project sheet to gain a Senate sponsor and then complete project request form with all details and submit by March 1, 2021. If included in budget, then a state contract will be authorized in June 2021 and the appropriations must be spent within the fiscal year (July 2021 – June 2022).

Jan - Feb — **Florida House of Representatives Appropriations**

- The County can use a project sheet to secure a House Member sponsor who then submits the project request form with all details. The Member needs to include the project in a Bill filed before the first day of session which is on March 2, 2021. The project must be included in the House budget for consideration.

March - April — **FDEP Section 319(h)**

- County can complete the Nonpoint Source Project Proposal Request online and submit supporting documents. Will need to have treatment area and TSS, TN, TP loadings calculated for pre and post project.

Jan - Feb — **RESTORE Act**

- The County can add this project to the master list of projects considered for the Direct Component funding. This list is managed by Collier County. The County can also submit the project for consideration in the next State Expenditure Plan developed by the State of Florida. Next steps include quantifying benefits and submitting the project in the Deepwater Horizon Project Proposal Form online.

Sept - Oct — **Florida Communities Trust Parks & Open Space Florida Forever Grant**

- If acquisition is needed, the County can partner with a non-profit to submit an application form FCT-5 for this funding. There is a lot of information required for the application so starting early will be recommended.

Continuous — **FDACS Cost Share Funding**

- Local agricultural producer can apply for this funding for the BMP improvements will take place on agricultural lands.

Continous — **USDA NRCS EQIP**

- Local agricultural producer can apply for this funding if any improvements will take place on agricultural lands.

7.0 RECOMMENDATIONS AND NEXT STEPS

7.1 RECOMMENDATIONS WITHIN STUDY SCOPE

- Based upon existing water quality data, flow modeling, and availability of land, the currently most feasible solution to improve water quality both in the Tamiami Canal and downgradient water resources is to intercept water at/near BR36 and then convey, detain, and treat the diverted water within a passive sequence of nature-based solutions in a 55-acre area of land located southwest of US41 and within immediate proximity to the Tamiami Canal. Land options are limited which provide both sufficient size for a treatment solution and are located immediately adjacent to the canal. Parcels falling in this area **(Appendix A)** include State-owned, agriculturally zoned, and other privately owned parcels further west. Challenges exist to placing the project within State-owned lands; however, the numerous benefits provided by a nature-based treatment system in these locations could outweigh those challenges.
- While flow measurements at BR36 are the lowest of the US41 gauging locations and is expected to decrease within implementation of the PSRP, BR36 also contains the highest concentration of sediment and nutrients. BR36 conveys the most concentrated flow from the Tamiami Canal while downgradient gauging locations contain larger diluted flow which are expected to become more diluted with implementation of the PSRP. The most cost-effective solution to improve water quality is to treat the highest concentration with lowest flow (i.e., BR36).
- Additional flow modeling generated hourly flow projections for the 2008 wet season for BR36 and BR37. Further flow modeling is recommended over multiple wet seasons to fine tune existing conditions, to model the future conditions post PSRP (including the impact of future flow at the new culvert) and to confirm basis of design assumptions for treatment solutions. Additional water quality sampling and modeling should also be conducted to verify the impact of intercepting, diverting, and treating the source water at BR36 on downgradient canal locations as well as other water resources (i.e., existing wetlands).
- Pursue land partnerships (public and private) as the final project area will influence the design. Identify one or more stakeholders who will pursue land partnerships.
- Identify one or more stakeholders who is/are willing to champion efforts to obtain funding from the list of opportunities as identified in Section 6. A sponsoring state senator and representative should also be identified to champion the request in the legislature.

7.2 ADDITIONAL RECOMMENDATIONS BEYOND STUDY SCOPE

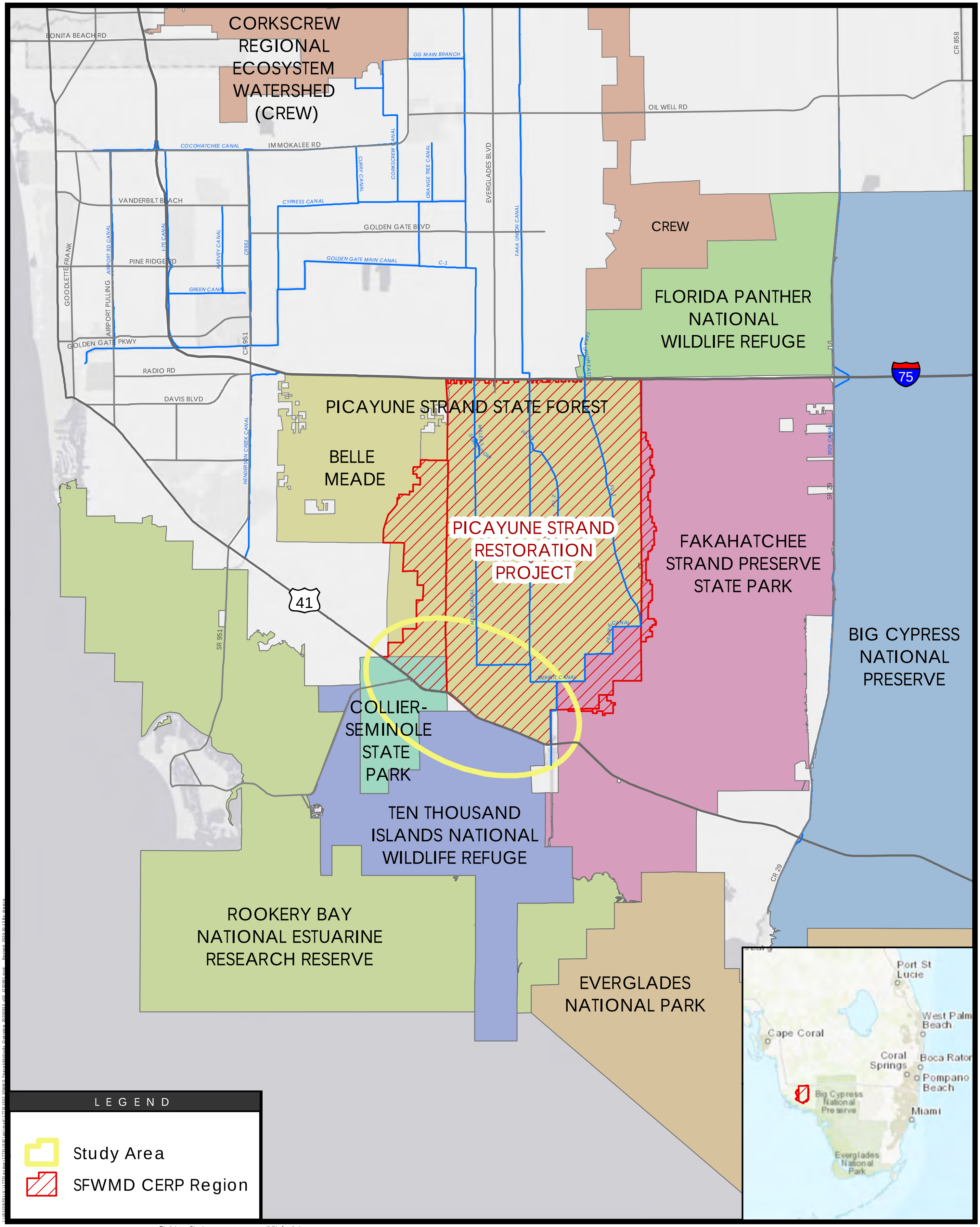
- Implementation of a synoptic routine water quality monitoring program in the region to identify nutrient sources for possible implementation of source control efforts to reduce loading to the constructed water quality treatment system. Routine water quality monitoring should include both dry and wet weather events to fully capture potential contributions and assess overall loading scenarios.

- Implementation of a monitoring program to confirm the effectiveness of the constructed water quality treatment system(s) and the downstream OFW(s).

- Local stakeholders, including both Public-Public and Public-Private Partnerships, pursue additional source control measures where appropriate through an effort to be conducted in parallel with the development of a water quality treatment system.

- It is recommended that a separate parallel effort be conducted concurrently with the development of a water quality treatment system design to optimize the reduction in nutrients, iron and copper being discharged south of US 41 and into OFWs. These parallel efforts to identify and treat sources of water quality degradation should be conducted on both urban and agricultural lands upstream of BR36. If these efforts lead to the implementation of additional BMPs to reduce sources of nutrients, the design of future projects and/or operation of existing implemented projects should be re-evaluated to maximize lifespan of the project(s), to adjust operation of implemented project(s), to maximize project lifespan and nutrient removal efficiencies, and to identify cost savings where appropriate.

Appendix A FEASIBILITY STUDY AREA MAP



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Notes:
1. Coordinate System: NAD 1983 StatePlane Florida East FIPS 0901 Feet
2. Source data: FNAI, Collier County, SFWMD
3. Imagery: ESRI

PICAYUNE WATERSHED WATER QUALITY STUDY

MAJOR PUBLIC LANDS AND STUDY AREA

October 2020

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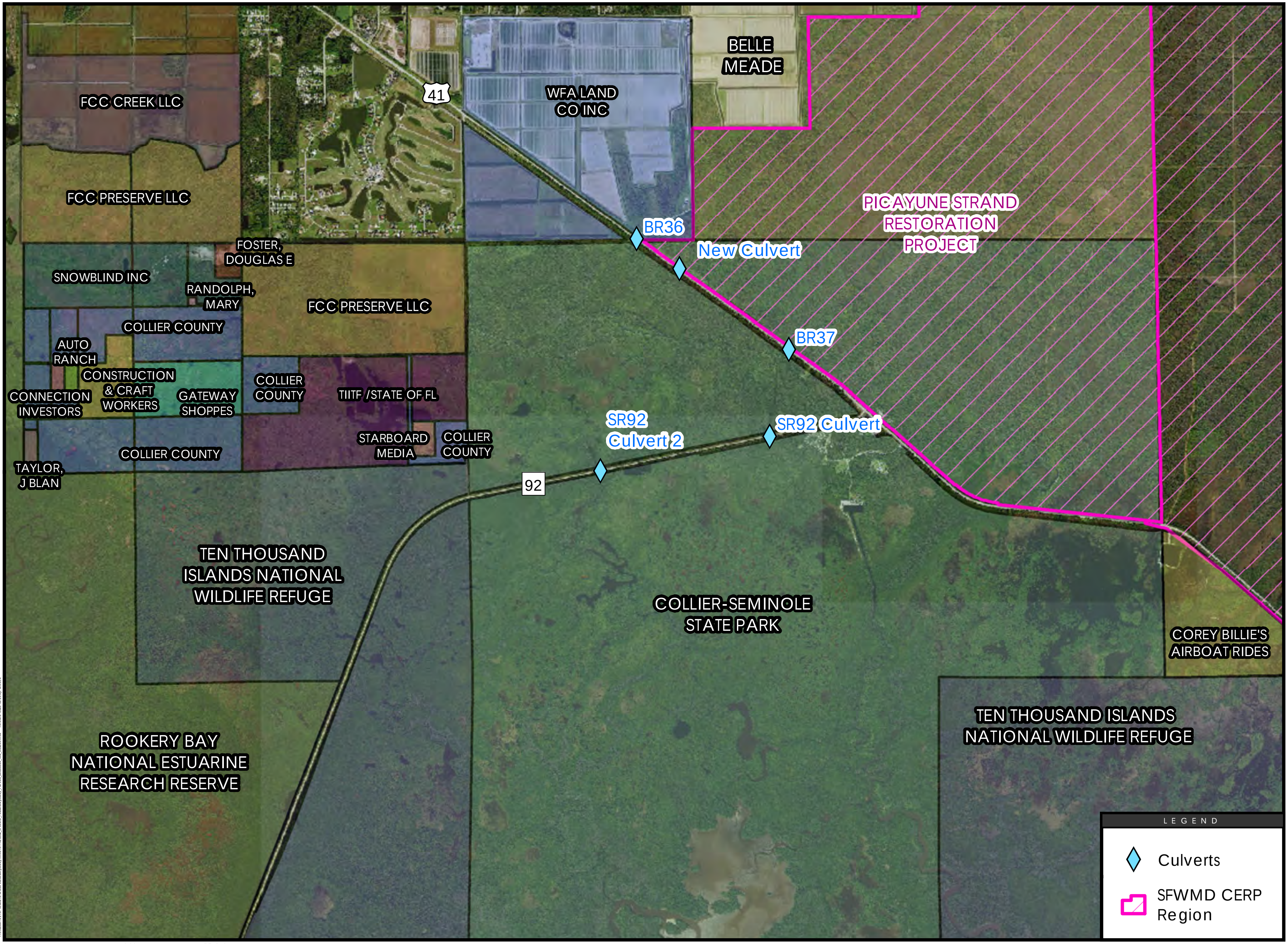
Prepared by: D.A.R. 10/13/20
Technical Review by: M.P. 08/11/20
Independent Review by: K.G. 08/13/20



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Notes:
1. Coordinate System: NAD 1983 StatePlane Florida East FIPS 0901 Feet
2. Source data: FNAI, SFWMD, Stantec
3. Imagery: Collier County

PICAYUNE WATERSHED WATER QUALITY STUDY

AREA PARCEL OWNERSHIP

November 2020

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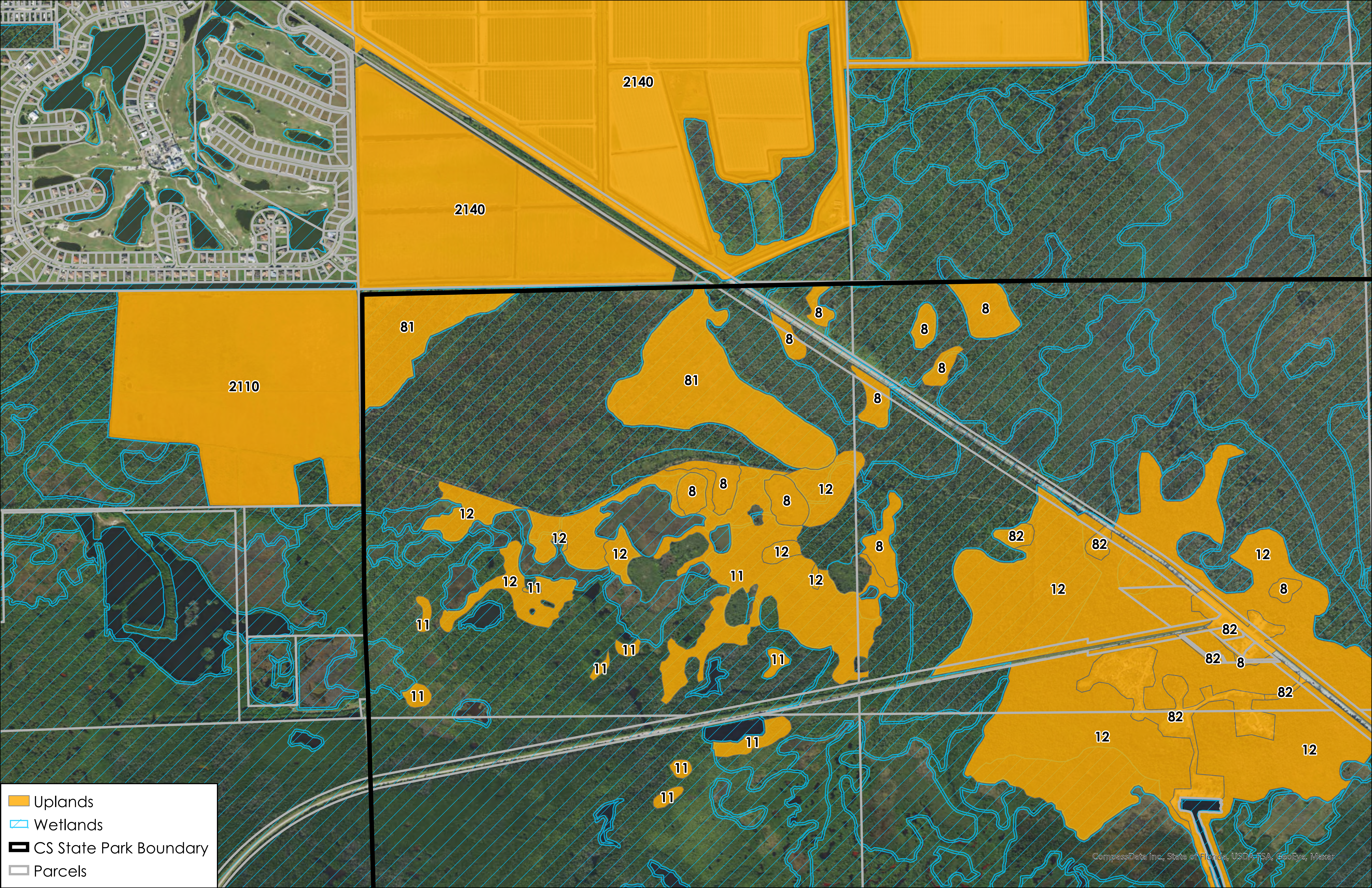
Technical Review by: X.X.X MM/DD/YY
Independent Review by: J.B. 08/19/20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Appendix B INFORMATION COLLECTION SUMMARY REPORT

Information Collection Summary Report

Picayune Watershed Water Quality Feasibility Study

October 13, 2020

Prepared for:

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Executive Summary

The South Florida Water Management District (District), Florida Department of Environmental Protection (FDEP), Collier County, and other local stakeholders have formed a Working Group to conduct this Picayune Watershed Water Quality Feasibility Study (Study) to address increased nutrient inflows for primarily Total Phosphorus (TP) and Total Nitrogen (TN). This will be accomplished through identification of potential treatment technologies based on a review of literature and other information identified by the Working Group. The Information Collection Summary Report presents the results of review of documents, web links and other information provided by the working group. The report also includes detailed descriptions of the nutrient treatment technologies found in the reviewed information and provides general recommendations regarding which technologies to focus on during the Task 4 Feasibility Study task that will follow this report.

This document summarizes the review of information provided by the Working Group, focusing on technologies identified within those resources. Overall, a total of 19 treatment options are described in detail within this report. Eleven proven technologies in common use were identified in numerous documents and are included as ‘Applicable’ project types below, including constructed treatment wetlands, detention areas and settling ponds, spreader swales and berms, restored wetland systems, air diffusion systems, the growth and removal of periphyton and submerged aquatic vegetation (SAV), polishing ponds, hybrid wetland treatment technology, bioreactors, iron enhanced sands, and Bold & Gold® filtration media .

Eight additional ‘Non-Applicable’ technologies are described below because they were identified in the reviewed documents as potential technologies for nutrient removal in previous South Florida studies. These include novel concepts that have generally only been demonstrated for smaller scale systems, including recyclable water containment areas, algal scrubbers, alum treatment systems, floating treatment wetlands, NutriGone Media™, Downstream Defender®. Aquifer storage and recovery (ASR), and deep well injection. Although these technologies appeared in the reviewed literature, none of these are recommended for additional consideration.

It is recommended that the Applicable treatment options be considered for further evaluation under the Task 4 Feasibility Study, possibly combining multiple technologies into a treatment train. It is also recommended that the operation and maintenance of treatment systems chosen for further investigation consider a sediment and or vegetative removal component. These options can prevent filtered nutrients from being re-released to downstream Outstanding Florida Waters (OFWs) through disturbance of sediments or the death and decomposition of vegetative growth. Several potential project locations are also discussed in this Study. Depending on the areas identified as potential locations for projects in Task 4, land availability for potential projects may require that the other novel technologies listed above also be considered.

1.0 INTRODUCTION AND BACKGROUND

On January 10, 2019, Florida Governor Ron DeSantis signed Executive Order 19-12, calling for greater protection of Florida's environment and water quality. The Executive Order directed the state agencies to take a more aggressive approach to address some of the environmental issues plaguing the state, with a significant emphasis on south Florida and water quality. The Picayune Strand Restoration Project (PSRP) is currently under construction north of the proposed water quality feasibility study area. The PSRP will increase discharges to Outstanding Florida Waters (OFWs) within Collier-Seminole State Park, Rookery Bay Estuarine Research Reserve, and the Cape Romano – Ten Thousand Islands Aquatic Preserve. A map of the area can be found in **Appendix A**. Additionally, these downstream estuaries have been assigned estuarine specific Numeric Nutrient Criteria by the Florida Department of Environmental Protection. Given the importance of the State Park and Aquatic Preserve water resources, this proposed water quality feasibility study will review existing data, evaluate sub-regional water quality conditions of flows into Collier-Seminole State Park, Rookery Bay National Estuarine Reserve, and Ten Thousand Islands National Wildlife Refuge and develop options to address those concerns.

The South Florida Water Management District (SFWMD, District), Florida Department of Environmental Protection (FDEP), Collier County, and other local stakeholders have formed a Working Group (**Table 1-1**) to conduct this Collier County Water Quality Feasibility Study (Study) to address increased nutrient inflows (primarily Total Phosphorus (TP) and secondarily Total Nitrogen (TN)). This will be accomplished through identification of potential treatment technologies based on a review of literature and other information provided by the Working Group. The results of the review of provided documents, web links, and other information are presented in this Information Collection Summary Report. The following document includes detailed descriptions of many of the nutrient treatment technologies identified in the documents provided, and general recommendations regarding technologies to focus on in the Task 4 Feasibility Study task that will follow this report.

Table 1-1: Work Group Organizations

SFWMD	Conservancy of SW FL
FDEP	FL Wildlife Federation
FDACS	Nat. Audubon Society
USFWS	Stantec (Consultant)
Lipman Family Farms	QCA (Consultant)
Collier County	Lago (Consultant)

A summary of water quality data found in the information resources provided by the Working Group is summarized in **Appendix B**, indicating areas with higher and lower inflowing and outflowing nutrient concentrations. Based on discussions with District staff, it is expected that the projects to be implemented will be placed south of US 41, downstream of two existing culverts and one new culvert that will carry water from the PSRP to the south. It is also expected that funding source limitations will preclude any projects from being placed on privately owned lands.

2.0 DATA SOURCES/REFERENCES REVIEWED

The data sources and references reviewed were largely collected from suggestions, documents, and links provided by members of the Working Group, with a few additional sources added as they were discovered during review of the provided information sources. Information sources provided by the Working Group were aggregated into **Appendix C** of the Study Work Plan, and then converted into the Document Summary Review Table (**Appendix D**) that also includes the parameters of interest as identified in the Work Plan. Responses to specific comments made by working group members are addressed in **Appendix E**. **Appendix F** provides a regional parcel ownership map which will be further utilized in the feasibility study. Stantec personnel also performed a physical site review for accessible areas in the region. A memo summarizing site review observations can be found in **Appendix G**.

The water quality parameters of interest are addressed below when the information was included in the reviewed documents or could be inferred from knowledge of the technology type or information in the reviewed documents. Additional parameters identified by the Work Plan include: nutrient reduction, estimated level of effectiveness, potential ecological impacts, the range of literature based unit costs (e.g. cost per unit acre or cost per unit volume), operation and maintenance requirements, regulatory constraints, schedule for implementation, general land area requirements, and ancillary benefits (e.g. wildlife habitat creation).

It should be noted that specific information regarding the additional parameters was not found during the review of many of the information sources. Furthermore, nutrient removal rates, level of effectiveness, potential ecological impacts, costs, and other parameters, when provided, cannot necessarily be used to estimate water quality treatment costs in this Study area. This is because site specific factors, including but not limited to project area size, economies of scale, soils, loading rates, downstream receiving systems, and potential ecological and engineering project limitations must be considered. These site-specific factors will be included, to the greatest extent practicable, with projects selected for further analysis in the Task 4 Feasibility Study once proposed technology types and additional site-specific information are known or can be reasonably estimated.

3.0 REVIEW METHODOLOGY

The information sources were gathered from the Working Group, generally as either links to documents or actual copies of the documents and were divided for review by a team of four Stantec staff members according to their expertise. The sources provided were then divided for review by a team of four Stantec staff according to expertise. Staff included two engineers with experience in stormwater management and nutrient modeling, one environmental/soil scientist with experience in nutrient sources, cycling and management techniques, and one water quality data specialist. Each staff member reviewed documents assigned by area of expertise and provided a summary of the studies conducted to assimilate water quality data (Appendix B), treatment options, and study results that may influence the efficacy of the various treatment options.

While reviewing the documents provided by the Working Group, it was discovered that many of the documents related to studies conducted in south Florida were very site specific and could not be directly applied to the project area. Many other documents described treatment technologies currently in use by the District in south Florida, but on a much larger scale than what can be accommodated by the space limitations of this project in the ‘normal’ form in use elsewhere in the region. These technologies were noted and described and generally included as potentially viable technologies, although they would need to be constructed on a much smaller scale.

When the information was found in the reviewed materials, nutrient treatment capacities of these technologies were recorded in the review table in Appendix D; however, the information regarding treatment efficiency was not always provided, or was provided in a manner that could not be used without knowing other technologies that would be linked with this project. Costs listed in the reviewed materials, when found, are provided in Appendix D; however, due to the vast difference in scale of the existing technologies and the limited area in which technologies may be installed for this project, as well as numerous site specific factors and considerations of other technologies installed in conjunction, these costs cannot be accurately used to predict costs for projects included in this study. Additional technologies were provided following Working Group review of the draft version of this document and have been added to this final report.

Many of the documents were not descriptions of technologies, but rather studies conducted related to the technologies. General descriptions of studies that described nutrient removal factors are included in Appendix D, although most studies did not apply to this Study. Some resources provided were simply maps with no context and at times no date, and these were noted as maps in the ‘Comments’ column. Water quality data resources were reviewed and summarized in the existing conditions column, with an overall summary of the most pertinent data provided in Appendix B.

When documents reviewed included a description of a technology that had water quality treatment capacities, even if treatment was only a secondary aspect of the technology, a brief summary of the information in the report was provided in the General Description of Technology column of the table in Appendix D. Responses to the additional factors to be considered as identified in the Work Plan were provided when available, but most of the reviewed documents did not include this information. Some columns were completed based on review staff knowledge and experience, including Regulatory Constraints, Schedule for Implementation, and Ancillary Benefits.

4.0 LITERATURE REVIEW AND ANALYSIS

The information reviewed generally fell into three categories: water quality data (Appendix B), studies on factors affecting performance of existing water quality treatment systems, and descriptions of the different technologies that might be used for water quality treatment. This section describes the identified treatment options in detail. A summary of treatment options, including pros and cons of each and recommendations for future consideration are summarized in **Table 5-1** in Section 5.0. Study information regarding factors affecting treatment systems should be considered during the Task 4 Feasibility Study to follow this report.

Discussion or data related to nutrient increases related to sea level rise or climate change was not found in the information reviewed for this task. The climatological influence of major storm events was mentioned in numerous documents. Major storm events, including hurricanes, are known to affect treatment systems through large inflows of water (and nutrients) over short periods. Wind and greatly increased flow rates associated with storms are known to disturb sediments and/or cause the death of vegetation, causing a release of nutrients stored within the sediments and/or vegetation. In general, major storm events have a detrimental effect on nutrient concentrations and the function of the treatment technologies described below, at least in the immediate aftermath of a storm and possibly longer term.

A review of the links and documents provided resulted in a list of ‘Applicable’ technologies, defined for the purpose of this study as the most common and well-established stormwater treatment technologies already in use within south Florida, as well as technologies that are less common that have a proven track record for nutrient removal within Florida and elsewhere. Additional ‘Non-Applicable’ technologies were provided and defined as having uncertain effectiveness due to lack of proven efficacy for large scale projects and/or for use in the south Florida environment. The identified technologies are listed under these two group headings below; it is recommended that technologies chosen for the feasibility study be selected from the Applicable group. However, depending on project site availability and limitations (particularly land size available for projects) to be identified in the feasibility study, other technologies may be considered. Numerous studies have been undertaken by the District to determine which aspects of existing treatment wetlands improve or hinder nutrient removal capacity and some of these studies are described further in the links provided in Appendix D.

4.1 APPLICABLE SOUTH FLORIDA PROJECT TYPES

4.1.1 Constructed Treatment Wetlands

Constructed treatment wetlands are the technology behind Stormwater Treatment Areas (STAs), which dominated many of the documents reviewed; however, STAs, as constructed in the eastern Everglades restoration area, are several thousand acres in size, which would not be feasible for this project area. Treatment Wetlands, also referred to as man-made, artificial, or engineered wetlands, are highly engineered systems designed to emulate and optimize the physical, chemical, and biological removal mechanisms used in conventional treatment technologies. The treatment wetlands environment consists of a complex mix of saturated substrates, emergent and submergent vegetation, animal life and water that mimic the appearance of natural wetlands containing various sequences of open water and shallow marshes.

Constructed treatment wetlands are one of the more reliable best management practices (BMPs) used by various states to effectively remove and retain stormwater contaminants. Treatment wetlands have been used to treat runoff from agricultural, commercial, industrial, and residential areas. Stormwater wetlands are highly engineered treatment systems designed to temporarily store runoff in shallow ponds and maximize the removal of contaminants via several synergistic mechanisms, including sedimentation, filtration, adsorption, absorption/plant uptake, and microbial breakdown. Stormwater wetlands can also reduce peak discharges of infrequent large storm events to reduce the occurrence of downstream flooding.

Suspended solids are present in the waste stream will drop out as water passes through the open water segments. The shallow marshes are typically composed of an organic substrate (e.g., compost) ranging in depth between 6 and 18 inches, planted with wetland vegetation to impede flow and filter fine particles and soluble contaminants. A second open water micropool is generally located at the outlet of the shallow marshes to provide polishing prior to discharge and facilitate water reuse. The effluent micropool should be designed with sufficient depth (3-4 feet) to increase the dissolved oxygen content prior to discharge.

Wetlands have the potential to be self-sustaining ecosystems and thus may represent a long-term solution to the water quality challenge. The effectiveness of treatment wetland technologies for the removal of solids and nutrients is due to the combination and interaction of physical, chemical, and biological processes. Treatment wetlands create a spatially complex mixture of aerobic and anaerobic environments in which microbial communities catalyze various chemical processes. These biological processes are unique to wetland systems and provide the basis for a variety of control mechanisms to operate simultaneously along an extended treatment flow path. The result is that inorganic and organic constituents can be physically removed through filtration, biologically degraded to non-toxic forms, absorbed by wetland plants, adsorbed to surfaces, or chemically transformed and stored within the wetland matrix.

Wetland environments contain diverse populations of microbes and plants controlling the chemical cycling of contaminants. This diversity of wetland organisms results in the ability of the system as a whole to adapt to changing environmental conditions. The natural inundation of wetland environments provides for electrochemical reducing conditions to facilitate denitrification reactions. A key component of the denitrification equation is a continuous source of organic matter. Wetland plants provide a continuous source of organic matter through natural plant degradation, providing the driving force for denitrification. Finally, wetland substrates, consisting of oxides, carbonates, and organic matter, provide sorption sites for continuous phosphorus removal and sequestration.

Multiple wetland cells of varying hydraulic regimes can be customized in series to meet treatment needs. The treatment wetland system may also be used in conjunction with conventional technologies to attain treatment objectives. HRT (hydraulic retention time), hydraulic loading rates and constituent loading rates are dictated by the specific volumes of water and contaminant concentrations to be treated in the wetland system. Treatment wetland size is determined based upon the required HRT as well as areal and topographic considerations. Regional climatic characteristics also affect design considerations such as evapotranspiration.

Nutrients such as nitrogen and phosphorus are removed through adsorption, biodegradation, nitrification/denitrification and/or plant uptake. Adsorption of nutrients to media can be a removal mechanism for inorganics (e.g., phosphorus). With all adsorption processes, there is a finite amount of adsorption sites, so the treatment lifespan must be a consideration. Nitrogen is removed through nitrification and denitrification processes. These processes are dependent on pH, temperature, dissolved oxygen, and alkalinity and can be inhibited by the presence of other contaminants, therefore the treatment wetland must be designed to incorporate various stages and sequencing.

Figure 4-1: Typical Constructed Wetland[1]

Typical removal rates from constructed treatment wetlands range from 50-75% for sediments and phosphorus and 25-55% for nitrogen. Typical costs associated with the construction of treatment wetlands can be expected to range from $480-$570 per acre, although site specific parameters may result in higher or lower costs[2].

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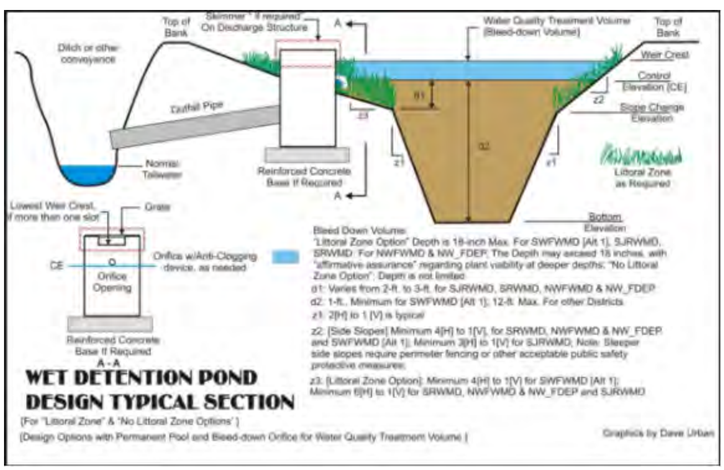
[1] Source: http://lochgroup.com/project/constructed-wetlands-for-cso-treatment/
[2] Stantec experience; Kadlec, R.H. and Wallace, S.D. 2008. Treatment Wetlands. 2nd Edition; Virginia Stormwater Design Specifications No. 13 Constructed Wetlands (2013

4.1.2 Detention Areas and Settling Ponds

Detention areas and settling ponds are designed primarily to slow peak flows from stormwater events to not overwhelm downstream water quality treatment areas (such as treatment wetlands) immediately following storms. By capturing and temporarily holding stormwater, and releasing the water at a controlled rate, flow into treatment areas are maintained at a more stabilized rate. As a result of stabilized flow rates, nutrient inputs into receiving waters downstream from detention/settling areas also enter the receiving waters at stabilized rates, without large rapid inputs immediately following storms. Stabilized flow rates into the receiving treatment area increases the ability of plants and soils in the treatment area to capture the nutrients in inflow waters. These areas have the added benefit of letting solids and associated nutrients to solids settle out as water velocities are reduced.

Stormwater detention areas and settling ponds may also uptake nutrients through plants, soils and periphyton in a manner similar to treatment wetlands, depending on design, operation, and maintenance parameters. For example, one study indicated that an existing Flow Equalization Basin (FEB - a large scale version of a detention area frequently mentioned in the documents reviewed) retained 90% of inflow phosphorus[3]; however, this should not be construed as a typical removal rate due to variability in site-specific factors, nor should this be considered a perpetual removal rate, as it is expected that at some point the system will become saturated unless plants and/or soils/sediments are periodically removed.

Figure 4-2: Typical Detention Pond Design[4]



Typical removal rates associated with sedimentation basins and wet detention ponds can be expected to be >70% for sediments, from 45-70% for phosphorus and from 30-50% for nitrogen. Typical costs of construction of these features may range from $0.50-$1.15 per cubic foot of pond, though site specific parameters may cause this cost to vary higher or lower[5].

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[3] www.sfwmd.gov/sites/default/files/documents/2020_SFER_highlights.pdf
[4] Diagram of typical detention pond design with littoral shelf of native plants
[5] Florida DOT Best Practices for Stormwater Runoff Designer and Review Manual (2015), USEPA 1999, nrcsolutions.org

4.1.3 Spreader Berms and Canals/Swales

Spreader berms and canals/swales mitigate high velocity concentrated water flow first through conveyance within wide canals/swales for initial velocity reduction and second by diffusing flow over a berm via multiple discharge locations to wide vegetated treatment area, where velocities are further reduced as the water is dispersed as sheet flow. This reduction in velocity promotes settling of suspended particulate matter and associated nutrients. Flow is dispersed from the initial spreader canal/swale to the vegetated treatment area through various methods, including, but not limited to:

- Overtopping a berm uniformly as the water rises behind the berm.
- Water flows into a canal or ditch and then overflows the downstream side of the ditch uniformly into receiving waters.
- Water may pass through a berm via multiple strategically spaced culverts.
- Water may be pumped over a berm or out of a canal in a dispersed manner into receiving waters.

Overall, this generally results in a more natural/historic sheet flow dispersal of water instead of historic channelized/point source flow, potentially restoring natural wetlands or creating new wetlands downstream of the berm or canal. Estimated costs for construction of spreader swales, using costs associated with the north Belle Meade and South I-75 Canal spreader swales range from $140,000/acre without a pump station to $240,000/acre with a pump station[6].

Figure 4-3: Spreader Berms and Canals

SFWMD Lake Hicpochee Shallow Storage with Spreader Canal. The G-726 will send stored water from the 670-acre flow equalization basin into a spreader canal for distribution into the northwest part of Lake Hicpochee[7].

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[6] Collier County Watershed Model Update and Plan Development, Vol. 2, 2011, Atkins www.colliercountyfl.gov/home/showdocument?id=38451
[7] https://www.flickr.com/photos/sfwmd/40084092234

4.1.4 Restored Wetlands

Conservation and mitigation programs which invest in strategically positioned wetland restoration projects have demonstrated water quality improvements, flood abatement, habitat value and overall watershed restoration. Wetlands have long demonstrated the ability to improve water quality. Observations of water quality improvements through natural wetlands led to study and creation of treatment wetlands for a variety of waste streams. The quiescent conditions of wetland promote the settling of suspended sediment and associated contaminants. Nutrients dissolved in runoff can be adsorbed by the wetland soil and absorbed by wetland plants.

Restoration of wetland hydrology is the predominant design element for successful wetland restoration. Historically drained wetlands offer the simplest location for potential wetland restoration where drainage ditches are plugged, berms are constructed to impound water, water control structures are installed, and surface topography is manipulated to help restore target wetland hydrology. Restored wetlands perform essentially the same functions as the treatment wetlands of the STAs described above, except not with the equivalent efficiency. Restored wetlands require significantly more land area to provide an equivalent level of treatment offered by an engineered constructed treatment wetland.

It should be noted that contribution of excess nutrients into a natural wetland may adversely alter the ecology of existing hydrologically connected wetlands by promoting the growth of nuisance and/or exotic wetland plant species, which often occurs in the presence of high nutrient levels. Nuisance and/or exotic plant growth may result in a dominance of one or two non-desirable plant species, such as cattails, which can outcompete desirable native vegetation, which can be detrimental to habitat quality. Restored wetlands are also not bermed, lined or otherwise segregated from adjacent natural systems like constructed treatment wetlands. Restored wetlands can remove up to 95% of inflow sediments, although site specific factors will greatly influence this removal rate.

Figure 4-4: Restored Wetlands

Restored wetlands and wildlife usage at the Allapattah Ranch Wetland Reserve Project in Martin County[8].

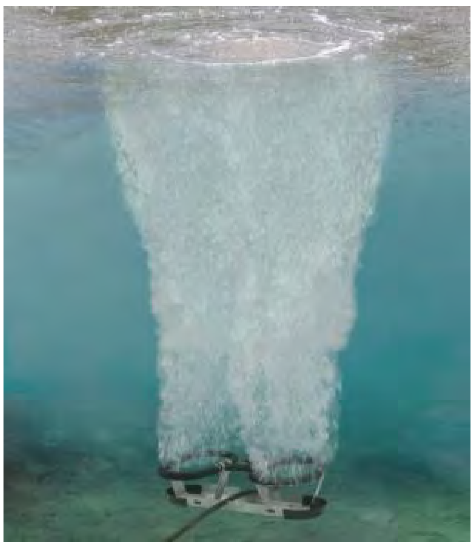
[8] https://www.sfwmd.gov/news/nr_2017_0922_allapattah_ranch_project

4.1.5 Air Diffusion System (ADS)

Aeration of stormwater ponds and/or natural lakes for nutrient removal typically involves installation of multiple air diffusers at the bottom of a pond, or possibly at the surface as a display aerator for less intense aeration. Aerating the sediments of a pond allows aerobic bacteria to work more effectively to break down sediments and decaying plant material (anaerobic bacteria work very slowly in comparison), which releases nutrients into the water column. Unless the lake is especially acidic, one of the first forms of nitrogen released from this enhanced decomposition is ammonium/ammonia. Ammonium typically dominates, though the percentage of ammonia increases as pH increases. Ammonia can leave the water column as a gas under aerated conditions. As ammonia is released, additional ammonium is converted to ammonia, which can again be released from the water as a gas. Aeration may change the form of phosphorus present within the water, but phosphorus will not leave as a gas and may only be resuspended within the water column as sediments are disturbed and organic matter within the sediments is decomposed.

These systems are useful in reducing algal growth by removing enough nitrogen from the water to prevent algal blooms, but they are not known to remove phosphorus, which does not become a gas under natural conditions. It should be noted that air diffusers placed on pond or lake bottoms can cause significant releases of phosphorus bound to bottom sediments into the water column, making the phosphorus available for downstream transport. Costs include not only the equipment and maintenance, but also electricity associated with continuous operation of pumps to run the aerators.

Figure 4-5: Air Diffusion System (ADS)



Air diffusion aeration system placed near a lake bottom[9].

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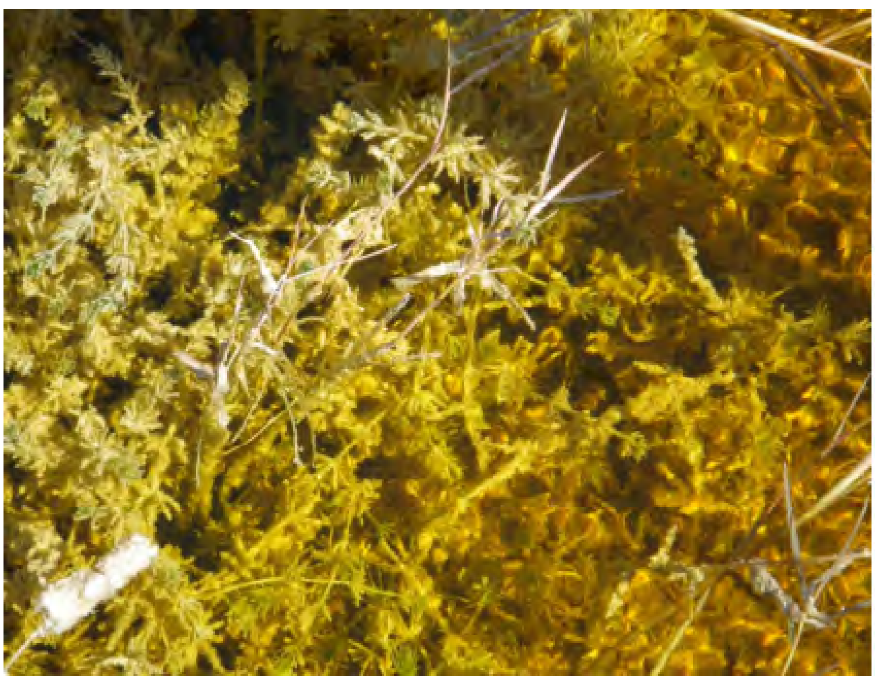
[9] http://floridalake.com/

4.1.6 Periphyton / Submerged Aquatic Vegetation (SAV) Growth and Removal

Periphyton includes freshwater organisms (e.g. algae, bacteria, and fungi) that grow attached to rocks, plants, and other objects located within the water column of a lake, pond, wetland, etc. SAV includes plants that grow beneath the water surface. In a treatment system using periphyton/SAV for nutrient removal, water flows through a system to promote the growth of biomass to uptake nutrients, after which the periphyton/SAV must be harvested and disposed of in an area where the decomposition of the material will not result in released nutrients returning to the waterbody. The periphyton or SAV may be used to create biofuels, cattle feed, crop fertilizers, soil amendments, or other bioproducts.

Periphyton growth and removal technology appears to be commonly used in the treatment of wastewater. One study[10] conducted within STA-3/4 in Southeast Florida indicated that periphyton growth in these stormwater treatment areas resulted in significant reductions in TP concentrations in water leaving the STAs; however, the information available does not indicate that the periphyton would be harvested at some point. Long term, periphyton can only permanently remove phosphorus from an aquatic system through harvest and disposal at upland sites where the nutrients can be used for other purposes. Periphyton left in a treatment system will eventually die off and potentially release nutrients back into the water column.

Figure 4-6: Periphyton[11]



[10] sfwmd.gov/sites/default/files/documents/ltp_mtg_12feb2013_psta_%20stormwater_%20periphyton_%20mesocosm_ivanoff.pdf
[11] sfwmd.gov/sites/default/files/documents/ltp_mtg_12feb2013_psta_%20stormwater_%20periphyton_%20mesocosm_ivanoff.pdf

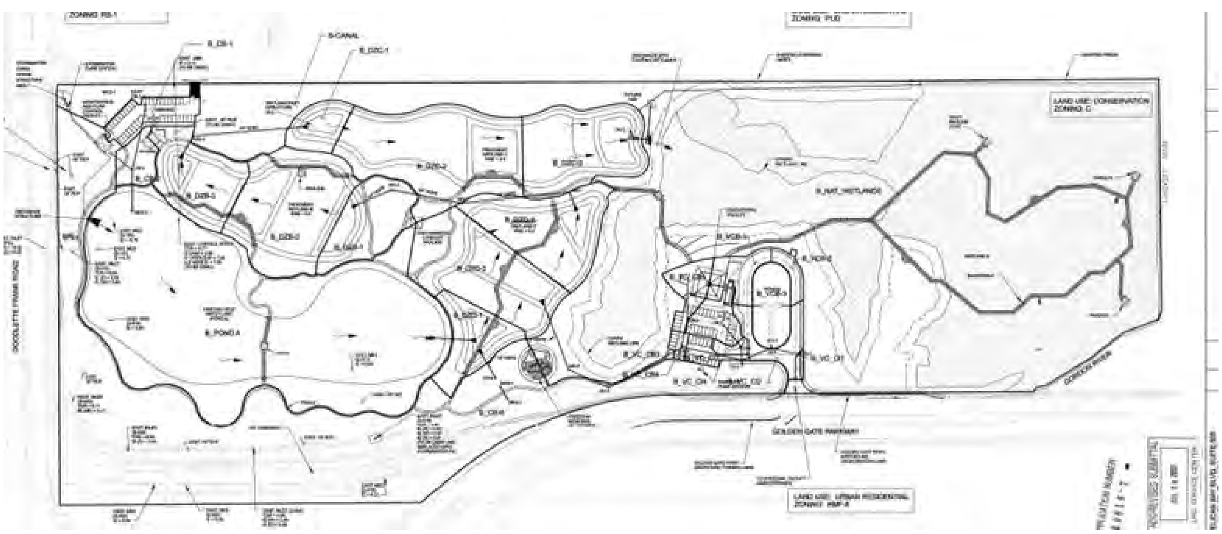
4.1.7 Polishing Ponds

Polishing ponds are generally the last in a series of settling ponds used to improve water quality. They typically follow an initial inlet deep pool or other design to cause flow dispersal and a primary treatment area. The Outlet Zone can be a deep pond to prevent re-suspension of sediments for a final 'polishing' step. There are many ways to design multiple ponds and/or wetland zone systems to accomplish this polishing, each with the Inlet Zone, Primary Treatment Area and Outlet Zone.

During the polishing treatment, the water is kept in natural condition will full exposure to air in one or many, usually compartmentalized, open water bodies (aka polishing ponds). These ponds are usually from five to ten feet deep and allow for the sedimentation of non-degraded and degraded suspended particles at the bottom of the pond is facilitated in a natural way. Further, aquatic plants, invertebrates and weed eating fish can be introduced in the polishing pond to absorb and consume remaining plant matter.

Freedom Park in Collier County has implemented a treatment train system that includes polishing ponds to treat roadway runoff with multiple basins that allow for chemical and biological treatment of water through retention time that allows sediment settling. This system was originally designed to treat stormwater runoff from Goodlette-Frank Road, with a standard wet detention system that discharged to the Gordon River via concrete weir discharge structure and grass swale to the river. The system was expanded by adding three treatment wetland zones, each with shallow and deep zones to encourage settling, prior to discharge into the existing natural wetland system. The man-made wetland zones are functioning as polishing ponds for the treatment system. This system is under further investigation for potential inclusion with treatment train technologies to be proposed in the feasibility study to follow this report.

Figure 4-7: Freedom Park Collier County – Polishing Pond Included in a Treatment Train[12]



[12] https://my.sfwmd.gov/ePermitting/ (SFWMD ERP 11-0082-S-02, Application 060816-7)

4.1.8 Hybrid Wetland Treatment Technology

Hybrid Wetland Treatment Technology (HWTT) combines the use of wetlands and chemicals to treat water quality. The typical design includes the addition of alum at the inlet of the system as pre-treatment to remove phosphorus by forming a floc that will settle out in deep pools constructed to capture the floc. The chemically treated water then discharges to treatment wetlands where some of the floc will remain active for additional P sorption , some will settle out and sequester phosphorus in the buried sediments, and residual nutrients are removed through the treatment wetlands per the processes described above.

As described further below in Section 4.2.3 (Offline Alum Treatment), design of the alum treatment portion of the system requires initial testing of water quality parameters of incoming waters to develop a dosing rate for alum, and possible pH adjustment requirements for inflow waters. Of the study sites included in the report found at https://www.fdacs.gov/content/download/76291/file/20210_FinalReport.pdf, the largest study site had a maximum treatment flow of 25-cfs and included a 6-acre floc contact pond, a 1.5-acre SAV pond, an additional 27-acre pond, and a 65-acre isolated wetland. This technology is well suited for treatment of point sources where high nutrient concentrations and flows can be predicted.

Figure 4-8: Hybrid Wetland Treatment Technology[13]

[13] https://www.sfwmd.gov/sites/default/files/documents/ne_hybrid_wetland.pdf

4.1.9 Media Filters

Media filters utilize physical and geochemical reactions to remove contaminants, without the addition of chemical reagents, through filtration, adsorption to soil surfaces, or are chemically transformed and stored within the soil matrix. These filters adsorb and sequester various contaminants including nutrients (nitrogen and phosphorus). Filters can be designed for nutrient removal by selecting a specific media (e.g., compost, peat, or wood chips for nitrate removal and iron enhanced sands for phosphorus removal). The following sections provide an overview of three applicable filter technologies.

4.1.9.1 Bioreactors

Bioreactors are buried organic material which function in an anaerobic environment. Water flows through the anaerobic filter, where nitrate nitrogen is converted to N2 gas, which is then subsequently released to the atmosphere. The buried materials vary and may consist of permeable reactive barriers or pass through filter systems. Filters can discharge directing to groundwater or incorporate an underdrain and discharge to a surface water body. Systems with underdrains can also control the water level within the filter and thus the hydraulic retention time to ensure the level and anaerobic treatment within the filter is achieved. Bioreactors are designed to treat high contaminant/low flow conditions with bypass of larger more dilute flows. It has been observed that bioreactor materials may degrade f they are not continuously kept in anerobic conditions. The Felts Avenue bioreactor was presented as an example system for review. This bioreactor consists of pipes and wood chips buried beneath a parking lot and is shown in the figure below.

Figure 4-9: Felts Avenue Bioreactor Bonita Springs[14]

[14] http://www.cityofbonitasprings.org/cms/One.aspx?portalId=11726542&pageId=16148711

4.1.9.2 Iron Enhanced Sands

Iron enhanced sand filters (IESF), also known as Minnesota filters, incorporate filtration media such as sand, with iron particles to remove dissolved particles such as phosphate. They can be used on sites where infiltration is not feasible, such as where a site has a high groundwater table. Sources for the iron include recycled scrap iron, steel wool, or iron fillings. Several forms of phosphorus bind to the iron, and filtration basins amended with iron filings have been shown capable of removing 92 percent of total suspended solids (TSS), 71 percent of total phosphorus, and 50 percent phosphate (Minnesota Stormwater Manual).

Two common designs are iron-enhanced sand filter basins (dry ponds) or iron-enhanced sand benches in wet ponds. IESF features have been applied to various water quality designs aside from stormwater ponds, including filtration basins, rain gardens and underground storage chambers/trenches. The Spring Lake Regional Park in Scott County, Minnesota, is one example where this technology was used. Roughly four miles of new paved trails required a stormwater management system that was amenable to the sensitive wetlands adjacent to the site. The outlet control structure diverts the excess water of the wetland into the IESF, where it then filters water down through the media, removing contaminants. The iron fillings act as a magnet to the dissolved phosphorus and attach to the fillings to create a more efficient sand filter. The filtered water is captured in an underdrain system (typically required to aerate the filter bed between storms) and discharged back into the original stream bed downstream of the outlet structures.

It should be noted that iron is not appropriate for all filtration practices due to the potential for iron loss or plugging in low oxygen or persistently inundated filtration practices. Iron-enhanced sand filters may be applied in the same manner as other filtration practices and are more suited to urban land use with high imperviousness and moderate solids loads. Iron-enhanced sand filters are more suitable to conditions with minimal groundwater intrusion or tailwater effects. The exit drain from the iron-enhanced sand filter should be exposed to the atmosphere and above downstream high-water levels to keep the filter bed aerated.

Iron-enhanced sand filters may be used in a treatment sequence, as a stand-alone BMP, or as a retrofit. If an iron-enhanced sand filter basin is used as a stand-alone BMP, an overflow diversion is recommended to control the volume of water, or more specifically, the inundation period in the BMP. As with all filters, it is important to have inflow be relatively free of solids or to have a pre-treatment practice in sequence.

IESF systems have the potential to remove >90% of inflow sediment and greater than 70% of inflow TP; however, nitrogen removal as a direct result of these systems is negligible. Estimated costs range from $140 to $175 per cubic yard of treatment volume[15].

[15] Minnesota Stormwater Manual https://stormwater.pca.state.mn.us/index.php/Iron_enhanced_sand_filter_(Minnesota_Filter)

Figure 4-10: Iron Enhanced Sands Filtration Example Schematic[16]

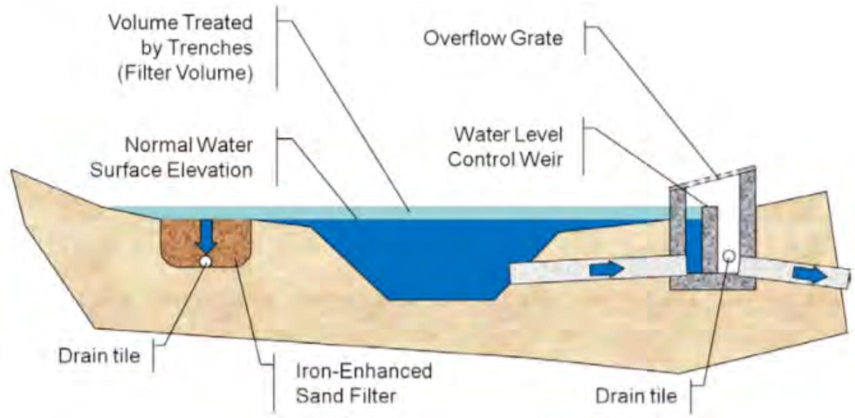


Figure 4-11: Iron Enhanced Sands Filtration Example[17]

[16] https://conservancy.umn.edu/bitstream/handle/11299/115602/pr549.pdf
[17] https://stormwater.pca.state.mn.us/images/5/50/Iron_enhanced_sand_filter.pdf

4.1.9.3 Bold & Gold®

Bold & Gold® CTS Filtration media is a Biosorption Activated Media (BAM) for stormwater treatment in conjunction with other structural or non-structural stormwater BMPs. Bold & Gold® (B&G) Filtration media is a patented product developed at the Stormwater Management Academy of the University of Central Florida. Environmental Conservation Solutions, LLC. (ECS) is the licensed manufacturer of the Bold & Gold® Filtration media.

B&G CTS Filtration media is recommended for stormwater nutrient removal to be used in low loading or slow-flow filters, either in 12-, 24- or 30-inch depth filters; after a wet pond or within a dry basin, swale and strips.

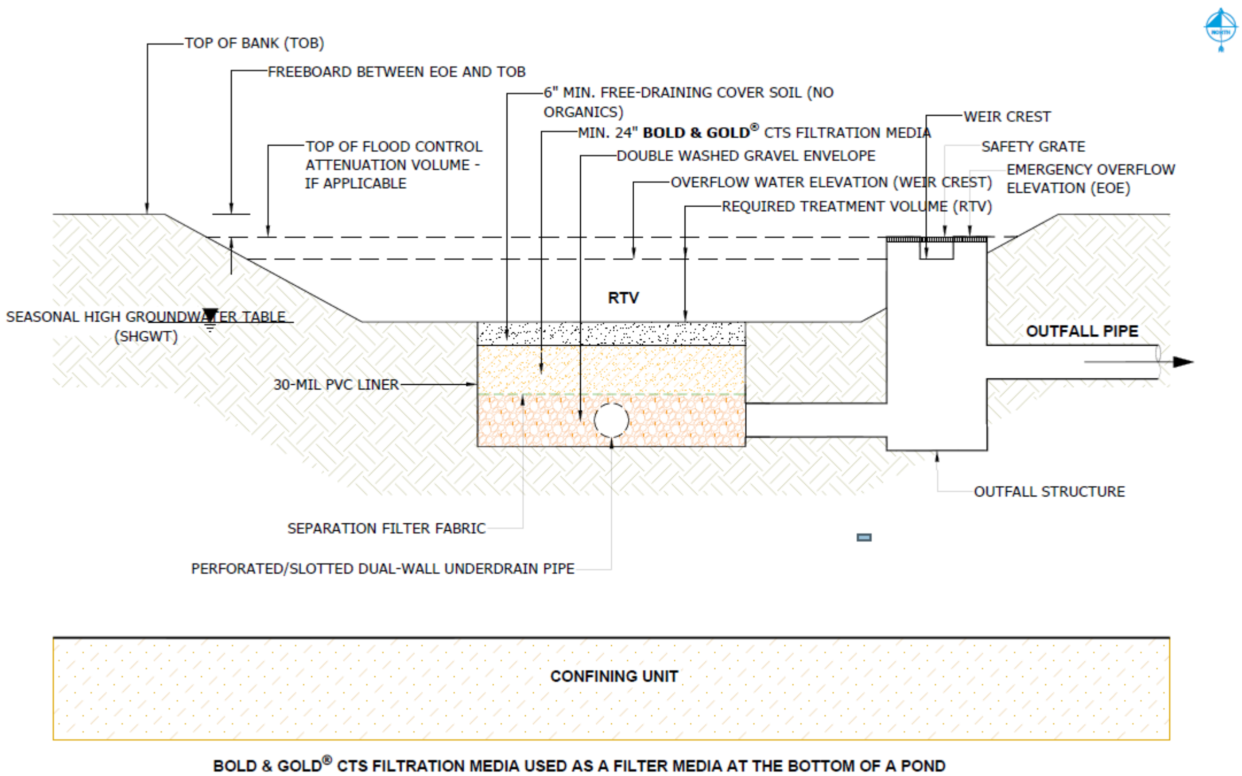
This technology uses a media that is a mixture of sand, clay, and recycled tires. According to the manufacturer, an anaerobic environment is created that converts nitrogen forms to nitrogen gas, which is then released to the atmosphere. The media also filters out particulate phosphorus and provides soil sorption sites to capture dissolved phosphorus; however, the media will eventually become saturated with phosphorus and must then be replaced. The manufacturer stated nitrogen (presumably TN but the reference document did not directly state this) removal rate in stormwater treatment applications is 75-95%, though TP removal rates are not indicated. The system is stated to have a 15-year life span, but it appears that this applies only to nitrogen removal, and media may need to be replaced more often for the system to continue removing TP for 15 years.

Maintenance requirements for the B&G CTS Filtration media shall be dependent on the proper functioning and maintenance of all components of the applicable BMP in which the filter media is used. To prevent the clogging of the voids of the B&G CTS Filtration media, there shall be installed an intermediary aggregate media that is free-draining and free of organics (clean sand, acceptable aggregates, etc.) as cover material directly above the top of the filter media surface. In addition, the cover material shall serve to control the erosion of the components of the B&G CTS Filtration media.

B&G CTS Filtration media is typically designed to last the life span of the applicable BMP. However, maintenance shall be performed if the Bold & Gold® CTS Filtration media has shown a reduction in the performance efficiencies on the reduction of Total Phosphorus (TP) below the design value before and/or at the expiration of the design service life. The maintenance procedure shall involve the removal of the cover material and B&G CTS Filtration media and replaced with new material and filter media meeting the original specifications. The spent filter media and cover material shall be disposed of at an approved landfill.

The primary control for sizing the B&G CTS Filtration media is to capture the water quality volume and pass it through the filter media with a specified hydraulic residence time (HRT) to achieve a specified drawdown time. The capture volume is dependent on the flow-through rate per available surface area of the filter media. B&G CTS has a design loading rate of five inches per hour. Assuming this loading rate, this media can be expected to remove up to 95% of TP (until the media becomes saturated, after which no additional TP would be removed until the media is replaced) and up to 75% of TN. Costs provided by the manufacturer of B&G CTS Filtration media range from $0.50 to $1.15 per cubic foot of media[18].

Figure 4-12: Bold & Gold®



Bold & Gold® media filtration system[19].

[18] Chris Bogdan, President of Environmental Conservation Solutions, LLC (B&G Manufacturer)
[19] https://ecs-water.com/stormwater-management/filtration-media-solutions/

4.2 NON-APPLICABLE TECHNOLOGIES

4.2.1 Recyclable Water Containment Areas

Recyclable Water Containment areas are designed to retain water on privately owned lands to control non-urban stormwater, sequester nutrients, and to improve soil quality. This technology is also commonly known as ‘water farming’. Land is entered into a program to retain water for a given number of years by building a small berm around the perimeter of the participating land to retain water in depths up to 2 feet. Following the designated retention period, the land would return to agricultural use.

Water contained in these areas is likely to raise surrounding water tables on adjacent lands, possibly reducing irrigation needs, and a high amount of loss of the water to evaporation is expected. Nutrients are stored in these retention areas and can settle out to improve soil fertility, reducing future fertilizer requirements. This technology works best where there is a confining layer in the soil, such as an argillic or spodic horizon.

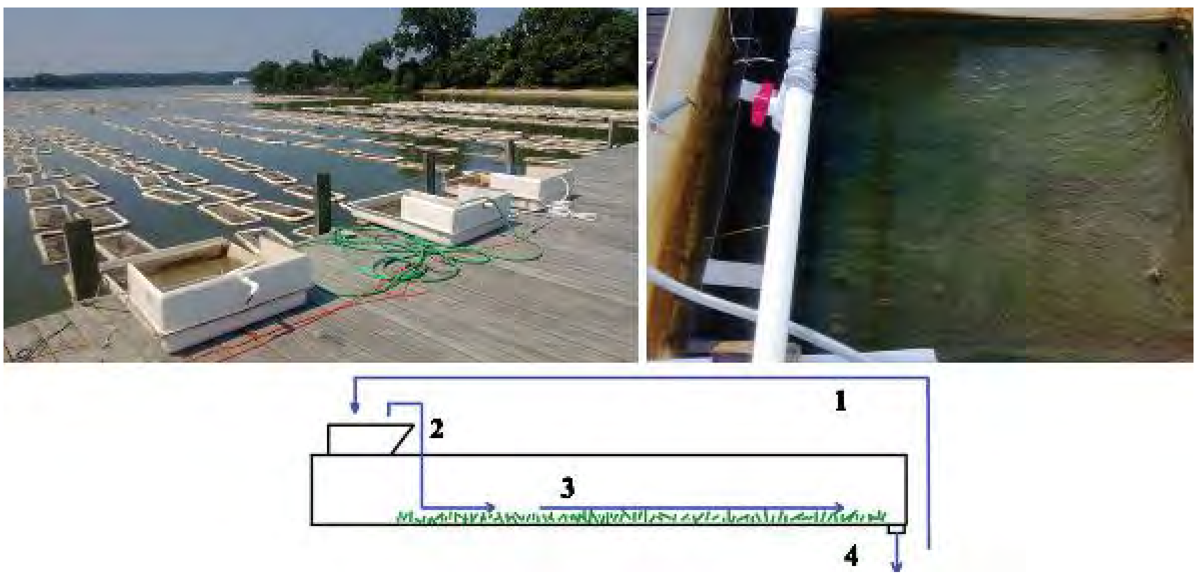
Figure 4-13: Recycled Water Containment Area – Conceptual Drawing[20]

[20] https://edis.ifas.ufl.edu/ss447

4.2.2 Algal Scrubbers

This technology involves providing a growth media for algae and intense lighting to promote the growth of algae on the media. The algae remove nutrients via absorption from the water flowing over the growth media, after which the algae are harvested. Harvested algae is then either properly disposed of in an area disconnected from receiving waters as nutrients can be released during algal decomposition, or used for biofuels, cattle feed, or other beneficial uses. This technology is O&M intensive and generally used for small scale systems, from home fish tanks to aquaculture production facilities. It is the team's professional judgment that the growth and harvesting of algae in large scale systems, as would be required for this project, would be better accomplished through the growth and removal of algae as periphyton as described in Section 4.2.3 above.

Figure 4-14: Algal Scrubbers



Algal turf scrubber components at an oyster aquaculture facility. Step 1 pumps water from the oyster aquaculture facility into the dump bucket (2). Once the dump bucket is sufficiently full the bucket tilts and dumps water across the algal turf. Water leaves the scrubber after flowing across the algae through a point (4) that re-releases water back into the aquaculture facility. This particular study is located in the Chesapeake Bay area and nutrient removal results focused on nitrogen rather than phosphorus[21].

[21] https://www.sciencedirect.com/science/article/pii/S0925857414001943

4.2.3 Offline Alum Treatment

Aluminum sulfate, or a similar aluminum compound, is added to inflow water which is directed into an offline pond. The aluminum ion binds with phosphate ions to form a floc that settles to the bottom of the pond. This aluminum phosphate floc will be periodically removed from the offline pond and disposed of appropriately. Treated water then flows out of the pond into downstream systems with reduced phosphorus concentrations.

Alum treatment is a technology that has been in use for many years, often as in-line treatment, where the produced floc settles into the natural systems. The accumulation of floc would not be desirable for the OFWs downstream of the area where treatment may occur, and therefore an offline treatment system is recommended if this option is pursued. Implementation of this technology requires advance study of inflow waters to determine required pH adjustments and alum dosing levels. Costs of these systems can vary widely depending on chemistry and volume of inflow water and include costs to periodically remove the floc.

Figure 4-15: Offline Alum Treatment

Example alum treatment system[22]

[22] https://www.florida-stormwater.org/assets/MemberServices/Conference/AC19/22%20-%20Harper%20Harvey.pdf

4.2.4 Floating Treatment Wetlands

Floating treatment wetlands are plants grown on a floating mat over open water to uptake nutrients through roots that extend into the water column. The plants might be periodically harvested if phosphorus uptake is limited and disposed of in upland areas, and possibly used for soil enrichment, to remove the nutrients from the system. These planted mats would need to cover large areas of open water to remove significant amounts of nutrients, although they are also simple additions to sedimentation basins/ponds to provide an additional level of treatment. Plant uptake of nutrients is minimal compared to the physical/chemical mechanisms for removal in ponds/wetlands. Harvesting and disposing of the plant material should also be considered before further investigation of the use of this technology.

Figure 4-16: Floating Treatment Wetlands

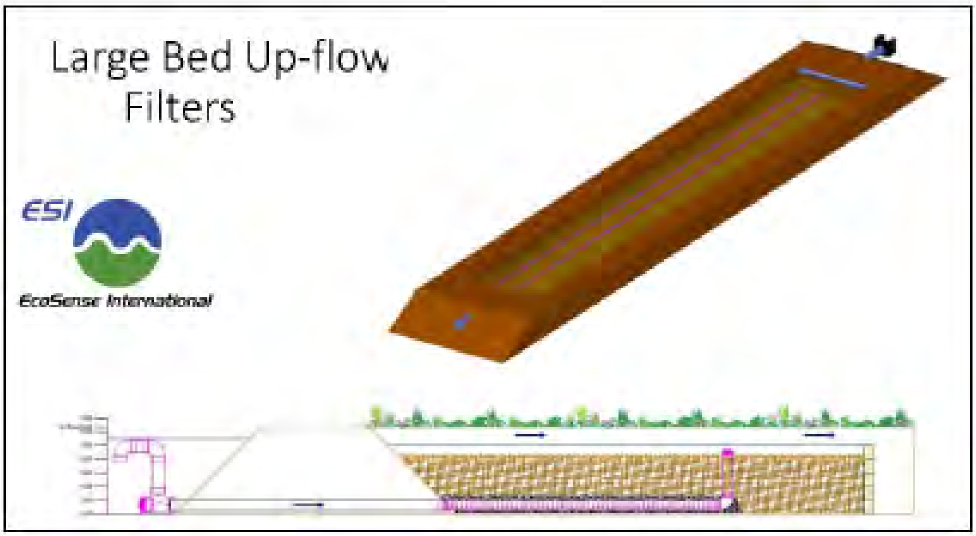
Floating treatment wetland showing vegetation growing on mats[23].

[23] Stormwater.wef.org

4.2.5 NutriGone Media™

This technology uses media comprised of organic and inorganic carbon and an ion adsorption mineral. This technology was described based on manufacturer provided data in the C-43 West Basin Storage Reservoir Water Quality Feasibility Study (2020)[9] and was recommended for testing for use in nutrient removal. It is unknown whether this technology has been used in large scale natural systems as the company website describes primarily installation of baffle boxes in stormwater collection systems. The estimated cost provided by the manufacturer to treat the C-43 basin site was $14,290,000 per 353 days.

Figure 4-17: NutriGone MediaTM



Example of NutriGone filter (EcoSense International, 2019)[24]

[24] www.sfwmd.gov/sites/default/files/C-43%20WBSR%20WQFS%20Information%20Summary%20Collection%20Report_04.03.2020.pdf

4.2.6 Downstream Defender®

This is a hydrodynamic vortex separator that is placed in-line with stormwater flows that removes sediments and any nutrients or other chemicals attached to the sediments. It appears that this separator is typically placed in-line with stormwater pipes; however, at least one example on the company's website indicates that this technology has been used on a larger scale project in Qatar, claiming that the system could remove pollutants at flows in excess of 64,000-gpm (approximately 142-cfs). Because this system only removes the solids and nutrients attached to the sediment, it is unclear how much nutrient loading could be treated in the water leaving the PSRP area, which would depend on the percentage of nutrients in dissolved form.

A study was conducted in the C-43 West Basin Storage Reservoir (former farmland) using this technology to treat runoff from a farm. It was found that the peak treatment rate was 38-cfs for a 12-foot diameter unit. Nutrient removal costs in this study were $45-$112 per lb. TP/yr. and $10-$100 per lb. ammonia-N/yr. (this is a fraction of total nitrogen).

The vendor indicates that the system may remove 70% of TP and 79% of Total Kjeldahl Nitrogen (TKN = TN minus nitrate/nitrite-N). If high levels of nutrients within the conveyed waters associated with this project are in dissolved form, the treatment might be relatively ineffective, particularly for TP removal. The need to remove and dispose of separated sediments should be considered if this technology is further investigated.

Figure 4-18: Downstream Defender®

Downstream Defender® system in Qatar[25].

[25] www.hydro-int.com/en/case-studies/unconventional-downstream-defender-system-helps-protect-gulf-waters-qatar-0

4.2.7 Aquifer Storage and Recovery (ASR)

This technology would involve injection of excess flows into a confined aquifer, to be re-pumped later to supply water for public use or for redistribution into natural systems. The appropriate geologic conditions to provide for a confined aquifer would need to exist in this region to make use of this technology, which also may require that water be treated to drinking water quality standards prior to injection. This technology would not result in nutrient removal beyond that achieved prior to injection into the aquifer. In addition, recovery rates of injected water vary widely.

Figure 4-19: Aquifer Storage and Recovery (ASR)

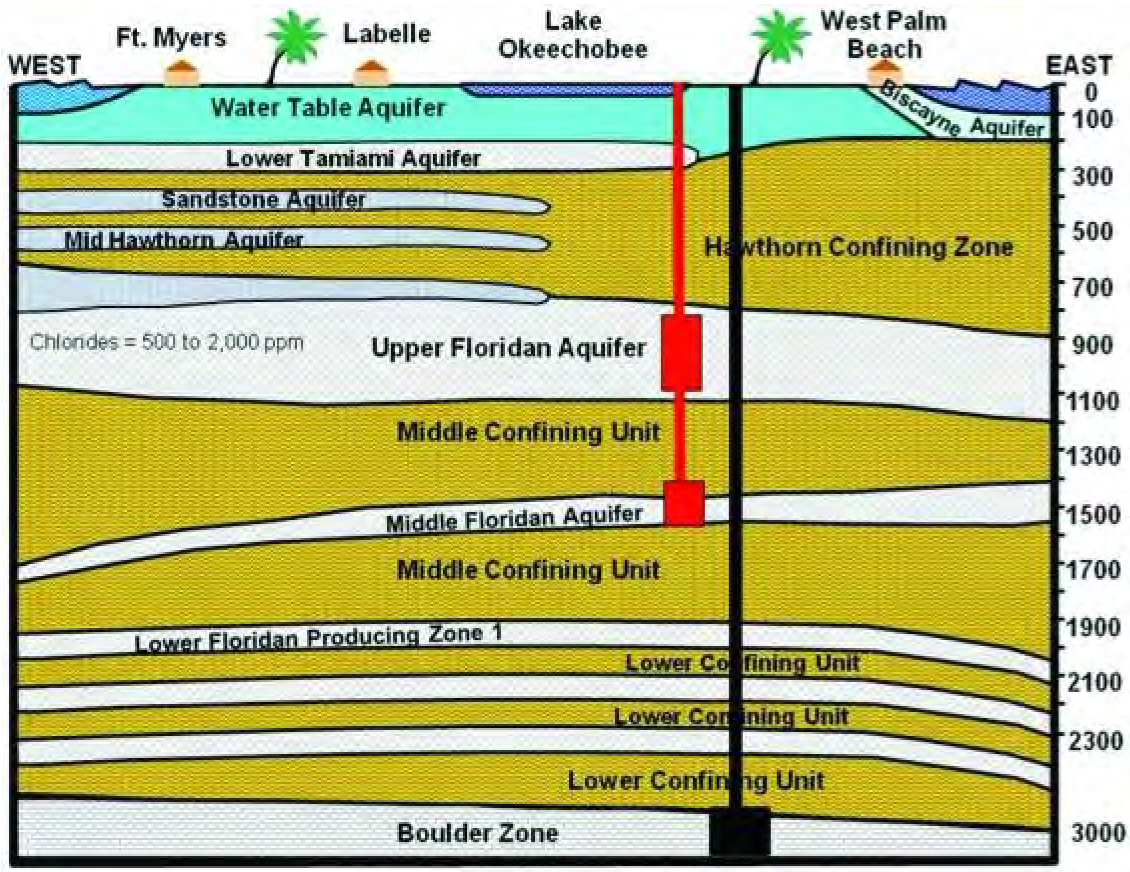
Aquifer Storage and Recovery facility for water supply in the South Florida Water Management District[26].

[26] https://www.saj.usace.army.mil/Missions/Environmental/Ecosystem-Restoration/Aquifer-Storage-and-Recovery-ASR-Regional-Study/

4.2.8 Deep Well Injection

This technology involves injecting excess water into deep aquifers from which the water will not be returned to the surface. While this permanently removes the nutrients along with the water, downstream systems may then be starved of essential freshwater flows.

Figure 4-20: Deep Well Injection



Example of deep well injection where water is injected into the 'Boulder Zone', below the Middle and Upper Floridan Aquifers normally used for water supply[27].

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[27] https://lakeokeechobeenews.com/lake-okeechobee/deep-wells-reduce-discharges-estuaries/

5.0 TREATMENT OPTIONS

Table 5-1 lists the treatment options described above, pros and cons of each, and whether the option should be further investigated in the Task 4 Feasibility Study to follow this report.

Table 5-1: Treatment Options Summary Table

Treatment Option	Pros	Cons	Recommended for Feasibility Study investigation?
Applicable Constructed Treatment Wetlands	• Proven technology in South Florida • Engineered for removal of specific contaminants • Passive and sustainable treatment approach • Provides excellent and prolonged treatment of nitrogen • Aesthetically pleasing • Provides habitat • Some recreational value for wildlife viewing and hunting	• May require a large land area to provide adequate treatment • Adsorption capacity for phosphorus may become limited • Will likely require permitting	Yes
Applicable Detention Areas and Settling Ponds	• Slows stormwater flow allowing sediments and associated nutrients to settle out • Tend to promote plant growth that would provide additional nutrient uptake and possible wildlife habitat value	• May require a large land area to provide adequate treatment • May require periodic sediment removal to maintain depths for proper sedimentation • Will likely require permitting	Yes
Applicable Spreader Berms and Canals	• Slows stormwater flow • Facilitates sheet flow for nutrients to settle out • Can manage large flows passively	• Need adequate land area to treat expected flows • Will likely require permitting	Yes
Applicable Restored Wetlands	• Restoration of historically drained areas to natural wetland systems • Can provide wildlife habitat value while wetland vegetation will slow water flows and uptake nutrients	• Need adequate land area to treat expected flows • Requires well vegetated treatment area • May require sediment removal to ensure vegetation survival • Will likely require permitting	Yes

Treatment Options

Treatment Option	Pros	Cons	Recommended for Feasibility Study investigation?
Applicable Air Diffusion Systems	• Can be retrofitting into sedimentation ponds and polishing ponds • Can remove potentially large amounts of TN • May not require permitting	• Does not really address TP removal • Requires a power source for blower • May have high maintenance requirements depending on site specifics	Possibly – may be used to supplement other technologies to enhance nitrogen removal
Applicable Periphyton and/or Submerged Aquatic (SAV) Vegetation Growth and Removal	• A natural treatment process, removed material may be used beneficially elsewhere • Has a high potential for nutrient removal	• May require a large treatment area • Requires periodic removal and transport of material • Death of biological material from extended cloudy periods or major storm events will re-release nutrients • Permitting may be required if a reservoir is constructed for growth	Yes
Applicable Polishing Ponds	• Promotes passive sedimentations of solids and associated contaminants • Provides recreational opportunities • Facilitates oxygen diffusion prior to discharge	• Requires large land area • Provides limited dissolved nutrient removal • Provides minimal wildlife habitat • Requires sediment removal on a periodic basis	Yes
Applicable Hybrid Wetland Treatment Technology	• Combination of efficient phosphorus pre-treatment and sustainable nitrogen removal	• Requires chemical addition • May require periodic sediment/floc removal	Yes
Applicable Bioreactors	• Provides efficient removal of nitrogen	• Provides limited removal of phosphorus • Can be prone to clogging (requires pretreatment for sediment removal)	Possibly – may be used to supplement other technologies to enhance nitrogen removal
Applicable Iron Enhanced Sands	• Provides efficient removal of phosphorus • Can be retrofitted into sedimentation ponds	• Can be prone to clogging (requires pretreatment for sediment removal) • May release iron • May require periodic cleaning and media replacement	Yes

Treatment Option	Pros	Cons	Recommended for Feasibility Study investigation?
Applicable Bold & Gold®	• Degrades and removes nitrogen by using sand, clay, and recycled tire material to convert nitrogen to nitrogen gas in an anaerobic environment	• Primarily for TN removal • TP removal capacity unknown and would require continual replacement of media as it becomes saturated with phosphorus • May be expensive • Unproven for project site conditions • Permitting possibly required depending on design	Possibly, only if more 'natural' technologies cannot be accommodated in the land area available
Non-Applicable Recyclable Water Containment Areas	• Relatively simple to construct • Can provide large treatment areas without land purchase and land removal from tax rolls	• Not a permanent solution, only provides detention and treatment for the length of the contract with the private landowner • Accumulated nutrients may be released if the land is returned to pre-containment conditions	No – would be located on private property, which is outside the scope of the current project
Non-Applicable Algal Scrubbers	• Uses growth of algae to passively remove nutrients • May not require permitting	• Not proven for large scale use • Requires more intensive maintenance of growth media and periodic removal and disposal of algae • Limited to plant uptake rates	Possibly, if more 'natural' technologies cannot be accommodated in the land area available
Non-Applicable Offline Alum Treatment	• Treatment can be conducted in a relatively small area • Proven technology for TP removal	• Does not remove TN • Requires site specific research to determine treatment regimen • Involves use of chemicals (offline treatment mitigates this undesirable aspect) • Expense may be very high depending on inflow TP loads • Will likely require permitting	No
Non-Applicable Floating Treatment Wetlands	• Uses growth of natural plants to remove nutrients from the water column • Can be combined with sedimentation/polishing ponds • Minimizes odors from open water systems • Roots systems promote nitrogen degradation • Possibly could provide some wildlife value	• Needs a ponded area to float on, requiring possibly large land area • Nutrient removal efficiency appears to be low as only nutrients near the water surface/root zone of the floating plants would be taken up • Lake creation would likely require a permit	Possibly in conjunction with other technologies

Treatment Options

Treatment Option	Pros	Cons	Recommended for Feasibility Study investigation?
None-Applicable NutriGone™ Treatment Media	• Previously reviewed by the District and recommended for further study	• Unproven • Only information on removal rates is from the manufacturer • Appears that it will be extremely expensive • Permitting unknown	Possibly, only if more 'natural' technologies cannot be accommodated in the land area available
Non-Applicable Downstream Defender®	• Vortex separator that removes solids and the nutrients attached to them	• System is only designed to remove solids and would not treat dissolved nutrients • May be very expensive • Large system likely to require permitting	Possibly, if more 'natural' technologies cannot be accommodated in the land area available
Non-Applicable Aquifer Storage and Recovery (ASR)	• Removes nutrients from downstream waters by temporarily removing the water itself	• Need the proper geology • Will likely need to treat water prior to injection • Injected nutrients will be returned to the surface upon use of the water • Permit required	No
Non-Applicable Deep Well Injection	• Permanently removes nutrients from the environment	• Permanently removes water from the environment • Starving downstream systems of a freshwater supply • Permit required	No

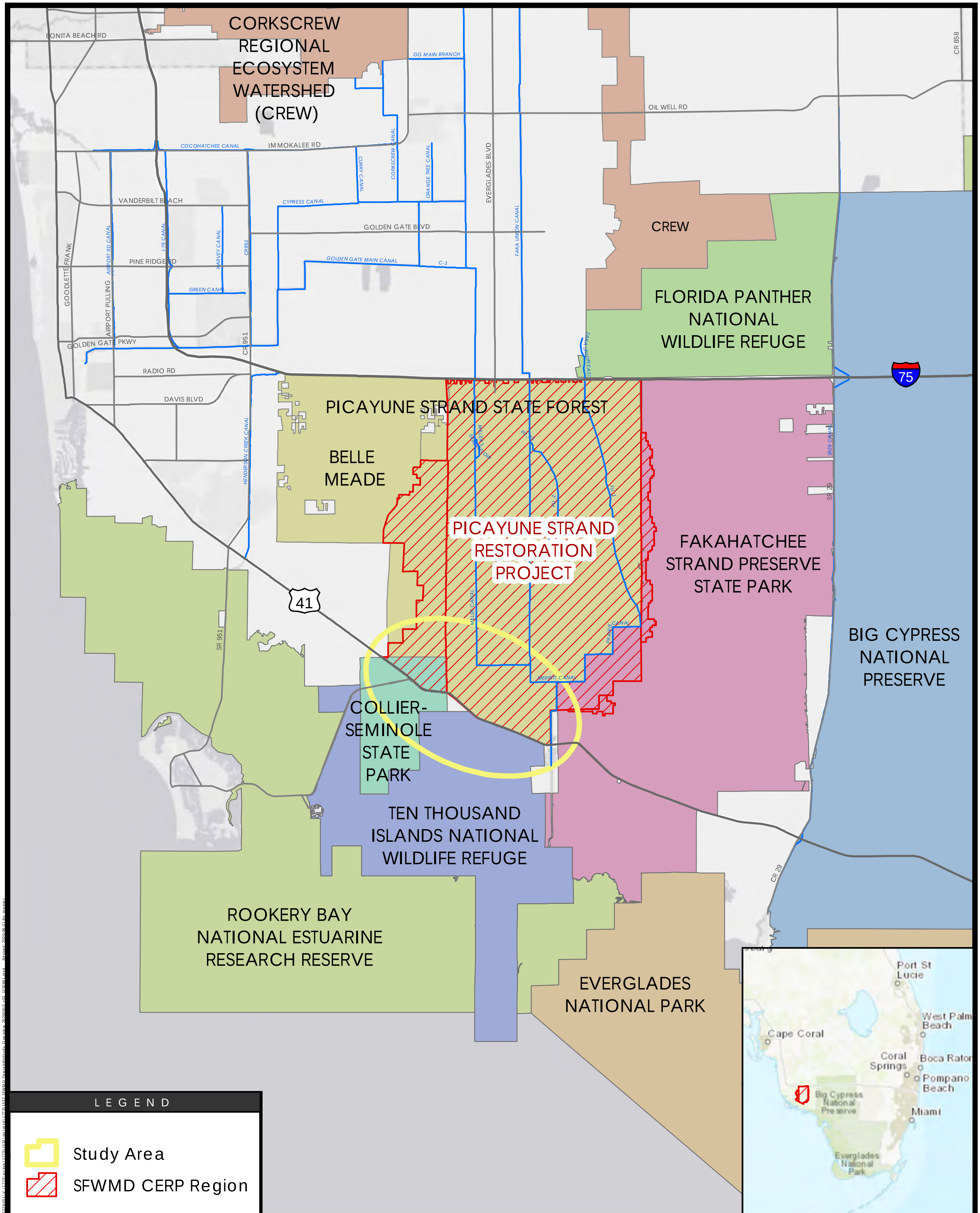
6.0 SUMMARY

The documents identified (Appendix C) by the Working Group (Table 1-1) were reviewed to identify potential technologies that might be used to treat outflow water from the region. Water quality data obtained from these documents, indicating the sources of nutrients and their relative contribution to the Study Area, are detailed in Appendix B. Based on discussions with District staff, it was determined that any project implemented would likely be located south of US 41 and designed to treat water leaving the PSRP area through culverts BR36, BR-37, and a new culvert. Projects are not anticipated to be located on private/agricultural land due to potential funding source restrictions.

A total of 19 project types were identified during this review of available literature, eleven of which are potentially applicable for further review during the Task 4 Feasibility Study. During this task, one or more treatment option(s) may be combined to provide the maximum attainable nutrient removal prior waters discharging to the OFWs to the south. The feasibility study will identify different combinations of technologies that may be used, as well as land potential treatment area availability, and will identify the maximum nutrient removal projected to be achieved given the land potentially available to be used for treatment.

These project types include constructed treatment wetlands, detention areas and settling ponds, spreader berms and/or canals, restored wetlands, aeration systems, periphyton and/or submerged aquatic vegetation growth and removal, polishing ponds, hybrid wetland treatment technology, bioreactors, Iron Enhanced Sands, and Bold & Gold®. Technologies reviewed but not recommended at this time include recyclable water containment areas, algal scrubbers, offline alum treatment, floating treatment wetlands, NutriGone Media™, Downstream Defender®, aquifer storage and recovery and deep well injection. It is recommended that periodic removal of sediments and/or vegetation be incorporated into the operation and maintenance of treatment systems to prevent these systems from becoming saturated with nutrients, as well as the subsequent release of nutrients following disturbance of sediments and/or the death of vegetation.

Appendix A PROJECT AREA SITE MAP



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Notes:
1. Coordinate System: NAD 1983 StatePlane Florida East FIPS 0901 Feet
2. Source data: FNAI, Collier County, SFWMD
3. Imagery: ESRI

SFWMD FEASIBILITY STUDY
MAJOR PUBLIC LANDS AND STUDY AREA
August 2020

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Independent Review by: K.G. 08/13/20

Appendix B WATER QUALITY DATA REVIEW SUMMARY

Water Quality Data Review Summary

A variety of reports and raw data files were sourced to study water quality near the proposed project area. Monitoring stations utilized by the Florida Department of Environmental Protection (FDEP), Collier County, and South Florida Water Management District (SFWMD) were reviewed to select sites for analyses. Stations containing reliable and relevant data included BR36/TAMTOM/TAMBR36 (BR36), BR37/TAMBR37 (BR37), BR39/TAMBR39 (BR39), BC20, BR49/TAMBR49 (BR49), TT175C, FAKA, Faka Union Canal, Blackwater River, TT175B, BC9, BC10, and BC11. Other stations located in proximity to these sites were considered but ultimately excluded as they did not provide unique perspectives for the analyses. Total Nitrogen (TN), Total Phosphorus (TP), Turbidity, Copper, and Iron data are included for each station when available, across all monitoring years, and used to determine the average parameter concentration within waters near each location. For sites where raw data could not be found or were believed to be incomplete, reports were used to determine summary statistics.

Compiled data were screened to remove analyzed samples containing qualifiers identifying potential inaccuracies. A conservative approach to data management was taken and included setting reported nutrient concentrations that were recorded below detection limits at the minimum detection limit (MDL). Station data that were available from multiple sources were compared to ensure consistency. The remaining number of samples were recorded (n) along with the date range associated with the data, before deriving summary information. Calculations included measures of central tendency and variability, such as average, geometric mean, median, standard deviation, minimum, and maximum. This approach to data screening and analysis was similar to the method described in the SFWMD Picayune Strand Restoration Project (PSRP) Water Quality Projections With “Southwestern Protective Levee” Feature report.

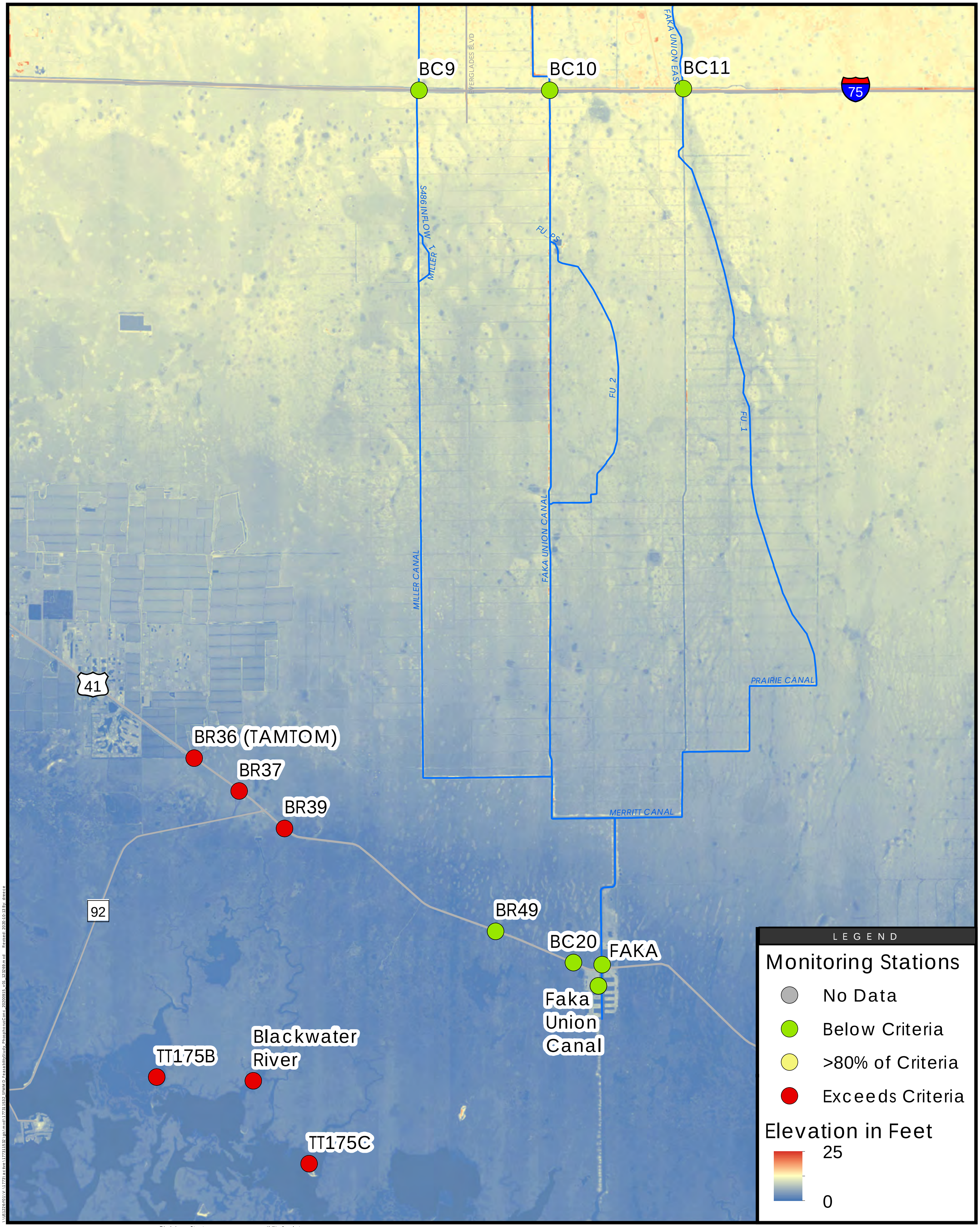
Recorded averages were compared against known criteria for each parameter across all chosen monitoring stations (FAC 62-602). The TP and TN standard narrative states that “in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna” (FAC 62-302.530 (48)(b)). To allow for nutrient comparisons between stations, and the categorization of high, moderate, and low concentrations, criteria associated with the Peninsular Nutrient Watershed Region were adopted in the absence of specific numeric TN and TP criteria (FAC 602-302.531(c)(2)). These thresholds were chosen as they were the closest geographical standards available for freshwater streams and canals. Collier County Pollution Control FY19 Surface Water Report also used Peninsular criteria (0.12 mg/L TP and 1.54 mg/L TN) for nutrient comparisons.

Stations located within downstream Outstanding Florida Waters (OFW) were identified as part of Estuary Nutrient Region E8 (ENRE8) Tidal Cocohatchee River/Ten Thousand Islands, Blackwater River (FAC 62-302.532(1)). As such, stations TT175C, Blackwater River, and TT175B were determined to have their own set of nutrient criteria thresholds (0.053 mg/L TP and 0.41 mg/L TN) used for comparison (FAC 60-302.532(1)(e)(6)). When available, turbidity and iron averages were compared against known criteria for freshwater and estuarine systems, including 29NTU turbidity and 300µg/L iron (FAC 60-302.530(23)/(70)). The copper criterion for estuarine waters is 3.7 µg/L, while standards for freshwater systems are variable. Copper data collected from stations located outside of estuaries were compared to criteria calculated from average hardness in mg/L using standard equations (FAC 60-302.530(38)). Hardness is a measurement of calcium carbonate concentration and is reflective of naturally high or low metal concentrations within a watershed. Using hardness as a means of calculating metal concentration criteria allows for site-specific standard adjustments. In compliance with Florida guidance, average hardness concentrations exceeding 400 mg/L were considered at 400 mg/L during the calculation of copper criteria.

Water quality averages derived from data recorded from each station were categorized as exceeding, within 80%, or below criteria thresholds, as a method of identifying areas with low, moderate, and high nutrient, copper, iron, and turbidity levels. Maps of stations and their associated criteria exceedances for each parameter can be found below (**Figure B-1**). Organized average water quality data can be found below (**Table B-1**). From the data available, freshwater monitoring stations BR36, BR37, and BR39 had average TP concentrations exceeding high nutrient criteria thresholds. BR36 also had a high average TN concentration, with BR37 having moderate concentrations. TN is not available for BR39. Estuarine station averages indicated high criteria threshold exceedances for both TN and TP across TT175C, Blackwater River, and TT175B. Monitoring data collected from locations north and south of the PSRP, including BC9, BC10, BC11, FAKA, and Faka Union Canal were shown to have averages below criteria. One exception to this includes BC20, which indicated waters had a moderate average TN concentration.

Turbidity averages were below threshold criteria across all monitoring stations, apart from the BR36 location, which had a moderate average measurement within 80% of the high threshold. Similarly, BR36 was the only station analyzed that had a copper average exceeding the site criterion. The iron criteria threshold was exceeded by two stations, with the most notable being BR36, which had an average concentration 3.7 times greater than the threshold value. BC9 also exceeded iron criteria with stations Faka Union Canal and BC10 having moderate average concentrations.

Turbidity, copper, and iron data were analyzed due to their potential impacts on the effectiveness of the water treatment technologies described in this report. TP and TN data were used to identify areas experiencing high nutrient levels and inform treatment train recommendations to be addressed in the feasibility report. Data included in this Appendix support the use of mitigation technologies and techniques to address high levels of nutrients, copper, iron, and turbidity near BR36, BR37, and BR39, with the goal of reducing nutrient loads impacting inland aquatic and terrestrial resources, and downstream OFWs. The feasibility of mitigation activities will be dependent on cost-benefit analyses, site-specific conditions, and subsequent land restrictions.



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Notes:
1. Coordinate System: NAD 1983 StatePlane Florida East FIPS 0901 Feet
2. Source data: Collier County, SFWMD, Stantec
3. Imagery: ESRI, Collier County

PICAYUNE WATERSHED WATER QUALITY STUDY

MONITORING STATIONS - TOTAL PHOSPHORUS CONCENTRATION

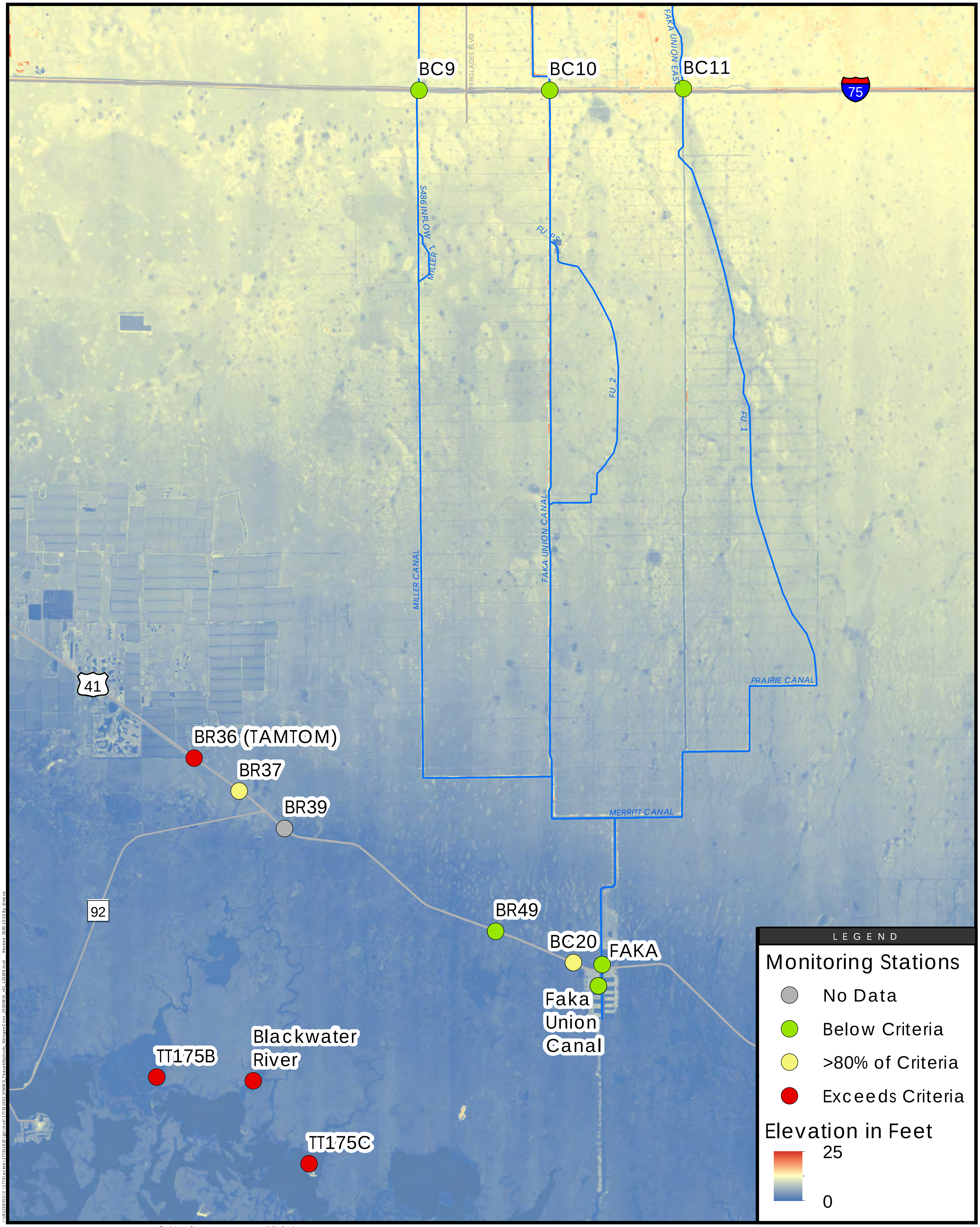
October 2020

0 5,000 10,000 Feet

N

Stantec Consulting Services Inc.
5801 Pelican Bay Blvd. Suite 300
Naples, FL 34108
tel 239.649.4040
fax 239.263.6449

Prepared by: D.A.R. 10/13/20
Technical Review by: M.P. 09/22/20
Independent Review by: B.P. 09/22/20



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3. Imagery: ESRI, Collier County

PICAYUNE WATERSHED WATER QUALITY STUDY

MONITORING STATIONS - TOTAL NITROGEN CONCENTRATION

October 2020

0 5,000 10,000 Feet

N

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Prepared by: D.A.R. 10/13/20
Technical Review by: M.P. 09/22/20
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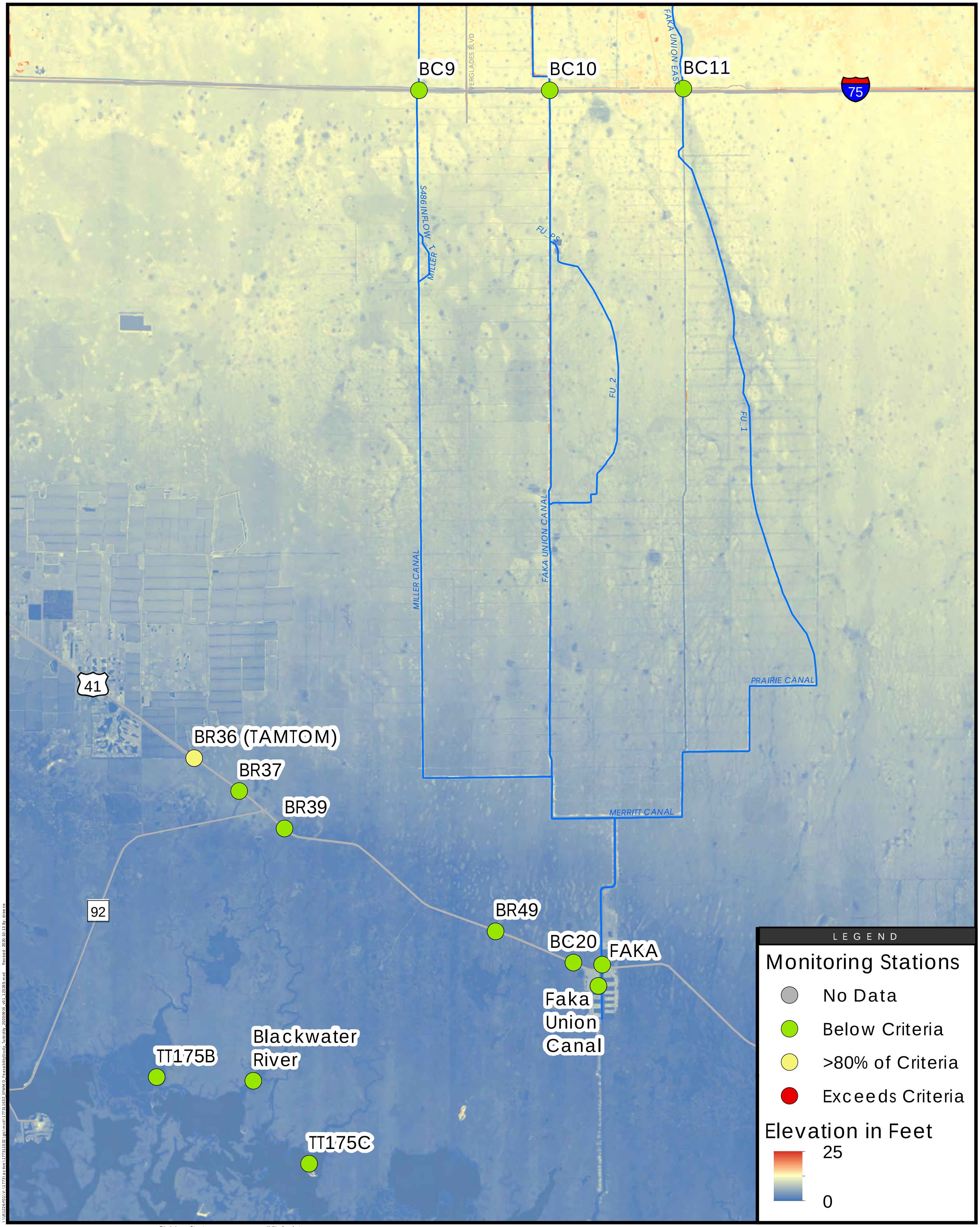

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3. Imagery: ESRI, Collier County

PICAYUNE WATERSHED WATER QUALITY STUDY

MONITORING STATIONS - TURBIDITY

October 2020

0 5,000 10,000 Feet

N

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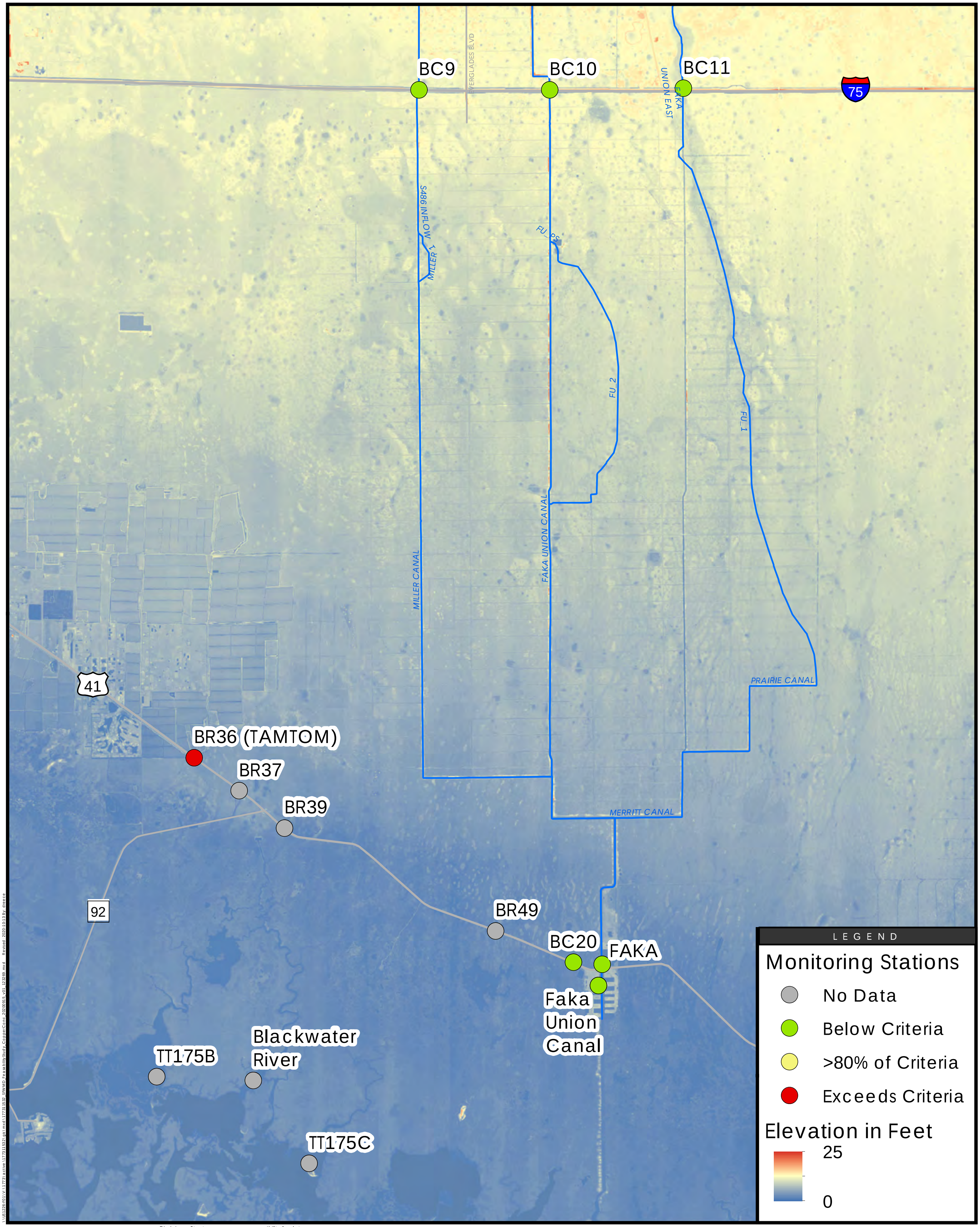

Notes:
1. Coordinate System: NAD 1983 StatePlane Florida East FIPS 0901 Feet
2. Source data: Collier County, SFWMD, Stantec
3. Imagery: ESRI, Collier County

PICAYUNE WATERSHED WATER QUALITY STUDY

MONITORING STATIONS - COPPER CONCENTRATION

October 2020

0 5,000 10,000 Feet

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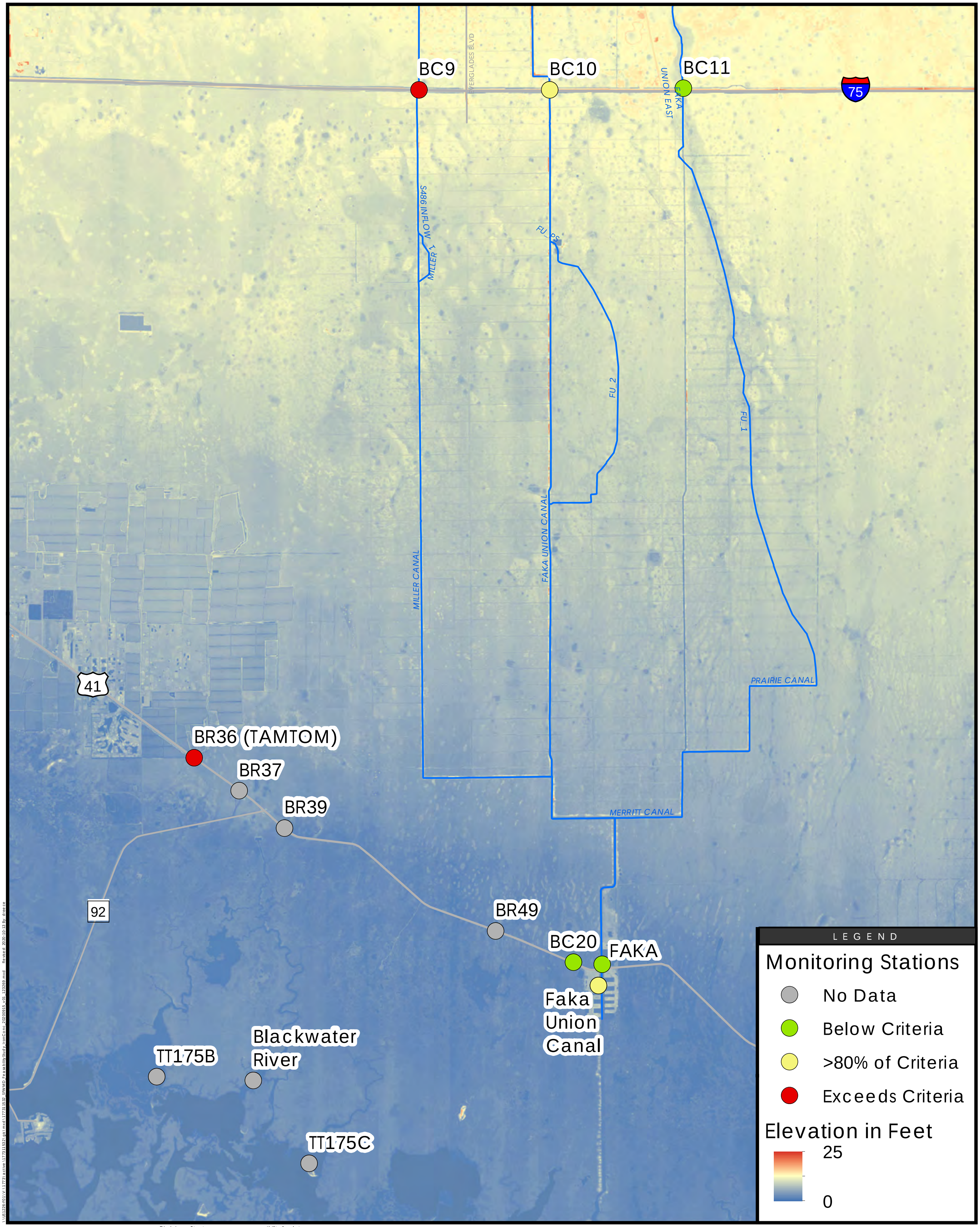

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Notes:
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2. Source data: Collier County, SFWMD, Stantec
3. Imagery: ESRI, Collier County

PICAYUNE WATERSHED WATER QUALITY STUDY

MONITORING STATIONS - IRON CONCENTRATION

October 2020

0 5,000 10,000 Feet

N

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Prepared by: D.A.R. 10/13/20
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Independent Review by: B.P. 09/22/20

Table B-1: Surface Water Quality Monitoring Data Summary

	Coordinates		Total Phosphorus (TP) [mg/L]										
Monitoring Stations	Latitude	Longitude	n	Mean Conc**	Standard Deviation	Geometric Mean Conc	Median	Min	Max	Date Range	Data Reference	Criteria Concentration	Criteria Reference
BR36/TAMTOM/TAMBR36	26.0057	-81.6092	88	0.362	0.306	0.303	0.276	0.106	2.428	Nov 2009-Aug 2019	1	0.12	A
BR37/TAMBR37	25.9985	-81.5982	37	0.314	0.197	0.274	0.251	0.088	1.007	Aug 2015-Oct 2019	1	0.12	A
BR39/TAMBR39	25.9903	-81.5871	8	0.162	0.063	0.147	0.191	0.056	0.214	Apr 1995-Aug 1995	2	0.12	A
BC20	25.9610	-81.5166	57	0.058	0.085	0.044	0.046	0.004	0.668	Sep 2009-Aug 2015	2	0.12	A
BR49/TAMBR49	25.9679	-81.5356	23	0.013	0.006	0.012	0.013	0.006	0.028	Sep 2016-Sep 2019	1	0.12	A
TT175C	25.9165	-81.5807	70	0.064	0.027	0.050	0.066	0.002	0.145	Feb 2016-Jul 2020	3	0.05	B
FAKA	25.9605	-81.5095	170	0.013	0.007	0.012	0.011	0.004	0.049	Oct 2001-Oct 2019	1	0.12	A
Faka Union Canal*	25.9559	-81.5105	163	0.027	0.019	0.022	0.023	0.004	0.109	Jan 2006-Feb 2020	2	0.12	A
Blackwater River	25.9347	-81.5945	24	0.072	0.025	0.068	0.067	0.040	0.134	Jan 2015-Jan 2020	2	0.05	B
TT175B	25.9354	-81.6179	70	0.057	0.022	0.046	0.059	0.002	0.112	Feb 2010-Jul 2020	3	0.05	A
BC9	26.1530	-81.5551	150	0.011	0.005	0.010	0.010	0.004	0.036	Oct 2001-Oct 2019	1	0.12	A
BC10	26.1531	-81.5232	151	0.022	0.015	0.018	0.018	0.004	0.084	Nov 2001- Sep 2015	1	0.12	A
BC11	26.1535	-81.4906	130	0.021	0.011	0.019	0.020	0.006	0.072	Nov 2001-Aug 2015	1	0.12	A

	Coordinates		Total Nitrogen (TN) [mg/L]										
Monitoring Stations	Latitude	Longitude	n	Mean Conc**	Standard Deviation	Geometric Mean Conc	Median	Min	Max	Date Range	Data Reference	Criteria Concentration	Criteria Reference
BR36/TAMTOM/TAMBR36	26.0057	-81.6092	84	1.71	0.67	1.61	1.59	0.66	5.42	Nov 2009- Aug 2019	1	1.54	A
BR37/TAMBR37	25.9985	-81.5982	37	1.34	0.61	1.23	1.21	0.61	3.79	Aug 2015-Oct 2019	1	1.54	A
BR39/TAMBR39	25.9903	-81.5871	-	-	-	-	-	-	-	-	-	-	-
BC20	25.9610	-81.5166	71	1.34	0.66	1.23	1.35	0.33	5.34	Oct 2009-Sep 2015	2	1.54	A
BR49/TAMBR49	25.9679	-81.5356	27	1.03	0.19	1.01	1.08	0.61	1.34	Sep 2015- Sep 2019	1	1.54	A
TT175C	25.9165	-81.5807	29	0.60	0.18	0.57	0.59	0.32	1.06	Jul 2014-Jul 2020	3	0.41	B
FAKA	25.9605	-81.5095	181	0.50	0.20	0.47	0.46	0.04	1.65	Oct 2001-Oct 2019	1	1.54	A
Faka Union Canal*	25.9559	-81.5105	165	0.60	0.21	0.56	0.56	0.03	2.03	Jan 2006-Feb 2020	2	1.54	A
Blackwater River	25.9347	-81.5945	24	0.60	0.19	0.57	0.57	0.31	1.03	Jan 2015-Jan 2020	2	0.41	B
TT175B	25.9354	-81.6179	30	0.54	0.17	0.48	0.53	0.02	0.81	Jul 2014-Jul 2020	3	0.41	A
BC9	26.1530	-81.5551	151	0.57	0.21	0.52	0.53	0.04	1.76	Oct 2001-Sep 2015	1	1.54	A
BC10	26.1531	-81.5232	155	0.52	0.02	0.47	0.47	0.04	1.61	Oct 2001-Sep 2015	1	1.54	A
BC11	26.1535	-81.4906	134	0.61	0.28	0.55	0.54	0.04	1.75	Oct 2001-Aug 2015	1	1.54	A

	Coordinates		Turbidity [NTU]										
Monitoring Stations	Latitude	Longitude	n	Mean Conc**	Standard Deviation	Geometric Mean Conc	Median	Min	Max	Date Range	Data Reference	Criteria Concentration	Criteria Reference
BR36/TAMTOM/TAMBR36	26.0057	-81.6092	37	24.31	15.34	19.68	24.00	4.30	65.00	Jul 2017-Feb 2020	1	29	C
BR37/TAMBR37	25.9985	-81.5982	-	-	-	-	-	-	-	-	-	-	-
BR39/TAMBR39	25.9903	-81.5871	9	1.23	0.30	1.21	1.20	1.00	2.00	Dec 1994-Aug 1995	2	29	C
BC20	25.9610	-81.5166	66	2.36	2.16	1.73	1.60	0.50	11.00	Oct 2009-Aug 2015	2	29	C
BR49/TAMBR49	25.9679	-81.5356	-	-	-	-	-	-	-	-	-	-	-
TT175C	25.9165	-81.5807	70	9.82	5.50	6.58	10.00	0.10	28.90	Feb 2010-Jul 2020	3	29	C
FAKA	25.9605	-81.5095	86	1.84	1.42	1.46	1.40	0.50	8.40	Oct 2009-Jun 2018	1	29	C
Faka Union Canal*	25.9559	-81.5105	23	3.22	1.13	3.04	3.20	1.20	6.20	Jan 2015-Jan 2020	2	29	C
Blackwater River	25.9347	-81.5945	24	7.89	3.11	7.42	7.15	3.30	18.10	Jan 2015-Jan 2020	2	29	C
TT175B	25.9354	-81.6179	70	8.93	4.42	6.45	8.25	0.10	23.10	Feb 2010-Jul 2020	3	29	C
BC9	26.1530	-81.5551	101	2.39	1.65	1.99	2.10	0.50	13.00	Oct 2009-Jun 2018	1	29	C
BC10	26.1531	-81.5232	203	2.00	1.44	1.57	1.70	0.10	9.50	Dec 2009-Feb 2020	1	29	C
BC11	26.1535	-81.4906	53	1.06	0.54	0.95	0.80	0.50	2.90	Nov 2009-May 2016	1	29	C

	Coordinates		Copper [µg/L]											
Monitoring Stations	Latitude	Longitude	n	Mean Conc**	Standard Deviation	Geometric Mean Conc	Median	Min	Max	Date Range	Data Reference	Average Hardness (mg/L)	Criteria Concentration***	Criteria Reference
BR36/TAMTOM/TAMBR36	26.0057	-81.6092	11	33.45	37.93	23.21	19.80	7.28	142.00	Jul 2017-Dec 2019	2	521	30	C
BR37/TAMBR37	25.9985	-81.5982	-	-	-	-	-	-	-	-	-	-	-	-
BR39/TAMBR39	25.9903	-81.5871	-	-	-	-	-	-	-	-	-	-	-	-
BC20	25.9610	-81.5166	16	1.13	0.96	0.82	0.75	0.15	3.35	Jul 2010-Apr 2015	2	1242	30	C
BR49/TAMBR49	25.9679	-81.5356	-	-	-	-	-	-	-	-	-	-	-	-
TT175C	25.9165	-81.5807	-	-	-	-	-	-	-	-	-	-	-	-
FAKA	25.9605	-81.5095	29	0.67	0.62	0.43	0.75	0.10	2.62	Oct 2009-Jul 2017	2	538	30	C
Faka Union Canal*	25.9559	-81.5105	12	2.57	2.40	2.01	2.05	0.88	9.74	Jan 2006-Sep 2009	2	1893	30	C
Blackwater River	25.9347	-81.5945	-	-	-	-	-	-	-	-	-	-	-	-
TT175B	25.9354	-81.6179	-	-	-	-	-	-	-	-	-	-	-	-
BC9	26.1530	-81.5551	25	0.75	0.84	0.44	0.75	0.10	3.91	Oct 2009-Jul 2017	2	290	23	C
BC10	26.1531	-81.5232	61	0.59	0.50	0.41	0.75	0.10	2.50	Oct 2009-Dec 2019	2	259	21	C
BC11	26.1535	-81.4906	18	1.12	1.94	0.58	0.75	0.10	8.61	Oct 2009-May 2016	2	253	21	C

	Coordinates		Iron [µg/L]										
Monitoring Stations	Latitude	Longitude	n	Mean Conc**	Standard Deviation	Geometric Mean Conc	Median	Min	Max	Date Range	Data Reference	Criteria Concentration	Criteria Reference
BR36/TAMTOM/TAMBR36	26.0057	-81.6092	11	1105.6	555.6	1003.6	905.0	529.0	2230.0	Jul 2017-Dec 2019	2	300	C
BR37/TAMBR37	25.9985	-81.5982	-	-	-	-	-	-	-	-	-	-	-
BR39/TAMBR39	25.9903	-81.5871	-	-	-	-	-	-	-	-	-	-	-
BC20	25.9610	-81.5166	23	186.9	138.3	143.3	141.0	35.6	547.0	Jan 2010-Jul 2015	2	300	C
BR49/TAMBR49	25.9679	-81.5356	-	-	-	-	-	-	-	-	-	-	-
TT175C	25.9165	-81.5807	-	-	-	-	-	-	-	-	-	-	-
FAKA	25.9605	-81.5095	35	112.3	88.8	80.9	85.7	11.8	341.0	Jan 2010-Jul 2017	2	300	C
Faka Union Canal*	25.9559	-81.5105	6	246.7	359.3	146.3	100.0	100.0	980.0	Oct 2006-Jul 2009	2	300	C
Blackwater River	25.9347	-81.5945	-	-	-	-	-	-	-	-	-	-	-
TT175B	25.9354	-81.6179	-	-	-	-	-	-	-	-	-	-	-
BC9	26.1530	-81.5551	36	350.7	235.0	252.4	323.0	27.4	820.0	Oct 2009-Jul 2017	2	300	C
BC10	26.1531	-81.5232	79	264.6	218.7	187.6	194.0	19.5	873.0	Oct 2009-Dec 2019	2	300	C
BC11	26.1535	-81.4906	20	189.6	90.9	168.9	176.0	38.3	431.0	Oct 2009-Jun 2016	2	300	C

Note: Red text signifies average concentrations exceed standard criteria thresholds for the given station, yellow signifies concentrations are within 80% of the standard nutrient criteria, and green signifies average concentrations are well below criteria. Cells populated with a hyphen symbolize no available data.

*Faka Union Canal station data were sourced from FDEP Run 59. Station coordinates were identical to those at FAKAUPOI, despite having containing slightly different data. As such, Faka Union Canal data were chosen to represent water quality conditions recorded from this location.

**Mean concentration is represented on the monitoring stations map.

***Copper criteria concentrations were calculated based on average hardness measured from each station. In compliance with standard methods, hardness concentrations greater than 400 mg/L were considered at 400 mg/L for the purpose of calculating copper criteria in µg/L.

1. Summary data sourced from the SFWMD PSRP Water Quality Projections With "Southwestern Protective Levee" Feature Report.

2. Raw data sourced from FDEP WBID Run 59.

3. Raw data sourced from SFWMD DBHYDRO.

A. Standard criteria based on Peninsular Standard Concentrations [FAC 60-302.531(c)(2)].

B. Standard criteria based on the Estuary-Specific Numeric Interpretations of the Narrative Nutrient Criterion table Blackwater River ENRE8 [FAC 60-302.532(1)(e)(6)].

C. Standard criteria based on the Surface Water Quality Criteria table [FAC 60-302.530(23)/(38)/(70)].

Appendix C DOCUMENT REVIEW LIST

Presentations:

Dr. Mark Clark's presentation
https://mediasite.video.ufl.edu/Mediasite/Play/b4c9df69735147edba7a186665919d3a1d

Reports:

Existing Picayune Strand Restoration Project (PSRP) design information

Existing PSRP water quality testing reports

Basin-specific feasibility studies/water quality improvement strategies

Existing MSSW / ERP near project sites

Review CERP project for applicable strategies

Parsons Stormwater Plan for Belle Meade, done well over a decade ago for Rookery Bay (Bradley Cornell may have a copy)

Described potential water re-distribution, passive/active water quality improvement projects from local stakeholders/working group – specific areas:

Collier-Seminole State Park

Rookery Bay Estuarine Research Reserve

1. Parsons. September 2006. Belle Meade Area Stormwater Management Master Plan. South Florida Water Management District
2. Rookery also did modeling of the Rookery Bay watershed as part of this examination of other plans.

Cape Romano – Ten Thousand Islands Aquatic Preserve

SFWMD Science and Data (review for opportunities / applicable project types):

1. https://www.sfwmd.gov/science-data/scientific-publications-sfer
2. https://issuu.com/southfloridawatermanagement/docs/2019_sfer_highlights_hr/2?ff
3. Big Cypress Basin
4. Estuaries
5. Restoration Strategies Science Plan – Related Documents
6. Saltwater Interface Maps by County
7. Stormwater Treatment Areas and Flow Equalization Basins
8. Water Supply – Hydrogeological Reports
9. Florida Waters Resources Manual [PDF]
10. Long-Term Plan for Achieving Water Quality Goals
11. Restoration Strategies Science Plan
12. SFWMD Formation Identification Guide [ZIP, 2.8 GB]
13. South Florida Water Management Model (SFWMM) Position Analysis – Initial Stage Values – Current Month [PDF]
14. Water Conservation
15. Water Supply Plans
16. Water Supply Reports

Data Collection Resources

Repository of pertinent studies available to use as resources for the C-43 WBSR Water Quality Feasibility Study - to access the repository, click the links below:

1. General Documents
2. Treatment Technologies Documents
3. Wetland Treatment Technology Documents
4. Basin Water Quality Study Documents
5. Blue-Green Algae Documents

Maps of proposed affected areas and locations of potential project locations

FY19 Collier County Surface Water Report

2015 Collier County Surface Water Trend Report and Appendices

Collier County Ground Water 2019 Trend Report

Florida International University's 2014 Sediment Report-Technical Report

Additional reports available at:

https://www.colliercountyfl.gov/your-government/divisions-f-r/pollution-control/water-quality-monitoring/pollution-control-water-resources-monitoring/pollution-control-water-quality-

Collier County Watershed Management Plan

https://www.colliercountyfl.gov/your-government/divisions-s-z/zoning-division/stormwater-and-environmental-planning/watershed-management-planning/wmp-development-archived-information

Collier County Comprehensive Watershed Improvement Plan (CWIP)—aka Belle Meade Flow-Way Restoration

https://www.colliercountyfl.gov/your-government/divisions-a-e/capital-project-planning-impact-fees-and-program-management/coastal-zone-management-section/collier-county-comprehensive-watershed-improvement-plan-8061

This project was also presented to the Big Cypress Basin Board at their Feb. 21, 2020 meeting which is available here:
https://www.sfwmd.gov/news-events/meetings

The PowerPoint presentation is here:
https://apps.sfwmd.gov/webapps/publicMeetings/viewFile/25422

Available Databases:

FDEPs STORET or WIN databases

FDEP's Impaired Waters Rule database and assessment tool (Run59 is the most recent)

DEP Water Quality Treatment Technologies Database

Online resources:

https://www.arcgis.com/home/webmap/viewer.html?webmap=62538b4691d64ff594e56f63791b98fd&extent=-81.9537,26.0644,-81.5794,26.3481

https://rookerybay.org/

http://cdmo.baruch.sc.edu/get/landing.cfm

Link to DEP's mapdirect web resource:

https://ca.dep.state.fl.us/mapdirect/?map=75bb9405d73748d38f40f64f652bad59

preloaded GIS layers in the link above:

1. The IWR stations layer will be helpful for IDing where the stations are located and their station IDs/names so you can more easily pull the correct data out of either the WIN or IWR database
2. I also loaded the "waters not attaining standards" layer which indicates which waterbodies (WBIDs) are impaired and for what parameters (TN, TP, etc)
3. The CERP project boundary layer is also pre-loaded on the map

C-43 reservoir WQ feasibility study website:

https://www.sfwmd.gov/content/c43waterqualitystudy

Some of the studies are specific to the C-43 basin, but others are not. Also, the mesocosm and other associated studies for the BOMA water quality treatment and testing facility has applicability beyond the Caloosahatchee watershed:

Links to FDACS reports and information:

As part of the development of water supply plans, FDACS provides information on agricultural water use demand pursuant to sections 570.93 and 373.709, Florida Statutes. To provide the required information, FDACS utilizes the Florida Statewide Agricultural Irrigation Demand (FSAID) to identify agricultural land uses and the associated irrigation demands. FSAID is updated annually.

Information on FSAID and the annual reports are available at: https://www.fdacs.gov/Agriculture-Industry/Water/Agricultural-Water-Supply-Planning.

The 2020 FSAID report will be available at the end of August. FDACS implements a BMP program. FDACS tracks enrollment in the FDACS BMP program and the status of implementation verification site visits of those parcels enrolled in the FDACS BMP program and provides annual status reports to the Legislature and Governor that are available at: https://www.fdacs.gov/Divisions-Offices/Agricultural-Water-Policy

A statewide BMP enrollment map is available at: https://www.fdacs.gov/ezs3download/download/78962/2320452/Media/Files/Agricultural-Water-Policy-Files/Maps/Statewide-Enrollment-Map/BMP-Enrollment-Statewide-%28online-map%29.pdf.

https://rookerybay.org/wp-content/uploads/5-RookeryBayWatershedProjects.pdf
This compiles a set of watershed restoration projects in the vicinity or including areas the WQ Feasibility Study is looking for projects. They are drawn from the Parsons 2006 Belle Meade Stormwater Master Plan, Collier County Watershed Plan (2011), the Southwest Florida Watershed Master Plan (SFWMD/ACOE - former SW Fla Feasibility Study), and other sources.

Appendix D DOCUMENT REVIEW SUMMARY TABLE

Organization/Title	Link	Comments	Existing Conditions	General Description of Technology/Treatment Type	Nutrient Reduction per Unit	Nutrient Removal Efficiency	Unit Costs	O&M Requirements	Regulatory Constraints	Implementation Schedule	General Land Area Requirements	Ancillary Benefits (e.g. provides wildlife habitat)	Potentially viable for this effort? Why or why not?	Supplementary Document
Presentations:														
Dr. Mark Clark's presentation	https://mediasite.video.ufl.edu/Mediasite/Play/b4c9df69735147edba7a186665919d3a1d	Video presentation	Irrigation drainage tile for ag	Adding a structure at the drainage pipe end can improve water quality - water control structure, controls flow from pipes. Water table is held constant by outfall pipe structures. Greatly reduces excess irrigation. Increased storage capacity in field reduces runoff. Soil below surface, closer to drainage tile, still had P holding capacity - unless that becomes saturated too some day. Board height management is critical.	P concentration reduced by 24.5% and P load runoff reduced by 43.5%. N concentration reduced by 2.5% and load reduced by 31% on average. Holding water table back creates anaerobic conditions to convert NO3 to N2. Can get near complete denitrification. Board height 24-26".	Reduced runoff by an average 39.6% across four different farms; irrigation requirement reduced by 30.1%	Enhanced BMPs - need cost share funding and will need help of researchers to get operating properly.	Farmer needs to manage control structure board heights	None known, a BMP	Implemented between crop seasons, will take up to 2-3 years for farmer to get fully operationally accustomed to operation.	No, placed under crop land.	Reduces water use for irrigation	Not eligible for government funding that will be requested, funding could not be used on private land.	NA
Online Resources:														
Map of water quality conditions	https://www.arcgis.com/home/webmap/viewer.html?webmap=62538b4691d64ff594e56f63791b98fd&extent=-81.9537,26.0644,-81.5794,26.3481	Useful for viewing stations monitored by Collier County.	More detailed information and relevant findings can be found in the CC FY 2019 report. In summary, monitoring stations located south of the PSRP and South Belle Mead areas show low to moderate concentrations of nutrients and measurements of turbidity. The TAMTOM station appears to contain high levels of nutrients and turbidity relative to other monitoring stations and the peninsular standard thresholds used for comparison. See Appendix B.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
Florida Department of Environmental Protection:														
Link to DEP's map direct web resource, preloaded layers at this link:	https://ca.dep.state.fl.us/mapdirect/?map=75bb9405d73748d38f40f64f652bad59	Indicates there are a variety of water quality stations located throughout the project area that are not included in the CC FY19 report.	Identified 36 monitoring stations applicable to the project area. Used the WIN and IWR databases to download and analyze all available water quality data for these stations.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A) The IWR stations layer will be helpful for IDing where the stations are located and their station IDs/names to more easily pull the correct data out of either the WIN or IWR database	See above	Compiled station info in the summary spreadsheet and notes document located in the project folder.	Station information was gathered.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
B) "Waters not attaining standards" layer which indicates which waterbodies (WBIDs) are impaired and for what parameters (TN, TP, etc)	See above	Useful for a preliminary review.	A variety of stations located north and south of the PSRP area are impaired with only a few indicating nutrient impairment. Further analysis is required to better understand the extent of nutrient pollution.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C) The CERP project boundary layer	See above	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FDEPs STORET or WIN databases	https://floridadep.gov/dear/watershed-services-program/content/winstoret	Raw data was downloaded and analyzed by Stantec staff to derive nutrient concentrations recorded at relevant station.	Stations experiencing Moderately to Very High TN and TP concentrations in the last 10 years included BR36, BR37, BC20, and WHITNEY RIVER. Although other stations appeared to contain varying degrees of high nutrient concentrations, available data were collected over 10 years ago and were therefore considered irrelevant to current site conditions. In 2019, the BR36 station presented an average TN concentration of 1.67 mg/L and an average TP concentration of 0.41 mg/L. BR37, located approximately 4,200 linear feet downstream of BR36, had an average yearly TN concentration of 1.04 mg/L and a TP concentration of 0.33 mg/L in 2016. Other moderate concentrations appeared at select locations near the southern border of the PSRP area; however, monitoring stations located within the PSRP canals presented nutrient concentrations below established thresholds. In addition to the aforementioned locations, the WHITNEY RIVER station data indicated consistently Very High TN and TP concentrations. This station was located near Button Wood Bay in the 10,000 Islands Park south of the PSRP area. See Appendix B.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
Collier County:														
Ag pumping on US 41E 6-8-20 photos	Project folder	Shows water being pumped from farm discharge pipes.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Collier County US 41 WQ sites	Project folder	Provides a graphical summary of CC WQ data recorded at the FAKA and TAMTOM stations. This data is also available in each FY report.	Document containing average TP and TN concentrations recorded from the EAGLECRK, BC22, SANDPIPE, and BR36 stations from 2016 to 2020. BR36 and FAKA stations are relevant to the water quality study because water passing through these locations will likely be influenced by or impact watershed pollution due to the PSRP project.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A) FY19 Collier County Surface Water Report	FY19 Collier County Surface Water Report	Review conducted in documents below.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
B) Surface Water Quality Assessment and Trend Report for Collier County Engineering and Natural Resources	2015 Collier County Surface Water Trend Report	Review conducted in documents below.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
C) Collier County Ground Water 2019 Trend Report	Collier County Ground Water 2019 Trend Report	Review conducted in documents below.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
D) Florida International University's 2014 Sediment Report-Technical Report	Florida International University's 2014 Sediment Report-Technical Report	Review conducted in documents below.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
Impaired waters rule FDEP and Store, see run 59	http://publicfiles.dep.state.fl.us/DEAR/IWR/	Not useful in identifying areas of high nutrient concentrations but provides descriptions of state laws related to water quality.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Monitor sites map	https://www.arcgis.com/home/webmap/viewer.html?webmap=62538b4691d64ff594e56f63791b98fd&extent=-81.9537,26.0644,-81.5794,26.3481	Review conducted in documents below.	2019 TP data included in CC WQ report.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Organization/Title	Link	Comments	Existing Conditions	General Description of Technology/Treatment Type	Nutrient Reduction per Unit	Nutrient Removal Efficiency	Unit Costs	O&M Requirements	Regulatory Constraints	Implementation Schedule	General Land Area Requirements	Ancillary Benefits (e.g. provides wildlife habitat)	Potentially viable for this effort? Why or why not?	Supplementary Document
County watershed management plan	https://www.colliercountyfl.gov/your-government/divisions-s-z/zoning-division/stormwater-and-environmental-planning/watershed-management-planning/wmp-development-archived-information	Probably not viable. These projects were recommended in 2011 and they may already be constructed. There do not appear to be any hard numbers for nutrient reduction or removal available in this report - only existing conditions. One project is an STA located north of US 41 northwest of the project site, unknown if this was built.	Volume 1 document provides existing conditions of all Collier County watersheds and estuaries. Volume 4 contains detailed technical analysis, for example "Total Phosphorus Pollution Loads by WBID and Watershed"	Volume 2 documents the wide variety of structural BMPs considered across the County, including 24 projects for Rookery Bay, 6 of which were identified for further detailed evaluation (Table 2-1).	The report evaluates the BMPs based on "watershed score" instead of using actual scientific units (lbs, tons, acres, gallons, etc.). See Vol. 2	Cost estimates are included for the projects evaluated in detail (including 6 for Rookery Bay). See Vol. 2	NA	NA	NA	NA	NA	NA	Probably not viable. These projects were recommended in 2011 and they may already be constructed. There do not appear to be any hard numbers for nutrient reduction or removal available in this report - only existing conditions. One project is an STA located north of US 41 northwest of the project site, unknown if this was built.	NA
County Watershed improvement plan	https://www.colliercountyfl.gov/home/showdocument?id=78252	2016 plan for flow diversion from Naples Bay to Rookery Bay thru Belle Meade. The maps in the presentation (two documents below) make clear that the discharge point of this project thru Belle Meade is actually northwest of the Tamiami Trail culverts that are the focus of this study.	This is a separate project that includes many different technologies to implement a large scale diversion of water flows. The individual technologies apply to the PSRP as types of projects that may be used, but the project as a whole is specific to a region west of the PSRP site.	Freshwater flow diversion from Golden Gate Canal through the Belle Meade area using Linear Pond and Spreader Swale. Includes pump stations flow ways, culverts, spreaders, cut openings in railroad berm.	Detailed nutrient reduction calculations are included for Naples Bay improvements (due to freshwater diversion), but not specifically for discharge into Rookery Bay	NA	$32M. Detailed cost estimate is included	Many O&M requirements for many different technologies across a wide region of Collier County	Extensive permitting required	Design 2020-2023, and Construction 2023-2026	Projects spread across western Collier County	Possibly some habitat value in ponds created.	Technologies used in the project are potentially viable for this project.	NA
CWIP Presentation	https://www.sfwmd.gov/news-events/meetings	Link is to a webpage with links to all SFWMD meeting documents.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CWIP Presentation	https://apps.sfwmd.gov/webapps/publicMeetings/viewFile/25422	Same plan as "County Watershed Improvement Plan" above. The maps in this presentation make clear that the discharge point of this project thru Belle Meade is actually northwest of the Tamiami Trail culverts that are the focus of this study	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Technologies used in the project are potentially viable for this project.	NA
FY19 Collier County Surface Water Report	FY19 Collier County Surface Water Report	Good source of information for FY2019. Supports a BMP location south of BR36.	Sandpipe and BC22 are both located within the Rookery Bay (East Segment) area. Both sites had no exceedances of TN, TP, or Turbidity compared to state thresholds. Nutrient loads exceeding state thresholds are likely being discharged from sources near of the BR36 station (TN: 2.25mg/L, TP: 0.452mg/L, and Turb: 35NTU). Stations located on canals near I-75 did not have significant exceedances indicating TN, turbidity, and TP are mostly within allowable ranges moving into the PSRP. The station located south of PSRP near I-41 did not have significant exceedances of TN, TP, or turbidity, indicating water currently leaving PSRP is within allowable limits of the parameters of interest (POI).	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
Older reports available at:	https://www.colliercountyfl.gov/your-government/divisions-f-r/pollution-control/water-quality-monitoring/pollution-control-water-resources-monitoring/pollution-control-water-quality-	Older surface water reports not discussed below could not be located. The link only had one report detailing high nutrient concentrations. All other reports were either groundwater related or focused on trends.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015 Collier County Surface Water Trend Report and Appendices	https://www.colliercountyfl.gov/home/showdocument?id=62700	Not useful in identifying areas of high nutrient concentrations.	Presents FAKA station loading and whether nutrient pollution was increasing or decreasing at each monitoring station. The CC FY19 is more useful in identifying current stations with high nutrient concentrations.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
Collier County Ground Water 2019 Trend R	Collier County Ground Water 2019 Trend Report	Not useful in identifying areas of high nutrient concentrations.	Report analyzed aquifer water quality trends throughout Collier County. Wells located near areas of interest were used to assess the Lower Tamiami and Mid-Hawthorn aquifers. Significant TN and TP water quality trends were not identified within either aquifer during the 10-year study from 2006-2016.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
Florida International University's 2014 Sediment Report	Florida International University's 2014 Sediment Report-Technical Report	Nutrient concentrations are measured per kg of suspended sediment and can therefore not easily be compared to Collier County data. Trends contrast with Collier County reports of areas of high nutrient concentrations. Numerical data collected from each station is required to confirm nutrient concentrations.	Water quality parameters related to sediment pollution were analyzed from collected samples in June 2014. CC028 is located south of the PSRP area, CC032 is located on the boundary between PSRP and the Collier Seminole State Park, and CC031 is located north of PSRP. Concentration data was presented graphically without tabular data for either TN or TP. As such, the presented data is only somewhat useful in locating areas of high nutrient concentrations within the areas of interest. At CC028, the 2014 TN concentration was around 1800 mg/kg and TP concentration was around 260 mg/kg. At CC032, the TN concentration was around 1000 mg/kg and TP concentration was around 280 mg/kg. At CC031, TN concentration was recorded at approximately 1,500 mg/kg and TP was recorded at around 1550 mg/kg. This data suggests moderately high concentrations of TN and high concentrations of TP are entering the PSRP area. Waters leaving the PSRP area contain lower levels of TP but higher levels of TN. Pollutant concentrations recorded near station CC032 are moderately high.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
Florida Department of Agriculture and Consumer Services:														
2019 Florida Statewide Agricultural Irrigation Demand Report	Information on FSAID and the annual reports are available at: https://www.fdacs.gov/Agriculture-Industry/Water/Agricultural-Water-Supply-Planning.	As part of the development of water supply plans, FDACS provides information on agricultural water use demand pursuant to sections 570.93 and 373.709, Florida Statutes. To provide the required information, FDACS utilizes the Florida Statewide Agricultural	Does not list projects; ag projections do not show any increased acreages in the vicinity of the project area; some ag lands to the west projected to be removed from ag by 2045; some ag areas have already been sold for development. Note - ag land adjacent to NW corner of CSSP is owned by FCC Preserve LLC.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015 Water Quality/Quantity Best Management Practices for Florida Vegetable and Agronomic Crops	https://www.fdacs.gov/content/download/77230/file/vegAgCropBMP-loRes.pdf	FDACS implements a BMP program. FDACS tracks enrollment in the FDACS BMP program and the status of implementation verification site visits of those parcels enrolled in the FDACS BMP program and provides annual status reports to the Legislature and Governor	Link to row crop BMP manual. Farmer is enrolled in BMP program but which BMPs are being implemented are unknown. Site is already farmed under a stormwater permit with maintenance requirements.	Many different BMPs are available but will not be discussed further here because BMPs chosen for the project will not be placed on privately owned lands.	Varies	Varies	Varies	Varies	Possible permit mod required if permitted features are altered, most BMPs would not require permits	Immediately up to a year or two depending on the BMP	Would be implemented on existing ag land	Unknown	No - Funding sources being sought will prohibit use of funds for projects on private lands.	NA
BMP enrollment map	https://www.fdacs.gov/ezs3download/download/78962/2320452/Media/Files/Agricultural-Water-Policy-Files/Maps/Statewide-Enrollment-Map/BMP-Enrollment-Statewide-%28online-map%29.pdf.	NA	Adjacent farm is enrolled in the program	Farmer pledges to implement water and nutrient BMPs practices, keep records of soil and fertilizer management	Varies	Varies	Varies	Varies	Gives state presumption of water quality compliance, subject to audit by FDACS	Varies	Varies	Unknown	No - Funding sources being sought will prohibit use of funds for projects on private lands.	
Collier Seminole State Park:														
2020 PRSP SWPF Project Area Estuarine Effects CSSP	Project folder	PowerPoint with 5 slides; shows flow direction, culvert locations	Slide 3 map shows existing culvert locations and proposed/possible culverts	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rookery Bay:														

Organization/Title	Link	Comments	Existing Conditions	General Description of Technology/Treatment Type	Nutrient Reduction per Unit	Nutrient Removal Efficiency	Unit Costs	O&M Requirements	Regulatory Constraints	Implementation Schedule	General Land Area Requirements	Ancillary Benefits (e.g. provides wildlife habitat)	Potentially viable for this effort? Why or why not?	Supplementary Document
Rookery Bay Website	https://rookerybay.org/	Requested data for monitoring stations located south of PSRP and south Belle Mead.	All three monitoring locations had turbidity concentrations within state thresholds (<29 NTU above background measurements). All three stations had average yearly measurements between 10 and 24 NTU apart from abnormally high turbidity values in 2014 and 2019. Analyzed data was collected between 2000 and 2020 with two of the three monitoring locations beginning in 2002. Monthly turbidity data indicated frequent spikes in turbidity during fall and winter months across all three stations. High turbidity values likely correspond with storm events.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
Rookery Bay Compilation of Projects	https://rookerybay.org/wp-content/uploads/5-RookeryBayWatershedProjects.pdf	NA	NA	Restoration of natural flow ways	Unknown	Unknown	Unknown	Varies	Would probably require ERP permitting for filling of canals	1+ years	Fill in canals	Rehydrates area to restore wetlands which would probably provide wildlife habitat.	Possible if the PSRP site has canals that need filling.	NA
A) Chapter 2.1 North Belle Meade Sto	NA	NA	NA	Storage reservoir	Unknown	Unknown	Unknown	Varies	Reservoirs require extensive design and permitting	2+ years	Typically 1000+ acres, would need to determine what is available in this region	Aquatic wildlife and bird foraging habitat	Not likely, water storage reservoirs are primarily for water supply rather than nutrient treatment.	NA
B) Chapter 2.2 North Belle Meade Re	NA	NA	NA	Wetland restoration - alterations to accept flows coming out of a reservoir	Unknown	Unknown	Unknown	Varies	Would need an ERP, wetland restoration ERPs are somewhat easier to obtain but modeling will be required to 'get the water right'.	1-2+ years to design, permit and construct	Unknown	Rehydrates area to restore wetlands which would probably provide wildlife habitat.	Possibly if a site with previously impacted wetlands can be obtained.	NA
C) Chapter 2.3 Golden Gate Canal Diverter Structure	NA	NA	NA	Diverter structure	Unknown	Unknown	Unknown	Varies	Changing the current flow of water, would need an ERP for pump stations, etc., could be done as environmental restoration, somewhat restoring natural historic flows	1 + years	Would occur in existing canals	None expected	Flow may need to be diverted depending on where land for projects is available.	NA
D) Chapter 2.4 Henderson Creek Off-Line Storage Reservoir	NA	NA	NA	Off-line storage reservoir: captures wet season flows to be released in a more natural hydrologic regime	Unknown	Unknown	Unknown	Varies	Needs an ERP, wetlands in the area may complicate permitting	2-3+ years	Typically large tracts of land are required for reservoirs	Possible foraging for birds, fish and aquatic life habitat	Not likely, water storage reservoirs are primarily for water supply rather than nutrient treatment.	
E) Chapter 2.5 Sabal Palm Road Spreader System	NA	NA	NA	Spreader system: multiple culverts under the road so water crosses in many places instead of a concentrated point	Unknown	Unknown	Unknown	Varies	Permitting will most likely be required	2-3+ years	Varies	None expected unless spreading water promotes growth of wetland vegetation, which may result in wading bird habitat	Possible - should be considered.	
F) Chapter 2.6 Tamiami Trail & Manatee Road Stormwater Treatment	NA	NA	NA	Stormwater Treatment: diverts water to slow flow to a more natural hydrologic regime	Unknown	Unknown	Unknown	Varies	Permitting will most likely be required	2-3+ years	Varies	None expected	Yes - slowing water flow rates will result in sediment deposition and nutrients attached to sediment will be removed from the water as well.	
G) Chapters 3.3 and 3.4 Belle Meade Agricultural Flow-way South of US 41	NA	NA	NA	Agricultural flow-way: located in triangle area owned by farmer - Only possible if land can be purchased	Unknown	Unknown	Unknown	Varies	Most likely needs an ERP permit but there do not appear to be wetlands on this ag land triangle; need to fill in historic ag canals.	1+ years for design, permitting, construction	Limited by what's available, would need to determine what this triangle parcel can treat	May result in wading bird foraging habitat	Potential - if farmer is willing to sell the triangle parcel	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.
H) Chapter 3.5 Tomato Road Diversio	NA	NA	NA	Diversions: installation of a swale south of 41	Unknown	Unknown	Unknown	Unknown	Most likely needs an ERP permit but there do not appear to be wetlands on this ag land triangle; need to fill in historic ag canals.	1+ years for design, permitting, construction	Land needed to construct a swale along US 41 - water may need to be pumped, requiring land for a pump station as well.	None expected	Potential - may need to divert water to available land for projects.	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.

Organization/Title	Link	Comments	Existing Conditions	General Description of Technology/Treatment Type	Nutrient Reduction per Unit	Nutrient Removal Efficiency	Unit Costs	O&M Requirements	Regulatory Constraints	Implementation Schedule	General Land Area Requirements	Ancillary Benefits (e.g. provides wildlife habitat)	Potentially viable for this effort? Why or why not?	Supplementary Document
I) Chapter 6.2 Henderson Creek Development Best Management Practices Retrofit	NA	A general description of algal turf scrubbers can be found at en.wikipedia.org/wiki/Algal_turf_scrubber	NA	An algae scrubber filters water by moving water rapidly over a rough, highly illuminated surface, which causes algae to start growing in large amounts. As the algae grow, they consume nutrients such as nitrate, phosphate, nitrite, ammonia, ammonium and even metals such as copper from the water.	Unknown	Unknown	Unknown	Unknown	Unknown	1+ years for design, possible permitting, construction	Unknown	None expected	Not likely - this technology is generally used for small scale systems.	
J) Chapter 6.5 Fiddler's Creek Spread	NA	NA	NA	Spreader system: breaching a road or berm in multiple places to spread water flow to more closely mimic natural sheet flow	Unknown	Unknown	Unknown	Unknown	Probably needs an ERP	1+ years for design, possible permitting, construction	Varies	Potential creation or enhancement of wetlands if water is spread to mimic sheet flow	Yes - need to find the right area to implement the technology though	
K) Chapters 6.7 and 6.8 County Road 951 and 92 Cross Drain Culverts	NA	NA	NA	Cross drain culvert: additional culverts under S R 92 to improve flow, possibly plugging canal, would cause water to sheet flow and nutrient uptake would be greater than if water flows through canal only	Unknown	Unknown	Unknown	Unknown	Probably needs an ERP	1+ years for design, possible permitting, construction	Varies	Potential creation or enhancement of wetlands if water is spread to mimic sheet flow	Yes -a known technology, would need to determine impacts downstream.	
Fiddler's Creek Mitigation PowerPoint Slide	Project folder	Proposed preserve areas	Appears to be owned by a developer, FCC Preserve LLC, which also owns the area to the NW. Plans for this area are unknown but the west half of the SE site and all of the NW site are covered in wetlands, which would cause permitting issues for any projects.	Map shows potential preserve locations. No technology was stated, nothing to review.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
FCC Preserve LLC ERP	Project folder	Permits located that show construction to the north but none of the permits reviewed included the easternmost FCC Preserve LLC block in planned construction or mitigation.	Copy of permit placed in project folder (additional time extension permits were issued that are not in the folder) - this eastern area is included in the polygon for the development permit to the NW, but the permit plans do not include this area - preserve areas are all within the development to the north	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Paul Julian Calculation Email	Project folder	Calculation of land area needed for treatment for the PSRP. Well over 300 acres of treatment will be needed if removal capacity is similar to STA 5.	None	STA	Outflow of approx. 50 to 100 TPFWM (µg/L) with a inflow concentration of 334 µg/L at 1056 Ac-Ft/Yr	Unknown for this project site	Unknown for this project site	Unknown for this project site	Will require a permit	2-3+ years for design and permitting	Well over 300 acres based on STA 5 removal rates estimate	Would provide wetland habitat for wading birds and aquatic animals.	Yes - technology is know to be effective, need to determine site specific land requirements and whether enough land can be obtained.	NA
N Collier Seminole Crucie Lakes RBNERR Restoration	Project folder	Map only	NA	Shows proposed culverts - i.e. spreader culverts under SR 92 and under bike path, both in CSSP, from 2004	NA	NA	NA	NA	NA	NA	NA	NA	Yes it's viable but would need agreement from CSSP.	an
Possible Stormwater Infrastructure Map	Project folder	Only shows parcel ownership	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rookery Bay Data NERR Data	https://cdmo.baruch.sc.edu/get/landing.cfm	Water quality data available	Turbidity data shows relatively consistent average yearly turbidity measurements, indicating there have been no major changes in watershed turbidity. Seasonally, there are large spikes in turbidity every year, most likely corresponding with tropical storms and hurricanes.	No project info	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
Parsons 2006 Belle Meade Stormwater Master Plan, Collier County Watershed Plan (2011), the Southwest Florida Watershed Master Plan (SFWMD/ACOE - Former SW Fla Feasibility Study), and Other Sources	https://rookerybay.org/wp-content/uploads/5-RookeryBayWatershedProjects.pdf	Compilation of a set of watershed restoration projects in the vicinity of the PSRP. One conceptual project in the area of interest will treat residential development discharge before entering Rookery Bay.	Royal Palm Estates and Auto Ranch Outfall: Existing lake servicing the development is adjacent to undeveloped land close to the Rookery Bay Reserve. The outfall is working poorly and the discharge path is undefined and maintained. Proposed project would include properly designed outfall to allow for water quality treatment and attenuation.	Existing wet detention system not functioning properly	Varies	Varies	Varies	Periodic inspections of control structure.	NA	1+ years, need to go though design and permitting before construction can begin	Varies	NA	Does not directly treat the water from the PSRP but does treat water quality that flows from residential areas of interest. Possible supplemental project if lands can be obtained.	NA
United States Fish and Wildlife Service (USFWS):														
FWS BO 4.04.2017	Project folder	USFWS document describing species concerns for Oyster Bay golf course community nearby, may be referenced for similar concerns on projects for the PSRP but no there are no treatment projects listed in the document.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
South Florida Water Management District (SFWMD):														
03010-2116 B US 41 at project	Project folder	US-41 Right-of-Way Map survey drawings. No project location or WQ information	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CR 92 FDOT ROW Map 03060-2102	Project folder	SR-92 Right-of-Way Map survey drawings. No project location or WQ information	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PRSP SFWMD WQ Summary Report 2020	Project folder	Includes water quality, flow rate and loading data.	Describes the techniques used to restore the PSRP area to include the construction of pump stations, tie-back levees, spreader berms, and canal plugs. The objectives of the report were to evaluate and determine TP and TN concentrations that could be expected in the PSRP restored flows, and evaluate changes in surface flows and nutrient concentrations before and after restoration. Stations included in this nutrient analysis includes TAMTOM, TMBR37, FAKA, S488, BC9, BC10, and BC11. Included data was sources from CC from 2001 to 2019. Note, monitoring data was previously discussed in reviews of other sources to include for the FDEP and CC 2019 surface water report. Results largely mimicked data previously discussed. In summary, the TAMTOM station had the highest mean nutrient concentration of all stations analyzed with TMBR7 and TMBR49 being the second and third highest, respectively.	Spreader berms, pump stations, levees, canal plugs	Installed for control of water quantity.	Unknown	Unknown	Varies	These technologies are also described elsewhere and generally require permitting	2-3+ years	Varies	If water detention creates wetlands may create aquatic fauna and wading bird habitat.	Yes - common technologies, would need to find the correct locations and enough land for each to be cost effective.	See Appendix A (doc_wq_lit_review.docx)
PSRP Conveyance Features Att A 12-4-19	Project folder	Discuses design build of culverts under road, did not see flow rates, includes culvert specs	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PS Culverts Map Book	Project folder	Map showing preliminary culvert locations from 8/2019	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C-43 reservoir WQ feasibility study website	https://www.sfwmd.gov/content/c43waterqualitystudy	The 18 month Study began on July 3, 2018 and will be completed by December 2020. Multiple water quality treatment technologies are being studied to reduce nutrients on former agricultural lands	Final Information Collection Summary Report (4/3/2020) provides a list of 25 Technologies Recommended for Further Evaluation https://www.sfwmd.gov/sites/default/files/C-43%20WBSR%20WQFS%20Information%20Summary%20Collection%20Report_04.03.2020.pdf; this list was narrowed to the technology most applicable for this study	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Organization/Title	Link	Comments	Existing Conditions	General Description of Technology/Treatment Type	Nutrient Reduction per Unit	Nutrient Removal Efficiency	Unit Costs	O&M Requirements	Regulatory Constraints	Implementation Schedule	General Land Area Requirements	Ancillary Benefits (e.g. provides wildlife habitat)	Potentially viable for this effort? Why or why not?	Supplementary Document
A) Air diffuser Systems (ADS)	https://www.sfwmd.gov/sites/default/files/C-43%20WBSR%20WQFS%20Information%20Summary%20Collection%20Report_04.03.2020.pdf	Table ES-1	NA	Technology includes a fine bubble aeration system for domestic and industrial installations. Information from ADS states that they have a clog-free design that requires minimal power input to provide aeration within the reservoir with little maintenance required. The fine bubble aerators create mixing and oxygen diffusion within the reservoir (ADS, 2020a).	Varies	Performance data provided by ADS indicate a 90% BOD reduction and 50% to 75% reduction of TN and TP	Varies	ADS technology is for in-reservoir treatment and does not produce residuals for maintenance. System lifespan is estimated at 20 years, and some systems have been fully functioning after 40 years of operation. Maintenance includes checks of compressors, air leak testing of supply piping and visual inspection of disc modules (ADS, 2020b).	NA	NA	For use within a reservoir or other open water area.	Improves fish habitat by reducing anoxia.	Yes, if a pond or other water feature is proposed this could provide an additional benefit when added to the system. Creating a lake solely for installation of an ADS would not be effective.	
B) Alum Treatment	https://www.sfwmd.gov/sites/default/files/C-43%20WBSR%20WQFS%20Information%20Summary%20Collection%20Report_04.03.2020.pdf	Table ES-1	NA	Aluminum Chloride/ Aluminum Sulfate - Flocculation/Coagulation	Varies	Varies	Varies	Varies	May require permitting	1+ years to study system to determine treatment needs	Applications typically fall under one of three types of applications: sediment separation, injection into the inflow, and in-reservoir treatment	NA	Potential as a supplement to other technologies, not likely as a stand-alone project.	NA
C) Bold & Gold	https://www.sfwmd.gov/sites/default/files/C-43%20WBSR%20WQFS%20Information%20Summary%20Collection%20Report_04.03.2020.pdf	Table ES-1	NA	A biosorption activated media formulated to remove nitrogen species, phosphorus species, algal toxins, algal mass, Escherichia coli, and per- and poly-fluoroalkyl substances (University of Central Florida, 2019). The media can be used in many different applications including up flow filters, side-bank filters within wet detention ponds, dry detention systems, infiltration basins, rain gardens, pervious pavers, vegetated filter strips, drain fields, and rapid infiltration basins. Bold & Gold is a mixture consisting of primarily mineral (Florida-based sand and Florida mined clay) and relatively slow degradable recycled materials (tire crumb) (Bogdan, 2020).	Varies	Performance data in applications treating stormwater state a nitrogen removal rate of approximately 75% to 95%.	The cost per pound of nitrogen removed is estimated at $10.23 for the 15-year lifespan (University of Central Florida, 2019).	The filters are estimated to be in service for 15 years with a TN treatment rate of0.05 gpm/ft2 (University of Central Florida, 2019). Materials supplied by the vendor do not discuss the handling of residuals. Media must be replaced more often if the technology is used to remove TP.	Unknown	Unknown	Varies	None expected	Probably not - Treats primarily TN with little TP treatment unless media is replaced frequently, possibly at great cost.	NA
D) Hybrid Wetland Treatment Technology (HWTT) - Alum	https://www.sfwmd.gov/sites/default/files/C-43%20WBSR%20WQFS%20Information%20Summary%20Collection%20Report_04.03.2020.pdf	Table ES-1	NA	Includes design, construction, and operation of a facility that combines wetland and chemical treatment approaches to reduce phosphorus (DeBusk, 2009). The treatment uses chemical coagulants added to the front end of a wetland treatment system, containing one or more deep water zones to capture the resulting floc material. The passive treatment of the wetlands partnered with the active coagulant sorption results in the reduction of phosphorus. The coagulant used for the HWTT is aluminum sulfate or alum (SFWMD, 2009).	Varies	Varies	Estimated operating costs range from $19 to $301 per pound of phosphorus removed, depending on the flow capacity and the phosphorus concentrations introduced.	Residuals management was not discussed in detail, but floc will be collected in the deep zone of the wetlands. Residual management will be minimal given proper design of wetlands. Energy is needed to power the alum feed pump. Site specific considerations may also arise.	May require permitting	1+ years to study system to determine treatment needs	Varies	NA	Potential as a supplement to other technologies, not likely as a stand-alone project.	NA
E) NutriGone™	https://www.sfwmd.gov/sites/default/files/C-43%20WBSR%20WQFS%20Information%20Summary%20Collection%20Report_04.03.2020.pdf	Table ES-1	NA	Primarily used in the removal of bio nutrients from stormwater prior to discharge, intercepting groundwater near surface water interfaces and filtering surface water from ponds and swales. NutriGone™ media sorbs the nutrients to the media.	Varies	50% TP removal efficiency stated by manufacturer	The cost estimate for a facility at the C-43 WBSR given a flow of 695 cfs is approximately $14,290,000 per 353 days. This includes the cost of the media and a media production center amortized over 20 years. Given a 50% TP removal rate, the cost is estimated at $108 per pound of TP removed (Burden, 2020).	The vendor expects the media will last 353 days before being at maximum capacity for phosphorus. The media will need to be removed and new media added. The vendor suggests construction of a media production facility near the filter site. Vendor materials indicate that the media is capable of being sold as a soil amendment after being used in the filter at roughly 50% of the original price (Burden, 2020).	Unknown	Unknown	Room for in-line filter systems with the media	NA	Not likely - may be too costly. Technology is not proven beyond small scale systems.	NA

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F) Downstream Defender® (DEP Number 1756)	https://www.sfwmd.gov/sites/default/files/C-43%20WBSR%20WQFS%20Information%20Summary%20Collection%20Report_04.03.2020.pdf	Table ES-1	NA	Uses a hydrodynamic vortex separator to remove fine and coarse particles, oils, and floatable debris.	Varies	Performance indicated by the vendor indicate 70% TP removal with up to 79% TKN removal. Downstream Defender® was implemented as a BMP for agricultural effluent (Moffa & Associates, 2002). Peak treatment flow rate is 38 cubic feet per second (cfs) for a 12-foot-diameter unit (Hydro International, 2020b). Downstream Defender® captures and stores sediment and oil within the chamber.	The cost of Downstream Defender® for treating the active farm effluent was approximately $45 to $112 per pound of TP removed per year and $10 to $100 per pound of ammonia-N removed per year (Moffa & Associates, 2002).	A sump-vac is used to remove captured sediment and floatables through the access ports located at the top (Hydro International, 2020b). Sediment disposal is needed after removal. Downstream Defender® is designed to be used in a surface water runoff treatment system using the flow from the storms, meaning there is no need for power input.	NA	NA	Unknown	NA	Potential - it removes fine and course particles, oils and floating debris (physical removal only); may be combined with other technologies, particularly if land space is limited.	NA
G) Treatment Wetlands	https://www.sfwmd.gov/sites/default/files/C-43%20WBSR%20WQFS%20Information%20Summary%20Collection%20Report_04.03.2020.pdf	Table ES-1	NA	Capable of achieving low TN and TP concentrations	Summary of Treatment performance in STAs for WY2018 provide an average TP load retained of 77%. TN % removal varies, ranging from 15% to 45% from 2001 to 2016	The lowest TP concentrations practically achievable in any type of treatment wetlands were in the range of 10 to 15 ppb. The lowest TN outflow concentrations observed were essentially all in the reduced forms (total organic nitrogen and ammonia-nitrogen) and equal to about 0.7 mg/L.	Varies	Varies	Permitting will most likely be required	2-3+ years for design and permitting	Significant land area may be needed	Wetland would provide wildlife habitat	Yes, if sufficient property can be acquired in the downstream location of the culverts	
SFWMD Publications and data	1. https://www.sfwmd.gov/science-data/scientific-publications-sfer	Highlights projects related to environmental modifications and protection within South Florida.	https://www.sfwmd.gov/sites/default/files/documents/2020_SFER_highlights.pdf	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
A) C-43	NA	NA	NA	C-43 reservoir: regulates water quantity	May have some ancillary benefits but nutrient reduction is not the primary purpose of a reservoir	Varies	Varies	Varies	Reservoirs require extensive permitting	Years for permitting and construction.	Varies	Aquatic wildlife and bird habitat	Probably not - reservoirs are primarily for water storage not water treatment, a large area of land would be needed for a low treatment efficiency.	NA
B) C-44	NA	NA	NA	C-44 Reservoir and STA	Unknown	Will remove nutrients, amount unknown	Varies	Maintain berms. structures, pumps, vegetation, etc.	May be difficult to permit if there are wetlands upstream or downstream where the hydrologic regime of existing wetlands would have to be addressed.	2-3+ years	Varies - but likely large land requirements	Aquatic wildlife and bird habitat	Partially - would be best to construct the STA without a large open water reservoir given land availability limitations.	NA
C) S-333	NA	NA	NA	Gated spillway: regulates water flows	Not for water quality though may have some benefits	Unknown	Unknown	Unknown	Will need design and permitting	1+ years for design and construction	Generally small for the spillway itself, but larger areas behind the spillway are needed, as are downstream receiving areas	None expected	May be a component of other technologies but not a standalone project	NA
D) C-111	NA	NA	NA	Spreader canal: regulates flow rates, design capacity 1150 cfs	Not for water quality though these often have some water quality benefits	Unknown	Unknown	Unknown	Will need design and permitting	1+ years for design and construction	Varies	May provide wading bird habitat if wetlands are restored by spreading water	Yes if a suitable location can be found	NA
E) L8 FEB	NA	NA	NA	Placed in front of an STA can enhance TP removal by STA, stores 48,000 ac-ft of water	Varies	Varies	Varies	Varies	Will need design and permitting	1+ years for design and construction	Varies	If water is backed up wading birds and aquatic wildlife may use the area	Yes if a suitable location can be found	NA
F) WCA 3	NA	NA	NA	Decompartmentalization: controls flow	NA	NA	NA	NA	NA	NA	NA	NA	No - no existing area to decompartmentalize	NA
G) Ten Mile Creek Water Preserve Area	NA	NA	NA	Previous year net inflow of 3800 ac-ft of water	Reduced TP by 80%	Reduced TP by 80%	Varies	Varies	Varies	Varies	Varies - generally requires large tracts of land	Can provide aquatic wildlife and bird foraging habitat	Probably not - typically a large land requirement that is unlikely to be available here.	NA
H) A1FEB	NA	NA	See here for details: https://www.sfwmd.gov/sites/default/files/documents/a1_feb_seepage_study_final.pdf - seepage study does not address nutrients though	A1 FEB	Retained 90% of inflow P	45.2 metric tons over 15,000 acres, stores 60,000 ac ft	Varies	Varies	Permitting will most likely be required	Varies	Varies	If water is backed up wading birds and aquatic wildlife may use the area	Yes - if the right area can be found	NA
I) Taylor Creek	NA	NA	NA	Taylor Creek STA	118 ac removed up to 2 metric tons TP/yr	Varies	Varies	Varies	Permitting will most likely be required	Varies	Varies	Can provide aquatic wildlife and bird foraging habitat	Yes - if the right area can be found	NA
J) C-139	NA	NA	NA	Annex restoration: restore ag land to wetlands, backfill 2.9 miles of canal	Unknown	Varies	Varies	Varies	Permitting will most likely be required	1-2+ years to design, permit and construct	Varies	Probably none unless wetlands and native areas are restored	Not likely unless ag land can be purchased	NA
K) Periphyton STA Study	https://www.sfwmd.gov/sites/default/files/documents/ltp_mtg_12feb2013_psta_%20stormwater_%20periphyton_%20mesocosm_ivanoff.pdf	NA	Study conducted in existing STA3-4	100 ac cell: high TP removal, 12th consecutive yr that outflow was 13 ppb or less TP	Unknown	Unknown	Unknown	Varies	Unknown	Unknown	Varies	Probably if wetlands and native areas are restored	Possible - additional research into technology specifics needed to determine if they are suitable for this site	NA
SFWMD Publications and data	1. Big Cypress Basin	https://www.sfwmd.gov/sites/default/files/documents/naplesbayreconfinal_2006.pdf	First link is to a page with many studies and other documents that are not relevant to this work. Second link includes some projects on pages 79-84. Relevant information is described here.	Gordon River Water Quality Park described here - 50 acres of ponds, polishing marshes and wetlands serve as a filtration system while recreational opportunities are provided - See also Orlando Wetlands Park (not described here) for mixed recreation and water quality treatment.	Unknown	Unknown	Unknown	Unknown	Permitting will most likely be required	Unknown	Unknown	Recreation and wildlife habitat likely	Yes - combines a number of technologies already identified as likely candidates for this project if land can be found.	NA

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SFWMD Publications and data	2. Estuaries	Describes mostly biological studies, mention but not description of wetlands flow ways	Caloosahatchee area	Wetland flow ways used to attenuate and treat stormwater runoff	Varies	Varies	Varies	Varies	Permitting will most likely be required	Varies	Varies	May provide wading bird and aquatic wildlife habitat	Yes - wetland treatment in various forms is recommended for this project if sufficient land to provide adequate treatment can be obtained.	NA
SFWMD Publications and data	3. Restoration Strategies Science Plan – Related Documents	Items here only include project related information and only projects not already described elsewhere in this table	STA 1 discharge canal P treatment study	Treatment of TP as water flows through STA treatment canal - saw significant reductions in TP, primarily due to settling of particulate P.	NA	Yearly TP reductions between canal inflow and outflow ranged from 8.3-49.7% between 2003-07; canal acted as a TP source between 2008-13; canal acted as TSS sink over whole period	NA	NA	Included in permitting of STA	1+ years	Varies	Probably provides wildlife habitat, depends on depth and vegetation present.	Yes, if an STA is created there may be a discharge canal.	NA
SFWMD Publications and data	3. Restoration Strategies Science Plan – Related Documents	Items here only include project related information and only projects not already described elsewhere in this table	Soil Amendment/Management Literature review	Lists dozens of potential soil amendments that might be tested in an STA to control P, including installation of a lime rock cap. Costs provided are estimates to conduct studies in existing STAs (2015)	NA	NA	NA	NA	NA	NA	NA	NA	No - This information is provided to describe costs and needs for studies, the silt amendments have not been tested in an STA.	NA
SFWMD Publications and data	3. Restoration Strategies Science Plan – Related Documents	Items here only include project related information and only projects not already described elsewhere in this table	STA Inflow Basin Canal Study	The inflow canal acted as a source of P to the STA, especially when flows were high after a storm event, apparently associated with resuspension of canal sediments.	NA	NA	NA	NA	NA	NA	NA	NA	No - An inflow canal for an STA may be needed but should not be considered a treatment technology.	NA
SFWMD Publications and data	4. Saltwater Interface Maps by County	Saltwater interface maps, does not include projects	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SFWMD Publications and data	5. Stormwater Treatment Areas and Flow Equalization Basins	List of Everglades studies	Majority of studies included in this page are not relevant to the Project area, as they are focused on the Everglades STAs, and do not provide relevant data or lessons learned as they are too specific to the particular projects, or are too broad to glean useful information when assessing treatment technologies	Stormwater Treatment Area management and water budgets	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SFWMD Publications and data	6. Water Supply – Hydrogeological Reports	Geology/aquifer investigation docs, not relevant to the project unless ASR or deep well injection are pursued (and these are not recommended)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SFWMD Publications and data	7. Florida Waters Resources Manual [PDF]	General reading, no project information	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SFWMD Publications and data	8. Long-Term Plan for Achieving Water Quality Goals	Applies to Everglades Protection Area. List of 27 documents since 2003. Executive Summary and Full Report downloaded.	Pre-2003 conditions are analyzed in detail	STAs with Submerged Aquatic Vegetation (SAV)	Exc. Summary Table ES.3, and Figure ES-2 contain broad nutrient reduction values for the entire long range plan. More detailed WQ data in the full report	NA	Cost in Executive Summary Table ES.4 for the entire long range plan. More detail in the full report	NA	NA	NA	NA	NA	Yes - STAs are a recommended treatment technology f sufficient land can be found.	NA
SFWMD Publications and data	9. Restoration Strategies Science Plan	Studies to evaluate different factors affecting P uptake and release	Studies on existing STA factors and how they affect P uptake, no new technologies described	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	an
SFWMD Publications and data	10. SFWMD Formation Identification Guide [ZIP, 2.8 GB]	Cannot open zip file, appears to be a geology document	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
SFWMD Publications and data	11. South Florida Water Management Model (Fwd.) Position Analysis – Initial Stage Values – Current Month [PDF]	3 page 2D model stage values exhibit. No WQ information. No project information	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SFWMD Publications and data	12. Water Conservation	Water quantity related information, does not address water quality or quantity issues related to this situation.	Does not apply to this project	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SFWMD Publications and data	13. Water Supply Plans	Mostly does not apply, report at link to the right addressed here.	https://www.sfwmd.gov/our-work/restoration-strategies	General discussion of use of Flow Equalization Basins (FEBs) and Stormwater Treatment Areas (STAs)	Preliminary estimates made by Paul Julian from FDEP would need 300 acres or more based on P removal rates in STA 5; this site is approximately 300 acres.	Depends on inflow concentrations and outflow rates	Unknown	Similar to existing STAs	Need land area available for STA use - then need to permit; will be additional regulatory constraints if the land already has wetlands on it.	2-3+ years	300+ acres based on Paul Julian calculations	Would likely provide extensive aquatic wildlife and bird foraging habitat.	Yes, if sufficient land is available.	NA
SFWMD Publications and data	14. Water Supply Reports	Weekly reports describing water levels, not projects	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Repository of pertinent studies available to use														
General Documents	1. General Documents	Multiple Studies done in FL, some relevant to this project	Studies conducted on former agricultural land	C-43 Efficacy of a Large-Scale constructed wetland to remove phosphorous and suspended solids from Lake Apopka, FL (Marsh Flow-way) which was constructed on former ag lands	Varies	Depends on inflow concentrations and outflow rates	$42 / kg TP and $0.03/ kg TSS	Similar to existing STAs	Permitting will most likely be required	2-3+ years	Large	NA	Yes - constructed wetlands (such as STAs are recommended for consideration for this project if sufficient land can be found.	NA
General Documents	1. General Documents	Multiple Studies done in FL, some relevant to this project	Studies conducted on former agricultural land	C-43 Large Constructed Wetlands for Phosphorous control: This review shows that large constructed wetlands all remove phosphorus. They do so more efficiently than the population of smaller counterparts, as measured by concentration reduction (median 71%) or removal rate coefficients (median 12.5 m¨year´1) for the entire period of record. However, large systems display lesser P load reductions (median 0.77 gP¨m´2¨year´1) than the larger general population of wetlands, in part because the large systems typically operate at lower incoming P loads (median 1.22 gP¨m´2¨year´1).	Varies	Median concentration reductions were 71%;	Varies	Similar to existing STAs	Permitting will most likely be required	2-3+ years	100 acres+	Vegetative biodiversity; protection and production of fauna; aesthetic, recreational, commercial and educational human uses	Yes, if sufficient land is available.	NA

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General Documents	1. General Documents	Evaluation of Total Nitrogen Reduction Options for the C-43 Water Quality Treatment Area Test Facility	Compares performance of various wetland plant community alternatives	Emergent Macrophyte Vegetation (EMV) would be most likely to achieve the lowest TN, TP, and TSS concentrations with the smallest footprint and the lowest construction cost. Pros: Highly complex microbial community, high TON mineralization, high denitrification, moderate P removal, high TSS removal, lowest cost, wide experience and applicability. Cons: limited aerobic zone	Varies	Varies	$38,000 cost per HA w/o land costs	Similar to existing STAs	Permitting will most likely be required	2-3+ years	Large	Would likely provide extensive aquatic wildlife and bird foraging habitat.	Yes, if sufficient land is available.	NA
Treatment Technologies Documents	2. Treatment Technologies Documents	Lake Hancock Water Quality Study	Reviewed other treatment technologies for possible use in Lake Hancock in central Florida	Various treatment systems throughout Florida reviewed for effectiveness, including a Water Conservation Area and multiple STAs	Varied by STA	Varied by STA	Varied by STA	Varied by STA	Permitting will most likely be required	2-3+ years	Varies	Would likely provide extensive aquatic wildlife and bird foraging habitat.	Yes, if sufficient land is available.	NA
Treatment Technologies Documents	2. Treatment Technologies Documents	FGCU Thesis by Dana Dettmar 2015	NA	Algae Control Using In Lake Floating Treatment Wetlands	Discussion about microbes rather than nutrient removal	Unknown	Unknown	Unknown	Probably few constraints	Unknown	Needs open water to float on	Unknown	No - This has limited ability to remove nutrients from the water column.	NA
Wetland Treatment Technology Docu	3. Wetland Treatment Technology Documents	Study information only	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Basin Water Quality Study Document	4. Basin Water Quality Study Documents	All information relates to the Caloosahatchee River. Not useful in identifying areas of high nutrient concentrations within Collier County.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
Blue-Green Algae Documents	Blue-Green Algae Documents		C43/Lake Okeechobee documents	ASR	Probably minimal	Water is intended to be repumped to the surface at some point, nutrients that don't migrate from storage area will be returned to the ecosystem when water is withdrawn; anaerobic conditions may turn Nitrogen forms to N2 gas that could be released to the atmosphere, but phosphorus is likely to remain.	Varies	Maintain well - may need to treat water prior to injection	Unknown if geology in the area is appropriate, may need to treat water prior to injection, water use permitting issues	Varies	Small land area for well and possible treatment facility	None	No - pre-injection treatment probably needed, unknown if geology is correct for use in this area, will not treat water quality, especially for P.	NA
			C43/Lake Okeechobee documents	Deep well injection	Unknown	Removes water permanently, including any nutrients in the water	Varies	Maintain deep well	Well permitting	Varies	Small land area for well	If the water is permanently removed from the system it will not provide desired restoration of freshwater flows to downstream waters	No - removes freshwater flows permanently, does not meet goals of restoring freshwater flows into systems to the south.	NA
PSRP ideas and map June 2019	Project folder - Numbers refer to locations on map	Ideas from 2019	1. This area is a mitigation site for the Eagle Lakes development to the north. An option would be to have Eagle Lakes donate this mitigation site to SFWMD and build an STA here. Water would have to be conveyed from the Tomato Road discharge site under US 41 to this area via a canal then discharged to the southeast into Collier-Seminole State Park.	STA	Preliminary estimates made by Paul Julian from FDEP would need 300 acres or more based on P removal rates in STA 5; this site is approximately 300 acres.	Depends on inflow concentrations and outflow rates	unknown	Similar to existing STAs	Area is already a mitigation area, would need to consider in permitting and maintain success criteria - need to look at permit to determine exactly where the mitigation is and the treatment/success criteria required.	Years for permitting and construction.	300+ acres based on Paul Julian calculations	Would likely provide extensive wildlife habitat for birds, alligators, turtles, etc.	Yes, if land is available for purchase and permitting considerations can be dealt with	NA
PSRP ideas and map June 2019		Ideas from 2019	2. The "bicycle seat" area can be used as an STA. Water would need to be conveyed from the Tomato Road discharge site under US41 to this area via a canal then discharged to the south into Collier-Seminole State Park.	STA	Preliminary estimates made by Paul Julian from FDEP would need 300 acres or more based on P removal rates in STA 5; this site is approximately 50 acres.	Depends on inflow concentrations and outflow rates	Unknown	Similar to existing STAs	Would need to obtain an ERP to construct the STA, does not appear to be wetlands in the area under existing conditions, if wetlands are present permitting will be slightly more complicated	2-3+ years	300+ acres based on Paul Julian calculations, about 50 acres available	Would likely provide extensive wildlife habitat for birds, alligators, turtles, etc.	Yes, if state park will allow the land to be used. Will still need other projects/technologies as this is probably not enough area to provide full treatment.	NA
PSRP ideas and map June 2019		Ideas from 2019	3. This is an old railroad bed that is now used as a hiking trail. This structure can be used as a type of spreader structure. Water would be conveyed from the Tomato Road discharge site to the spreader via a canal. The spreader would distribute water over this area of the State Park. The natural forested area should remove nutrients from the agricultural discharge.	Spreader swale to allow P uptake from water spread across a broader region	unknown	unknown	unknown	Would need to maintain the berm and any structures	May be difficult to permit if there are wetlands upstream or downstream where the hydrologic regime of existing wetlands would have to be addressed	years to permit and construct	Unknown	May increase wet area providing additional wading bird habitat	No - State park does not want projects outside the area for item 1	NA
PSRP ideas and map June 2019		Ideas from 2019	4. A farm discharge pipe can be built into the SWPF levee and pumped to the north. The water can be released on the northern end of the SWPF into the PSRP natural forested area via a spreader canal. The forested area should naturally remove some nutrients that are in the agricultural discharge. The amount of phosphorus a forest removes from water is not known but generally accepted to be much less than an STA. This water will then flow south and be conveyed under US41 via the proposed culverts and bridges to Collier-Seminole State Park. This option will also prevent water from stacking up between the farm's levee and the SWPF.	Projects need to be south of 41 and not ag related	NA	NA	NA	NA	NA	NA	NA	NA	Prospective funding limitations are expected to prohibit use for projects on private lands	NA
PSRP ideas and map June 2019		Ideas from 2019	5. This area is in the project footprint. The area outline is approximately 380 acres but could be increased if needed. This area could contain an FEB for attenuation of flows with some emergent vegetation to help reduce phosphorus concentrations before moving the water to Collier-Seminole State Park to the south.	Cannot build projects in the PSRP area without USACE revisions and congressional approval	NA	NA	NA	NA	NA	NA	NA	NA	No, cannot build new projects in this area without CERP modification	NA
PSRP ideas and map June 2019		Ideas from 2019	6. Improve or widen the Tamiami Canal to convey more water to the existing Bridges 37 and 39. A culvert under CR92 will be placed south of Bridge 37 to move water through the park. In this option, the project will not build a new opening through US41.	Not clear	Unknown	Unknown	Unknown	increased canal maintenance	Unclear if this could be permitted, unknown if land is available to widen canal.	years to permit and construct	Unknown without knowing canal widening width	None likely	No- it does not appear that this would treat water quality issues	NA

Organization/Title	Link	Comments	Existing Conditions	General Description of Technology/Treatment Type	Nutrient Reduction per Unit	Nutrient Removal Efficiency	Unit Costs	O&M Requirements	Regulatory Constraints	Implementation Schedule	General Land Area Requirements	Ancillary Benefits (e.g. provides wildlife habitat)	Potentially viable for this effort? Why or why not?	Supplementary Document
PSRP ideas and map June 2019		Ideas from 2019	7. Build a small canal from the Tomato Road discharge area west to the northeast corner of the mitigation area then south to Rookery Bay. Rookery Bay managers have stated that they need water and would take the water from the project.	Assuming referring to Area 1 on map. It appears that this would resolve the additional water issue but would do nothing to address water quality prior to water entering Rookery Bay	Minimal?	Not effective to remove nutrients by building a canal to convey water without a treatment area	Unknown	Basic canal maintenance to control vegetation - spraying cattails and other plants would result in releases of large quantities of nutrients following chemical treatment.	Would need to permit the canal including modeling	tears to permit and construct	Land to excavate to construct canal - unknown without knowing canal width.	None likely	Probably not - does not provide a water quality treatment function prior to entering Rookery Bay	NA
Henderson Creek Diversion Project	HCDP in project folder	NA	NA	Project looks at diverting water from Naples Bay to Henderson Bay - project dropped as not feasible, not applicable to PSRP area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hydraulic Assessment for Henderson Creek	Final Draft Henderson in project folder	NA	NA	Engineering assessment for the terminated Henderson Creek Diversion Project	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Other:														
Maps of proposed affected areas and locations of potential project locations	To be identified in reviews of above information													
Basin-specific feasibility studies/water quality improvement strategies	Need to identify basins and search for plans													
Existing MSSW / ERP near project sites	https://ca.dep.state.fl.us/mapdirect/?focus=standard		There are both ag and residential ERPs adjacent to this property. One currently vacant land owned by a developer south of the Eagle Lakes golf club was reported to have mitigation on it for another project but no permits found in the SFWMD database show this as anything other than an old ag permit area.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Review CERP project for applicable	Covered in SFWMD links above	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Parsons Stormwater Plan for Belle Meade	Cannot locate document	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Existing Picayune Strand Restoration Project (PSRP) design information	https://www.saj.usace.army.mil/Missions/Environmental/Ecosystem-Restoration/Picayune-Strand-Restoration-Project/	Webpage with links to all assorted documents about the PSRP, presentations, meeting minutes, overviews, but no information on WQ technical information. Some of surface water modeling data, no WQ modeling found	Canals run throughout state forest, associated with development plans from decades ago	Described above	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Existing PSRP water quality testing reports	Water quality summary report provided as document listed above	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
FCC Creek and FCC Oyster Harbor consultation letter dated April 4, 2017	This is the same as the FWS-BO-4.04.2017 document listed above	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Collier-Seminole State Park	https://floridadep.gov/sites/default/files/2004%20Collier-%20Seminole%20State%20Park.pdf	Start with management plan, search for other documents; reviewed MGMT Plan, could not locate any other documents related to Park	2004 Report: MGMT plan calls for hydraulic restoration to restore the hydraulic regime nearly as possible to its original state, and to "reverse and obliterate" all biological changes brought on by known hydrological disruptions. No water quality projects or technologies proposed in report.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rookery Bay Estuarine Research Reserve	Link provided is same as compilation of proposed projects in Rookery Bay watershed listed above	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Rookery also did modeling of the Rookery Bay watershed as part of this examination of other plans.	Link provided is same as compilation of proposed projects in Rookery Bay watershed listed above	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Cape Romano – Ten Thousand Islands Aquatic Preserve	https://myfwc.com/media/11888/ten-thousand-islands.pdf	NA	This report primarily focuses on seagrasses within Cape Romano. Supplemental optical physical water parameters were measured at 30 sites throughout the project area. Nutrient sampling was conducted by Florida International University until 2008. This data was analyzed and reported by the National Park Service separate from this document. Not relevant to this project.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	See Appendix A (doc_wq_lit_review.docx)
Proposed Numeric Nutrient Criteria for South Florida Estuaries and Coastal	https://www.nps.gov/ever/learn/nature/upload/ENP-NNC-Report-Revised-05-12.pdf	Document is unavailable	Referenced in the ten thousand islands summary report above.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Harvey Harper presentation on alum treatment	https://www.florida-stormwater.org/assets/MemberServices/Conference/AC19/22%20-%20Harper%20Harvey.pdf	ppt	NA	Use of Alum to remove TP from inflow water to a lake	0.12 kg/ac ft-yr	85% removal of TP	$386/lb TP removed - 175.1 ac drainage basin, treating 156 ac ft/yr	maintain equipment - cost will vary by size; periodic removal of floc from pond	need offline treatment	1-2 years	depends on inflow loading	none expected	maybe - alum treatment not always well received	NA
Additional Resources Reviewed Following Draft Report:														
Constructed Wetlands for Pollution Control	https://www.sfwmd.gov/sites/default/files/documents/02-constructed%20wetlands%20for%20pollution%20control%20IWA%202000.pdf	Design considerations for constructed wetlands	NA	Constructed treatment wetlands - general overview, not a description of a specific project	Varies	Varies	Varies	Varies	Permit likely required	1-2 years	Varies	Would likely provide extensive aquatic wildlife and bird foraging habitat.	Yes - constructed wetlands are recommended for consideration for this project if sufficient land can be found.	SRWQFS technologies and design considerations
Evaluation of Current Stormwater Design Criteria within the State of Florida	http://www.erd.org/ERD%20Publications/EVAL%20OF%20CURRENT%20SW%20DESIGN%20CRITERIA%20WITHIN%20THE%20STATE%20OF%20FLA-2007.pdf	Design criteria and nutrient removal information for stormwater ponds	NA	Stormwater pond design	Varies	Varies	Varies	Varies	Permit likely required	1-2 years	Varies	Would likely provide aquatic wildlife and bird foraging habitat.	Not included, not diretly designing stormwater ponds	SRWQFS technologies and design considerations
Hybrid Wetland Treatment Technology	https://www.sfwmd.gov/sites/default/files/documents/lowpp_tcns_000_mm10_sheet.pdf	Technology combines alum treatment with constructed wetlands	SFWMD fact sheet discussing HWTT	Combination of alum treatment and constructed wetlands	Varies	Varies	Varies	Varies	Permit likely required	1-2 years	Varies	Would likely provide aquatic wildlife and bird foraging habitat.	Not included, not diretly designing stormwater ponds	
Implementation of Hybrid Wetland Treatment Technology in the Northern Everglades Watershed	https://www.fdacs.gov/content/download/76291/file/20210_FinalReport.pdf	Technology combines alum treatment with constructed wetlands	Report discusses use of HWTT at numerous sites in the Northern Everglades Watershed	Combination of alum treatment and constructed wetlands	Varies	Varies	Varies	Varies	Permit likely required	1-2 years	Varies	Would likely provide aquatic wildlife and bird foraging habitat.	Not included, not diretly designing stormwater ponds	

Appendix E RESPONSES TO WORKING GROUP COMMENTS ON DRAFT REPORT

Stantec

CCSR WQFS Draft Information Summary Report Comment and Response Memo

The following includes summary of comments made by the stakeholders of the CCSR WQFS project. General edits to the text of the report are not included in the following memo. Similar comments are combined, and the respective reviewers are referenced for each comment with superscript. Critical comments or those made by at least 3 separate editors are presented in bold font.

Narrative Comments

1. Recommend showing small scale projects instead of district large scale regional projects. Focus on something like the Lely canal spreader berm, polish ponds like Freedom Park, the use of Bold & Gold or some other medium for nutrient uptake as well as looking at the City of Bonita Springs water quality projects (bio reactor). [B]

   Answer: Staff have added the bioreactor technology as a treatment option for this project. Treatment train options will be developed from known technology and will be presented within the feasibility study.

2. Address and recommend the use of technologies that address treatment of BOTH TN and TP so as to not cause cyanobacteria dominance. [A]

   Answer: Technology presented in the document review is intended to discuss all technologies included within reviewed documents. Treatment trains presented within the feasibility study will address both TN and TP mitigation.

3. Provide treatment options that prevent nutrients from entering the environment, as this is more cost effective than treatment. [A]

   Answer: Treatment options will be investigated to reduce pollution entering the watershed. South Florida Water Management District staff will provide guidance on restrictions associated with source treatment options.

4. Will further evaluations consider hydraulic modeling that was done for the PSRP since the project will likely be downstream of the new conveyances associated with the PSRP project? [C]

   Answer: Yes, modeling will be considered when investigating the hydraulic and nutrient removal capacities of the proposed treatment trains during the feasibility study.

5. Was the Hybrid Wetland treatment technology (HWTT) considered in this evaluation of potential treatment technologies? [C]

   Answer: This technology has been added to this report.

6. Section 4.1.1. There are several examples of constructed treatment wetlands that are much smaller in scale than the Everglades STAs. Key factors to consider when designing and sizing a constructed treatment wetland are treatment columns and hydraulic loading rates, inflow nutrient concentration and outflow nutrient concentration targets. A treatment wetland that compares in size to the EAA STAs is not feasible in this area, but likely not necessary either, depending on the treatment goals and anticipated treatment volumes. Examples of smaller scale treatment wetlands include: Ten Mile Filter Marsh (Lee County), Powell Creek Filter Marsh (Lee County), Orlando Easterly Wetlands (treats reclaimed water, but successful in reducing nutrient concentrations over 1,200 acres. [C]

   Answer: The document review was based upon all provided and discovered documents, which primarily focused on large scale projects; however, the technology behind STAs (constructed treatment wetlands) and FEBs (spreader berms and swales) are applicable to this study and will be included in the Task 4 feasibility study as options to the extent that land is available for their use.

7. Section 4.2.2. Air Diffusion System (ADS) does not seem promising in this area with high TP. ADS may be beneficial as part of treatment train to supplement technology that removes TP at a greater efficiency than TN, but may require more intense operator involvement, maintenance, and monitoring to ensure there is no export of phosphorus. [C]

   Answer: All technologies contained within the presented or discovered documentation were investigated, including ADS. This is however not a reflection of recommendation. Recommended treatment trains designed to target both TN and TP pollution will be presented in the feasibility study. The treatment trains may include multiple technologies, some of which address only one nutrient or the other, but in combination the treatment train technologies will address both nutrients to the greatest extent practicable.

8. **Work with agencies to establish clear nutrient removal targets the project will attempt to achieve based on concentrations within downstream OFWs. Maximum attainable nutrient removal is not sufficient.** [D, F, G]

   Answer: Staff will present removal targets within the feasibility study based on treatment area restrictions. These targets may be based on downstream OFWs and/or achieving a certain level of efficacy for the proposed treatment trains within the feasibility study report.

9. **The sources of pollution should be addressed in the feasibility study and should be included in the suite of treatment options. The feasibility study should not exclude technologies and treatment areas based on costs. All treatment options and areas should be considered, especially those options that treat the source of pollutants directly. There are funding sources, such as FDACS cost-share programs, that are tailored specifically for projects on privately owned land. The feasibility study should include an evaluation of projects on both publicly and privately owned land.** [D, F, G]

   Answer: The current scope of services does not allow for recommended treatment options to be located on private land. The feasibility study will provide considerations for future studies on pollutant sources and direct load reduction strategies from a regulatory perspective.

10. Consider the use of IFAS research supported Recyclable Water Containment measure in researching BMP treatment options for source controls. [G]

    Answer: This treatment option has been included in the revised report.

11. Consider incorporating the long-discussed private land parcels for consideration: a) the triangular Lipman field south of US41, and b) the permitted preserve managed by Fiddlers Creek development. These have been discussed in several meetings. [G]

    Answer: The current scope of services does not allow for recommended treatment options to be located on private land. The feasibility study will provide considerations for future studies on pollutant sources and direct load reduction strategies from a regulatory perspective.

12. Need to provide additional studies on alum treatment to ensure that it's use would not impact downstream areas, even if floc wasn't an issue because it's been removed or regulated to offline treatment (changes in pH, methylation of mercury, etc.). [D, F]

    Answer: Alum treatment is included in this report as a technology identified by multiple resource documents; however, at this time it will not be recommended for treatment trains.

13. Suggest removal of alum treatment from consideration given this is a natural system where studies on the efficacy of this method is unknown. [E, F]

    Answer: Alum treatment is included in this report as a technology identified by multiple resource documents; however, at this time it will not be recommended for treatment trains.

14. Removal of Floc is also a cost associated with alum treatment. [D]

    <u>Answer</u>: Alum treatment is included in this report as a technology identified by multiple resource documents; however, at this time it will not be recommended for treatment trains.

15. Bold & Gold treatment does not address phosphorus and would need to be applied outside the sensitive wetland and upland areas of CSSP and RBNERR due to the uncertain long-term effects on natural systems. Suggest removal from consideration. [E, F]

    <u>Answer</u>: All potential treatment technologies identified as part of the document review are included in the report. In the feasibility study, it is unlikely that single technologies will be recommended for sole use in mitigation. A variety of treatment trains will likely be proposed to include multiple technologies and techniques to address both TN and TP loads. Concerns regarding the efficacy and impacts of various treatment options will be considered while developing the feasibility study.

16. NutriGone media technology is problematic and suggest removal from consideration given this is a natural system where studies on efficacy of this method is unknown. [E, F]

    <u>Answer</u>: All potential treatment technologies were investigated as part of the document review. In the feasibility study, it is unlikely that single technologies will be recommended for use in mitigation. A variety of treatment trains will likely be proposed to include multiple technologies and techniques to address both TN and TP loads. Concerns regarding the efficacy and impacts of various treatment options will be considered while developing the feasibility study.

17. **Aquifer storage and recovery (ASR) technology recovery rates can vary widely. Recommend removal from consideration. [D, E, F]**

    <u>Answer</u>: All potential treatment technologies identified during document review are included in this report. ASR is included as an identified technology but is not recommended for use in this project.

18. Deep well injection requires permanent disposal of freshwater needed for natural systems restoration and is contrary to the overall watershed restoration goals. Treatment options should be focused on surface water. Recommend removal from consideration. [D, F]

    <u>Answer</u>: All potential treatment technologies identified during document review are included in this report. Deep well injection is included as an identified technology but is not recommended for use in this project.

19. Address not only how the quantity of flow will impact water quality but also historic habitats and endangered species. [E]

    <u>Answer</u>: Nutrient load estimates and increases to flow as a result of the PSRP will be considered when developing treatment trains. Specifications regarding the proposed mitigation project options will be described in accordance with the scope of services.

<u>Appendix A</u>

1. The general boundary should include the farms for which the Southwest Protection Feature is being built. These large farms must be included as they have been shown to be the primary source of nutrient pollution that may threaten water quality in the OFWs. [G]

    <u>Answer</u>: Maps will be updated as needed given the existing scope of services.

<u>Appendix B</u>

1. **Can the data table include data sources and periods of record for determining the average concentration of TN and TP? [A, C, D]**

    <u>Answer</u>: Yes, this is included in the updated Appendix B.

2. Include averages across multiple years vs a single year. [A]
   Answer: Yes, this is included in the updated Appendix B.

3. When determining average, how were results handled that were below detection limit? [A]
   Answer: A conservative approach was taken to samples that were labeled with qualifiers indicating values below Minimum Detection Limits (MDL). These data values were considered at the MDL for the purpose of this study.

4. How were qualified data handled? [A]
   Answer: Qualified data were handled differently for the updated Appendix B. The revised Appendix B includes an explanation of how qualified data was handled and updated summary data given these changes. In general, data that contained qualifiers indicating some level of mismanagement or inaccuracy were removed from the dataset prior to analysis.

5. **Refer to station BR36 as TAMTOM/BR36 or TAMTOM in the table. [A, D, F]**
   Answer: All stations will be referred to in the water quality summary table by all known names (e.g. BR36/TAMTOM/TAMBR36) with shortened naming within the report text and mapping.

6. Consider copper, iron, and/or chlorophyll in the analysis. [A]
   Answer: Copper and iron will be considered in the updated analyses due to their potential impacts on future proposed mitigation. Since there is TN and TP data available and these are the primary parameters of interest in recommending treatment option, Chlorophyll will not be included as it is a response variable to these parameters.

7. Mention the numeric criteria of the receiving waters and list sources for all standards. [A]
   Answer: Numeric criteria associated with each station in listed in the updated Appendix B along with source information.

8. Update the TN/TP concentrations for Whitney River. [A]
   Answer: The Whitney River station data has been replaced with data collected from TT175C, which was sourced from the SFWMD DBHYDRO. This change in sourcing was determined to provide a more complete view of the pollutants leaving Whitney River than the previous station provided.

9. Support why the Peninsular standards were used and if they are appropriate in this region. [C]
   Answer: Support for using the Peninsula region nutrient standards is provided in the updated Appendix B. The standards represent the nearest geographical numeric criteria available for freshwater streams and canals. Specific numeric TN and TP criteria for the inland water monitoring stations do not exist for this region.

10. **Create a map to display the locations of the various monitoring stations referenced in Appendix B for those who are less familiar with the area. [C, D, F]**
    Answer: Maps are now provided to show both the locations of the various stations and whether their averages exceeded the established numeric concentration criterion for each parameter of interest.

11. Why were values exceeding 80% used? Clarify 80% vs 70% as a moderate concentration. [C, D]
    Answer: Values exceeding 80% were used as a method of identifying areas with average parameter concentrations below but near the established numeric criteria. These stations were considered to have moderate concentrations for comparative purposes.

12. Do not use threshold criteria at each monitoring station to determine success but rather state clear nutrient reduction targets the project will attempt to meet within the receiving waters (OFWs). [D]

Answer: Staff will present removal targets within the feasibility study based on treatment area restrictions. These targets may be based on downstream OFWs and/or achieving a certain level of efficacy for the proposed treatment trains within the feasibility study report.

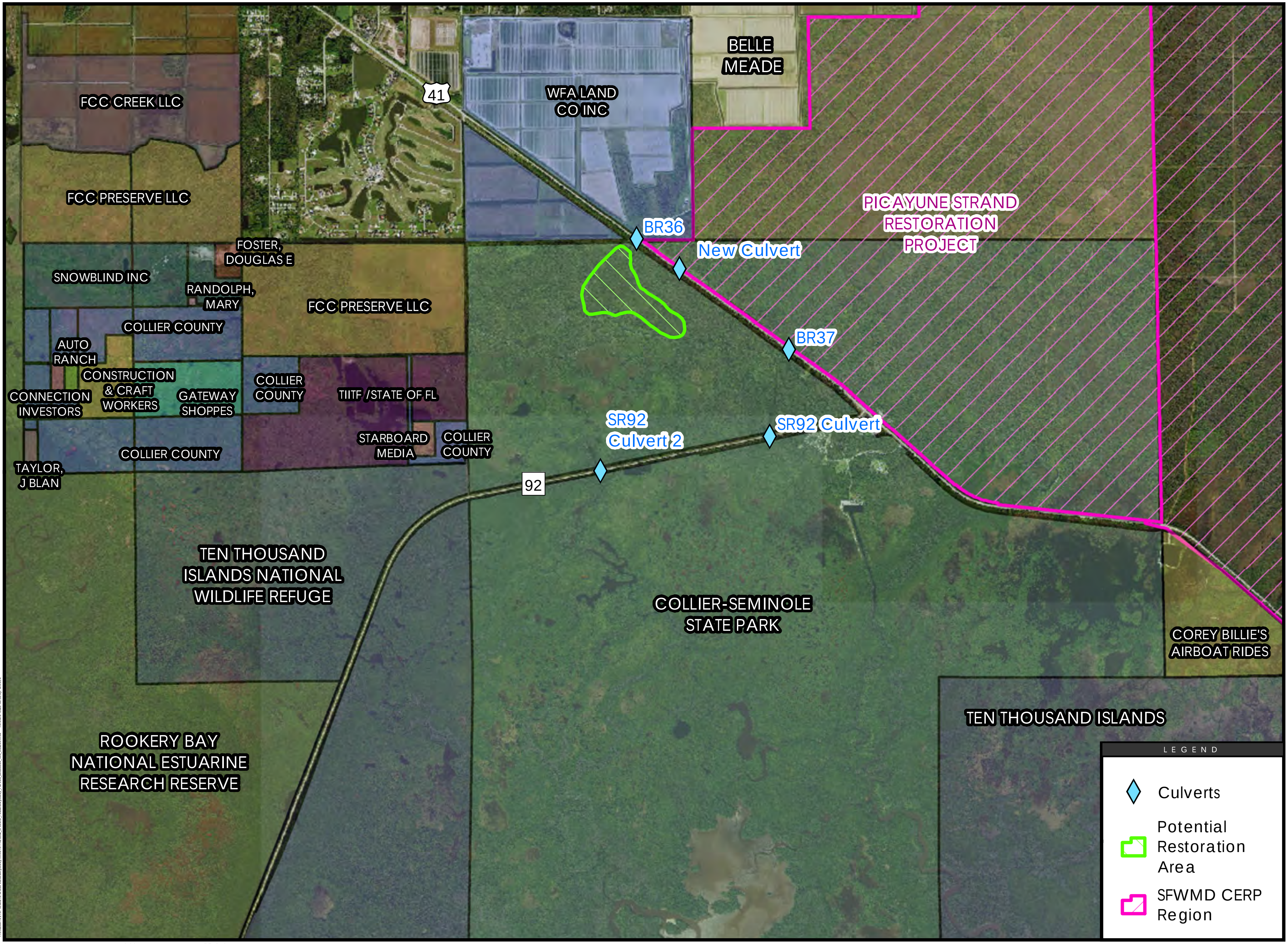
Appendix D

1. Refer to Paul Julian's comments on considering treatment area sizing based on modeled data. [C]
   Answer: This information will be reviewed while preparing aspects of the feasibility study.

Reviewers

A. Rhonda Watkins, Collier County
B. Lisa Koehler, SFWMD
C. Dr. Paul Julian, FDEP
D. Marisa Carrozzo, Conservancy of Southwest Florida
E. Kathy Worley, Conservancy of Southwest Florida
F. Meredith Budd, Florida Wildlife Federation
G. Bradley Cornell, Audubon Western Everglades

Appendix F AREA PARCEL OWNERSHIP MAP



Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

Notes:
1. Coordinate System: NAD 1983 StatePlane Florida East FIPS 0901 Feet
2. Source data: FNAI, SFWMD, Stantec
3. Imagery: Collier County

COLLIER COUNTY WATER QUALITY STUDY
AREA PARCEL OWNERSHIP
September 2020

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Prepared by: D.A.R. 09/30/20
Technical Review by: X.X.X MM/DD/YY
Independent Review by: J.B. 08/19/20

Appendix G SITE REVIEW MEMO

Collier County Water Quality Feasibility Study
Site Review Memo
October 5, 2020

A site review was conducted by Stantec staff to field assess potential water quality treatment areas located north of San Marco Road (C.R. 92) and west of Tamiami Trail East (U.S. 41).

1.Curcie Road-Collier County Property

The Collier County-owned property is located west of Curcie Road and in the southeast corner of an abandoned rock quarry. The perimeter of the subject property contains mangroves, buttonwood, and scattered amounts of Brazilian pepper. The interior of the property contains large areas of cattails, spikerush, juncus, small open water areas, and scattered amounts of melaleuca. This property could be used to receive pumped water, attenuate the pumped water for water quality treatment before being discharged. Water quality could be enhanced by the treatment/removal of exotic and nuisance vegetation on the property. Water quality could also be enhanced by re-planting nuisance/exotic vegetation removal areas with desirable native plant species. Water quality treatment ponds/cells could be constructed on the property to provide additional water quality treatment before discharge.

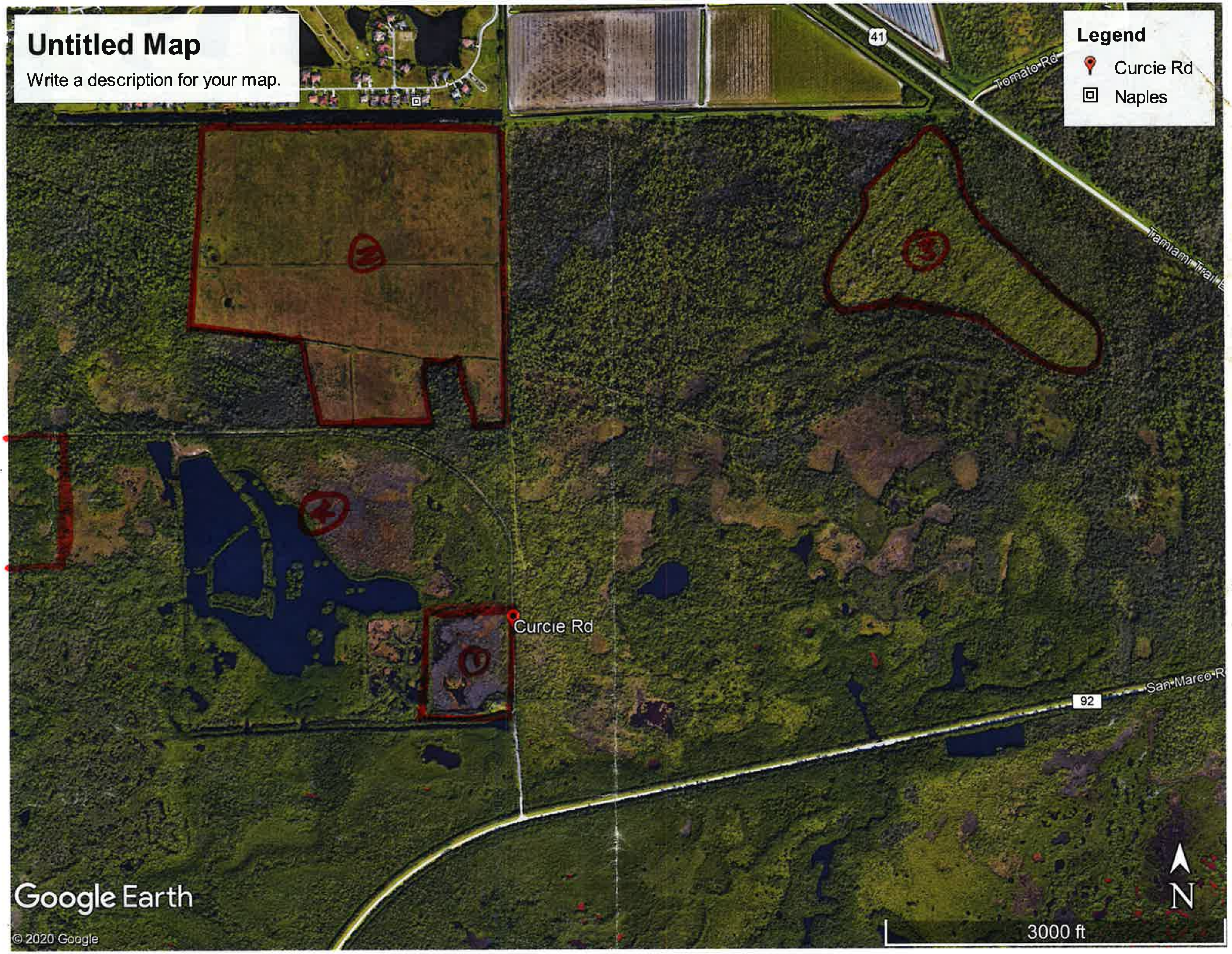
2.Fiddler's Creek Agricultural Property

Stantec was not able to gain access to the Fiddler's Creek agricultural property but staff was able to use binoculars from Curcie Road and view some of the vegetation occurring on the site. The property does not appear to be in active agricultural production and would be considered fallow agricultural lands. The property contained standing water and appeared to be dominated by freshwater plant species including spikerush, juncus, torpedograss, and sawgrass, with scattered melaleuca, wax myrtle, and Brazilian pepper. This property could be used to receive pumped water, attenuate the pumped water for water quality treatment before being discharged. Water quality could be enhanced by the treatment/removal of exotic and nuisance vegetation within the property, and further enhanced by re-planting nuisance/exotic vegetation removal areas with desirable native plant species. Water quality treatment ponds/cells could be constructed on the property to provide additional water quality treatment before discharge.

3.Fallow Agricultural Area

A fallow agricultural area was observed occurring west of Tamiami Trail East (U.S. 41) and southwest of Tomato Road. The fallow agricultural area appears to have been abandoned many years ago. A perimeter berm surrounds the fallow agricultural area and the interior contained large amounts of primrose willow (exotic) and Carolina willow. Scattered cypress trees were also observed within this area. Pumped water could be directed into this system, attenuated for water quality treatment, and then discharged. Water quality could be enhanced by the treatment/removal of exotic and nuisance vegetation within this system, and further enhanced by re-planting nuisance/exotic vegetation removal areas with desirable native plant species. The native habitats adjacent to the fallow agricultural area contained varying amounts of Brazilian pepper, Java plum, melaleuca, Old World climbing fern, Caesar-weed, and other nuisance/exotic plant species. The treatment/removal of exotic/nuisance plant species from surrounding habitats could also improve regional water quality. Water quality treatment ponds/cells could be constructed on the fallow agricultural property to provide additional water quality treatment before discharge. According to the NRCS Soils Survey, there may be scattered upland habitats located between the Fallow Agricultural Area, Curcie Road, and the Fiddlers Creek Agricultural property. Upland areas could be converted to water quality treatment systems if approved by local, state, and federal permitting agencies. Additional field review will be required to assess the subject area for potential upland habitats.

4.The Rookery Bay-owned Curcie Road rock quarry property contains mangrove/buttonwood habitats, open-water areas, and freshwater habitats. Water quality could be enhanced on the site by the treatment/removal of exotic and nuisance vegetation. Water quality could also be enhanced by re-planting nuisance/exotic vegetation removal areas with desirable native plant species. If water could be pumped into the property, additional water quality treatment could occur before discharge. Pumped water could be directed into this system, attenuated for water quality treatment, and then discharged. Water quality treatment ponds/cells could be constructed on the property to provide additional water quality treatment before discharge.


Untitled Map
Write a description for your map.
Legend
Curcie Rd
Naples
41
Tomato Rd
Tamiami Trail E
Curcie Rd
92
San Marco Rd
N
3000 ft
Google Earth
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Appendix C PUBLIC MEETING NOTES AND MATERIALS

Public Meeting Summary Notes

Stantec

Project Name: **Collier County Sub-Regional Water Quality Feasibility Study**
Meeting Title: Public Workshop 1
Date/Time: Monday, August 31, 2020, 3 p.m.
Location Via Zoom: https://zoom.us/webinar/register/WN_WHiQOgh_QV29vxbxM9SqUQ

Meeting opened at 3:00 p.m.

ATTENDEES

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Karl Schneider, kschneider@gannett.com	Tom MacVicar, tom@macv-inc.com
Kathleen Smith, kathleen.smith@myfwc.com	Tracy Robb, tracy.robb@floridadep.gov
Kenny Hayman, kenneth.hayman@floridadep.gov	Ximena Pernett, xpernett@northstar.com
Kevin Yue, kyue@sfwmd.gov	Yvonne McClennan, Quest Corporation, Yvonne.mcclennan@QCAusa.com

Attendees via phone without ID:
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INTRODUCTIONS

Joanna Weaver, Project Manager for South Florida Water Management District, opened the first public meeting for the study that will develop alternatives for improvements of flows to downstream areas of Outstanding Florida Waters.

Charlette Roman, South Florida Water Management District, governing board member, welcomed attendees to the first public meeting of the Collier County Sub-Regional Water Quality Feasibility Study. In the spirit of Governor DeSantis' Executive Order 19-12 calling for greater protection of Florida's environment, the District proposed a collaborative water quality feasibility study within the Big Cypress Basin and involving local stakeholders in Collier County. Included in this study would be evaluating current and future flows under U.S. 41 and CR 92 south and west of the Comprehensive Everglades Restoration Project, south of the Picayune Strand Restoration Project. In May, the governing board approved the proposal and work began. Together the stakeholders, the public, contractors and our staff will all work with the District to review the data and evaluate sub-regional water quality conditions of flows into Collier Seminole State Park, Rookery Bay National Estuarine Research Reserve and the Ten Thousand Island National Wildlife Refuge, and come up with solutions to address flows and improve water quality. She urged public participation in this study to meet the desired outcomes of the project. If we are to put together a conceptual plan along with cost benefit analysis to address these flows and water quality, we will need everyone's participation to achieve that outcome.

Yvonne McClennan introduced the partner agencies and instructions for overall technical support and for the questions and answers session.

Tim Hancock, Stantec, introduced panelists from Stantec Consulting, Kyle Goodwin and Jennifer Brunty.

PRESENTATION

Overview (Tim Hancock, Stantec)

Unlike other studies that start from scratch, this study will build on prior work and successful practices to identify potential projects that upon implementation, will serve to improve downstream water quality. We will not be starting over. We are going to stand on work to date and bring that forward through an evaluation and assessment process. This will provide a running start to move forward with funding and allow for short term improvements while longer term gains continue to be evaluated.

The physical study areas generally are best described as the contributory areas feeding into the Collier-Seminole State Park, Rookery Bay and Cape Romano.

This study is a key step and will develop a collaborative list of cost-effective alternatives to improve water quality. By evaluating the large body of work that has been done to date in the larger project area, as well as an assessment of proven effective techniques that are ongoing in Florida, our team will be able to identify cost effective options that serve to reduce downstream nutrient discharge and/or re-distribute flows prior to entering downstream waters and provide better water quality feeding our Outstanding Florida Waters (OFW).

As the study is further developed, we will be able to share with the community the findings and recommendations through a series of public meetings. This is the first of three meetings and is an introduction to the project.

Project Scope (Kyle Goodwin, Stantec)

The scope for this project includes three primary tasks: the information collection summary report, public meetings, and a feasibility study. We have reviewed a wide range of existing studies, literature and potential water quality treatment approaches relevant to this study area based on information provided by the Project working group. A list of these resources will be included in the information collection summary report. The feasibility study report will include a general review of technically feasible project alternatives for water quality improvement identified in the study area. Four to six specific alternatives identified in the information collection summary report will be chosen for further analysis under the feasibility study. The information collection summary report will also include a narrative of why treatment alternatives were included or excluded.

Public Meetings (Tim Hancock, Stantec)

This meeting is being recorded and available for review and comment. The second meeting is tentatively scheduled for the week of October 19, 2020, during which we will share the draft information collection summary report and have more detailed discussion on potential applications. The third meeting will be held the week of December 7, 2020, to review the draft feasibility study and further discuss the potential applications being considered.

Feasibility Study (Kyle Goodwin, Stantec)

The feasibility study will further detail the information that was collected during the information collection summary report and provide a suite of actionable water quality improvement technologies. The previously identified four to six water quality improvement alternatives will be evaluated based on several criteria, including nutrient reduction, estimated level of effectiveness, potential ecological impacts, cost, O&M requirements, regulatory constraints, schedules, land use and availability, funding, and a trade-off analysis.

Project Schedule (Kyle Goodwin, Stantec)

The three project tasks include the information collection review report, public involvement meetings, and the feasibility study report. Stantec has been working in concert with the District and the Stakeholders on the information collection and review report since early July and will be submitting the final report on October 13, 2020. Two more public meetings are planned. The second meeting is tentatively scheduled for the week of October 19, 2020 with the third the week of December 7, 2020. The information collection and review report will be released prior to the next public meeting. We will begin the feasibility study this week. Materials from that report, stakeholder input and public comments will be used to guide this study and will be included in the final report.

Potential Applications (Jennifer Brunty, Stantec)

The team has reviewed many documents and information on water quality, studies on different technologies and information about the technologies themselves. From the literature reviewed, we selected 14 technologies identified during review of information sources provided by the working group. We will introduce the most common three examples today. They are the most proven technologies in nutrient reduction.

- First is the Constructed Treatment Wetland, which is used frequently and has been proven effective. These are built in a confined area with a berm around them with plants inside that remove nutrients and reduce concentrations of nitrogen and phosphorous in the water between the in-flow and the out-flow of the wetland. These wetlands can be designed in many ways with many possibilities which we will be looking at in the feasibility study. This is a very proven technology with many of these already in use. Plants are generally the best technology to remove nitrogen from the water. There are also wildlife habitat benefits associated with constructed treatment wetlands.

- The second is Stormwater Detention Areas and/or Settling Ponds, which can be designed in many ways. They may or may not have plants to remove nutrients, but their primary function is to detain water flows long enough to allow sediments and suspended solids to settle out, either over a wide shallow basin or within a deeper pond. As the sediment settles out, many nutrients attached to the sediments (particularly phosphorus) settles out as well. Also, these ponds or detention areas slow down large slugs of stormwater after significant rainfall events, allowing the water to leave the outflow area at a controlled rate and not overwhelm other downstream receiving systems. This controlled flow has a better chance to treat outcoming water for nutrients overall and reduces erosion and destruction of plants.

The third technology is the Spreader Canal or Berm, which also have many different design options. The spreader features transform a point source flow into a sheet flow pattern or more wide-spread dispersion pattern to redirect the point source flow over a larger area. Instead of having a single canal discharge in a single place, you may have a canal that has numerous breaks in the levee next to the canal to let flow downstream in many places to more closely resemble sheet flow. This helps not to overwhelm the downstream receiving systems and helps to re-hydrate hydrologically altered wetlands. This technology spreads the water over a wider area and may be treated by a wider area of plants or other technologies available downstream. A spreader canal may be designed so that the downstream side of this linear spreader feature is lower than the upstream side, resulting water spilling over into the receiving area in a relatively uniform sheetflow pattern. Alternatively, culverts may be placed through a berm at equal heights to allow water to flow from the detention area upstream of the berm through the berm in a dispersed pattern that more closely mimics sheetflow.
There are various ways to design the discussed technologies or a series of technologies. Currently, we are not recommending one technology over another at this time, though design options will be reviewed during the feasibility study phase of the project.

Summary (Tim Hancock, Stantec)

We hope this effort has provided a better overview of the target areas for improvement and the specific objectives for the study. Also, the elements that will be coming forward for public review and comment as we proceed. As information is reviewed and evaluated, increased focus will turn to identifying the proven applications for implementation in the very near future. This is a very targeted direct effort, that starts with Governor DeSantis and carries throughout the State. The Governing Board is implementing the project through both the District and the Big Cypress Basin (?), and we are extremely pleased to be partnered with them to make this happen. Our next milestone will be the completion of the information summary collection report, which will be available on October 13, 2020. The next public meeting, where we will discuss the information collection summary report in detail, will be held the week of October 19, 2020.

We hope this format has been successful in conveying base information that will foster thought and ideas. One of the benefits of these virtual meetings is we have seen public participation levels that meet or exceed in-person events.

QUESTIONS/ANSWERS (Yvonne McClennan, Quest Corporation of America)

Q/A 1

Tracy Robb: I noticed that the map oval doesn't include the area to the west that looks like there would have an opportunity for treatment and I was wondering if it was restricted because of the Corps plan to just focus on the Picayune or can we look further west? In the information gathering are you looking at existing permits in the area?

Tim Hancock: Clarified that the map is a general study area, not an absolute boundary. Some of the area is outside of the oval. This is general area to see alternatives for improvements.

Jennifer Brunty: Yes, we have looked at existing permits and land where alternatives can be included. The draft report includes some of those relevant permits.

Q/A 2

Michael Ramsey: Is there any data to suggest the need for a feasibility study in this area? If so, what is it?

Jennifer Leeds (SFWMD): Yes, in general we have existing data and monitoring sites with partners throughout this area, Picayune Forest and in Collier State Forest collections (?). We have seen some major projects and changes to hydrology and flows and this is a good time to work with stakeholders for opportunities to address concerns in those flows. We have the data and can share it.

Q/A 3

Thomas Van Lent: My first question is related to the study objective. The stated objective was "reduce nutrient loading." However, the receiving waterbodies are Outstanding Florida Waters, and current nutrient levels are likely resulting in degradation. Why isn't the objective "What is needed to meet OFW water quality standards?"

Jennifer Leeds: We are on a rapid timeline for this feasibility project. We want it completed within a couple of months. We are also working with local partners and state agencies – not looking at hard numeric target but knowing there are lots of narrative standards but also look within the time that we have within this study. Good suggestion and we will take into consideration with the time we have.

Q/A 4

Thomas Van Lent: My second question is related to the repeated emphasis on “actionable alternatives.” What is the definition of “actionable?” Is it related to cost, available technology, land availability, or something else?

Kyle Goodwin: The feasibility study will identify several water quality improvement technologies. Each improvement will have different criteria and the feasibility study will describe how they relate to each other. Depends on which one is done at a time. It is a reference for the area.

Q/A 5

Gary Ritter: Was the study area determined based on existing water quality data that showed improvements were needed?

Jennifer Brunty: The Picayune Strand Resource Project shows a projected increase in flows under US 41 after the project is constructed. This project is intended to assist with treating the nutrient loading that may result from these and other flows.

Jennifer Leeds (SFWMD): Water quality is a much higher priority statewide and for the Governor. We are looking to see how to improve water quality within the area available for improvements. We are looking at the water quality in the area to see what can be done quickly while thinking out of the box instead of putting in massive projects in large areas. More constructed wetlands and more passive in nature. Low key that provide good lasting water quality benefit and fit into smaller areas. Rerouting, spreader swales, passive approaches versus pumping. Lowkey but provide water quality improvements. There are small land areas and we do not want water wetlands to address and improve water wetlands (?). We want to group them to capitalize and utilize alternatives. We are looking at funding options like grants and potentially cost sharing to make improvements quickly.

Tim Hancock: There are two ways to score runs: grand slams or lots of singles and doubles. This is not a grand slam. These are interim actionable items that can make a positive impact. We are going to do it incrementally, a run at a time. Land and costs will be part of the matrix for a recommendation.

Q/A 6

Tracy Robb: Water quality part, is the study also looking at sources of the water quality or just treatment?

Jennifer Leeds: We are focused on what we can do going forward to improve water quality and less on the source.

Q/A 7

Michael Ramsey: The comments indicate that proposals for alternatives are already being proposed for issues that have not been shown to be present. For example, I am not aware of any algae issues in this area of Collier County. Also, the hydrological area of the Big Cypress Basin does not have the same issues as the Everglades basin and should not be imposed as such.

Jennifer Brunty: We have available documentation from the Everglades area but we are also looking at engineering issues, land issues, flow rates, nutrients, site specific factors, and lessons learned from the basic technology which can be adjusted to this site for the feasibility study.

Tim Hancock: We talked about available alternatives; however, they are not pre-determined. They were presented to give you things to think about. We will consider various components.

Q/A 8

Michael Ramsey: Prior comments give me concern about unintended consequences to Golden Gate Estates with this study.

Jennifer Brunty: There should not be any effect to Golden Gate Estates since we are looking at implementing projects only south of U.S. 41.

Michael Ramsey thanked the group.

Yvonne encouraged the public to sign-up for meeting notifications. Tim also asked attendees to forward the meeting information to others.

Meeting closed at 3:48 p.m.

South Florida Water Management District

Collier County Sub-Regional Water Quality Feasibility Study

Stantec

Charlette Roman

South Florida Water Management District Governing Board Chair

Agency Stakeholders

Introductions

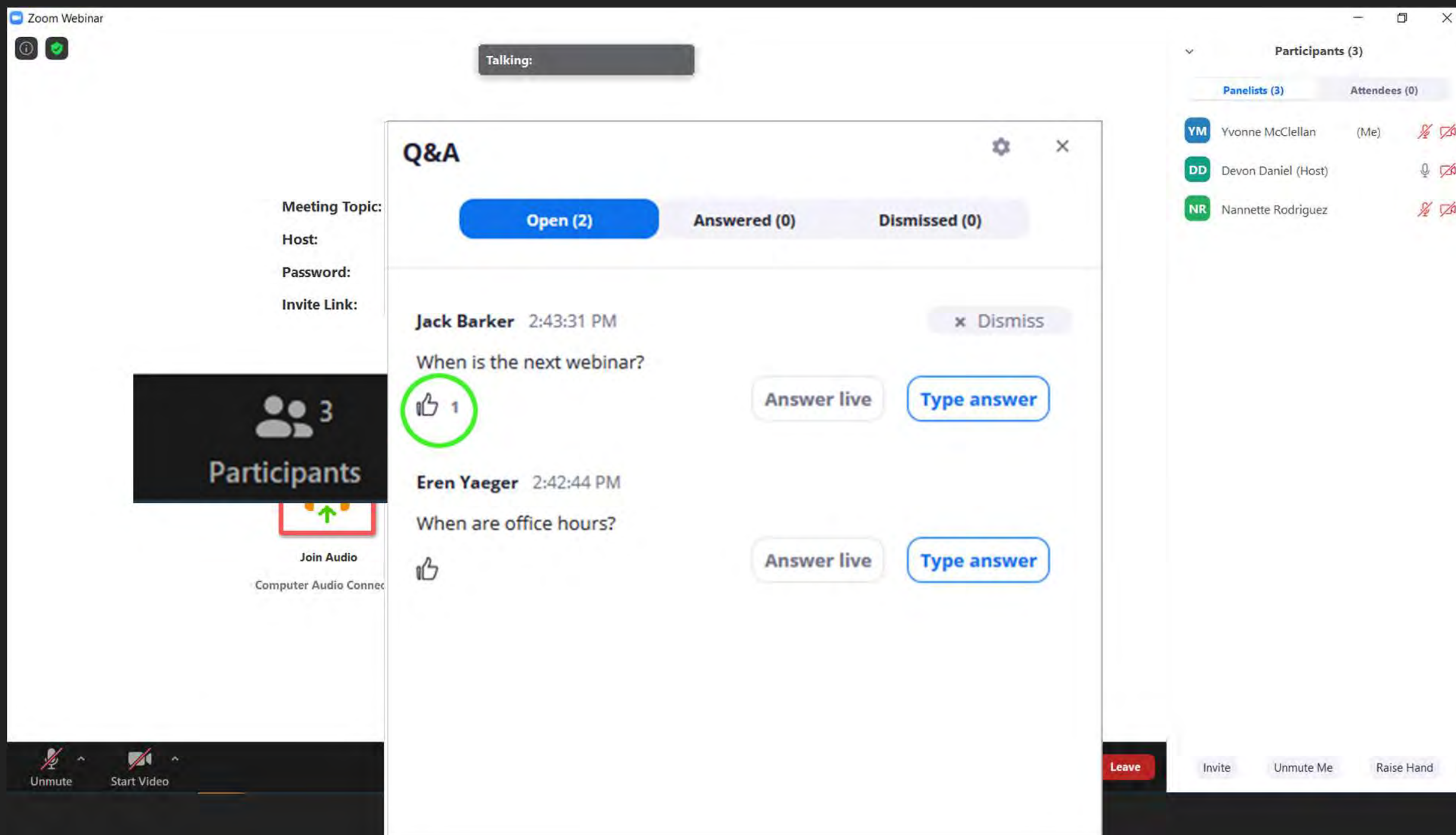
Zoom Technical Support – Online Resources
https://support.zoom.us/hc/en-us/articles/201362003

Zoom Support Live Chat

- Visit the website below and select the “Contact Support” link in the upper right corner

https://support.zoom.us/hc/en-us

Zoom meeting troubleshooting



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DD Devon Daniel (Host)
NR Nannette Rodriguez
Invite
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Raise Hand

Q&A

Kyle Goodwin
Stantec

Jennifer Brunty
Stantec

Tim Hancock
Stantec

Panelists

Agenda

- Overview
- Project Scope
- Project Schedule
- Potential Applications
- In Summary
- Q&A

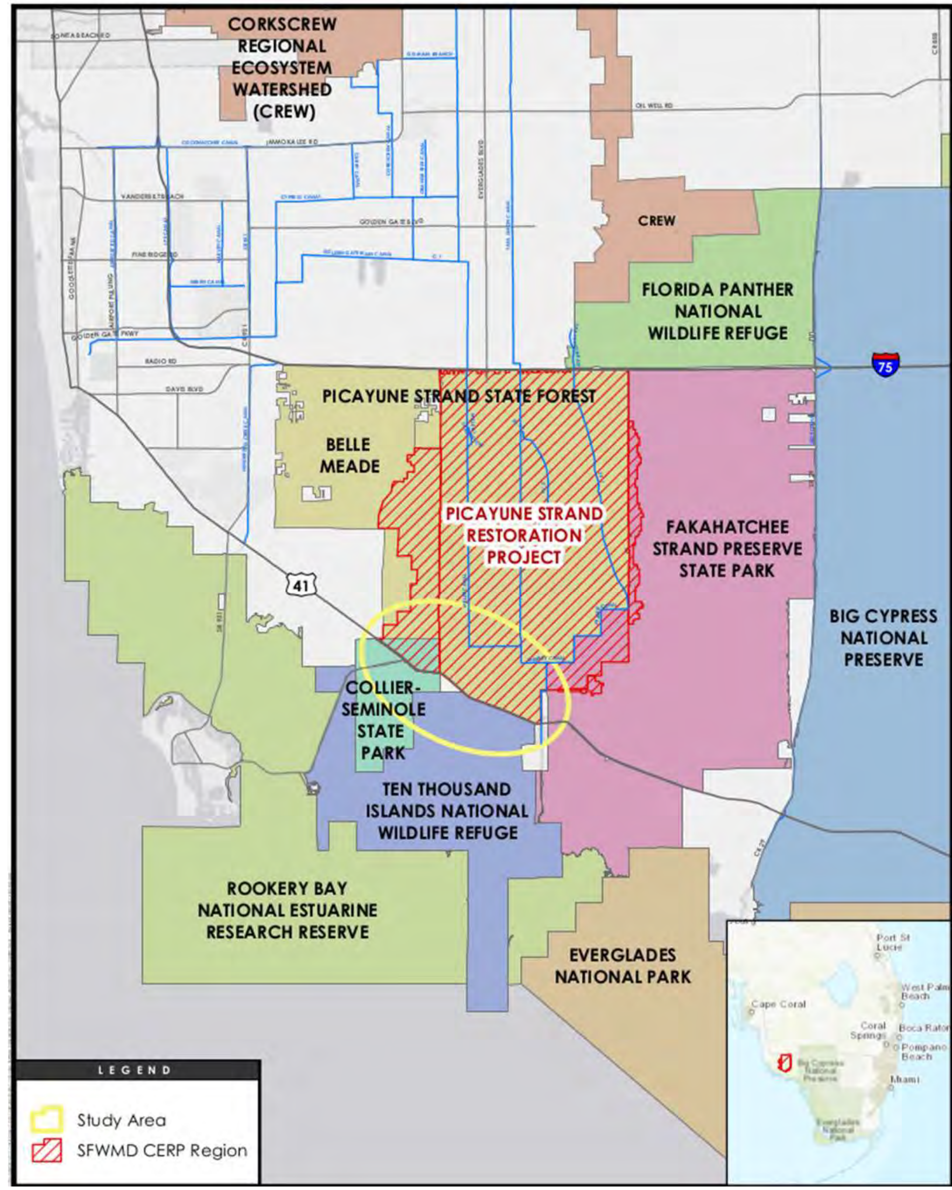
Study Overview

Study Overview

To examine conventional and innovative water treatment resources, stormwater redistribution, and active or passive water quality improvement projects towards reducing nutrients in the downstream areas of the Outstanding Florida Waters (OFWs) from the Picayune, Belle Meade, agriculture, and urban watersheds.

Discharges to OFW

- Collier-Seminole State Park
- Rookery Bay Estuarine Research Reserve
- Cape Romano-Ten Thousand Islands Aquatic Preserve



Study Objectives

- Collaboratively **develop a suite of alternatives** of cost-effective projects to **improve water quality** and/or re-distribute flows prior to entering the downstream OFW

- Conduct a literature review of existing pertinent studies and literature

- Conduct three (3) public meetings

- Identify cost-effective options that reduce discharge of nutrients

Project Scope

Project Scope

- Information Collection Summary Report
- Public Meetings
- Feasibility Study

Information Collection Summary Report

- Executive Summary
- Introduction and Background
- List of Reviewed Data Sources/Literature and References
- Review Methodology
- Literature Review and Analysis
- Applicable Treatment Options
- Summary

Public Meetings

- **Public Meeting 2**
  - Tentatively scheduled for week of 10/19/20
  - At end of the preliminary draft feasibility study task
  - Updated information about potential applications being considered

- **Public Meeting 3**
  - Tentatively scheduled for the week of 12/7/20
  - During draft feasibility study task
  - Updated information about potential applications being considered

Feasibility Study

- Executive Summary
- Introduction and Background
- Identify Problems, Constraints and Opportunities
- Formulate Alternatives
- Evaluate Alternatives
- Compare Alternatives
- Funding Options
- Recommendations and Next Steps
- Appendices (Work product from Tasks 2 and 3)

Review Project Schedule

Project Schedule

Collier County Sub-Regional Water Quality Feasibility Study

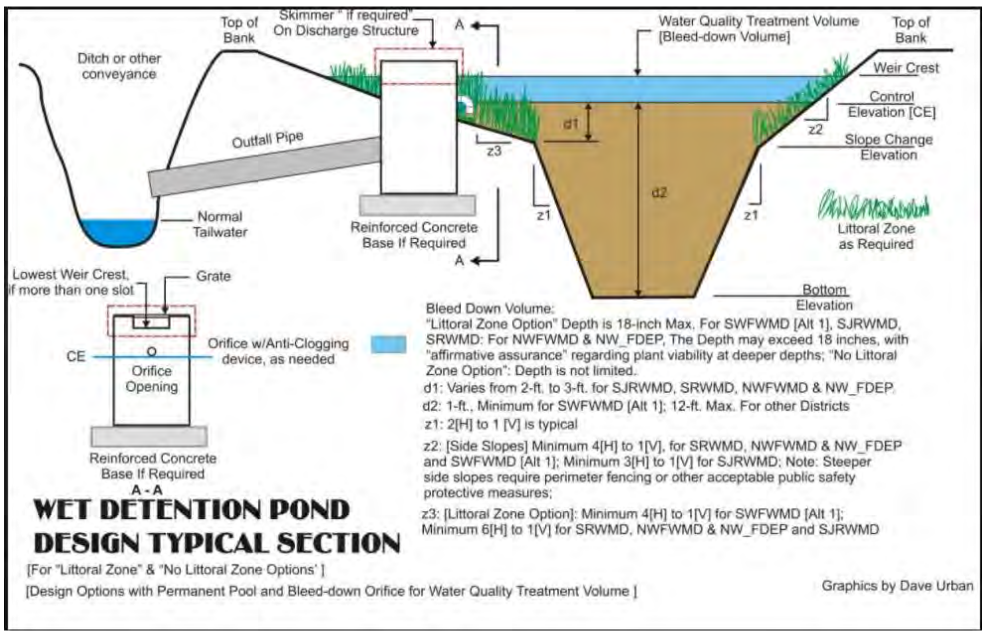
Schedule - Public Involvement Meeting #1

Task	2020																		2021												
	31-Aug	7-Sep	14-Sep	21-Sep	28-Sep	5-Oct	12-Oct	19-Oct	26-Oct	2-Nov	9-Nov	16-Nov	23-Nov	30-Nov	7-Dec	14-Dec	21-Dec	28-Dec	4-Jan	11-Jan	18-Jan	25-Jan	1-Feb	8-Feb	15-Feb	22-Feb	1-Mar	8-Mar	15-Mar	22-Mar	29-Mar
Information Collection and Review Report																															
Public Involvement Meetings																															
Feasibility Study Report																															

Potential Applications

Constructed Treatment Wetlands

- Constructed wetlands mimic functions of natural wetlands
- Numerous already in use
- Reduce nutrients through plant uptake, sediment deposition
- Proven technology
- Land area requirement depends upon nutrient loading
- Provides wildlife benefits



Stormwater Detention/Settling Ponds

- Captures peak stormwater flows
- Releases water at a steady rate to receiving water, including constructed or natural wetlands
- Allows for sediment deposition
- Allows downstream systems to better treat stormwater
- Have been shown to reduce nutrients between inflow and outflow
- Land area requirement varies

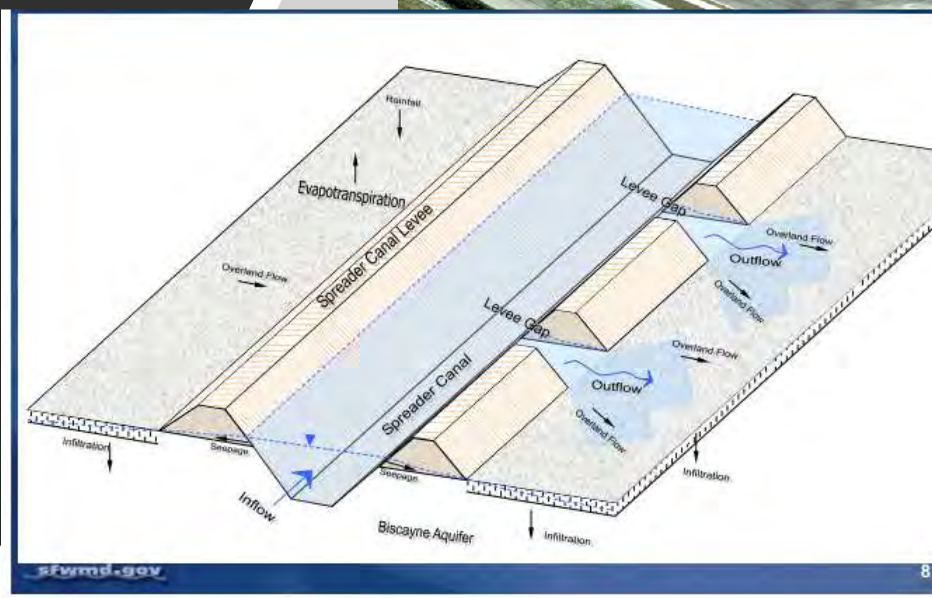
Photo: Diagram of typical detention pond design with littoral shelf of native plants

Source: https://cybererpreviewer.com/about-software/wet-detention-with-permanent-pool-littoral-zone-and-bleed-down/

Spreader Canal/Berm

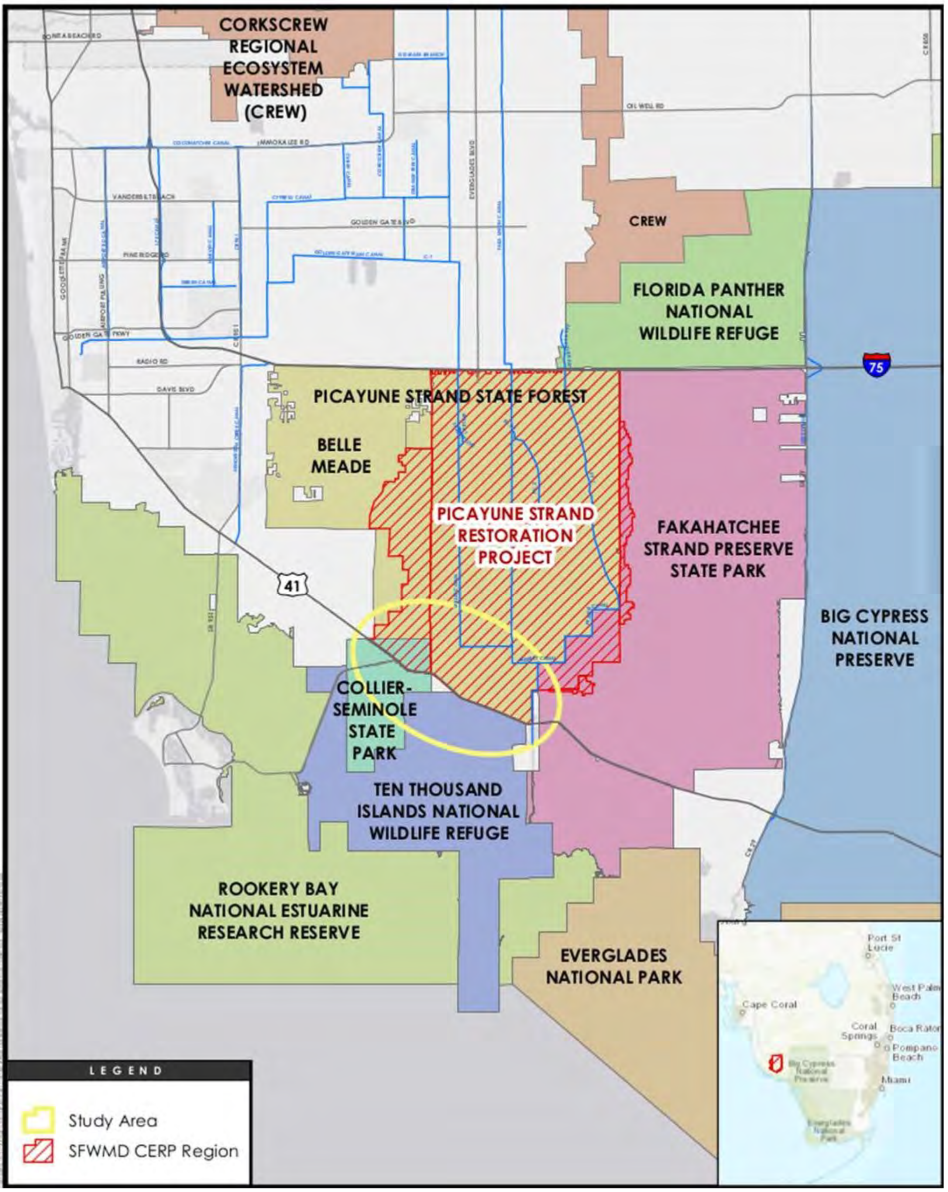
- Slows flow through detention
- Allows sediment deposition
- Assists other technologies such as constructed wetlands
- Improves treatment in receiving waters
- Spreads outflow to mimic sheetflow – restores hydropatterns
- May require a large area

SFWMD Lake Hicpochee Shallow Storage with Spreader Canal. The G-726 will send stored water from the 670-acre flow equalization basin into a spreader canal for distribution into the northwest part of Lake Hicpochee



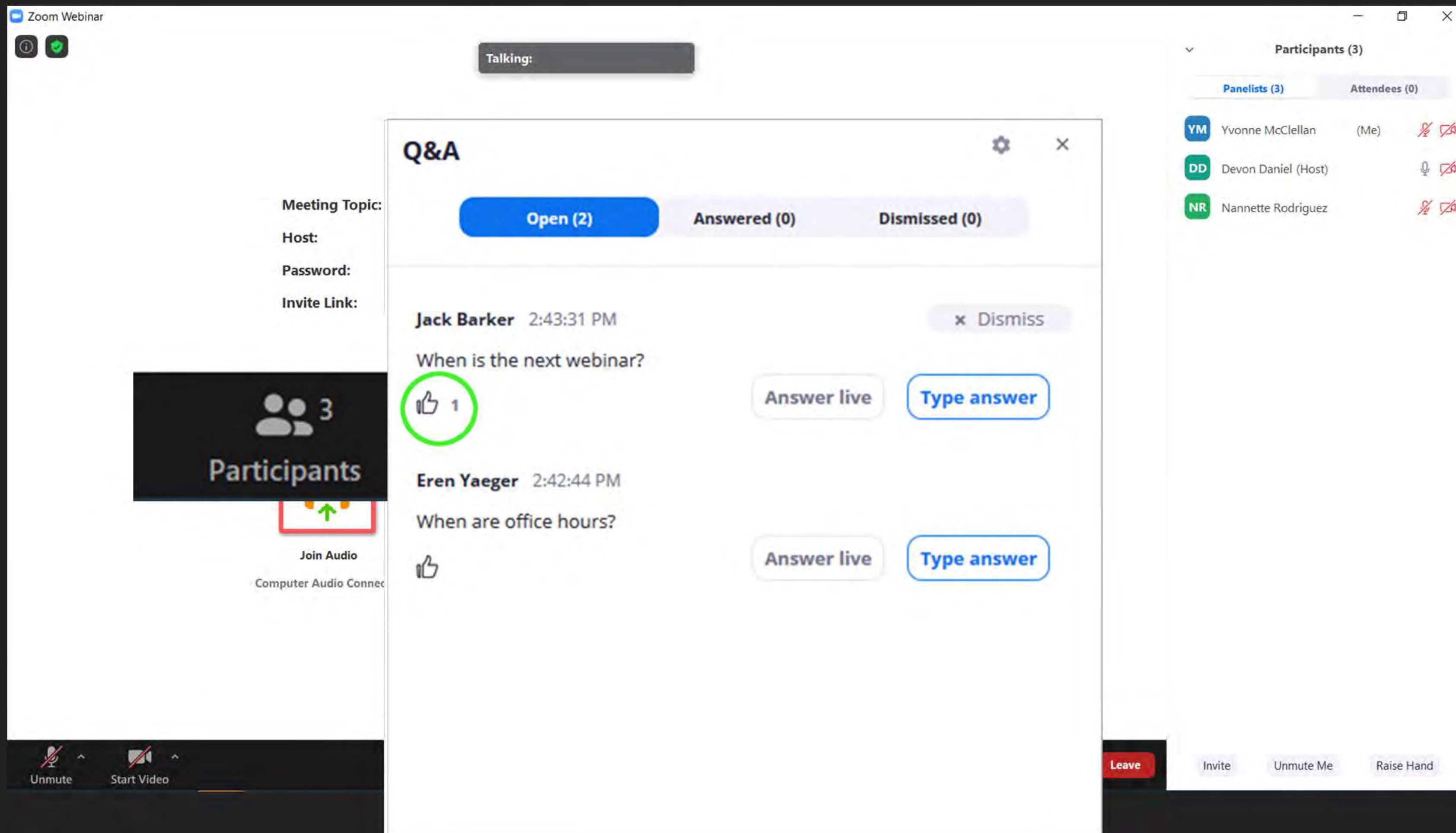
The Spreader Canal is designed to receive water from the C111 Canal and disperse the water across the marsh to create sheet flow. This is the schematic diagram of the Spreader Canal segment with the levee gaps on the south side, to promote sheet flow across the restored marsh.

Summary



Summary

- Project Overview
- Objectives
  - Information Collection Summary report
  - Public Involvement Meetings
  - Feasibility report
- Potential Applications
- Next Steps
  - Completion of Information Collection Summary Report
    - 10/13/2020
  - Next Public Meeting
    - Tentatively 10/19 – 10/23/2020



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Q&A

If you’re participating via Zoom –

- Submit your questions via the Q&A chat box
- If you are unable to, use the Raise Hand feature

If you’re participating via Phone –

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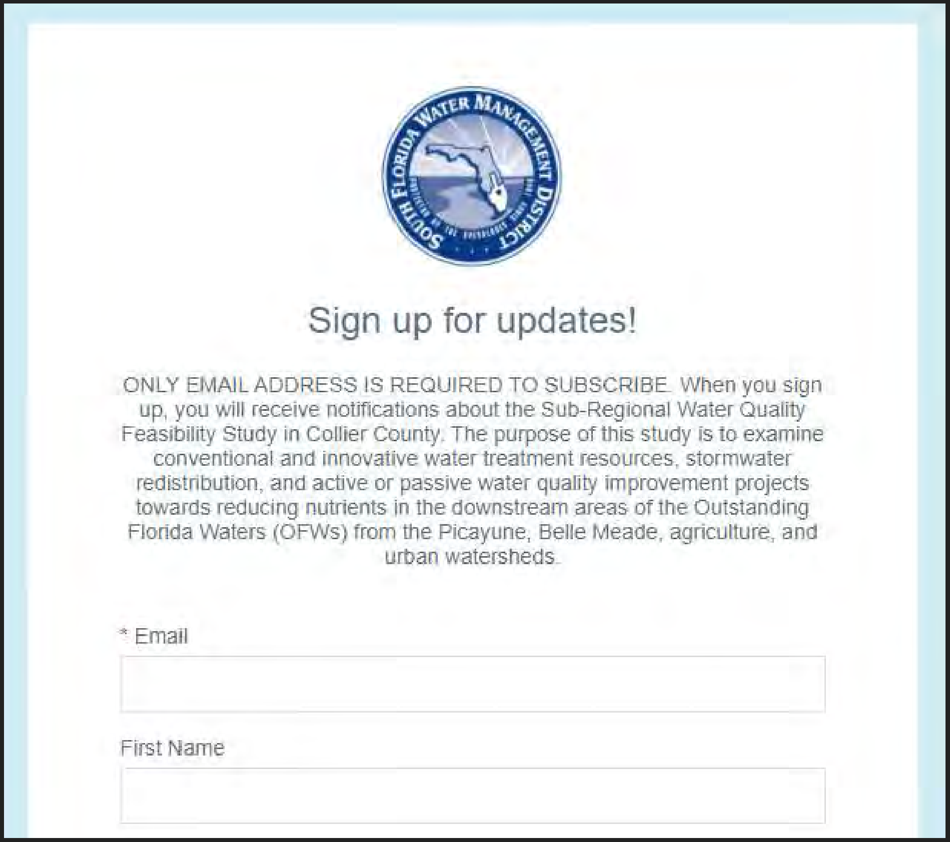
Q&A

To sign up for project notifications, visit:

https://lp.constantcontactpages.com/su/8G8AunX/CCSRWaterQStudy



SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Sign up for updates!

ONLY EMAIL ADDRESS IS REQUIRED TO SUBSCRIBE. When you sign up, you will receive notifications about the Sub-Regional Water Quality Feasibility Study in Collier County. The purpose of this study is to examine conventional and innovative water treatment resources, stormwater redistribution, and active or passive water quality improvement projects towards reducing nutrients in the downstream areas of the Outstanding Florida Waters (OFWs) from the Picayune, Belle Meade, agriculture, and urban watersheds.

* Email

First Name

Thank you for your participation!

Current Potential Applications List[1]

- Constructed Treatment Wetlands
- Detention/Settling Ponds
- Spreader Berms and Canals
- Restored Wetlands
- Offline Alum Treatment
- Air Diffusion System (ADS)
- Periphyton/Submerged Aquatic Vegetation (SAV)
- Algal Scrubbers
- Floating Treatment Wetlands
- Bold & Gold
- NutriGone Media™
- Downstream Defender®
- Aquifer Storage and Recover (ASR)
- Deep Well Injection

1. Identified during the literature review. These potential applications will be analyzed during the Feasibility Analysis.

Picayune Watershed Water Quality Feasibility Study
Public Workshop 2
Monday, October 20, 2020, 3 p.m.
Location: Via Zoom https://zoom.us/webinar/register/WN_DfOyLJ5YTmyUsBPFrfXhFQ
YouTube presentation replay: https://www.youtube.com/watch?v=KHXGXnxWE7U&t=1282s

Meeting opened at 3:00 p.m.

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INTRODUCTIONS

Joanna Weaver, the project manager for South Florida Water Management District leading the study opened the second workshop for the Picayune Watershed Water Quality Feasibility Study, formerly known as the Collier County Sub-Regional Water Quality Feasibility Study. She explained the project's working group felt it important to change the name of the study to better reflect the area that comprises the study. She thanked members of the working group, technical group, and the public for attending the workshop and participating in this important study to develop alternatives for cost-effective water quality improvement to the flows to the Outstanding Florida Waters and Collier County. Ms. Weaver introduced Jennifer Reynolds, a division director of the ecosystem restoration and capital projects for the South Florida Water Management District.

Jennifer Leeds thanked everyone for participating in the workshop and shared that about 100 people joined the Zoom meeting. She shared that we are at a very important place in this study – we are at the point where we start to really roll up our sleeves and talk about what we can do now and in the very foreseeable future.

She shared we are all here as part of the team to ensure our beloved and sensitive water bodies – including Rookery Bay, the Ten Thousand Islands, and Collier-Seminole State Park – get the cleanest water possible.

There have been long-standing agricultural businesses in this area, coupled with increasing development and everything associated with adding people to the landscape – all those activities contribute to the nutrients and the runoff that are problematic.

This study is not about pinpointing the specific sources and volumes of these nutrients and flows. Ms. Reynolds stated the upstream source contributors are in legal compliance with the statutes, the framework, and the regulations that are currently in place. She shared: maybe you want to change some of those things. That is ok, and I encourage you to engage if you want to. But this is not the place to do that.

She emphasized this meeting serves as the place to help us design some projects that fit onto the landscape that allow us to take the water we have, at the concentrations we have, and make it cleaner. If in the future, source control gets better, well, I don't think anyone will complain about our projects making the water too clean.

She shared she wants us to be practical and pragmatic. So, she presented a few things on the table up front—farms in this area have been inspected by FDACS in the past 6 months. They are all in compliance with their Best Management Practices (BMPs) – and Lipman Farms, in particular is implementing advanced BMPs that exceed their regulatory requirements. They have also been longtime supporters of the Picayune Strand Restoration Project, and have, in fact – which most of you probably don't know, made a significant contribution to the project by donating a necessary easement on their property. She called attendees to focus on how we work together as a team with the water that we have and asked that we not point fingers trying to place blame or make someone out to be a villain for continuing to run their business, water their lawns, or drain their streets or fields into the canals designed for those purposes. Instead, to focus on what we could do if we can find a partner or partners willing to work with us. She shared she would like to partner with landowners and/or developers to implement projects on private or existing public lands that improve water quality and don't create an additional burden on anyone. Maybe that includes enhancing treatment in existing stormwater ponds, maybe that includes enhancing wetlands in conjunction with existing mitigation areas, maybe that includes cleaning out exotic vegetation and creating a natural wetland or adding chemical treatments to a settling pond. Maybe it is a project that would enhance the property for recreational use. Maybe it would be a temporary project allowing the land to revert back to existing use in the future, like our dispersed water management projects do.

All of those are options that we can consider during this study. Let's focus on the map. Let's be realistic about how to make everyone a willing partner in the solution. And let's develop some projects the District can have up and running in the next 2 to 3 years.

PRESENTATION

Stakeholder Introductions & Technology Housekeeping (Yvonne McClellan, Quest)
Prior to starting the formal presentation, Yvonne McClellan of Quest Corporation of America, introduced agency stakeholders who are involved and working collaboratively on the project including South Florida Water Management District (District), the Florida Department of Environmental Protection (DEP), the Florida Department of Agriculture and Consumer Services, Florida Wildlife Federation, U.S. Fish and Wildlife Service, Conversancy of Southwest Florida, Collier County, Audubon Society, LAGO consulting services and Stantec.

Ms. McClellan presented some troubleshooting options for those having issues connecting to the meeting and/or hearing the audio. She explained the format for the meeting would include the presentation followed by a question-and-answer session and that attendees could submit questions at any time via the Q&A chat box and presented visuals that would help attendees clearly understand how to access this meeting tool. The Q&A chat box tool also allows attendees to see questions submitted by others and to click the "thumbs up" icon below the question to help promote the question as more important to the overall audience in the meeting.

Team Introductions & Agenda (Kyle Goodwin, Stantec)
Kyle Goodwin introduced himself and the Stantec team participating in the second public workshop.

- **Kyle Goodwin, Senior Project Manager with Stantec**, in the Naples, Florida office who is serving as the project manager on this study working closely with the District's Project Manager, Joanna Weaver, and has more than 15 years of experience in civil engineering specializing in land development, project management, and stormwater management. He is also a licensed professional engineer in Florida and Kentucky and holds an MBA. Prior to working for Stantec, he was the City Engineer for Georgetown, Kentucky where he planned city budgets, developed, and executed Capital Improvement Plans, and managed the city's MS4 Phase II program.
- **Dr. Jennifer Brunty**, with Stantec, has 27 years of experience in water quality BMP research and BMP implementation in both agricultural and urban settings. Her masters and doctoral level research focused on using BMPs to address nutrient management. Prior to working for Stantec, Jennifer worked as a Natural Resource Specialist with the Highlands County Lakes Management program for 5 years and as a Wetland Scientist for the Southwest Florida Water Management District for 12 years.
- **Amanda Ludlow**, a principal at Stantec, specializing in green infrastructure practices and sustainable treatment design. She has more than 20 years of environmental consulting experience. Ms. Ludlow has spent her career focusing on the development of innovative sustainable solutions to solve environmental problems including constructed treatment wetlands, phyto-remediation, natural media filtration, and sustainable stormwater management.
- **Tim Hancock**, a principal at Stantec with more than 30 years of public policy and community outreach experience. As a Florida native, Tim has extensive background working with the complex regulatory framework in Southwest Florida. Tim also leads public outreach and engagement efforts on environmental projects throughout the United States.

Mr. Goodwin also mentioned several District and DEP staff took part in the meeting to help facilitate discussion during the Q&A session at the end of the presentation.

Mr. Goodwin reviewed the agenda for today's meeting which included providing a review of the first public meeting which provided an overview of the project, a recap of the purpose for the study, and a summary meeting review with a few key takeaways.

He discussed how the meeting would include an overview of the information collection summary report to familiarize attendees with the project progress, and also discuss a few of the potential treatment technologies identified in the report.

Following the summary report, the project team would provide a brief overview of the feasibility study, review a real-world case study. This would be followed by a summary of the main points from the meeting and a Q&A session.

Overview (Tim Hancock, Stantec)
Tim Hancock first provided an overview of the first public meeting that was held on August 31st. The focus of the study is to review existing water quality improvement applications and studies and create an information collection summary report that will help inform decisions going forward. This report was the primary subject of this meeting. The next phase will be the feasibility study, which was discussed later in the presentation. Mr. Hancock explained the study area is intended to take the existing and future flows from the north and northeast and look for opportunities to apply proven water quality treatment applications to improve downstream water quality, which is critical because it's being received by Outstanding Florida Waters (OFWs) to the south, specifically the Collier-Seminole State Park, the Rookery Bay Estuarine Research Reserve and the Cape Romano Ten Thousand Islands Aquatic

Preserve. The purpose of the study, with the information collection summary report acting as a guide going forward, is to develop a potential suite of cost-effective projects to improve downstream water quality via reductions in nutrient levels present for current and future discharges. He explained this project is not intended to be a singular comprehensive solution but really should be viewed more as a piece of an overall matrix that will provide and improve conditions in a measurable fashion. The project area, like a lot of Southwest Florida, is dealing with a severely altered drainage scenario that is creating and contributing to some water quality issues. There are a number of upstream discharges and flows and they're restricted as they pass under US 41. He stated that this project, and this meeting, is looking at opportunities for downstream water quality improvements and doesn't have source control as its focus.

Mr. Hancock discussed how the information collection summary report informs the project team and the District going forward and how that will be discussed further later on in the meeting, along with the project schedule, anticipated dates for the next public meeting, key takeaways for the study at its current phase, and input received from the public and stakeholder groups from a high level. He stressed how water quality is a concern and a priority across the state and the last few years have served as a reminder to how critical water quality is to the success of the state and how this study will focus on passive systems that do not require a substantial degree of mechanical infrastructure to operate. Mr. Hancock reiterated that this project is viewed as part of a longer-term effort to address the ongoing issue of water quality in the area which looks to provide incremental positive impacts that can be part of a longer-term solution or solutions that serve to protect, preserve and enhance the quality of the downstream OFWs.

Review (Kyle Goodwin, Stantec)
The information collection summary report is an important foundational aspect of the study and includes the following sections: Introduction and Background, Data Sources/References Reviewed, Review Methodology, Literature Review and Analysis and Treatment Options. The many stakeholders identified earlier in the presentation have been integral to the development of the report and have been present since the beginning of the study, providing information and data sources, raising concerns, and guiding the study.

Stantec reviewed a multitude of data sources and literature both identified by the stakeholders and obtained separately. The data sources generally fell into three categories: water quality data, performance studies of existing water quality treatment systems, and descriptions of the different technologies that might be used for water quality treatment. This information formed much of the basis for the summary report and a table containing the sources reviewed is included. Within the report Stantec discussed our methodology and describe how the data sources were reviewed and utilized.

The literature review and analysis section is structured around applicable and non-applicable technologies and is essentially a consolidation of the information reviewed and presented in a format to support the feasibility study. Applicable was defined as the most common and well-established stormwater treatment technologies already in use within south Florida, as well as less common technologies that have a proven track record for nutrient removal within Florida and elsewhere. Non-applicable was defined as having uncertain effectiveness for large scale projects or for use in the south Florida environment. Within the treatment options section, a table is presented identifying pros, cons, and a recommendation on whether or not to consider the technology for the feasibility study. In summary, the primary purpose of the information collection summary report is to inform the feasibility study.

Also included in the report, are several maps and a site review memo. The area parcel map is presented in a larger format in the report and identifies adjacent properties and will be used in more detail during the feasibility study to bring scale to potential projects. This map is currently facilitating conversation and supporting efforts to identify potential project sites and understand area limitations.

With support from the Florida DEP and Parks, a site review was performed by Stantec staff to assess potential water quality treatment areas south of US 41 and a site review memo is included in the report. Stantec has reviewed a variety of reports, in addition to raw data files, to better understand water quality near the study area. Existing monitoring stations utilized by the Florida Department of Environmental Protection, Collier County, and the South Florida Water Management District were identified, and water quality data from these stations was compiled and used as the basis for the water quality study.

The nutrients summarized within the report, include: total phosphorus, total nitrogen, turbidity, copper, and iron. Monitoring station data for these nutrients have been mapped and overlaid on a digital elevation model to help provide perspective. Additional information on the data sources reviewed, the review methodology, a summary table, and the concentration maps are provided in the report.

Treatment Technology Review (Jennifer Brunty and Amanda Ludlow, Stantec)
A variety of technologies were reviewed in preparing the information collection summary report, which include:

- **Spreader Berms and Canals**
- **Polishing Ponds**
- **Constructed Treatment Wetlands**
- **Sedimentation Basin**
- **Media Filters**
- Bioreactors
- Iron Enhanced Sands
- Bold & Gold ®
- Restored Wetlands
- Air Diffusion Systems
- Periphyton (SAV)
- Hybrid Wetland Treatment Technology
- NutriGone Media™
- Recycled Water Containment Area
- Algal Scrubbers
- Offline Alum Treatment
- Floating Treatment Wetlands
- Downstream Defender®
- Aquifer Storage and Recovery (ASR)
- Deep Well Injection

Jennifer Brunty explained the technologies in bold are the technologies the project team is recommending for further review and for the feasibility study. The difference between these applicable technologies and the non-applicable technologies is that the applicable technologies on the left have a proven track record of working. A lot of them are very common types of technologies. The project team is looking at combining multiple technologies into a treatment train. We will discuss at greater length spreader berms and canals, sedimentation basins, constructed treatment wetlands, polishing ponds and various types of media filters, and additional technologies that may still be considered for use in the feasibility study including restored wetlands, air diffusion systems and periphyton.

Ms. Brunty went into detail about the recommended technology options in bold. Restored wetlands are self-explanatory. The diffusion system includes having an air diffuser or fountain or something similar into a pond or open water area and that can have some effectiveness on removal of nitrogen. It’s a supplemental technology that may or may not be added to any kind of treatment train. Periphyton goes along with constructed treatment wetlands. It’s different organisms that are growing on rocks or other plants and would probably naturally appear in constructed treatment wetlands anyway. For the non-applicable technologies, the hybrid wetland treatment technology was considered after the initial report and several stakeholders asked us to review it. However, it is non-applicable because part of this treatment technology includes the use of alum and there was a lot of sentiment against using alum treatments in natural systems. NutriGone Media is not really a proven technology. Recycled water is marginal and was identified as a technology for further research in the C-43 basin. Recycled water containment areas use berms around agricultural lands to holding water on them to let nutrients settle out and possibly be used for crop uptake later when the berms are removed at a later time. This is sometimes called water farming. Algal scrubbers aren't very effective on a large scale, and alum treatments have a negative association, especially with incorporating it into natural systems. Floating treatment wetlands only have a small-scale effect on nutrient removal and are essentially floating wetlands that are built into a mesh that floats around on top of open water and its nutrient uptake abilities are limited. Downstream Defender is a technology that doesn't have a long track record. Aquifer storage and recovery and deep well injection don't really apply to this project. All are included in the information collection summary report. The project team was given a number of documents to review during the information collection summary report phase of the project and they are mentioned in the report, but the project team does not recommend all of the treatment technologies that were considered.

Ms. Brunty reviewed the first few of the technologies the project team is recommending.
The **spreader canal or berm** allows water to flow in at a point source inlet and spreads out over an area, either behind a berm or in a created canal and, as it does this, a lot of the sediments will fall out. A lot of the nutrients in the water are attached to the sediment, so as the sediment falls out and settles to the bottom of the swale or the area behind the berm, a lot of the nutrients are initially removed that way. The water can leave a spreader swale or spreader berm area or the edge of a swale at a uniform elevation across a length of land so that as the water rises, it spills over uniformly. There may be a berm that has a number of culverts through it that also causes the water to spread out in a dispersed fashion mimicking sheet flow, which is always desirable compared to having a single point source where water is blasting out into just one little area of land and by spreading the water out, you first slow the velocity letting sediment settle and it also reduces scouring in the receiving area. Some limitations include the need for an appropriate downstream receiving area so the water doesn't overflow over the edge of the canal or the berm into a sensitive upland area that's going to be adversely impacted by suddenly receiving a lot of water that it didn't receive before. Or, say there may be gopher tortoises downstream of the spreader berm and they would get drowned out, so you need the right kind of receiving land. You also need a length of linear land in which to build this treatment option, which may or may not be possible depending on the site specifics. It also requires periodic maintenance through the removal of sediment from the bottom of the canal or behind the berm. If a big storm kicks up and a lot of sediment has accumulated, it's possible that the sediment can be re-suspended and discharge and, along with it, nutrients attached to that sediment would be discharged. These do need to be periodically maintained.

The **sedimentation basin** has some similar functions to the spreader berm canal. It is essentially a pond where water flows into it and has a chance to slow down and sediments have a chance to drop out of the water column and settle on the bottom of the pond. This is most effective for larger particles, but some smaller particles can settle out as well. It is a simple treatment technology to design; it can be sized very large or really small and is easily incorporated into treatment trains. It has excellent sediment removal capacity and, as a result, it is excellent at removing nutrients attached to sediments. Like the spreader canal it requires periodic maintenance to remove the sediments that have settled out so that if a big storm event comes, the sediment doesn't become resuspended and discharged. Sedimentation basins can be several different sizes. It may require a large land area, but it really depends on the amount of water you're trying to treat.

The **constructed treatment wetland** is a wetland that was built in an upland and the whole idea is to mimic the physical, chemical, and biological treatment mechanisms that occur in natural wetlands. First, water slows down, and sediments settle out. You can design these in a number of ways to cause a number of different types of treatment. One of the key factors is these constructed wetlands will have a lot of plants growing in them and plants are excellent at uptaking nutrients and removing them from the water column. They slow down the velocity of the water allow the sediment to settle out. The shallow marshes filter out the finer sediments, which doesn't necessarily happen in just a deep open water pool. The dissolved nutrients or uptake are taken up by plants and they can also absorb onto marsh sediments because the water is moving so slow. An additional benefit to constructed treatment wetlands is that wildlife tends to really love to congregate in these and a lot of wading birds do a log of foraging in these just as they would in a regular wetland. Typically, constructed treatment wetlands have low operation and maintenance costs if you can get them set up right and keep nuisance and exotic species out. Some limitations are that the treatment rates of a constructed treatment wetland are very site-specific, and it depends on soils, it depends on the nutrient concentrations and inflow waters. It depends on how much time the water spends in the wetland and a lot of other things. A disadvantage is that to get the full amount of treatment that you're looking for, you may need a very large land area to meet water quality criteria, although if you don't have that large land area, constructing a treatment wetland can remove at least some of the nutrients entering it. It can do a good job even it it's not large enough to fully treat the water.

Ms. Amanda Ludlow reviewed several other of the recommended treatment technologies. **Polishing ponds** are essentially a series of smaller sedimentation basins similar to the constructed treatment wetlands discussed previously. They are primarily used for sedimentation practices, including removing solids and the nutrients that are associated with those suspended solids. They are very well fitted into a situation where a larger sedimentation pond wouldn't be practical due to land area limitation so they can be more strategically fitted into a specific site design. Initially, that first sedimentation basin pond is used primarily for large, suspended solids removal. The second ponds, third ponds and any additional ponds beyond that are primarily used for reducing re-suspension of sedimentation from previous ponds as well as re-aeration of the water prior to discharge. Similar to the other technologies reviewed in depth, some periodic maintenance will be needed through sediment removal excavation and removal of those suspended set of the settled solids, which could limit the use of this technology.

Media Filters were the final type of treatment technology discussed at length. Ms. Ludlow explained that media filters utilize physical, chemical, and biological reactions to remove the specific contaminants through filtration, absorption onto the media surface, chemical transformation, degradation and ultimately sequestration in the media matrix. They are designed specifically for nutrient removal by selecting specific media for instance organic media such as compost, peat, wood chips for nitrogen removal, or using iron-enhanced sands for phosphorous removal. Because they are filters, they can clog easily, and it's extremely important to have an upfront solids removal step as a pre-treatment typically in the form of a sedimentation pond, where solids will settle out and not clog the filter as it functions in a downflow filter. Because of the potential clogging associated with media filters as well as the contaminant-specific design, media filters can be added to the end of a treatment sequence to polish effluent prior to discharge thereby concentrating that treatment for specific contaminant of concern.

Feasibility Study Overview (Tim Hancock, Stantec)
These treatment options that have been discussed during the public meeting are considered to be the tools in the toolbox after all the data and summary review that we have performed. On the technical side, we've ruled some potential options and next, we will consider if these treatment options are

available to us and will have positive impacts in two- or three-years' time. The feasibility study overview considers how we will make those treatment options work best and consider the potential constraints of implementing these treatment options. In providing downstream water quality treatments, the project team will consider the land and space that may be needed to accomplish effective water treatment, and if that land or site is available. We want to select land carefully that minimizes impacts to larger systems. The project team will take the puzzle pieces and begin trying to insert them into the landscape in a manner that is appropriate and effective. This will then lead to the development of a variety of alternatives, which we can compare and analyze. In addition, there has to be a funding focus as well to the recommendations we make going forward to ensure they have funding viability.

Related Case Study Review (Amanda Ludlow, Stantec)
Ms. Amanda Ludlow described a case study to show how some of the abstract ideas for the treatment options are currently being applied with a treatment option that is in use today. The project team selected Freedom Park in the City of Naples as its case study, which is a good example of a natural treatment sequence that has been implemented and is functioning very well for nutrient removal. This specific sample uses natural treatment processes for a watershed-based solution to a water quality problem. Freedom Park is a roughly 20-acre treatment system and is constructed to manage runoff within a 3,000-acre watershed, which consists of runoff from residential, industrial, commercial, and recreational land, all prior to discharging into the Gordon River. The 20-acre system is composed of a 4.7-acre sedimentation pond, of which its primary purpose is to promote sedimentation and removal of suspended solids and the nutrients and contaminants that are associated with those solids. Next, the water flows into a series of three treatment wetlands, which are a mixture of shallow marshes and deep open water ponds and that the function of the treatment wetlands is to remove those residual solids, filter out those solids, absorb, and sequester the nutrients prior to discharge into an 11.4-acre restored natural wetland. Overall, the entire system treats about 200 million gallons of water a year before the Gordon River discharges into Naples Bay. There's been significant nutrient removal with total nitrogen being reduced by 41 whereas total phosphorous has been reduced by 84 and then as consistent with the sedimentation practices, they're also seeing metals reduced to background levels prior to discharge. One of the unique aspects of this project as well are the number of pedestrian boardwalks and nature trails. The project team recommended visiting the park to see a natural and affordable treatment sequence in person.

Potential Process Schematic (Jennifer Brunty, Stantec)
The feasibility study will take the eight different applicable technology and treatment options and further review them. Five applicable technologies were discussed at length and were presented in different sequences in a treatment train, which uses the technologies in different orders so there could be a hundred different combinations of putting these technologies and treatment options together in a sequence. The project team shared a visual of a possible treatment train, which could potentially show the wetland earlier in the train and then the sedimentation pond later on. The project team will analyze what is most logical and what can fit into the available space identified for the project. Once that area is further identified and the project team can identify the space that is available, it will play a large role in determining the technologies and the sequence in which they are organized.

Summary (Tim Hancock, Stantec)
The project team presented a large-scale more graphic focused overview of the technologies and processes being considered for water treatment quality and delineated the ways that water could be treated and used in a treatment train. All the treatment options are scalable and that's going to become increasingly important as the available land is considered in later phases of this study. In addition, the project team wants to be sure to arrange the treatment train in the most effective way.

The project team is collecting stakeholder comments from this meeting and incorporating it into later phases of this feasibility study. Mr. Hancock thanked all of the stakeholder group that have been working closely with the project team to share a significant amount of their time for input and will continue to track and report back to them on identifying the most appropriate application of the identified processes. The project team aims to provide the greatest benefit given the project and physical constraints.

The next public meeting will be held the week of December 7, 2020

QUESTIONS/ANSWERS (Yvonne McClellan, Question Corporation of America)

Q/A 1
David Rasmussen: Why focus on clean up methods as opposed to eliminating nutrients entering the environment?

Tim Hancock: One of the problems that we have is that there are decades of development and operation and input occurring out there, and we need to be looking for more than just one solution, while we work within the slower framework of dealing with changes in use, education of homeowners and property owners, and what to do and not to do as well as working with regulatory bodies to, slowly over time, bring into place regulatory changes that improve the water quality. We need to be looking at opportunities such as the one before us and, for example, as presented in the case study for Freedom Park. For those of us that have decades of experience living in Southwest Florida know that Naples Bay went through a very significant period of extreme degradation and we knew where the input was coming from. Freedom Park was one of those kind of interceptor concepts that considered it would take a long time to change the behaviors and the regulations, so instead it focused on intercepting and treating what it could and make the improvements it could. It has been a success story. For this study, we need to look at it as a multi-pronged approach, not just dealing with the inputs, but also dealing with the fact that anything we can do along the treatment stream to improve downstream water quality, we should take advantage of those opportunities when we can.

Q/A 2
David Rasmussen: What is your opinion on using reuse water for land adjacent to impaired waterways? AND What is your opinion of using landscaping and lawn fertilizer on land adjacent to impaired waterways by the DEP?

Tim Hancock: Less is more. The less material that and nutrients that go into the downstream collectors the better. Again, this study is focused on looking at tools that we can apply on the ground to help improve downstream water quality. What you're asking about is going to take cooperation and collaboration from regulatory bodies from local, county and state government to make those longer-term changes and to affect the way in which we operate. I know Collier County Pollution Control has got a significant education program and are out in the community and speaking with homeowner's association, and when to apply and how to apply. For example, we've seen the City of Naples has taken an aggressive approach with wind and how you can fertilize so again, I think as these things change, we continue to want to support those, but also need to consider all aspects, and I believe midstream and downstream projects can improve water quality and will help solve that.

Q/A 3
Darren Rumbold: A question above alluded to agriculture as a source; I guess I missed it, but what are the sources of these nutrients – is it mainly agriculture or Golden Gate? Are you considering future loads from developments in east Collier e.g., proposed Rivergrass Village and others? What is the primary nutrient – phosphorus and nitrogen that you want to reduce? Each is removed differently, particularly if organic nitrogen?

Jennifer Brunty: As the study doesn't focus on the source of the nutrients, I will not get into a lot of detail about it. Nutrients come from a variety of different areas including agriculture and the developments that are in the watershed. The primary nutrients of interest are both nitrogen and phosphorous. Each is definitely removed differently. There are some technologies that remove one but not the other. The technologies we talked about during the presentation are typically going to remove both. Sedimentation basins and wetlands with plants uptaking both nitrogen and phosphorous to grow. We'll remove both organic nitrogen and, I think much of the nitrogen that is entering the system is not actually organic nitrogen, but I believe its inorganic. We have a section Appendix B in the information collection summary report that further discusses the nutrients that are coming into the system and there's maps showing where the nutrients are higher and lower. We are considering though, if we do implement a technology that focuses on removing phosphorous, we would have a corresponding technology if possible, to focus on removing nitrogen and we would also focus on technologies that remove both.

What we're considering right now are existing loads. The Picayune Strand Restoration Project is expected to include increases to the quantity of flow discharging south of US 41. When you increase quantity, you're increasing total loading, so we're addressing the future flow of the Picayune Strand Restoration Project but not a future loading from any other land use.

Q/A 4
Darren Rumbold: Are you considering water quantity as well as quality, i.e., storage?
AND
David Crain: What is the daily/yearly flow being considered for treatment?

Amanda Ludlow: This overlaps into a couple of other questions regarding the estimated daily/yearly flow to a proposed treatment system. The project team showed a map of BR 36. This map helps illustrate and address the scale and technically how many Freedom Parks would be needed to capture, detain, and treat these constituents. At BR 36, the average daily flow at that location is about 72 million gallons a day, so significantly higher than Freedom Park. Yes, you would need dozens of Freedom Parks, but due to the potential space restrictions – there's going to be a balancing act between how much of that flow can you actually treat within a specific land area. So, if we tried to treat the entire flow, you're looking at 500 to 1,000 acres to treat the entire flow in that area. That is likely not feasible, so we'd have to be looking at capturing a specific percentage of that flow and diverting it based upon what land is available to construct the treatment practice.

Tim Hancock: What we're looking at here is that we're looking at an incremental step. It's one thing – it's not a silver bullet, it's not the be all and end all, but if we can treat and improve water quality for a portion of that 72 million gallons per day, we're doing more than we are today. I think we're being asked to look at this from a big picture standpoint of having one incremental impact that can improve downstream water quality, and if that's a fraction of that 72 million gallons, then at least that is something that's being treated, that's not occurring today, and that's an important tenet of what we're looking at.

Q/A 5
Michael Ramsey: What is the problem that you are trying to address with this study?

Jennifer Reynolds (SFWMD): Part of the reason that we wanted to make this a very public process was to encourage and incorporate feedback from the public, from landowners, from local agencies and from state coordinating agencies. That's part of why it was really important for us to do this as a very public process because there is limited land available, in order to look at treatment opportunities in this area as we look at the flows increasing as a result of the Picayune Strand Restoration Project.

Q/A 6
Source Control questions/comments:
Bob Roth: I appreciate Freedom Park, but here you have a much greater size requirement. Source control is key. Water quality needs to be dealt with at the source. Once you get this far downstream, it's fruitless.
Andrew Tyler: If you can't focus on the sources, then how can you devise appropriate systems to efficiently mitigate?
Tom MacVicar: Thank you for the excellent summary of potential solutions. Is there an equivalent summary of the problem, specifically where the water we are trying to address comes from, what is the quality of the water, what is the design volume to be treated?

Jennifer Reynolds (SFWMD): A couple of things that we're doing concurrently with this study effort are efforts with some of those other agencies. We are looking at land ownership within the study area and coordinating with the agencies who own and/or manage the land, in order to address any potential for better source control or better management practices on those properties. We're doing that concurrently with this study effort and we'll be able to give you updates on that as we progress, but we don't want to wait and count on those things being able to solve the problem because we know that the problem is bigger than that. We are also looking for opportunities for landowners that are in this area to do some of that themselves – take a look at opportunities within the management of their own lands, whether those are HOAs or private businesses – different folks who manage their lands and seeing if there are opportunities for them to be a part of the solution. Are there opportunities to hold back water on their own lands to use reuse water for irrigation, things like that with grants available – not necessarily as part of the study, but concurrent with this study that we are willing to assist folks with if they need technical help in order to figure out: "how do I get started to do something like that?" We want to encourage those conversations as part of this endeavor and then to take a look at what the actual problem is that we're trying to solve.

Jennifer Leeds (SFWMD): The project came about when we were getting close to awarding the last contracts for the Picayune Strand Restoration Project. And there's some additional culverts that are going to go under US 41 and CR 92 to help facilitate some of the sheet flow that we are going to realize as a part of that restoration project with some of the canals that we're backfilling and the road we're taking out. The current flow methods for water to get under US 41 and then down into Collier-Seminole State Park and those other areas instead of being funneled into Faka Union Canal. So, a lot of questions came up with those new project efforts that were going in and then also with the levy that's being built – we call it the southwest protection feature that's on the west side of the Picayune Strand into the east side of the agricultural and urban areas. That's there to provide flood protection, but it's also going to help funnel some of those flows that are coming off from the agricultural and urban areas and they'll meet up to the north and bring them south. A lot of our local stakeholders were asking a lot of questions about the quality of the water, the quantity, where it's going into, the downstream areas and so because water quality wasn't a focus of the Comprehensive Environmental Review Procedure (CERP) project, the District felt these are really important questions and they're really important issues. Water quality is at the top of the state's priority. It's one of the governor's priority efforts when he took office. He said what we want to do is do this type of feasibility study exactly as Jennifer Reynolds explained, not only with other agencies that are in the area, but with local stakeholders with local knowledge to see how we could come up with solutions that would address some of these issues. It's not easy. There's a lot of Outstanding Florida Waters, there's a lot of conservation, preserves down to the south and so it's this balancing act of how can we either reroute flows, how can we put in alternatives or projects that can help improve some of the water quality and how can we partner with people. At the same time, how can we look for cost-sharing projects that are out there to help fund our efforts as well. And, also, at the end of the day we heard from a lot of the local stakeholders who really wanted to be able to communicate this to their state legislators because getting a project off the ground and moving requires funding. You need to be able to communicate what the problem is, what the needs are and what the cost will be to the people who will fund these types of things. That's also one of the products that's coming out of this study. At the end of the day, we'll end up with several different alternatives. It could be two or three put together or it could be partnering with private landowners. It could be partnering with other agencies. It could be looking at multiple funding sources for other projects, kind of in a culmination of what could really be best for this area. I thought it would be good for folks to hear this, who weren't able to join us during the first public meeting and show that this is our overarching thought process. Today, defining the problem we're trying to solve was really more a culmination of several things.

Jennifer Leeds addressing Tom MacVicar's question: I'll follow up a little bit to Tom's question. So, we're primarily looking at what we kind of want to call the Picayune Watershed, so we're really looking at waters from the Picayune Strand Cert Project, we're looking at flows from Belle Meade, the agriculture areas, the urban areas all to the north of US 41 and all those flows as they head south under US 41 and into Collier-Seminole State Park, and the further areas to the downstream areas. Within that we do have information, flows state, and some water quality information in all of those flows. We're not necessarily at this point looking to use that to put into a design for a stormwater treatment area. We're trying to see if we can focus on something, some type of solutions that will be on a smaller scale, maybe more passive in nature, but looking at the quality of the water and which of those alternatives would be needed to address those issues and concerns.

Q/A 7
Phoebe Clark: Will only one "treatment train" be used, or will several different "train" paths be utilized (and compared for the best method)?

Tim Hancock: That will be determined in the feasibility study phase of the project. This meeting presented the tools and possible applications.

Q/A 8
Andrew Tyler: Waters that currently flow south from the Farms immediately north of US41, and currently monitored Collier Pollution Control at the 'Tomato Rd' monitoring station, are a point of concern. Currently, those waters flow east along a canal and presumably flow under US41 at the east end of the Collier-Seminole Park. How much further monitoring currently occurs regarding the outflow of the agricultural pollutants contained in those waters?

Kyle Goodwin: We don't have anyone from Collier County here on the panelist list so to answer that question in specific detail will be a little bit of a challenge. It is my understanding that the monitoring stations are currently operating.

Tim Hancock: I would assume with the additional openings that are going to occur as part of the Picayune Strand Restoration Project, there will be additional monitoring that goes with that down that road, but if I am incorrect about that, the District can correct me.

Joanna Weaver: There are some water quality monitoring stations further east along US 41 in addition to the one at Tomato Road, and if you know we decide that additional monitoring is required to gain a better understanding of nutrients and the flows, that certainly could be a recommendation of the study.

Q/A 9
Kathy and John Macalone: Are there any specific sites that you are considering MORE PRIORITY over others?

Tim Hancock: We don't want to get ahead of ourselves here. We want to address that in the feasibility study, obviously, conversations will need to happen with property owners and, again, it's a little bit of a jigsaw puzzle of trying to put the pieces together as best you can to have the greatest result and the largest improvements in downstream water quality. We can't answer that in this stage of the study, but I look forward to addressing this and give a little more information during our December public meeting.

Q/A 10
Andrew Tyler: If you can't focus on the sources, then how can you devise appropriate systems to efficiently mitigate?

Jennifer Reynolds: We are certainly looking at what the contributing waters are in terms of what are the nutrients in there and what are the volumes that need to be treated. That's how we're looking at the scope of the problem, not necessarily trying to pinpoint how much of which of those nutrients are coming from which specific property, for example, but rather as we look at this water that used to flow through the Faka Union Canal and discharge directly into the Ten Thousand Islands, it's the same water, but now it's being distributed differently and we want to make sure that we don't have any additional impacts to other areas as we are addressing the source controls through other concurrent activities.

Q/A 11
Darren Rumbold: Thank you for that explanation – I think many of us were just confused – if the water quality is poor, why not go through Impaired Waters rule/Total Maximum Daily Loads (TMDL) and Best Management Practices (BMPs).

Jennifer Leeds (SFWMD): It's a good question, and certainly we can do that. You could do that in a parallel effort. It's a little bit outside the scope of this particular project. This was more focusing on something that could be done very quickly. TMDLs and BMPs take a long time especially if you have to go through rulemaking. Those could be years away. I don't think anyone wants to wait for that, but certainly that can be an effort that can be pursued by people outside of this particular project, while at the same time we try to look at what we can do in the near term to help improve some of the water quality flowing into the downstream areas.

Q/A 12
David Rasmussen: What responsibility do the farmers have in covering cost to clean up their runoff?

Yvonne McClellan: Early in the presentation we did mention that the Florida Department of Agriculture and Consumer Services (FDACS) has been working with farmers and they are meeting the requirements and guidelines.

Tim Hancock: I think Jennifer did a nice job at the introduction talking about how those landowners are working in a collaborative fashion with the District going forward. Some are even exceeding their expectations out there of what the standards are, and I think that kind of continued collaboration is important. We cannot underestimate or understate the importance of agriculture to the area and to the economy, and to our food sources so it's part of the balancing act. Again, we are looking for continued collaboration. We're looking for landowners that are willing to enter into pilot projects, anything that we can do to kind of push that innovative edge forward. I think we see a willing participation from landowners, but again, these are businesses, and they do, as long as they are operating within their permits, then there's a limit on what can be exacted at that point.

Jennifer Brunty: I've done a lot of work with ag over the years and have worked with FDACS and their BMP program and if a farmer is enrolled in the FDACS BMP program, which this farmer is, and they're keeping the records properly and doing everything that they agreed to do in that BMP program, they do get a presumption of compliance for state water quality standards from the state. The state cannot hold them responsible for paying for cleanup as long as they are following their BMP program.

Q/A 13
Dennis Vasey: County hydrology is under stress from both agriculture and residential development that seem to be getting worse. 77 percent of the land in Collier County is preserved, according to county reports. What actions can Ms. Reynolds take to focus these public lands on water quality and habitat corridors?

Jennifer Reynolds: What I can commit to is looking at the land ownership across Collier County, and we are doing that in conjunction with the agencies that own and manage those lands in order to look for potential for doing better source control and doing anything to improve management practices on those lands.

Q/A 14
Loren Wieland: How do you see alligators, alligator holes, and various hammocks spreading out throughout large areas as a treatment option?

Jennifer Brunty: We're not planning to use natural wildlife habitat areas for treatment. That would be counterproductive to the promotion of wildlife habitat, so what we're looking at is constructing treatment uplands, possibly severely degraded wetlands but not in high quality currently existing animal habitats. That would not be a desirable thing to do.

Q/A 15
Bob Roth: I have concern that these are only BMPs for a massive drainage area, which is not practical.

Tim Hancock: Again, if you're looking to treat the whole system with one project, that's simply not going to happen – The available land is not there, but again we're looking at incremental steps and you have to take an approach where "if you can't do it all, then do nothing" is really not a viable alternative. We do want to take the lead of the governor, and the governing board and look at opportunities to make improvements where possible and to do that in a fiscally responsible way.

Q/A 16

Andrew Theadford Jr.: Are the lakes brackish or freshwater in the developments?

Tim Hancock: I'll give you the non-technical response, and then let somebody correct me if necessary, but as someone born and raised in Florida, it really depends on the hydrology and the hydraulic connections. I can remember being in areas where you felt like you were way inland, and the next thing you know you're fishing and you jump a tarpon, which is a saltwater species so obviously there's been some type of hydraulic connection. So, the closer you are to the coastal areas, the more likely you are to get some of that saltwater push, but a lot of the projects, CERP projects and others, are kind of restoring historic hydro periods to the degree we can to push back against that saltwater intrusion and that conversion, if you will, of what could have been or maybe should have been a freshwater system into a brackish system. I don't think we can give you an answer from a holistic standpoint. It really is a case by case, location by location basis and it all depends on the hydraulic connections for that body of water. I think the idea here is to try and get that natural balance as best we can. This project isn't focusing specifically on that, but at least that's some anecdotal background from a Florida boy.

Q/A 17

Barry Hoey: Can we receive a copy of the slides?

Yvonne McClellan: This meeting is being streamed and a copy of the recording of this presentation will be available on YouTube following the meeting for the District's account.

Q/A 18

Bob Roth: Isn't the upstream drainage area concentrated in 3 massive pump stations? Those flows are huge.

Jennifer Leeds: Mr. Roth is referring to the three pump stations that are associated with the Picayune Strand Restoration project, and again, with that project, one of the primary purposes is hydrologic restoration, so restoring the sheet flow in the area, but we're not just looking for the flows coming from Picayune Strand. It's also some of the flows that are heading south from Belle Meade and some of the agricultural and urban areas. Yes. Those pump stations are very large, but they are large to be able to promote the sheet flow that is necessary to restore the Picayune Strand Restoration Area

Tim Hancock: I think it's very easy to look at all of the myriad of projects that are going on, we talk about the larger pump stations that are restoring sheet flow and the Picayune Strand, but what we're really dealing with in this study area is that we have an existing condition where we have got known flows coming through known locations that have water quality issues associated with them. When we look at what's going on with the Picayune Strand and future flows, we're going to see in all likelihood due to increased sheet flow in this direction instead of the old point, source channelized version we're looking at a potential for increased flows in the area, and I think those two things combined are why it's important to at least take incremental action now and begin looking at what we can do in the future. The idea that if we just sit, wait and see what happens down the road, we're going to be losing the opportunity to make some of those incremental improvements and make some changes that help us in the shorter term instead of the long term.

Jennifer Leeds: When someone asks do you want to use the impaired waters rule, TMDL and BMPs, those are really good tools to be able to use, but they take a lot of time. I think Tim hit the nail on the head when talking about this incremental approach… what we can add to things incrementally and see the improvements in downstream areas, and as we go through time, see how some of those improvements happen. If there's a need to come back through some type of adaptive management, look at that as well.

Q/A 19
Nick Roach: Is all of the funding for these projects coming from the government? Has there been any discussion of allowing an in-lieu fee mitigation program to create these treatment options or could either state or private mitigation banks be allowed to restore areas and sell credits?

Tim Hancock: Part of our feasibility study is really looking at what the potential temporary or interim solutions may be, what the cost of each are, and then the District and the basin and others are going to work very closely with all of their partners to identify funding for that. As it stands right now, because we don't really have a project clearly defined, it's difficult to answer any funding questions. I'll defer to someone in the District if they would like to address funding. At this point its going to be a collaborative effort and will probably involve one or more agencies to get anything done and I think those agencies are committed to working together to make that happen.

Jennifer Reynolds: I would love to have the conversation about opportunities for mitigation and mitigation credits. I think that Is an area that is woefully underutilized right now in south, and Southwest Florida – really all of Florida. I think that there are ample opportunities to look at how mitigation of our developing state can work more hand in hand with restoring, preserving, and conserving our water resources. I would love to have that conversation.

Q/A 20
David Crain: Has more water been diverted south in the last 10 years in an effort to reduce flow in the Golden Gate Canal?

Tim Hancock: There hasn't been to my knowledge any significant diversion projects, but there is one that may if it comes to fruition, and I think the funding source may have been tied back to money that went out to coastal communities from the pb oil spill. That could potentially divert and treat water from the Golden Gate Canal, but as far as I know, there hasn't been anything inside that last 10 years that have provided a significant diversion flow. But again, I'll defer to the District to correct me on that position if I have not stated it properly. I'm not going to give anyone more time to correct me.

Jennifer Reynolds: For the District, it's a good question and I don't know the answer to that, so I'd like to come back and answer for that.

Q/A 21
John and Kathy Macalone: You said you were focusing something that can be done quickly but all these ideas sound like they will take a lot of time and planning. How 'quickly' is 'quick'??? When would this get underway???

Jennifer Reynolds: We would like to see something moving forward. It may need to be incremental but having something that can start to work hand in hand with the Picayune Strand Project as it comes online. So that the components of the project are complete in 2023 and then the final canal plugging is scheduled to complete in 2024, so by that timeline I'd like to have a solution in place.

Tim Hancock: That sounds like a long way off, but for those of us that have been watching that project develop over literally decades, hearing that the end is inside is really good news.

Q/A 22
Bob Roth: Is the 72 million gallons the non-storm runoff flow rate?

Amanda Ludlow: It's actually upon the monthly flow that's broken out for a daily basis, so my assumption is yes, it does include storm flow, but it's been normalized.

Tim Hancock: So that number really is a discharge rate at that point, correct?

Amanda Ludlow: Correct.

Q/A 23
Bob Roth: If the farmers are compliant, then we have a big problem, because where else are the nutrients coming from? There is minimal impervious surface in the watershed.

Jennifer Leeds: As part of the study, we're going to have not just alternatives, for projects, but we also want to have a recommendation section, so if we feel that we don't have enough information to determine exactly where things are coming from, or if we feel we need to put some more monitoring in to help us tell the story on where the new flows are coming under US 41 or potentially upstream areas. Then one of the recommendations to come out of this could be for some additional monitoring to help determine and answer some of those questions.

Additional Comments
David Crain: If you could also include flows diverted that used to go south farther east near Port of the Isles that would also be appreciated.

Michael Ramsey: It appears that there has been no "problem" that has occurred. It sounds like there is an attempt to solve symptoms, but not problem exists. It sounds like there is an assumption there will be an algal bloom problem, but no problem exists. These proposals are an excessive response to a problem that does not exist. More data needs to be collected before making erroneous solutions. Wait and collect more data, before wasting time and taxpayer money. We don't know that collected data is detrimental to areas south of US 41. With more data collection it may be shown there is no problem. Build the protective levee first, collect more data, then re-evaluate.

Bob Roth: What you're doing is a great first step. By the way, the 72 mgd is only 833 cfs which is way less than each of the pump stations.

David Rasmussen: Thanks for kicking this off. Find the money and the land donations from the farmers.

Barry Hoey: Great presentation.

In Summary (Tim Hancock)
The week of December 7th is when we are targeting our next public meeting. We do expect to hopefully have a little more detailed land-based report to share with you as a result of the feasibility analysis. A lot of the questions received during the meeting are really going to be addressed in the next phase of the study to a greater degree.

Meeting ended at 4:47 p.m.

Brief Overview of Public Outreach Efforts

Quest Corporation of America prepared a press release and distributed it to established media outlets in the area in advance of the meeting. In addition, it followed up via phone and email once more before the meeting to announce how to register and participate.

In addition, the South Florida Water Management District published a FAR Notice two weeks in advance of the meeting.

Quest Corporation of America also notified a wide range of stakeholder groups and interested parties in the community including more than a 600-person mailing list of residents and businesses located near the project study area via email twice in advance of the public meeting.

South Florida Water Management District

Picayune Watershed Water Quality Feasibility Study

Stantec

Jennifer Reynolds

South Florida Water Management District
Division Director
Ecosystem Restoration & Capital Projects

Agency Stakeholders

Introductions

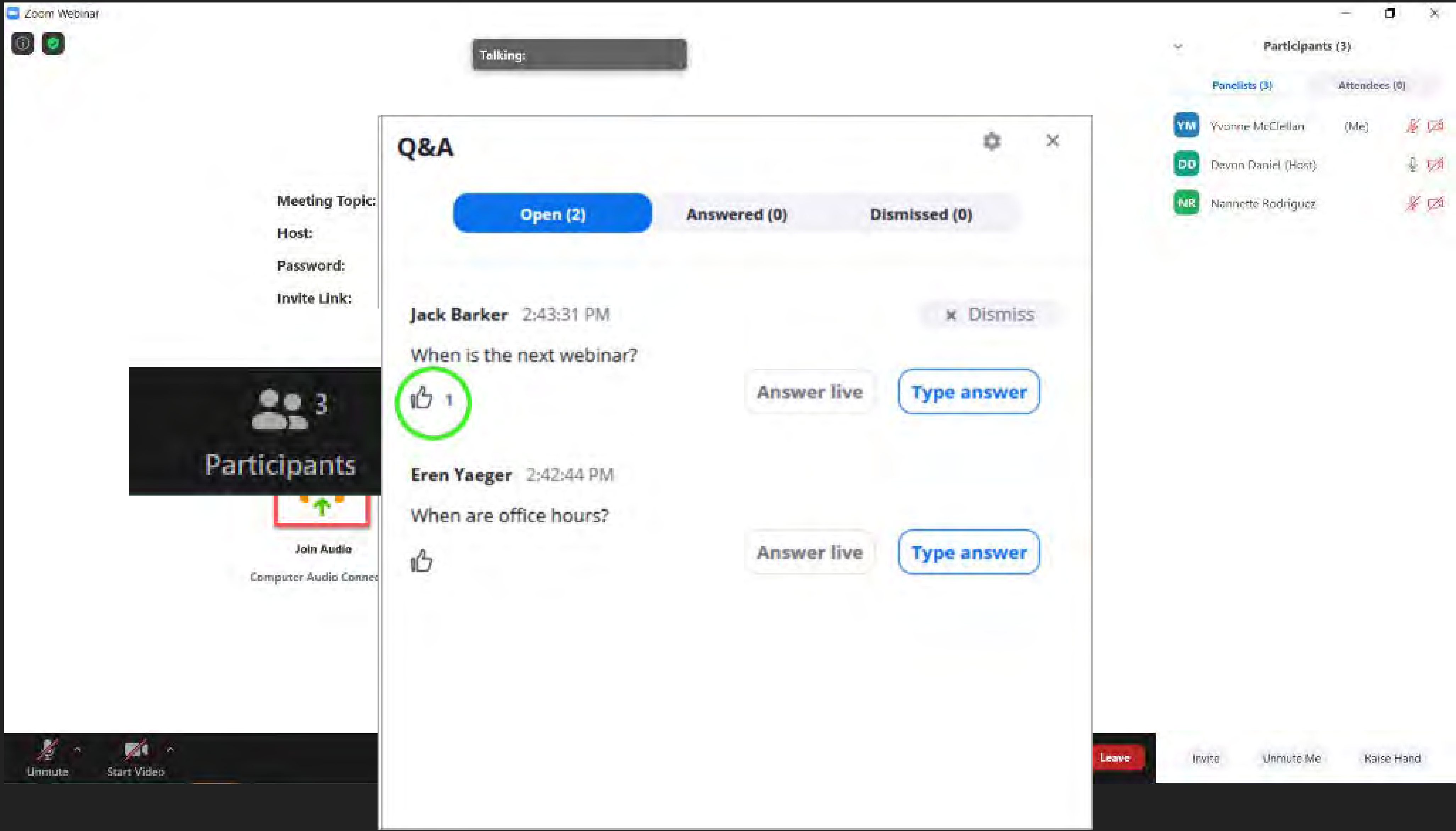
Zoom Technical Support – Online Resources
https://support.zoom.us/hc/en-us/articles/201362003

Zoom Support Live Chat

- Visit the website below and select the “Contact Support” link in the upper right corner

https://support.zoom.us/hc/en-us

Zoom meeting troubleshooting


Zoom Webinar
Talking:
Participants (3)
Panelists (3)
Attendees (0)
YM Yvonne McClellan (Me)
DD Devon Daniel (Host)
NR Nannette Rodriguez
Meeting Topic:
Host:
Password:
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Participants
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Open (2)
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Jack Barker 2:43:31 PM
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Answer live
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Invite
Unmute Me
Raise Hand

Q&A

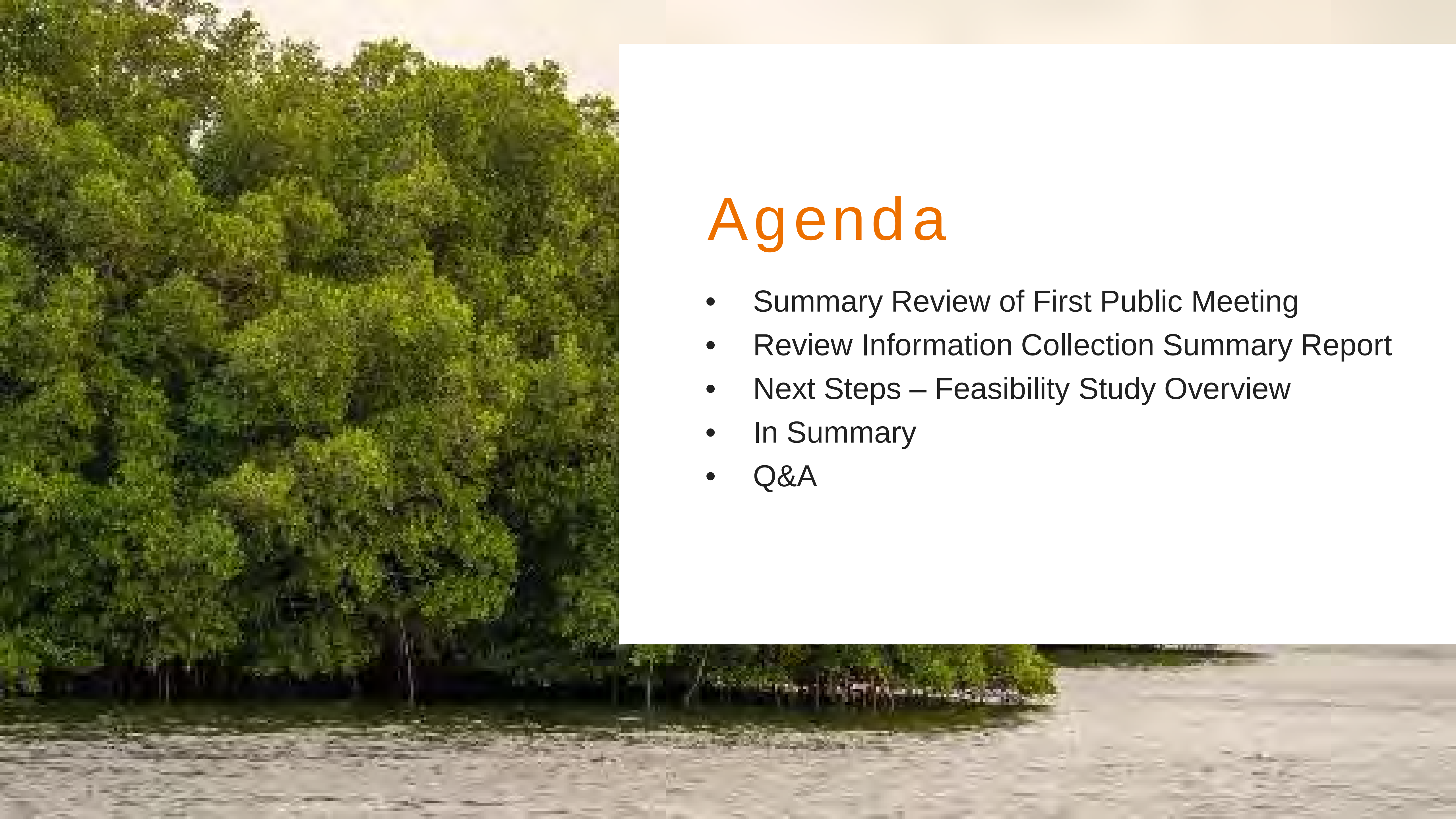
Kyle Goodwin
Stantec

Jennifer Brunty
Stantec

Amanda Ludlow
Stantec

Tim Hancock
Stantec

Panelists



Agenda

- Summary Review of First Public Meeting
- Review Information Collection Summary Report
- Next Steps – Feasibility Study Overview
- In Summary
- Q&A

Summary Review of First Public Meeting

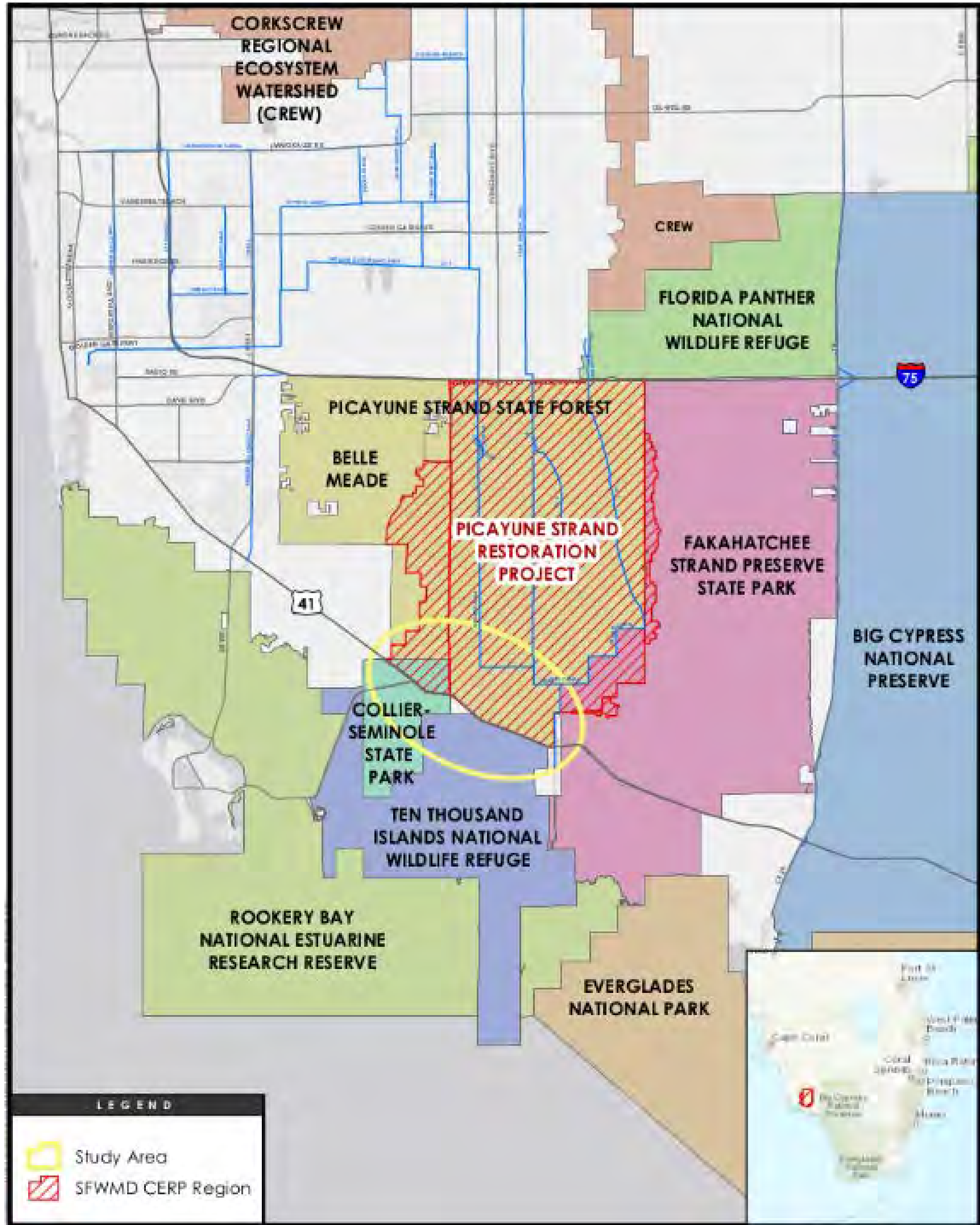
Study Overview

To examine conventional and innovative water treatment resources, stormwater redistribution, and active or passive water quality improvement projects towards reducing nutrients in the downstream areas of the Outstanding Florida Waters (OFWs) from the Picayune, Belle Meade, agriculture, and urban watersheds.

- Outstanding Florida Waters (OFWs) Explained

Discharges to OFW

- Collier-Seminole State Park
- Rookery Bay Estuarine Research Reserve
- Cape Romano-Ten Thousand Islands Aquatic Preserve



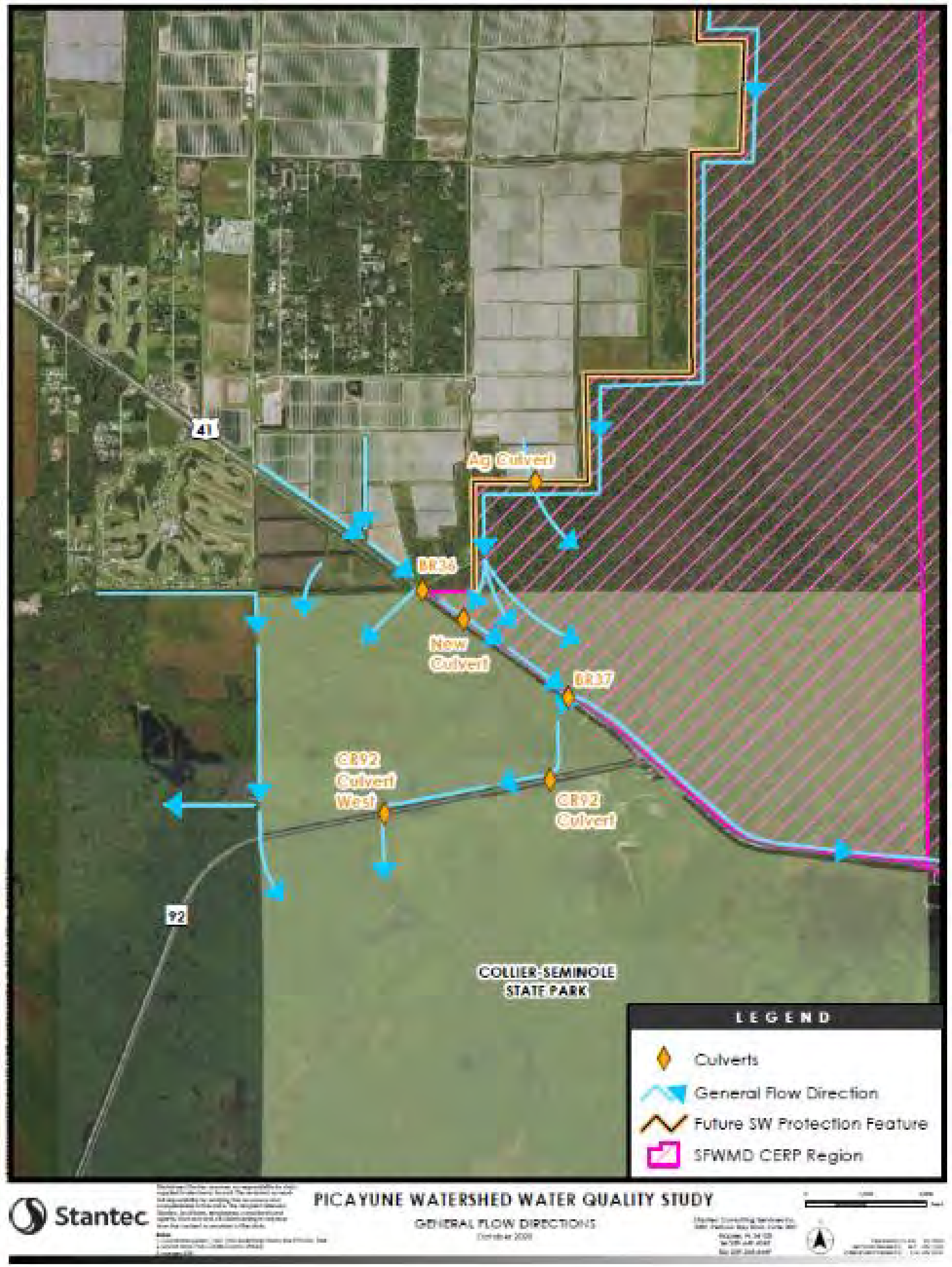
Study Purpose

Purpose:

- Collaboratively **develop a suite of alternatives** of cost-effective projects to **improve water quality** and/or re-distribute flows to downstream OFWs.
- Identify cost-effective options that reduce nutrient level present in current and future discharges.

Orientation:

- Upstream Sources
- Review Flow Map
- Downstream Water Quality
- Does Not Include Source Control



Meeting Review

- Information Collection Summary Report Status
- Public Meeting Schedule (Draft)
- Feasibility Study
- Shared the Project Schedule
- Potential Applications were Reviewed

<u>Key Takeaways</u>

- Water quality is a high priority in Florida
- Focus on passive systems
- Incremental projects with positive impacts

Review Information Collection Summary Report

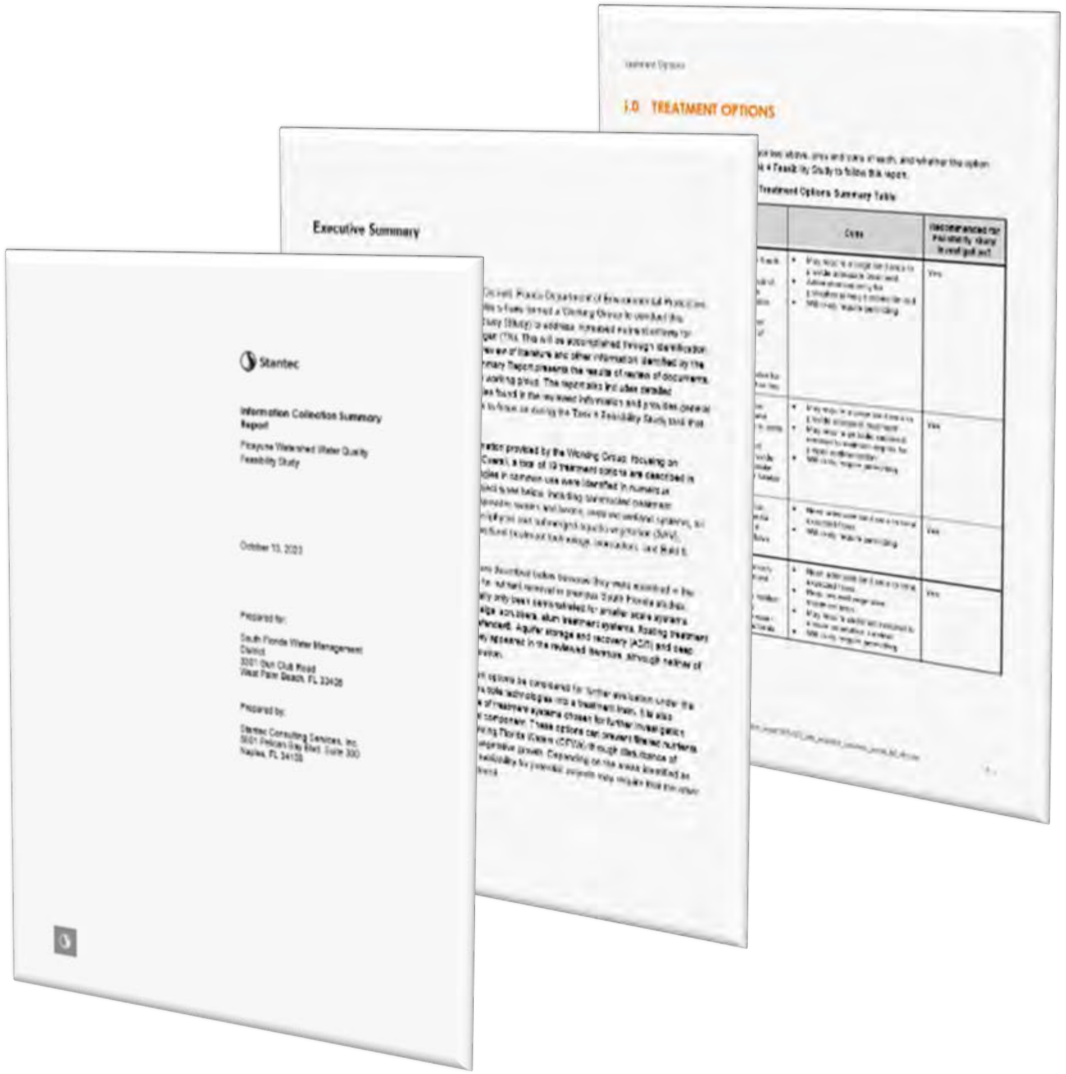
Information Collection Summary Report

Sections:

- Introduction and Background
- Data Sources / References Reviewed
- Review Methodology
- Literature Review and Analysis
- Treatment Options

Purpose:

Inform the Feasibility Study



https://www.sfwmd.gov/our-work/picayune-watershed-water-quality-feasibility-study

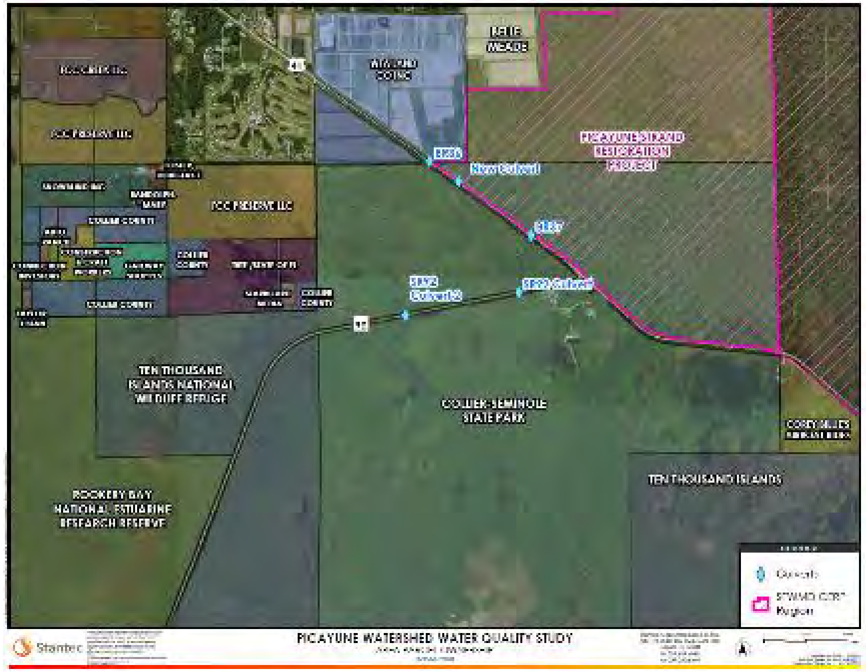
Information Collection Summary Report

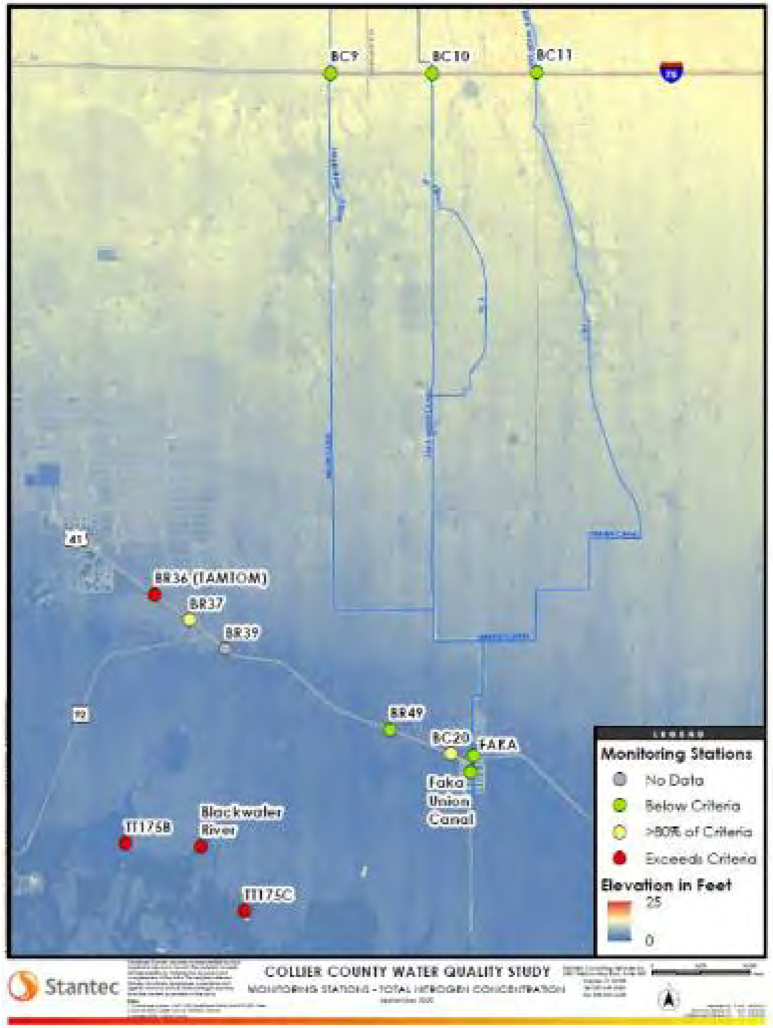
Area Parcel Map

Site Review Memo

Water Quality Sampling Data & Maps:

- Total Phosphorus
- Total Nitrogen
- Turbidity
- Copper
- Iron





Treatment Options Reviewed

Applicable

- **Spreader Berms and Canals**
- **Sedimentation Basin**
- **Constructed Treatment Wetlands**
- **Polishing Ponds**
- **Media Filters**
  - Bioreactors
  - Iron Enhanced Sands
  - Bold & Gold ®
- Restored Wetlands
- Air Diffusion Systems
- Periphyton (SAV)

Non-Applicable

- Hybrid Wetland Treatment Technology
- NutriGone MediaTM
- Recycled Water Containment Area
- Algal Scubbers
- Offline Alum Treatment
- Floating Treatment Wetlands
- Downstream Defender®
- Aquifer Storage and Recovery (ASR)
- Deep Well Injection

Spreader Canal/Berm

Function:

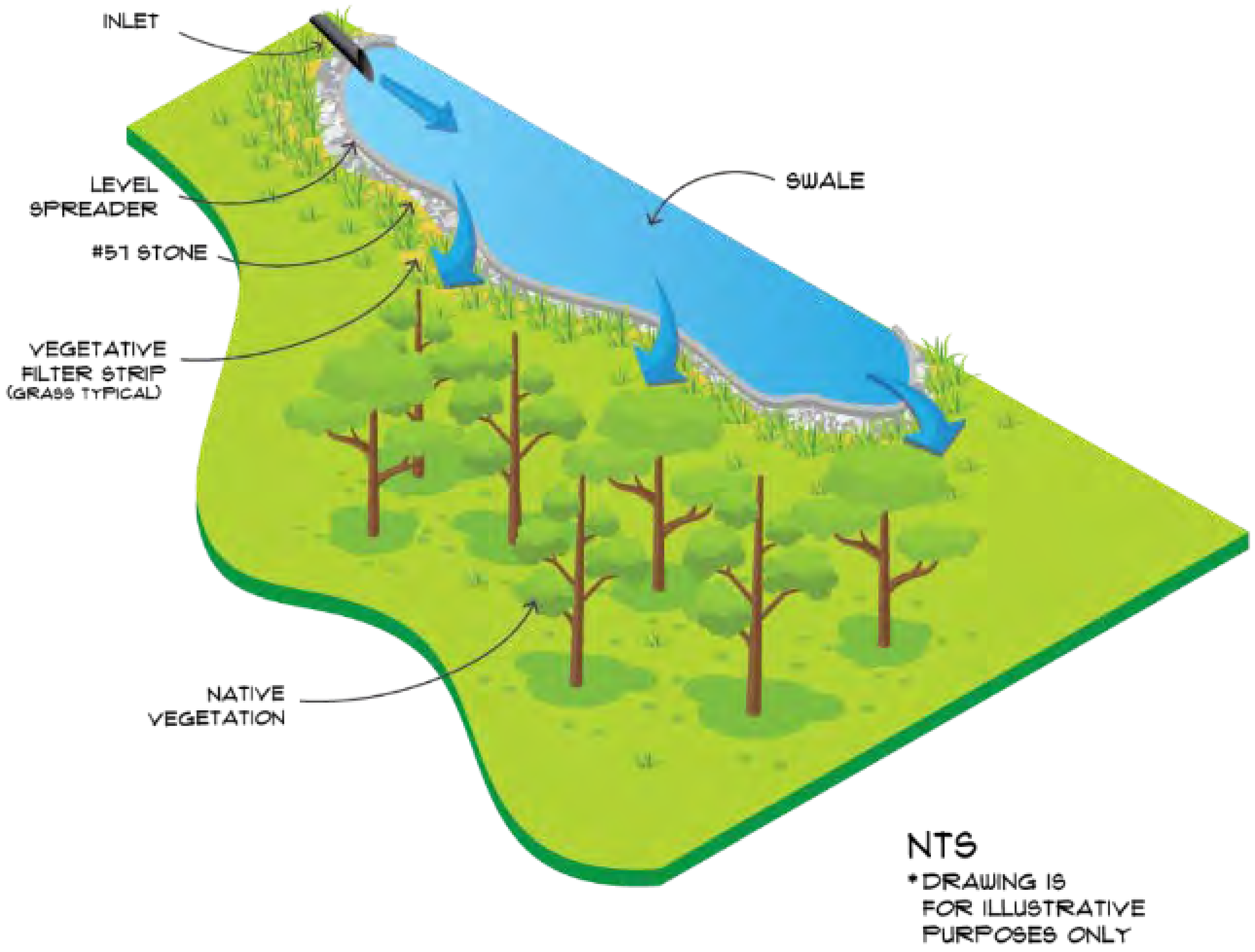
- Attenuates velocities by spreading flow over a wide area – uniform overflow or through dispersed discharges

Advantages:

- Promotes sheet flow
- Promotes sediment deposition and removal of constituents attached to sediments
- Slows velocity to reduce scouring

Limitations:

- Requires appropriate downstream receiving area
- Removal of dissolved constituents dependent on downstream treatment
- Requires long stretch of land
- Requires maintenance/periodic sediment removal and disposal



Sedimentation Basin

Function:

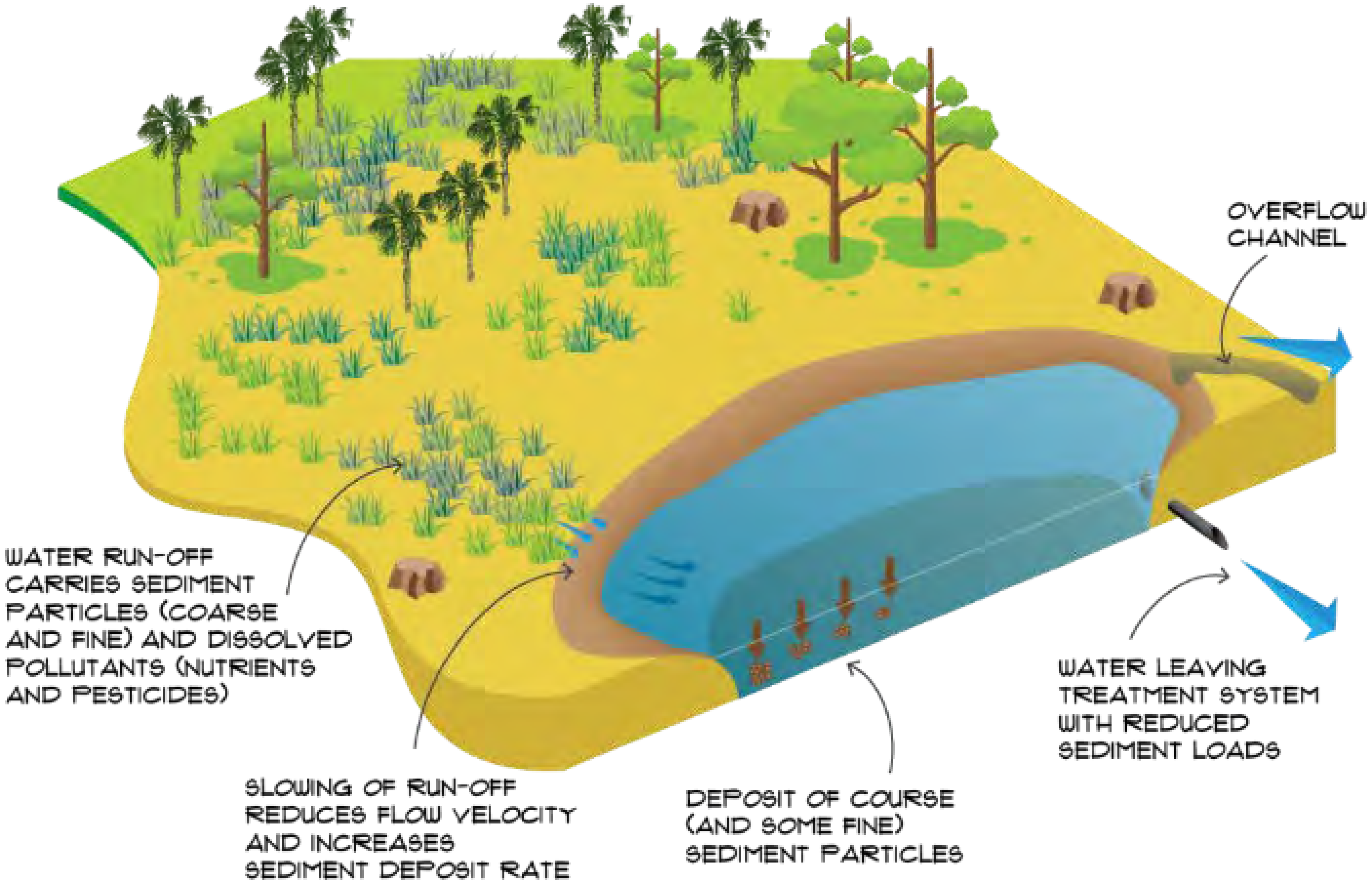
- Attenuates velocities to promote sediment deposition

Advantages:

- Excellent sediment removal and removal of constituents attached to sediments
- Simple design

Limitations:

- Requires periodic maintenance (removal and disposal of sediments)
- May require large land area
- Sediments resuspension may occur after storm events



Constructed Treatment Wetland

Function:

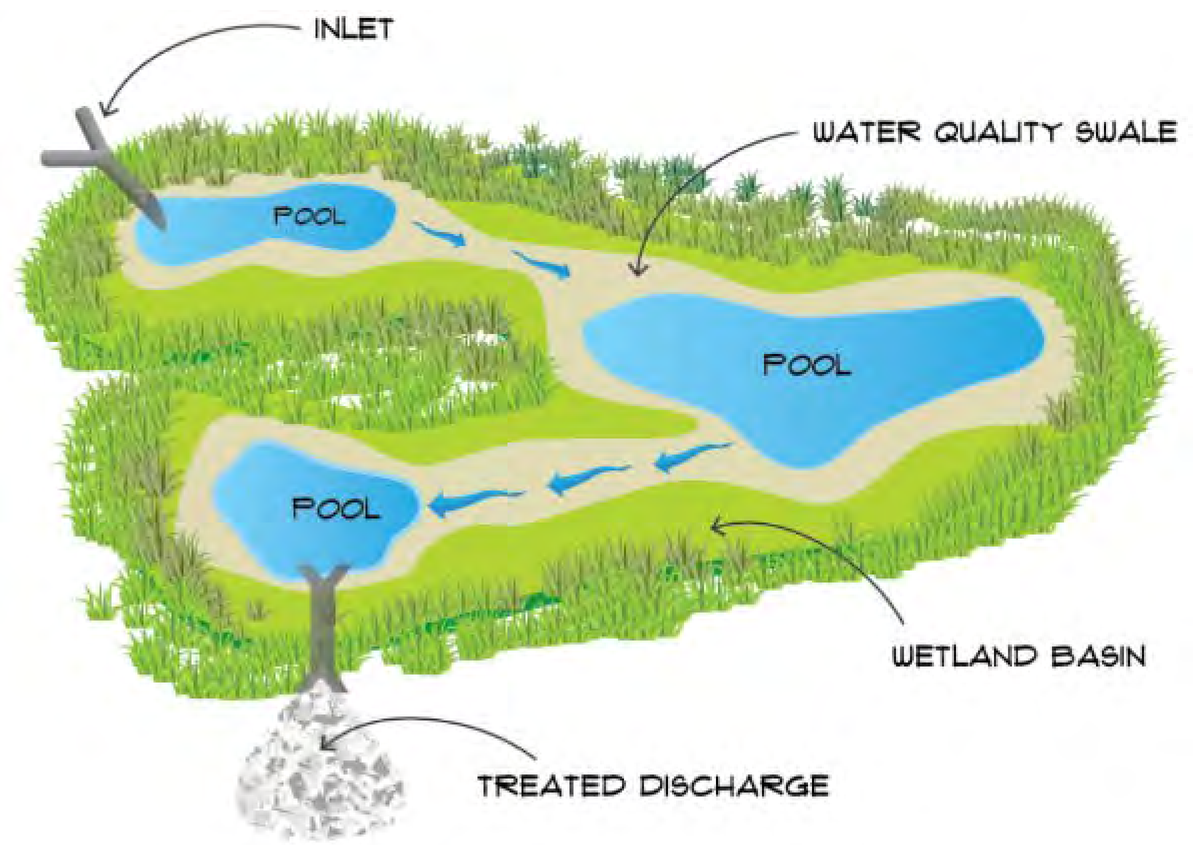
- Mimics physical, chemical and biological treatment mechanisms of natural wetlands

Advantages:

- Open water ponds attenuate velocities and promote sediment deposition and removal of constituents attached to sediments
- Shallow marshes filter finer sediments and remove dissolved constituents via plant uptake and adsorption onto marsh sediments
- Provides wildlife benefits
- Low operation and maintenance costs

Limitations:

- Treatment rates and costs are site specific
- Removal rates are dependent on influent loading
- May require large land area to meet water quality criteria



Polishing Pond

Function:

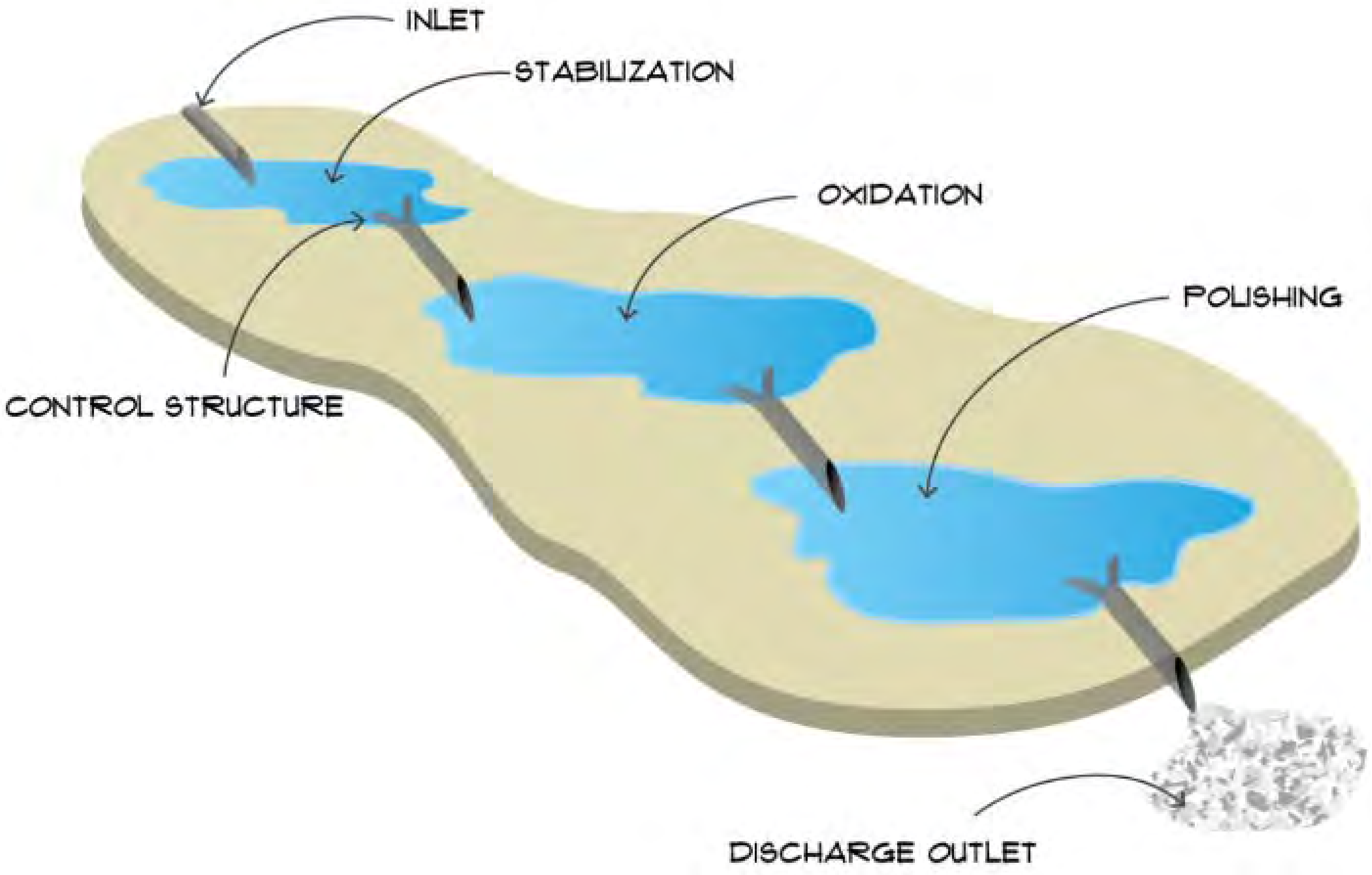
- Final polishing to promote sedimentation and aeration of effluent prior to discharge

Advantages:

- Excellent sediment removal and removal of constituents attached to sediments
- Multiple ponds in series easier to construct in lands with space limitations

Limitations:

- Requires periodic maintenance (removal and disposal of sediments)
- Sediments resuspension may occur after storm events



Media Filters

Function:

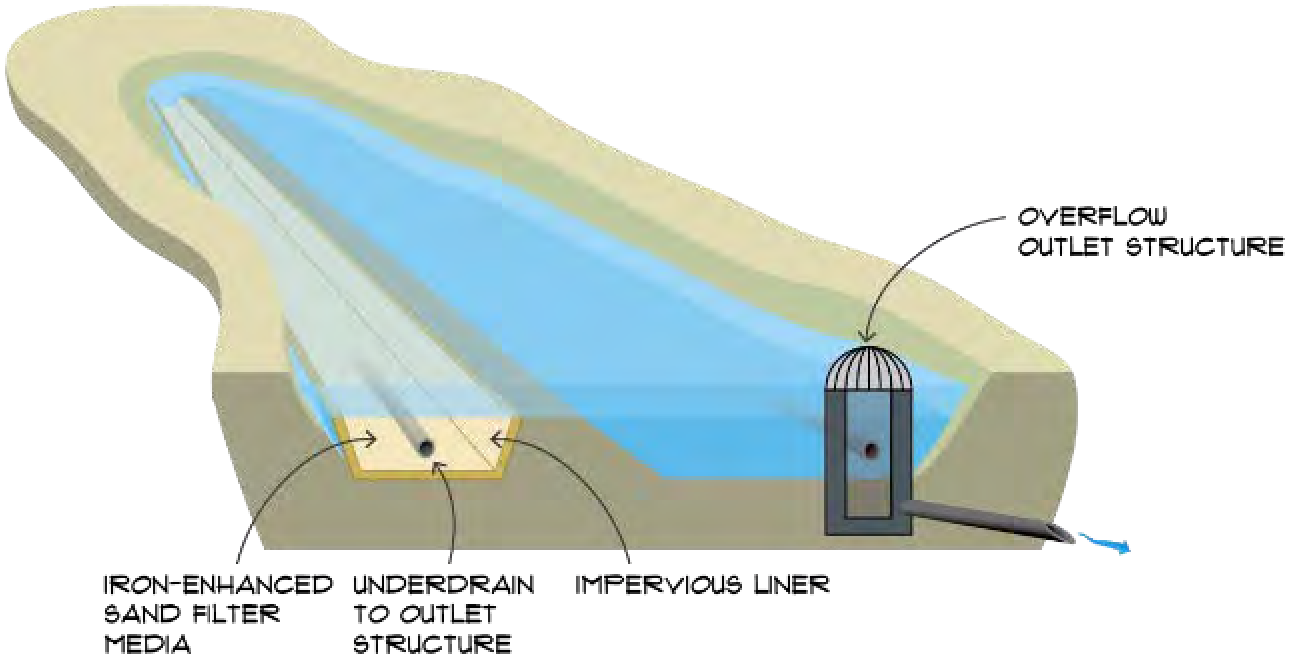
- Utilize physical and geochemical reactions to remove contaminants through filtration, adsorption to soil surfaces, or are chemically transformed and stored within the soil matrix

Advantages:

- Excellent sediment and nutrient removal performance
- Easily retrofitted into design sequence

Limitations:

- May require pretreatment to minimize clogging
- Designs are contaminant specific
- Designs tailored to smaller, more concentrated flows (use technology strategically)



Next Steps – Feasibility Study Overview

Feasibility Study Overview

Currently:

- Identifying Problems, Constraints and Opportunities
- Formulating Alternatives

Next Steps:

- Evaluate Alternatives
- Compare Alternatives
- Funding Options
- Recommendations

Freedom Park Case Study

Ponds → Treatment Wetlands → Restored Wetlands

Freedom Park Case Study

- 50-acre parcel

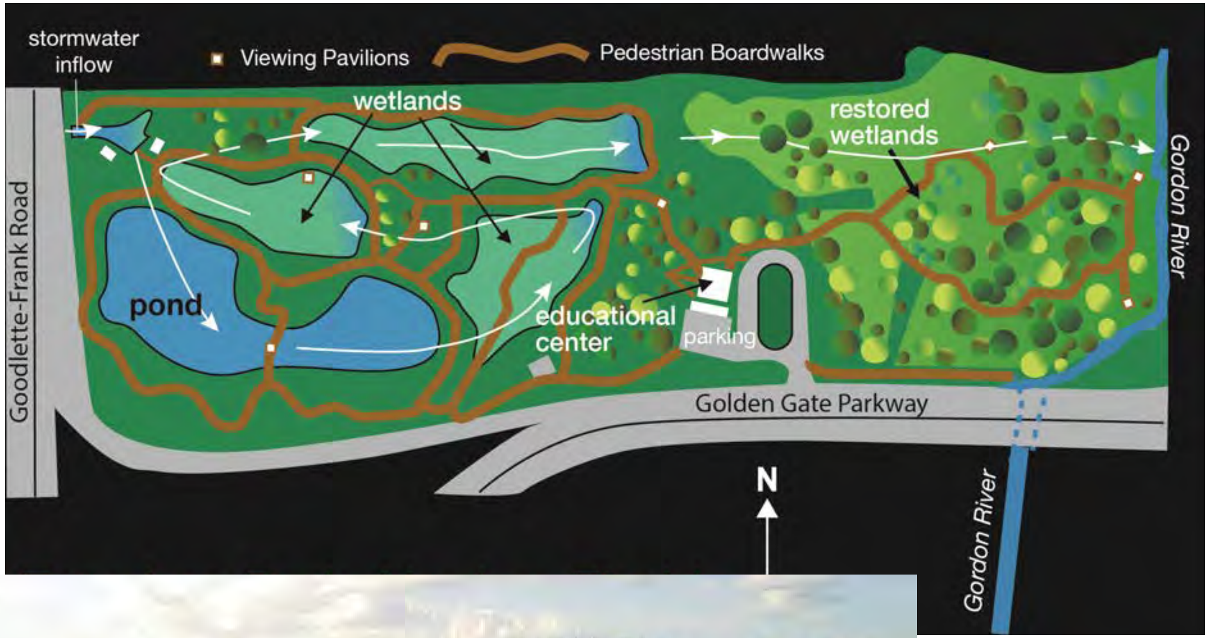
  4.7 ac Pond

  6.7 ac Treatment Wetlands

  <u>11.4 ac Restored Wetlands</u>

  22.8 ac total treatment sequence

- Treats runoff from 3,000 acres
  – *200 MG/yr treated before Naples Bay*
  – *Total Nitrogen reduced by 41% (from 1.38 mg/L to 0.87 mg/L)*
  – *Total Phosphorus reduced by 84% (from 0.179 mg/L to 0.033 mg/L)*
  – *Metals reduced to background levels*



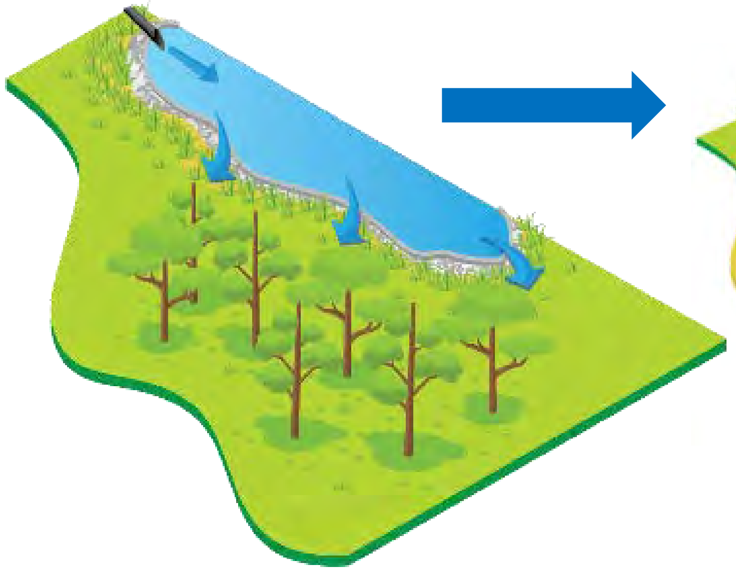
Potential Process Schematic

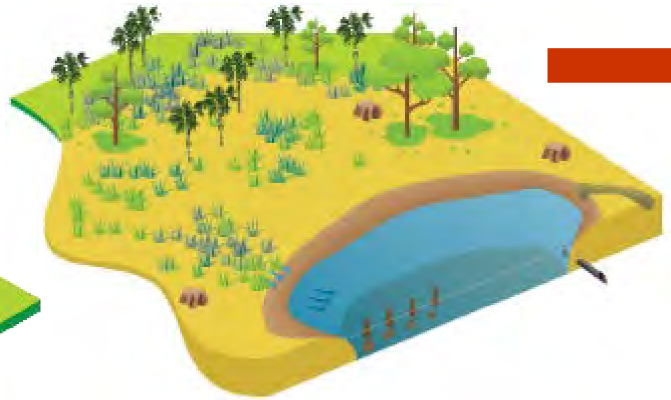
Spreader Swale
- Conveyance and flow dispersion

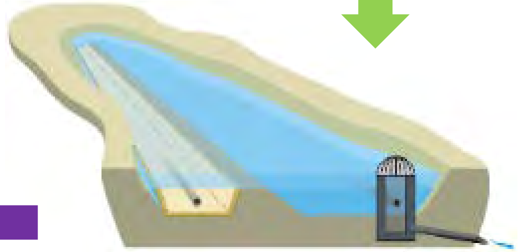
Sedimentaton Basin
- Removal of sediment + associated nutrients/ contaminants

Treatment Wetlands
- Removal of dissolved contaminants
- Removal of fine sediments

Media Filter
- Filtration of residual nutrients/contaminants





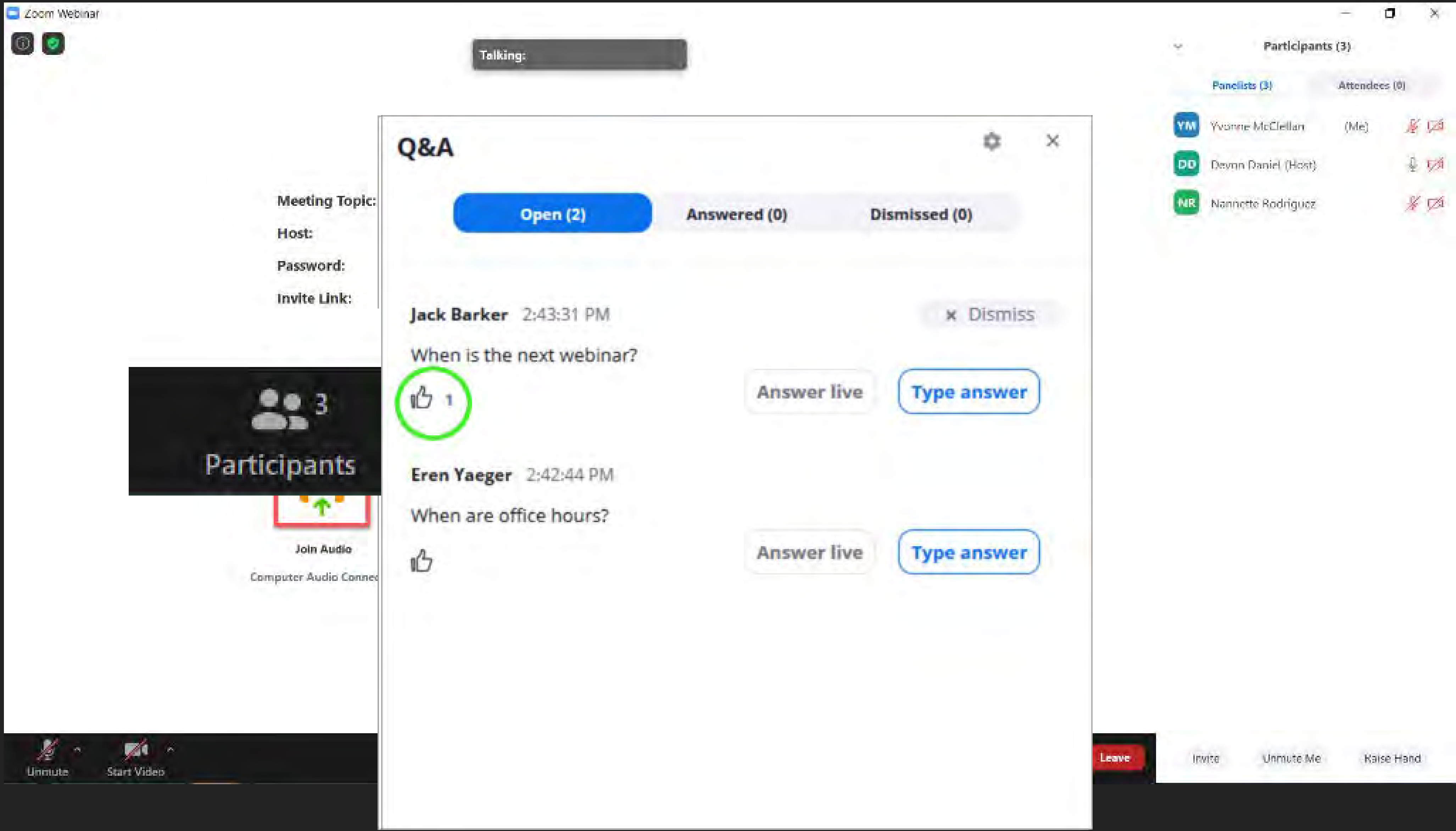


Discharge

Summary

Summary

- Project Overview
- Information Collection Summary Report
- Next Steps – Feasibility Study Overview
- Next Public Meeting
    - Tentatively 12/07 – 12/11/2020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Q&A

If you’re participating via Zoom –

- Submit your questions via the Q&A chat box
- If you are unable to, use the Raise Hand feature

2:00

If you’re participating via Phone –

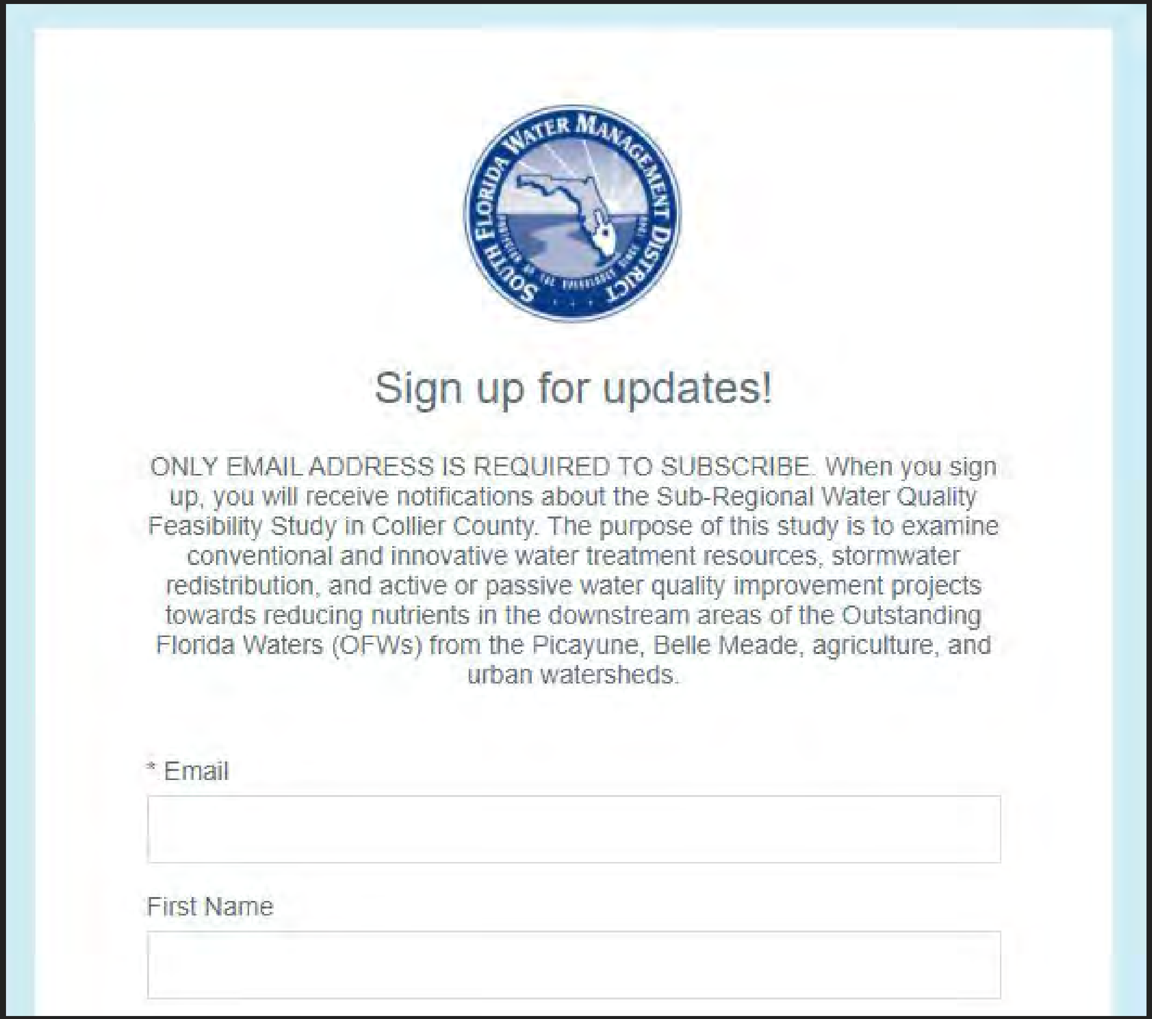
*6 Mutes/Unmutes

*9 Raises Hand

Q&A

To sign up for project notifications, visit:

https://lp.constantcontactpages.com/su/8G8AunX/CCSRWaterQStudy



Sign up for updates!

ONLY EMAIL ADDRESS IS REQUIRED TO SUBSCRIBE. When you sign up, you will receive notifications about the Sub-Regional Water Quality Feasibility Study in Collier County. The purpose of this study is to examine conventional and innovative water treatment resources, stormwater redistribution, and active or passive water quality improvement projects towards reducing nutrients in the downstream areas of the Outstanding Florida Waters (OFWs) from the Picayune, Belle Meade, agriculture, and urban watersheds.

* Email

First Name

Thank you for your participation!

Picayune Watershed Water Quality Feasibility Study
Public Workshop 3
Tuesday, December 15, 2020, 3 p.m.
Location: Via Zoom https://zoom.us/webinar/register/WN__8_Hh-rxTSC-FOnr8vdfUg.
YouTube presentation replay: https://www.youtube.com/watch?v=aAiNz_TEzH4

Meeting opened at 3:00 p.m.

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INTRODUCTIONS

Joanna Weaver, the project manager for the Picayune Watershed Water Quality Feasibility Study with the South Florida Water Management District, welcomed all attendees to the third public workshop for the feasibility study and thanked them for joining the discussion of the objectives of the study, the study alternatives and why a water quality feasibility study became necessary. To date, the District has organized two public meetings and this public meeting focused on presenting the results and the potential suite of alternatives from this expedited study.

As the study is being done in an expedited time frame, the focus and scope are limited to developing some projects that fit on the landscape that allow us to take the water we have at the concentrations that we have and to make it cleaner. From the cypress swamps to the coastlands and wetlands, nutrients like phosphorus were once found at very low levels. With decades of residential and agricultural growth, the levels of nutrients and other trace pollutants making their way into these natural areas began to rise. Water quality samples collected downstream of the Picayune Watershed area north of US 41 show concentrations higher than what would be anticipated flowing into an Outstanding Florida Water.

As a result, native ecosystems as well as the plants and animals that are part of those systems, began to change. To protect and restore these ecosystems, the South Florida Water Management District is working to remove excess nutrients and other pollutants or prevent them from entering natural systems. Several alternatives, either standalone or combined, can effectively achieve this such as building constructed wetlands, requiring best management practices for agricultural and urban stormwater runoff, and creating surface or groundwater storage for seasonal water surpluses. In addition, reviewing the existing monitoring and making recommendations for additional monitoring, if required, to gain a clearer understanding of all upstream flows and sources. For the Picayune Watershed Water Quality Feasibility Study, one main objective is to identify technically feasible and cost-effective options to reduce discharge of nutrients in flows from upstream sources such as the Picayune Watershed which includes the Picayune Strand Restoration Project (PRSP), the Belle Meade area, residential developments, and agricultural areas into the downstream Outstanding Florida Waters. Given the importance of the state park and the other water resources, this proposed water quality feasibility study will evaluate conditions of flows from agricultural areas, Picayune strand Restoration Project and residential developments and to Collier-Seminole State Park, Rookery Bay National Estuarine Reserve and Ten Thousand Islands National Wildlife Refuge and will develop options to address those concerns. She thanked those who were in attendance to discuss the study and expressed appreciation for the input from the public and the local stakeholders to address these concerns in Collier County.

Agency stakeholders
On behalf of the project team, the District and the Big Cypress Basin, Stantec recognized the agency partners and stakeholders that have been involved in the project study and thanked them for their time, effort and input during the feasibility study process. He explained how critical their individual and collective contributions have been for the study and emphasized how these partnerships will continue to be important going forward.

Those partners include: the Florida Department of Environmental Protection (DEP), Florida Department of Agriculture and Consumer Services (FDACS), Florida Wildlife Federation, U.S. Fish & Wildlife Service, Conservancy of Southwest Florida, Audubon, Collier County, Lipman Family Farms, LAGO Consulting & Services, and the South Florida Water Management District (SFWMD).

Quest Corporation of America, the subconsultant for public involvement for this project, briefly presented troubleshooting for the Zoom platform and explained to meeting participants how to participate in the Q&A following the presentation. Quest also expressed the importance of their feedback during the public meetings and how all public input would be incorporated into the project record to help finetune the direction of the feasibility study.

Following the presentation, panelists were available to answer questions and, at the start of the public meeting, participants were encouraged to submit questions via the Q&A chat box and view questions from other participants. They were also encouraged to click the thumbs up icon to emphasize audience interest in a particular question.

Staff Introductions
Kyle Goodwin, the senior project manager with Stantec for the Picayune Watershed Water Quality Feasibility Study, introduced the Stantec project team. Below are highlights of the credentials of each staff member.

- Kyle Goodwin: Has more than 15 years of experience in civil engineering, specializing in land development, project management and stormwater management. He is a licensed professional engineer in Florida and Kentucky and holds an MBA. Prior to working for Stantec, he was the City Engineer for Georgetown, Kentucky where he planned city budgets, developed, and executed Capital Improvement Plans, and managed the City's MS4 Phase II program.

- Dr. Jennifer Brunty: Has 27 years of experience in water quality BMP research and BMP implementation in both agricultural and urban settings. Her master's- and doctoral-level research focused on using BMPs to address nutrient management. Prior to working for Stantec she worked as a Natural Resource Specialist with the Highlands County Lakes Management program for 5 years, and as a Wetland Scientist for the Southwest Florida Water Management District for 12 years.

- Amanda Ludlow: A Principal with Stantec, specializes in green infrastructure practices and sustainable treatment design. She has more than 20 years of environmental consulting experience. Amanda has spent her career focusing on the development of innovative sustainable solutions to solve environmental problems including constructed treatment wetlands, phytoremediation, natural media filtration and sustainable stormwater management.

- Tim Hancock: A Principal with Stantec with 30 years of public policy and community outreach experience. Tim is a Florida native with an extensive background working within the complex regulatory framework in Southwest Florida and leads our public outreach engagement efforts on environmental projects throughout the United States.

Kyle also mentioned that several District and DEP staff participated in the meeting and helped facilitate the discussion during the Q&A session at the end of the presentation.

PRESENTATION AGENDA

Kyle discussed the public meeting agenda which included an overview of the project, a recap of the purpose for the study and a summary and meeting review with a few key takeaways. The agenda also included a review of the Information Collection Summary Report for those who were not involved in previous public meetings for the feasibility study. The full report is available upon request and located on the project website. The agenda also featured several key items of the feasibility study including, a discussion of where we are currently, an overview of three alternatives, a comparison of the alternatives, and a review of the alternatives summary.

The presentation also included a brief review of the funding strategy and preliminary draft recommendations for the study as well as next steps.

STUDY OVERVIEW

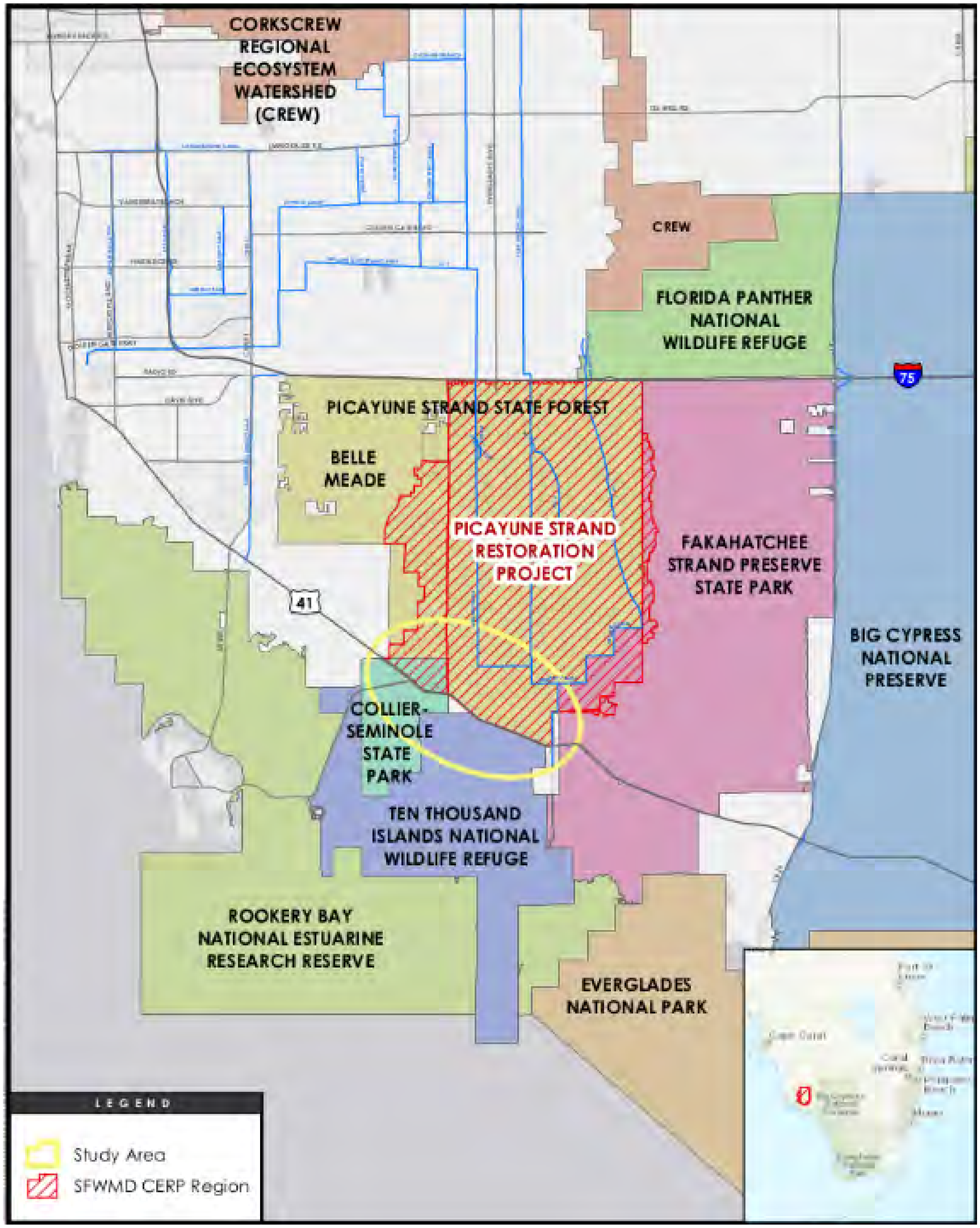
From a broad perspective, the study is designed to consider potential water quality improvements, that while originating from a fairly large area, are impacting some Outstanding Florida Waters (OFWs) including Collier-Seminole State Park, Rookery Bay Estuarine Research Reserve and the Cape Romano-Ten Thousand Islands Aquatic Preserve. The area of potential application for this study, although the contributory areas are fairly sizable, is marked on the project area map shown on page 4 of this report as a yellow oval. That is the area of focus where the potential application of some of these systems are both appropriate and doable.

STUDY PURPOSE

The purpose of this study was to develop, in concert with partners and stakeholders, a suite of alternatives, which when applied at various scales and potentially in connection with other configurations, will serve to improve the downstream water quality of OFWs. It is not a one-size-fits-all solution, but the idea is to make sure that together they will improve the downstream water quality for the OFWs. There are many flow conditions coming into a very small area as shown in the yellow oval in the project area map on page 4 of this report. Depending on the land available through partnerships going forward, the study will propose proven means of treatment systems that, when used either singularly or in combination, will serve to improve overall water quality. While it is important to better understand the upstream source and nutrient contributions occurring, this study does not focus primarily on source control. That being said, Stantec has included in its recommendations a testing protocol to help better inform future decisions.

Instead, the focus is the potential solutions that can be applied fairly quickly and in incremental steps to start improving conditions sooner rather than later.

Project Area Study Map



SUMMARY REVIEW OF PUBLIC MEETINGS
The panel reviewed what has been presented in prior public meetings for the benefit of those attending for the first time. A key part of the public meeting process for this study has been the need for both public information dissemination of project progress and findings, but also input from the public as well.

In previous public meetings, the project team presented an Information Collection Summary Report, which is a collection of documents that were all reviewed by the study's technical advisory team to better inform and understand the applications and processes under consideration going forward. Previous meetings also discussed the feasibility study. What was of particular interest in earlier meetings, were the potential technologies and applications that were reviewed, as well as some samples of how they could be used in tandem. For example, if you're in the early phases of implementation and you only have X amount of acreage available, that may warrant a certain technology or application, but as more land may become available you can place them in tandem with other technologies and create a treatment train process.

Through this study process the project team is working to maintain maximum flexibility so as the land application side of this project goes forward, we're ready to serve the environmental improvements that are the focus of the study. The project team shared some of those schematics. Water quality is a high priority in Florida and has heightened in the last few years due to the algae conditions and water quality conditions we have seen occurring. The focus of this study is on passive systems. We are not looking at massive pumping type projects, rather the passive systems can be readily maintained to improve downstream water quality – incremental projects each showing positive impacts and that those improvements are both measurable and attainable.

Information Collection Summary Report Review
This report is the foundational aspect of the study and includes the following sections:

- Introduction and Background
- Data Sources, References Reviewed
- Review Methodology
- Literature Review and Analysis
- Treatment Options

Stakeholders have been integral to the development of the report and have been present throughout providing information and data sources, raising concerns, and essentially guiding the study.

Stantec reviewed a multitude of data sources and literature both identified by the stakeholders and obtained separately. The data sources generally fell into three categories: water quality data, performance studies of existing water quality treatment systems, and descriptions of the different technologies that might be used for water quality treatment. This information formed much of the basis for the summary report. The report also includes methodology and describes how the data sources were reviewed and utilized.

The literature review and analysis section was structured around applicable and non-applicable technologies and is essentially a consolidation of the information reviewed and presented in a format to support the feasibility study. Applicable was defined as the most common and well-established stormwater treatment technologies already in use within south Florida, as well as less common technologies that have a proven track record for nutrient removal within Florida and elsewhere. Non-applicable was defined as having uncertain effectiveness for large-scale projects or for use in the south Florida environment.

Within the treatment options section, a table is presented identifying pros, cons, and a recommendation on whether or not to consider the technology for the feasibility study. In summary the primary purpose of the information collection summary report is to inform the feasibility study.

The full list of treatment options was reviewed and categorized as applicable or non-applicable. While these treatment options were reviewed in more detail during prior meetings, the full report is available for download at the project website: https://www.sfwmd.gov/our-work/picayune-watershed-water-quality-feasibility-study.

FEASIBILITY STUDY OVERVIEW

Kyle provided a current update on the progress of the feasibility study. At the time of the last public meeting the feasibility study was in its early stages with identifying the problems, constraints, and opportunities as well as formulating alternatives. Those efforts have continued and been expanded upon to include the evaluation comparison of three alternatives.

PROBLEMS, CONSTRAINTS AND OPPORTUNITIES

Amanda Ludlow discussed the problems, constraints and opportunities in formulating the alternatives to treat water quality in the project study area, specifically for discharges from culverts crossing under US 41 and in particular the existing BR36 culvert, the new culvert and from the existing BR37 culvert.

One of the primary constraints is **water quality** so what is discharging under US 41 from those culverts, specifically BR36 and BR37, are above water quality standards for total nitrogen, phosphorus, and various metals. Therefore, any chosen treatment system will need to address these elevated constituents. The next constraint is **water quantity**. The total volume of water discharging south through these culverts is expected to increase in the future so that one of the major goals of the project is to come up with a solution that can treat as much of that future flow as possible. The primary constraint to building a solution is the **land availability**. There are both public and private lands located to the south of US 41 in the project region and availability of the land for the project use is currently unknown. In addition, some of these lands contain wetlands and upland habitat which could limit sizing and configuration of any treatment solution.

With the **technology** of these alternatives, each solution has its own challenges and constraints. For example, some systems may be more efficient at treating one constituent over another. A solution may also require a larger footprint than feasible based upon the land available and, therefore, would not be capable of treating the full volume of water. **Potential permitting constraints** may be another hurdle as wetlands and habitat are located throughout the project region. Therefore, construction in or around these resources would require additional analysis and permitting could potentially cause delays. **Constraints related to funding** include restrictions on use of funding resources to only public or private lands, and the timing, which may require months to a year in advance for planning to obtain funding for the projects particularly when funding must be approved through government budget cycles. These solutions may require **cost sharing** and, if limited funding is available, implementation may need to occur in stages.

In formulating various alternatives, the project team's goal is to look at treatment of sediment, phosphorus, nitrogen, and metals.

THREE ALTERNATIVES

Amanda Ludlow explained the various treatment mechanisms considered and where each technology is acceptable for treating a specific constituent. Based upon a variety of these technologies the project team developed the following alternative sequencing --with alternatives Options A, B and C.
For this exercise, the project team focused on BR36 and BR37 as well as the new culvert which will be diverting flow from the new PSRP restoration project.

- Option A considers only BR36, which would intercept the most concentrated flow so it's a lower flow but higher concentrations of nutrients and suspended solids. The goal would be to treat that entire flow with first a sedimentation basin to settle out those solids and any nutrients associated with those solids and then that would be conveyed to a media filter which would be focused on removing dissolved constituents, including nitrogen and phosphorus, and then discharging back into the canal.
- Option B would look at intercepting and treating only BR36, but solution differs in that we would similarly have a sedimentation basin, but instead of the media filter, dissolved constituents would be treated through a treatment wetland and the effluents from the treatment wetlands would flow via a spreader swale south to the existing wetlands. This would provide some benefits to restore the fresh water supply south, specifically to the national wildlife refuge which would improve freshwater habitat and work to mitigate some of the blocking of flow that construction of the trail had resulted in.
- Option C would similarly follow the same treatment sequence. It would be larger because we'd be intercepting and treating all of the flow: BR36, BR37 as well as the new culvert so this is a significantly higher volume of flow that would require treatment. Similarly to Option B, we would be discharging south and restoring the freshwater supply to those existing wetlands.

EVALUATING ALTERNATIVES

Considering how best to evaluate these alternatives and providing a mechanism to score the advantage of one option over another, the main considerations are: treatment performance – how big that solution has to be; how much area it takes up; what operation and maintenance considerations we need to take into account; the total cost and, thus, how much funding would be needed; how long it would take to implement the solution and then also the overall longevity – how long the solution will last and how sustainable it will be.

Treatment Performance

When considering the alternatives, in particular treatment performance, the more flow you capture the more and more you can treat, the greater treatment performance. It's important to keep in mind that most of our treatment technology can be contaminant dependent. For instance, with nitrogen we can get equivalent performance from media filters and treatment wetlands but when we look at phosphorus, media filters have a much better treatment performance for phosphorus than treatment wetlands, and that contributes to the scoring. For treatment performance, Option C ranked the best.

Area Requirements

The next evaluation is looking at how big these systems must be. For ranking, a one would be a much larger area whereas a five would be a smaller area. Therefore, five is better being smaller so much of the sizing is going to be directly proportional to the flow captured and treated and thus the hydraulic retention time which ultimately determines the size of your system. For example, media filters can process water much faster than a treatment wetland and, thus, require less area. Area requirements are also dependent on where the system is located and how far the system is from the intersection point, that conveyance distance is critical as well for determining the overall size requirements. Option A ranked the best for area requirements.

Operation and Maintenance
These requirements contribute directly to cost because the more time that's required for operation and maintenance, the higher costs and higher man hours. For ranking in this category, one represents the most O&M that is needed, whereas a five is the least O&M. Media filters require more frequent inspection and clean out to prevent clogging, whereas sedimentation basins require periodic sediment removal and treatment wetlands require very little O&M. Option B ranked the best with the least O&M requirements.

Cost Funding
For ranking the options, a one represents the highest cost and a five represents the lowest cost. Larger systems will require more funding. Also, custom media for media filters are much more expensive than using local soil. More O&M requirements means more costs.

Schedule/Time
This category considers how long it takes to implement these systems. For ranking, a one represents the longest time and a five represents the shortest schedule. Larger systems require longer construction schedules. Permitting may contribute to long to longer schedules, so if we're working in an area that has wetlands or habitat, which would require a permit, it may delay the project and result in a longer schedule.

Longevity
Looking at media filters, that treatment solution may become exhausted over time as their absorption potential safe for phosphorus gets exhausted. It would need replacement, so media filters have a much shorter longevity, therefore Option A has a one ranking, for shortest treatment lifespan. The more passive the technology, the longer the treatment performance so Options B and C have a higher score due to that longer lifespan.

Comparing Alternatives Summary
In comparing all of the evaluation criteria, Option A scored 19 points, which consisted of the sedimentation basin plus the media filter. Option B scored 20 points with the sedimentation basin, treatment wetlands, and spreader swale to the existing wetlands. Both Options A and B are only treating BR 36, so they scored very similarly but because we're discharging south and in a completely passive approach. Option C has a similar sequence to Option B but it's much larger, so it results in a much lower score, at 16 points.

FUNDING
The project team is currently reviewing and developing a potential funding strategy to implement treatment solutions and has identified and reviewed several funding mechanisms including specific grants, loans, partnerships, which were shared with participants during the meeting. These funding strategies are under development and the opportunities are currently prioritized on a 1-5-10 scale rank with 10 having the best alignment with the current project characteristics. Moving forward, this funding strategy will be updated to further prioritize based on several factors including anticipated stakeholder

participation, compatibility with the project, schedule, and other factors. Once finalized, recommendations on which funding sources to pursue will be provided along with the identification of potential stakeholders who are best positioned to carry the ball forward. While funding sources are important, the project team emphasized the importance of looking to stakeholders to see who can support with moving the project forward. The final report will define each of these opportunities and include a full matrix identifying all the factors.

PRELIMINARY DRAFT RECOMMENDATIONS

The project team presented preliminary and additional draft recommendations to give stakeholders a general idea of what some of the final recommendations will look like inside the feasibility study. The list presented was not an exhaustive list, and the draft recommendations may be modified in the future. The final feasibility study will be due in March, so the project team will further refine its recommendations.

The preliminary draft recommendations essentially refer to specific aspects of the future project where the additional draft recommendations refer to activities or projects that could be undertaken independently or in concert with this project. The project team highlighted some preliminary draft recommendations, including pursuing land partnerships, both public and private, because land availability will influence the design, and this will be tied to the feasibility of Option A. While Options B and C are similar, C is much larger so one of those might be better suited for a smaller versus a larger footprint. Option A maybe even better suited to even a smaller footprint than Option B so those are some of the considerations currently being explored by the project team.

Of the additional draft recommendations, the project team recommended implementation of a synoptic water quality monitoring program in the region, which is important to have a good understanding of water quality in the area and would help support additional efforts in the future. Stantec also recommended implementation of a monitoring program to confirm the effectiveness of the constructive water quality treatment system. Monitoring is critical to measure operation and conformance with criteria. Stantec is also recommending including both public-public and public-private partnerships and pursue additional source control measures where appropriate. While this study is focused on a specific region, the project team acknowledges that it's important to pursue additional source control measures where appropriate.

NEXT STEPS

As the project team began to discuss next steps for the study, Tim Hancock emphasized the importance of recognizing the purpose of this study is to identify the potential tools, the ability and the opportunity to measure their effectiveness, and to understand what those tools are so as we determine the available land and available funding, we can bring to bear the greatest benefit possible. This study will not be the end all for water quality for those properties that are receiving waters to the south, but the argument that you should do nothing if you can’t do it all is an invalid argument.

We're trying to identify the tools and then, as we go forward and continue partnerships in this feasibility study, create a launching pad to develop incremental improvements. On example, many cities and counties Stantec works with may have a limited area within an urban section that they want to use for water quality treatment, and you install a certain type of system that fits that and then you measure its effectiveness and its effectiveness if it turns out to be great. You then have the impetus to carry that to the next level to expand the size and application. This may be an appropriate approach for this study. Now at the midline of the feasibility study, the project team plans to complete it by the end of March.

The additional input received from this meeting will further inform the study. As the report is finalized, the project team will continue to work with the stakeholder groups very closely. The feasibility study will serve as a road map that the agencies can use as they go forward and try and clarify in advance funding to create partnerships for land applications. As the project progresses to design and construction, these recommendations in the feasibility study will find purchase in informing the future direction of a water quality treatment solution.

Q&A

Comment 1
Bob Roth: It was explained at the last Picayune webinar in October, that the study will not be looking at water quality in the upstream drainage area since all the farms up there have BMPs that are inspected by the state and found to be compliant. I have learned that the farms are regulated by the Department of Agriculture rather than DEP. The BMPs of the Department of Agriculture are not the same BMPs which have been proven and practiced by DEP. Frankly, the BMPs for the farms are quite lame and include things such as putting up a fence to contain your herd or installing gutters on your chicken coop or following the manufacturer's recommendations for fertilizer applications. These BMPs are ineffective as the farms are still causing all of the polluted runoff in the upstream drainage areas that this study will try to address at the downstream end. The volumes and rates at the locus area are simply too great to effectively treat the runoff for nutrient removal. This study is misleading.

Tim Hancock: It really deals with the issue of who regulates the agricultural operations and how the BMPs that have been discussed and referred to in the past – where they originate from, who enforces them, are they significant? Those are all relevant questions.

Joanna Weaver: FDACS is in charge of the BMPs for the farms in that area. The farms are in compliance with the statutes, the framework, and the regulations. In this study, who regulates BMPS, or measures their effectiveness is not in the scope of the study as the farms are in compliance.

Tim Hancock: There are things that are background that exist today that you may be looking at years if not decades of operations that would have to be altered and that type of thing. The focus the study is what can be done going forward to provide incremental improvements to the downstream properties because each day we do nothing, nothing gets better, and so that's why I think the effectiveness of the different applications that the team has looked at is important.

Yvonne: I wanted to point out the comment and how it asks about the distinction between the BMPs regulated by FDACS and the BMPs practiced by the DEP and if there's a distinction that we can discuss as it's another level of standard being put into question regarding what is regulated by FDACS versus the DEP.

Jennifer Brunty: My background is in agriculture and I worked for farmers for a lot of years. The state has essentially turned over regulation of agriculture to the District. It is not DEP; they are hands off. It has been turned over to the water management district for regulation. For assisting with getting people signed up for BMP programs and helping with cost share programs water management districts have cost share programs, but so does FDACS. Having said that, FDACS has what is called a NOI or notice of intent program and they go around asking farmers nicely to sign up for this notice of intent program saying that they will implement BMPs and, as part of that program, they keep the farmer keeps records describing how they implemented the BMPs that they agreed to implement with FDACS. Early on many years ago, there was an expectation that the DEP expected FDACS to get 90% participation from all the farmers and it didn't happen by the deadline, and then many years after the deadline passed it still didn't happen. Then around 2011 or 2012, there was talk of DEP there were talks that if the agency didn't get that 90% participation by a certain date, it would make the NOI program mandatory for farmers. That never really happened, but around 2011 and 2012, DEP set more stringent standards for FDACS to monitor all of the BMP notices of intent that farmers had signed to make sure that the farmers are meeting the requirements they outlined in the NOIs. FDACS doesn't have regulatory authority; they have a cooperative relationship with the farmers. The cost-share funding with farmers is not a contract between the farmers and FDACS. FDACS funnels all its money through other entities, mainly water conservation districts. The actual regulation of agriculture has been assigned to the water management districts and not FDEP, but there's this overriding FDEP expectation that a really high-level percentage of farmers, I believe 90%, will sign up for this notice of intent program, and if they don't the DEP can legislatively enact further requirements of farmers and nobody wants to do that. That being said, FDACS has increased its audits of the farmers that are already in the NOI programs and they continue to try to encourage farmers to sign up for the program because if FDACS doesn't get enough participation voluntarily the NOI program will become mandatory.

Comment 2

Bob Roth: Option A will at least address the existing farm tomato road on route US 41, but you really need an option A at the downstream end of every farm in the upstream watershed.

Tim Hancock: If we could turn back the clock and do post discharge treatment systems for every single level of output, that that would be great, but we certainly are limited in doing that at this stage. I don't think anyone would disagree that having treatment systems at the discharge points of all agricultural operations would be ideal, but we just have to work within the system we have at this point.

Amanda Ludlow: After the last public meeting, we actually went back and did some re-analysis, and we had some more defined flows. Intercepting all of the flow at BR 36 actually appears to be feasible so, essentially, the combined flow that will be coming down through BR 36 and Options A and B would be treated entirely with a solution. Option C would treat BR36 and BR37 and the new culvert. Because we did this re-evaluation of the flows, the solutions are feasible south of US 41.

Jennifer Leeds: Let's quickly revisit the higher-level purpose and intent that put us down the path of the feasibility study and give everyone a refresher on how we got to where we are today. At beginning of this presentation we touched on this, and a lot of the questions are focused on some of the agricultural areas that are upstream of US 41, but over the summer, as we were moving forward to trying to get the last contract awarded for the CERP project of Picayune Strand Restoration, we knew that in the future we needed to put some additional culverts under the road of US 41 and County Road 92 and we looked downstream to where those flows are going to go. We know that we had some changes upstream, and while there's been some focus on the agricultural areas upstream, there are other areas in what we're calling the Picayune Watershed as a whole. We have the Picayune Strand Restoration Project, which is CERP, which is returning 55,000 acres with canals and point-source discharge where those canals in the future will be backfilled, and the roads will be removed. It's ongoing today to facilitate sheet flow. That sheet flow will produce a much higher level of water quality coming off the landscape. We also have the Belle Meade area, and the agricultural areas and then there are urban areas all kind of mixed in together, so there's actually a variety of some upstream sources. We knew we were not going to have enough time to turn this into a regulatory study to look at trying to develop BMPs, but what we really wanted to do was to be able to be responsive to the stakeholder concerns, and not just some of the other governmental agencies like Collier County, DEP and Collier-Seminole State Park, but with also the partners that we've been working with including environmental groups and the agricultural community. Everyone has come together with this study to try to see what kinds of solutions we can come up with. We know that land is a concern – there's not a lot of land availability so what could be some suite of alternatives that could be implemented that we can employ to start chipping away at this, as Tim talked about earlier, to help improve the water quality some. Because this was such a fast feasibility study – it will be completed within 6 months, which typical feasibility studies of these types can go anywhere from 12 to 18 months. We are very, very focused and so that kept our scope very focused, and we look forward to coming up with a good suite of alternatives that we can communicate to address and improve the water quality going downstream.

Q/A 3
David Rasmussen: Where is Southwest Florida Water Management District in this discussion?

Yvonne: Perhaps the stakeholder meant South Florida Water Management District. If so, you have heard from Jennifer Leeds who is one of the panelists for the District and you heard from Joanna Weaver earlier today.

Joanna Weaver: If you are referring to Southwest Florida Water Management District this is not in their district. It starts at about Charlotte County, so they're not included in this study. But the South Florida Water Management District is working closely with Stantec to complete the study by the end of March.

Q/A 4
David Rasmussen: What is the potential for acquiring enough land in county, state and federal parks and reserves to construct the proposed bioreactor ponds?

Tim Hancock: The project team is working on that with the many partnerships that the District has in both the public and private sector. Earlier, Amanda mentioned that there were options that the project team felt could provide a very significant amount of treatment at the BR 36 culvert. What kind of rough acreage are we looking at for some of these options? Some can be implemented in fairly small areas. Others take a little bit more. Is there kind of a goal post from an acreage standpoint? At this point are we comfortable saying these would work in an X amount of acreage scenario?

Amanda Ludlow: Yes. We're looking at essentially less than about 30 acres for a true intercepting of all of BR 36.

Tim Hancock: While we can't say that a parcel has been identified or, here's the acreage we know we need to do X, we can at least give that context that for BR 36 culvert and the options we've looked at for roughly a 30-acre parcel would be a really good start.

Q/A 5
Bob Roth: Until the water quality from the farms is properly addressed with proper DEP BMP's these conditions will persist. You're trying to treat the Mississippi in Baton Rouge. It's too late where you're looking.

Tim Hancock: This is not just about agriculture. There are a lot of other contributors in the area, but the bottom line is that as Jennifer Leeds set the stage and as Amanda mentioned, if we can successfully treat the volume of water coming through BR 36 and make a significant positive impact downstream, then I think we've accomplished something there so I'll let anyone add to that who wishes to, but I think those two responses in combination earlier probably at least addressed, as far as this study goes, what we're trying to accomplish and what may be achievable.

Q/A 6 & 7
David Crain: Do you have a slide showing where you would propose putting these options and the size of each?

Phoebe Clark: Have federally/state listed endangered/threatened species been considered in the alternatives analysis? This could create timeline delays due to consultation, or additional costs due to mitigation or minimization measures.

Tim Hancock: (Q/A 6) As land is identified and partnerships are created, that certainly would be a part of the process. (Q/A 7) There's another question that may come up a little bit later that talks about you know have federally listed or threatened species been considered in the analysis, and no matter what treatment system or physical location is determined in the end, it will have to go through a proper permitting process so an evaluation of potential impacts to species and to vegetation and to habitat will occur as a part of the permitting process. At this stage we don't really have a physical location map that we can show you, but hopefully that will occur sooner than later.

Q/A 8
Tracy Robb: For option A, where is the existing canal that will receive the discharges from the facility?

Tim Hancock: That's something that will be determined, and I'm not so sure that the phrase canal necessarily is appropriate. There's certainly going to be conveyance measures depending on the physical location of the treatment systems to get the water from point A to point B and how it discharges into the OFWs to the south is somewhat to be determined and will be parcel specific. I'm more of the generalist on this, so if one of our technical folks wants to add to it, feel free to. For the most part, once the location is identified, the scale and scope is identified. I think the question regarding discharge and actual routing can be most appropriately answered then.

Q/A 9
Tracy Robb: For the treatment wetlands, what type of vegetation is proposed given the existing and future water environment (tidal and SLR)?

Amanda Ludlow: In the feasibility stage, we're not necessarily at the stage of designing, but any final design would take into account if it's brackish water, fresh water, tidal – all of those would be taken into consideration and what species would be able to grow in that environment, those obligate species, those back wet species, and making sure that we're using native emergent species maybe even incorporating some more woody vegetation as well.

Jennifer Brunty: The project team is going down and looking what vegetation is growing already in that area. That usually is the most helpful in achieving success. I've been down there a couple of times and I've noted that some particular plant species that really like the brackish water areas. We'll look at what's actually out there now in the areas that we want to replicate.

Q/A 10
Richard Blonna: Is one alternative public-private partnerships with the farms to purchase land that parallels US 41 to use for ponds or media filtration so that the contaminated water doesn't cross the highway and threaten Collier-Seminole State Park and Marco Island's waterways?

Tim Hancock: We don't have a parcel-specific plan at this stage. I will tell you that that there are a lot of people on this call, both that represent both public and private landowners, and we are continuing to work and seek those partnerships to create as much opportunity as possible. There are some folks out there that are very willing to work with the District and move that forward, but I don't think, at this point, we can talk specifically about a parcel here or a parcel there, and if there's anything to add to that I would defer to Jen Leeds.

Jennifer Leeds: We've talked about how that's one of our challenges in this area – land availability and that's why we're really trying to highlight those partnerships, not just public-private, but between public agencies as well to see what we can leverage and to see what kind of good solutions we can come up with to move forward.

Tim Hancock: Either way it's going to take partnerships on both sides – public and private – to effectively address the matter.

Q/A 11
David Rasmussen: How much water quality improvement is anticipated with the water reactor ponds?

Amanda Ludlow: Each solution is really designed to bring the concentrations down to below water quality criteria, so that's the ultimate goal when we talk about treatment performance – to really bring these elevated concentrations that we're seeing at BR 36 and BR 37 and bring those down to below water quality criteria.

Q/A 12
Bob Roth: To what extent will this project help rebalance or further unbalance the salinity of the three Goldilocks estuaries? In further clarification, the 3 "goldilocks" estuaries are the areas below, east, and west of the study locus. One is too salty, one is too fresh, and one is just right. It's a term coined by Rookery Bay.

Tim Hancock: We understand the question on the standpoint of ensuring that salinity balances are improved or maintained, whatever may be most appropriate. When we start looking at whatever potential implementable solutions there are, how we are going to address those downstream impacts from a salinity basis to ensure that those situations that are either just right or not enough or too much are improved? I'm going to give Jennifer Brunty an opportunity to respond.

Jennifer Brunty: It will be hard to say right now without knowing where we're going to be putting our projects, which directly affects where the discharge is going to go. I believe the Ten Thousand Islands National Wildlife Refuge would like some extra fresh water, so if we can route extra fresh water in that direction that would be good. I don't know all the details about which other two estuaries have the correct salinity and two little salinity, so I need more information on that I need some time to look at it and absorb that before I could answer it, but it is going to depend on where we end up putting our project if we put it at BR 36 or BR 37 or both, that affects where the water goes to and cleaning up that water will basically increase fresh water flows.

In follow up, Keith Laakkonen recommended reaching out to Dr. Brita Jessen as the appropriate contact for water quality data at Rookery Bay, and Pat O-Donnell at Rookery Bay for fisheries data.

In addition, a stakeholder identified the 3 water bodies as Falahatchee Bay, Faka Union Bay and Pumpkin Bay.

Q/A 13
David Rasmussen: How much of this is a man-power overhead solution looking for a problem?

Tim Hancock: I think Jen Leeds from the District covered that very clearly earlier as to what the study is intended to do. We have got a tremendous amount of data on the water quality, particularly BR 36 and other areas. We know there's an additional crossing that will be coming along US 41 there, so the problem is pretty clearly identified as far as what exists, and, again, I'm looking for a way to take advantage of any opportunity for incremental improvements to see fewer nutrients feeding the downstream property. The problem is there, the question is what is yet another tool in the toolbox that we can bring to a suite of solutions that will make things better overall?

Q/A 14
Andrew Tyler: Please identify who you consider to be stakeholders for this project?

Tim Hancock: Going back to the stakeholder slide of the presentation, there are a lot of local and regional NGOs as well as landowners, farmers. We certainly can make that available. Everyone on this call is a stakeholder. A stakeholder is anyone who is interested in the overall water quality of this area. That is why we have these public meetings, to make sure that we inform people as much as possible. We are working with a technical group and they are folks that have been very much engaged or involved over a number of years in water quality improvement efforts in the area and we are greatly appreciative of their time. I would refer back to the slide that we shared earlier as what I would consider to be that core group of stakeholders.

Yvonne McClellan: For this project we've been coordinating with the City of Marco Island, City of Naples Collier County to ensure that we're broadcasting as much as we can to the residents in the area, reaching out to the HOAs to share project information with them to distribute to the residents in the area as well. A lot of the information presented especially with the acronyms can sometimes be a little bit confusing for someone who's just getting into the conversation but we're more than happy to answer any questions or clarify anything that is a little bit of confusing.

Comment 15
Tracy Robb: It is understood that the major farm located just north of this project is enrolled in the FDACS BMP program which grants an "assumption of meeting water quality". However, permits issued to the farm by SFWMD are still in effect regardless of the BMPs in place. This would include enforcing the allowable discharge rate for the drainage basin. This would help with minimizing the water quality impacts due to excessive discharges.

Tim Hancock: As Jen Leeds mentioned earlier, it's not within the scope of our study to address the BMPs that are in place or to enforce the BMPs that are within the larger area that is contributory, so we appreciate the information. All information that is provided and comments that are provided as a part of this meeting are made a part of the project process and the study overall, but that doesn't really lie within the scope of what we're trying to accomplish here.

Comment 16
Bob Roth: Even of you had all the land and money, you're still looking in the wrong place to solve this problem effectively.

Tim Hancock: It's an opinion, and I don't think that what we're looking at accomplishing here is unimportant or ineffectual. So, it is a part of an overall larger-term regional solution and I don't think, as I said earlier, there's a single silver bullet that accomplishes everything. We know the cost of doing nothing and we see this as a very appropriate step in order to identify opportunities so that as the land and funding becomes available, we can at least have downstream improvements. Again, I appreciate the comment and the sentiment, but what's being proposed is scalable and appropriate and, as the land and funding becomes available, it can make a real difference down the road.

Q/A 17
David Crain: Has there been any thought of partnerships with existing golf courses and or housing developments in that area that have existing lakes, ponds, etc.?

Tim Hancock: This is something that Collier County has done very effectively in a lot of areas where they have worked with housing developments to use their systems and their lake systems in concert with longer term improvements. For example, Isle of Collier Preserve is one of those examples.
It is not within the scope of this project to do necessarily, however, we do know that, for example, Fiddler's Creek, which is very close to our project, has a very strong water quality component in how they look at their discharges and whatnot and certainly they're an entity that we would look for opportunities to work with as well. Those things are all considered, but, again, not specifically within the scope of this study.

Q/A 18
David Crain: What is the goal as far as water quality improvement for each of these options?

Amanda Ludlow: The project team's goal is to bring those elevated concentrations down to the below the water quality criteria.

Q/A 19
Michael Ramsey: More water quality data needs to be collected south of US 41 between the culverts on US 41 north to CR 951 to better understand what is going on. Current data set is limited.

Tim Hancock: We tend to agree, that's why part of the project team's recommendation is increased and improved monitoring of the synoptic data. I can't say that anyone on this team would disagree that additional information would be helpful. We do have a lot of data on what flows.

Amanda Ludlow: We have a variety of data at those BR locations, but they are limited for a full data set for all water quality parameters, so there are limitations to the data sets we have.

Tim Hancock: Our recommendation is really to expand so that as we go forward and can determine the degree of measured success or lack of success, if that were the case, but hopefully not.

Comment 20
Bob Roth: This is a matter of public health. DEP must take over the regulation of farms. Rather than asking farmers to sign up on the NOI, DEP should be telling them, just like they do on every other land use. Until that happens and the system changes this problem will persist.
Yvonne McClellan: While we've mentioned this isn't part of the scope of our project, it is something that should be brought up with FDACS and DEP separate from this project.

Q/A 21
Tracy Robb: It is unclear how Options A & B are sufficient given that three new culverts are proposed (New Opening) that will have the same water quality as BR 36 (aka TAMTOM) discharging directly into Collier-Seminole State Park south of US 41. Flows will increase with the project. Knowing this situation, where are the downstream "wetlands" identified in the options?

Tim Hancock: We know that there is going to be a new culvert there, and that we can anticipate that the water quality coming through that area will be somewhat similar, but we don't have that data yet obviously because it's not in place. I think those additional flows are part of why we were looking at Option C.

Amanda Ludlow: From the data sets, we do know that BR 36 has higher or elevated concentrations of nutrients and suspended solids compared to BR 37. We may in the future see effective dilution with the new flows, but, again, Option C does look at intercepting all three flows and containing and treating it to water quality criteria, but BR 36 is a much smaller flow compared to BR 37 but just has higher concentration, so intercepting, treating and focusing on BR 36 is a very efficient use of any treatment solution.

Tim Hancock: To address the last part of the question about downstream wetlands that are identified in the options, we've got a rather diverse and expansive wetland system to the south and Collier-Seminole and others but are there any more that you can kind of add to that?

Jennifer Brunty: The downstream wetlands in the existing condition with BR 36, the new culvert, and BR 37, the downstream wetlands adjacent to US 41 are going to be getting increased loads. The new water that is going to be diverted from the PRSP and is going to have lower concentrations, but higher volumes so overall the load is going to increase. If nothing is done, then all of those increase loads are going to just go into the state park at the location of these culverts. If we put in some treatment systems, the water quality would be fairly easy to improve, relatively speaking, in relatively small areas that we're talking so it would provide a net benefit reduction in loading. We don't have all of the modeling that but I would expect from what we've seen so far that there would be a reduction in loading to the wetlands downstream with these relatively smaller projects that we've been talking about, especially if we put one in at both BR 36 and BR 37, putting one in at BR 36, the concentrations are higher at BR 36 with the flows are lower so the loading isn’t as high as at BR 37 where concentrations are a little bit lower, but the flows are a lot higher. There’re advantages to putting treatment systems in that would improve the overall water quality of downstream wetlands.

Q/A 22
Darren Rumbold: I believe that during public workshops held by the county in February 2019, there was a consensus that approvals of Stewardship Receiving Areas (SRA) in RLSA should stop if either the quality

or quantity of water was negatively affected – do you anticipate results from the monitoring program be used to assess future zoning decisions?

Tim Hancock: That's a jump of about 30 steps beyond where we are today. The comments provided today will become publicly available, and how it is used, whether by Collier County or others, to look at future land use decisions is really up to them. I don't think it's appropriate for anyone on the project team to address that question with any specificity. It is outside of the scope of what we're doing, but obviously the information is publicly available and, from a design standpoint, the more data we have the more information we have, so the better our designs are going to be.

Q/A 23
Andrew Tyler: That area the Ten Thousand Islands south of US 41) is already showing signs of saltwater intrusion and vegetative change. Please talk with the Panther Wildlife Refuge regarding that situation. Presumably, the additional fresh water might redress that balance. Hope USFWS is part of the stakeholder group already?

Yvonne McClellan: Yes. U.S. Fish and Wildlife is already part of the stakeholder group.

Tim Hancock: The refuge is part of the working group and knows what we're doing going forward so that coordination is existing already, but we certainly appreciate the mindfulness and making sure that it's there.

Q/A 24
Andrew Tyler: In the previous public meeting, presenters described the Gordon River project and the ratio of watershed to treatment area. Is that ratio a fair expectation for this one?

Amanda Ludlow: While we do not have that information about the Freedom Park project readily available, I recall the Freedom Park project being approximately 20 acres of treatment solutions.

Tim Hancock: As we don't have clear data at our fingertips, the project team would be hesitant to say that the treatment ratio of Freedom Park could be applied in this situation because the inputs are different. We used it as an example of a type of treatment system, that elements, which would have potential application for the Picayune Watershed area, because one of our charges was to look at proven systems – things that are out there and are working that are measurable. We believe Freedom Park is a really good example of a treatment solution that people understand and can appreciate and as you look at the options that we've put forward, you see elements of what exists in Freedom Park in those as well.

Q/A 25
Tracy Robb: What is the discharge rate for each option that will need to be addressed, and what is the basis for this information?

Tim Hancock: We have different input rates because we know what our volumes are, and what our rates are coming into what would be these systems, for example, from BR 36 or BR 37. As far as discharge rates, that's going to be a function of the design and the treatment goals of the system, or treatment opportunities of the system.

Amanda Ludlow: Most of the water flow, the water quantity measurements and estimates were based upon the PSRP Water Quality Projections report for the southwestern protective levee feature and the projections for future flows and the new culvert. Much of that data also reflected a 6-month discharge through those culverts, so what we're looking at, at say BR 36, is about, taking into account that 6-month period and really condensing the flow to over a 6-month period as opposed to over a year, you're looking at about 900,000 gallons a day at BR 36 and about 5 million gallons a day at BR 37.

Additional Comments

M B: Why are we almost 20 minutes into the meeting and we haven't covered anything? Why are we being so verbose without accomplishing anything. Historically the PSRP meetings were run much more efficiently.

Yvonne McClellan response: Hi MB, some participants are joining us for the first time and providing some background on the study and what's been presented previously is helpful to those attendees. Also, it gives some time for those who were not able to join right at 3 p.m. I noticed several attendees were running a bit late. Thank you for your patience.

David Rasmussen: Thanks for your explanations. I reinforce your intent to improve water quality. TMDL is important to protect these three areas. Growth should not happen if we cannot protect the environment.

CLOSING STATEMENTS

Tim Hancock thanked attendees for participating in the meeting on behalf of the project team of professionals and experts at Stantec, it's partner Quest Corporation of America, the South Florida Water Management District, the Basin and all of the stakeholders that have been a part of the program and will continue to be going forward. He thanked attendees for their questions, their participation, and their passion for improved water quality across the board in Southwest Florida. Stantec and the project team are pleased to be a part of this process and look forward to advancing the goals of the state and improve water quality across every opportunity.

Jennifer Reynolds offered closing statements as the division director at the South Florida Water Management District for ecosystem restoration and capital projects. She also thanked everyone for participating in this public meeting and workshop discussing challenging issues. Part of the reason it's challenging, is due to the nature of this feasibility study and how it isn't your typical feasibility study. The reason behind this feasibility study came from looking at the PRSP and, completing the construction on that restoration effort, realizing the flows from many of these areas that flow into Picayune Strand Forest would now be rerouted and would be flowing into the canals adjacent to US 41 and, from there, go into the Outstanding Florida Waters that were discussed during the meeting. Jennifer Leeds also mentioned how Dr. Jennifer Brunty spoke about looking at the increased volumes; and there were multiple stakeholders, both NGOs and other agency groups, that came to the District and project team and asked if we had taken a look at the potential increased load of nutrients that it could bring to OFWs and, that as we continue to look at the operations of Picayune Strand and what that might entail, to think about whether there might be a need for an additional water quality project moving forward into the future. That's what this study is about – taking a look at a very early basis of what potential water quality projects could look like in an area where there isn't a lot of land available to construct something to address nutrient loads. She reiterated and reinforced with this group that this is not the only effort that has to do with this problem set. As we look at this problem set, we're continuing to examine what the operations for the Picayune Strand project are really going to look like as we finish construction and look at operating that project. Simultaneously, we are coordinating with other agencies – the Florida Department of Environmental Protection and the Department of Agriculture and Consumer Services on their BMPs and regulatory programs in this area, and we're also looking at increasing our water quality monitoring and more succinctly addressing and identifying sources of those nutrients so that we can more appropriately address both through source control, through existing projects and programs, and through potential new projects this bigger problem set. While it may be frustrating for a lot of stakeholders that the panel was not able to answer all of the questions submitted during the meeting, the panel wanted stakeholders to understand that this study is not the only way that we're getting after this solution for this bigger problem set, and that we are committed to continuing to work with all agencies and interested parties to address these questions and issues and concerns to make sure that all of our water bodies are as protected as possible. She hoped that her explanation shed a little bit of light on why we couldn't answer, in this study, all of the questions received during the meeting. She thanked all attendees for participating in the meeting and expressed that she looked forward to continuing the dialogue about water quality with the community and interested stakeholders in the future.

The meeting concluded with once again sharing the project website information as well as the constant contact landing web page to sign up for updates about this project as it progresses.

Constant Contact: https://lp.constantcontactpages.com/su/8G8AunX/CCSRWaterQStudy

Project Website: https://www.sfwmd.gov/our-work/picayune-watershed-water-quality-feasibility-study

The meeting ended at 4:40 p.m.

Brief Overview of Public Outreach Efforts

Quest Corporation of America prepared a press release and distributed it to established media outlets in the area in advance of the meeting. In addition, it followed up via phone and email once more before the meeting to announce how to register and participate.

The South Florida Water Management District published a FAR Notice two weeks in advance of the meeting. Quest Corporation of America also notified a wide range of stakeholder groups and interested parties in the community including more than a 600-person mailing list of residents and businesses located near the project study area via email twice in advance of the public meeting.

South Florida Water Management District

Picayune Watershed Water Quality Feasibility Study

Stantec

Joanna Weaver

South Florida Water Management District
Lead Project Manager
Ecosystem Restoration and Capital Projects

Agency Stakeholders

Introductions

South Florida Water Management District

Florida Department of Environmental Protection

Florida Department of Agriculture and Consumer Services

Florida Wildlife Federation

LIPMAN family farms

Conservancy of Southwest Florida
Our Water, Land, Wildlife, Future.

Audubon

Collier County
POLLUTION CONTROL
LIVE GREEN. SAVE BLUE.

LAGO
Consulting & Services

Stantec

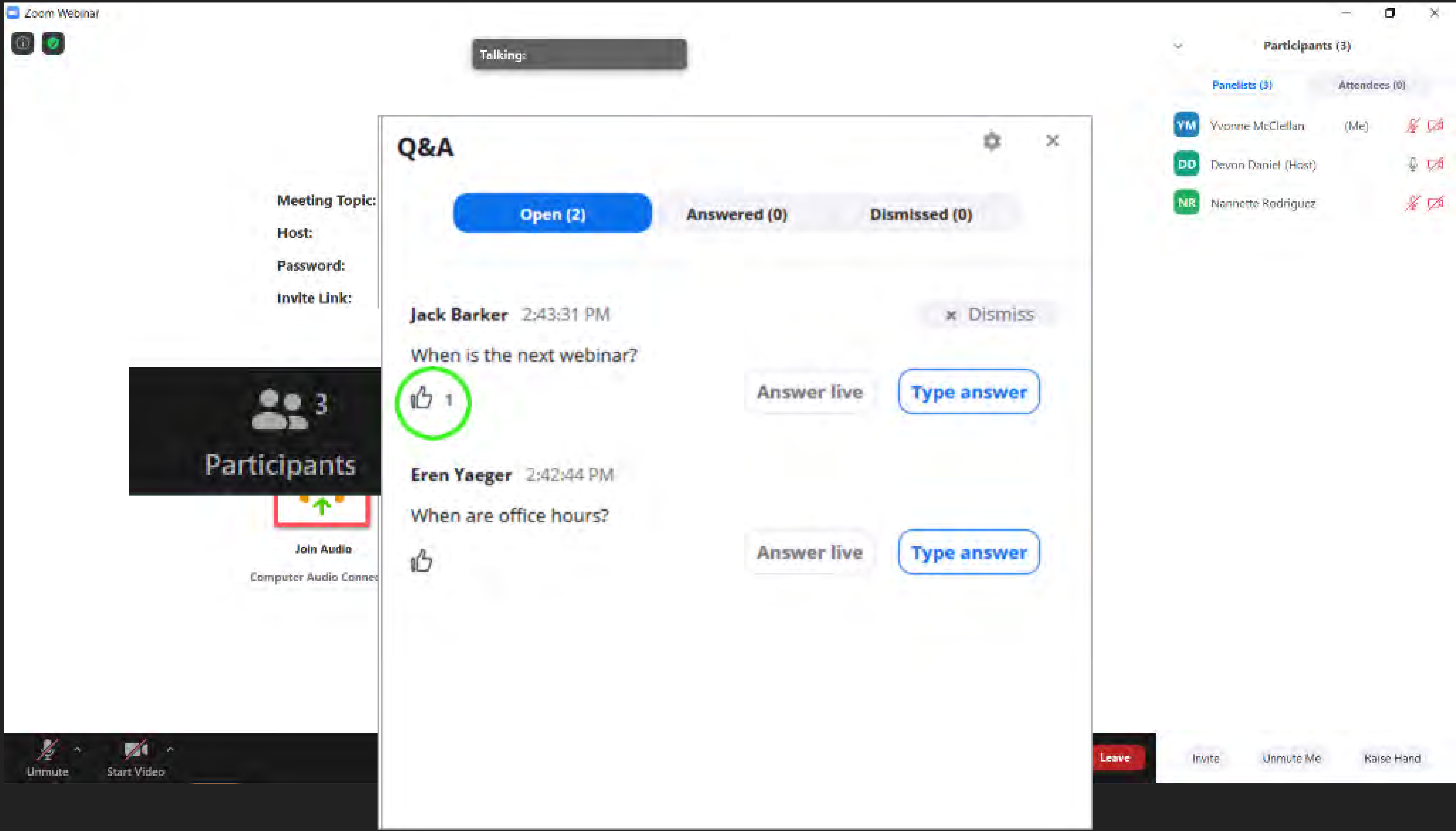
Quest Corporation of America

Zoom Technical Support – Online Resources
https://support.zoom.us/hc/en-us/articles/201362003

Zoom Support Live Chat
- Visit the website below and select the “Contact Support” link in the upper right corner

https://support.zoom.us/hc/en-us

Zoom meeting troubleshooting



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Panelists (3)
Attendees (0)
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DD Devon Daniel (Host)
NR Nannette Rodriguez
Meeting Topic:
Host:
Password:
Invite Link:
3
Participants
Join Audio
Q&A
Open (2)
Answered (0)
Dismissed (0)
Jack Barker 2:43:31 PM
Dismiss
When is the next webinar?
1
Answer live
Type answer
Eren Yaeger 2:42:44 PM
When are office hours?
Answer live
Type answer
Unmute
Start Video
Leave
Invite
Unmute Me
Raise Hand

Q&A

Kyle Goodwin
Stantec

Jennifer Brunty
Stantec

Amanda Ludlow
Stantec

Tim Hancock
Stantec

Panelists

Agenda

- Study Overview and Purpose
- Summary Review of the First Two Public Meetings
- Information Collection Summary Report
- Feasibility Study Overview
- Next Steps
- In Summary
- Q&A

Study Overview and Purpose

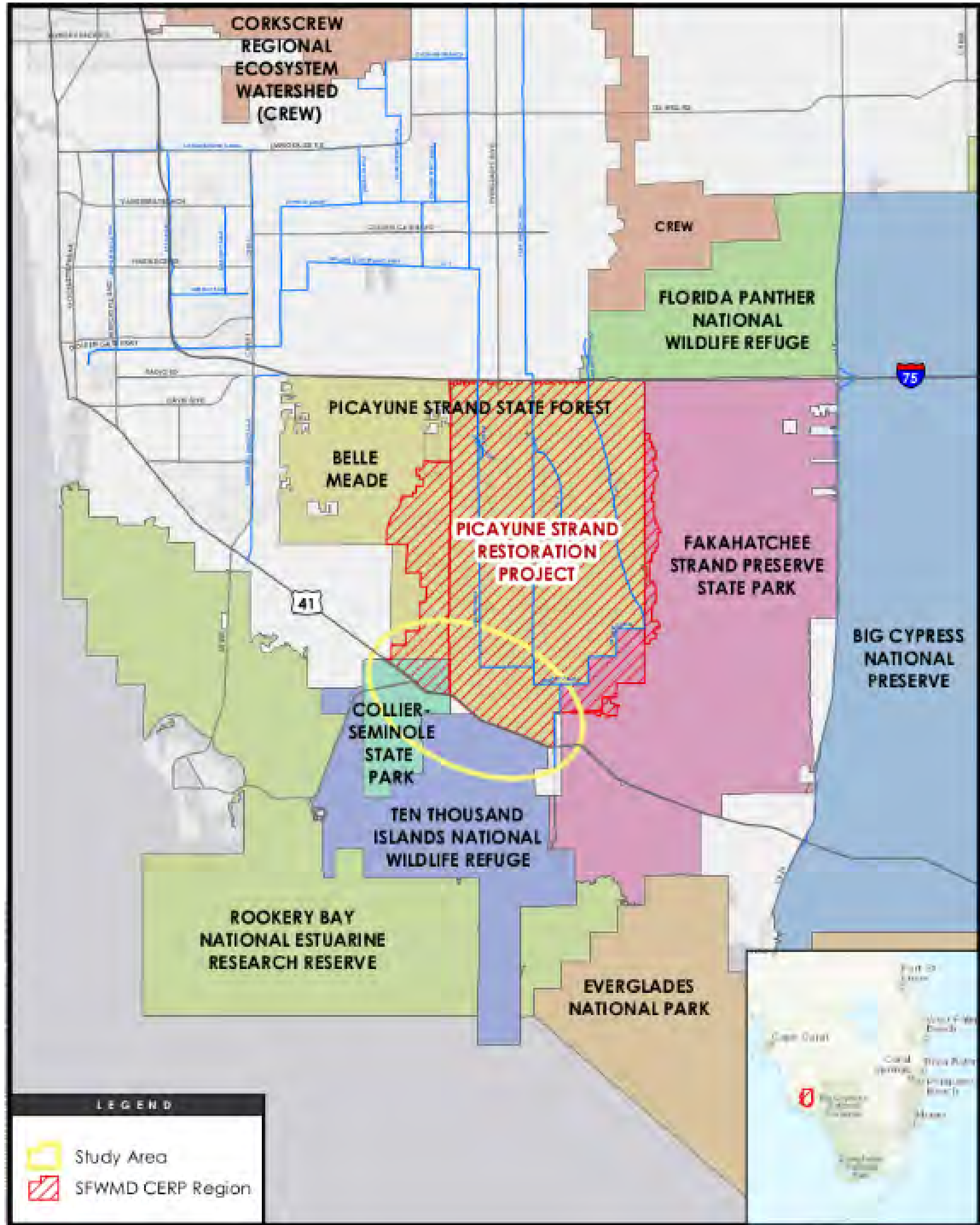
Study Overview

To examine conventional and innovative water treatment resources, stormwater redistribution, and active or passive water quality improvement projects towards reducing nutrients in the downstream areas of the Outstanding Florida Waters (OFWs) from the Picayune, Belle Meade, agriculture, and urban watersheds.

- Outstanding Florida Waters (OFWs) Explained

Discharges to OFW

- Collier-Seminole State Park
- Rookery Bay Estuarine Research Reserve
- Cape Romano-Ten Thousand Islands Aquatic Preserve



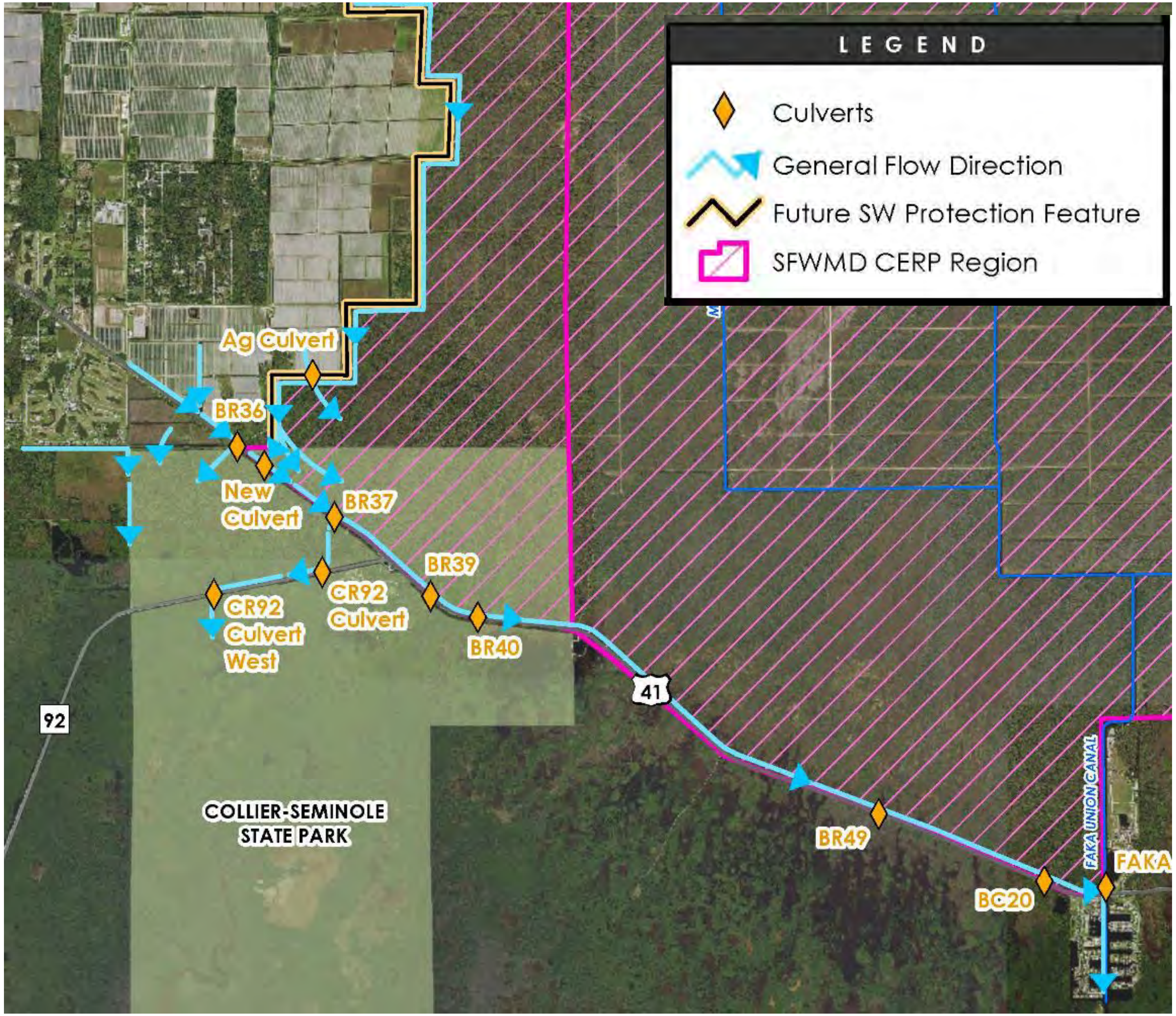
Study Purpose

Purpose:

- Collaboratively **develop a suite of alternatives** of cost-effective projects to **improve water quality** and/or re-distribute flows to downstream OFWs.
- Identify cost-effective options that reduce nutrient level present in current and future discharges.

Orientation:

- Upstream Sources
- Review Flow Map
- Downstream Water Quality
- Does Not Include Source Control



Summary Review of Public Meetings

Meeting Review

- Information Collection Summary Report Status
- Feasibility Study
- Shared the Project Schedule
- Potential Technologies were Reviewed
- Freedom Park Case Study
- Example Process Schematic

<u>Key Takeaways</u>

- Water quality is a high priority in Florida
- Focus on passive systems
- Incremental projects with positive impacts

Review Information Collection Summary Report

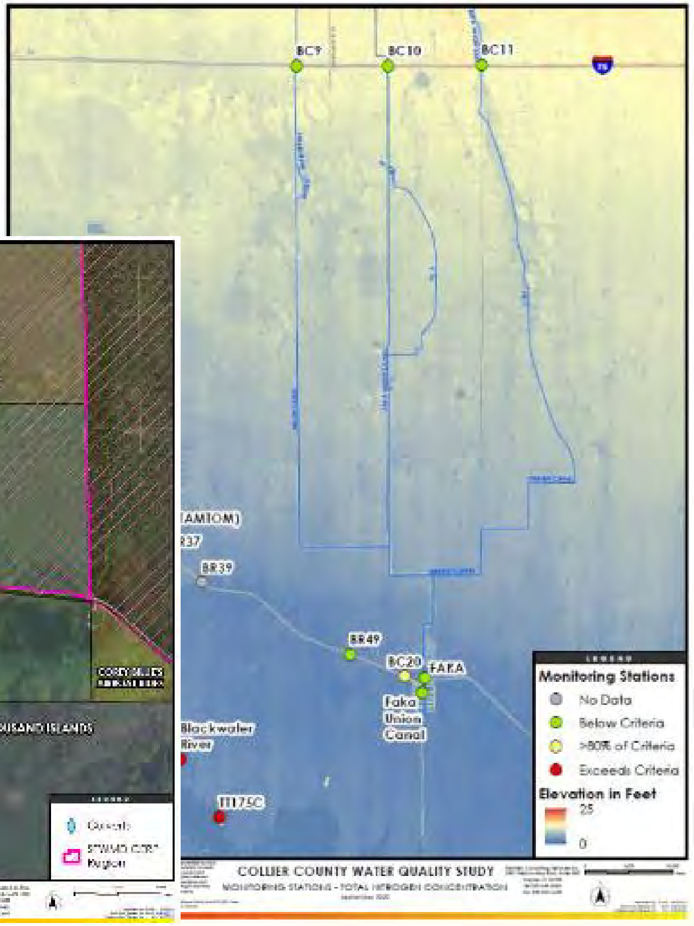
Information Collection Summary Report

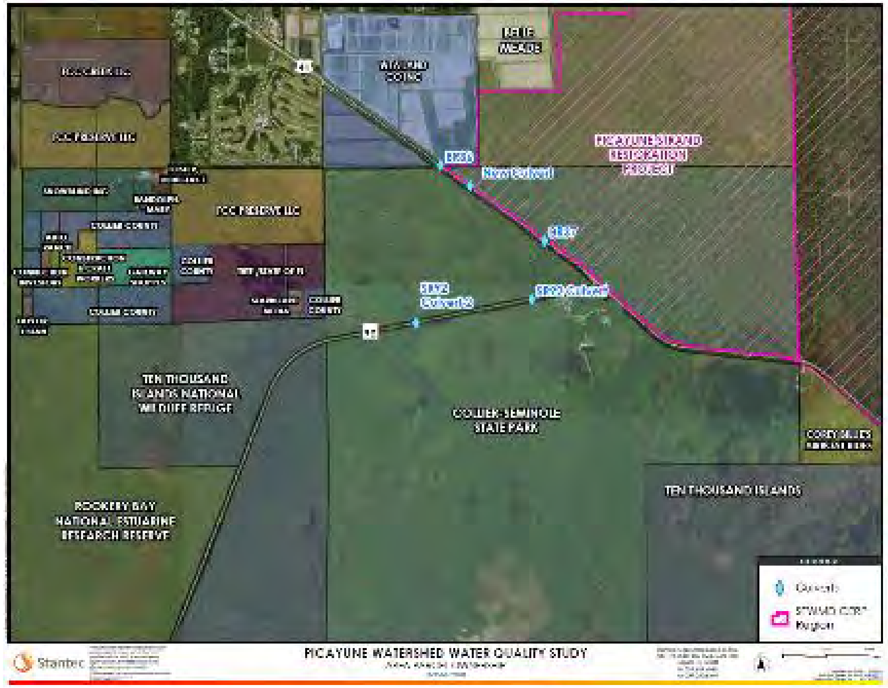
Sections:

- Introduction and Background
- Data Sources / References Reviewed
- Review Methodology
- Literature Review and Analysis
- Treatment Options

Purpose:

Inform the Feasibility Study





https://www.sfwmd.gov/our-work/picayune-watershed-water-quality-feasibility-study

Treatment Options Reviewed

Applicable

- Spreader Berms and Canals
- Sedimentation Basin
- Constructed Treatment Wetlands
- Polishing Ponds
- Media Filters
  - Bioreactors
  - Iron Enhanced Sands
  - Bold & Gold ®
- Restored Wetlands
- Air Diffusion Systems
- Periphyton (SAV)

Non-Applicable

- Hybrid Wetland Treatment Technology
- NutriGone MediaTM
- Recycled Water Containment Area
- Algal Scrubbers
- Offline Alum Treatment
- Floating Treatment Wetlands
- Downstream Defender®
- Aquifer Storage and Recovery (ASR)
- Deep Well Injection

Feasibility Study Overview

Feasibility Study Overview

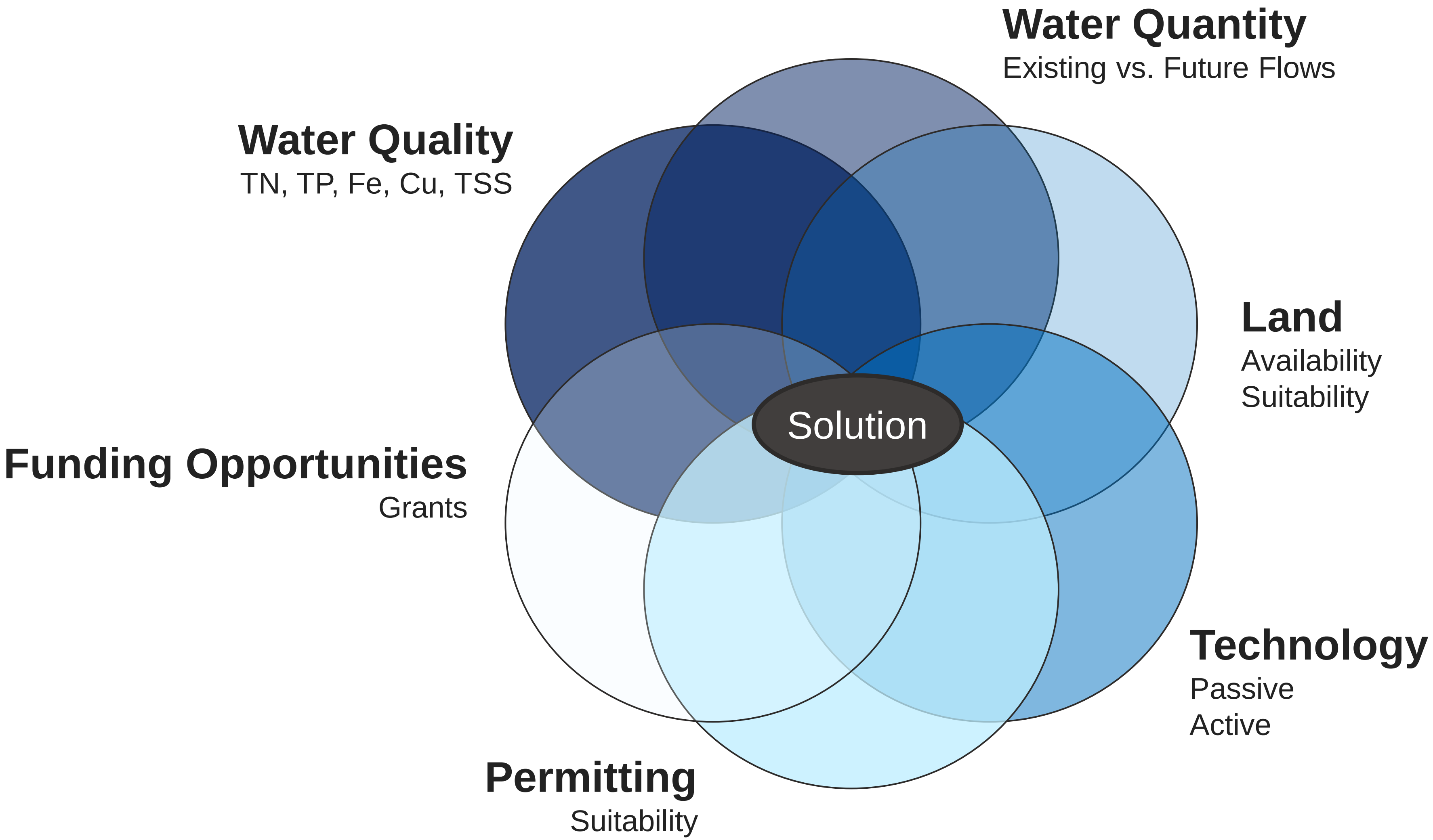
Currently:

- Identifying Problems, Constraints and Opportunities
- Formulating Alternatives
- Evaluate Alternatives
- Compare Alternatives

Next Steps:

- Funding Strategy
- Recommendations

Problems, Constraints, and Opportunities



Formulating Alternatives

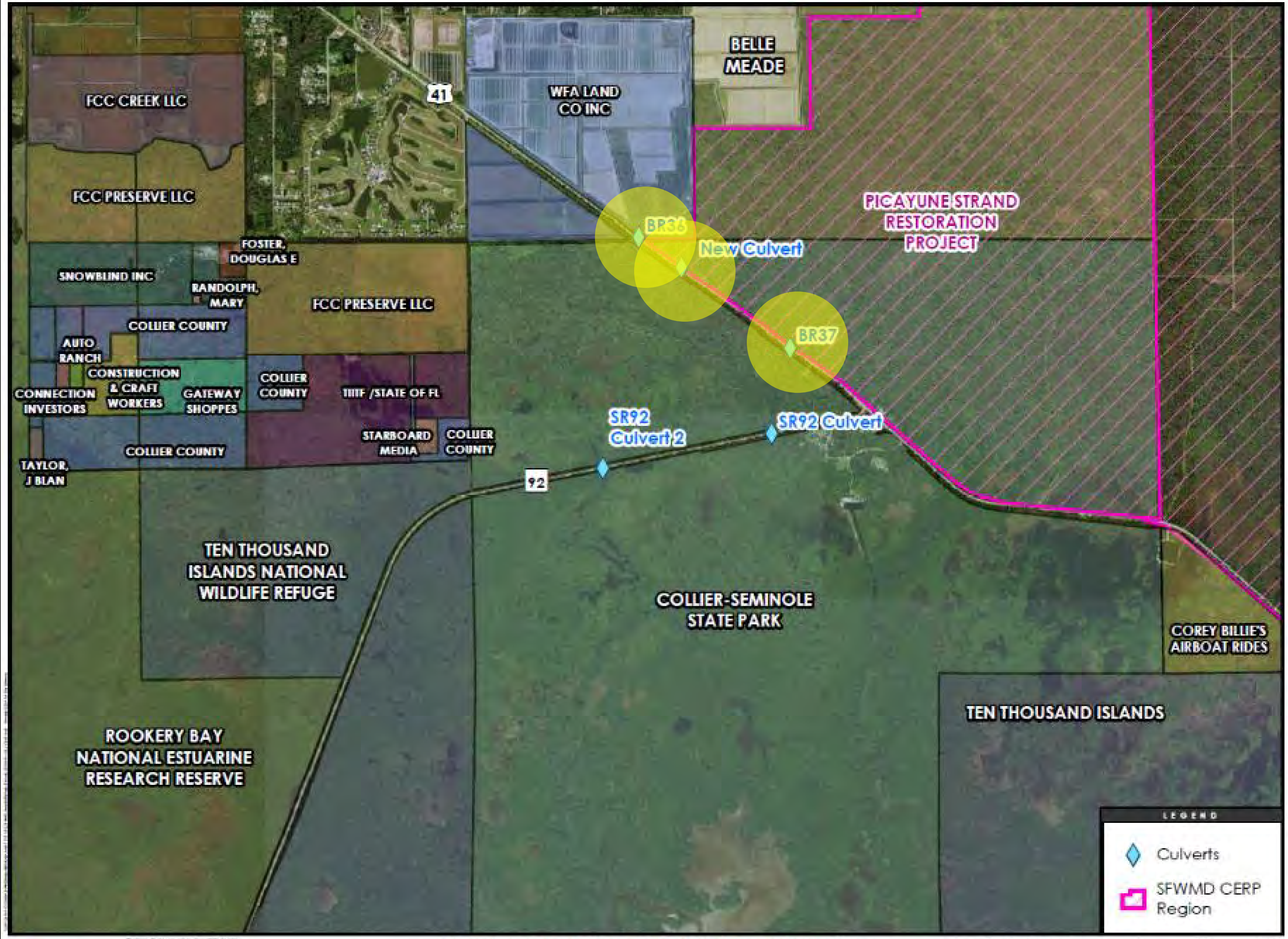
Treatment Mechanisms:

- Sediment
- Phosphorus
- Nitrogen
- Metals

Alternative Sequencing:

- Option A
- Option B
- Option C

Technology	Water Storage	Sediment	Particulate Phosphorus	Dissolved Phosphorus	Particulate Nitrogen	Dissolved Nitrogen	Particulate Metals	Dissolved Metals
Spreader Swale/Canal/Berm								
Sedimentation Basin								
Treatment Wetlands								
Polishing Ponds								
Media Filters								



Stantec

PICAYUNE WATERSHED WATER QUALITY STUDY

AREA PARCEL OWNERSHIP

October 2020

Stantec Consulting Services Inc.
5801 Pelican Bay Blvd. Suite 300
Naples, FL 34108
Tel 239.649.4040
Fax 239.263.6449

0 1,500 3,000 Feet

Formulating Alternatives

Option A – BR36 Only

Sedimentation Basin

- Removal of sediment + associated nutrients/ contaminants

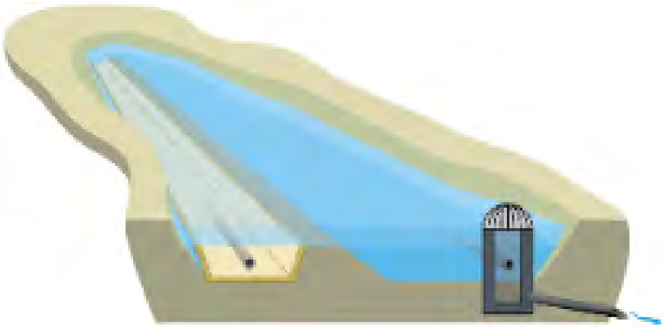
→

Media Filter

- Filtration of residual nutrients/ contaminants

→

Discharge to Existing Canal



Location Map

Formulating Alternatives

Option B – BR36 Only

Sedimentation Basin

- Removal of sediment + associated nutrients/ contaminants

Treatment Wetlands

- Removal of dissolved contaminants
- Removal of fine sediments

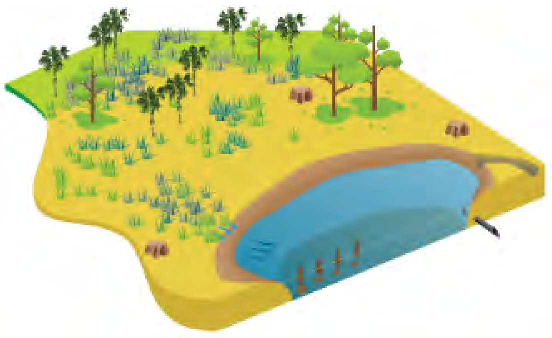
Spreader Swale

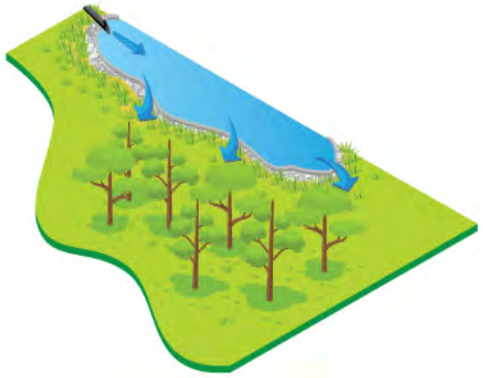
- Conveyance and flow dispersion

Discharge

Existing Wetlands

- Restoration of freshwater supply
- Habitat Enhancement





Location Map

Formulating Alternatives

Option C – BR36/New Culvert/BR37

Sedimentation Basin (Larger)

- Removal of sediment + associated nutrients/ contaminants

Treatment Wetlands (Larger)

- Removal of dissolved contaminants
- Removal of fine sediments

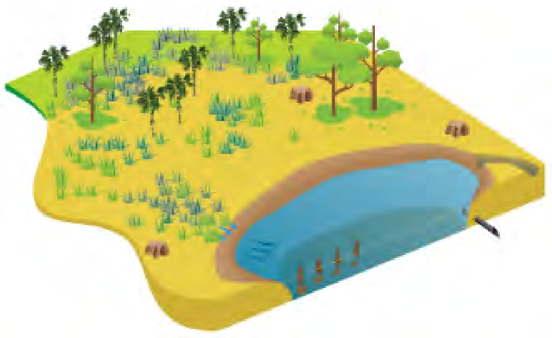
Spreader Swale

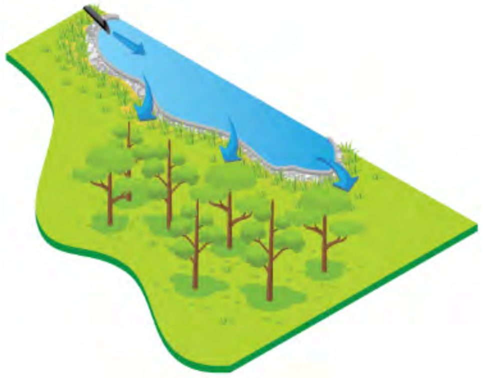
- Conveyance and flow dispersion

Discharge

Existing Wetlands

- Restoration of freshwater supply
- Habitat Enhancement





Location Map

Evaluating Alternatives

- Treatment Performance
- Area Requirements
- Operation and Maintenance Requirements
- Cost/Funding Need
- Implementation Schedule/Time
- Longevity

Comparing Alternatives

Evaluation Parameter	Option A	Option B	Option C
Sequence	1. Sedimentation Basin 2. Media Filter 3. Existing Canal	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands
Treatment Performance	4	3	5

1 least treatment / 5 best performance

- More flow captured and treated = greater treatment performance
- Contaminant dependent
  - *Nitrogen:* Equivalent performance can be expected from media filters and treatment wetlands
  - *Phosphorus:* Media filters provide better and more consistent treatment than treatment wetlands

Comparing Alternatives

Evaluation Parameter	Option A	Option B	Option C
Sequence	1. Sedimentation Basin 2. Media Filter 3. Existing Canal	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands
Area Requirements	5	4	2

1 larger area requirements / 5 smaller area requirements

- Proportional to flow captured/treated and hydraulic retention time
  - *e.g., media filter processes water faster than treatment wetlands and thus requires less area*
- Conveyance distance

Comparing Alternatives

Evaluation Parameter	Option A	Option B	Option C
Sequence	1. Sedimentation Basin 2. Media Filter 3. Existing Canal	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands
O&M Requirements	2	4	3

1 most O&M requirements / 5 least O&M requirements

- Media filters require more frequent inspection and cleanout to prevent clogging
- Sedimentation basins require periodic sediment removal

Comparing Alternatives

Evaluation Parameter	Option A	Option B	Option C
Sequence	1. Sedimentation Basin 2. Media Filter 3. Existing Canal	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands
Cost/Funding Need	3	4	2

1 highest cost / 5 lowest cost

- Larger systems will require more funding
- Custom media costs more than local soil
- More O&M requirements = more costs

Comparing Alternatives

Evaluation Parameter	Option A	Option B	Option C
Sequence	1. Sedimentation Basin 2. Media Filter 3. Existing Canal	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands
Schedule/Time	3	1	1

1 longest schedule / 5 shortest schedule

- Larger systems = longer construction schedule
- Permitting may contribute to longer schedule

Comparing Alternatives

Evaluation Parameter	Option A	Option B	Option C
Sequence	1. Sedimentation Basin 2. Media Filter 3. Existing Canal	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands
Longevity	1	3	3

1 shortest treatment lifespan / 5 longest treatment lifespan

- Media filters may become exhausted over time and require replacement
- More passive the technology, the longer the treatment performance

Comparing Alternatives – Draft Summary

Evaluation Parameter	Option A	Option B	Option C
Sequence	1. Sedimentation Basin 2. Media Filter 3. Existing Canal	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands	1. Sedimentation Basin 2. Treatment Wetlands 3. Spreader Swale 4. Existing Wetlands
Treatment Performance	4	3	5
Area Requirements	5	4	2
O&M Requirements	2	4	3
Cost/Funding Need	3	4	2
Implementation Schedule/Time	3	1	1
Longevity	1	3	3
Ranking	18	19	17

Funding Strategy

Currently reviewing:

- Grants
- Loans
- Partnerships

Prioritize funding options

Provide recommendations

Identify stakeholders

Category	Program	Rank
Grant	State of Florida Legislative Appropriations	10
Grant	Florida Department of Environmental Protection Section 319(h)	10
Partnership	Public-Public Partnerships	10
Partnership	Public-Private Partnerships	10
Grant	Florida Department of Environmental Protection Florida Communities Trust Parks and Open Space Florida Forever Grant Program (Acquisition needed)	10
Grant	Florida Department of Environmental Protection State Water-quality Assistance Grant (SWAG)	10
Grant	Florida Department of Agriculture and Consumer Services Cost Share Funding	10
Grant	USDA Natural Resources Conservation Service Environmental Quality Incentives Program (EQIP)	10
Grant	USDA Natural Resources Conservation Service Conservation Stewardship Program (CSP)	5
Grant	National Fish and Wildlife Foundation Gulf Environmental Benefit Fund	5
Loan	Florida Department of Environmental Protection Clean Water State Revolving Fund	5
Grant	Florida Department of Environmental Protection Florida Communities Trust Parks and Open Space Florida Forever Grant Program (No acquisition needed)	1-10
Grant	National Fish and Wildlife Foundation Five Star and Urban Waters Restoration	1
Grant	National Fish and Wildlife Foundation National Coastal Resilience Fund	1
Grant	Army Corps of Engineers Water Resources Development Act	1
Grant	US Fish and Wildlife Service National Coastal Wetlands Grant Program	1

Preliminary Draft Recommendations

Preliminary Draft Recommendations (to be finalized within the report)

- Pursue land partnerships (public and private) as the available area will influence the design
- Right-size the project based on land availability and efficiency
  - Option B is well suited for a smaller footprint
  - Option C is well suited for a larger footprint

Additional Draft Recommendations (to be finalized within the report)

- Implementation of a synoptic water quality monitoring program in the region
- Implementation of a monitoring program to confirm the effectiveness of the constructed water quality treatment system(s)
- Local stakeholders, including both Public-Public and Public-Private Partnerships, pursue additional source control measures where appropriate

Next Steps

Next Steps

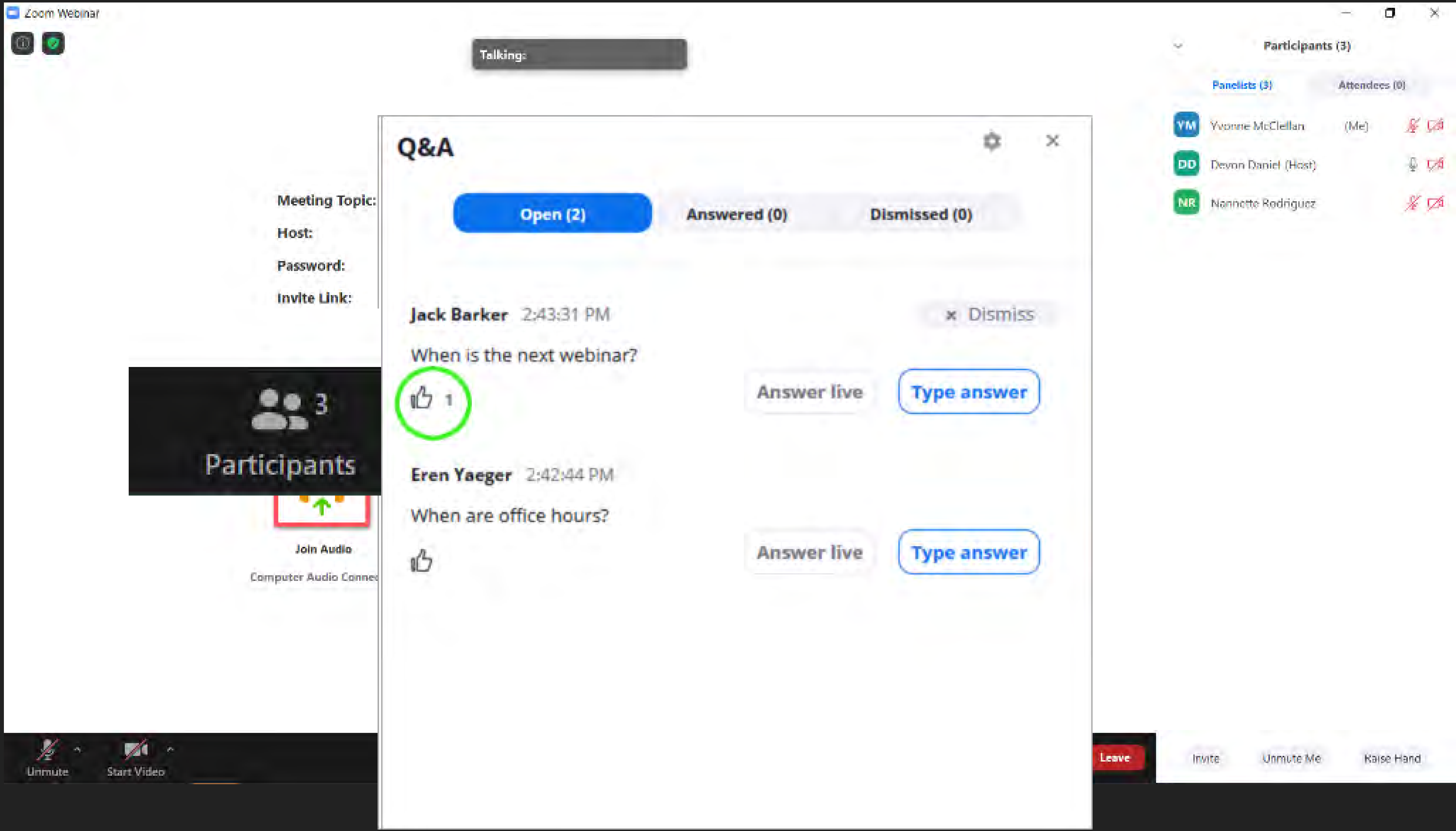
- Feasibility Study
  - Refine Alternatives
  - Update Evaluation
  - Revise Comparison
  - Provide Final Recommendations
- Submit Final Feasibility Study
  - March 2021

Task	2020																		2021												
	31-Aug	7-Sep	14-Sep	21-Sep	28-Sep	5-Oct	12-Oct	19-Oct	26-Oct	2-Nov	9-Nov	16-Nov	23-Nov	30-Nov	7-Dec	**14-Dec**	21-Dec	28-Dec	4-Jan	11-Jan	18-Jan	25-Jan	1-Feb	8-Feb	15-Feb	22-Feb	1-Mar	8-Mar	15-Mar	22-Mar	29-Mar
Information Collection and Review Report																															
Public Involvement Meetings																															
Feasibility Study Report																															

Summary

Summary

- Project Overview
- Meeting Review
- Feasibility Study Overview
- Next Steps



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Join Audio
Unmute
Start Video
Leave
Invite
Unmute Me
Raise Hand
Q&A
Open (2)
Answered (0)
Dismissed (0)
Jack Barker 2:43:31 PM
Dismiss
When is the next webinar?
1
Answer live
Type answer
Eren Yaeger 2:42:44 PM
When are office hours?
Answer live
Type answer

Q&A

If you’re participating via Zoom –

- Submit your questions via the Q&A chat box
- If you are unable to, use the Raise Hand feature

2:00

If you’re participating via Phone –

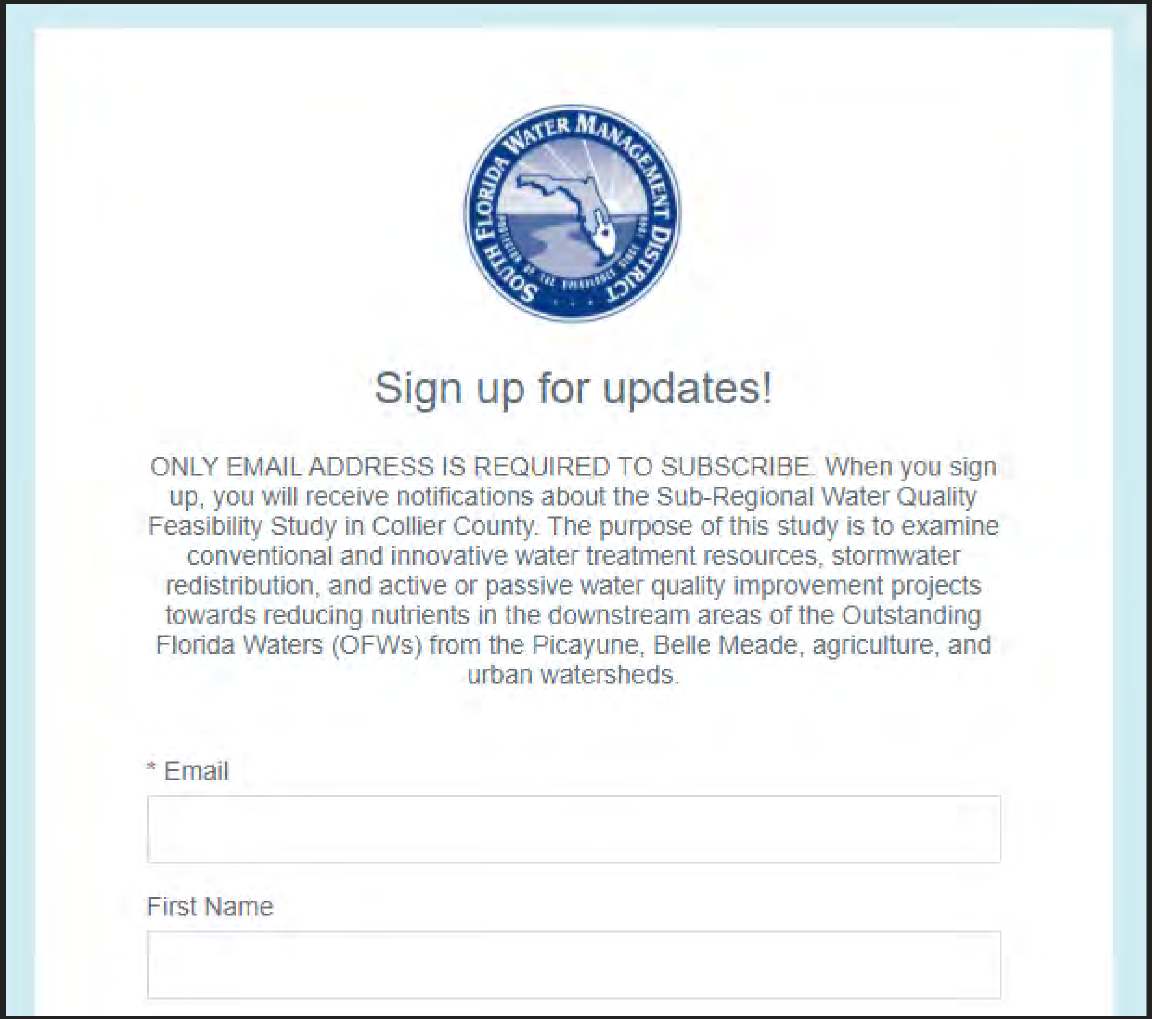
*6 Mutes/Unmutes

*9 Raises Hand

Q&A

To sign up for project notifications, visit:

https://lp.constantcontactpages.com/su/8G8AunX/CCSRWaterQStudy



To visit the project website:

https://www.sfwmd.gov/our-work/picayune-watershed-water-quality-feasibility-study

Thank you for your participation!

Appendix D WATER QUALITY SUMMARY

Water Quality Data Review Summary

A variety of reports and raw data files were sourced to study water quality near the proposed project area. Monitoring stations utilized by the Florida Department of Environmental Protection (FDEP), Collier County, and South Florida Water Management District (SFWMD) were reviewed to select sites for analyses. Stations containing reliable and relevant data included BR36/TAMTOM/TAMBR36 (BR36), BR37/TAMBR37 (BR37), BR39/TAMBR39 (BR39), BC20, BR49/TAMBR49 (BR49), TT175C, FAKA, Faka Union Canal, Blackwater River, TT175B, BC9, BC10, and BC11. Other stations located in proximity to these sites were considered but ultimately excluded as they did not provide unique perspectives for the analyses. Total Nitrogen (TN), Total Phosphorus (TP), Turbidity, Copper, and Iron data are included for each station when available, across all monitoring years, and used to determine the average parameter concentration within waters near each location. For sites where raw data could not be found or were believed to be incomplete, reports were used to determine summary statistics.

Compiled data were screened to remove analyzed samples containing qualifiers identifying potential inaccuracies. Tidal influence was not factored in as part of the analysis. A conservative approach to data management was taken and included setting reported nutrient concentrations that were recorded below detection limits at the minimum detection limit (MDL). Station data that were available from multiple sources were compared to ensure consistency. The remaining number of samples were recorded (n) along with the date range associated with the data, before deriving summary information for the period of record (POR). Calculations included measures of central tendency and variability, such as average, geometric mean, median, standard deviation, minimum, and maximum. This approach to data screening and analysis was similar to the method described in the SFWMD Picayune Strand Restoration Project (PSRP) Water Quality Projections With “Southwestern Protective Levee” Feature report.

Recorded averages were compared against known criteria for each parameter across all chosen monitoring stations (FAC 62-602). The TP and TN standard narrative states that “in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna” (FAC 62-302.530 (48)(b)). The area of study is impaired for both TN and TP.

Stations located within downstream Outstanding Florida Waters (OFW) were identified as part of Estuary Nutrient Region E8 (ENRE8) Tidal Cocohatchee River/Ten Thousand Islands, Blackwater River (FAC 62-302.532(1)). As such, stations TT175C, Blackwater River, and TT175B were determined to have their own set of nutrient criteria thresholds (0.053 mg/L TP and 0.41 mg/L TN) used for comparison (FAC 60-302.532(1)(e)(6)). When available, turbidity and iron averages were compared against known criteria for freshwater and estuarine systems, including 29NTU turbidity and 300µg/L iron (FAC 60-302.530(23)/(70)). The copper criterion for estuarine waters is 3.7 µg/L, while standards for freshwater systems are variable. Copper data collected from stations located outside of estuaries were compared to criteria calculated from average hardness in mg/L using standard equations (FAC 60-302.530(38)). Hardness is a measurement of divalent metal cations (e.g. Ca and Mg), which primarily exist bound to bicarbonate, sulfate, or chloride in natural waters and is reflective of naturally high or low metal concentrations within a watershed, as well as toxicity. Using hardness as a means of calculating metal concentration criteria allows for site-specific standard adjustments. In compliance with Florida guidance, average hardness concentrations exceeding 400 mg/L were considered at 400 mg/L during the calculation of copper criteria.

Water quality standards for South Florida are largely based on geometric means over particular periods of time. The purpose of this analysis was not to evaluate which monitoring stations were in or out of compliance, as this is well documented. Staff instead compared arithmetic and geometric averages for the POR to known standards as a means of focusing attention on those stations with comparatively or unusually high concentrations of nutrients, turbidity, copper, iron, and salinity. As a result, concentrations exceeding standard criteria are not necessarily an indication the station is out of compliance as the specific requirements for comparison as part of a compliance evaluation were not met. However, those stations with mean concentrations that were higher than the applicable standards were considered comparatively high and within 80% of the applicable standards were considered moderately high. Organized average water quality data can be found below (**Table D-1**). Although numeric nutrient thresholds do not exist for non-OFW systems in South Florida, the area is impaired for TN and TP. Stations BR36, 37, and 39 had mean TP concentrations at an average of 25, 12, and 13 times higher than those freshwater stations capturing water quality north of the PSRP (BC9, BC10, BC11), respectively. TN mean concentrations were an average of 3, 2, and 2 times higher at stations BR36 and 37 as compared with stations BC9, 10, and 11, respectively. Although station BR39 summary information is presented, the POR for the dataset was limited and should therefore not be strongly considered as indicative of existing water quality conditions. Estuarine station averages indicated high criteria threshold exceedances for both TN and TP across TT175C, Blackwater River, and TT175B. Monitoring data collected from locations north and south of the PSRP, were shown to have relatively low concentration averages.

Although turbidity criteria are best described as less than or equal to 29 NTU above natural background conditions, a conservative threshold was set as 29 NTU for comparison. Turbidity averages were below threshold criteria across all monitoring stations, apart from the BR36 location, which had a moderate average measurement within 80% of the high threshold. Similarly, BR36 was the only station analyzed that had copper and iron averages exceeding the site criterion.

Measurements of salinity confirmed site assumptions. Although data could not be found for stations BR36, 37, 39, or 49, the remaining locations had associated salinity data. Stations BC 9, 10, and 11 indicated freshwater conditions across the full range of data for the POR. Stations BC20, FAKA, and Faka Union Canal indicated tidal influences with salinity ranging from freshwater to saline. Estuarine stations located in the OFW were consistently saline.

Turbidity, copper, iron, and salinity data were analyzed due to their potential impacts on the effectiveness of the water treatment technologies described in this report. TP and TN data were used to identify areas experiencing comparatively high nutrient levels and inform treatment train recommendations to be addressed in the feasibility report. Data included in this Appendix support the use of mitigation technologies and techniques to address high levels of nutrients, copper, iron, and turbidity near BR36 and BR37, with the goal of reducing nutrient loads impacting inland aquatic and terrestrial resources, and downstream OFWs. The feasibility of mitigation activities will be dependent on cost-benefit analyses, site-specific conditions, and subsequent land restrictions.

To aid in the calculation of particulate nutrients near station BR36, a sub dataset was created from collected samples to estimate the percentage of particulate nitrogen (PN) and particulate phosphorus (PP) associated with total nitrogen (TN) and total phosphorus (TP) concentrations. In total, 45 samples from the period of record had all required nutrient parameters for calculation. For each sample, staff calculated the concentration of PN and PP using required parameters, such as Total Kjeldahl Nitrogen, Nitrate/Nitrite, TP, and Phosphate. PN, PP, TN, and TP were averaged and divided by each other to calculate the percentage of TN that was PN and TP that was PP. These calculations resulted in estimates of settleable nutrients associated with existing loads near the proposed treatment area.

Table D-1: Surface Water Quality Monitoring Data Summary

	Coordinates		Total Phosphorus (TP) [mg/L]										
Monitoring Stations	Latitude	Longitude	n	Mean Conc**	Standard Deviation	Geometric Mean Conc	Median	Min	Max	Date Range	Data Reference	Criteria Concentration	Criteria Reference
BR36/TAMTOM/TAMBR36	26.0057	-81.6092	88	0.362	0.306	0.303	0.276	0.106	2.428	Nov 2009-Aug 2019	1	-	A
BR37/TAMBR37	25.9985	-81.5982	37	0.314	0.197	0.274	0.251	0.088	1.007	Aug 2015-Oct 2019	1	-	A
BR39/TAMBR39	25.9903	-81.5871	8	0.162	0.063	0.147	0.191	0.056	0.214	Apr 1995-Aug 1995	2	-	A
BC20	25.9610	-81.5166	57	0.058	0.085	0.044	0.046	0.004	0.668	Sep 2009-Aug 2015	2	-	A
BR49/TAMBR49	25.9679	-81.5356	23	0.013	0.006	0.012	0.013	0.006	0.028	Sep 2016-Sep 2019	1	-	A
TT175C	25.9165	-81.5807	70	0.064	0.027	0.050	0.066	0.002	0.145	Feb 2016-Jul 2020	3	0.053	B
FAKA	25.9605	-81.5095	170	0.013	0.007	0.012	0.011	0.004	0.049	Oct 2001-Oct 2019	1	-	A
Faka Union Canal*	25.9559	-81.5105	163	0.027	0.019	0.022	0.023	0.004	0.109	Jan 2006-Feb 2020	2	-	A
Blackwater River	25.9347	-81.5945	24	0.072	0.025	0.068	0.067	0.040	0.134	Jan 2015-Jan 2020	2	0.053	B
TT175B	25.9354	-81.6179	70	0.057	0.022	0.046	0.059	0.002	0.112	Feb 2010-Jul 2020	3	0.053	B
BC9	26.1530	-81.5551	150	0.011	0.005	0.010	0.010	0.004	0.036	Oct 2001-Oct 2019	1	-	A
BC10	26.1531	-81.5232	151	0.022	0.015	0.018	0.018	0.004	0.084	Nov 2001- Sep 2015	1	-	A
BC11	26.1535	-81.4906	130	0.021	0.011	0.019	0.020	0.006	0.072	Nov 2001-Aug 2015	1	-	A

	Coordinates		Total Nitrogen (TN) [mg/L]										
Monitoring Stations	Latitude	Longitude	n	Mean Conc**	Standard Deviation	Geometric Mean Conc	Median	Min	Max	Date Range	Data Reference	Criteria Concentration	Criteria Reference
BR36/TAMTOM/TAMBR36	26.0057	-81.6092	84	1.71	0.67	1.61	1.59	0.66	5.42	Nov 2009- Aug 2019	1	-	A
BR37/TAMBR37	25.9985	-81.5982	37	1.34	0.61	1.23	1.21	0.61	3.79	Aug 2015-Oct 2019	1	-	A
BR39/TAMBR39	25.9903	-81.5871	-	-	-	-	-	-	-	-	-	-	A
BC20	25.9610	-81.5166	71	1.34	0.66	1.23	1.35	0.33	5.34	Oct 2009-Sep 2015	2	-	A
BR49/TAMBR49	25.9679	-81.5356	27	1.03	0.19	1.01	1.08	0.61	1.34	Sep 2015- Sep 2019	1	-	A
TT175C	25.9165	-81.5807	29	0.60	0.18	0.57	0.59	0.32	1.06	Jul 2014-Jul 2020	3	0.41	B
FAKA	25.9605	-81.5095	181	0.50	0.20	0.47	0.46	0.04	1.65	Oct 2001-Oct 2019	1	-	A
Faka Union Canal*	25.9559	-81.5105	165	0.60	0.21	0.56	0.56	0.03	2.03	Jan 2006-Feb 2020	2	-	A
Blackwater River	25.9347	-81.5945	24	0.60	0.19	0.57	0.57	0.31	1.03	Jan 2015-Jan 2020	2	0.41	B
TT175B	25.9354	-81.6179	30	0.54	0.17	0.48	0.53	0.02	0.81	Jul 2014-Jul 2020	3	-	B
BC9	26.1530	-81.5551	151	0.57	0.21	0.52	0.53	0.04	1.76	Oct 2001-Sep 2015	1	-	A
BC10	26.1531	-81.5232	155	0.52	0.02	0.47	0.47	0.04	1.61	Oct 2001-Sep 2015	1	-	A
BC11	26.1535	-81.4906	134	0.61	0.28	0.55	0.54	0.04	1.75	Oct 2001-Aug 2015	1	-	A

	Coordinates		Turbidity [NTU]										
Monitoring Stations	Latitude	Longitude	n	Mean Conc**	Standard Deviation	Geometric Mean Conc	Median	Min	Max	Date Range	Data Reference	Criteria Concentration	Criteria Reference
BR36/TAMTOM/TAMBR36	26.0057	-81.6092	37	24.31	15.34	19.68	24.00	4.30	65.00	Jul 2017-Feb 2020	1	29	C
BR37/TAMBR37	25.9985	-81.5982	-	-	-	-	-	-	-	-	-	-	-
BR39/TAMBR39	25.9903	-81.5871	9	1.23	0.30	1.21	1.20	1.00	2.00	Dec 1994-Aug 1995	2	29	C
BC20	25.9610	-81.5166	66	2.36	2.16	1.73	1.60	0.50	11.00	Oct 2009-Aug 2015	2	29	C
BR49/TAMBR49	25.9679	-81.5356	-	-	-	-	-	-	-	-	-	-	-
TT175C	25.9165	-81.5807	70	9.82	5.50	6.58	10.00	0.10	28.90	Feb 2010-Jul 2020	3	29	C
FAKA	25.9605	-81.5095	86	1.84	1.42	1.46	1.40	0.50	8.40	Oct 2009-Jun 2018	1	29	C
Faka Union Canal*	25.9559	-81.5105	23	3.22	1.13	3.04	3.20	1.20	6.20	Jan 2015-Jan 2020	2	29	C
Blackwater River	25.9347	-81.5945	24	7.89	3.11	7.42	7.15	3.30	18.10	Jan 2015-Jan 2020	2	29	C
TT175B	25.9354	-81.6179	70	8.93	4.42	6.45	8.25	0.10	23.10	Feb 2010-Jul 2020	3	29	C
BC9	26.1530	-81.5551	101	2.39	1.65	1.99	2.10	0.50	13.00	Oct 2009-Jun 2018	1	29	C
BC10	26.1531	-81.5232	203	2.00	1.44	1.57	1.70	0.10	9.50	Dec 2009-Feb 2020	1	29	C
BC11	26.1535	-81.4906	53	1.06	0.54	0.95	0.80	0.50	2.90	Nov 2009-May 2016	1	29	C

Monitoring Stations	Coordinates		Copper [µg/L]											
	Latitude	Longitude	n	Mean Conc**	Standard Deviation	Geometric Mean Conc	Median	Min	Max	Date Range	Data Reference	Average Hardness (mg/L)	Criteria Concentration***	Criteria Reference
BR36/TAMTOM/TAMBR36	26.0057	-81.6092	11	33.45	37.93	23.21	19.80	7.28	142.00	Jul 2017-Dec 2019	2	521	30	C
BR37/TAMBR37	25.9985	-81.5982	-	-	-	-	-	-	-	-	-	-	-	-
BR39/TAMBR39	25.9903	-81.5871	-	-	-	-	-	-	-	-	-	-	-	-
BC20	25.9610	-81.5166	16	1.13	0.96	0.82	0.75	0.15	3.35	Jul 2010-Apr 2015	2	1242	30	C
BR49/TAMBR49	25.9679	-81.5356	-	-	-	-	-	-	-	-	-	-	-	-
TT175C	25.9165	-81.5807	-	-	-	-	-	-	-	-	-	-	-	-
FAKA	25.9605	-81.5095	29	0.67	0.62	0.43	0.75	0.10	2.62	Oct 2009-Jul 2017	2	538	30	C
Faka Union Canal*	25.9559	-81.5105	12	2.57	2.40	2.01	2.05	0.88	9.74	Jan 2006-Sep 2009	2	1893	30	C
Blackwater River	25.9347	-81.5945	-	-	-	-	-	-	-	-	-	-	-	-
TT175B	25.9354	-81.6179	-	-	-	-	-	-	-	-	-	-	-	-
BC9	26.1530	-81.5551	25	0.75	0.84	0.44	0.75	0.10	3.91	Oct 2009-Jul 2017	2	290	23	C
BC10	26.1531	-81.5232	61	0.59	0.50	0.41	0.75	0.10	2.50	Oct 2009-Dec 2019	2	259	21	C
BC11	26.1535	-81.4906	18	1.12	1.94	0.58	0.75	0.10	8.61	Oct 2009-May 2016	2	253	21	C

Monitoring Stations	Coordinates		Iron [µg/L]										
	Latitude	Longitude	n	Mean Conc**	Standard Deviation	Geometric Mean Conc	Median	Min	Max	Date Range	Data Reference	Criteria Concentration	Criteria Reference
BR36/TAMTOM/TAMBR36	26.0057	-81.6092	11	1105.6	555.6	1003.6	905.0	529.0	2230.0	Jul 2017-Dec 2019	2	1000	C
BR37/TAMBR37	25.9985	-81.5982	-	-	-	-	-	-	-	-	-	-	-
BR39/TAMBR39	25.9903	-81.5871	-	-	-	-	-	-	-	-	-	-	-
BC20	25.9610	-81.5166	23	186.9	138.3	143.3	141.0	35.6	547.0	Jan 2010-Jul 2015	2	1000	C
BR49/TAMBR49	25.9679	-81.5356	-	-	-	-	-	-	-	-	-	-	-
TT175C	25.9165	-81.5807	-	-	-	-	-	-	-	-	-	-	-
FAKA	25.9605	-81.5095	35	112.3	88.8	80.9	85.7	11.8	341.0	Jan 2010-Jul 2017	2	1000	C
Faka Union Canal*	25.9559	-81.5105	6	246.7	359.3	146.3	100.0	100.0	980.0	Oct 2006-Jul 2009	2	1000	C
Blackwater River	25.9347	-81.5945	-	-	-	-	-	-	-	-	-	-	-
TT175B	25.9354	-81.6179	-	-	-	-	-	-	-	-	-	-	-
BC9	26.1530	-81.5551	36	350.7	235.0	252.4	323.0	27.4	820.0	Oct 2009-Jul 2017	2	1000	C
BC10	26.1531	-81.5232	79	264.6	218.7	187.6	194.0	19.5	873.0	Oct 2009-Dec 2019	2	1000	C
BC11	26.1535	-81.4906	20	189.6	90.9	168.9	176.0	38.3	431.0	Oct 2009-Jun 2016	2	1000	C

Monitoring Stations	Coordinates		Salinity (PSU)										
	Latitude	Longitude	n	Mean Conc**	Standard Deviation	Geometric Mean Conc	Median	Min	Max	Date Range	Data Reference	Criteria Concentration	Criteria Reference
BR36/TAMTOM/TAMBR36	26.0057	-81.6092	-	-	-	-	-	-	-	-	-	-	-
BR37/TAMBR37	25.9985	-81.5982	-	-	-	-	-	-	-	-	-	-	-
BR39/TAMBR39	25.9903	-81.5871	-	-	-	-	-	-	-	-	-	-	-
BC20	25.9610	-81.5166	76	5.49	7.19	2.52	2.40	0.26	32.92	Jan 2009-Dec 2015	2	-	-
BR49/TAMBR49	25.9679	-81.5356	-	-	-	-	-	-	-	-	-	-	-
TT175C	25.9165	-81.5807	65	32.29	5.01	31.81	34.00	14.00	39.30	Feb 2010-Jan 2021	3	-	-
FAKA	25.9605	-81.5095	129	1.52	2.87	0.63	0.37	0.23	16.31	Jan 2009-Dec 2018	2	-	-
Faka Union Canal*	25.9559	-81.5105	211	16.28	14.05	6.52	14.21	0.25	40.97	Jan 2006-Dec 2020	2	-	-
Blackwater River	25.9347	-81.5945	21	31.12	5.70	30.58	32.80	21.40	39.00	Jan 2015-Nov 2020	2	-	-
TT175B	25.9354	-81.6179	67	32.11	5.20	31.59	34.00	13.90	39.60	Feb 2010-Jan 2021	3	-	-
BC9	26.1530	-81.5551	142	0.29	0.03	0.29	0.30	0.14	0.36	Jan 2009-Dec 2018	2	-	-
BC10	26.1531	-81.5232	365	0.25	0.06	0.24	0.26	0.09	0.34	Oct 2000-Jun 2017	2	-	-
BC11	26.1535	-81.4906	295	0.24	0.05	0.23	0.25	0.08	0.35	Oct 2000-Jun 2016	2	-	-

*Faka Union Canal station data were sourced from FDEP Run 59. Station coordinates were identical to those at FAKAUPOI, despite having containing slightly different data. As such, Faka Union Canal data were chosen to represent water quality conditions recorded from this location.

**Mean concentration is represented on the monitoring stations map.

***Copper criteria concentrations were calculated based on average hardness measured from each station. In compliance with standard methods, hardness concentrations greater than 400 mg/L were considered at 400 mg/L for the purpose of calculating copper criteria in µg/L.

1. Summary data sourced from the SFWMD PSRP Water Quality Projections With "Southwestern Protective Levee" Feature Report.

2. Raw data sourced from FDEP WBID Run 59.

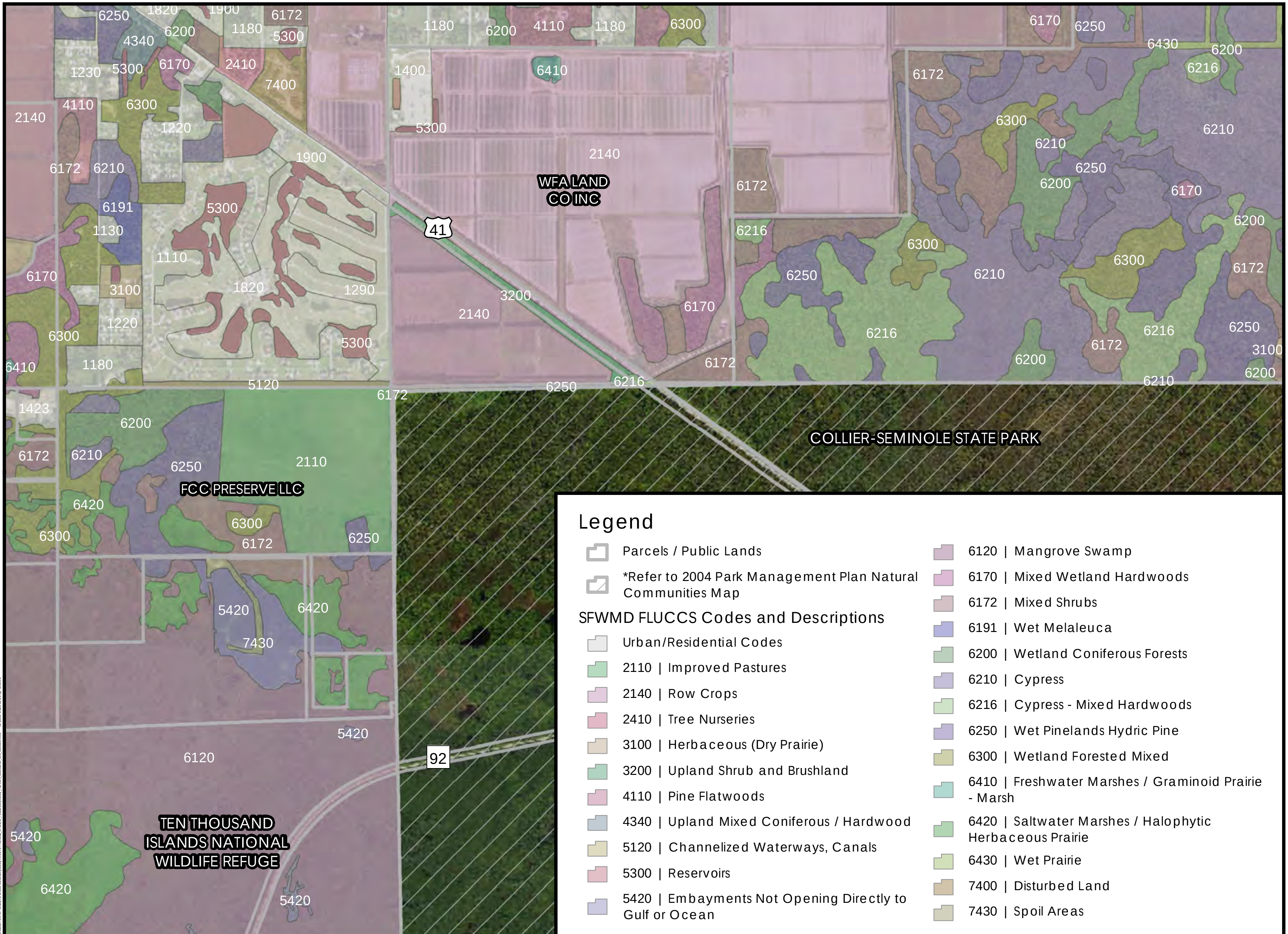
3. Raw data sourced from SFWMD DBHYDRO.

A. No numeric threshold, narrative criterion in paragraph FAC 62-302.530(47(b)) apply. Waters in this area are impaired for nutrients, including TN and TP.

B. Standard criteria based on the Estuary-Specific Numeric Interpretations of the Narrative Nutrient Criterion table Blackwater River ENRE8 [FAC 60-302.532(1)(e)(6)].

C. Standard criteria based on the Surface Water Quality Criteria table [FAC 60-302.530(23)/(38)/(70)].

Appendix E LAND USE MAP



Stantec

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

Notes:
1. Coordinate System: NAD 1983 StatePlane Florida East FIPS 0901 Feet
2. Source data: FNAI, SFWMD, Stantec
3. Imagery: Collier County

PICAYUNE WATERSHED WATER QUALITY STUDY

FLUCCS ZONES

October 2020

Stantec Consulting Services Inc.
5801 Pelican Bay Blvd. Suite 300
Naples, FL 34108
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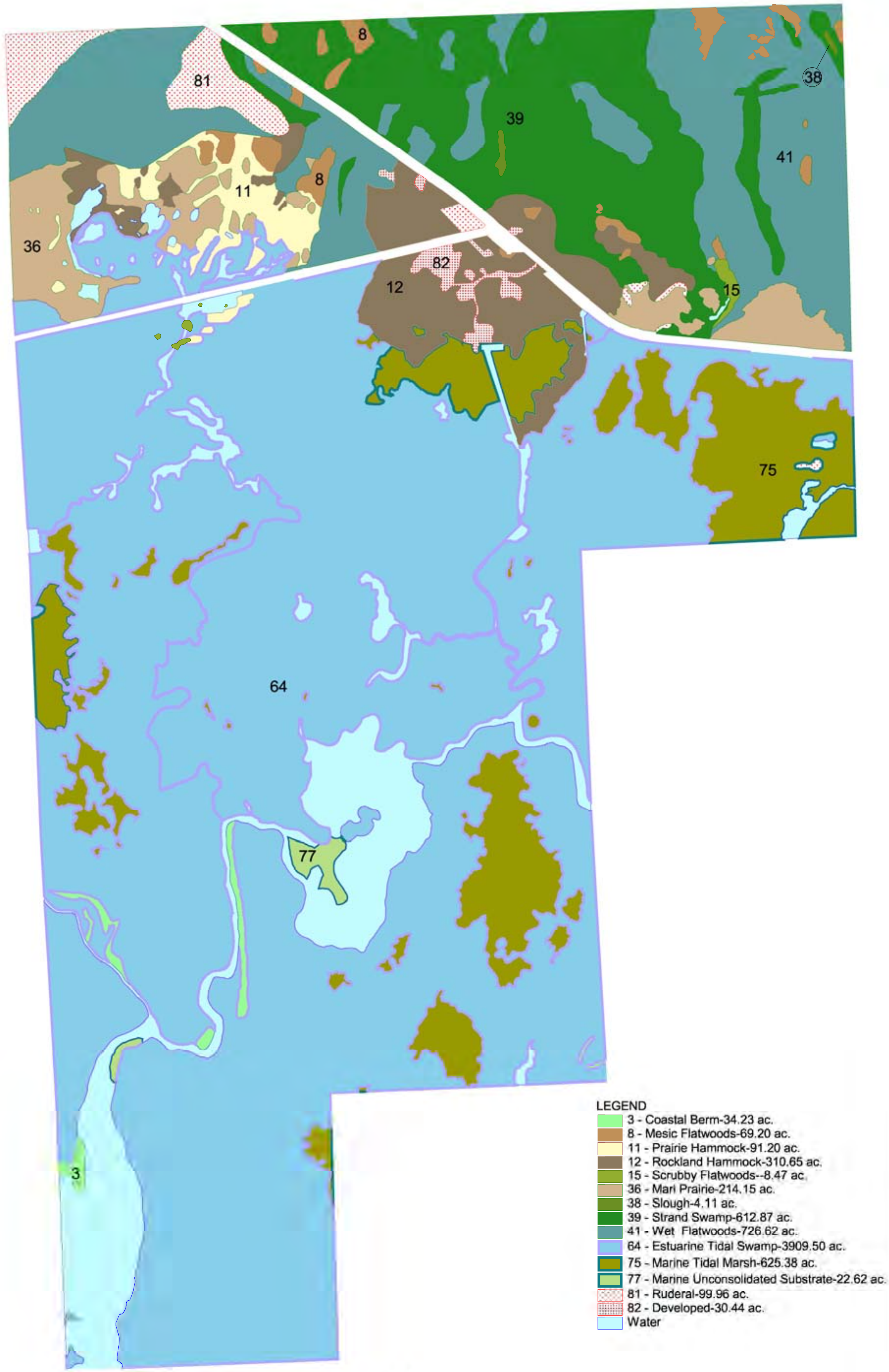
Prepared by: D.A.R. 10/20/20
Technical Review by: X.X.X MM/DD/YY
Independent Review by: J.B. 08/19/20



COLLIER-SEMINOLE
STATE PARK

N
2000 0 2000 4000 Feet

Prepared by:
Florida Department of Environmental Protection
Division of Recreation and Parks
Office of Park Planning

NATURAL COMMUNITIES
MAP

Appendix F COLLIER SEMINOLE STATE PARK MANAGEMENT PLAN

COLLIER—SEMINOLE STATE PARK

UNIT MANAGEMENT PLAN

APPROVED

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Recreation and Parks

FEBRUARY 6, 2004

Department of
Environmental Protection

Jeb Bush Governor	Marjorie Stoneman Douglas Building 3900 Commonwealth Boulevard, MS 140 Tallahassee, Florida 32399-3000	David B. Struhs Secretary

February 6, 2004

Ms. BryAnne White
Government Operations Consultant II
Office of Park Planning
Division of Recreation and Parks

Re: Collier-Seminole State Park

Lease Number: #3612

Dear Ms. White:

On February 6, 2004, the Acquisition and Restoration Council recommended approval of the Land Management Plan for Collier-Seminole State Park. Therefore, the Office of Environmental Services, acting as agent for the Board of Trustees of the Internal Improvement Trust Fund approves this plan. Pursuant to Section 253.034 and 259.032, Florida Statutes, and Chapter 18-2, Florida Administrative Code the plan's 10-year update will be due in February 2014.

Approval of this land management plan does not waive the authority or jurisdiction of any governmental entity that may have an interest in this project. Implementation of any upland activities proposed by this management plan may require a permit or other authorization from federal and state agencies having regulatory jurisdiction over those particular activities.

Sincerely,

Delmas T. Barber

Delmas T. Barber, OMC Manager
Office of Environmental Services
Division of State Lands

TABLE OF CONTENTS

LAND USE COMPONENT

TABLE

LIST OF ADDENDA

MAPS

INTRODUCTION

Collier-Seminole State Park is located in Collier County about 15 miles south of Naples. Access to the park is from U.S. Highway 41, just south of its junction with State Road 92 (see Vicinity Map). The vicinity map also reflects significant land and water resources existing near the park.

For this plan, park acreage has been calculated based on the composition of natural communities, in addition to ruderal and developed areas. Currently the park contains approximately 6,759.40 acres.

Collier-Seminole State Park was acquired through a donation on March 8, 1944. The Division presently manages Collier-Seminole State Park under the Lease No. 3612; the lease will expire on January 22, 2067. Public outdoor recreation and conservation is the designated single use of the property. There are no legislative or executive directives that constrain the use of this park (see Addendum 1).

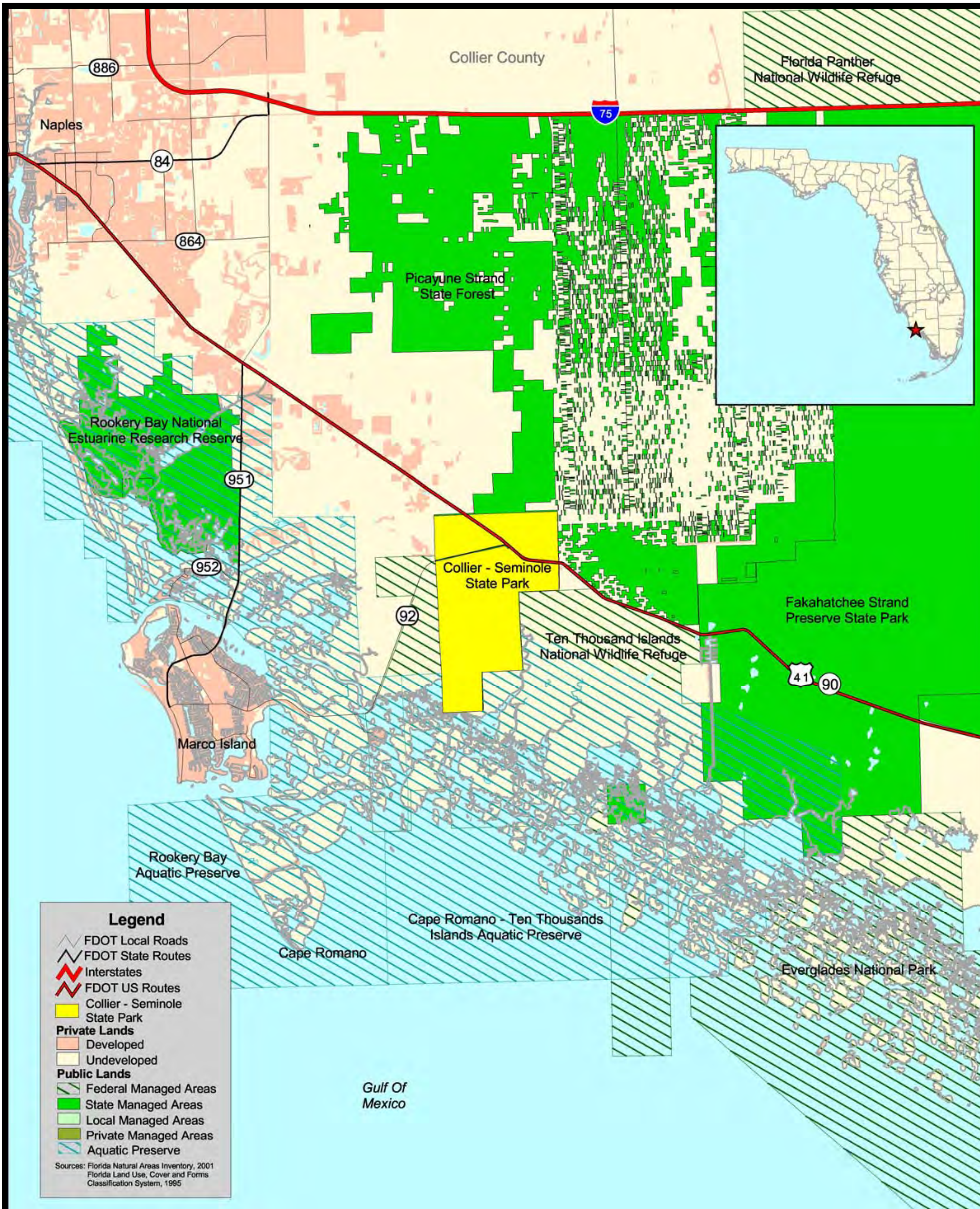
PURPOSE AND SCOPE OF THE PLAN

This plan serves as the basic statement of policy and direction for the management of Collier-Seminole State Park as a unit of Florida's state park system. It identifies the objectives, criteria and standards that guide each aspect of park administration, and sets forth the specific measures that will be implemented to meet management objectives. The plan is intended to meet the requirements of Sections 253.034 and 259.032, Florida Statutes, Chapter 18-2, Florida Administrative Code, and intended to be consistent with the State Lands Management Plan. With approval, this management plan will replace the current approved plan of January 21, 1998. All development and resource alteration encompassed in this plan is subject to the granting of appropriate permits; easements, licenses, and other required legal instruments. Approval of the management plan does not constitute an exemption from complying with the appropriate local, state or federal agencies. This plan is also intended to meet the requirements for beach and shore preservation, as defined in Chapter 161, Florida Statutes and Chapters 62B-33, 62B-36 and 62R-49, Florida Administrative Code.

The plan consists of two interrelated components. Each component corresponds to a particular aspect of the administration of the park. The resource management component provides a detailed inventory and assessment of the natural and cultural resources of the park. Resource management problems and needs are identified, and specific management objectives are established for each resource type. This component provides guidance on the application of such measures as prescribed burning, exotic species removal, and restoration of natural conditions.

The land use component is the recreational resource allocation plan for the unit. Based on considerations such as access, population, and adjacent land uses, an optimum allocation of the physical space of the park is made, locating use areas and proposing types of facilities and volume of use to be provided.

In the development of this plan, the potential of the park to accommodate secondary management purposes ("multiple uses") was analyzed. These secondary purposes were considered within the context of the Division's statutory responsibilities and an analysis of the resource needs and values of the park. This analysis considered the park natural and cultural resources, management needs, aesthetic values, visitation and visitor experiences. For this park, it was determined that no secondary purposes could be accommodated in a manner that would not interfere with the primary purpose of resource-based outdoor recreation and conservation. Uses such as water resource development projects, water supply projects, stormwater management projects, linear facilities and sustainable agriculture and forestry



Collier - Seminole State Park
Vicinity Map

Florida Department Of Environmental Protection
Division Of Recreation And Parks
Office Of Park Planning

(other than those forest management activities specifically identified in this plan) are not consistent with this plan or the management purposes of the park and will be discouraged.

The potential for generating revenue to enhance management was also analyzed. Visitor fees and charges are the principal source of revenue generated by the park. It was determined that multiple-use management activities would not be appropriate as a means of generating revenues for land management. Instead, techniques such as entrance fees, concessions and similar measures will be employed on a case-by-case basis as a means of supplementing park management funding.

MANAGEMENT PROGRAM OVERVIEW

Management Authority and Responsibility

In accordance with Chapter 258, Florida Statutes, and Chapter 62D-2, Florida Administrative Code, the Division of Recreation and Parks (Division) is charged with the responsibility of developing and operating Florida's recreation and parks system. These are administered in accordance with the following policy:

> It shall be the policy of the Division of Recreation and Parks to promote the state park system for the use, enjoyment, and benefit of the people of Florida and visitors; to acquire typical portions of the original domain of the state which will be accessible to all of the people, and of such character as to emblemize the state's natural values; conserve these natural values for all time; administer the development, use and maintenance of these lands and render such public service in so doing, in such a manner as to enable the people of Florida and visitors to enjoy these values without depleting them; to contribute materially to the development of a strong mental, moral, and physical fiber in the people; to provide for perpetual preservation of historic sites and memorials of statewide significance and interpretation of their history to the people; to contribute to the tourist appeal of Florida.

The Trustees have also granted management authority of certain sovereign submerged lands to the Division under Management Agreement MA 68-086 (as amended January 19, 1988). The management area includes a 400-foot zone from the edge of mean high water where a park boundary borders sovereign submerged lands fronting beaches, bays, estuarine areas, rivers or streams. Where emergent wetland vegetation exists, the zone extends waterward 400 feet beyond the vegetation. The agreement is intended to provide additional protection to resources of the park and nearshore areas and to provide authority to manage activities that could adversely impact public recreational uses.

Many operating procedures are standard system wide and are set by policy. These procedures are outlined in the Division **Operations Procedures Manual** (OPM) and cover such areas as personnel management, uniforms and personal appearance, training, signs, communications, fiscal procedures, interpretation, concessions, camping regulations, resource management, law enforcement, protection, safety and maintenance.

In the management of Collier-Seminole State Park, a balance is sought between the goals of maintaining and enhancing natural conditions and providing various recreational opportunities. Natural resource management activities are aimed at management of natural systems. Development in the park is directed toward providing public access to and within the park, and to providing recreational facilities, in a reasonable balance, that are both convenient and safe. Program emphasis is on interpretation on the park's natural, aesthetic and educational attributes.

Park Goals and Objectives

The following park goals and objectives express the Division's long-term intent in managing the state park. At the beginning of the process to update this management plan, the Division reviewed the goals and objectives of the previous plan to determine if they remain meaningful and practical and should be included in the updated plan. This process ensures that the goals and objectives for the park remain relevant over time.

Estimates are developed for the funding and staff resources needed to implement the management plan based on these goals, objectives and priority management activities. Funding priorities for all state park management and development activities are reviewed each year as part of the Division's legislative budget process. The Division prepares an annual legislative budget request based on the priorities established for the entire state park system. The Division also aggressively pursues a wide range of other funds and staffing resources, such as grants, volunteers and partnerships with agencies, local governments and the private sector, for supplementing normal legislative appropriations to address unmet needs. The ability of the Division to implement the specific goals, objectives and priority actions identified in this plan will be determined by the availability of funding resources for these purposes.

Natural and Cultural Resources

1. Control invasive exotic plants.
- **A.** Eliminate melaleuca trees and monitor sites of infestation for reentrants.
- **B.** Eliminate large Brazilian pepper plants and regularly monitor for reentrants.
- **C.** Eliminate air potato and regularly monitor for reentrants.
- **D.** Regularly monitor remote areas of the park for infestations of climbing fern.

2. Carry out prescribed burning in all pyrrhic communities.
- **A.** Burn frequently; annually if possible.

3. Restore hydrology as near to pre-drainage conditions as possible.
- **A.** Find funds for a hydrological study to identify corrective measures.
- **B.** Eliminate pine trees where they have invaded hydric communities.

4. Protect and monitor archaeological sites, historical structures and objects for vandalism, unauthorized digging or collecting, erosion, and other forms of encroachment.
- **A.** Maintain the walking dredge in accordance with the Secretary of Interior Standards for the Treatment of Historic Properties.
- **B.** Maintain and interpret the blockhouse.
- **C.** Maintain and interpret the Old Marco Road.
- **D.** Protect and interpret Grocery Place, Old Grove and all archaeological sites.
- **E.** Maintain a Cultural Resource Management File for the park.
- **F.** Draft a Scope of Collections Statement for the park.
- **G.** Develop an Interpretive Statement for the park.
- **H.** Coordinate any plans for ground-disturbing activity through the Division of Historical Resources as required in the DHR/Division Compliance Review Matrix.
- **I.** Complete Florida Master Site File documentation for all known sites.

Recreational Goals

5. Continue to provide quality resource based outdoor recreational and interpretive programs and facilities at the state park.
- **A.** Maintain opportunities to explore the park through a network of nature (hiking) shared-use (hiking/biking) and canoe trails.
- **B.** Provide onsite interpretive programming through regularly scheduled ranger talks, guest speakers and boat tours.
- **C.** Maintain opportunities for extended stays at the park through both developed and primitive camping.
- **D.** Highlight the park's unique natural and cultural features within the blockhouse interpretive center.
- **E.** Provide passive interpretive opportunities through interpretive signs and kiosks at

important resource locations.
   F. Continue to host special events to support increased visitation and an interest and understanding of park resources and history.

6. Seek funding to expand recreational and interpretive opportunities through the improvement of programs and the development of new use areas and facilities, as outlined in this management plan.
   A. Improve access and operational efficiency within the boat basin by relocating the concession, constructing a waiting shelter and upgrading the dock facilities.
   B. Enhance use of the picnic area by replacing existing shelters, playground equipment and restrooms and constructing a screened pavilion and BBQ shelter.
   C. Reconfigure and upgrade campsites and replace existing bathhouses to provide a modern, more accessible, state park quality campground.
   D. Expand the group camp area to accommodate larger groups.
   E. Improve the Royal Palm Hammock Nature Trail by replacing the boardwalk and providing interpretive signage.
   F. Improve the shared-use trail by providing interpretive and trail directional signage and linking the trail system with the main use areas of the park.
   G. Improve park interpretation by upgrading interpretive center exhibits and the dugout canoe exhibit.

Park Administration/Operations

7. Provide efficient and effective management of park resources and facilities while maintaining a high level of visitor service.
   A. Secure funding for two full-time positions to speed progress in exotic plant control, facilitate a more rigorous schedule of prescribed burning, and allow the park staff more time to research and conduct interpretative programs.
   B. Provide universally accessible public facilities.
   C. Collaborate with other land managers to share information, resources and coordinate recreation and resource management planning efforts.
   D. Recruit and maintain volunteer support to assist park staff with the maintenance of park facilities, protection of park resources and implementation of park programs.
   E. Develop partnerships and seek other funding alternatives to the legislative appropriation process.
   F. Conduct routine safety and maintenance inspections of facilities and public areas and correct deficiencies as needed. Assure compliance with state and federal safety guidelines.
   G. Provide staff with appropriate training opportunities in visitor services, resource management, park operations and interpretation.
   H. Promote Collier Seminole State Park as a destination for nature and heritage based tourism groups.
   I. Network with existing institutions dedicated to promoting recreation opportunities in Collier County to encourage both new and repeat visitors to Collier-Seminole State Park.
   J. Promote responsible use of the park’s land and water resources through signage and interpretive programming.
   K. Monitor land use activities outside the park that may impact park resources or the visitor experience, and increase public awareness of the resource management needs of the park.

Management Coordination

The park is managed in accordance with all applicable Florida Statutes and administrative rules. Agencies having a major or direct role in the management of the park are discussed in this plan.

The Department of Agriculture and Consumer Services, Division of Forestry (DOF), assists Division staff in the development of wildfire emergency plans and provides the authorization required for prescribed burning. The Florida Fish and Wildlife Conservation Commission (FFWCC), assists staff in the enforcement of state laws pertaining to wildlife, freshwater fish and other aquatic life existing within park boundaries. In addition, the FFWCC aids the Division with wildlife management programs, including the development and management of Watchable Wildlife programs. The Department of State, Division of Historical Resources (DHR) assists staff to assure protection of archaeological and historical sites. The Department of Environmental Protection (DEP), Office of Coastal and Aquatic Managed Areas (CAMA) aids staff in aquatic preserves management programs. The DEP, Bureau of Beaches and Wetland Resources aids staff in planning and construction activities seaward of the Coastal Construction Line. In addition, the Bureau of Beaches and Wetland Resources aid the staff in the development of erosion control projects. Emphasis is placed on protection of existing resources as well as the promotion of compatible outdoor recreational uses.

The Division recognizes that coordinating planning efforts and monitoring of land use changes would benefit all area land managers. Sharing information and combining resources can improve the management capacity of individual agencies, particularly in time of limited resources. A coordinated approach to recreation planning limits unnecessary duplication of facilities, provides for a diversity of uses and avoids a one-size-fits all approach to the allocation of recreation opportunities. Changing land development patterns affect all conservation lands and can have detrimental impacts to hydrology, wildlife, the use of prescribed fire and even the visitor experience. With this in mind, the Division is committed to inter-agency cooperation in resource management, recreation planning and environmental monitoring.

Public Participation

The Division provided an opportunity for public input by conducting a public workshop and an advisory group meeting. A public workshop will be held on May 1, 2003. The purpose of this meeting was to present this draft management plan to the public. A DEP Advisory Group meeting will be held on May 2, 2003. The purpose of this meeting was to provide the Advisory Group members the opportunity to discuss this draft management plan. Addendum 1 contains a list of advisory group members and the advisory group meeting staff report.

Other Designations

Collier-Seminole State Park is within the Big Cypress Area of Critical State Concern as defined in section 380.05, Florida Statutes. The park is a component of the Florida Greenways and Trails System. The park is listed on the National Register of Historic places. The walking dredge is listed on the National Register of Historic Places and is designated a National Historic Mechanical Engineering Landmark.

All permanent water bodies within the park boundaries have been designated as Outstanding Florida Waters, pursuant to Chapter 62-302 Florida. Surface waters in this unit are also classified as Class II waters by DEP.

The southern portion of Collier-Seminole State Park lies within the Cape Romano-Ten Thousand Islands Aquatic Preserve as designated under provision of the Florida Aquatic Preserve Act of 1975 (section 258.35, Florida Statutes). The boundary of the preserve includes areas below the mean high water line, which includes Mud Bay and the marsh and tidal swamp communities to the south.

RESOURCE MANAGEMENT COMPONENT

INTRODUCTION

The Division of Recreation and Parks has implemented resource management programs for preserving for all time the representative examples of natural and cultural resources of statewide significance under its administration. This component of the unit plan describes the natural and cultural resources of the park and identifies the methods that will be used to manage them. The stated management measures in this plan are consistent with the Department's overall mission in ecosystem management. Cited references are contained in Addendum 2.

The Division's philosophy of resource management is natural systems management. Primary emphasis is on restoring and maintaining, to the degree practicable, the natural processes that shape the structure, function and species composition of Florida's diverse natural communities as they occurred in the original domain. Single species management may be implemented when the recovery or persistence of a species is problematic provided it is compatible with natural systems management.

The management goal of cultural resources is to preserve sites and objects that represent all of Florida's cultural periods as well as significant historic events or persons. This goal may entail active measures to stabilize, reconstruct or restore resources, or to rehabilitate them for appropriate public use.

Because park units are often components of larger ecosystems, their proper management is often affected by conditions and occurrences beyond park boundaries. Ecosystem management is implemented through a resource management evaluation program (to assess resource conditions, evaluate management activities, and refine management actions), review of local comprehensive plans, and review of permit applications for park/ecosystem impacts.

RESOURCE DESCRIPTION AND ASSESSMENT

Natural Resources

<u>Topography</u>

Collier County is entirely within the coastal lowlands topographic division of Florida. Collier-Seminole State Park is situated near the coast where the imperceptible downward slope of the land gradually encounters the sea. The submerged western portion of the park lies within a network of coastal swamps and is covered by water at high tide. Topography throughout is subdued. The uplands in the park exceed five feet in elevation only at a few locations. The topography has been altered by borrow canals bordering State Road 92 and U.S. Highway 41, and by a dike enclosing organic soils at a site once used for farming. The dike is in Section 28, T51S, R27E.

<u>Geology</u>

Geological formations. The Tamiami limestone formation, which can be seen exposed along the Tamiami Trail, underlies nearly all of Collier County and is approximately six million years old. The formation was created during the Miocene epoch and seems to range between 10 and 50 feet in thickness, although this has not been clearly established. It is capped by hard rock, overlying sand, silts and clays, shell marls, and shell-free, greenish clay.

Geologically, the region around the park has been described as having a "karst" topography, which refers to a land type based on carbonate rocks, chiefly limestone. The drainage sloughs in the park are karst features that develop when limestone, formed as sedimentary rock below sea level, is exposed in a setting where there is high precipitation. Water mixed with carbon dioxide easily forms carbonic acid which seeps into openings in the soluble rock and dissolves the limestone. The cypress strands so common in the region may follow old marine erosion features in the surface rock.

Soils

Over most of Collier County, a thin blanket of sand and marl, and fine shell of Pamlico Sea origin, covers the limestone (see Soils Map). Organic matter has filled natural depressions in the limestone. These sands and their accumulated organic material form the substratum for the biological systems of the county and, before the hydrological disruptions caused by extensive canal building were in direct or close contact with the water table. It is the organic material in the upper layer that yields the acids responsible for dissolution of the underlying limestone. Addendum 3 contains detailed soil descriptions for this unit. Currently, there are no soil conservation or erosion issues at this park.

Minerals

Mineral resources of economic value in southern Florida include limestone, high silica sand, clay, phosphate rock, peat, oil and gas. As implied above under the section on geology, limestone underlies the entire park. The uppermost strata are within a few feet of the ground surface, being covered in most instances by a layer of sand or marl. During the 1980s, seismic explorations, using explosives, were conducted in the park during a search for oil. Presumably, none was discovered.

Hydrology

Most of the county is so low and level that drainage is indefinite and sluggish. The coastal region has numerous embayments, rivers, creeks and lagoons that permit tidewater to extend inland, in a northerly direction. Following heavy rains, and during the rainy season in summer, wet prairies, and even the islands within the big Cypress Swamp may be covered by a few inches to several feet of water.

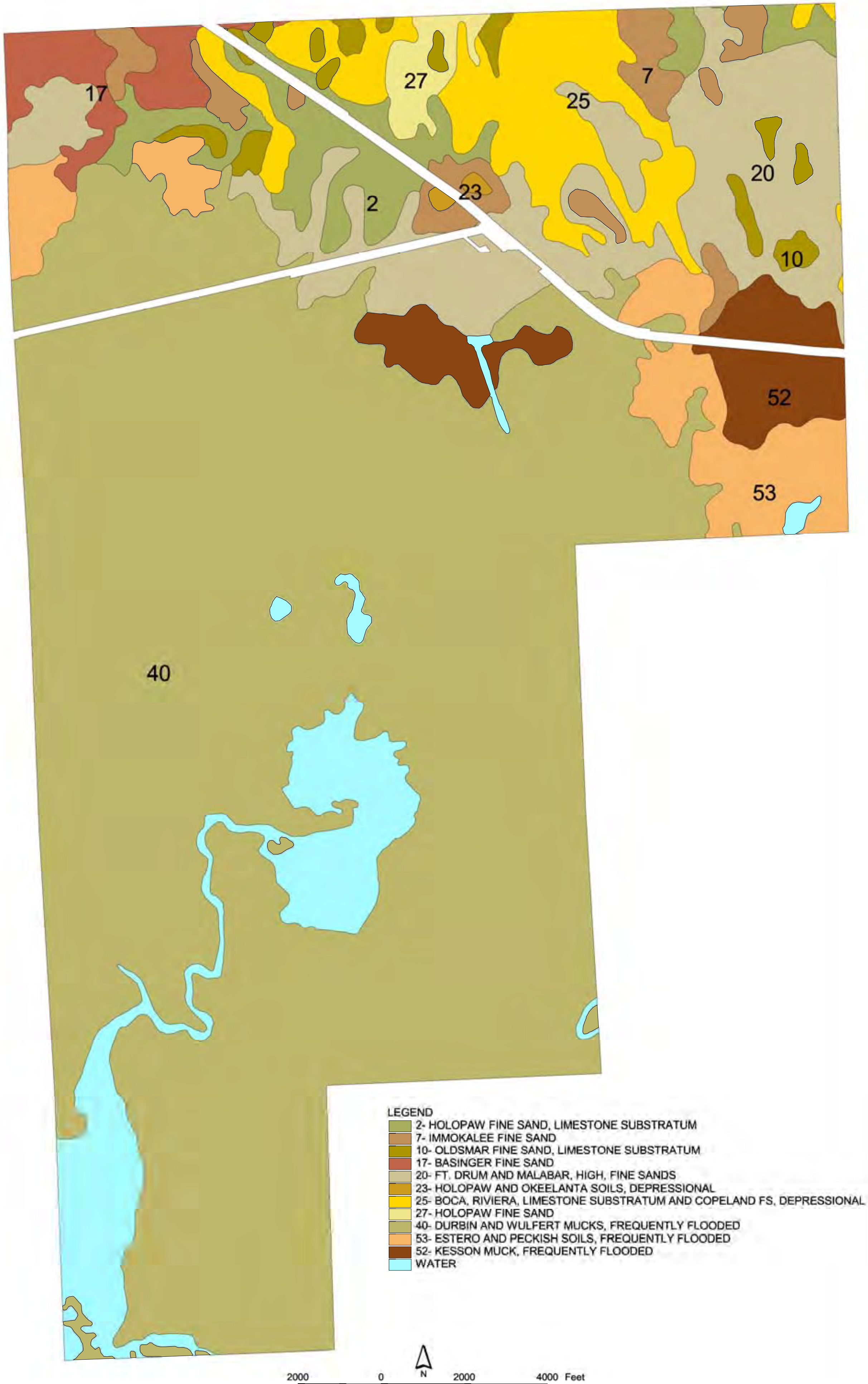
Drainage has been extensively altered in Collier County, first by highway development, and later by agriculture, and still later by urbanization and by the gigantic land sales project of the Gulf American Corporation (now known as Golden Gate).

Park hydrology. All surface waters in the park are designated as Class II waters by the Department of Environmental Regulation as stipulated under Chapter 17-3, Florida Statutes. They are also designated Outstanding Florida Waters meaning that no actions can be taken that will degrade the existing quality. Water conservation issues will be addressed latter in the section on management needs.

Surface water. In this region drainage is seasonal, normally building in the months of heaviest rainfall (June through September), with a peak in the fall and a slow subsidence in the months thereafter, sometimes ceasing altogether, leaving water standing in surface depressions. In very dry years, all surface water is lost to evaporation or absorbed by the porous substrate. During the wettest months, the water historically moved southward as sheet flow, perhaps as slowly as 0.3 feet per second (0.5 miles per day) on its way to estuaries south of the park. However, the historic flow pattern of surface water has been disrupted on a massive scale.

A map published in 1976 shows the historic drainage basins of western Collier County. Collier-Seminole State Park is situated in the Camp Keasis Basin, a narrow, elongate feature originating just south of Lake Trafford and extending southward to the saline waters below U.S. Highway 41.

Unfortunately, the original surface water flow in this basin has been intercepted northwest of the park by the South Golden Gate canal grid that discharges the water through the Faka Union Canal into Faka Union Bay. Other tracts in this basin to the north and northwest of



COLLIER-SEMINOLE STATE PARK

Florida Department of Environmental Protection
Division of Recreation and Parks
Office of Park Planning

SOILS MAP

the park have been ditched and diked to grow vegetables, thereby potentially displacing a volume of surface water equal to the size of each tract. All these disturbances have rendered the Camp Keasis Basin dysfunctional. The Collier County Comprehensive Plan contains a map of drainage basins revised to reflect the current reality imposed by canals on the movement of surface water; in this scheme the land in and around Collier-Seminole, north of U.S. Highway 41, is named the Southern Coastal Basin, while a large region south of U.S. Highway 41 is designated Miscellaneous Coastal Basins.

Drainage is also altered by canals along the Tamiami Trail (U.S. Highway 41) from Naples to the southeastern corner of the county and along State Road 92 from Marco Island to Royal Palm Hammock. Both highways make a juncture in the park. The canals formed excavations of material that became the roadbed.

Groundwater. Groundwater has been affected by man-made canals constructed through, and adjacent to, the park. During the dry season, when surface water falls, the canals facilitate the lowering of groundwater from nearby subsurface strata. This pattern contributes to the shortening of hydroperiods, the consequences of which can be seen in vegetative changes occurring in the park's natural communities; for example, the encroachment of slash pines into communities formerly dominated by cypress.

Internal drainage. The drainage within the park finds its strongest expression in the Blackwater River. The river first becomes identifiable within the park, north of Highway 41. It is actually a creek at this point. It flows under U.S. Highway 41, and thereafter becomes better identified as a stream that widens to a river as it flows southward. Thus, the Blackwater River has a length of about eight miles. The flow varies seasonally, increasing in volume during periods of greatest rainfall.

As noted above, there are several man-made canals within, and adjacent to, the park. They were originally built to facilitate draining the roads, an agricultural site and residential areas. These canals have lowered the water table, accelerated runoff during the rainy season and reduced hydroperiods. Drainage has also contributed to salt water intrusion in the park (and in the surrounding countryside). The Golden Gate Estates Redevelopment Study, Tabb et. al. June 1976, states; "We have noted, with special concern, the strong inland flow of tide water through the Blackwater River culvert under the Tamiami Trail. During low groundwater stages, this is a serious point source of contamination of sand-filled basin storage in the southeastern Belle Meade (drainage) Basin as well as the southern end of the Picayune Strand. Finally, although not within the confines of the Golden Gate Estates, some measure of control should be established on the Blackwater River at Collier-Seminole State Park. A control structure (C11) should be considered at the U.S. Highway 41 bridge to prevent over-drainage of the southeastern portion of the Belle Meade Basin." This and other control measures should be investigated to restore hydroperiods in the park.

Natural Communities

The system of classifying natural communities employed in this plan was developed by the Florida Natural Areas Inventory (FNAI) **FNAI Descriptions**. The premise of this system is that physical factors, such as climate, geology, soil, hydrology and fire frequency generally determine the species composition of an area, and that areas which are similar with respect to these factors will tend to have natural communities with similar species compositions. Obvious differences in species composition can occur, despite similar physical conditions. In other instances, physical factors are substantially different, yet the species compositions are quite similar. For example, coastal strand and scrub--two communities with similar species compositions--generally have quite different climatic environments, and these necessitate different management programs.

Collier-Seminole State Park contains 12 distinct natural communities in addition to ruderal and developed areas (see Natural Communities Map). Park specific assessments of the existing natural communities are provided in the narrative below. A list of plants and animals occurring in the unit is contained in Addendum 4.

Mesic flatwoods. The mesic flatwoods community is present in the northern portion of the park interspersed as scattered islands among wet flatwoods and strand swamps. This community is a relatively small portion. In the park, mesic flatwoods is distinguished from wet flatwoods by the presence of large, contiguous patches of saw palmetto. Some large, pre-disturbance slash pines can be seen here. Both communities have slash pines in the overstory although they are generally more stunted in wet flatwoods. As for ground cover, the mesic flatwoods has enough continuous coverage of saw palmetto to give a characteristic "slick" signature on aerial photographs. Although small in proportion, the community is noteworthy because of the slash pine trees that are quite old and of an impressive size even, though some trees were removed during the 1960s through selective cutting.

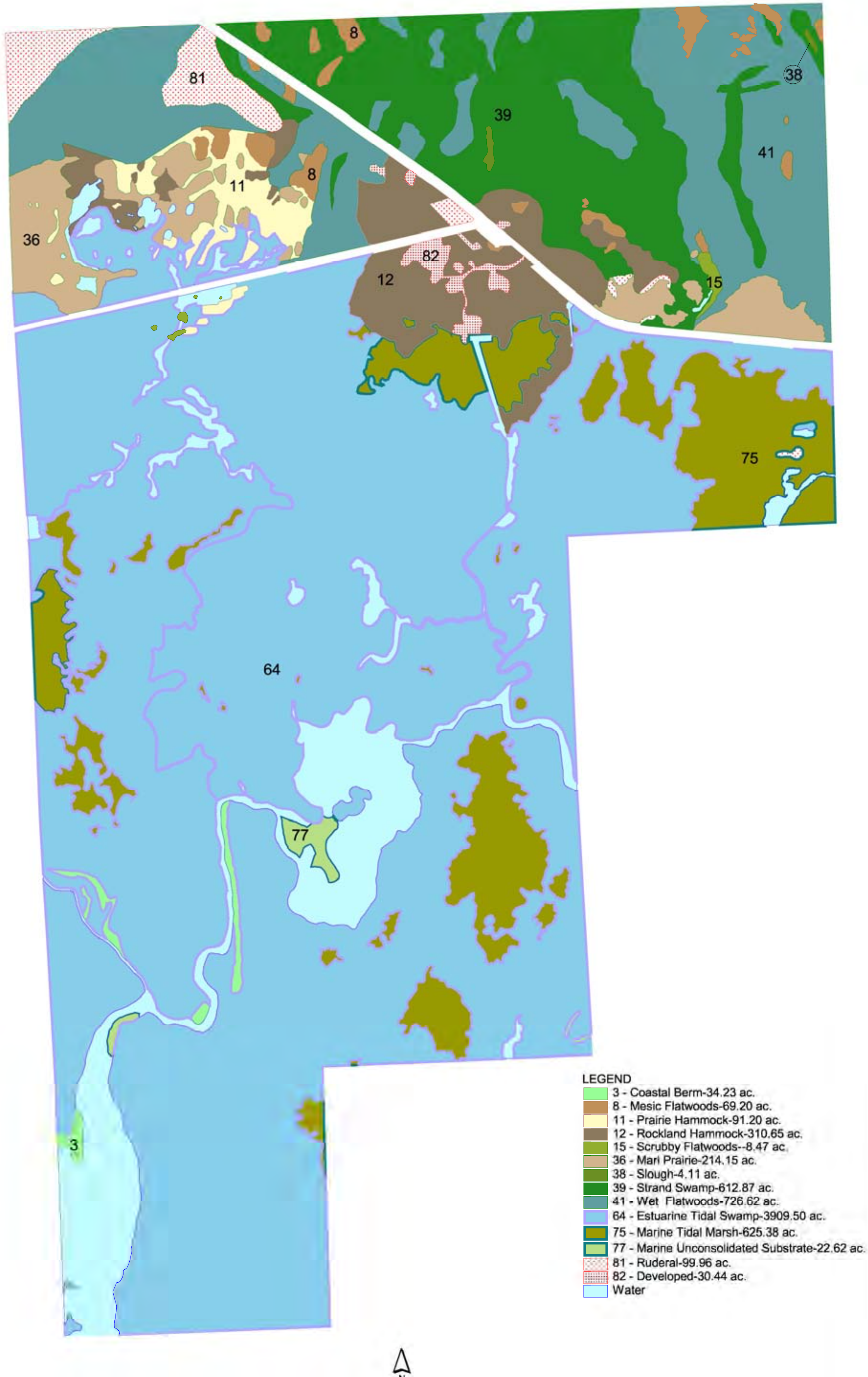
Mesic flatwoods are closely associated with and often grade into wet flatwoods or scrubby flatwoods. The differences between these communities are generally related to minor topographic changes. Wet flatwoods occupy the lower, wetter areas while scrubby flatwoods occupy the higher, drier areas.

Scrubby flatwoods. This community is a relatively small proportion of the park acreage. It is the driest of natural communities in the park, being on elevated sands. It is characterized by a dense growth of sand live oaks and myrtle oaks. However, other scrub oak species commonly found in scrubby flatwoods are conspicuously absent or present in much reduced quantity at this southerly latitude. For example, running oak (*Quercus minima*) is present but is not abundant. Gopher tortoises, although few in number, are often seen here. Scrubby flatwoods occurs--just north of U.S. Highway 41, next to the borrow pit. This site was partially destroyed by the digging of a borrow pit in the 1970s. The other principal locations for this community in the park are near the borrow pit along the south side of Hwy 92 and near West Palm Run as it approaches Highway 92.

Wet flatwoods. The wet flatwoods community is more common than the above two named. With respect to ground cover, except for the abundance of the parasitic *Cassythia filiformis* (love vine), this community closely resembles the standard description given for it by FNAI. In the park and surrounding region, the demarcation between wet flatwoods and adjoining strand swamps is often indistinct. This blending effect is in part due to disruptions in the hydrological regime followed by the spread of slash pine into adjoining strand swamps. In spite of these perturbations, this community remains a remarkably fine example of south Florida flatwoods.

Prairie hammock. This community is found in the western part of the park, immediately south of the Old Marco Road. Prairie hammocks in the park are characterized as clumps of cabbage palms and live oaks in the midst of marl prairie or marsh communities. This community is itself likely the product of an advanced successional stage of marl prairie. Prairie hammocks have a relatively open understory. Typical understory plants include wax myrtle, white stopper, Spanish stopper, marlberry, pigeon plum, poison ivy, orchids and an occasional gumbo-limbo tree. If this community escapes fires long enough, it will eventually succeed into rockland hammock as the above-mentioned understory plants may suggest. That will require the buildup of large amounts of humus.

Marl prairie. Examples of this community occur in the western part of the park, south of



COLLIER-SEMINOLE STATE PARK

NATURAL COMMUNITIES MAP

Old Marco Road and in the eastern part of the park, just north of U.S. Highway 41. Generally, vegetation in the more northerly parts of the prairie reflect the influence of freshwater sheet flow coming in from the north, whereas the southerly ones, by contrast, show the brackish influence of infrequent tidal surges. To the north, under freshwater influence, sawgrass is more abundant, while in the tidal-influenced marl prairies, *Eleocharis cellulosa*, a salt tolerant spikerush, shows up. In the latter case, FNAI's synonym for marl prairie of "spikerush marsh" is more appropriate. However, the widely scattered, stunted cypress or mangrove trees that FNAI describes as being present are not seen in this park. That community-type is more indicative of the Everglades regions of Everglades National Park and Big Cypress National Preserve.

Rockland hammock. Rockland hammock is the reason the park was created. The proponents of Lincoln-Lee National Park saw this appealing tropical forest as its principal feature. They were especially eager to safeguard the large royal palms. Even aside from the royal palms, it remains an excellent example of a surviving tropical hardwood forest in southern Florida. About 35 species of trees have been identified including the most northerly records for such species as gulf graytwig (*Schoepfia chrysophylloides*) inkberry (*Exothea paniculata*), and guiana plum (*Drypetes lateriflora*). From a nature trail, fine examples of satinleaf (*Chrysophyllum oliviforme*), Jamaica dogwood or Florida fishpoison tree (*Piscidia piscipula*), and Simpson's stopper (*Myrcianthes fragrans*) can be seen. A specimen of devil's claw (*Pisonia aculeata*) growing along this trail may be the largest in Florida. A strangler fig (*Ficus aurea*) of impressive size grows in the hammock near the service area. Unfortunately, when the park was developed, some of the trees were cleared to make way for park facilities, although there may have been some clearing prior to that time by settlers or perhaps Native Americans. The memorial field, service area, picnic areas and part of the campground were originally rockland hammock. Part of the old memorial field is being restored by planting tropical hardwood trees grown in the park nursery.

In 1960, the hammock was flattened by Hurricane Donna. Trunks of many of the old hardwoods can still be seen prostrate on the ground. In 1992, another strong hurricane, Hurricane Andrew passed south of the park; although it flattened hammocks near the east coast, the observable impact to large trees at Collier-Seminole State Park was principally to laurel oaks that frequently are afflicted by heart rot in this environment and are easily toppled by strong winds.

There are two smaller rockland hammocks in the park, one is in the eastern portion, north of U.S. Highway 41. The other is in the western part of the park, south of Old Marco Road. These intergrade with, and are undoubtedly successional products of, prairie hammocks. Those examples south of Old Marco Road superficially appear to be prairie hammocks because of the signature given by oaks and cabbage palms, but an examination of the understory shows species indicative of an emerging rockland hammock. Whether these prairie hammocks eventually completely succeed to rockland hammock depends on whether or not fire enters them which is itself largely dependent on how much moisture is retained in the emerging humus layer during dry years.

Strand swamp. This community, where the cypress strands appear discontinuous, may resemble cypress domes. They have suffered from fire exclusion and altered hydroperiods. Regarding the latter, numerous man-made canals in the region have contributed to drainage of the strand swamps. The drainage canals have reduced the residence time for standing water with the most obvious effect being an abnormally large scattering of slash pines among cypress. As pointed out under wet flatwoods, the effects of these changes are more noticeable in those places where strand swamps border on wet flatwoods. Brazilian peppers have also invaded strand swamps to some extent. Nevertheless the park's strand swamps, represent some of the finest examples of this community in southwestern Florida. Although large cypress trees were logged earlier in this century, some trees in the park escaped. A good example is seen near the headwaters of the Blackwater River, just north of U.S. Highway 41 near the Indian Village. This strand swamp is comprised of huge cypress trees that may be 100-feet tall. It is small in geographical extent, but in character, it resembles the finest examples seen in the Fakahatchee Strand or at Corkscrew Swamp. Generally, the biggest trees reflect where water is deepest and remains longest.

Canopy plants are mainly temperate; for example, cypress and red maple, while understory and epiphytic plants are mainly tropical. While this community is not usually considered as fire adapted, infrequent fire is essential for its maintenance; without fire (FNAI estimates between 30 and 200 years), hardwood invasion, and peat accumulation will shift the community to more mesic conditions in a few hundred years. Cypress is tolerant of light surface fires, but muck fires burning into the peat can kill the trees, lower the ground surface and transform a strand into a slough. The largest trees on the deepest and wettest peat usually withstand fires. This is often where sloughs are found.

Slough. This community occupies the deeper drainageways of cypress strand interiors and is distinguishable by water which is present at least two-thirds of the year (ca. 250 days), and by the abundance of pond apple, pop ash trees, and cutgrass or southern wild rice in deeper sloughs (*Zizaniopsis miliacea*). Sloughs are usually in the lowest part of linear depressions in the underlying limestone bedrock. With the almost constant water presence, the relative humidity is higher than in the surrounding or associated strand swamps as indicated by greater numbers of epiphytic bromeliads, ferns and orchids. The nearly constant presence of water also moderates temperature and provides some degree of frost protection for the delicate epiphytic plants during the colder winter months. Sloughs are vulnerable to hydrologic disturbance and must have a permanent, reliable, water source of good quality to persist. Currently only two well-defined sloughs are recognized and mapped in the park.

Estuarine tidal marsh. This graminoid-dominated community of the park is best developed near tidal streams and along the inland boundary of the tidal swamps. Spike rush (*Eleocharis cellulosa*) and cordgrasses dominate tidal marshes at Collier-Seminole. The most accessible example is near the boat dock. It remains in an apparently pristine condition, but mangrove trees have gradually encroached at the margins over the past 30 years (personal communication, Ken Alvarez).

Estuarine tidal swamp. This community occupies most of the park. It is a segment of the great mangrove swamp of southern Florida, one of the largest in the world. The dominant plants are red, black and white mangroves and buttonwood. The community appears to be in an original condition, except for the infestation of Brazilian pepper in some locales where the ground is elevated above the reach of high tide. In this bioenergetically rich community, plant diversity is low compared to animal diversity that is especially high because of the abundant fish and invertebrate species.

Marine unconsolidated substrate. FNAI's most appropriate synonyms for this community are probably mud flats or tidal flats. An excellent example is found in Mud Bay where considerable numbers of wading birds, shore birds and waterfowl can be seen at low tide. Although superficially appearing barren, this community is rich in invertebrates and bottom-feeding fish that explain the presence of numerous birds. The community appears to be in very good condition.

Coastal berm. This designation is the closest FNAI analog to a community that has been identified by Division district biologists as Tropical thorn scrub. Unfortunately, this community is not recognized in the Guide to Natural Communities of Florida (FNAI, 1990). Tropical thorn scrub is distinctive, but sparsely scattered in small units among mangroves so that it was apparently overlooked by FNAI. It is indicated on the natural communities map as a coastal berm community to which it has some affinities, although superficial. This inaccuracy will be corrected by the necessary administrative measures when time permits. In south Florida, it can be characterized as a coastal natural community with predominately xeric plant species many of which are conspicuously armed with spines or thorns. The xeromorphic features of these plants include reduced leaf surface area, succulence, and, as mentioned, spines or thorns. The majority are woody perennials of short stature, between 2-5 meters in height. This community type has been recognized in subtropical to tropical regions at similar latitudes around the globe and, therefore, on a global scale is not rare.

The closest ecological counterpart in Florida outside of Collier-Seminole State Park may be in the Cape Sable hammock region of Monroe County, mentioned by Craighead, 1971, in *The Trees of Southern Florida Vol. 1, The Natural Environments and their Succession,* as a possibly distinct plant association within the Cape Sable hammocks. The community was originally described by Harper, 1927, in *Natural Resources of Southern Florida.* He called these communities shore hammocks or cactus thickets. Others have described this community as a thorn woodland. Rzedowski, 1986 in *Vegetacion de Mexico* called it *Bosque espinoso* or Thorn Forest. The examples in the park are too lacking in stature to call a forest; scrub is more appropriate.

Typical plants in the park's thorn/scrub include (Full names are given as this community is not described in Addendum 4 with the FNAI natural communities): indigo berry (*Randia aculeata*), coin vine or fishpoison vine (*Dalbergia ecastophyllum*), buttonwood (*Conocarpus erectus*), Florida wild olive or forestiera (*Forestiera segregata*), wild lime (*Zanthoxylum fagara*), gray nicker (*Caesalpinia bonduc*), soapberry (*Sapindus saponaria*), limber caper (*Capparis flexuosa*), Jamaica caper (*Capparis cynophallophora*), cat-claw (*Pithecellobium unguis-cati*), devil's claw (*Pisonia aculeata*), white stopper (*Eugenia axillaris*), Spanish stopper (*Eugenia foetida*), saffron plum (*Bumelia celastrina*) Florida bully or milk buckthorn (*Bumelia reclinata*), Christmas berry (*Lycium carolinianum*), cabbage palm (*Sabal palmetto*), snowberry (*Chiococca alba*), Jamaica dogwood or Florida fishpoison (*Piscidia piscipula*), gumbo limbo (*Bursera simaruba*), crimson dicliptera (*Dicliptera sexangularis*), yellow chaff-flower (*Alternanthera flavescens*), saltwort (*Batis maritima*), rubber vine (*Rhabdadenia biflora*), giant air plant (*Tillandsia fasciculata*), and sometimes cacti (*Cereus* spp.). No data have yet been accumulated on the fauna of this community, but it is likely that animals from the surrounding mangrove swamps and tidal marshes are common visitors.

This community occurs in the park at three locations--Grocery Place, Old Grove and an unnamed site along the Blackwater River in the southeast corner of the park. Grocery Place has evidence of human habitation in the early part of the twentieth century. No records have been found of habitation at Old Grove. At the Old Grove site, the natural community is re-establishing itself, while at Grocery Place, clearing dominated by St. Augustine grass are maintained for primitive camping. Of the three sites, the plant community in the Blackwater River area is the smallest. Oftentimes, the only evidence of it is a narrow strip of small catclaw along brackish watercourses.

Ruderal and developed. Ruderal areas are characterized by having the natural substrate or the natural community overwhelmingly altered because of human activity. Native vegetation is sparse and is often replaced by weedy or exotic species. These areas normally require a long-term restoration effort. At Collier-Seminole State Park, ruderal acreages are primarily abandoned agricultural areas near Old Marco Road. Developed areas consist of natural biological communities that have been replaced or nearly replaced by structures or permanently cleared areas such as roads, visitor facilities, campgrounds, recreation areas, parking lots or concessions.

Designated Species

Designated species are those that are listed by the Florida Natural Areas Inventory (FNAI), U.S. Fish and Wildlife Service (USFWS), Florida Fish and Wildlife Conservation Commission (FFWCC), and the Florida Department of Agriculture and Consumer Services (FDA) as endangered, threatened or of special concern. Addendum 5 contains a list of the designated species and their designated status for this park. Management measures will be addressed later in this plan.

Thirty-one species of vascular plants have been identified and 42 species of vertebrates. The variety and number of designated species are remarkable for a park of this size and are attributable to its tropical latitude and its diversity of habitats, estuarine, aquatic and upland. Collier-Seminole State Park is one of only three sites in Florida where native royal palms grow in natural abundance. It is home to one of the most extensive populations of the golden leather fern (*Acrostichum aureum*), in the United States. The wild birdnest fern, which is uncommon, grows among the tropical hardwood trees of the rockland hammock. Epiphytic orchids are numerous in the trees of the hammock, and in mangrove and cypress trees. The cowhorn orchid that has become scarce because it is treasured by collectors was recently rediscovered in the park.

The records of bottlenosed dolphins, West Indian manatees, American crocodiles, Florida black bears and the Florida panther hint at the wide diversity of vertebrates in this park. Red-cockaded woodpeckers have been seen and nest cavities found, although not in recent years.

Special Natural Features

The rockland hammock, between the boat dock and the Barron Collier Memorial, with its large number of royal palms is a special natural feature of Collier-Seminole State Park and ranks among the best examples of this natural community on the mainland of south Florida, and is probably the finest on the western side of the peninsula. The park itself might be considered a special natural feature, being remarkable for having such a variety of biological communities' characteristic of the Everglades region in such a relatively small area.

Cultural Resources

Evaluating the condition of cultural resources is accomplished using a three part evaluative scale, expressed as good, fair, and poor. These terms describe the present state of affairs, rather than comparing what exists against the ideal, a newly constructed component. Good describes a condition of structural stability and physical wholeness, where no obvious deterioration other than normal occurs. Fair describes a condition in which there is a discernible decline in condition between inspections, and the wholeness or physical integrity is and continues to be threatened by factors other than normal wear. A fair judgment is cause for concern. Poor describe an unstable condition where there is palpable, accelerating decline, and physical integrity is being compromised quickly. A resource in poor condition suffers obvious declines in physical integrity from year to year. A poor condition suggests immediate action to reestablish physical stability.

The Florida Master Site File recognizes three sites in the park: 8CR34, 8CR125 and 8CR138. Previously, a fourth site, 8CR33 (GV), was reported as being within the boundary of the park. Research at the FMSF indicates this site is not within park boundary, and it will be excluded from this plan. Note: the, "GV" designation indicates the site was recorded as a "General Vicinity" site, which means its exact location was uncertain. Such sites were commonly recorded in years past based on imprecise data, usually from the verbal or written accounts passed on to professional archaeologists who, being perhaps unable to verify the report with a field visit, recorded the sites based on somewhat vague information. Although the FMSF does not indicate who recorded the site it was probably recorded by John Goggin based on a 1947 personal communication by a Mr. D. Graham Copeland. Maps in the FMSF indicate the site is on the east bank of the Blackwater River in Township 52S, Range 27E, Section 15.

Site 8CR34 (Grocery Place) is located on a rise at the mouth of Royal Palm Hammock Creek. Two other rises on that same creek are unrecorded in the Florida Master Site File, but perhaps should be; as noted in the 8CR33 site comments, “any tree islands next to creeks likely contain archaeological sites.” One site near Grocery Place is identified on old park maps as “Old Grove.” Grocery Place is a multi-component site: a shell and black-dirt midden that contains aboriginal pottery dating between 500 BC and AD 900 or perhaps later.The site was also homesteaded in the late 19th or early 20th century and two cisterns remain at the site from that occupation. Initials and the date "1914" are carved into one of the cisterns. A reference to the Grocery Place is found in Tebeau’s history of Collier County (Tebeau 1971), which tells of the Cannon family shipwrecked on Marco Island in 1900. The entire family was thrown into the surf. Fortunately, it was shallow and the parents waded ashore, carrying their children with them. On the beach were a Mr. Harris and several members of the Robertson family who lived on an island just inside the pass. The Cannons remained for some time with these hospitable people. They then made their way overland to Royal Palm Hammock where they built and lived in a palmetto shack for a short time. However, before the year 1901 ended they made their way by skiff down Royal Palm Hammock Creek to the Grocery Place and thence again to Marco. Tebeau further reports that another center of settlement for a time was up Royal Palm Creek in the bay of the same name. Several species of exotic plants, from the period of settlement, are found here. The exotic species include lead tree, (*Leucanea leucocephala*) and Hibiscus, (*Hibiscus rosasinensis*). A map in the park file shows a spot of elevated land upstream from Grocery Place that is referred to as the “Old Grove".

Site 8CR125 includes the entire park and lands to the southeast. It was listed on the National Register of Historic Places in 1970 based on the excellent preservation of a full range of south Florida land types (scrub cypress, pine, open prairie, mangrove, etc.), and the presence of the Collier Memorial, the walking dredge and the "blockhouse". During the development of Collier-Seminole State Park in the 1940s, Collier County, using funds from the Collier Corporation, constructed the blockhouse to commemorate the efforts of the US soldiers in the Seminole Wars. Although not a replica of typical construction from the period, it is a stylized version of the type used during these frontier conflicts, although there does not appear to be any evidence of one ever having been constructed near Collier-Seminole State Park. The blockhouse is a historic structure. There is also a prehistoric canoe on display in the park.

Site 8CR138 is the Bay City Walking Dredge, used in the construction of the Tamiami Trail. It was nominated to the National Register of Historic Places in 1973, and was listed as a National Historic Mechanical Engineering Landmark by the American Society of Mechanical Engineers in 1993. The financing and construction of the Tamiami Trail is an interesting part of the history of Collier County, and is summarized in Tebeau’s history of Collier County. Finally, The Old Marco Road is an unrecorded archaeological site.

RESOURCE MANAGEMENT PROGRAM

Special Management Considerations

Timber Management Analysis

Chapters 253 and 259, Florida Statutes, require an assessment of the feasibility of managing timber in land management plans for parcels greater than 1,000 acres if the lead agency determines that timber management is not in conflict with the primary management objectives of the land. The feasibility of harvesting timber at this park during the period covered by this plan was considered in context of the Division's statutory responsibilities, and an analysis of the park's resource needs and values. The long-term management goal for forest communities in the state park system is to maintain or re-establish old-growth characteristics to the degree practicable, with the exception of early successional communities such as sand pine scrub and coastal strand.

During the development of this plan, an analysis was made regarding the feasibility of timber management activities for this park. It was then determined that the primary management objectives of the unit could be met without conducting timber management activities for this management plan cycle. Timber management will be reevaluated during the next update of this management plan.

Additional Considerations

As pointed out in the natural communities description for rockland hammock, much of the original rockland hammock was cleared in the development of the park; and the memorial field, service area, picnic areas, and part of the campground were originally rockland hammock. Although restoration of the old memorial field is underway, it is proceeding very slowly. Emphasis should be placed on speeding up the process by devoting more staff time to the project.

Management Needs and Problems

The three primary resource management problems for natural resources at this park are those associated with hydrological disruptions, invasive exotic plant species, and prescribed burning.

The natural vegetation at Collier-Seminole State Park is fundamentally shaped by and responsive to local hydrological patterns. The land is flat. In the wet season much of it covered by a film of water which moves slowly toward the tidal region. The depth of water and its time of residence over the uneven ground surface--the hydroperiod--dictate the patterns of vegetation, some plants being more tolerant of prolonged inundation than others. A few inches difference in ground elevation from one spot, to another one nearby, is revealed by different assemblages of plants.

Drainage canals near the park have reduced the residence time for standing water. The most obvious effect is an increase of pine trees in natural communities where they were absent or less numerous. Other changes may be less visible. The need is to restore the original flow and periodicity of surface water as much as possible. A surface water problem of another kind is the pumping of water from an adjacent agricultural field onto the park. This diked field is west of U.S. 41. Excess water is vented through a large pipe during periods of heavy rainfall.

Brazilian pepper is the most widespread invasive exotic plant. At some places in the park it has formed monotypic stands, completely displacing all other vegetation. The park environment is strongly encouraging to Brazilian pepper as to conditions of soil and moisture. Not only do birds and raccoons distribute seeds but Florida black bears also. The park staff is small relative to the extent of infestation. The principal need is for staff increase.

Melaleuca trees were once widespread in the park. They have now been reduced to one site, but here they have proved persistent despite repeated attempts to destroy them. A problem, as with Brazilian pepper, is that of warm, wet conditions favoring rapid growth. Moreover, the remaining site of infestation is a hammock where thick undergrowth impedes the easy detection of seedlings. The need is for continuing pressure by the staff until melaleucas are gone.

Air potato has made its appearance at this park in the last ten years. The first plants were noted just north of the Indian village in 1989. There they have increased in density and climbed into the treetops. Once established, air potato is stubbornly resistant to elimination. The principal need is to prevent its spread to other places in the park, then to make regular and frequent visits to the site of infestation until it is gone.

Climbing fern (*Lygodium microphyllum*), another dangerous exotic, has appeared at remote places in the park. Three large patches have been found in the last three years. Fortunately, climbing fern is vulnerable to herbicides and easily treated if discovered in the first few years of infestation. If not treated however, it can climb into the canopy while simultaneously forming a dense biomass in the substrate, particularly in strand swamps. It can destroy the park.

Approximately 2,321 acres are natural communities that require prescribed burning. Although such a program has been in effect since the 1970s, it has been irregular and sometimes lacking for a year or more at a time, with the result that progress has been made in some burn zones toward eliminating hardwood encroachment, but not as much as desired, while in other zones hardwoods have grown tall and thick, completely altering the original community structure. The need is for regular, frequent burns in all designated zones. A long growing season at this southerly latitude, and abundant rainfall, stimulate the rapid encroachment of hardwood vegetation. Therefore, shortened burn intervals may be needed. Burning annually or at least semi-annually may prove to be the best interval.

The Walking Dredge is in fair condition. Corrosion is still present primarily where metal touches metal. All cables have been replaced including the cable for supporting the bucket. For safety, a chain link fence has been constructed. The Blockhouse, which contains exhibits on the first floor and office storage space on the second floor, is in fair condition. The roof was replaced in 2002; however, exposed sections of some rafters are rotted. An ADA ramp has been built along with a concrete sidewalk. A Historic Structure Report is in progress to determine how the Blockhouse should be managed. An architectural history will be completed also. The wooden canoe is in fair condition now, but will deteriorate over time if not treated or removed to a climate-controlled environment. The pedestal of the Collier memorial has been damaged and the original bust of Barron Collier stolen. A replica bust is now on display. The occasional pressure washing of the memorial is needed to ensure it meets the standards of preserving historic stonework.

All archaeological sites should be considered threatened because of erosion. At Grocery Place, one of the cisterns is now at the shoreline and is being undermined. Vegetation is also causing damage.

Management Objectives

The resources administered by the Division are divided into two principal categories: natural resources and cultural resources. The Division's primary objective in natural resource management is to maintain and restore, to the extent possible, to the conditions that existed before the ecological disruptions caused by man. The objective for managing cultural resources is to protect these resources from human-related and natural threats. This will arrest deterioration and help preserve the cultural resources for future generations to enjoy.

The objective for hydrological restoration is just that--to restore the hydrological regime as nearly as possible to its original state, and to reverse and obliterate all biological changes brought on by hydrological disruption that can be identified.

The objective for invasive exotic plants is to eliminate all mature plants. Reentry of individual plants will continue so long as they are widespread beyond the park and therefore removing or killing the reentrants will become a permanent aspect of park maintenance. The objective, stated another way, is to bring control of invasive exotics to the maintenance phase.

The objective of prescribed burning at Collier-Seminole State Park is reintroducing fire at the appropriate fire return intervals to the following natural communities: mesic flatwoods, scrubby flatwoods, wet flatwoods, marl prairie, and perhaps tidal marsh when appropriate. A present rule-of-thumb for return intervals in mesic flatwoods and wet flatwoods is three years. However, given the density of fine fuels in the wet flatwoods--and in the marl prairies--it may be reasonable to assume that before modern times, fire return intervals were shorter in those natural communities.

The objective in managing cultural resources is to return them to the appearance of the most significant cultural period, to the degree that present day constraints will allow. When properly interpreted, period restoration enhances the visitor's understanding of the historic events of the site under conditions then prevailing. In all matters of cultural resource management, the Division works in consultation with the DHR.

The following objectives should guide the management of the cultural resources of Collier-Seminole. Successful completion of the objectives will result in preservation of the resources and the information they contain for future generations.

1. Maintain and protect cultural resources according to DHR and Department of the Interior best management practices, guided by rigorous research and appropriate funding levels.
2. Develop cyclical maintenance plans for the dredge, blockhouse and memorial.
3. Regularly assess the condition of archaeological sites through patrolling for vandalism and the use of photopoints.
4. Complete Florida Master Site File documentation for all known sites.

Management Measures for Natural Resources

Hydrology

The following discussion includes measures to conserve water resources. As indicated earlier, canals in and around the park have led to the encroachment of slash pines into communities that would not normally have them in high proportions. Strand swamps, for example, currently have greater numbers of slash pines growing among cypress than in times past, as early aerial photographs show. Furthermore, the slash pines are presently stunted in appearance that suggests they are not in their optimum habitat. These "slash pine infested" cypress strands no longer have water standing long enough to prevent the establishment of pine seedlings.

The indistinctiveness of some of the natural communities described above is a result of the regional disruption of hydrological patterns. Therefore, part of the remedy is not fully within the control of land managers within the Division of Recreation and Parks. At Collier-Seminole State Park the hydrology of lands to the north and northeast are most important since the sheet flow is generally south to southwest. Fortunately, much of that region, recently designated the Picayune Strand State Forest, is coming into public ownership as landowners sell their small private lots to the state.

Before any remedial hydrological measures are attempted, baseline hydrological data, as called for in the 1988 Collier County Comprehensive Plan, are needed on hydrodynamics, topography, flow volumes and other physical characteristics. In addition, as indicated above, the South Florida Water Management District should be a part of any actions affecting hydrology.

The pumping of excess water from an adjacent agricultural field onto the park, as described above under Management Needs and Problems, was grandfathered by permitting agencies and thus does not present an obvious solution. Nonetheless, management will remain alert to opportunities that present a solution to this problem.

Serious consideration should be given to pushing in the walls of the old dike system north of Old Marco Road and south of U.S. Highway 41 (Section 28, T51S, R27E). There is historical evidence that this site was once a wetland. Currently this large feature supports unnaturally large strands of Carolina willow and serves as a source of Brazilian pepper re-infestation. It is difficult to penetrate on foot because of the artificially impounded water behind the dike, and because of the density of willows and Brazilian peppers. Other canals and ditches within the park will be filled in where feasible.

Prescribed Burning

The objectives of prescribed burning are to create those conditions that are most natural for a particular community, and to maintain ecological diversity within the unit's natural communities. To meet these objectives, the park is partitioned into burn zones, and burn prescriptions are prepared for each zone. All prescribed burns are conducted with authorization from the Department of Agriculture and Consumer Services, Division of Forestry (DOF). Wildfire suppression activities will be coordinated between the Division and the DOF.

The burn plan will incorporate the frequency and seasonal timing of prescribed burns. Frequent late spring and early summer burns are effective in controlling hardwood encroachment in fire-adapted communities. Burns conducted during this season cause the release of nutrients from burned vegetation. After allowing for these factors, the timing of most prescribed burns should correspond with the natural fire season, which occurs between April and July. Unfortunately, regulations that sometimes prevent burning during very dry periods of the year--when, in the pre-Columbian era, much of the burning would have occurred. Some variation within the natural fire season is also important. Instead of conducting burns during the same month each year, they should be scheduled for different months within the natural fire season. However, in this park, it is important to burn frequently even if that means burning “out of season”.

Although many communities are adapted to spring and summer fire, a spring or summer fire should not be introduced into a community that has a high fuel buildup. When a community has not been burned for a number of years, consideration should be given to an initial fall or winter fuel-reduction burn, before using a growing-season burn. After a fuel-reduction burn, a natural fire regime can again prevail.

A smoke management concern at Collier-Seminole is the necessity of keeping smoke off the two highways that transect the park and make a junction within its boundaries: U.S. Highway 41, which passes through the park from northwest to southeast, and State Road 92, which intersects with U.S. Highway 41 from the west.

Careful planning is necessary when burning near the Seminole Indian Village; a line will have to be cleared in the woods just to the west of the village. The line should curve northward from the highway to the large strand swamp, just to the north of the village.

Designated Species Protection

The welfare of designated species is an important concern of the Division. In many cases, these species will benefit most from proper management of their natural communities. At times, however, additional management measures are needed because of the poor condition of some communities, or because of unusual circumstances that aggravate the particular problems of a species. To avoid duplication of efforts and conserve staff resources, the

Division will consult and coordinate with appropriate federal, state and local agencies for management of designated species. Specifically, data collected by the FWC and USFWS as part of their ongoing research and monitoring programs will be periodically reviewed to inform management decisions that may have an impact on designated species at the park.

This park is noteworthy for the large number of designated species. As pointed out earlier, 31 designated species of vascular plants and 42 species of vertebrates have been identified.

U.S. Fish and Wildlife Service (USFWS) recovery plans have been written for the following park species: American crocodile (*Crocodylus acutus*), eastern indigo snake (*Drymarchon corais couperi*), Florida panther (*Felis concolor coryi*), West Indian manatee (*Trichechus manatus*) wood stork (*Myceteria americana*), and bald eagle, (*Haliateeus leucocephalus),* red-cockaded woodpecker (*Picoides borealis*). The management recommendations in these species recovery plans will be followed.

Other listed species, for which there are no recovery plans, include the Florida black bear and several orchid species. The orchids are subject to poaching, and park patrolling is the recommended protective action, but a low staff to acreage ratio makes executing this recommendation difficult as it does for exotic plant species control.

Exotic Species Control

Exotic species are those plants or animals that are not native to Florida, but were introduced because of human-related activities. Exotics have fewer natural enemies and may have a higher survival rate than do native species, as well. They may also harbor diseases or parasites that significantly affect non-resistant native species. Consequently, it is the strategy of the Division to remove exotic species from native natural communities.

Plants. Seed (or spore) dispersal is the means of entry or reentry to the park. Brazilian pepper then will be the most troublesome since so many seeds are produced and can be carried long distances by a variety of animal transmitters. Maintenance will probably be demanding and never-ending. After intitial treatment of Brazilian pepper has been conducted, followup treatment will be necessary because of resprouting from the trunks and the roots.

Melaleuca seeds are not dispersed so readily. Once cleared from the park they can be kept out with a minimum of vigilance. Climbing fern spores are brought on the winds from afar to grow unexpectedly in remote parts of the park. Regular probes into the backcountry by staff will be important. Air potato seems to move about with direct human assistance. Therefore, early detection and removal will be essential. Additional staff is needed to carry out these demanding tasks. Grants, mitigations, Americorps and the like are helpful, but without adequate manpower based on the park, it will be difficult at best to keep exotic plants out.

Animals. The park's armadillo population is relatively small and control is ongoing. Feral hogs occur, but infrequently. Fire ants are present, and evidence is mounting elsewhere that they are capable of killing the young of small mammals. At present, there is no practical method of control.

Problem Species

Problem species are defined as native species whose habits create specific management problems or concerns. Occasionally, problem species are also a designated species, such as alligators. The Division will consult and coordinate with appropriate federal, state and local agencies for management of designated species that are considered a threat or problem.

Mosquito control. Collier-Seminole has long been known for its mosquitoes. The unusually dense concentrations, especially salt marsh species, may be a result, at least in part, of the artificially impounded water that occurred when the park was developed.

The mosquitoes add an element of difficulty to park operations and make visitation during certain times almost unbearable. Infestations are historically worse during periods of moderate rainfall. In wetter years, gambusias help control them, and in very dry years, it is difficult for the eggs and larva to survive.

At one time, several holes had been dug at sites throughout the park so that the mosquito larvae-eating fish (gambusia) could seek refuge during the dry season and spread out through the swamps and marshes during the rainy season. Minnows were collected from other locations to stock the holes. These measures should be re-examined.

Management Measures for Cultural Resources

The management of cultural resources is often complicated because these resources are irreplaceable and extremely vulnerable to disturbances. The advice of historical and archaeological experts is required in this effort. Approval from Department of State, Division of Historical Resources (DHR) must be obtained before taking any actions, such as development or site improvements that could affect or disturb the cultural resources on state lands (see **DHR Cultural Management Statement**).

Actions that require permits or approval from DHR include development, site excavations or surveys, disturbances of sites or structures, disturbances of the substrate, and any other actions that may affect the integrity of the cultural resources. These actions could damage evidence that would someday be useful to researchers attempting to interpret the past.

The most important management measures for cultural resources are to continue to preserve and protect the Bay City Walking Dredge, the Blockhouse and the Barron Collier Memorial. With consultation from the Bureau of Natural and Cultural Resources, cyclical maintenance plans should be developed and permanent records maintained. This will ensure that routine needs are met and potential problems are identified.

The Walking Dredge's condition can be upgraded to good if stabilization work is completed following recommendations from the DHR Bureau of Archaeological Research. In addition, park staff should make sure that no metal parts are in contact with the ground.
Restoration work is needed on the Blockhouse rafters. The Secretary of the Interior Standards should be followed. Routine termite inspection should be scheduled. At Grocery Place are the remains of two cisterns built in the early 1900s. Grant funding should be sought to restore the cisterns providing that the substrate around them can be stabilized. Encroaching vegetation should be cleared away. Archaeologists and historical preservationists should be consulted for determining preventive measures for the entire site. This site and the Old Grove should be monitored for erosion, vandalism and encroaching vegetation. The midden at Grocery Place needs archaeological testing to determine its integrity and history.

Research Needs

Natural Resources

Any research or other activity that involves the collection of plant or animal species on park lands requires a collecting permit from the Department of Environmental Protection. Additional permits from the Florida Fish and Wildlife Conservation Commission, the Department of Agriculture and Consumer Services, or the U.S. Fish and Wildlife Service may also be required.

As pointed out under the section on "Management Measures for Natural Resources--Hydrology", baseline hydrological data need to be established in accord with the type of proposal called for in the 1988 Collier County Comprehensive Plan, in which hydrodynamics, topography, flow volumes, and other physical characteristics will be considered. In addition, as indicated earlier, the South Florida Water Management District should be a part of any actions affecting hydrology.

In order to monitor the effects of prescribed burning on vegetation, photo points should be considered.

Cultural Resources

The park would benefit from the documentation resulting from the following types of research:

1. A Phase II archaeological survey at Grocery Place and Old Grove.
2. Oral history interviews of Bobby Clay (Seminole leader) and others who currently live or have lived in or near the park.
3. Research on human occupation at Grocery Place and the Old Grove.
4. Research on Old Marco Road to determine if it can be recorded as an archaeological site.
5. Research on Tamiami Canal to determine if it can be recorded as an archaeological site.
6. Research on history of canoe for an interpretive panel.
7. Research on history of the "blockhouse" to record it as a historic structure, although it is mentioned in the National Register nomination for 8CR125 as a contributing element to the NR site.

Resource Management Schedule

A priority schedule for conducting all management activities that is based on the purposes for which these lands were acquired, and to enhance the resource values, is contained in Addendum 6. Cost estimates for conducting priority management activities are based on the most cost effective methods and recommendations currently available (see Addendum 6).

Land Management Review

Section 259.036, Florida Statutes, established land management review teams to determine whether conservation, preservation, and recreation lands titled in the name of the Board of Trustees of the Internal Improvement Trust Fund are being managed for the purposes for which they were acquired and in accordance with a land management plan adopted pursuant to s. 259.032, the board of trustees, acting through the Department of Environmental Protection (department). The managing agency shall consider the findings and recommendations of the land management review team in finalizing the required update of its management plan.

The park was subject to a land management review on October 7, 2003. The review team made the following determinations:

1. The land is being managed for the purpose for which it was acquired.
2. The actual management practices, including public access, complied with the management plan for this site.

LAND USE COMPONENT

INTRODUCTION

Land use planning and park development decisions for the state park system are based on the dual responsibilities of the Division of Recreation and Parks. These responsibilities are to preserve representative examples of original natural Florida and its cultural resources, and to provide outdoor recreation opportunities for Florida's citizens and visitors.

The general planning and design process begins with an analysis of the natural and cultural resources of the unit, and then proceeds through the creation of a conceptual land use plan that culminates in the actual design and construction of park facilities. Input to the plan is provided by experts in environmental sciences, cultural resources, park operation and management, through public workshops, and environmental groups. With this approach, the Division's objective is to provide quality development for resource-based recreation throughout the state with a high level of sensitivity to the natural and cultural resources at each park.

This component of the unit plan includes a brief inventory of the external conditions and the recreational potential of the unit. Existing uses, facilities, special conditions on use, and specific areas within the park that will be given special protection, are identified. The land use component then summarizes the current conceptual land use plan for the park, identifying the existing or proposed activities suited to the resource base of the park. Any new facilities needed to support the proposed activities are described and located in general terms.

EXTERNAL CONDITIONS

An assessment of the conditions that exist beyond the boundaries of the unit can identify any special development problems or opportunities that exist because of the unit's unique setting or environment. This also provides an opportunity to deal systematically with various planning issues such as location, adjacent land uses, and the park interaction with other facilities.

Collier-Seminole State Park is located on the Gulf coast in Collier County, roughly 15 miles south of Naples. The park lies within the Southwest Florida Planning District, which includes Charlotte, Collier, Glades, Hendry, Lee and Sarasota County. According to the Florida Statistical Abstract 2002, the District is the fifth most populous and second fastest growing of the state's eleven planning districts, having grown nearly 33 percent since 1990 to more than 1.2 million residents. This growth rate exceeds the statewide district average of 23.5 percent. Lee County is the most populous, with nearly 37 percent of the total District population. However, Collier County is notable as the third fastest growing county in the state, having increased its population by over 65 percent since 1990 to better than 250,000 residents. Medium projections calculate an additional 23 percent growth in District population by 2010.

The closest incorporated area is Marco Island roughly five miles east, off County Road 92, with a 2000 population of nearly 15,000. A short drive north along the coast is the city of Naples, with roughly 21,000 residents. Extensive commercial and residential development occurs from the Naples area north to Lee County.

Existing Use of Adjacent Lands

The land surrounding Collier-Seminole State Park is at a low elevation and poorly suited to development. Much of the land around the park is within public ownership and managed for its natural resource and recreation value. Conservation lands in the area include Picayune State Forest, Fakahatchee Strand Preserve State Park, Ten Thousand Islands

National Wildlife Refuge, Everglades National Park, Cape Romano-Ten Thousand Islands Aquatic Preserve, Rookery Bay Aquatic Preserve and Rookery Bay National Estuarine Research Reserve. As a result, the park is not seriously threatened by encroaching development, although development activity associated with agricultural and residential uses, and road construction have impacted hydrology within the park, complicated prescribed burning efforts, and contributed to incidents of unauthorized use.

The park is fragmented into three pieces by U. S. Highway 41 and San Marco Drive (County Road 92). A small parcel of commercial property is located on the south side of the intersection of these two roads and a small Seminole Indian community is located on the north side of U. S. Highway 41. Agricultural lands are located along the northwestern boundary and are a permitted source of water discharge onto park lands. A residential golf course community has recently been constructed immediately west of this area. The Picayune State Forest manages a portion of lands along the north and northeastern boundary. Vacant private parcels associated with the defunct Golden Gate Estates land scheme are also located in this area, which is a source of unauthorized ATV access. A private parcel of land on the south side of U. S. Highway 41 at the northeast corner of the park supports an airboat tour business that has contributed to airboat use of park waters. The Ten Thousand Islands National Wildlife Refuge extends along the east, south and western boundaries. The Cape Romano-Ten Thousand Islands Aquatic Preserve includes the waters of Blackwater Bay, Palm Bay and the Gulf of Mexico to the south of the park.

The park employs a combination of monitoring, enforcement and education to mitigate the impacts from human uses of adjacent land. The park will work with adjacent landowners and the county to facilitate the use of prescribed fire, and seek ways to address problems associated with hydrology and unauthorized access of off-road vehicles and airboats. The park will also seek assistance from the Florida Park Patrol and local law enforcement and use signage and fencing as means to reduce illegal intrusions along the park boundary.

Planned Use of Adjacent Land

Much of the adjacent lands around the park are currently being managed for conservation purposes. However, residential development continues to creep from the Naples area toward the park along the U.S. Highway 41 corridor. Surrounding lands currently being used for agriculture may eventually be converted to residential development as the population of southwest Florida continues to grow.

The park is in the heart of a rapidly developing ecotourism destination. With large tracts of public land preserving open space ideally suited for a wilderness experience, it is anticipated that the number of visitors seeking resource-based recreation opportunities will continue to increase in the region.

PROPERTY ANALYSIS

Effective planning requires a thorough understanding of the unit's natural and cultural resources. This section describes the resource characteristics and existing uses of the property. The unit's recreation resource elements are examined to identify the opportunities and constraints they present for recreational development. Past and present uses are assessed for their effects on the property, compatibility with the site, and relation to the unit's classification.

Recreation Resource Elements

This section assesses the unit’s recreation resource elements those physical qualities that, either singly or in certain combinations, supports the various resource-based recreation activities. Breaking down the property into such elements provides a means for measuring the property's capability to support individual recreation activities. This process also analyzes the existing spatial factors that either favor or limit the provision of each activity.

Due to the extensive presence of wetlands, only a small area of the park is developed for recreational use, allowing visitors to experience Florida's natural heritage in an area virtually undisturbed by humans. Over 68 percent of the park is designated as a Wilderness Preserve designed to protect the primeval character and wilderness experience of a large, undisturbed area. Most of the property is an impenetrable tangle of mangrove swamps and marshes. The flat topography of the park is typical of coastal southwest Florida.

The park includes both tropical and temperate zones creating a unique community of flora. This is one of the few places in America where the royal palm occurs in its natural setting. Lush tropical hardwoods meet the swamps of the Big Cypress region at a forest of impressive mangroves. Marine tidal swamp is the predominant natural community in the park. These mangrove communities are highly productive and extremely vulnerable to human disturbance.

The most significant water body in the park is the Blackwater River. The freshwater flow from the headwaters of this small stream is seasonal and dries up during certain times of the year. As the Blackwater River travels south toward the Gulf of Mexico, its waters become brackish. Canoeing, boating and fishing are popular activities in the river.

The remote areas of the Wilderness Preserve offer habitat to numerous forms of wildlife including such rare and endangered species as the crocodile and manatee. The Florida panther may utilize portions of the park as part of its range. Bird species are abundant, and bald eagles, brown pelicans, wood storks and ospreys have all been seen in the park. The scrubby flatwoods support a small isolated population of gopher tortoises, one of Florida's threatened species. In the summertime, the park is almost uninhabitable due to high concentrations of mosquitoes.

Several historic objects available for public viewing at the park serve as recreation resources that help to interpret the park's role in national, state and local history. The Walking Dredge, Collier Monument, blockhouse with its interpretive displays, and the dugout canoe, all serve as attractions that help the visiting public appreciate the historic aspects of the region.

Assessment of Use

All legal boundaries, significant natural features, structures, facilities, roads, trails and easements existing in the unit are delineated on the base map (see Base Map). Specific uses made of the unit are briefly described in the following sections.

Past Uses

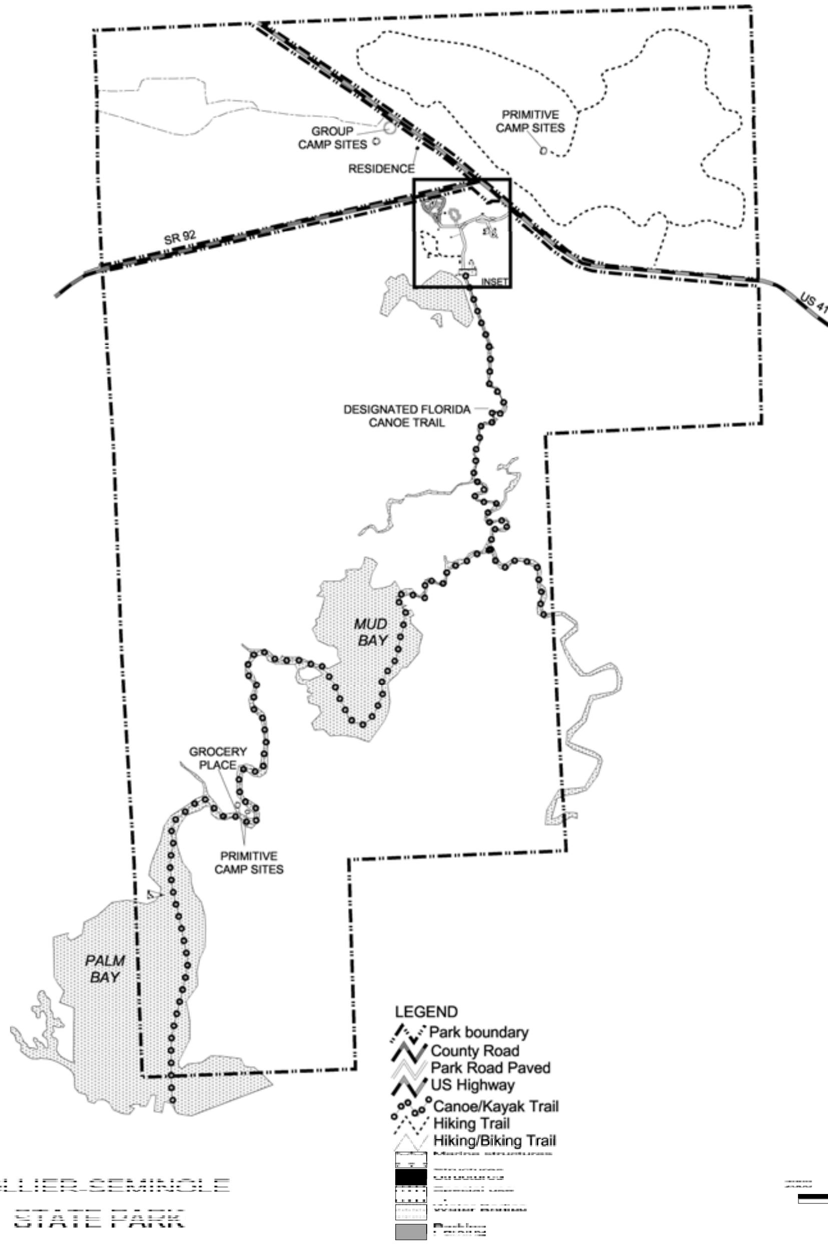
Before state acquisition, the majority of the land was owned by the Lee County Land Company, and much of the upland property was logged for pines.

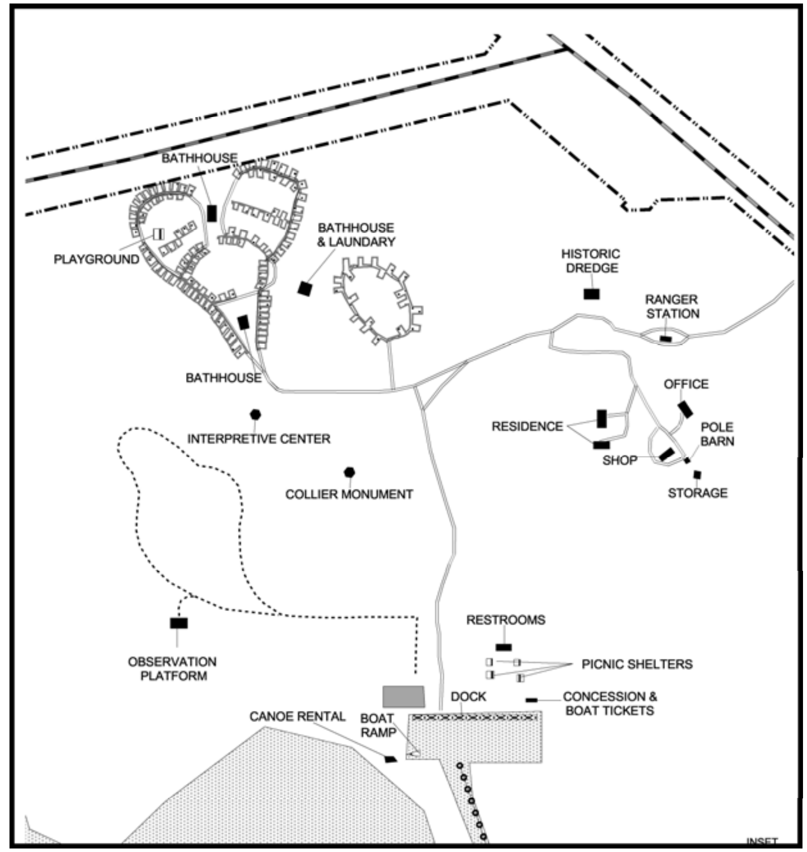
Recreational Uses

The existing forms of recreation at Collier-Seminole State Park include tent and RV camping, primitive camping, hiking, off-road biking, nature study, picnicking, fishing, canoeing/kayaking, and boating. A concessionaire operates boat tours into the wilderness preserve via the Blackwater River.

Protected Zones

A protected zone is an area of high sensitivity or outstanding character from which most types of development are excluded as a protective measure. Generally, facilities requiring extensive land alteration or resulting in intensive resource use, such as parking lots, camping areas, shops or maintenance areas, are not permitted in protected zones. Facilities with minimal resource impacts, such as trails, interpretive signs, and boardwalks are





COLLIER-SEMINOLE
STATE PARK

BASE MAP

generally allowed. All decisions involving the use of protected zones are made on a case-by-case basis after careful site planning and analysis.

At Collier-Seminole State Park the coastal berm, rockland hammock, marl prairie, slough, strand swamp, wet flatwoods, marine tidal marsh, marine tidal swamp, and marine unconsolidated substrate have been designated as protected zones as delineated on the Conceptual Land Use Plan. These lands comprise over 96 percent of the park.

Wilderness Preserves

Wilderness Preserve designations are reserved for large, undeveloped areas within a park that have retained their principal character and influence without permanent alteration. They are protected and managed in a manner to preserve the natural appeal and values of a significant portion of the park. The characteristics of a Wilderness Preserve are as follows:

- Generally appears to have been affected primarily by the forces of nature, with human impacts substantially unnoticeable;
- Offers outstanding opportunities for solitude, or a primitive and unconfined type of recreation;
- Is expansive and sufficient in size to make preservation and use in an unimpaired condition practical;
- May also contain ecological, archaeological, or other features of scientific, educational, scenic, or historic value.

Uses are to be limited, passive in nature, and related to the aesthetic, educational and scientific enjoyment of the features and conditions maintained. Other uses may be permitted if fully compatible. Activities that are generally recognized as being compatible within a Preserve are trail use, canoeing/kayaking, nature study and natural scenery appreciation. Facilities are limited to those considered essential for management and appropriate forms of public use.

Approximately 4,900 acres of creeks, rivers, tidal marsh and tidal swamp south of San Marco Road, U. S. Highway 41 and the boat basin have been designated as a Wilderness Preserve at Collier Seminole State Park.

Existing Facilities

Boat Basin and Picnic Area. The boat basin provides access to the Blackwater River for private boats, canoes/kayaks and a concession operated tour boat. A boat ramp and rental canoes are located on the east end of the basin. The basin is partially enclosed with a seawall and has a wooden loading dock along the north side. The seawall and dock are showing signs of wear and do not meet universal accessibility requirements. A concession building is located north of the basin, along its midpoint, at the edge of the picnic area. In addition to scheduling boat tours, visitors can purchase snack foods, soft drinks, T-shirts, and souvenirs at this facility. The picnic area contains four small, aging, chickee-style picnic shelters, a restroom, scattered tables and grills and dated playground equipment. A paved parking lot is located between the boat basin and the picnic area, serving both uses. The parking lot contains 71 standard, 13 oversize and four handicapped parking spaces. The trailhead for the Royal Palm Hammock Trail is located at the west end of the parking lot.

Camping. The campground contains 156 sites, 19 of which are for tent camping only. A portion of the RV sites does not have electric service. The campgrounds include two bathhouses, dump station, and screened activity room with restrooms, fireplace, fans and a small concession. A primitive group camp is located north of San Marco Road with facilities limited to privies. Primitive camping is also available along Royal Palm Hammock Creek and the hiking trail north of U. S. Highway 41. The former site is only accessible by canoe or kayak.

Trails and interpretation. A well-marked canoe trail extends for approximately 13 miles along the Blackwater River, Mud Bay and Royal Palm Creek. Trail markers are provided so that inexperienced paddlers do not get lost in the vast mangrove forest. The Royal Palm Hammock nature trail begins at the boat basin parking lot and forms a partial loop through the park's exceptional Rockland Hammock, ending at an observation platform that provides wildlife viewing opportunities over a tidal marsh. The boardwalk portion of the trail is nearly 1,900 feet long and in poor condition. The northeast section of the park contains a 6.5-mile hiking trail through the prairie, pine flatwoods and alongside strand swamp. The northwest corner of the park contains approximately 5.5-mile shared-use trail for hiking and off-road biking, and a primitive group camp.

Cultural resource interpretation is enhanced at the park by several features. The Bay City Walking Dredge is located near the entrance to the park and was used in the construction of the Tamiami Trail. A short distance further along the park drive is the Barron Collier Memorial, which includes a small monument and lawn. The lawn area supports park special events, such as the annual Native American Heritage Festival. A prehistoric wooden canoe is housed in an open-air display case adjacent to the memorial. A replica of a 1830s era military blockhouse is located near the campground and serves as a small interpretive center.

Support facilities. Park residences and shop facilities are located just south of the entrance station.

The following is a listing of existing facilities at Collier-Seminole State Park (see Base Map).

Boat Basin and Picnic Area
Concession building
Boat dock
Boat ramp
Paved parking (71 spaces)
Small picnic shelters (4)
Scattered tables and grills
Playground equipment
Canoe/kayak storage
Interpretive signs (2)
Restrooms

Camping
Standard campground (156 sites)
 Screened activity room
 Bathhouses (2)
Primitive campsites (2 locations)
Primitive Group Camp
 Privies (2)

Trails and Interpretation
Canoe trail (13 miles)
Royal Palm Hammock Nature Trail (.5 mi)
Boardwalk and overlook
Hiking trail (6.5 miles)
Shared-use trail (5.5 miles)
Blockhouse Interpretive Center
Paved parking (6 spaces)
Bay City Walking Dredge
Barron Collier Memorial
Paved parking (4 spaces)
Prehistoric canoe

Support Facilities
Entrance station
Residences (2)
Volunteer host sites (8)
Two bay garage
Three bay shop
Pole barn
Office/storage trailer
Storage shed
Flammable storage building

CONCEPTUAL LAND USE PLAN

The following narrative represents the current conceptual land use proposal for this park. As new information is provided regarding the environment of the park, cultural resources, recreational use, and as new land is acquired, the conceptual land use plan may be amended to address the new conditions (see Conceptual Land Use Plan). A detailed development plan for the park and a site plan for specific facilities will be developed based on this conceptual land use plan, as funding becomes available.

During the development of the unit management plan, the Division assesses potential impacts of proposed uses on the resources of the property. Uses that could result in unacceptable impacts are not included in the conceptual land use plan. Potential impacts are more thoroughly identified and assessed through the site planning process once funding is available for the development project. At that stage, design elements, such as sewage disposal and stormwater management, and design constraints, such as designated species or cultural site locations, are more thoroughly investigated. Advanced wastewater treatment or best available technology systems are applied for on-site sewage disposal. Stormwater management systems are designed to minimize impervious surfaces to the greatest extent feasible, and all facilities are designed and constructed using best management practices to avoid impacts and to mitigate those that cannot be avoided. Federal, state and local permit and regulatory requirements are met by the final design of the projects. This includes the design of all new park facilities consistent with the universal access requirements of the Americans with Disabilities Act (ADA). After new facilities are constructed, the park staff monitors conditions to ensure that impacts remain within acceptable levels.

Potential Uses and Proposed Facilities

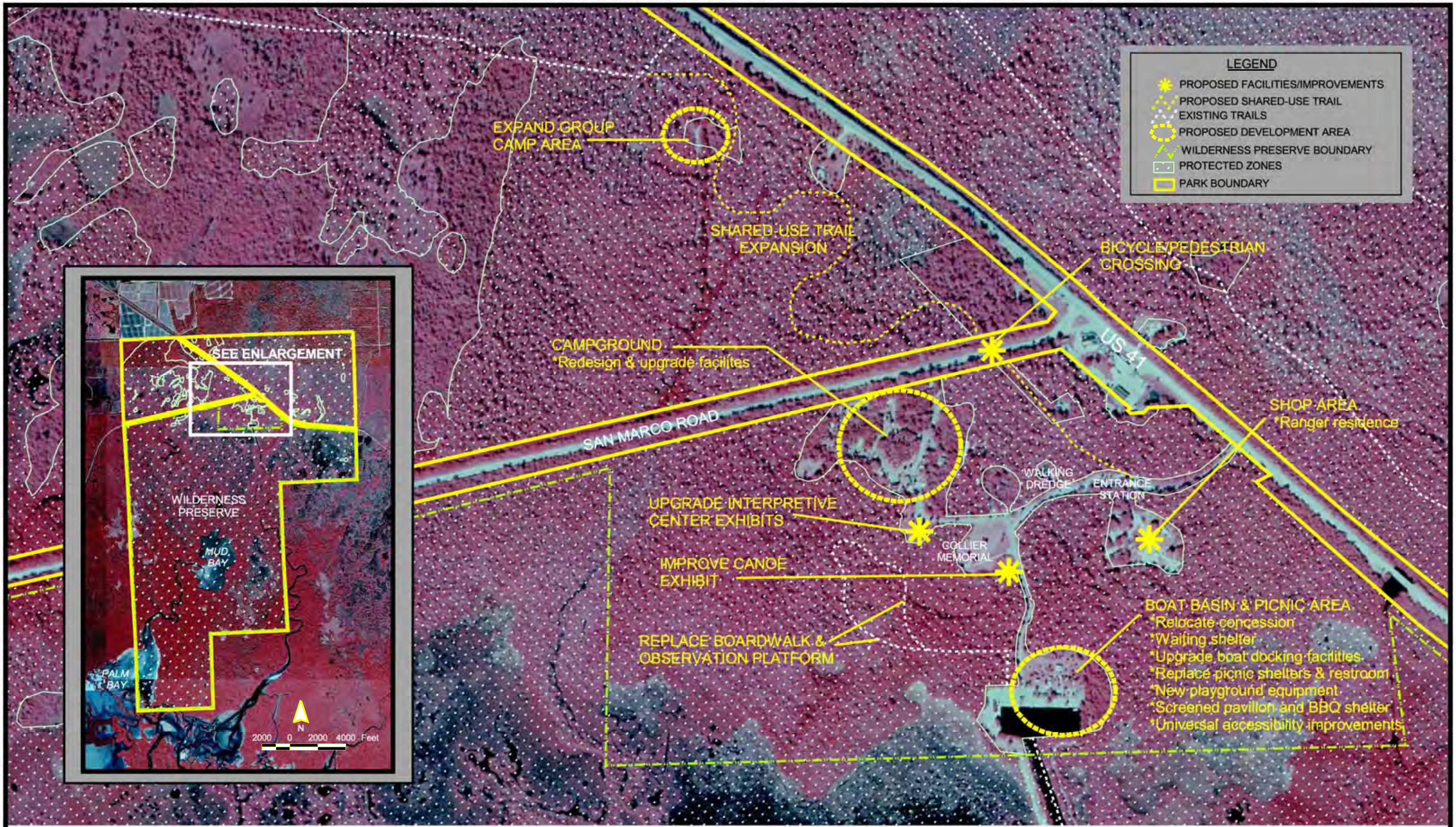
Existing recreational uses are appropriate and should be continued. Many of the facilities at Collier-Seminole were constructed many years ago and are showing their age. The current plan focuses primarily on replacing and/or upgrading and improving existing facilities as opposed to establishing new use areas. The following narrative discusses proposed improvements to interpretive, camping, trail and support facilities.

Boat Basin and Picnic Area. The existing location of the concession building encourages pedestrian traffic through the parking area, and obstructs views of the boat basin from the picnic area. It is recommended that this structure be removed and a new concession area be established on the eastern side of the boat basin in an existing disturbed area. Relocating the concession will also allow for an expansion of concession services in the future. A screened tour boat waiting shelter is recommended as part of a new concession facility. Interpretive signage should be incorporated into the design of this project to take advantage of the visitors concentrated in this area.

The existing boat dock and retaining wall need to be evaluated for improvements necessary to facilitate universal access, address existing maintenance needs, and allow for efficient organization of private boats that enter the basin. The conversion of the existing dock to a floating dock system is desirable to facilitate boat loading and unloading during different tidal stages.

The existing shelters, restrooms and playground in the picnic area are proposed for replacement.

A large screened pavilion with a barbecue pit is proposed in this area to accommodate group meetings and picnics during times when biting insects are a problem. The existing network of sidewalks should be expanded to provide universal access to all facilities and to



COLLIER-SEMINOLE STATE PARK

PREPARED BY: FL
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF RECREATION AND PARKS
OFFICE OF PARK PLANNING

CONCEPTUAL LAND USE PLAN

link the picnic area to the new concession location.

Camping. A partial redesign and upgrade of the main campground is recommended to better accommodate larger recreation vehicles, provide buffering between the dump station, trash dumpsters, campsites, and facilities that meet current park service standards. A portion of sites may need to be removed or combined to create a limited number of larger sites and the space necessary to relocate or adequately buffer waste disposal facilities. Existing bathhouses are quite old and in need of renovation or replacement, and electrical service is recommended to be extended to all sites. Improvements should be made within the existing footprint of the campground, if possible. Additional clearing, if necessary, will be limited to surrounding disturbed areas and will not impact the adjacent tropical hammock.

The group camp is proposed for limited expansion as exotic vegetation is removed around the site.

Trails and Interpretation. To provide for an organized, comprehensive approach to interpretive programming it is recommended that a statement for interpretation be developed for the park. The statement will identify the primary thematic elements for interpretation and provide a foundation for proposed interpretive improvements.

The Royal Palm Hammock Nature Trail boardwalk was constructed in the 1980s. It is in poor condition and needs to be replaced. Interpretive signage is recommended along the trail to educate users about the unique tropical hammock community.

Recommended improvements for the shared-use trail include trail directional signage, interpretive signage aimed at educating users about the historic significance of Marco Road and an expansion of the trail to link with the main area of the park. The proposed expansion would extend south from the existing trail near its juncture with U. S. Highway 41, weaving through ruderal areas and tropical hammock towards San Marco Road. Recent acquisition of property near the intersection of San Marco Road and U. S. Highway 41 provides an opportunity to link these two areas. The design and layout of this trail connection will consider potential impacts to sensitive resources and may require the use of boardwalks to traverse wet areas. The Division will coordinate the placement of signage and pavement striping with the county to provide a safe crossing of San Marco Road.

There is the potential to provide a trail connection between the park and trails planned on the adjacent Picayune Strand State Forest. It is recommended that the Division of Recreation and Parks and the Division of Forestry coordinate trail planning efforts to provide this linkage. Additional coordination will be necessary with the Department of Transportation to provide a safe crossing of U. S. Highway 41 when the opportunity exists to connect the state park and state forest trails.

Collier County and Marco Island are also interested in providing trail connections between population centers and existing conservation lands. County has expressed interest in Collier-Seminole State Park serving as an important destination and jumping off point within this trail network. While the Division supports local trail planning initiatives, specific proposals for trailheads and trail connections will need to be evaluated by staff to consider impacts to visitor circulation and access, park resources and operations before they are implemented at the park. The Division is committed to working with local governments, and trail user groups to develop a system of trails that encourages safe bicycle and pedestrian access to the state park and other conservation lands.

The existing exhibits in the park interpretive center have served an important role in educating visitors about the natural and cultural resources of the park for over 30 years. It is recommended that the exhibits be replaced with ones that reflect modern standards of interpretation.

The wooden canoe is in a low-visibility location that is not conducive to interpretation. This artifact was recovered from a location off-site and moved to the park for display. A determination is needed whether to continue displaying it at the park or to search for a more appropriate setting. If it is to be maintained at the park, consideration should be given to relocating this artifact where visitors are more likely to see it, providing interpretive signage and replacing the display case. Possible locations include the interpretive center or the boat basin.

Wilderness Preserve. The wilderness preserve provides a unique opportunity for visitors to leave behind most traces of human activity and achieve a real feeling of isolation and solitude. High-speed boat traffic on the Blackwater River poses a potential threat to not only this experience but also visitor health and safety and sensitive resources. It is also recognized that boating access to park waters will only increase in the future. In order to address these concerns and preserve the integrity of the visitor experience in this remote area of the park, it is recommended that the stretch of Blackwater River within the park boundary be designated a minimum wake zone. Signage will be posted within the boat basin and the point where the river leaves the park to educate boaters to the change in boat speed.

Support Facilities

The park needs an additional ranger residence to meet staff housing needs. This facility will be located within the existing shop and residence compound.

The spray field for the park sewage treatment plant does not function properly during the wet season when much of the park is flooded. The capacity of the existing system is also strained to handle the loads generated by peak season use. Unfortunately, the extensive presence of wetlands at the park does not provide another suitable location for the spray field a practical distance from the plant. Ideally, park facilities should be connected to central sewer lines when they are extended near the park. Currently, the nearest sewer lines are located over two miles to the north.

Facilities Development

Preliminary cost estimates for the following list of proposed facilities are provided in Addendum 6 and are based on the most cost-effective construction standards available at this time. The preliminary estimates are provided to assist the Division in budgeting future park improvements, and may be revised as more information is collected through the planning and design processes.

Boat Basin and Picnic Area
Relocate concession
Tour boat waiting shelter
Boat dock improvements
Replace picnic shelters (4)
Replace picnic restroom
Replace playground equipment
Screened pavilion and BBQ pit
Universally accessible walkways

Camping
Redesign/upgrade main campground

Trails and Interpretation
Royal Palm Hammock Nature Trail
 Replace boardwalk
 Interpretive signage
Shared-use trail expansion
 Link to main use area
 Trail directional signage
 Interpretive signage
 Pedestrian crossing
Upgrade interpretive center exhibits
Canoe exhibit improvements

Wilderness Preserve
Post minimum wake zone signage

Support Facilities
Ranger residence

Existing Use and Optimum Carrying Capacity

Carrying capacity is an estimate of the number of users a recreation resource or facility can accommodate and still provide a high quality recreational experience and preserve the natural values of the site. The carrying capacity of a unit is determined by identifying the land and water requirements for each recreation activity at the unit, and then applying these requirements to the unit's land and water base. Next, guidelines are applied which estimate the physical capacity of the unit's natural communities to withstand recreational uses without significant degradation. This analysis identifies a range within which the carrying capacity most appropriate to the specific activity, the activity site, and the unit's classification is selected (see Table 1).

The optimum carrying capacity for this park is a preliminary estimate of the number of users the unit could accommodate after the current conceptual development program has been implemented. When developed, the proposed new facilities would approximately increase the unit's carrying capacity as shown in Table 1.

Table 1-- Existing Use And Optimum Carrying Capacity

	Existing Capacity		Proposed Additional Capacity		Estimated Optimum Capacity	
Activity/Facility	**One Time**	**Daily**	**One Time**	**Daily**	**One Time**	**Daily**
Trails						
Shared Use	55	220	10	40	65	260
Nature	70	140			70	140
Picnicking	36	72	40	80	76	152
Camping						
Developed	624	624			624	624
Group Camp	30	30	20	20	50	50
Primitive	20	20			20	20
Interpretive Center	10	40			10	40
Tour Boat	40	160			40	160
***Wilderness Preserve**	90	90			90	90
TOTAL	**925**	**1,396**	**70**	**140**	**995**	**1,536**

*** Wilderness Preserve capacity based on canoe/kayak access of 30 boats per day.**

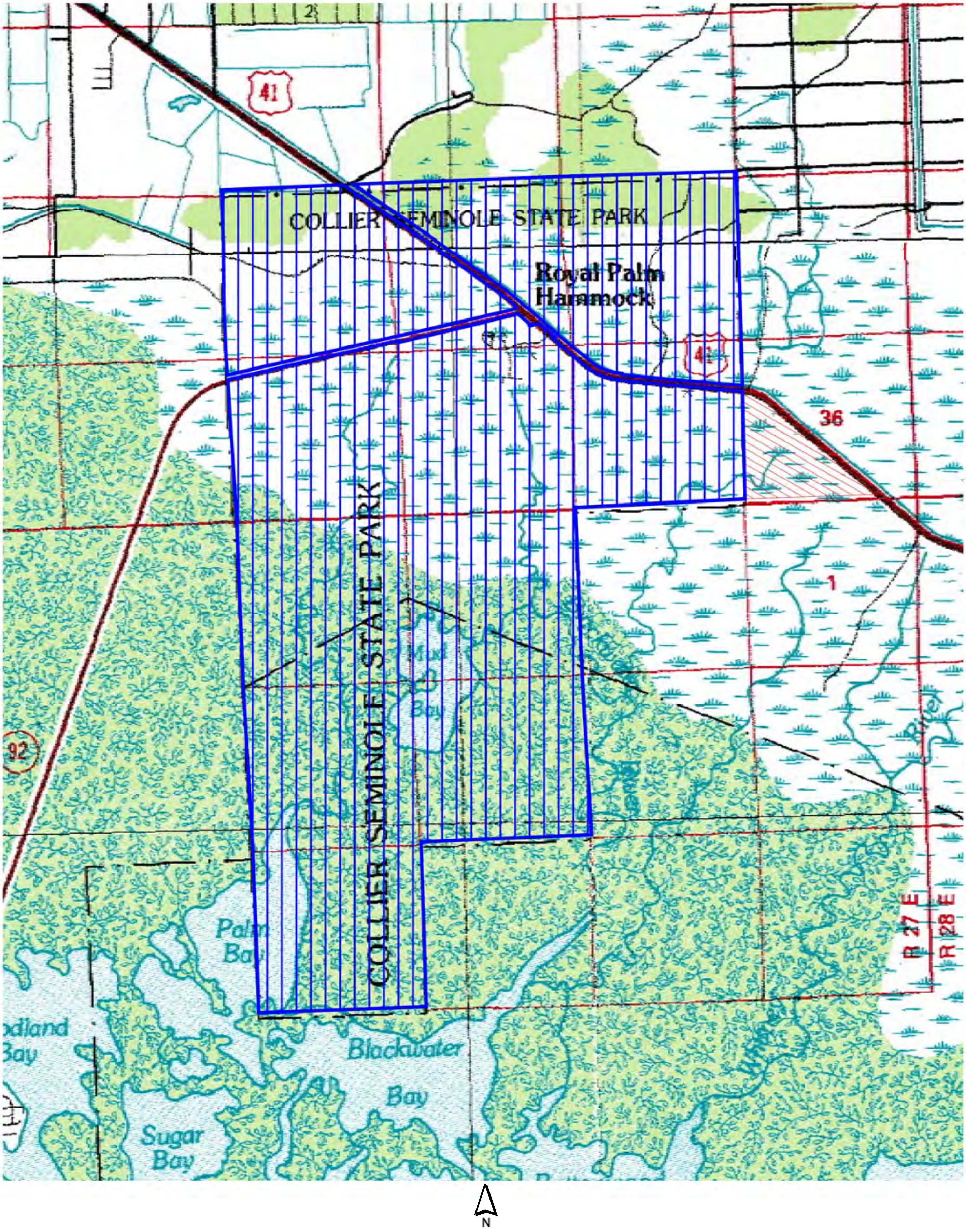
Optimum Boundary

As additional needs are identified through park use, development, research, and as adjacent land uses change on private properties, modification of the unit's optimum boundary may occur for the enhancement of natural and cultural resources, recreational values and management efficiency.

Identification of lands on the optimum boundary map is solely for planning purposes and not for regulatory purposes. A property's identification on the optimum boundary map is not for use by any party or other government body to reduce or restrict the lawful right of private landowners. Identification on the map does not empower or require any government entity to impose additional or more restrictive environmental land use or zoning regulations. Identification is not to be used as the basis for permit denial or the imposition of permit conditions.

The optimum boundary map reflects lands identified for direct management by the Division as part of the park. These parcels may include public as well as privately owned lands that improve the continuity of existing park lands, provide additional natural and cultural resource protection, and/or allow for future expansion of recreational activities.

Acquisition of the identified parcel would assist with management control of airboat access into park waters. At this time, no lands are considered surplus to the needs of the park.



COLLIER-SEMINOLE STATE PARK

Florida Department of Environmental Protection
Division of Recreation and Parks
Office of Park Planning

OPTIMUN BOUNDARY MAP

Addendum 1—Acquisition History and Advisory Group Documentation

Purpose and Sequence of Acquisition

The State of Florida acquired Collier-Seminole State Park to develop, operate and maintain the property for outdoor recreation, park, conservation, historic, and related purposes.

On March 8, 1944, the State of Florida, obtained title to the property constituting the initial area of Collier-Seminole State Park. Lee County Land Company donated the property to the state. Since this initial donation, several additional parcels under a perpetual lease and the P2000/A and I land acquisition program have been acquired.

On January 23, 1967, the Division of Recreation and Parks (Division), transferred and conveyed its title to Collier-Seminole State Park to the Board of Trustess of the Internal Improvement Trust Fund (Trustees). On January 23, 1968, the Trustees conveyed its management authority of Collier-Seminole State Park to the Division under Lease No. 2324. The lease is for a period of ninety-nine (99) years and will expire on January 23, 2067. In 1988, the Division of State Lands, Bureau of Uplands Management, assigned a new lease number, Lease No. 3612, to Collier-Seminole State Park without changing any of the terms and conditions of Lease No. 2324.

According to this lease, the Division manages the property only for the conservation and protection of natural, historical, and cultural resources and for resource-based public outdoor recreation compatible with the conservation and protection of the property.

Title Interest

The Trustees hold fee simple title to Collier-Seminole State Park.

Special Conditions on Use

Collier-Seminole State Park is designated single-use to provide resource-based public outdoor recreation and other park related uses. Uses such as water resource development projects, water supply projects, storm-water management projects, and linear facilities and sustainable agriculture and forestry (other than those forest management activities specifically identified in the unit management plan of this park) are not consistent with the management purposes of the park.

Outstanding Reservations

Following is a listing of outstanding rights, reservations, and encumbrances that apply to Collier-Seminole State Park

Instrument:	Easement
Instrument holder:	Division
Beginning date:	November 24, 1975
Ending date:	Coterminous with Lease No. 3612
Outstanding rights, uses, etc.:	The easement allows Lee County Electric Cooperative, Inc. to construct, install, operate and maintain a single-phase distribution system for the transmission and distribution of electricity.

Instrument:	Easement
Instrument holder:	Division
Beginning date:	January 28, 1974
Ending date:	Coterminous with Lease No. 3612
Outstanding rights, uses, etc.:	The easement grants a road right-of- way to Seminole County across a specified portion of the subject property.

Instrument:	Easement
Instrument holder:	FBPHM
Beginning date:	March 29, 1954
Ending date:	when the state ceases to own the subject property
Outstanding rights, uses, etc.:	The easement allows Lee County Electric Cooperative, Inc. to construct, install, operate and maintain a line or lines for the transmission of electrical power.

Instrument:	Warranty Deed
Instrument holder:	Lee County
Beginning date:	March 8, 1944
Ending date:	Forever
Outstanding rights, uses, etc.:	The property shall be used only as part of Collier-Seminole State Park and maintained wholly by state of Florida.

The Honorable James N. Coletta, Jr., Chair
Collier County Board of County Commissioners
3301 East Tamiami Trail
Naples, Florida 34112

Joe Howard, Park Manager
Collier-Seminole State Park
20200 East Tamiami Trail
Naples, Florida 34114

Mike Ramsey, Chair
Collier Soil and Water Conservation District
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Naples, Florida 34120

Ms. Sonja Durrwacher, Manager
Picayune Strand State Forest
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Naples, Florida 34120

Mr. Steve Coughlin, Regional Biologist
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Lane Hamilton, Refuge Manager
Florida Panther and Ten Thousand Islands National Wildlife Refuges
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Don Bottomley, Chapter Chair
Florida Trail Association
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Kristen Smith, President
Earth Outfitters
1968 Tamiami Trail
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Brian Zepeda, Operations Manager
Ah-tah-Thi-Ki Museum
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Mr. Bobby Clay
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Charles Hannsz, President
Friends of Collier-Seminole State Park
Post Office Box 745
Richmond, Missouri 64085

The Advisory Group appointed to review the proposed land management plan for Collier-Seminole State Park met at the Rookery Bay National Estuarine Research Reserve on May 2, 2003. Judy Haner represented Gary Lytton. Chip Bilbrey, Mike Ramsey, Sandi Trapasso, Bobbie Lee Hasty, Kristen Smith, Bobby Clay and Charles Hannsz did not attend the meeting. All other appointed Advisory Group members or their representatives were present. The meeting was also attended by Marla Ramsey (Collier County Parks and Recreation), Tessie Sillery (Collier County Alternative Transportation Modes), and Beth Kelso (FTA). Attending staff were Robert Wilhelm, Ken Alvarez, Joe Howard, and Michael Kinnison.

Mr. Kinnison began the meeting by explaining the purpose of the advisory group and reviewing the meeting agenda and format. He also provided a brief overview of the Division's planning process and summarized public comments received during the previous evening's public workshop. He then asked each member of the advisory group to express his or her comments on the plan. Additional comments were provided by other attendees and are included in the summary below.

Summary Of Advisory Group Comments

Commissioner Coletta stated that he was very interested in maintaining public access for a variety of different interests and uses, and cited area beaches as an example of diminishing public access. He acknowledged the need to balance access with resource protection and encouraged the park to consider expanding recreational uses.

Marla Ramsey discussed the importance of forming partnerships and the untapped opportunities that exist to promote the park locally. She indicated that the park's campground was one of only a few in Collier County and supported its enhancement and expansion, if possible. She also would like to see more promotion of water access opportunities at the park. **Mr. Wilhelm** discussed park visitation patterns, which are seasonal and on the low side compared to other parks in the District. **Commissioner Coletta** asked why visitation has not kept pace with population growth. **Mr. Howard** discussed the need to let potential visitors know about all the opportunities at the park, and the challenge of bringing local residents back for repeat visits. **Commissioner Coletta** suggested working with the County to be included in promotional brochures and the local government channel. **Beth Kelso** suggested networking with the Visitor and Convention Bureau. **Ms. Ramsey** indicated that Marco Island residents were very interested in establishing a bike trail along CR 92 that would connect with SR 41 that could provide a connection to the park. **Mr. Kinnison** discussed plans for expanding the park's existing bike trail with a crossing of CR 92 and encouraged coordinating local plans with the park so that operational issues can be properly addressed with regard to trail connections. A discussion followed focusing on the idea of Collier-Seminole as a jumping off point for trails to Everglades City and other public lands. **Sonja Durrwacher** stated that the U.S. Army Corps of Engineers were planning to put in a berm parallel to Miller Boulevard that could provide a dual function as a trail connection to Picayune Strand State Forest.

Candice Tinkler described the park as a local jewel that, while not currently well linked to other public lands and their visitors, has great potential for increased interpretation and recreation opportunities. She discussed the possibility of a backcountry water-based connection between the park and the Marco Island area. She stated that visitors to Everglades National Park are always looking for additional hiking and biking experiences that Collier-Seminole could provide. She agreed with earlier comments regarding the need for improved local promotion. She discussed the staffing challenges all land managers face and the potential for personnel from different parks to support each other. **Layne Hamilton** recommended coordinating education programs.

John Donahue expressed approval of the plan and its content. He echoed previous comments regarding public access, resource protection and the need for maintaining and upgrading facilities.

He emphasized the importance of a regional approach to recreation planning and resource management that involved a coordinated effort between different land managers. He discussed how individual parks cannot provide all possible recreational opportunities and certain uses are more appropriate than others at any given location. While he indicated that this type of coordination occurred on an informal basis, he felt it important to acknowledge the need to bolster within the plan. He discussed the concept of life cycle costing of park facilities, stressed the need to embrace the concept of sustainability in all park activities, and the importance of letting the public know of these efforts. He touched on the tremendous opportunities for partnering with other agencies on the use of prescribed fire, historic preservation, and environmental leadership and the tendency of large agencies to overlook smaller parks when allocating resources. He suggested that with enough resources Collier-Seminole could be a model for comprehensively cataloguing a park's flora and fauna. He explained that a multi-agency visitor center was being planned on SR 41 and invited Collier-Seminole State Park to participate as a means to encourage visitation. He talked about the Everglades heritage trail concept that involves a scenic driving tour with kiosks at key locations and the potential to work with the county to expand stops along the trail. **Mr. Kinnison** and **Mr. Wilhelm** indicated that kiosks were currently in place at Collier-Seminole and Fakahatchee Strand Preserve.

Judy Haner stated that the new Rookery Bay nature center would provide an opportunity to showcase all agencies and the lands they manage. She expressed support for Mr. Donahue's call for more coordinated planning. She encouraged the park to be innovative and a leader in environmental design when building facilities. She discussed how changing land uses were impacting the area's watershed and indicated that the Reserve was advocating for more increased environmental monitoring. She discussed the need for a coordinated involvement of all land managers in monitoring land use changes and regional restoration projects, such as the Everglades, and warned of current plans that call for increasing hydroperiods with culverts along 41 that could effect park hydrology. She also expressed interest in coordinating efforts to protect and manage cultural resources and explained the Reserve's plans for acquiring new land. She explained that this area contained an old railbed that would be researched for its cultural significance and recreation opportunities. **Mr. Alvarez** supported the concept of increased interagency coordination, particularly with regard to hydrology and burning. **Ms. Haner** also suggested that land managers were more likely to be able to enlist the assistance of the interagency fire team if managers coordinated their burning needs.

Brian Zepeda asked how increasing access and visitation may impact park resources. **Commissioner Coletta** responded that most visitors stay within the easily accessible areas at the park and that it is important that the resource be made available to everybody. **Mr. Alvarez** added that existing levels of access have a very low impact on resources, and that exotics, hydrological alteration and past fire suppression are of more concern. **Ms. Kelso** stated that all points in the park do not have to be made accessible in the same way. **Ms. Hamilton** responded that agencies are obligated to comply with the requirements of the Americans with Disabilities Act (ADA). **Mr. Kinnison** responded that the Division of Recreation and Parks (DRP) constructs new facilities to meet ADA standards. He added that regulations regarding the provision of universal access for outdoor recreation facilities have not been finalized so agencies are not clear on exactly what is required. **Ms. Haner** responded that cost is an important factor in decisions to construct facilities that are universally accessible. **Mr. Zepeda** stated that visitors to the museum were often interested in other sites to visit. He asked if the park could handle large groups of children. **Mr. Howard** explained that the park's tour boat can accommodate 30 at one time, every 1.5 hours during the season. He indicated that coordination would be needed with the park concessionaire to handle large groups. **Mr. Zepeda** also offered the assistance of the museum's archaeological expertise.

Sonja Durwaccher discussed the difficulty in conducting annual burns as suggested in the plan.

She supported the goal of summer burning but recommended burning whenever conditions permit since it is hard to control smoke in the summer. She raised the issue of sharing burn equipment between agencies and discussed the problems staff turnover has presented to the Division of Forestry's burn program at Picayune Strand State Forest. **Ms. Haner** indicated that the Reserve would support the sharing of agency resources to improve burning opportunities. **Ms. Durwaccher** explained that the U.S. Army Corps is the lead agency on restoration within the state forest. She supported earlier calls for interagency involvement in Corps restoration plans and verified that current plans appear to reduce water flow to Collier-Seminole. She added that the State Forest contains four active red-cockaded woodpecker clusters and that the birds may utilize lands within Collier-Seminole in the future. **Mr. Alvarez** responded that most burnable areas have fine fuels and are possible to burn annually. He indicated that moisture is more of a factor than fuel loads and stated that burns are conducted whenever the opportunity presents itself.

Tess Sillery stated that she was interested in working with the park in terms of trail planning. She felt that trail linkages with the park would help promote the park locally and increase visitation. **Commissioner Coleta** added that local speakers bureaus, the Tourism Development Council and a friends of the park volunteer group could also help with local promotion efforts. **Mr. Kinnison** explained that the park currently has a Citizen Support Organization.

Layne Hamilton stated that the current draft plan was well written and informative. She discussed plans for trail improvements and an observation tower at the National Wildlife Refuge and the challenges of finding sufficient uplands for parking. She expressed a need for partnerships due to limited staffing at the Refuge, and echoed the concept presented by others about coordinating planning efforts. **Mr. Wilhlem** discussed the Division's use of outsourcing to bolster staff resources. **Ms. Haner** responded that outsourcing does not always provide a better or cheaper service. **Ms. Tinkler** asked if a fee was required on the park's hiking trail. **Mr. Howard** explained that visitors are expected to check in and pay at the entrance station to gain access to park trails. He added that compliance is better on the hiking trail since access is controlled by a gate.

Roger Rose stated that the Florida Trail Association (FTA) is involved with building and maintaining over 1,200 miles of trails statewide and that the local chapter is relatively new, with a focus on developing and maintaining Collier County trails. He discussed FTA involvement with the park's hiking trail and the recent construction of a trail bridge. He presented a long-term vision of connecting trails from Collier-Seminole State Park through the Picayune Strand, Fakahatchee Strand and on to Big Cypress and the Florida National Scenic Trail. He added that volunteers also assist with removing exotic plants along the park's hiking trail corridor. Mr. Rose indicated that the local group is helping promote the park through media interviews, and FTA literature. He emphasized that the park needs volunteer support and suggested that FTA volunteers may be able to assist other land managers with trail projects.

Beth Kelso was pleased to see such a high level of interagency cooperation. She encouraged outreach to non-traditional groups, such as new moms, schools and gated communities. She emphasized the importance of linking promotional efforts with the travel industry and using special events to bring people to the park.

Ted Below stated that he has reviewed many different management plans and generally approved of this one. He was concerned about human impacts to park resources and wished that this issue was more of a concern for the group. He recommended banning motorized boats, particularly personal watercraft, from park waters and indicated he had seen personal watercraft in the more remote areas of the park. **Mr. Alvarez** responded that while personal watercraft are a problem in state parks their exclusion is difficult to enforce. **Mr. Howard** added that current operation of personal watercraft within the park is sporadic. **Ms. Haner** stated that local eco-tour operators are now providing personal watercraft tours to the 10,0000 Islands area. **Mr. Alvarez** emphasized that any regulation of motorized boating would require inter-agency cooperation to enforce and implement effectively. **Commissioner Coleta** emphasized that limiting watercraft would need to be supported by evidence that they were having undesirable impacts. He added that unwanted public exposure on the issue could generate additional boating traffic in the area. **Ms. Haner** discussed the Reserve's experience with boats and stated that additional study was needed to quantify impacts from personal watercraft. **Ms. Tinkler** added that agencies needed to consider where other opportunities were available before prohibiting a user activity. She pointed out that personal watercraft present public safety issues in addition to environmental ones. **Mr. Donahue** added that the noise from personal watercraft affects the experience of other visitors. **Commissioner Coleta** suggested that it might be possible to provide designated routes for watercraft instead of prohibiting their use. **Mr. Below** also recommended removing reference to annual burning in the plan goals and objectives. He pointed out that the plan made no reference to follow up treatment of exotic plants and emphasized that stopping the seed source was critical to successfully removing invasive exotics. **Mr. Alvarez** clarified that while it may not be clearly stated in the plan, staff understand the importance of follow up treatment when removing exotic plants.

Joe Howard discussed the challenge of enforcing a regulation that would prohibit only one type of watercraft. He expressed appreciation for all the agency and public support provided to the park and specifically mentioned DOF assistance with burning.

Ms. Tinkler asked if the park's Statement for Interpretation had been completed. **Mr. Kinnison** indicated that he did not believe it was complete.

The meeting was then adjourned.

It should be noted that on more than one occasion, at both the advisory group and previous evening's public workshop, complementary statements were made regarding the cooperative attitude and management performance of Mr. Howard and his staff at Collier-Seminole State Park.

Staff Recommendation

Staff recommends approval of the proposed management plan for Collier-Seminole State Park as presented with the following recommendations.

Park Promotion

- Promoting state parks is largely the responsibility of the Division's marketing section. However, it is acknowledged that much can be done to help promote the park at the local level. An objective will be added to the plan that acknowledges the importance of networking with local institutions in actively promoting Collier-Seminole State Park throughout Collier County.

Coordinated Planning

- The Division agrees that coordinating planning efforts and monitoring of land use changes would benefit all area land managers. Language will be added to the plan that indicates Division support for inter-agency cooperation in resource management, recreation planning and environmental monitoring.

Personal Watercraft

- Staff do not feel that the current level of use of personal watercraft warrants prohibiting this type of activity. However, it is acknowledged that boating access to park waters will only increase in the future and that high speed motorized boat traffic is not appropriate in the park's Wilderness Preserve. Language will be added to the plan that recommends designating the stretch of Blackwater River within the park boundary as a no wake zone to protect public health and safety, marine resources and maintain a quality visitor experience for other users.

Local Trail Planning Efforts

- The Division supports local greenways planning initiatives. Language will be added to the plan that discusses Collier County trail planning efforts, the need for coordination with public land managing agencies and the potential to link with Collier-Seminole State Park.

Addendum 2—References Cited

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Addendum 3—Soils Description

(2) Holopaw fine sand, limestone substratum. This nearly level, poorly drained soil is in sloughs and broad, poorly defined drainageways. Individual areas are elongated and irregular in shape, and they range from 20 to 300 acres in size. The slope is 0 to 2 percent.

Typically, the surface layer is dark gray fine sand about 5 inches thick. The subsurface layer is fine sand to a depth of about 57 inches. The upper part of the subsurface layer is white, and the lower part is light gray and dark grayish brown. The subsoil extends to a depth of about 62 inches. It is dark grayish brown fine sandy loam. Limestone bedrock is at a depth of about 62 inches.

In 95 percent of the areas mapped as Holopaw fine sand, limestone substratum, Holopaw and similar soils make up 78 to 97 percent of the map unit. In the remaining areas, the Holopaw soil makes up either a higher or lower percentage of the mapped areas. The characteristics of Malabar, Pineda, and Riviera soils that have a limestone substratum are similar to those of the Holopaw soil.

The dissimilar soils in this map unit are small areas of Basinger, Boca, and Chobee soils in landscape positions similar to those of the Holopaw soil. These soils make up about 3 to 22 percent of the unit.

The permeability of this soil is moderate to moderately slow. The available water capacity is low. Under natural conditions, the seasonal high water table is within a depth of 12 inches for 3 to 6 months during most years. During the other months, the water table is below a depth of 12 inches, and it recedes to a depth of more than 40 inches during extended dry periods. During periods of high rainfall, the soil is covered by shallow, slowly moving water for about 7 days.

The natural vegetation consists of scattered areas of South Florida slash pine, cypress, cabbage palm, saw palmetto, waxmyrtle, sand cordgrass, chalky bluestem, and gulf muhly.

(7) Immokalee fine sand. This nearly level, poorly drained soil is on flatwoods. Individual areas are elongated and irregular in shape, and they range from 10 to 500 acres in size. The slope is 0 to 2 percent.

Typically, the surface layer is black fine sand about 6 inches thick. The subsurface layer is light gray fine sand to a depth of about 35 inches. The subsoil is fine sand to a depth of about 58 inches. The upper part of the subsoil is black, the next part is dark reddish brown, and the lower part is dark brown. The substratum is pale brown fine sand to a depth of about 80 inches.

In 95 percent of the areas mapped as Immokalee fine sand, Immokalee and similar soils make up 89 to 99 percent of the map unit. In the remaining areas, the Immokalee soil makes up either a higher or lower percentage of the mapped areas. The characteristics of Myakka and Oldsmar soils are similar to those of the Immokalee soil.

The dissimilar soils in this map unit are small areas of Basinger and Holopaw soils in sloughs. These soils make up about 1 to 11 percent of the unit.

The permeability of this soil is moderate. The available water capacity is low. Under natural conditions, the seasonal high water table is at a depth of 6 to 18 inches for 1 to 6 months during most years. During the other months, the water table is below a depth of 18 inches, and it recedes to a depth of more than 40 inches during extended dry periods.

The natural vegetation consists of South Florida slash pine, saw palmetto, waxmyrtle, chalky bluestem, creeping bluestem, and pineland threeawn.

(10) Oldsmar fine sand, limestone substratum. This nearly level, poorly drained soil is on flatwoods. Individual areas are elongated and irregular in shape, and they range from 10 to 300 acres in size. The slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown fine sand about 4 inches thick. The subsurface layer is fine sand to a depth of about 35 inches. The upper part of the subsurface layer is light gray, and the lower part is light brownish gray. The subsoil extends to a depth of about 60 inches. The upper part of the subsoil is black fine sand, the next part is very dark grayish brown fine sand, and the lower part is dark grayish brown fine sandy loam. Limestone bedrock is at a depth of about 60 inches.

In 95 percent of the areas mapped as Oldsmar fine sand, limestone substratum, Oldsmar and similar soils make up 85 to 98 percent of the map unit. In the remaining areas, the Oldsmar soil makes up either a higher or lower percentage of the mapped areas. The characteristics of Immokalee and Wabasso soils are similar to those of the Oldsmar soil.

The dissimilar soils in this map unit are small areas of Malabar, Pineda, and Riviera soils in sloughs. These soils make up about 0 to 15 percent of the map unit.

The permeability of this soil is slow. The available water capacity is low. Under natural conditions, the seasonal high water table is between a depth of 6 to 18 inches for 1 to 6 months during most years. During the other months, the water table is below a depth of 18 inches, and it recedes to a depth of more than 40 inches during extended dry periods.

The natural vegetation consists mostly of cabbage palm, South Florida slash pine, saw palmetto, waxmyrtle, and chalky bluestem.

(17) Basinger fine sand. This nearly level, poorly drained soil is in sloughs and poorly defined drainageways. Individual areas are elongated and irregular in shape, and they range from 20 to 800 acres in size. The slope is 0 to 2 percent.

Typically, the surface layer is grayish brown fine sand about 3 inches thick. The subsurface layer is light gray fine sand to a depth of about 25 inches. The subsoil is brown fine sand to a depth of about 44 inches. The substratum is brown fine sand to a depth of about 80 inches.

In 95 percent of the areas mapped as Basinger fine sand, Basinger and similar soils make up 83 to 98 percent of the map unit. In the remaining areas, the Basinger soil makes up either a higher or lower percentage of the mapped areas. The characteristics of Malabar soils are similar to those of the Basinger soil.

The dissimilar soils in this map unit are small areas of Immokalee soils on the flatwoods. These soils make up 17 percent or less of the map unit.

The permeability of this soil is rapid. The available water capacity is low. Under natural conditions, the seasonal high water table is within a depth of 12 inches for 3 to 6 months during most years. During the other months, the water table is below a depth of 12 inches, and it recedes to a depth of more than 40 inches during extended dry periods. During periods of high rainfall, the soil is covered by shallow, slowly moving water for about 7 days.

The natural vegetation consists of scattered areas of South Florida slash pine, cypress, cabbage palm, saw palmetto, waxmyrtle, blue maidencane, sand cordgrass, pineland threeawn, chalky bluestem, and St. Johnswort.

(20) Ft. Drum and Malabar, high, fine sands. These nearly level, poorly drained soils are on ridges along sloughs. Individual areas are elongated and irregular in shape, and they range from 10 to 200 acres in size. The slope is 0 to 2 percent.

Typically, the Ft. Drum soil has a surface layer of very dark grayish brown fine sand about 5 inches thick. The subsoil is fine sand to a depth of about 20 inches. The upper part of the subsoil is light brownish gray, and lower part is light gray. The substratum is fine sand to a depth of about 80 inches. The upper part of the substratum is brownish yellow, the next part is white, and the lower part is brown.

Typically, the Malabar, high, soil has a surface layer of dark gray fine sand about 2 inches thick. The subsurface layer is light brownish gray fine sand to a depth of about 15 inches. The subsoil extends to a depth of about 72 inches. The upper part of the subsoil is brownish yellow and yellow fine sand, the next part is very pale brown and light gray fine sand, and the lower part is grayish brown, mottled sandy clay loam. The substratum is light gray fine sand to a depth of about 80 inches.

Mapped areas consist entirely of the Ft. Drum soil, entirely of the Malabar soil, or any combination of the two soils. The two soils were not separated in mapping because of similar management needs and soil characteristics.

The dissimilar soils in this map unit are small areas of Basinger, Holopaw, and Pineda soils in sloughs. These soils make up about 0 to 18 percent of the unit.

The permeability in the Ft. Drum soil is rapid. The permeability in the Malabar soil is slow or very slow. The available water capacity of both soils is low. Under natural conditions, the seasonal high water table is within a depth of 6 to 18 inches for 1 to 6 months during most years. During the other months, the water table is below a depth of 18 inches, and it recedes to a depth of more than 40 inches during extended dry periods.

The natural vegetation consists mostly of South Florida slash pine, saw palmetto, live oak, cabbage palm, waxmyrtle, chalky bluestem, creeping bluestem, low panicum, and pineland threeawn.

(23) Holopaw and Okeelanta soils, depressional. These level, very poorly drained soils are in depressions and marshes. Individual areas are circular or elongated in shape, and they range from 5 to 200 acres in size. The slope is 0 to 1 percent.

Typically, the Holopaw soil has a surface layer of dark gray fine sand about 5 inches thick. The subsurface layer is fine sand to a depth of about 52 inches. The upper part of the subsurface layer is light gray, and the lower part is light brownish gray. The subsoil extends to a depth of about 62 inches. The upper part of the subsoil is dark grayish brown fine sand, and lower part is dark grayish brown fine sandy loam. The substratum is gray loamy fine sand to a depth of about 80 inches.

Typically, the Okeelanta soil has surface soil of black and dark reddish brown muck about 20 inches thick. The substratum extends to a depth of about 80 inches. The upper part of the substratum is dark grayish brown fine sand, and the lower part is light brownish gray loamy fine sand.

Mapped areas can consist entirely of the Holopaw soil, entirely of the Okeelanta soil, or any combination of the two soils. The two soils were not separated in mapping because of similar management needs resulting from the ponding. The characteristics of Riviera soils are similar to those of the major soils.

The dissimilar soils in this map unit are small areas of Basinger and Gator soils in similar landscape positions. These soils make up about 10 percent of less of the unit.

The permeability in the Holopaw soil is moderate to moderately slow, and the available water capacity is low. The permeability in the Okeelanta soil is slow or very slow, and the available water capacity is high. Under natural condition, These soils are ponded for 6 months of more each year. During the other months, the water table is within a depth of 12 inches, and it recedes to a depth of 12 to 40 inches during extended dry periods.

These soils are used for natural wetlands. The natural vegetation consists of St. Johnswort, maidencane, rushes, primrose willow, fireflags, pickerelweed, sawgrass, Florida willow, and a few cypress trees.

(25) Boca, Riviera, limestone substratum, and Copeland fine sands, depressional. These level, very poorly drained soils are in depressions, cypress swamps, and marshes. Individual areas are elongated and irregular in shape, and they range from 100 to 3,000 acres in size. The slope is 0 to 1 percent.

Typically, the Boca soil has a surface layer of very dark gray fine sand about 4 inches thick. The subsurface layer is fine sand to a depth of about 26 inches. The upper part of the subsurface layer is light gray, and lower part is brown. The subsoil is dark grayish brown fine sandy loam to a depth of about 30 inches. Limestone bedrock is at a depth of about 30 inches.

Typically, the Riviera soil has a surface layer of gray fine sand about 6 inches thick. The subsurface layer is fine sand to a depth of about 32 inches. The upper part of the subsurface layer is light brownish gray, and the lower part is light gray. The subsoil is sandy clay loam to a depth of about 54 inches. The upper part of the subsoil is grayish brown, and the lower part is dark gray. Limestone bedrock is at a depth of about 54 inches.

Typically, the Copeland soil has a surface layer of black fine sand about 6 inches thick. The subsurface layer is fine sand to a depth of about 18 inches. The upper part of the subsurface layer is very dark grayish brown, and the lower part is dark gray. The subsoil is light gray, mottled sandy clay loam to a depth of about 24 inches. The substratum is light gray marl to a depth of about 30 inches. Limestone bedrock is at a depth of about 30 inches.

Mapped areas can consist entirely of the Boca soil, entirely of the Riviera soil, entirely of the Copeland soil, or any combination of the three soils. These three soils were not separated in mapping because of similar management needs resulting from the ponding. The characteristics of Holopaw, Malabar, and Pineda soils are similar to those of the major soils.

The dissimilar soils in this map unit are small areas of Basinger, Dania, Gator, and Hallandale soils in similar landscape positions. These soils make up about 20 percent or less of the map unit.

The permeability in the Boca soil is moderate, and the available water capacity is very low. The permeability in the Riviera soil is moderately rapid to moderately slow, and the available water capacity is low. The permeability in the Copeland soil is moderately slow, and the available water capacity is moderate. Under natural conditions, these soils are ponded for 6 months or more each year. During the other months, the water table is within a depth of 12 inches, and it recedes to a depth of 12 to 40 inches during extended dry periods.

The natural vegetation consists that found in natural wetlands: baldcypress, pickerelweed, rushes, fireflag, sawgrass, and Florida willow.

(27) Holopaw fine sand. This nearly level, poorly drained soil is in sloughs and poorly defined drainageways. Individual areas are elongated and irregular in shape, and they range from 10 to 400 acres in size. The slope is 0 to 2 percent.

Typically, the surface layer is dark gray fine sand about 5 inches thick. The subsurface layer is fine sand to a depth of about 52 inches. The upper part of the subsurface layer is light gray, and the lower part is light brownish gray. The subsoil extends to a depth of about 62 inches. The upper part of the subsoil is dark grayish brown fine sand, and the lower part is dark grayish brown fine sandy loam. The substratum is gray loamy fine sand to a depth of about 80 inches.

In 90 percent of the areas mapped as Holopaw fine sand, Holopaw and similar soils make up 87 to 98 percent of the map unit. In the remaining areas, the Holopaw soil makes up either a higher or lower percentage of the mapped areas. The characteristics of Malabar, Pineda, and Riviera soils are similar to those of the Holopaw soil.

The dissimilar soils in this map unit are small areas of Basinger and Oldsmar soils in landscape positions similar to those of the Holopaw soil. These soils make up about 13 percent or less of the unit.

The permeability of this soil is moderate to moderately slow. The available water capacity is low. Under natural conditions, the seasonal high water table is within a depth of 12 inches for 3 to 6 months during most years. During the other months, the water table is below a depth of 12 inches, and it recedes to a depth of more than 40 inches during extended dry periods. During periods of high rainfall, the soil is covered by shallow, slowly moving water for about 7 days.

The natural vegetation consists of scattered areas of slash pine, cypress, cabbage palm, saw palmetto, waxmyrtle, sand cordgrass, gulf muhly, panicums, chalky bluestem, plumgrass, gulf dune paspalum, and blue maidencane.

(40) Durbin and Wulfert mucks, frequently flooded. These level, very poorly drained soils are in tidal mangrove swamps. Individual areas are elongated and irregular in shape, and they range from 50 to 1,000 acres in size. The slopes are 0 to 1 percent.

Typically, the Durbin soil has a surface soil of dark reddish brown to black muck about 63 inches thick. The substratum is dark gray fine sand to a depth of about 80 inches.

Typically, the Wulfert soil has a surface soil of dark reddish brown to black muck about 40 inches thick. The substratum is dark gray fine sand to a depth of about 80 inches.

Mapped areas can consist entirely of the Durbin soil, entirely of the Wulfert soil, or any combination of the two soils. The two soils were not separated in mapping because of similar management needs resulting from the tidal flooding.

The dissimilar soils in this map unit are small areas of Kesson and Pennsuco soils in similar landscape positions. These soils make up about 0 to 10 percent of the unit.

The permeability in the Durbin soil is rapid, and the available water capacity is high. The permeability in the Wulfert soil is rapid, and the available water capacity is moderate. The water table fluctuates with the tide. It is within a depth of 12 inches for most of the year. The soil is subject o tidal flooding.

The natural vegetation consists of red, white, and black mangroves.

(52) Kesson muck, frequently flooded. This level, very poorly drained soil is in frequently flooded tidal marshes. Individual areas are elongated and irregular in shape, and they range from 300 to 1,000 acres in size. The slope is 0 to 1 percent.

Typically, the surface layer is black muck about 5 inches thick. The subsurface layer is dark gray fine sand to a depth of about 10 inches. The substratum is fine sand to a depth of about 80 inches. The upper part of the substratum is gray, the next part is light brownish gray, and the lower part is pale brown.

In 80 percent of the area mapped as Kesson muck, frequently flooded, the Kesson soil makes up 75 to 90 percent of the map unit. In the remaining areas, it makes up either a higher or lower percentage of the mapped areas.

The dissimilar soils in this map unit are small areas of Basinger, Dania, and Peckish soils in landscape positions similar to those of the Kesson soil. These soils make up about 10 to 25 percent of the unit.

The permeability of this soil is rapid to moderately rapid. The available water capacity is high. The water table fluctuates with tidal action and seasonal rainfall. It is at or near the surface for long periods. This soil is frequently flooded.

The natural vegetation consists of cordgrass, saltgrass, rushes, needlegrass, saltwort, and scattered areas of mangroves.

(53) Estero and Peckish soils, frequently flooded. These level, very poorly drained soils are in frequently flooded tidal marshes. Individual areas are elongated and irregular in shape, and they range from 300 to 1,000 acres in size. The slopes are 0 to 1 percent.

Typically, the Estero soil has a surface layer of black muck about 6 inches thick. The subsurface layer is fine sand to a depth of about 40 inches. The upper part of the subsurface layer is black, and lower part is dark grayish brown. The subsoil is dark brown and very dark brown fine sand to a depth of about 62 inches.

Typically, the Peckish soil has a surface layer of very dark grayish brown mucky find sand about 9 inches thick. The subsurface layer is grayish brown fine sand to a depth of about 37 inches. The subsoil is dark brown fine sand to a depth of about 42 inches. The substratum is light brownish gray fine sand to a depth of about 80 inches.

Mapped areas can consist entirely of the Estero soil, entirely of the Peckish soil, or any combination of the two soils. The two soils were not separated in mapping because of similar management needs resulting from the flooding.

The dissimilar soils in this map unit are small areas of Wulfert soils in similar landscape positions. These soils make up about 0 to 5 percent of the unit.

The permeability in the Estero soil is moderately rapid, and the available water capacity is moderate. The permeability in the Peckish soil is rapid, and the available water capacity is moderate. The water table fluctuates with tidal action and seasonal rainfall. It is at or near the surface for long periods. These soils are frequently flooded.

The natural vegetation consists of cordgrass, saltgrass, rushes, needlegrass, saltwort, and scattered mangrove.

Addendum 4—Plant And Animal List

Collier-Seminole State Park

Plants

Common Name	*Scientific Name*	Primary Habitat Codes (for designated species)
	FERNS	
Golden leather fern	*Acrostichum aureum*	75,76
Giant leather fern	*Acrostichum danaeifolium*	
Wild birdnest fern	*Asplenium serratum*	12
Toothed mid-sorus fern	*Blechnum serrulatum*	
Strap fern	*Campyloneurum phyllitidis*	
Nodding club-moss	*Lycopodiella cernua*	41
Climbing fern *	*Lygodium microphyllum*	
Giant sword fern	*Nephrolepis biserrata*	12,39
Boston sword fern	*Nephrolepis exaltata*	
Hand fern	*Ophioglossum palmatum*	12,39
Golden polypody	*Phlebodium aureum*	
Resurrection fern	*Pleopeltis polypodioides var. michauxiana*	
Whisk fern; Fork fern	*Psilotum nudum*	
Bracken fern	*Pteridium aquilinum var. caudatum*	
Giant ladderbrake *	*Pteris tripartita*	
Ladderbrake *	*Pteris vittata*	
Willdenow's maiden fern	*Thelypteris interrupta*	
Widespread maiden fern	*Thelypteris kunthii*	
Marsh fern	*Thelypteris palustris* var. *pubescens*	
Shoestring fern	*Vittaria lineata*	
Virginia chain fern	*Woodwardia virginica*	
	GYMNOSPERMS AND CYCADS	
Slash pine	*Pinus elliottii*	
Pond cypress	*Taxodium ascendens*	
Bald cypress	*Taxodium distichum*	
	MONOCOTS	
Yellow colic-root	*Aletris lutea*	
Blue maidencane	*Amphicarpum muhlenbergianum*	
Glaucous bushy bluestem	*Andropogon glomeratus var. glaucopsis*	
Bushy bluestem	*Andropogon glomeratus var. pumilus*	
Splitbeard bluestem	*Andropogon ternarius*	
Tall threeawn	*Aristida patula*	
Purple feather	*Aristida purpurascens*	
Bottlebrush threeawn	*Aristida spiciformis*	
Wiregrass	*Aristida stricta var. beyrichiana*	
Giant reed *	*Arundo donax*	
Common carpetgrass	*Axonopus fissifolius*	
Big carpet grass	*Axonopus furcatus*	
Pine pink	*Bletia purpurea*	39,41
Pitted bluestem *	*Bothriochloa pertusa*	
Watergrass *	*Bulbostylis barbata*	
Capillary hairsedge	*Bulbostylis ciliatifolia*	
Tuberous grass pink	*Calopogon tuberosus*	

* Non-native Species

Plants

Common Name	***Scientific Name***	**Primary Habitat Codes (for designated species)**
Golden canna	*Canna flaccida*	
Coastal sandbur	*Cenchrus spinifex*	
Jamaican sawgrass	*Cladium jamaicense*	
Coconut palm *	*Cocos nucifera*	
Wrinkled jointtail	*Coelorachis rugosa*	
Dayflower	*Commelina diffusa*	
Erect dayflower	*Commelina erecta*	
String-lily; Swamp-lily	*Crinum americanum*	
Bermuda grass *	*Cynodon dactylon*	
Baldwin's flatsedge	*Cyperus croceus*	
Sheathed flatsedge	*Cyperus haspan*	
Alabama swamp flat sedge	*Cyperus ligularis*	
Fragrant flatsedge	*Cyperus odoratus*	
Many-spike flat sedge	*Cyperus polystachyos*	
Pinebarrens flatsedge	*Cyperus retrorsus*	
Tropical flatsedge	*Cyperus surinamensis*	
Cowhorn orchid; Cigar orchid	*Cyrtopodium punctatum*	39
Durbana crowfoot grass *	*Dactyloctenium aegyptium*	
Ghost Orchid	*Dendrophylax lindenii*	39,12
Needleleaf witchgrass	*Dichanthelium aciculare*	
Variable witchgrass	*Dichanthelium commutatum*	
Cypress witch grass	*Dichanthelium dichotomum*	
Witch grass	*Dichanthelium portoricense*	
Slender crabgrass	*Digitaria filiformis*	
Air potato *	*Dioscorea bulbifera*	
Seashore salt grass	*Distichlis spicata*	
Florida cockspur	*Echinochloa paludigena*	
Baldwin's spike rush	*Eleocharis baldwinii*	
Gulfcrest spike rush	*Eleocharis cellulosa*	
Canada spikerush	*Eleocharis geniculata*	
Knotted spikerush	*Eleocharis interstincta*	
Indian goose grass *	*Eleusine indica*	
Pan-american balsamscale	*Elionurus tripsacoides*	
Tampa butterfly orchid	*Encyclia tampensis*	12,39
Dingy-flowered epidendrum	*Epidendrum anceps*	38,39
Umbelled epidendrum	*Epidendrum floridense*	38
Night-scent orchid	*Epidendrum nocturnum*	38
Rigid epidendrum	*Epidendrum rigidum*	38
Thalia love grass *	*Eragrostis atrovirens*	
Gophertail lovegrass *	*Eragrostis ciliaris*	
Centipedegrass *	*Eremochloa ophiuroides*	
Hatpins; Flattened pipewort	*Eriocaulon compressum*	
Ten-angle pipewort	*Eriocaulon decangulare*	
Wild coco; Ground coco	*Eulophia alta*	
Saltmarsh finger grass	*Eustachys glauca*	
Pinewoods finger grass	*Eustachys petraea*	

* Non-native Species

Common Name	***Scientific Name***	**Primary Habitat Codes (for designated species)**
Slender fimbry	*Fimbristylis autumnalis*	
Hurricanegrass	*Fimbristylis cymosa*	
Marsh fimbry	*Fimbristylis spadicea*	
Saltmarsh umbrella sedge	*Fuirena breviseta*	
Southern umbrella sedge	*Fuirena scirpoidea*	
Hammock false rein orchid	*Habenaria distans*	12
Snowy orchid; Bog torch	*Platanthera nivea*	41
Long-horn false rein orchid	*Habenaria quinqueseta*	
Threadroot orchid	*Harrisella porrecta*	39
West Indian marsh grass *	*Hymenachne amplexicaulis*	
Mangrove spider-lily	*Hymenocallis latifolia*	
Jaragua*	*Hyparrhenia rufa*	
Shorerush	*Juncus marginatus*	
Big-head rush	*Juncus megacephalus*	
Needle rush; black rush	*Juncus roemerianus*	
Shortleaf spikesedge *	*Kyllinga brevifolia*	
Asian spikesedge	*Kyllinga squamulata*	
Bloodroot; Carolina redroot	*Lachnanthes caroliana*	
Whitehead bogbutton	*Lachnocaulon anceps*	
Florida tibisee; Small cane	*Lasiacis divaricata*	
Pine lily; Catesby's lily	*Lilium catesbaei*	8,41
Awned halfchaff sedge	*Lipocarpha aristulata*	
Hairawn muhly	*Muhlenbergia capillaris*	
Nakedstem dewflower *	*Murdannia nudiflora*	
Banana *	*Musa Xparadisiaca*	
Southern water nymph	*Najas guadalupensis*	
Silk reed; Burma reed *	*Neyraudia reynaudiana*	
Monk orchid; Ground orchid *	*Oeceoclades maculata*	
Woods grass; Short-leaf basket grass	*Oplismenus hirtellus*	
Beaked panicum	*Panicum anceps*	
Fall panicum	*Panicum dichotomiflorum*	
Maidencane	*Panicum hemitomon*	
Gaping panicum	*Panicum hians*	
Torpedo grass *	*Panicum repens*	
Redtop panicum	*Panicum rigidulum*	
Switch grass; Wand-shape panicum	*Panicum virgatum*	
Egyptian paspalidium	*Paspalidium geminatum*	
Gulfdune paspalum	*Paspalum monostachyum*	
Bahia grass	*Paspalum notatum*	
Water paspalum	*Paspalum repens*	
Thin paspalum	*Paspalum setaceum*	
Vasey grass *	*Paspalum urvillei*	
Seashore paspalum	*Paspalum vaginatum*	
Senegal date palm *	*Phoenix reclinata*	
Common reed	*Phragmites australis*	

* Non-native Species

Common Name	*Scientific Name*	Primary Habitat Codes (for designated species)
Florida needle grass	*Piptochaetium avenacioides*	
Pale-flowered polystachya	*Polystachya concreta*	38,39
Pickerelweed	*Pontederia cordata*	
Red Natal grass *	*Rhynchelytrum repens*	
Falling beak sedge	*Rhynchospora caduca*	
White-tops; Star-rush	*Rhynchospora colorata*	
Narrow-fruit horned beaksedge	*Rhynchospora inundata*	
Sand-swamp white-tops; Star-rush	*Rhynchospora latifolia*	
Southern beaksedge	*Rhynchospora microcarpa*	
Millet beak sedge	*Rhynchospora miliacea*	
Shortbeak beaksedge; baldrush	*Rhynchospora nitens*	
Fragrant beaksedge	*Rhynchospora odorata*	
Fairy beaksedge	*Rhynchospora pusilla*	
Tracy's beak sedge	*Rhynchospora tracyi*	
Florida royal palm	*Roystonea regia*	12,39
Cabbage palm	*Sabal palmetto*	
Sugarcane plumegrass	*Saccharum giganteum*	
American cupscale	*Sacciolepis striata*	
Grass-leaf arrowhead	*Sagittaria graminea*	
Chapman's arrowhead	*Sagittaria graminea var.chapmanii*	
Bull-tongue arrowhead	*Sagittaria lancifolia*	
Broadleaf arrowhead	*Sagittaria latifolia*	
Sunnybells	*Schoenolirion albiflorum*	
Black sedge	*Schoenus nigricans*	
Seaside bulrush	*Scirpus robustus*	
Netted nut rush	*Scleria reticularis*	
Saw palmetto	*Serenoa repens*	
Knotroot foxtail	*Setaria parviflora*	
Narrow-leaf blueeyed-grass	*Sisyrinchium angustifolium*	
Ear-leaf greenbrier	*Smilax auriculata*	
Saw greenbrier	*Smilax bona-nox*	
Laurel greenbrier	*Smilax laurifolia*	
Lopsided Indian grass	*Sorghastrum secundum*	
Sand cord grass; Bunch cord grass	*Spartina bakeri*	
Fragrant ladies'-tresses	*Spiranthes odorata*	
Spring ladies'-tresses	*Spiranthes vernalis*	
Smut grass *	*Sporobolus indicus var. pyramidalis*	
Seashore dropseed	*Sporobolus virginicus*	
St. Augustine grass *	*Stenotaphrum secundatum*	
Bantam-buttons; Yellow hatpins	*Syngonanthus flavidulus*	
Arrowhead vine *	*Syngonium podophyllum*	
Fireflag; Alligator-flag	*Thalia geniculata*	
Medusahead air plant	*Tillandsia balbisiana*	12,39
Cardinal air plant; Stiff-leaved wild pine	*Tillandsia fasciculata*	12,39,41
Twisted air plant	*Tillandsia flexuosa*	11,76

* Non-native Species

Collier-Seminole State Park

Plants

Common Name	*Scientific Name*	Primary Habitat Codes (for designated species)
Air plant; Wild pine	*Tillandsia paucifolia*	
Fuzzy-wuzzy air plant	*Tillandsia pruinosa*	12,38,39
Ball moss	*Tillandsia recurvata*	
Grass-leaved air plant	*Tillandsia setacea*	
Spanish-moss	*Tillandsia usneoides*	
Spreading air plant	*Tillandsia utriculata*	11,12,39,41
Soft-leaved wild pine	*Tillandsia variabilis*	12
Recurved air plant	*Tillandsia Xfloridana*	
Three-rib arrowgrass	*Triglochin striata*	
Eastern gama grass	*Tripsacum dactyloides*	
Southern cattail	*Typha domingensis*	
Para grass *	*Urochloa mutica*	
Coastalplain yellow-eyed-grass	*Xyris ambigua*	
Short-leaved yellow-eyed-grass	*Xyris brevifolia*	
Carolina yellow-eyed-grass	*Xyris caroliniana*	
Elliott's yellow-eyed-grass	*Xyris elliottii*	
Savannah yellow-eyed-grass	*Xyris flabelliformis*	
Richard's yellow-eyed-grass	*Xyris jupicai*	
Spanish bayonet; aloe yucca	*Yucca aloifolia*	
Lawn orchid; Soldier's orchid *	*Zeuxine strateumatica*	
Cutgrass; Southern wild rice	*Zizaniopsis miliacea*	
	DICOTS	
Sweet acacia; Mealy wattle	*Acacia farnesiana*	
Southern red maple	*Acer rubrum*	
Creeping spotflower	*Acmella oppositifolia var. repens*	
Shyleaf	*Aeschynomene americana*	
Flax-leaf false-foxglove	*Agalinis linifolia*	
Saltmarsh false-foxglove	*Agalinis maritima*	
Large purple false-foxglove	*Agalinis purpurea*	
Yellow chaff-flower	*Alternanthera flavescens*	
Southern water-hemp	*Amaranthus australis*	
Common ragweed; Annual ragweed	*Ambrosia artemisiifolia*	
Pink redstem; Toothcup	*Ammannia latifolia*	
Pepper vine	*Ampelopsis arborea*	
Pond apple	*Annona glabra*	
Island marlberry	*Ardisia escallonioides*	
Swamp milkweed	*Asclepias incarnata*	
Few-flower milkweed	*Asclepias lanceolata*	
Long-leaf milkweed	*Asclepias longifolia*	
Netted pawpaw	*Asimina reticulata*	
Sand atriplex; Seabeach orach	*Atriplex cristata*	
Black mangrove	*Avicennia germinans*	
Saltwater false-willow	*Baccharis angustifolia*	
Silverling; Groundsel tree	*Baccharis glomeruliflora*	
Saltbush; Groundsel tree	*Baccharis halimifolia*	
Blue water-hyssop; Lemon bacopa	*Bacopa caroliniana*	

* Non-native Species

Plants

Common Name	*Scientific Name*	Primary Habitat Codes (for designated species)
Coastal water-hyssop	*Bacopa monnieri*	
Saltwort	*Batis maritima*	
Rattan vine	*Berchemia scandens*	
Spanish needles; Beggar-ticks	*Bidens alba var. radiata*	
Browne's blechum *	*Blechum pyramidatum*	
Small-spike false-nettle; Bog hemp	*Boehmeria cylindrica*	
Red spiderling; Wine-flower	*Boerhavia diffusa*	
Erect spiderling	*Boerhavia erecta*	
False-aster; Small-head doll's daisy	*Boltonia diffusa*	
Sea daisies; Sea oxeye	*Borrichia frutescens*	
American blueheart	*Buchnera americana*	
Gumbo-limbo	*Bursera simaruba*	
Gray nicker	*Caesalpinia bonduc*	
American beautyberry	*Callicarpa americana*	
Florida bellflower	*Campanula floridana*	
Seaside bean; Bay bean	*Canavalia rosea*	
Caper	*Caperonia castaneifolia*	
Jamaica caper-tree	*Capparis cynophallophora*	
Bay-leaved caper-tree	*Capparis flexuosa*	
Tabasco pepper *	*Capsicum frutescens*	
Bitter cress	*Cardamine sp.*	
Papaya *	*Carica papaya*	
Florida paintbrush; Coastalplain chaffhead	*Carphephorus corymbosus*	
False Vanilla-leaf	*Carphephorus odoratissimus var. subtropicanus*	
Love vine; Devil's-gut	*Cassytha filiformis*	
Hackberry; Sugarberry	*Celtis laevigata*	
Spadeleaf	*Centella asiatica*	
Spurred butterfly pea	*Centrosema virginianum*	
Buttonbush	*Cephalanthus occidentalis*	
Partridge pea; Sleeping plant	*Chamaecrista fasciculata*	
Wild sensitive plant; Partridge pea	*Chamaecrista nictitans var. aspera*	
Pillpod sandmat	*Chamaesyce hirta*	
Graceful sandmat	*Chamaesyce hypericifolia*	
Prostrate sandmat	*Chamaesyce prostrata*	
Pineland daisy; Sunbonnets	*Chaptalia tomentosa*	
Snowberry; West Indies milkberry	*Chiococca alba*	
Jack-in-the-bush	*Chromolaena odorata*	
Coco-plum	*Chrysobalanus icaco*	
Satinleaf	*Chrysophyllum oliviforme*	12
Horrid thistle; Purple thistle	*Cirsium horridulum*	
Thistle	*Cirsium nuttallii*	
Possum-grape	*Cissus verticillata*	
Key lime *	*Citrus Xaurantiifolia*	
Pigeon-plum; Tie-tongue	*Coccoloba diversifolia*	
Seagrape	*Coccoloba uvifera*	

* Non-native Species

Collier-Seminole State Park

Plants

Common Name	*Scientific Name*	Primary Habitat Codes (for designated species)
Buttonwood; Button-mangrove	*Conocarpus erectus*	
Blue mistflower	*Conoclinium coelestinum*	
Dwarf horseweed	*Conyza canadensis var. pusilla*	
Leavenworth's tickseed; Coreopsis	*Coreopsis leavenworthii*	
Stiff cornel; Swamp dogwood	*Cornus foemina*	
Rabbit-bells	*Crotalaria rotundifolia*	
Tropical croton	*Croton glandulosus*	
Columbian waxweed *	*Cuphea carthagenensis*	
Gulfcoast swallowwort	*Cynanchum angustifolium*	
Leafless swallowwort	*Cynanchum scoparium*	
Coin-vine	*Dalbergia ecastaphyllum*	
Whitetassels	*Dalea carnea*	
Beggar tick; Zarzabacoa comun	*Desmodium incanum*	
Panicled tick-trefoil	*Desmodium paniculatum*	
Threeflower tick-trefoil *	*Desmodium triflorum*	
Carolina pony-foot; False-pennywort	*Dichondra carolinensis*	
Crimson dicliptera; Seven-angle foldwing	*Dicliptera sexangularis*	
Virginia buttonweed	*Diodia virginiana*	
Persimmon	*Diospyros virginiana*	
Pink sundew	*Drosera capillaris*	
Drymary; West Indian chickweed	*Drymaria cordata*	
Guiana-plum	*Drypetes lateriflora*	12
Pineland twinflower	*Dyschoriste angusta*	
Twinflower; Oblong-leaf snakeherb	*Dyschoriste oblongifolia*	
False daisy	*Eclipta prostrata*	
Tall elephant's-foot	*Elephantopus elatus*	
Tassel flower *	*Emilia sonchifolia*	
Fireweed; American burn	*Erechtites hieraciifolius*	
Southern fleabane; Oakleaf fleabane	*Erigeron quercifolius*	
Early white-top fleabane	*Erigeron vernus*	
Baldwin's eryngium	*Eryngium baldwinii*	
Button snakeroot; Rattlesnake-master	*Eryngium yuccifolium*	
Southeastern coral bean; Cherokee bean	*Erythrina herbacea*	
White stopper	*Eugenia axillaris*	
Spanish stopper	*Eugenia foetida*	
Surinam-cherry *	*Eugenia uniflora*	
Dog-fennel	*Eupatorium capillifolium*	
False-fennel	*Eupatorium leptophyllum*	
Semaphore thoroughwort	*Eupatorium mikanioides*	
Mohr's thoroughwort	*Eupatorium mohrii*	
Late-flowering thoroughwort	*Eupatorium serotinum*	
Slender grass-leaf goldenrod	*Euthamia caroliniana*	

* Non-native Species

Collier-Seminole State Park

Plants

Common Name	*Scientific Name*	Primary Habitat Codes (for designated species)
Silver dwarf morning-glory	*Evolvulus sericeus*	
Inkwood; Butterbough	*Exothea paniculata*	
Florida strangler fig; Golden fig	*Ficus aurea*	
Wild banyan tree	*Ficus citrifolia*	
Cuban laurel *	*Ficus microcarpa*	
Florida yellowtops	*Flaveria floridana*	
Narrowleaf yellowtops	*Flaveria linearis*	
Florida privet	*Forestiera segregata*	
Carolina ash; Pop ash; Water ash	*Fraxinus caroliniana*	
Elliott's milk pea	*Galactia elliottii*	
Eastern milk pea; Florida milk pea	*Galactia regularis*	
Milk pea	*Galactia volubilis*	
Coastal bedstraw	*Galium hispidulum*	
Southern gaura; Southern beeblossom	*Gaura angustifolia*	
Cudweed	*Gnaphalium sp.*	
Wild cotton	*Gossypium hirsutum*	3
Rough hedge-hyssop	*Gratiola hispida*	
Branched hedge-hyssop	*Gratiola ramosa*	
Scarlet bush; Fire bush	*Hamelia patens*	
Southeastern sneezeweed	*Helenium pinnatifidum*	
Seaside heliotrope	*Heliotropium polyphyllum*	
Swamp hibiscus; Swamp rose-mallow	*Hibiscus grandiflorus*	
Hibiscus *	*Hibiscus rosa-sinensis*	
Hawkweed; Queendevil	*Hieracium gronovii*	
Hippocratea	*Hippocratea volubilis*	
Innocence; Round-leaf bluet	*Houstonia procumbens*	
Manyflower marsh pennywort	*Hydrocotyle umbellata*	
Whorled pennywort	*Hydrocotyle verticillata*	
Skyflower	*Hydrolea corymbosa*	
Night-blooming cereus *	*Hylocereus undatus*	
Coastal plain St. John's-wort	*Hypericum brachyphyllum*	
Round-pod St. John's-wort	*Hypericum cistifolium*	
Peel-bark St. John's-wort; Sandweed	*Hypericum fasciculatum*	
St. Andrew's-cross	*Hypericum hypericoides*	
Four-petal St. John's-wort; St. Peter's-wort	*Hypericum tetrapetalum*	
Musky mint; Cluster bush mint	*Hyptis alata*	
Dahoon holly	*Ilex cassine*	
Inkberry; Gallberry	*Ilex glabra*	
Moonflower; Tropical white morning-glory	*Ipomoea alba*	
Ocean-blue morning-glory	*Ipomoea indica var. acuminata*	
Glade morning-glory	*Ipomoea sagittata*	

* Non-native Species

Collier-Seminole State Park

Plants

Common Name	*Scientific Name*	Primary Habitat Codes (for designated species)
Juba's bush; Blood-leaf	*Iresine diffusa*	
Big-leaf marsh-elder	*Iva frutescens*	
Beach elder; Seacoast marsh-elder	*Iva imbricata*	
Piedmont marsh-elder	*Iva microcephala*	
Pineland water-willow	*Justicia angusta*	
Senegal mahogany; African mahogany *	*Khaya senegalensis*	
Saltmarsh mallow; Virginia fen-rose	*Kosteletzkya virginica*	
White mangrove	*Laguncularia racemosa*	
Piedmont pinweed	*Lechea torreyi*	
Poorman's-pepper	*Lepidium virginicum*	
White leadtree; Leadtree; Jumbie *	*Leucaena leucocephala*	
Garber's blazing star; Garber's gayfeather	*Liatris garberi*	
Carolina sea-lavender	*Limonium carolinianum*	
Canada toadflax	*Linaria canadensis*	
Malaysian false pimpernel *	*Lindernia crustacea*	
Savannah false pimpernel	*Lindernia grandiflora*	
Stiff yellow flax	*Linum medium var. texanum*	
Bay lobelia	*Lobelia feayana*	
Glade lobelia	*Lobelia glandulosa*	
White lobelia	*Lobelia paludosa*	
Southeastern primrose-willow	*Ludwigia linifolia*	
Seaside primrose-willow	*Ludwigia maritima*	
Smallfruit primrose-willow	*Ludwigia microcarpa*	
Mexican primrose-willow	*Ludwigia octovalvis*	
Peruvian primrose-willow	*Ludwigia peruviana*	
Creeping primrose-willow	*Ludwigia repens*	
Christmasberry; Carolina desert-thorn	*Lycium carolinianum*	
Coastal plain staggerbush	*Lyonia fruticosa*	
Wild tamarind	*Lysiloma latisiliquum*	
Wing-angle loosestrife	*Lythrum alatum var. lanceolatum*	
Sweet bay	*Magnolia virginiana*	
Texas wax mallow; Turk's-cap mallow *	*Malvaviscus penduliflorus*	
Mango *	*Mangifera indica*	
Punk tree; Cajeput; Paper tree *	*Melaleuca quinquenervia*	
Snow squarestem	*Melanthera nivea*	
Chocolate weed; Bretonica peluda	*Melochia spicata*	
Creeping cucumber	*Melothria pendula*	
Poorman's-patch	*Mentzelia floridana*	
Florida key hempvine	*Mikania cordifolia*	
Climbing hempvine	*Mikania scandens*	
Miterwort; Lax hornpod	*Mitreola petiolata*	

* Non-native Species

Common Name	***Scientific Name***	**Primary Habitat Codes (for designated species)**
Miterwort; Swamp hornpod	*Mitreola sessilifolia*	
Redgal	*Morinda royoc*	
Red mulberry	*Morus rubra*	
Simpson's stopper	*Myrcianthes fragrans*	12
Wax myrtle; Southern bayberry	*Myrica cerifera*	
Royal blue waterlily	*Nymphaea elegans*	
Fragrant white waterlily	*Nymphaea odorata*	
Floating hearts	*Nymphoides aquatica*	
Lancewood	*Ocotea coriacea*	
Seaside evening-primrose	*Oenothera humifusa*	
Flat-top bluet *	*Oldenlandia corymbosa*	
Clustered bluet	*Oldenlandia uniflora*	
Erect prickly-pear cactus	*Opuntia stricta*	3
Water dropwort; Water cowbane	*Oxypolis filiformis*	
Golden ragwort; Butterweed	*Packera glabella*	
Coastalplain palafox	*Palafoxia integrifolia*	
Florida pellitory	*Parietaria floridana*	
Virginia creeper; Woodbine	*Parthenocissus quinquefolia*	
Pineland passion vine	*Passiflora pallens*	12
Corky-stemmed passionflower	*Passiflora suberosa*	
Sanddune cinchweed	*Pectis glaucescens*	
Spreading lemongrass	*Pectis prostrata*	
Wild allamanda	*Pentalinon luteum*	
Swampbay	*Persea palustris*	
Frog fruit; Carpetweed; Capeweed	*Phyla nodiflora*	
Chamber bitter *	*Phyllanthus urinaria*	
Low hairy ground-cherry	*Physalis pubescens*	
Starry-hair ground-cherry	*Physalis walteri*	
Obedient plant	*Physostegia purpurea*	
American pokeweed; Pokeberry	*Phytolacca americana*	
Artillery plant	*Pilea microphylla*	
Wild pennyroyal	*Piloblephis rigida*	
Small butterwort	*Pinguicula pumila*	
Piriqueta; Carolina stripeseed	*Piriqueta cistoides subsp. caroliniana*	
Jamaica-dogwood; Florida fishpoison tree	*Piscidia piscipula*	
Coastal devil's-claw	*Pisonia aculeata*	
Cat's-claw; Catclaw blackbead	*Pithecellobium unguis-cati*	
Grass-leaved goldenaster	*Pityopsis graminifolia*	
Common plantain	*Plantago major*	
Saltmarsh fleabane	*Pluchea odorata*	
Rosy camphorweed	*Pluchea rosea*	
Baldwin's milkwort	*Polygala balduinii*	
Drumheads	*Polygala cruciata*	
Large-flowered polygala	*Polygala grandiflora*	
Procession flower	*Polygala incarnata*	

* Non-native Species

Common Name	*Scientific Name*	Primary Habitat Codes (for designated species)
Candyroot	*Polygala nana*	
Wireweed; Hairy jointweed	*Polygonella ciliata*	
Jointweed; Octoberflower	*Polygonella polygama*	
Octoberflower	*Polygonella polygama var. brachystachya*	
Dotted smartweed	*Polygonum punctatum*	
Rustweed	*Polypremum procumbens*	
Ghost orchid; Palm polly	*Polyradicion lindenii*	38,39
Mermaid-weed	*Proserpinaca palustris*	
Guava *	*Psidium guajava*	
Wild coffee; Seminole balsamo	*Psychotria nervosa*	
Sulzner's wild coffee	*Psychotria sulzneri*	
Rabbit tobacco; Coastal blackroot	*Pterocaulon pycnostachyum*	
Hairlike mock bishop's-weed	*Ptilimnium capillaceum*	
Sand live oak	*Quercus geminata*	
Laurel oak; Diamond oak	*Quercus laurifolia*	
Dwarf live oak	*Quercus minima*	
Myrtle oak	*Quercus myrtifolia*	
Virginia live oak	*Quercus virginiana*	
White indigo-berry	*Randia aculeata*	
Myrsine; Guiana colicwood	*Rapanea punctata*	
Rubber vine	*Rhabdadenia biflora*	
Red mangrove	*Rhizophora mangle*	
Winged sumac; Shining sumac	*Rhus copallinum*	
Rouge plant; Bloodberry	*Rivina humilis*	
Southern dewberry	*Rubus trivialis*	
Blackeyed Susan	*Rudbeckia hirta*	
Britton's wild petunia *	*Ruellia tweediana*	
Bartram's marsh pink	*Sabatia bartramii*	
Short-leaf marsh pink	*Sabatia brevifolia*	
Coastal rose-gentian	*Sabatia calycina*	
Large-flower rose-gentian	*Sabatia grandiflora*	
Rose-of-Plymouth	*Sabatia stellaris*	
Small-flower mock-buckthorn	*Sageretia minutiflora*	
Perennial glasswort	*Salicornia perennis*	
Carolina willow; Coastal plain willow	*Salix caroliniana*	
Elderberry; American elder	*Sambucus nigra subsp. canadensis*	
Water pimpernel	*Samolus ebracteatus*	
Southern soapberry; False-dogwood	*Sapindus saponaria*	
Popcorn tree; Chinese tallow *	*Sapium sebiferum*	
White vine	*Sarcostemma clausum*	
Beachberry; Inkberry	*Scaevola plumieri*	3
Brazilian pepper; Florida-holly *	*Schinus terebinthifolius*	
Gulf graytwig; Graytwig	*Schoepfia chrysophylloides*	
Sweet broom; Licorice-weed	*Scoparia dulcis*	
Florida scrub skullcap	*Scutellaria arenicola*	

*** Non-native Species**

Collier-Seminole State Park

Plants

Common Name	*Scientific Name*	Primary Habitat Codes (for designated species)
Bahama wild sensitive plant	*Senna ligustrina*	
Danglepod; Bequilla	*Sesbania herbacea*	
Shoreline sea-purslane	*Sesuvium portulacastrum*	
Common wireweed; Broomweed	*Sida acuta*	
Saffron-plum	*Sideroxylon celastrinum*	
False mastic; Wild-olive	*Sideroxylon foetidissimum*	
Florida Bully; Milk buckthorn	*Sideroxylon reclinatum*	
Willow bustic	*Sideroxylon salicifolium*	
Tough bully; Scrub buckthorn	*Sideroxylon tenax*	
Paradise tree	*Simarouba glauca*	
Common nightshade	*Solanum americanum*	
Mullein nightshade	*Solanum donianum*	11,12
Potato tree	*Solanum erianthum*	
Pinebarren goldenrod	*Solidago fistulosa*	
Chapman's goldenrod	*Solidago odora var. chapmanii*	
Seaside goldenrod	*Solidago sempervirens*	
Wand goldenrod	*Solidago stricta*	
Common sow-thistle *	*Sonchus oleraceus*	
Yellow necklace pod	*Sophora tomentosa var. truncata*	
African tulip tree *	*Spathodea campanulata*	
Woodland false-buttonweed	*Spermacoce assurgens*	
False-buttonweed *	*Spermacoce verticillata*	
Creeping oxeye *	*Sphagneticola trilobata*	
Blue porterweed; Blueflower	*Stachytarpheta jamaicensis*	
Sweet shaggytuft	*Stenandrium dulce*	
Corkwood; Water toothleaf	*Stillingia aquatica*	
Cheesytoes	*Stylosanthes hamata*	
Bay-cedar	*Suriana maritima*	
West Indian mahogany	*Swietenia mahagoni*	12
Scale-leaf aster	*Symphyotrichum adnatum*	
Climbing aster	*Symphyotrichum carolinianum*	
Rice-button aster	*Symphyotrichum dumosum*	
Simmond's aster	*Symphyotrichum simmondsii*	
Annual saltmarsh aster	*Symphyotrichum subulatum*	
Jambolan-plum *	*Syzygium cumini*	
Rose-apple *	*Syzygium jambos*	
Wood sage; American germander	*Teucrium canadense*	
Chiggery grapes; Soldier vine	*Tournefortia hirsutissima*	12
Eastern poison ivy	*Toxicodendron radicans*	
Jamaican nettle tree; Florida trema	*Trema micranthum*	
Forked blue-curls	*Trichostema dichotomum*	
Caesar weed *	*Urena lobata*	
Horned bladderwort	*Utricularia cornuta*	
Floating bladderwort	*Utricularia inflata*	
Eastern purple bladderwort	*Utricularia purpurea*	
Eastern purple bladder	*Utricularia subulata*	

* Non-native Species

Common Name	***Scientific Name***	**Primary Habitat Codes (for designated species)**
Darrow's blueberry	*Vaccinium darrowii*	
Shiny blueberry	*Vaccinium myrsinites*	
Frostweed; White crownbeard	*Verbesina virginica*	
Four-leaf vetch	*Vicia acutifolia*	
Piedmont cow pea	*Vigna luteola*	
Long-leaf violet; Bog white violet	*Viola lanceolata*	
Summer grape	*Vitis aestivalis*	
Southern fox grape	*Vitis rotundifolia*	
Calusa grape	*Vitis shuttleworthii*	
Tallowwood; Hog-plum	*Ximenia americana*	
Wild-lime; Lime prickly-ash	*Zanthoxylum fagara*	

Collier-Seminole State Park

Animals

Common Name	*Scientific Name*	Primary Habitat Codes (for all species)
AMPHIBIANS		
Southern toad	*Bufo terrestris*	8,41
Oak toad	*Bufo quercicus*	8,41
Green treefrog	*Hyla cinerea*	8,41,11,12,39
Cuban treefrog	*Osteopilus septentrionalis* *	11,12
Pig frog	*Rana grylio*	36
Southern leopard frog	*Rana sphenocephala*	36
Eastern narrowmouth toad	*Gastrophryne carolinensis*	39
REPTILES		
American alligator	*Alligator mississippiensis*	39
American crocodile	*Crocodylus acutus*	64,65
Florida snapping turtle	*Chelydra serpentina osceola*	39
Striped mud turtle	*Kinosternon bauri palmarum*	36
Florida mud turtle	*Kinosternon subrubrum steindachneri*	36
Florida box turtle	*Terrapene carolina bauri*	8,41
Diamondback terrapin	*Malaclemys terrapin*	64,65
Florida chicken turtle	*Deirochelys reticularia chrysea*	39
Gopher tortoise	*Gopherus polyphemus*	15
Florida softshell	*Trionyx ferox*	39
Green anole	*Anolis carolinensis carolinensis*	11,12
Cuban brown anole	*Anolis sagrei sagrei* *	11,12
Indo-Pacific gecko	*Hemidactylus garnotii* *	82
Ashy gecko	*Sphaerodactylus elegans* *	82
Six-lined racerunner	*Cnemidophorus sexlineatus sexlineatus*	15
Southeastern five-lined skink	*Eumeces inexpectatus*	11,12
Brown water snake	*Nerodia taxispilota*	39
Mangrove water snake	*Nerodia fasciata compressicauda*	65
Eastern garter snake	*Thamnophis sirtalis sirtalis*	8
Peninsula ribbon snake	*Thamnophis sauritus sackeni*	39
Southern ringneck snake	*Diadophis punctatus punctatus*	8
Southern black racer	*Coluber constrictor priapus*	8,11,12
Eastern indigo snake	*Drymarchon corais couperi*	All Types
Corn snake	*Elaphe guttata guttata*	8,41,11,12
Yellow rat snake	*Elaphe obsoleta quadrivittata*	8,41,11,12
Common kingsnake	*Lampropeltis getulus*	8,41,11,12
Scarlet kingsnake	*Lampropeltis triangulum elapsoides*	8,41
Florida scarlet snake	*Cemophora coccinea coccinea*	39
Florida cottonmouth	*Agkistrodon piscivorus conanti*	39
Dusky pigmy rattlesnake	*Sistrurus miliarius barbouri*	36
Eastern diamondback rattlesnake	*Crotalus adamanteus*	8,41
BIRDS		
Common loon	*Gavia immer*	64,65
Pied-billed grebe	*Podilymbus podiceps*	36

* Non-native Species

Collier-Seminole State Park

Animals

Common Name	***Scientific Name***	**Primary Habitat Codes (for all species)**
American white pelican	*Pelecanus erythrorhynchos*	64,65
Eastern brown pelican	*Pelecanus occidentalis carolinensis*	64,65
Double-crested cormorant	*Phalacrocorax auritus*	64,65
Anhinga	*Anhinga anhinga*	65
Great white heron	*Ardea herodias occidentalis*	64,65
Great blue heron	*Ardea herodias*	39,63,65
Green heron	*Butorides virescens*	39,65
Cattle egret	*Bubulcus ibis* *	81
Little blue heron	*Egretta caerulea*	39,65
Great egret	*Ardea alba*	36,39,65
Snowy egret	*Egretta thula*	36
Tricolored heron	*Egretta tricolor*	36
Black-crowned night heron	*Nycticorax nycticorax*	39
Yellow-crowned night heron	*Nycticorax violaceus*	39
American bittern	*Botaurus lentiginosus*	36
Wood stork	*Mycteria americana*	36,65
Glossy ibis	*Plegadis falcinellus*	36
White ibis	*Eudocimus albus*	36
Roseate spoonbill	*Ajaia ajaja*	36,65
Mottled duck	*Anas fulvigula*	36
Green-winged teal	*Anas crecca*	65
Blue-winged teal	*Anas discors*	65
Northern shoveler	*Anas clypeata*	65
Ring-necked duck	*Aythya collaris*	65
Lesser scaup	*Aythya affinis*	65
Muscovy duck	*Cairina moschata* *	MTC
Turkey vulture	*Cathartes aura*	All Types
Black vulture	*Coragyps atratus*	All Types
Swallow-tailed kite	*Elanoides forficatus*	8,41,39
Snail kite	*Rostrhamus sociabilis*	OF
Sharp-shinned hawk	*Accipiter striatus*	8,41
Cooper's hawk	*Accipiter cooperii*	8,41
Red-tailed hawk	*Buteo jamaicensis*	8,41
Red-shouldered hawk	*Buteo lineatus*	All Types
Broad-winged hawk	*Buteo platypterus*	11,12
Short-tailed hawk	*Buteo brachyurus*	8,41,39
Southern bald eagle	*Haliaeetus leucocephalus*	8, OF
Northern harrier	*Circus cyaneus*	36
Osprey	*Pandion haliaetus*	63,64,65
Peregrine falcon	*Falco peregrinus tundrius*	75
Eastern American kestrel	*Falco sparverius sparverius*	8,41
Northern bobwhite	*Colinus virginianus*	8
Wild turkey	*Meleagris gallopavo*	8,41
Sandhill crane	*Grus canadensis*	OF
Limpkin	*Aramus guarauna*	75
King rail	*Rallus elegans*	36

* Non-native Species

Collier-Seminole State Park

Animals

Common Name	***Scientific Name***	**Primary Habitat Codes (for all species)**
Virginia rail	*Rallus limicola*	63
Clapper rail	*Rallus longirostris*	63
Common moorhen	*Gallinula chloropus*	36
American coot	*Fulica americana*	36
American oystercatcher	*Haematopus palliatus*	65
Semipalmated plover	*Charadrius semipalmatus*	65
Killdeer	*Charadrius vociferus*	82
Black-bellied plover	*Pluvialis squatarola*	65
American woodcock	*Scolopax minor*	39
Common snipe	*Gallinago gallinago*	36
Whimbrel	*Numenius phaeopus*	65
Spotted sandpiper	*Actitis macularia*	65
Greater yellowlegs	*Tringa melanoleuca*	36
Lesser yellowlegs	*Tringa flavipes*	36
Willet	*Catoptrophorus semipalmatus*	65
Least sandpiper	*Calidris minutilla*	36
Dunlin	*Calidris alpina*	65
Semipalmated sandpiper	*Calidris pusilla*	65
Short-billed dowitcher	*Limnodromus griseus*	65
Black-necked stilt	*Himantopus mexicanus*	36
Ring-billed gull	*Larus delawarensis*	65
Laughing gull	*Larus atricilla*	65
Forster’s tern	*Sterna forsteri*	65
Common tern	*Sterna hirundo*	65
Least tern	*Sterna antillarum*	65
Royal tern	*Sterna maxima*	65
Sandwich tern	*Sterna sandvicensis*	65
Caspian tern	*Sterna caspia*	65
White-crowned pigeon	*Columba leucocephala*	64
Mourning dove	*Zenaida macroura*	8
Common ground-dove	*Columbina passerina*	15
Monk parakeet	*Myiopsitta monachus* *	81
Mangrove cuckoo	*Coccyzus minor*	64
Yellow-billed cuckoo	*Coccyzus americanus*	12
Smooth-billed ani	*Crotophaga ani* *	81
Barn owl	*Tyto alba*	11,12
Eastern screech-owl	*Otus asio*	8,41,11,12
Great horned owl	*Bubo virginianus*	8
Barred owl	*Strix varia*	8,15,41,39,11,12
Chuck-will’s-widow	*Caprimulgus carolinensis*	8
Whip-poor-will	*Caprimulgus vociferus*	11,12
Common nighthawk	*Chordeiles minor*	8,36
Ruby-throated hummingbird	*Archilochus colubris*	82
Belted kingfisher	*Ceryle alcyon*	63
Northern flicker	*Colaptes auratus*	8
Pileated woodpecker	*Dryocopus pileatus*	11,12

* Non-native Species

Collier-Seminole State Park

Animals

Common Name	*Scientific Name*	Primary Habitat Codes (for all species)
Red-bellied woodpecker	*Melanerpes carolinus*	8,41,11,12
Yellow-bellied sapsucker	*Sphyrapicus varius*	11,12
Southern hairy woodpecker	*Picoides villosus audubonii*	8,41
Downy woodpecker	*Picoides pubescens*	11,12
Red-cockaded woodpecker	*Picoides borealis*	8,41
Eastern kingbird	*Tyrannus tyrannus*	8,41
Gray kingbird	*Tyrannus dominicensis*	64
Western kingbird	*Tyrannus verticalis*	82
Scissor-tailed flycatcher	*Tyrannus forficatus*	82
Great crested flycatcher	*Myiarchus crinitus*	11,12
Eastern phoebe	*Sayornis phoebe*	12
Tree swallow	*Tachycineta bicolor*	All Types
Bank swallow	*Riparia riparia*	36
Barn swallow	*Hirundo rustica*	36
Purple martin	*Progne subis*	OF
Blue jay	*Cyanocitta cristata*	All Types
American crow	*Corvus brachyrhynchos*	All Types
Fish crow	*Corvus ossifragus*	All Types
Tufted titmouse	*Parus bicolor*	11,12
Brown-headed nuthatch	*Sitta pusilla*	8,41
House wren	*Troglodytes aedon*	8
Carolina wren	*Thryothorus ludovicianus*	11,12
Sedge wren	*Cistothorus platensis*	36
Northern mockingbird	*Mimus polyglottos*	MTC
Gray catbird	*Dumetella carolinensis*	11,12
Brown thrasher	*Toxostoma rufum*	11,12
American robin	*Turdus migratorius*	8,41,12,36
Hermit thrush	*Catharus guttatus*	11,12
Eastern bluebird	*Sialia sialis*	8,41
Blue-gray gnatcatcher	*Polioptila caerulea*	11,12
Ruby-crowned kinglet	*Regulus calendula*	11,12
Cedar waxwing	*Bombycilla cedrorum*	11,12
Loggerhead shrike	*Lanius ludovicianus*	8,41
White-eyed vireo	*Vireo griseus*	11,12,39
Blue-headed vireo	*Vireo solitarius*	11,12,39
Black-whiskered vireo	*Vireo altiloquus*	64
Red-eyed vireo	*Vireo olivaceus*	39
Black and white warbler	*Mniotilta varia*	11,12,39
Blue-winged warbler	*Vermivora pinus*	11,12,39
Tennessee warbler	*Vermivora peregrina*	11,12,39
Orange-crowned warbler	*Vermivora celata*	11,12,39
Northern parula	*Parula americana*	11,12,39
Black-throated blue warbler	*Dendroica caerulescens*	11,12,39
Yellow-rumped warbler	*Dendroica coronata*	11,12,39
Black-throated green warbler	*Dendroica virens*	11,12,39
Yellow-throated warbler	*Dendroica dominica*	11,12,39

* Non-native Species

Collier-Seminole State Park

Animals

Common Name	***Scientific Name***	**Primary Habitat Codes (for all species)**
Blackpoll warbler	*Dendroica striata*	11,12,39
Pine warbler	*Dendroica pinus*	8,41
Florida prairie warbler	*Dendroica discolor paludicola*	64
Palm warbler	*Dendroica palmarum*	11,12,39
Ovenbird	*Seiurus aurocapillus*	11,12,39
Common yellowthroat	*Geothlypis trichas*	8,36
American redstart	*Setophaga ruticilla ruticilla*	11,12,39
Eastern meadowlark	*Sturnella magna*	36
Red-winged blackbird	*Agelaius phoeniceus*	36
Boat-tailed grackle	*Quiscalus major*	36
Common grackle	*Quiscalus quiscula*	36,39
Northern cardinal	*Cardinalis cardinalis*	11,12
Rose-breasted grosbeak	*Pheucticus ludovicianus*	82
Painted bunting	*Passerina ciris*	MTC
Eastern towhee	*Pipilo erythrophthalmus*	8
Savannah sparrow	*Passerculus sandwichensis*	36
Swamp sparrow	*Melospiza georgiana*	36
Song sparrow	*Melospiza melodia*	36
American goldfinch	*Carduelis tristis*	36
	MAMMALS	
Virginia opossum	*Didelphis virginiana*	All Types
Short-tailed shrew	*Blarina brevicauda*	11,12
Eastern mole	*Scalopus aquaticus*	8,81
Nine-banded armadillo	*Dasypus novemcinctus* *	11,12
Marsh rabbit	*Sylvilagus palustris*	36
Gray squirrel	*Sciurus carolinensis*	11,12,39
Big Cypress fox squirrel	*Sciurus niger avicennia*	64
Marsh rice rat	*Oryzomys palustris*	36
Cotton mouse	*Peromyscus gossypinus gossypinus*	11,12
Hispid cotton rat	*Sigmodon hispidus*	8
Gray fox	*Urocyon cinereoargenteus*	All Types
Florida black bear	*Ursus americanus floridanus*	All Types
Raccoon	*Procyon lotor*	All Types
River otter	*Lutra canadensis*	64,65
Long-tailed weasel	*Mustela frenata olivacea*	MTC
Eastern spotted skunk	*Spilogale putorius*	41
Spotted skunk	*Mephitis mephitis*	12,81
Florida panther	*Puma concolor*	All Types
Bobcat	*Felis rufus*	All Types
West Indian manatee	*Trichechus manatus*	64,65
Atlantic bottle-nosed dolphin	*Tursiops truncatus*	65
Wild pig	*Sus scrofa* *	8,41
White-tailed deer	*Odocoileus virginianus*	8,41

* Non-native Species

Habitat Codes

Terrestrial

1. Beach Dune
2. Bluff
3. Coastal Berm
4. Coastal Rock Barren
5. Coastal Strand
6. Dry Prairie
7. Maritime Hammock
8. Mesic Flatwoods
9. Coastal Grasslands
10. Pine Rockland
11. Prairie Hammock
12. Rockland Hammock
13. Sandhill
14. Scrub
15. Scrubby Flatwoods
16. Shell Mound
17. Sinkhole
18. Slope Forest
19. Upland Glade
20. Upland Hardwood Forest
21. Upland Mixed Forest
22. Upland Pine Forest
23. Xeric Hammock

Palustrine

24. Basin Marsh
25. Basin Swamp
26. Baygall
27. Bog
28. Bottomland Forest
29. Depression Marsh
30. Dome
31. Floodplain Forest
32. Floodplain Marsh
33. Floodplain Swamp
34. Freshwater Tidal Swamp
35. Hydric Hammock
36. Marl Prairie
37. Seepage Slope
38. Slough
39. Strand Swamp
40. Swale
41. Wet Flatwoods
42. Wet Prairie

Lacustrine

43. Clastic Upland Lake
44. Coastal Dune Lake
45. Coastal Rockland Lake
46. Flatwood/Prairie Lake
47. Marsh Lake

Lacustrine—Continued

48. River Floodplain Lake
49. Sandhill Upland Lake
50. Sinkhole Lake
51. Swamp Lake

Riverine

52. Alluvial Stream
53. Blackwater Stream
54. Seepage Stream
55. Spring-Run Stream

Estuarine

56. Estuarine Composite Substrate
57. Estuarine Consolidated Substrate
58. Estuarine Coral Reef
59. Estuarine Grass Bed
60. Estuarine Mollusk Reef
61. Estuarine Octocoral Bed
62. Estuarine Sponge Bed
63. Estuarine Tidal Marsh
64. Estuarine Tidal Swamp
65. Estuarine Unconsolidated Substrate
66. Estuarine Worm Reef

Marine

67. Marine Algal Bed
68. Marine Composite Substrate
69. Marine Consolidated Substrate
70. Marine Coral Reef
71. Marine Grass Bed
72. Marine Mollusk Reef
73. Marine Octocoral Bed
74. Marine Sponge Bed
75. Marine Tidal Marsh
76. Marine Tidal Swamp
77. Marine Unconsolidated Substrate
78. Marine Worm Reef

Subterranean

79. Aquatic Cave
80. Terrestral Cave

Miscellaneous

81. Ruderal
82. Developed

MTC Many Types Of Communities

OF Overflying

Addendum 5—Designated Species List

Rank Explanations
For FNAI Global Rank, Fnai State Rank, Federal Status, And State Status

The Nature Conservancy and the Natural Heritage Program Network (of which FNAI is a part) define an element as any exemplary or rare component of the natural environment, such as a species, natural community, bird rookery, spring, sinkhole, cave, or other ecological feature. An element occurrence (EO) is a single extant habitat that sustains or otherwise contributes to the survival of a population or a distinct, self-sustaining example of a particular element.

Using a ranking system developed by The Nature Conservancy and the Natural Heritage Program Network, the Florida Natural Areas Inventory assigns two ranks to each element. The global rank is based on an element's worldwide status; the state rank is based on the status of the element in Florida. Element ranks are based on many factors, the most important ones being estimated number of Element occurrences, estimated abundance (number of individuals for species; area for natural communities), range, estimated adequately protected EOs, relative threat of destruction, and ecological fragility.

Federal and State status information is from the U.S. Fish and Wildlife Service; and the Florida Game and Freshwater Fish Commission (animals), and the Florida Department of Agriculture and Consumer Services (plants), respectively.

FNAI GLOBAL RANK DEFINITIONS

G1	=	Critically imperiled globally because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.
G2	=	Imperiled globally because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
G3	=	Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction of other factors.
G4	=	apparently secure globally (may be rare in parts of range)
G5	=	demonstrably secure globally
GH	=	of historical occurrence throughout its range, may be rediscovered (e.g., ivory-billed woodpecker)
GX	=	believed to be extinct throughout range
GXC	=	extirpated from the wild but still known from captivity or cultivation
G#?	=	tentative rank (e.g.,G2?)
G#G#	=	range of rank; insufficient data to assign specific global rank (e.g., G2G3)
G#T#	=	rank of a taxonomic subgroup such as a subspecies or variety; the G portion of the rank refers to the entire species and the T portion refers to the specific subgroup; numbers have same definition as above (e.g., G3T1)
G#Q	=	rank of questionable species - ranked as species but questionable whether it is species or subspecies; numbers have same definition as above (e.g., G2Q)
G#T#Q	=	same as above, but validity as subspecies or variety is questioned.
GU	=	due to lack of information, no rank or range can be assigned (e.g., GUT2).
G?	=	not yet ranked (temporary)
S1	=	Critically imperiled in Florida because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.
S2	=	Imperiled in Florida because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
S3	=	Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction of other factors.
S4	=	apparently secure in Florida (may be rare in parts of range)
S5	=	demonstrably secure in Florida
SH	=	of historical occurrence throughout its range, may be rediscovered (e.g., ivory-billed woodpecker)
SX	=	believed to be extinct throughout range
SA	=	accidental in Florida, i.e., not part of the established biota
SE	=	an exotic species established in Florida may be native elsewhere in North America

SN	=	regularly occurring, but widely and unreliably distributed; sites for conservation hard to determine
SU	=	due to lack of information, no rank or range can be assigned (e.g., SUT2).
S?	=	not yet ranked (temporary)

LEGAL STATUS

N	=	Not currently listed, nor currently being considered for listing,by state or federal agencies.

FEDERAL **(Listed by the U. S. Fish and Wildlife Service - USFWS)**

LE	=	Listed as Endangered Species in the List of Endangered and Threatened Wildlife and Plants under the provisions of the Endangered Species Act. Defined as any species that is in danger of extinction throughout all or a significant portion of its range.
PE	=	Proposed for addition to the List of Endangered and Threatened Wildlife and Plants as Endangered Species.
LT	=	Listed as Threatened Species. Defined as any species that is likely to become an endangered species within the near future throughout all or a significant portion of its range.
PT	=	Proposed for listing as Threatened Species.
C	=	Candidate Species for addition to the list of Endangered and Threatened Wildlife and Plants. Defined as those species for which the USFWS currently has on file sufficient information on biological vulnerability and threats to support proposing to list the species as endangered or threatened.
E(S/A)	=	Endangered due to similarity of appearance.
T(S/A)	=	Threatened due to similarity of appearance.

STATE

Animals **(Listed by the Florida Fish and Wildlife Conservation Commission - FFWCC)**

LE	=	Listed as Endangered Species by the FFWCC. Defined as a species, subspecies, or isolated population which is so rare or depleted in number or so restricted in range of habitat due to any man-made or natural factors that it is in immediate danger of extinction or extirpation from the state, or which may attain such a status within the immediate future.
LT	=	Listed as Threatened Species by the FFWCC. Defined as a species, subspecies, or isolated population which is acutely vulnerable to environmental alteration, declining in number at a rapid rate, or whose range or habitat is decreasing in area at a rapid rate and as a consequence is destined or very likely to become an endangered species within the foreseeable future.
LS	=	Listed as Species of Special Concern by the FFWCC. Defined as a population which warrants special protection, recognition, or consideration because it has an inherent significant vulnerability to habitat modification, environmental alteration, human disturbance, or substantial human exploitation which, in the foreseeable future, may result in its becoming a threatened species.

Plants **(Listed by the Florida Department of Agriculture and Consumer Services - FDACS)**

LE	=	Listed as Endangered Plants in the Preservation of Native Flora of Florida Act. Defined as species of plants native to the state that are in imminent danger of extinction within the state, the survival of which is unlikely if the causes of a decline in the number of plants continue, and includes all species determined to be endangered or threatened pursuant to the Federal Endangered Species Act of 1973,as amended.
LT	=	Listed as Threatened Plants in the Preservation of Native Flora of Florida Act. Defined as species native to the state that are in rapid decline in the number of plants within the state, but which have not so decreased in such number as to cause them to be endangered.

Collier-Seminole State Park

Designated Species

Plants

Common Name/ *Scientific Name*	**FDA**	**USFWS**	**FNAI**
		Designated Species Status	
Golden leather fern *Acrostichum aureum*	LT		G5,S3
Wild birdnest fern *Asplenium serratum*	LE		G4,S1
Pine pink *Bletia purpurea*	LT		
Satinleaf *Chrysophyllum oliviforme*	LT		
Cowhorn orchid; Cigar orchid *Cyrtopodium punctatum*	LE		G5?,S1
Guiana-plum *Drypetes lateriflora*	LT		
Tampa butterfly orchid *Encyclia tampensis*	CE		
Dingy-flowered epidendrum *Epidendrum anceps*	LE		
Umbelled epidendrum *Epidendrum floridense*	LE		
Night-scent orchid *Epidendrum nocturnum*	LE		G4G5,S2
Rigid epidendrum *Epidendrum rigidum*	LE		
Wild cotton *Gossypium hirsutum*	LE		G4G5,S3
Hammock false-rein orchid *Habenaria distans*	LE		G5S1
Snowy orchid; Bog torch *Habenaria nivea*	LT		
Jingle-bell orchid *Harrisella porrecta*	LT		
Pine lily; Catesby's lily *Lilium catesbaei*	LT		
Nodding club-moss *Lycopodiella cernua*	CE		
Simpson's stopper *Myrcianthes fragrans*	LT		
Giant sword fern *Nephrolepis biserrata*	LT		
Hand fern *Ophioglossum palmatum*	LE		G4,S2
Erect prickly-pear cactus *Opuntia stricta*	LT		
Pineland passion vine *Passiflora pallens*	LE		G3G4,S2
Ghost orchid *Dendrophylax lindenii*	LE		G2G4,S2

Collier-Seminole State Park

Designated Species

Plants

Common Name/ *Scientific Name*	**FDA**	**USFWS**	**FNAI**
Pale-flowered polystachya *Polystachya concreta*	LE		
Florida royal palm *Roystonea regia*	LE	MC	G2,S2
Beachberry; Inkberry *Scaevola plumieri*	LT		
Mullein nightshade *Solanum donianum*	LT		
West Indian mahogany *Swietenia mahagoni*	LT		G3G4,S3
Medusahead air plant *Tillandsia balbisiana*	LT		
Cardinal air plant; Stiff-leaved wild pine *Tillandsia fasciculata*	LE		
Twisted air plant *Tillandsia flexuosa*	LT		G5,S3
Fuzzy-wuzzy air plant *Tillandsia pruinosa*	LE		G4,S1
Spreading air plant *Tillandsia utriculata*	LE		
Soft-leaved wild pine *Tillandsia variabilis*	LT		
Chiggery grapes; Soldier vine *Tournefortia hirsutissima*	LE		

Collier-Seminole State Park

Designated Species

Animals

Common Name/ *Scientific Name*	**FFWCC**	**USFWS**	**FNAI**
		Designated Species Status	
REPTILES			
American alligator *Alligator mississippiensis*	LS	T(S/A)	G5/S4
American crocodile *Crocodylus acutus*	LE	LE	G2/S1
Gopher tortoise *Gopherus polyphemus*	LS		G3/S3
Eastern indigo snake *Drymarchon corais*	LT	LT	G4T3/S3
BIRDS			
Eastern brown pelican *Pelecanus occidentalis*	LS		G4/S3
Great white heron *Ardea herodias*			G5T2/S2
Little blue heron *Egretta caerulea*	LS		G5S4
Great egret *Ardea alba*			G5/S4
Snowy egret *Egretta thula*	LS		G5/S3
Tricolored heron *Egretta tricolor*	LS		G5/S4
Black-crowned night heron *Nycticorax nycticorax*			G5/S3
Yellow-crowned night heron *Nycticorax violaceus*			G5/S3
Wood stork *Mycteria americana*	LE	LE	G4/S2
Glossy ibis *Plegadis falcinellus*			G5/S3
White ibis *Eudocimus albus*	LS		G5/S4
Roseate spoonbill *Ajaia ajaja*	LS		G5/S2
Snail kite *Rostramus sociabilis*	LE	LE	G4G5T2/S2
Cooper's hawk *Accipiter cooperii*			G5/S3
Short-tailed hawk *Buteo brachyurus*			G4G5/S1
Southern bald eagle *Haliaeetus leucocephalus*	LT	LT	G4/S3
Osprey *Pandion haliaetus*			G5/S3S4

Collier-Seminole State Park

Designated Species

Animals

Common Name/ *Scientific Name*	**FFWCC**	**USFWS**	**FNAI**
	Designated Species Status		
Peregrine falcon *Falco peregrinus*	LE		G4/S2
Limpkin *Aramus guarauna*	LS		G5/S3
American oystercatcher *Haematopus palliatus*	LS		G5/S2
Least tern *Sterna antillarum*	LT		G4/S3
Royal tern *Sterna maxima*			G5/S3
Sandwich tern *Sterna sandvicensis*			G5/S2
Caspian tern *Sterna caspia*			G5/S2
White-crowned pigeon *Columba leucocephala*	LT		G3/S3
Mangrove cuckoo *Coccyzus minor*			G5/S3
Southern hairy woodpecker *Picoides villosus*			G5/S3
Red-cockaded woodpecker *Picoides borealis*	LT	LE	G3/S2
Black-whiskered vireo *Vireo altiloguus*			G5/S3
Florida prairie warbler *Dendroica discolor*			G5T3/S3
American redstart *Setophaga ruticilla*			G5/S2
MAMMALS			
Mangrove fox squirrel *Sciurus niger avicennia*	LT		G5T2/S2
Florida black bear *Ursus americanus*	LT		G5T2/S2
Long-tailed weasel *Mustela frenata*			G5T3/S3
Florida panther *Puma concolor*	LE	LE	G5T1/S1
West Indian manatee *Trichechus manatus*	LE	LE	G2/S2

Addendum 6—Priority Schedule And Cost Estimates

Estimates are developed for the funding and staff resources needed to implement the management plan based on goals, objectives and priority management activities. Funding priorities for all state park management and development activities are reviewed each year as part of the Division's legislative budget process. The Division prepares an annual legislative budget request based on the priorities established for the entire state park system. The Division also aggressively pursues a wide range of other funds and staffing resources, such as grants, volunteers, and partnerships with agencies, local governments and the private sector for supplementing normal legislative appropriations to address unmet needs. The ability of the Division to implement the specific goals, objectives and priority actions identified in this plan will be determined by the availability of funding resources for these purposes.

ADMINISTRATION

1. Two FTE positions. 10 years. **Estimated cost:** **$448,000.**

RESOURCE MANAGEMENT

2. Procure new brush truck. 0-1 years. **Estimated cost:** **$50,000.**

3. Prescribed burning program to maintain and restore natural communities, 0-10 years. **Estimated Cost: $5110/yr. Reoccurring (10 yrs):** **$51,100.**

4. Exotic plant removal/control. **Estimated Cost: $4000/yr. Reoccurring (10 yrs):** **$40,000.**

Total Estimated Cost: **$ 589,100.**

Collier-Seminole State Park
Priority Schedule And Cost Estimates

Item	Quantity	Unit	Unit Price	Multiplier	Amount
NEW FACILITY CONSTRUCTION					
Boat Basin and Picnic Area					
Concrete Sidewalks	2000.000	SF	$4.00	1.25	$10,000.00
Relocated Concession Building	1.000	ea.	$90,000.00	1.25	$112,500.00
Dock Improvements	1.000	ea.	$180,000.00	1.25	$225,000.00
Screened Pavilion and BBQ Pit	1.000	ea.	$60,000.00	1.25	$75,000.00
Replace Medium Picnic Restroom	1.000	ea.	$105,000.00	1.25	$131,250.00
Replace Playground Equipment	1.000	ea.	$24,000.00	1.25	$30,000.00
Replace Small Picnic Shelters	4.000	ea.	$21,000.00	1.25	$105,000.00
Waiting Shelter	1.000	ea.	$60,000.00	1.25	$75,000.00
Campground					
Redesign and Upgrade Standard Camping Area	1.000	ea.	$500,000.00	1.25	$625,000.00
Support Facilities					
Ranger Residence	1.000	ea.	$165,000.00	1.25	$206,250.00
Trails and Interpretation					
Replace Nature Trail Boardwalk	2640.000	LF	$75.00	1.25	$247,500.00
Upgrade Interpretive Center Exhibits	1.000	LS	$70,000.00	1.25	$87,500.00
Interpretive Signs	6.000	ea.	$5,000.00	1.25	$37,500.00
Expand Shared-Use Trail	5280.000	LF	$1.00	1.25	$6,600.00
Safety Signs / Crosswalk	1.000	ea.	$15,000.00	1.25	$18,750.00

Sub-Total$1,992,850.00

20 Percent Design, Permitting and Contingency Fee $398,570.00

Total$2,391,420.00

NOTE: These preliminary cost estimates, based on Divisions standards, do not include costs for site-specific elements not evident at the conceptual level of planning. Additional costs should be investigated before finalizing budget estimates. All items fall in the new facility construction category © of the uniform cost accounting system required by ch. 259.037 F.S.

This summary presents the hierarchical classification and brief descriptions of 82 Natural Communities developed by Florida Natural Areas Inventory and identified as collectively constituting the original, natural biological associations of Florida.

A Natural Community is defined as a distinct and recurring assemblage of populations of plants, animals, fungi and microorganisms naturally associated with each other and their physical environment. For more complete descriptions, see Guide to the Natural Communities of Florida, available from Florida Department of Natural Resources.

The levels of the hierarchy are:

Natural Community Category - defined by hydrology and vegetation.

Natural Community Groups - defined by landform, substrate, and vegetation.

Natural Community Type - defined by landform and substrate; soil moisture condition; climate; fire; and characteristic vegetation.

TERRESTRIAL - Upland habitats dominated by plants which are not adapted to anaerobic soil conditions imposed by saturation or inundation for more than 10% of the growing season.

XERIC UPLANDS - very dry, deep, well-drained hills of sand with xeric-adapted vegetation.

Sandhill - upland with deep sand substrate; xeric; temperate; frequent fire (2-5 years); longleaf pine and/or turkey oak with wiregrass understory.

Scrub - old dune with deep fine sand substrate; xeric; temperate or subtropical; occasional or rare fire (20 - 80 years); sand pine and/or scrub oaks and/or rosemary and lichens.

Xeric Hammock - upland with deep sand substrate; xeric-mesic; temperate or subtropical; rare or no fire; live oak and/or sand live oak and/or laurel oak and/or other oaks, sparkleberry, saw palmetto.

COASTAL UPLANDS - substrate and vegetation influenced primarily by such coastal (maritime) processes as erosion, deposition, salt spray, and storms.

Beach Dune - active coastal dune with sand substrate; xeric; temperate or subtropical; occasional or rare fire; sea oats and/or mixed salt-spray tolerant grasses and herbs.

Coastal Berm - old bar or storm debris with sand/shell substrate; xeric-mesic; subtropical or temperate; rare or no fire; buttonwood, mangroves, and/or mixed halophytic herbs and/or shrubs and trees.

Coastal Grassland - coastal flatland with sand substrate; xeric-mesic; subtropical or temperate; occasional fire; grasses, herbs, and shrubs with or without slash pine and/or cabbage palm.

Coastal Rock Barren - flatland with exposed limestone substrate; xeric; subtropical; no fire; algae, mixed halophytic herbs and grasses, and/or cacti and stunted shrubs and trees.

Coastal Strand - stabilized coastal dune with sand substrate; xeric; subtropical or temperate; occasional or rare fire; dense saw palmetto and/or seagrape and/or mixed stunted shrubs, yucca, and cacti.

Maritime Hammock - stabilized coastal dune with sand substrate; xeric-mesic; subtropical or temperate; rare or no fire; mixed hardwoods and/or live oak.

Shell Mound - Indian midden with shell substrate; xeric-mesic; subtropical or temperate; rare or no fire; mixed hardwoods.

MESIC UPLANDS - dry to moist hills of sand with varying amounts of clay, silt or organic material; diverse mixture of broadleaved and needleleaved temperate woody species.

Bluff - steep slope with rock, sand, and/or clay substrate; hydric-xeric; temperate; sparse grasses, herbs and shrubs.

Slope Forest - steep slope on bluff or in sheltered ravine; sand/clay substrate; mesic-hydric; temperate; rare or no fire; magnolia, beech, spruce pine, Shumard oak, Florida maple, mixed hardwoods.

Upland Glade - upland with calcareous rock and/or clay substrate; hydric-xeric; temperate; sparse mixed grasses and herbs with occasional stunted trees and shrubs, e.g., eastern red cedar.

Upland Hardwood Forest - upland with sand/clay and/or calcareous substrate; mesic; temperate; rare or no fire; spruce pine, magnolia, beech, pignut hickory, white oak, and mixed hardwoods.

Upland Mixed Forest - upland with sand/clay substrate; mesic; temperate; rare or no fire; loblolly pine and/or shortleaf pine and/or laurel oak and/or magnolia and spruce pine and/or mixed hardwoods.

Upland Pine Forest - upland with sand/clay substrate; mesic-xeric; temperate; frequent or occasional fire; longleaf pine and/or loblolly pine and/or shortleaf pine, southern red oak, wiregrass.

ROCKLANDS - low, generally flat limestone outcrops with tropical vegetation; or limestone exposed through karst activities with tropical or temperate vegetation.

Pine Rockland - flatland with exposed limestone substrate; mesic-xeric; subtropical; frequent fire; south Florida slash pine, palms and/or hardwoods, and mixed grasses and herbs.

Rockland Hammock - flatland with limestone substrate; mesic; subtropical; rare or no fire; mixed tropical hardwoods, often with live oak.

Sinkhole - karst feature with steep limestone walls; mesic-hydric; subtropical or temperate; no fire; ferns, herbs, shrubs, and hardwoods.

MESIC FLATLANDS - flat, moderately well-drained sandy substrates with admixture of organic material, often with a hard pan.

Dry Prairie - flatland with sand substrate; mesic-xeric; subtropical or temperate; annual or frequent fire; wiregrass, saw palmetto, and mixed grasses and herbs.

Mesic Flatwoods - flatland with sand substrate; mesic; subtropical or temperate; frequent fire; slash pine and/or longleaf pine with saw palmetto, gallberry and/or wiregrass or cutthroat grass understory.

Prairie Hammock - flatland with sand/organic soil over marl or limestone substrate; mesic; subtropical; occasional or rare fire; live oak and/or cabbage palm.

Scrubby Flatwoods - flatland with sand substrate; xeric-mesic; subtropical or temperate; occasional fire; longleaf pine or slash pine with scrub oaks and wiregrass understory.

PALUSTRINE - Wetlands dominated by plants adapted to anaerobic substrate conditions imposed by substrate saturation or inundation during 10% or more of the growing season. Includes non-tidal wetlands; tidal wetlands with ocean derived salinities less than 0.5 ppt and dominance by salt-intolerant species; small (less than 8 ha), shallow (less than 2 m deep at low water) water bodies without wave-formed or bedrock shoreline; and inland brackish or saline wetlands.

WET FLATLANDS - flat, poorly drained sand, marl or limestone substrates.

Hydric Hammock - lowland with sand/clay/organic soil, often over limestone; mesic-hydric; subtropical or temperate; rare or no fire; water oak, cabbage palm, red cedar, red maple, bays, hackberry, hornbeam, blackgum, needle palm, and mixed hardwoods.

Marl Prairie - flatland with marl over limestone substrate; seasonally inundated; tropical; frequent to no fire; sawgrass, spikerush, and/or mixed grasses, sometimes with dwarf cypress.

Wet Flatwoods - flatland with sand substrate; seasonally inundated; subtropical or temperate; frequent fire; vegetation characterized by slash pine or pond pine and/or cabbage palm with mixed grasses and herbs.

Wet Prairie - flatland with sand substrate; seasonally inundated; subtropical or temperate; annual or frequent fire; maidencane, beakrush, spikerush, wiregrass, pitcher plants, St. John's wort, mixed herbs.

SEEPAGE WETLANDS - sloped or flat sands or peat with high moisture levels maintained by downslope seepage; wetland and mesic woody and/or herbaceous vegetation.

Baygall - wetland with peat substrate at base of slope; maintained by downslope seepage, usually saturated and occasionally inundated; subtropical or temperate; rare or no fire; bays and/or dahoon holly and/or red maple and/or mixed hardwoods.

Seepage Slope - wetland on or at base of slope with organic/sand substrate; maintained by downslope seepage, usually saturated but rarely inundated; subtropical or temperate; frequent or occasional fire; sphagnum moss, mixed grasses and herbs or mixed hydrophytic shrubs.

FLOODPLAIN WETLANDS - flat, alluvial sand or peat substrates associated with flowing water courses and subjected to flooding but not permanent inundation; wetland or mesic woody and herbaceous vegetation.

Bottomland Forest - flatland with sand/clay/organic substrate; occasionally inundated; temperate; rare or no fire; water oak, red maple, beech, magnolia, tuliptree, sweetgum, bays, cabbage palm, and mixed hardwoods.

Floodplain Forest - floodplain with alluvial substrate of sand, silt, clay or organic soil; seasonally inundated; temperate; rare or no fire; diamondleaf oak, overcup oak, water oak, swamp chestnut oak, blue palmetto, cane, and mixed hardwoods.

Floodplain Marsh - floodplain with organic/sand/alluvial substrate; seasonally inundated; subtropical; frequent or occasional fire; maidencane, pickerelweed, sagittaria spp., buttonbush, and mixed emergents.

Floodplain Swamp - floodplain with organic/alluvial substrate; usually inundated; subtropical or temperate; rare or no fire; vegetation characterized by cypress, tupelo, black gum, and/or pop ash.

Freshwater Tidal Swamp - river mouth wetland, organic soil with extensive root mat; inundated with freshwater in response to tidal cycles; rare or no fire; cypress, bays, cabbage palm, gums and/or cedars.

Slough - broad, shallow channel with peat over mineral substrate; seasonally inundated, flowing water; subtropical; occasional or rare fire; pop ash and/or pond apple or water lily.

Strand Swamp - broad, shallow channel with peat over mineral substrate; seasonally inundated, flowing water; subtropical; occasional or rare fire; cypress and/or willow.

Swale - broad, shallow channel with sand/peat substrate; seasonally inundated, flowing water; subtropical or temperate; frequent or occasional fire; sawgrass, maidencane, pickerelweed, and/or mixed emergents.

BASIN WETLANDS - shallow, closed basin with outlet usually only in time of high water; peat or sand substrate, usually inundated; wetland woody and/or herbaceous vegetation.

Basin Marsh - large basin with peat substrate; seasonally inundated; temperate or subtropical; frequent fire; sawgrass and/or cattail and/or buttonbush and/or mixed emergents.

Basin Swamp - large basin with peat substrate; seasonally inundated, still water; subtropical or temperate; occasional or rare fire; vegetation characterized by cypress, blackgum, bays and/or mixed hardwoods.

Bog - wetland on deep peat substrate; moisture held by sphagnum mosses, soil usually saturated, occasionally inundated; subtropical or temperate; rare fire; sphagnum moss and titi and/or bays and/or dahoon holly, and/or mixed hydrophytic shrubs.

Coastal Interdunal Swale - long narrow depression wetlands in sand/peat-sand substrate; seasonally inundated, fresh to brackish, still water; temperate; rare fire;

graminoids and mixed wetland forbs.

Depression Marsh - small rounded depression in sand substrate with peat accumulating toward center; seasonally inundated, still water; subtropical or temperate; frequent or occasional fire; maidencane, fire flag, pickerelweed, and mixed emergents, may be in concentric bands.

Dome Swamp - rounded depression in sand/limestone substrate with peat accumulating toward center; seasonally inundated, still water; subtropical or temperate; occasional or rare fire; cypress, blackgum, or bays, often tallest in center.

LACUSTRINE - Non-flowing wetlands of natural depressions lacking persistent emergent vegetation except around the perimeter.

Clastic Upland Lake - generally irregular basin in clay uplands; predominantly with inflows, frequently without surface outflow; clay or organic substrate; colored, acidic, soft water with low mineral content (sodium, chloride, sulfate); oligo-mesotrophic to eutrophic.

Coastal Dune Lake - basin or lagoon influenced by recent coastal processes; predominantly sand substrate with some organic matter; salinity variable among and within lakes, and subject to saltwater intrusion and storm surges; slightly acidic, hard water with high mineral content (sodium, chloride).

Coastal Rockland Lake - shallow basin influence by recent coastal processes; predominantly barren oolitic or Miami limestone substrate; salinity variable among and within lakes, and subject to saltwater intrusion, storm surges and evaporation (because of shallowness); slightly alkaline, hard water with high mineral content (sodium, chloride).

Flatwoods/Prairie Lake - generally shallow basin in flatlands with high water table; frequently with a broad littoral zone; still water or flow-through; sand or peat substrate; variable water chemistry, but characteristically colored to clear, acidic to slightly alkaline, soft to moderately hard water with moderate mineral content (sodium, chloride, sulfate); oligo-mesotrophic to eutrophic.

Marsh lake - generally shallow, open water area within wide expanses of freshwater marsh; still water or flow-through; peat, sand or clay substrate; occurs in most physiographic regions; variable water chemistry, but characteristically highly colored, acidic, soft water with moderate mineral content (sodium, chloride, sulfate); oligo-mesotrophic to eutrophic.

River Floodplain Lake - meander scar, backwater, or larger flow-through body within major river floodplains; sand, alluvial or organic substrate; colored, alkaline or slightly acidic, hard or moderately hard water with high mineral content (sulfate, sodium, chloride, calcium, magnesium); mesotrophic to eutrophic.

Sandhill Upland Lake - generally rounded solution depression in deep sandy uplands or sandy uplands shallowly underlain by limestone; predominantly without surface inflows/outflows; typically sand substrate with organic accumulations toward middle; clear, acidic moderately soft water with varying mineral content; ultra-oligotrophic to mesotrophic.

Sinkhole Lake - typically deep, funnel-shaped depression in limestone base; occurs in most physiographic regions; predominantly without surface inflows/outflows, but frequently with connection to the aquifer; clear, alkaline, hard water with high mineral content (calcium, bicarbonate, magnesium).

Swamp Lake - generally shallow, open water area within basin swamps; still water or flow-through; peat, sand or clay substrate; occurs in most physiographic regions; variable water chemistry, but characteristically highly colored, acidic, soft water with moderate mineral content (sodium, chloride, sulfate); oligo-mesotrophic to eutrophic.

RIVERINE - Natural, flowing waters from their source to the downstream limits of tidal influence and bounded by channel banks.

Alluvial Stream - lower perennial or intermittent/seasonal watercourse characterized by turbid water with suspended silt, clay, sand and small gravel; generally with a distinct, sediment-derived (alluvial) floodplain and a sandy, elevated natural levee just inland from the bank.

Blackwater Stream - perennial or intermittent/seasonal watercourse characterized by tea-colored water with a high content of particulate and dissolved organic matter derived from drainage through swamps and marshes; generally lacking an alluvial floodplain.

Seepage Stream - upper perennial or intermittent/seasonal watercourse characterized by clear to lightly colored water derived from shallow groundwater seepage.

Spring-run Stream - perennial watercourse with deep aquifer headwaters and characterized by clear water, circumneutral pH and, frequently, a solid limestone bottom.

SUBTERRANEAN - Twilight, middle and deep zones of natural chambers overlain by the earth's crust and characterized by climatic stability and assemblages of trogloxenic, troglophilic, and troglobitic organisms.

Aquatic Cave - cavernicolous area permanently or periodically submerged; often characterized by troglobitic crustaceans and salamanders; includes high energy systems which receive large quantities of organic detritus and low energy systems.

Terrestrial Cave - cavernicolous area lacking standing water; often characterized by bats, such as Myotis spp., and other terrestrial vertebrates and invertebrates; includes interstitial areas above standing water such as fissures in the ceiling of caves.

MARINE/ESTUARINE (The distinction between the Marine and Estuarine Natural Communities is often subtle, and the natural communities types found under these two community categories have the same descriptions. For these reasons they have been grouped together.) - Subtidal, intertidal and supratidal zones of the sea, landward to the point at which seawater becomes significantly diluted with freshwater inflow from the land.

Consolidated Substrate - expansive subtidal, intertidal and supratidal area composed primarily of nonliving compacted or coherent and relatively hard, naturally formed mass of mineral matter (e.g., coquina limerock and relic reefs); octocorals, sponges, stony corals, nondrift macrophytic algae, blue-green mat-forming algae and seagrasses sparse, if present.

Unconsolidated Substrate - expansive subtidal, intertidal and supratidal area composed primarily of loose mineral matter (e.g., coralgal, gravel, marl, mud, sand and shell); octocorals, sponges, stony corals, nondrift macrophytic algae, blue-green mat-forming algae and seagrasses sparse, if present.

Octocoral Bed - expansive subtidal area occupied primarily by living sessile organisms of the Class Anthozoa, Subclass Octocorallia (e.g., soft corals, horny corals, sea fans, sea whips, and sea pens); sponges, stony corals, nondrift macrophytic algae and seagrasses spares, if present.

Sponge Bed - expansive subtidal area occupied primarily by living sessile organisms of the Phylum Porifera (e.g., sheepswool sponge, Florida loggerhead sponge and branching candle sponge); octocorals, stony corals, nondrift macrophytic algae and seagrasses sparse, if present.

Coral Reef - expansive subtidal area with elevational gradient or relief and occupied primarily by living sessile organisms of the Class Hydrozoa (e.g., fire corals and hydrocorals) and Class Anthozoa, Subclass Zoantharia (e.g., stony corals and black corals); includes deepwater bank reefs, fringing barrier reefs, outer bank reefs and patch reefs, some of which may contain distinct zones of assorted macrophytes, octocorals, & sponges.

Mollusk Reef - substantial subtidal or intertidal area with relief from concentrations of sessile organisms of the Phylum Mollusca, Class Bivalvia (e.g., molluscs, oysters, & worm shells); octocorals, sponges, stony corals, macrophytic algae and seagrasses sparse, if present.

Worm Reef - substantial subtidal or intertidal area with relief from concentrations of sessile, tubicolous organisms of the Phylum Annelida, Class Polychaeta (e.g., chaetopterids and sabellarids); octocorals, sponges, stony corals, macrophytic algae and seagrasses sparse, if present.

Algal Bed - expansive subtidal, intertidal or supratidal area, occupied primarily by attached thallophytic or mat-forming prokaryotic algae (e.g, halimeda, blue-green algae); octocorals, sponges, stony corals and seagrasses sparse, if present.

Grass Bed - expansive subtidal or intertidal area, occupied primarily by rooted vascular macrophytes, (e.g., shoal grass, halophila, widgeon grass, manatee grass and turtle grass); may include various epiphytes and epifauna; octocorals, sponges, stony corals, and attached macrophytic algae sparse, if present.

Composite Substrate - expansive subtidal, intertidal, or supratidal area, occupied primarily by Natural Community elements from more than one Natural Community category (e.g., Grass Bed and Algal Bed species; Octocoral and Algal Bed species); includes both patchy and evenly distributed occurrences.

Tidal Marsh - expansive intertidal or supratidal area occupied primarily by rooted, emergent vascular macrophytes (e.g., cord grass, needlerush, saw grass, saltwort, saltgrass and glasswort); may include various epiphytes and epifauna.

Tidal Swamp - expansive intertidal and supratidal area occupied primarily by woody vascular macrophytes (e.g., black mangrove, buttonwood, red mangrove, and white mangrove); may include various epiphytes and epifauna.

DEFINITIONS OF TERMS Terrestrial and Palustrine Natural Communities

Physiography

Upland - high area in region with significant topographic relief; generally undulating
Lowland - low area in region with or without significant topographic relief; generally flat to gently sloping
Flatland - generally level area in region without significant topographic relief; flat to gently sloping
Basin - large, relatively level lowland with slopes confined to the perimeter or isolated interior locations
Depression - small depression with sloping sides, deepest in center and progressively shallower towards the perimeter
Floodplain - lowland adjacent to a stream; topography influenced by recent fluvial processes
Bottomland - lowland not on active floodplain; sand/clay/organic substrate

Hydrology

occasionally inundated - surface water present only after heavy rains and/or during flood stages
seasonally inundated - surface water present during wet season and flood periods
usually inundated - surface water present except during droughts

Climatic Affinity of the Flora

tropical - community generally occurs in practically frost-free areas
subtropical - community generally occurs in areas that experience occasional frost, but where freezing temperatures are not frequent enough to cause true winter dormancy
temperate - community generally occurs in areas that freeze often enough that vegetation goes into winter dormancy

Fire

annual fire - burns about every 1-2 years
frequent fire - burns about every 3-7 years
occasional fire - burns about every 8-25 years
rare fire - burns about every 26-100 years
no fire - community develops only when site goes more than 100 years without burning

LATIN NAMES OF PLANTS MENTIONED IN NATURAL COMMUNITY DESCRIPTIONS

anise - *Illicium floridanum*
bays:
  swamp bay -*Persea palustris*
  gordonia -*Gordonia lasianthus*
  sweetbay -*Magnolia virgiana*
beakrush - *Rhynchospora* spp.
beech - *Fagus grandifolia*
blackgum - *Nyssa biflora*
blue palmetto - *Sabal minor*
bluestem - *Andropogon* spp.
buttonbush - *Cephalanthus occidentalis*
cabbage palm - *Sabal palmetto*
cacti - *Opuntia* and *Harrisia* spp., predominantly *stricta* and *pentagonus*
cane - *Arundinaria gigantea* or *A. tecta*
cattail - *Typha* spp.
cedars:
  red cedar - *Juniperus silicicola*
  white cedar - *Chamaecyparis thyoides* or *C. henryi*
cladonia - *Cladonia* spp.
cypress - *Taxodium distichum*
dahoon holly - *Ilex cassine*
diamondleaf oak - *Quercus laurifolia*
fire flag - *Thalia geniculata*
Florida maple - *Acer barbatum*
gallberry - *Ilex glabra*
gums:
  tupelo - *Nyssa aquatica*
  blackgum - *Nyssa biflora*
  Ogeechee gum - *Nyssa ogeche*
hackberry - *Celtis laevigata*
hornbeam - *Carpinus caroliniana*
laurel oak - *Quercus hemisphaerica*
live oak - *Quercus virginiana*
loblolly pine - *Pinus taeda*
longleaf pine - *Pinus palustris*
magnolia - *Magnolia grandiflora*
maidencane - *Panicum hemitomon*
needle palm - *Rhapidophyllum hystrix*
overcup oak - *Quercus lyrata*
pickerel weed - *Pontederia cordata* or *P. lanceolata*
pignut hickory - *Carya glabra*
pop ash - *Fraxinus caroliniana*
pond apple - *Annona glabra*
pond pine - *Pinus serotina*
pyramid magnolia - *Magnolia pyramidata*
railroad vine - *Ipomoea pes-caprae*
red cedar - *Juniperus silicicola*
red maple - *Acer rubrum*
red oak - *Quercus falcata*
rosemary - *Ceratiola ericoides*
sagittaria - *Sagittaria lancifolia*
sand pine - *Pinus clausa*
saw palmetto - *Serenoa repens*
sawgrass - *Cladium jamaicensis*
scrub oaks - *Quercus geminata, Q. chapmanii, Q. myrtifolia,Q. inopina*
sea oats - *Uniola paniculata*
seagrape - *Coccoloba uvifera*
shortleaf pine - *Pinus echinata*
Shumard oak - *Quercus shumardii*
slash pine - *Pinus elliottii*
sphagnum moss - *Sphagnum* spp.
spikerush - *Eleocharis* spp.
spruce pine - *Pinus glabra*
St. John's wort - *Hypericum* spp.
swamp chestnut oak - *Quercus prinus*
sweetgum - *Liquidambar styraciflua*
titi - *Cyrilla racemiflora*, and *Cliftonia monophylla*
tuliptree - *Liriodendron tulipfera*
tupelo - *Nyssa aquatica*
turkey oak - *Quercus laevis*
water oak - *Quercus nigra*
waterlily - *Nymphaea odorata*
white cedar - *Chamaecyparis thyoides*
white oak - *Quercus alba*
willow - *Salix caroliniana*
yucca - *Yucca aloifolia*

Management Procedures For
Archaeological And Historical Sites And Properties
On State -- Owned Or Controlled Lands
(Revised August, 1995)

A. GENERAL DISCUSSION

Archaeological and historic sites are defined collectively in 267.021(3), F.S., as "historic properties" or "historic resources." They have several essential characteristics that must be recognized in a management program.

First of all, they are a finite and non-renewable resource. Once destroyed, presently existing resources, including buildings, other structures, shipwreck remains, archaeological sites and other objects of antiquity, cannot be renewed or revived. Today, sites in the State of Florida are being destroyed by all kinds of land development, inappropriate land management practices, erosion, looting, and to a minor extent even by well-intentioned professional scientific research (e.g., archaeological excavation). Measures must be taken to ensure that some of these resources will be preserved for future study and appreciation.

Secondly, sites are unique because individually they represent the tangible remains of events that occurred at a specific time and place.

Thirdly, while sites uniquely reflect localized events, these events and the origin of particular sites are related to conditions and events in other times and places. Sites can be understood properly only in relation to their natural surroundings and the activities of inhabitants of other sites. Managers must be aware of this "systemic" character of historic and archaeological sites. Also, it should be recognized that archaeological sites are time capsules for more than cultural history; they preserve traces of past biotic communities, climate, and other elements of the environment that may be of interest to other scientific disciplines.

Finally, the significance of sites, particularly archaeological ones, derives not only from the individual artifacts within them, but equally from the spatial arrangement of those artifacts in both horizontal and vertical planes. When archaeologists excavate, they recover, not merely objects, but also a record of the positions of these objects in relation to one another and their containing matrix (e.g., soil strata). Much information is sacrificed if the so-called "context" of archaeological objects is destroyed or not recovered, and this is what archaeologists are most concerned about when a site is threatened with destruction or damage. The artifacts themselves can be recovered even after a site is heavily disturbed, but the context -- the vertical and horizontal relationships -- cannot. Historic structures also contain a wealth of cultural (socio-economic) data that can be lost if historically sensitive maintenance, restoration or rehabilitation procedures are not implemented, or if they are demolished or extensively altered without appropriate documentation. Lastly, it should not be forgotten that historic structures often have associated potentially significant historic archaeological features that must be considered in land management decisions.

B. STATUTORY AUTHORITY

Chapter 253, Florida Statutes ("State Lands") directs the preparation of "single-use" or "multiple-use" land management plans for all state-owned lands and state-owned sovereignty submerged lands. In this document, 253.034(4), F.S., specifically requires that "all management plans, whether for single-use or multiple-use properties, shall specifically describe how the managing agency plans to identify, locate, protect and preserve, or otherwise use fragile non-renewable resources, such as archaeological and historic sites, as well as other fragile resources..."

Chapter 267, Florida Statutes is the primary historic preservation authority of the state. The importance of protecting and interpreting archaeological and historic sites is recognized in 267.061(1)(a), F.S.:The rich and unique heritage of historic properties in this state, representing more than 10,000 years of human presence, is an important legacy to be valued and conserved for present and future generations. The destruction of these nonrenewable historic resources will engender a significant loss to the state's quality of life, economy, and cultural environment. It is therefore declared to be state policy to:

1. Provide leadership in the preservation of the state's historic resources; [and]
2. Administer state-owned or state-controlled historic resources in a spirit of stewardship and trusteeship;...

Responsibilities of the Division of Historical Resources in the Department of State pursuant to 267.061(3), F.S., include the following:

1. Cooperate with federal and state agencies, local Governments, and private organizations and individuals to direct and conduct a comprehensive statewide survey of historic resources and to maintain an inventory of such responses.
2. Develop a comprehensive statewide historic preservation plan.
3. Identify and nominate eligible properties to the National Register of Historic Places and otherwise administer applications for listing properties in the National Register of Historic Places.
4. Cooperate with federal and state agencies, local governments, and organizations and individuals to ensure that historic resources are taken into consideration at all levels of planning and development.
5. Advise and assist, as appropriate, federal and state agencies and local governments in carrying out their historic preservation responsibilities and programs.
6. Carry out on behalf of the state the programs of the National Historic Preservation Act of 1966, as amended, and to establish, maintain, and administer a state historic preservation program meeting the requirements of an approved program and fulfilling the responsibilities of state historic preservation programs as provided in subsection 101(b) of that act.
7. Take such other actions necessary or appropriate to locate, acquire, protect, preserve, operate, interpret, and promote the location, acquisition, protection, preservation, operation, and interpretation of historic resources to foster an appreciation of Florida history and culture. Prior to the acquisition, preservation, interpretation, or operation of a historic property by a state agency, the Division shall be provided a reasonable opportunity to review and comment on the proposed undertaking and shall determine that there exists historic authenticity and a feasible means of providing for the preservation, interpretation and operation of such property.
8. Establish professional standards for the preservation, exclusive of acquisition, of historic resources in state ownership or control.
9. Establish guidelines for state agency responsibilities under subsection (2).

Responsibilities of other state agencies of the executive branch, pursuant to 267.061(2), F.S., include:

1. Each state agency of the executive branch having direct or indirect jurisdiction over a proposed state or state-assisted undertaking shall, in accordance with state policy and prior to the approval of expenditure of any state funds on the undertaking, consider the effect of the undertaking on any historic property that is included in, or eligible for inclusion in, the National Register of Historic Places. Each such agency shall afford the division a reasonable opportunity to comment with regard to such an undertaking.

2. Each state agency of the executive branch shall initiate measures in consultation with the division to assure that where, as a result of state action or assistance carried out by such agency, a historic property is to be demolished or substantially altered in a way that adversely affects the character, form, integrity, or other qualities that contribute to [the] historical, architectural, or archaeological value of the property, timely steps are taken to determine that no feasible and prudent alternative to the proposed demolition or alteration exists, and, where no such alternative is determined to exist, to assure that timely steps are taken either to avoid or mitigate the adverse effects, or to undertake an appropriate archaeological salvage excavation or other recovery action to document the property as it existed prior to demolition or alteration.

3. In consultation with the division [of Historical Resources], each state agency of the executive branch shall establish a program to locate, inventory, and evaluate all historic properties under the agency's ownership or control that appear to qualify for the National Register. Each such agency shall exercise caution to assure that any such historic property is not inadvertently transferred, sold, demolished, substantially altered, or allowed to deteriorate significantly.

4. Each state agency of the executive branch shall assume responsibility for the preservation of historic resources that are owned or controlled by such agency. Prior to acquiring, constructing, or leasing buildings for the purpose of carrying out agency responsibilities, the agency shall use, to the maximum extent feasible, historic properties available to the agency. Each agency shall undertake, consistent with preservation of such properties, the mission of the agency, and the professional standards established pursuant to paragraph (3)(k), any preservation actions necessary to carry out the intent of this paragraph.

5. Each state agency of the executive branch, in seeking to acquire additional space through new construction or lease, shall give preference to the acquisition or use of historic properties when such acquisition or use is determined to be feasible and prudent compared with available alternatives. The acquisition or use of historic properties is considered feasible and prudent if the cost of purchase or lease, the cost of rehabilitation, remodeling, or altering the building to meet compliance standards and the agency's needs, and the projected costs of maintaining the building and providing utilities and other services is less than or equal to the same costs for available alternatives. The agency shall request the division to assist in determining if the acquisition or use of a historic property is feasible and prudent. Within 60 days after making a determination that additional space is needed, the agency shall request the division to assist in identifying buildings within the appropriate geographic area that are historic properties suitable for acquisition or lease by the agency, whether or not such properties are in need of repair, alteration, or addition.

6. Consistent with the agency's mission and authority, all state agencies of the executive branch shall carry out agency programs and projects, including those under which any state assistance is provided, in a manner which is generally sensitive to the preservation of historic properties and shall give consideration to programs and projects which will further the purposes of this section.

Section 267.12 authorizes the Division to establish procedures for the granting of research permits for archaeological and historic site survey or excavation on state-owned or controlled lands, while Section 267.13 establishes penalties for the conduct of such work without first obtaining written permission from the Division of Historical Resources. The Rules of the Department of State, Division of Historical Resources, for research permits for archaeological sites of significance are contained in Chapter 1A-32, F.A.C.

Another Florida Statute affecting land management decisions is Chapter 872, F.S. Section 872.02, F.S., pertains to marked grave sites, regardless of age. Many state-owned properties contain old family and other cemeteries with tombstones, crypts, etc. Section 872.05, F.S., pertains to unmarked human burial sites, including prehistoric and historic Indian burial sites. Unauthorized disturbance of both marked and unmarked human burial site is a felony.

C. MANAGEMENT POLICY

The choice of a management policy for archaeological and historic sites within state-owned or controlled land obviously depends upon a detailed evaluation of the characteristics and conditions of the individual sites and groups of sites within those tracts. This includes an interpretation of the significance (or potential significance) of these sites, in terms of social and political factors, as well as environmental factors. Furthermore, for historic structures architectural significance must be considered, as well as any associated historic landscapes.

Sites on privately owned lands are especially vulnerable to destruction, since often times the economic incentives for preservation are low compared to other uses of the land areas involved. Hence, sites in public ownership have a magnified importance, since they are the ones with the best chance of survival over the long run. This is particularly true of sites that are state-owned or controlled, where the basis of management is to provide for land uses that are minimally destructive of resource values.

It should be noted that while many archaeological and historical sites are already recorded within state--owned or controlled--lands, the majority of the uplands areas and nearly all of the inundated areas have not been surveyed to locate and assess the significance of such resources. The known sites are, thus, only an incomplete sample of the actual resources - i.e., the number, density, distribution, age, character and condition of archaeological and historic sites - on these tracts. Unfortunately, the lack of specific knowledge of the actual resources prevents formulation of any sort of detailed management or use plan involving decisions about the relative historic value of individual sites. For this reason, a generalized policy of conservation is recommended until the resources have been better addressed.

Management Procedures For
Archaeological And Historical Sites And Properties
On State -- Owned Or Controlled Lands
(Revised August, 1995)

The generalized management policy recommended by the Division of Historical Resources includes the following:

1. State land managers shall coordinate all planned activities involving known archaeological or historic sites or potential site areas closely with the Division of Historical Resources in order to prevent any kind of disturbance to significant archaeological or historic sites that may exist on the tract. Under 267.061(1)(b), F.S., the Division of Historical Resources is vested with title to archaeological and historic resources abandoned on state lands and is responsible for administration and protection of such resources. The Division will cooperate with the land manager in the management of these resources. Furthermore, provisions of 267.061(2) and 267.13, F.S., combined with those in 267.061(3) and 253.034(4), F.S., require that other managing (or permitting) agencies coordinate their plans with the Division of Historical Resources at a sufficiently early stage to preclude inadvertent damage or destruction to known or potentially occurring, presently unknown archaeological and historic sites. The provisions pertaining to human burial sites must also be followed by state land managers when such remains are known or suspected to be present (see 872.02 and 872.05, F.S., and 1A-44, F.A.C.)

2. Since the actual resources are so poorly known, the potential impact of the managing agency's activities on historic archaeological sites may not be immediately apparent. Special field survey for such sites may be required to identify the potential endangerment as a result of particular management or permitting activities. The Division may perform surveys, as its resources permit, to aid the planning of other state agencies in their management activities, but outside archaeological consultants may have to be retained by the managing agency. This would be especially necessary in the cases of activities contemplating ground disturbance over large areas and unexpected occurrences. It should be noted, however, that in most instances Division staff's knowledge of known and expected site distribution is such that actual field surveys may not be necessary, and the project may be reviewed by submitting a project location map (preferably a 7.5 minute U.S.G.S. Quadrangle map or portion thereof) and project descriptive data, including detailed construction plans. To avoid delays, Division staff should be contacted to discuss specific project documentation review needs.

3. In the case of known significant sites, which may be affected by proposed project activities, the managing agency will generally be expected to alter proposed management or development plans, as necessary, or else make special provisions to minimize or mitigate damage to such sites.

4. If in the course of management activities, or as a result of development or the permitting of dredge activities (see 403.918(2)(6)a, F.S.), it is determined that valuable historic or archaeological sites will be damaged or destroyed, the Division reserves the right, pursuant to 267.061(1)(b), F.S., to require salvage measures to mitigate the destructive impact of such activities to such sites. Such salvage measures would be accomplished before the Division would grant permission for destruction of the affected site areas. The funding needed to implement salvage measures would be the responsibility of the managing agency planning the site destructive activity. Mitigation of historic structures at a minimum involves the preparation of measured drawings and documentary photographs. Mitigation of archaeological resources involves the excavation, analysis and reporting of the project findings and must be planned to occur sufficiently in advance to avoid project construction delays. If these services are to be contracted by the state agency, the selected consultant will need to obtain an Archaeological Research Permit from the Division of Historical Resources, Bureau of Archaeological Research (see 267.12, F.S. and Rules 1A-32 and 1A-46 F.A.C.).

5. For the near future, excavation of non-endangered (i.e., sites not being lost to erosion or development) archaeological site is discouraged. There are many endangered sites in Florida (on both private and public lands) in need of excavation because of the threat of development or other factors. Those within state-owned or controlled lands should be left undisturbed for the present - with particular attention devoted to preventing site looting by "treasure hunters". On the other hand, the archaeological and historic survey of these tracts is encouraged in order to build an inventory of the resources present, and to assess their scientific research potential and historic or architectural significance.

6. The cooperation of land managers in reporting sites to the Division that their field personnel may discover is encouraged. The Division will help inform field personnel from other resource managing agencies about the characteristics and appearance of sites. The Division has initiated a cultural resource management training program to help accomplish this. Upon request the Division will also provide to other agencies archaeological and historical summaries of the known and potentially occurring resources so that information may be incorporated into management plans and public awareness programs (See Management Implementation).

7. Any discovery of instances of looting or unauthorized destruction of sites must be reported to the agent for the Board of Trustees of the Internal Improvement Trust Fund and the Division so that appropriate action may be initiated. When human burial sites are involved, the provisions of 872.02 and 872.05, F. S. and Rule 1A-44, F.A.C., as applicable, must also be followed. Any state agent with law enforcement authority observing individuals or groups clearly and incontrovertibly vandalizing, looting or destroying archaeological or historic sites within state-owned or controlled lands without demonstrable permission from the Division will make arrests and detain those individuals or groups under the provisions of 267.13, 901.15, and 901.21, F.S., and related statutory authority pertaining to such illegal activities on state-owned or controlled lands. County Sheriffs' officers are urged to assist in efforts to stop and/or prevent site looting and destruction.

In addition to the above management policy for archaeological and historic sites on state-owned land, special attention shall be given to those properties listed in the National Register of Historic Places and other significant buildings. The Division recommends that the Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings (Revised 1990) be followed for such sites.

The following general standards apply to all treatments undertaken on historically significant properties.

1. A property shall be used for its historic purpose or be placed in a new use that requires minimal change to the defining characteristics of the building and its site and environment.

2. The historic character of a property shall be retained and preserved. The removal of historic materials or alterations of features and spaces that characterize a property shall be avoided.
3. Each property shall be recognized as a physical record of its time, place and use. Changes that create a false sense of historical development, such as adding conjectural features or architectural elements from other buildings, shall not be undertaken.
4. Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved.
5. Distinctive features, finishes, and construction techniques or examples of craftsmanship that characterize a historic property shall be preserved.
6. Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and other visual qualities and, where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.
7. Chemical or physical treatments, such as sandblasting, that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, shall be undertaken using the gentlest means possible.
8. Significant archaeological resources affected by a project shall be protected and preserved. If such resources must be disturbed, mitigation measures shall be undertaken.
9. New additions, exterior alterations, or related new construction shall not destroy materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.
10. New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired. (see Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings [Revised 1990]).

Divisions of Historical Resources staff are available for technical assistance for any of the above listed topics. It is encouraged that such assistance be sought as early as possible in the project planning.

D. MANAGEMENT IMPLEMENTATION

As noted earlier, 253.034(4), F.S., states that "all management plans, whether for single-use or multiple-use properties, shall specifically describe how the managing agency plans to identify, locate, protect and preserve, or otherwise use fragile non-renewable resources, such as archaeological and historic sites..." The following guidelines should help to fulfill that requirement.

1. All land managing agencies should contact the Division and send U.S.G.S. 7.5 minute quadrangle maps outlining the boundaries of their various properties.

2. The Division will in turn identify site locations on those maps and provide descriptions for known archaeological and historical sites to the managing agency.
3. Further, the Division may also identify on the maps areas of high archaeological and historic site location probability within the subject tract. These are only probability zones, and sites may be found outside of these areas. Therefore, actual ground inspections of project areas may still be necessary.
4. The Division will send archaeological field recording forms and historic structure field recording forms to representatives of the agency to facilitate the recording of information on such resources.
5. Land managers will update information on recorded sites and properties.
6. Land managers will supply the Division with new information as it becomes available on previously unrecorded sites that their staff locate. The following details the kind of information the Division wishes to obtain for any new sites or structures that the land managers may report:

A. Historic Sites

(1) Type of structure (dwelling, church, factory, etc.).
(2) Known or estimated age or construction date for each structure and addition.
(3) Location of building (identify location on a map of the property, and building placement, i.e., detached, row, etc.).
(4) General Characteristics: (include photographs if possible) overall shape of plan (rectangle, "L" "T" "H" "U", etc.); number of stories; number of vertical divisions of bays; construction materials (brick, frame, stone, etc.); wall finish (kind of bond, coursing, shingle, etc.); roof shape.
(5) Specific features including location, number and appearance of:
(a) Important decorative elements;
(b) Interior features contributing to the character of the building;
(c) Number, type, and location of outbuildings, as well as date(s) of construction;
(d) Notation if property has been moved;
(e) Notation of known alterations to building.

B. Archaeological Sites

(1) Site location (written narrative and mapped location).
(2) Cultural affiliation and period.
(3) Site type (midden, burial mound, artifact scatter, building rubble, etc.).
(4) Threats to site (deterioration, vandalism, etc.).
(5) Site size (acreage, square meters, etc.).
(6) Artifacts observed on ground surface (pottery, bone, glass, etc.).
(7) Description of surrounding environment.

7. No land disturbing activities should be undertaken in areas of known archaeological or historic sites or areas of high site probability without prior review by the Division early in the project planning.
8. Ground disturbing activities may proceed elsewhere but land managers should stop disturbance in the immediate vicinity of artifact finds and notifies the Division if previously unknown archaeological or historic remains are uncovered. The provisions

of Chapter 872, F.S., must be followed when human remains are encountered.

9. Excavation and collection of archaeological and historic sites on state lands without a permit from the Division are a violation of state law and shall be reported to a law enforcement officer. The use of metal detectors to search for historic artifacts shall be prohibited on state lands except when authorized in a 1A-32, F.A.C., research permit from the Division.

10. Interpretation and visitation which will increase public understanding and enjoyment of archaeological and historic sites without site destruction or vandalism is strongly encouraged.

11. Development of interpretive programs including trails, signage, kiosks, and exhibits is encouraged and should be coordinated with the Division.

12. Artifacts found or collected on state lands are by law the property of the Division. Land managers shall contact the Division whenever such material is found so that arrangements may be made for recording and conservation. This material, if taken to Tallahassee, can be returned for public display on a long term loan.

E. ADMINISTERING AGENCY

Questions relating to the treatment of archaeological and historic resources on state lands may be directed to:

Compliance Review Section
Bureau of Historic Preservation
Division of Historical Resources
R.A. Gray Building
500 South Bronough Street
Tallahassee, Florida 32399-0250

Contact Person: **Susan M. Harp**
Historic Preservation Planner
Telephone (850) 245-6333
Suncom 205-6333
FAX (850) 245-6437

Final Land Management Review Report

LMR Review Date---January 27, 1999

Florida Department of

Memorandum **Environmental Protection**

April 13, 1999

TO: Mr. Robert Clark, Program Administrator
Division of State Lands

FROM: Dana C. Bryan, Chief, Bureau of Natural & Cultural Resources
Albert Gregory, Chief, Office of Park Planning
Division of Recreation and Parks

SUBJECT: Response to Land Management Review (LMR);
Collier-Seminole State Park

The Land Management Review dated March 15, 1999, determined that the management of the Collier-Seminole State Park meets the two tests prescribed by law. The review team concluded that the land is being managed for the purposes for which it was acquired and in accordance with the land management plan.

The following comments are provided by field staff and our offices in response to specific concerns and, where appropriate, recommendations that were included in the LMR. We have identified land management plan revisions and field management actions we plan to take to address the review team's concerns.

<u>Checklist Results - Plan Review</u>:

I.B.1.a. - West Indian manatee, Inventory: Disagree. *
I.B.1.b. - West Indian manatee, Monitoring: Disagree. *
I.B.2.a. - Crocodile, Inventory: Disagree. *
I.B.2.b. - Crocodile, Monitoring: Disagree. *
I.B.3.a. - Florida black bear, Inventory: Disagree. *
I.B.4.a. - Florida panther, Inventory: Disagree. *
I.B.4.b. - Florida panther, Monitoring: Disagree. *
I.B.5.a. - Red-cockaded woodpecker, Inventory: Disagree. *
I.B.5.b. - Red-cockaded woodpecker, Monitoring: Disagree. *
I.B.6.a. - Big Cypress fox squirrel, Inventory: Disagree. *
I.B.6.b. - Big Cypress fox squirrel, Monitoring: Disagree. *
I.B.7.a. - Bald eagle, Inventory: Disagree. *

*It is appropriate to respond to this section on listed species collectively rather than separately. All of the selected listed species have been identified in the plan. We don't see a need to inventory or monitor any of these listed species. The typical inventory and monitoring performed by the Florida Park Service consists of recording observations on forms filled out by staff, biologists, and qualified volunteers and visitors. We occasionally make special efforts to inventory and monitor certain species or populations (scrub jays or gopher tortoises, for example) when we determine that a specific need exists. There doesn't appear to be any need for the park to conduct special studies for any of the listed species mentioned above. West Indian manatees are comprehensively monitored statewide by another branch of our agency; crocodiles, Florida black bears, Florida panthers, and bald eagles are comprehensively monitored by the Florida Game and Fresh Water Fish Commission; and red-cockaded woodpeckers and Big Cypress fox squirrels are rarely observed at this park.

III.E.4.a. - Ground water quality, Monitoring: Agree. **
III.E.4.b. - Ground water quantity, Monitoring: Agree. **
III.E.5.a. - Surface water quality, Monitoring: Agree. **
III.E.5.b. - Surface water quantity, Monitoring: Agree **

**Concerns about hydrology are emphasized in the UMP. Additional commentary will be inserted in the next updated plan to address the above items.

III.F.1.a. - Unauthorized use, ATV trespassing: Agree. This will be addressed in the next updated plan.

III.H.1.a. - Adjacent Property Concerns, Fiddler's Creek subdivision: Agree. Issues related to the adjacent Fiddler's Creek subdivision will be covered in the next updated plan. Unfortunately, if this development is constructed it will complicate smoke management and hamper prescribed burning activities.

III.H.1.b. - Adjacent Property Concerns, Agricultural field: Agree. The issue of excess water being pumped onto the park from the diked agricultural field will be addressed in the next updated plan. However, efforts will be made to resolve this problem prior to the next plan revision.

III.H.1.c. - Adjacent Property Concerns, Airboat operator: Agree. This matter will be mentioned in the next updated plan.

<u>Checklist Results - Field Review</u>:

III.B.1. - Restoration, All natural communities: Agree. The RMC of the plan covers hydrological restoration in a regional context, specifying that the South Florida Water Management District should be involved in any actions affecting hydrology.

III.B.2. - Restoration, Diked wetlands: Agree. Efforts should be made to restore the wetland area that is currently diked. This is identified as a desired action in the text of the RMC, although it was not specifically identified in the goals and objectives.

III.D.2.a. - Non-native Invasive Species, Plants, Control: Agree. Additional efforts will be made to control invasive exotic plants as more funding and resources become available.

III.H.1.a - Adjacent Property Concerns, Fiddler's Creek subdivision: Agree. See above comments. The adjacent subdivision will cause problems with smoke management. We will make efforts to reach understandings with the local government, the developer, and residents to support our need to continue to protect and manage natural resources of the park using prescribed fire.

III.H.1.b - Adjacent Property Concerns, Agricultural field: Agree. The agricultural field discharges excess water onto the park through a three-foot diameter pipe. The owners claim that they have the right to continue to discharge the water. Efforts should be taken to see what, if any, action can be taken to either eliminate the discharge or to minimize the flows/impacts.

III.I.3.a. - Buildings: Agree. Additional buildings, especially a shop compound, are needed. The existing shop is a metal building which is deteriorating due to rust. It is small, frequently flooded, and cannot be used during heavy rains because of electrical hazards. Although funding for construction will be pursued, construction of buildings is contingent on DRP and DEP budget resources and priorities and also on legislative action.

III.I.3.b. - Equipment: Agree. A new and better fire truck is needed. The park acquires new and used equipment as needed relative to other DRP priorities and budgetary limitations.

III.I.4. - Staff: Agree. Operational needs have increased over the years with the addition of a concession, off-site interpretive programs, increased training programs for staff, new invasive exotic plant problems (like climbing fern) with no increases in staff. Additional staff, especially park rangers, are needed for resource management. The park is under its identified staffing needs. However, no new staff can be assigned to this or any park unit unless the new positions are appropriated by the Legislature or reassigned from other units. Additional staff is needed by many of our parks which is why we regularly seek positions, volunteers, and partners to help us overcome staff deficiencies.

III.I.5. - Funding: Agree. Additional funds will be pursued. Funding is always contingent on DRP and DEP budget resources and priorities and also on legislative action.

Recommendations: (those not covered by responses to checklist items)

1) Coordinate with Collier County on smoke management and greenline issues: Efforts will be made to contact county planners and inform them about the greenlines and their purpose. In particular, we will make them aware of importance of using prescribed fire to properly manage natural communities, provide for the public safety, and protect listed species.

2) Hydrological restoration and management: We believe the existing plan adequately covers hydrological problems and needs of the park. If we can achieve the hydrological goals outlined in the plan, impacts to the flora and fauna will be reduced substantially. We realize that hydrological restoration in the park is linked to regional restoration needs. Although we cannot design anything to resolve regional problems, we will support the process.

3) Ecological management efforts: We can employ ecological management measures to enhance natural resources of the park, but we will encourage others at the local and regional levels to take similar measures to protect and manage resources outside the park.

Thank you for the opportunity to comment on the LMR.

DCB/AG/mb
cc: Mike Murphy, Chief, Parks District 4

Collier-Seminole State Park
Final Land Management Review Report
LMR Review Date-- January 27, 1999

Management Review Team Members

Agency Represented	Team member appointed	Team member in attendance
DEP/DRP	Mr. Ken Alvarez	Mr. Ken Alvarez
DEP South Florida District	Mr. Bruce Boler	Mr. Bruce Boler
DACS/DOF	Mr. Bill Korn	Mr. Bill Korn
GFC	Mr. Jim Schortemeyer	Mr. Jim Schortemeyer
Soil and Water Conservation	Ms. Laurie Mitchell	Ms. Laurie Mitchell
County Commission	Mr. Bill Lorenz	Mr. Mac Hatcher
Conservation Organization	Ms. Rebecca Jetton (Sierra Club)	Ms. Rebecca Jetton
Private Land Manager	Mr. Charley Babb	None

Process for Implementing Regional Management Review Teams
Legislative Intent and Guidance:
Chapter 259.036, F. S. was enacted in 1997 to determine whether conservation, preservation, and recreation lands owned by the state Board of Trustees of the Internal Improvement Trust Fund (Board) are being managed properly. It directs the Department of Environmental Protection (DEP) to establish land management review teams to evaluate the extent to which the existing management plan provides sufficient protection to threatened or endangered species, unique or important natural or physical features, geological or hydrological functions, and archaeological features. The teams also evaluate the extent to which the land is being managed for the purposes for which it was acquired and the degree to which actual management practices, including public access, are in compliance with the adopted management plan. If a land management plan has not been adopted, the review shall consider the extent to which the land is being managed for the purposes for which it was acquired and the degree to which actual management practices are in compliance with the management policy statement and management prospectus for that property. If the land management review team determines that reviewed lands are not being managed for the purposes for which they were acquired or in compliance with the adopted land management plan, management policy statement, or management prospectus, DEP shall provide the review findings to the Board, and the managing agency must report to the Board its reasons for managing the lands as it has. A report of the review findings are given to the managing agency under review, the Land Acquisition and Management Advisory Council (LAMAC), and to the Division of State Lands. Also, DEP shall report the annual review findings of its land management review teams to the Board no later than the second board meeting in October of each year.

Review Site

The management review of Collier Seminole State Park considered approximately 6,433 acres in Collier County that are managed by DEP/Division of Recreation and Parks. The team evaluated the extent to which current management actions are sufficient, whether the land is being managed for the purpose for which it was acquired, and whether actual management practices, including public access, are in compliance with the management plan. The Division of State Lands approved the management plan on December 5, 1997 and the management plan update is due in December 2002.

Review Team Analysis

The management review checklist was analyzed as follows: The checklist consisted of two parts: a plan review section that answered whether or not the management plan sufficiently addressed protection/ restoration/ management needs for a series of items; and a field review section that scored to what extent sufficient management actions were being taken for a series of items. For each item in each section the scores for all team members were averaged. Some items received high scores (≥ 2.5) in the field review, which indicates that exceptional management actions are being taken.

Review Team Findings

Exceptional management actions

III.A.3	Fire: quality	The quality of prescribed burns at the park was excellent--the desired results were achieved.
III.B.3	Restoration: Rockland hammock field	Restoration of the old field to rockland hammock is excellent.
IV.	Education/Public outreach	Efforts toward public education and outreach are outstanding.

Inadequate items:		**Plan review**
I.B.1.a	West Indian manatee: Inventory	The inventory of manatees should be addressed in the plan update.
I.B.1.b	West Indian manatee: Monitoring	Monitoring of manatees should be addressed in the plan update.
I.B.2.a	Crocodile: Inventory	The inventory of crocodiles should be addressed in the plan update.
I.B.2.b	Crocodile: Monitoring	Monitoring of crocodiles should be addressed in the plan update.
I.B.3.a	Florida black bear: Inventory	The inventory of Florida black bears should be addressed in the plan update.
I.B.4.a	Florida panther: Inventory	The inventory of Florida panthers should be addressed in the plan update.
I.B.4.b	Florida panther: Monitoring	Monitoring of Florida panthers should be addressed in the plan update.
I.B.5.a	Red-cockaded woodpecker: Inventory	The inventory of red-cockaded woodpeckers should be addressed in the plan update.
I.B.5.b	Red-cockaded woodpecker: Monitoring	Monitoring of red-cockaded woodpeckers should be addressed in the plan update.
I.B.6.a	Big Cypress fox squirrel: Inventory	The inventory of Big Cypress fox squirrels should be addressed in the plan update.
I.B.6.b	Big Cypress fox squirrel: Monitoring	Monitoring of Big Cypress fox squirrels should be addressed in the plan update.
I.B.7.a	Bald eagle: Inventory	The inventory of bald eagles should be addressed in the plan update.
III.E.4.a	Ground water quality	The monitoring of ground water quality should be addressed in the plan update.
III.E.4.b	Ground water quantity	The monitoring of ground water quantity should be addressed in the plan update.
III.E.5.a	Surface water quality	The monitoring of surface water quality should be

		addressed in the plan update.
III.E.5.b	Surface water quantity	The monitoring of surface water quantity should be addressed in the plan update.
III.F.1.a	Unauthorized use: ATV trespassing	The problem of ATV trespassing should be addressed in the plan update.
III.H.1.a	Adj. Property concerns: Fiddler's Creek subdivision*	The management problems/concerns caused by the adjacent Fiddler's Creek subdivision should be addressed in the plan update.
III.H.1.b	Adj. Property concerns: Agricultural field*	The management problems/concerns caused by the adjacent agricultural field on the north boundary should be addressed in the plan update.
III.H.1.c	Adj. Property concerns: Airboat operator	The management problems/concerns caused by the adjacent air boat operator should be addressed in the plan update.

Inadequate items		**Field review**
III.B.1	Restoration: All natural communities	Hydrological restoration of the entire park is needed and DRP should identify long-term hydrological needs as part of the regional watershed planning effort.
III.B.2	Restoration: Diked Wetlands	Effort should be made to restore the wetland area that is currently diked.
III.D.2.a	Non-native invasive plants: control	Additional effort is needed to control non-native invasive plants,especially old-world climbing fern, Brazilian pepper, and melaleuca.
III.H.1.a	Adj. Property concerns: Fiddler's Creek subdivision*	Effort should be made to minimize the management problems/concerns caused by the adjacent Fiddler's Creek subdivision.
III.H.1.b	Adj. Property concerns: Agricultural field*	Effort should be made to minimize the management problems/concerns caused by the adjacent agricultural field on the north boundary.
III.I.3.a	Buildings	Additional buildings, especially a shop compound, are needed for property management.
III.I.3.b	Equipment	Additional equipment, especially for prescribed burning, is needed.
III.I.4	Staff	Additional staff, especially park rangers, are needed for resource management.
III.I.5.	Funding	Additional funding is needed for all aspects of property management.

Recommendations to the managing agency

The following recommendations resulted from a discussion and vote of review team members.

1. The team recommends that the Division of Recreation and Parks coordinate with Collier County on smoke management and greenline issues between the park and adjacent properties.

2. Hydrological restoration and management should be designed to restore and protect regional and locally important floral and faunal communities. Management objectives should identify these values.

3. Ecological management should be designed to protect and/or restore important local and regional floral and faunal communities.

Commendations to the managing agency

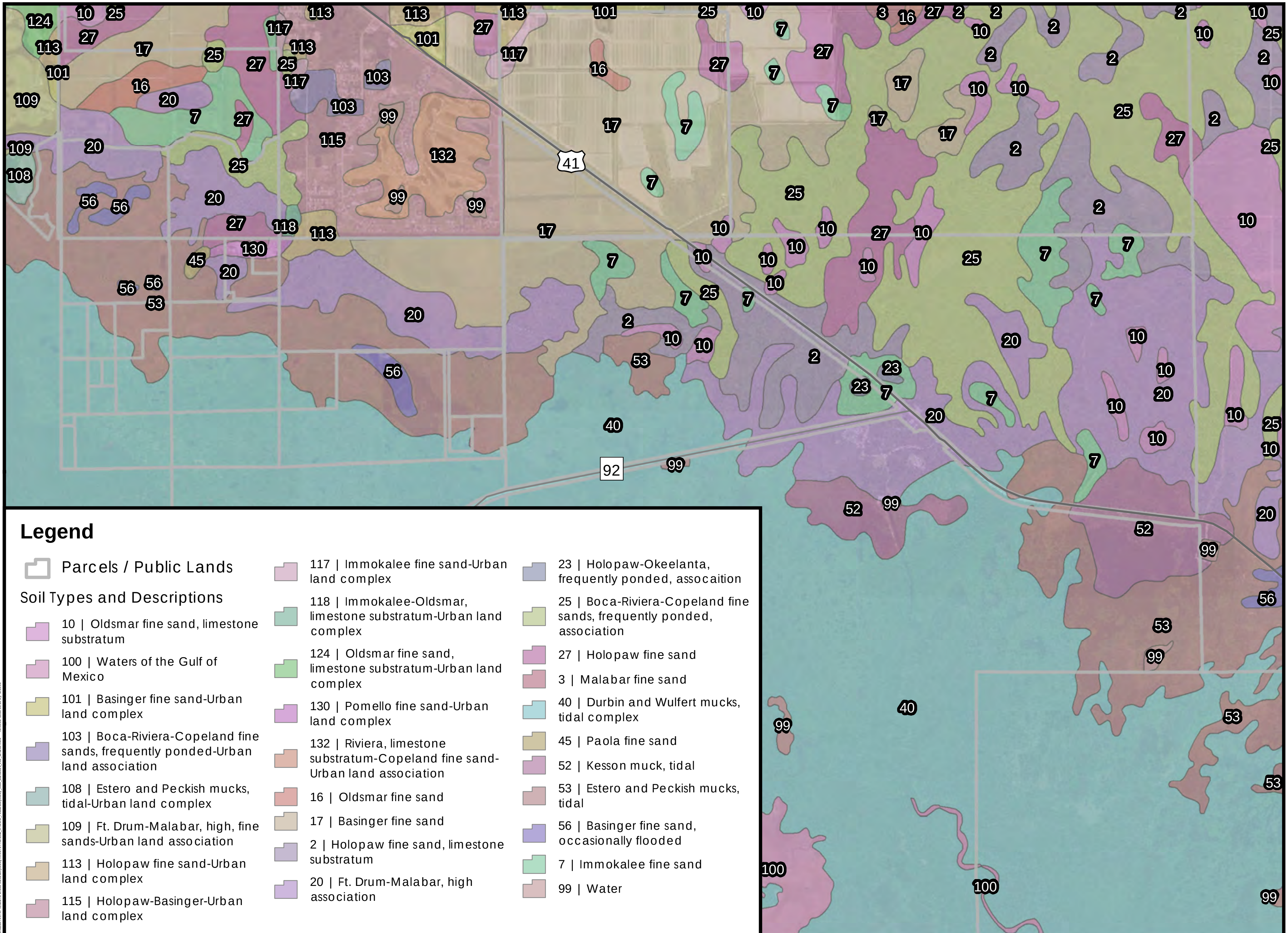
The review team commends the efforts of the park manager in the use of inmates, CSO personnel, and volunteers in all park programs, including visitor services, park services, and land management.

1. Is the land being managed for the purpose for which it was acquired?
All team members agreed that Collier Seminole State Park is being managed for the purpose for which it was acquired.

2. Are actual management practices, including public access, in compliance with the management plan?

All team members agreed that actual management practices, including public access, were in compliance with the management plan for this site.

Appendix G SOILS MAP



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Notes:
1. Coordinate System: NAD 1983 StatePlane Florida East FIPS 0901 Feet
2. Source data: FNAI, SFWMD, Stantec
3. Imagery: Collier County

PICAYUNE WATERSHED WATER QUALITY STUDY

NRCS SOILS

October 2020

Stantec Consulting Services Inc.
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Naples, FL 34108
tel 239.649.4040
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Prepared by: D.A.R. 10/20/20
Technical Review by: X.X.X MM/DD/YY
Independent Review by: J.B. 08/19/20

Appendix H FUNDING SOURCE MATRIX

FUNDING SOURCES MATRIX											
Rank	**Category**	**Agency**	**Program**	**Purpose / Goals**	**Eligible Applicants**	**Eligible Use of Funds**	**Loan or Grant Maximum**	**Terms/Requirements/ Notes**	**Funding Cycle**	**Contact**	**Website**
10	Grant	Florida Senate	Legislative Appropriations	Provides funding for priority projects within the state.	For-profit, Non-profit 501(c) organizations, state government agencies, local governments, municipal governments, Indian tribes and educational institutions.	Any projects that meet the criteria in Joint Rule 2-2 and 2-3 defines appropriation projects and the President of the Senate reserves the authority determine if a submitted request meets that definition.	Grant, no maximum	Must be sponsored by Senator; State contract will be authorized in June/July of the funding fiscal year with funding spent that year; nonrecurring.	Follows legislative cycle.	PublicInfo@myfloridahouse.gov	https://www.flsenate.gov/Session/Appropriations/2021
10	Grant	Florida House of Representatives	Legislative Appropriations	Provides funding for priority projects within the state.	For-profit, Non-profit 501(c) organizations, state government agencies, local governments, municipal governments, Indian tribes and educational institutions.	Any projects that meet the criteria in House Rule 5.14 defines projects that can be submitted; improve stormwater management and improve surface water quality are benefits outlined in the project request.	Grant, no maximum, no match required.	In order for an Appropriations Project to be eligible to be funded in the House budget: a House Member must submit an Appropriations Project Request form containing detailed information about the proposed project; a House Member must file an Appropriations Project Bill relating to the project; the organization or entity for which the Appropriations Project Request form was submitted must file an attestation with the Public Integrity & Elections Committee; and the Appropriations Project Bill must be heard and reported favorably by a committee or subcommittee of the House to be included in the House budget.State contract will be authorized in June/July of the funding fiscal year with funding spent that year; nonrecurring.	File Bill by noon the 1st day of regular session (March 2, 2021).	PublicInfo@myfloridahouse.gov	https://www.myfloridahouse.gov/Sections/Appropriations/projects.aspx
1	Grant	National Fish and Wildlife Foundation	Five Star and Urban Waters Restoration	Projects should address water quality issues in priority watersheds, i.e. erosion due to unstable streambanks, pollution from stormwater runoff, and degraded shorelines caused by development. The program focuses on the stewardship and restoration of coastal, wetland and riparian ecosystems across the country.	Non-profit 501(c) organizations, state government agencies, local governments, municipal governments, Indian tribes and educational institutions.	Ecological improvements may include one or more of the following: wetland, riparian, forest and coastal habitat restoration; wildlife conservation, community tree canopy enhancement, water quality monitoring and green infrastructure best management practices for managing run-off. Projects should also increase access to the benefits of nature, reduce the impact of environmental hazards and engage local communities, particularly underserved communities, in project planning, outreach and implementation.	Grant, up to $50,000, 1:1 match minimum required.	Projects should engage a diverse group of community partners to achieve ecological and educational outcomes.	January 30, annually	Chloe Elberty, 202-595-2434, Chloe.Elberty@nfwf.org	https://www.nfwf.org/
5	Grant	National Fish and Wildlife Foundation	Gulf Environmental Benefit Fund	Remedy harm to natural resources (habitats, species) where there has been injury to, or destruction of, loss of, or loss of use of those resources resulting from the oil spill. GEBF priorities include: 1) restoring and maintaining coastal habitats, 2) restoring and maintaining bays and estuaries, and 3) replenishing and protecting living resources.	Any individual or organization.	GEBF Restoration Strategy outlines projects that are high priority dune restoration; **improvements to freshwater inflows to priority bays;** oyster restoration; reduce light pollution, nest predation and other activities to increase reproductive success of sea turtles, etc.	No matching funds	Florida solicits project proposals from the public by way of the Project Portal: http://www.surveygizmo.com/s3/4186358/Deepwater-Horizon-Project-Proposal-Form.	Project selection is conducted yearly, with pre-proposals submitted to NFWF in March, full proposals submitted in June, and the NFWF Board making awards in November.	deepwaterhorizon@dep.state.fl.us.	https://www.nfwf.org/gulf-environmental-benefit-fund/florida

Rank	Category	Agency	Program	Purpose / Goals	Eligible Applicants	Eligible Use of Funds	Loan or Grant Maximum	Terms/Requirements/ Notes	Funding Cycle	Contact	Website
1	Grant	National Fish and Wildlife Foundation	National Coastal Resilience Fund	Restores, increases and strengthens natural infrastructure to protect coastal communities while also enhancing habitats for fish and wildlife.	Institutions of higher education, nonprofit and for-profit organizations, U.S. territories and states, Native American tribes, and local governments including counties, municipalities, and cities.	Conservation projects that restore or expand natural features such as coastal marshes and wetlands, dune and beach systems, oyster and coral reefs, forests, coastal rivers and floodplains, and barrier islands that minimize the impacts of storms and other naturally occurring events on nearby communities.	Varies	Applicants must submit a pre-proposal by email to resilience.grants@noaa.gov.	April proposals due	Erika Feller Director, Marine and Coastal Conservation erika.feller@nfwf.org 202-595-3911	www.nfwf.org/programs/national-coastal-resilience-fund
1	Grant	Army Corps of Engineers	Water Resources Development Act	Address flood control, navigation improvements, and watershed and aquatic ecosystem restoration. WRDA is federal legislation that authorizes the US Army Corps of Engineers to participate in local and regional water resources projects around the country.	Public bodies (city, township, county or special district), Indian tribes	New guidance anticipated with new appropriation.	Grant	Authorizing legislation passed and in 60 day comment period (ends 2/12/19); Annual appropriations still needed.	Awaiting federal appropriation	WRDA2018@usace.army.mil	https://www.usace.army.mil/Missions/Civil-Works/Project-Planning/Legislative-Links/wrda_2018/
10	Grant	Florida Department of Environmental Protection	State Water-quality Assistance Grant (SWAG)	Implementation of best management practices designed to reduce pollutant loads to waters not meeting water quality standards from urban stormwater discharges.	Florida's local governments, including county and municipal governments, special districts, water management districts.	Best Management Practices, nonpoint pollution reduction in priority watersheds, green infrastructure, ground water protection.	$5 million total funding annually; no match required but encouraged.	Calculate load reductions using the BMPTRAINS Model.	Submit anytime; proposals evaluated in September/October and March/April.	Amanda Peck, Program Administrator, 3900 Commonwealth Boulevard - MS 357, Tallahassee, FL 32399-3600; Phone: 850-245-2836	https://floridadep.gov/wra/319-tmdl-fund
10	Grant	Florida Department of Environmental Protection	Section 319(h)	Address nonpoint source pollution.	Florida's local governments, including county and municipal governments, special districts, water management districts, other state agencies, public universities/colleges, and national estuary programs located in Florida.	Bioswales, green roofs, pervious pavement, plantings for bank stabilization, low-impact development projects, erosion control best management practices (BMPs), education related to nonpoint source pollution, agriculture demonstration projects, septic to sewer projects (laying laterals from residences and/or businesses to main sewer line, connection to line, and grinding station), and monitoring activities for project to evaluate BMP effectiveness.	$5 million total funding annually;40% Non-federal, matching funds or in-kind contributions are required.	Varies		Amanda Peck, Program Administrator, 3900 Commonwealth Boulevard - MS 357, Tallahassee, FL 32399-3600; Phone: 850-245-2836	

Rank	Category	Agency	Program	Purpose / Goals	Eligible Applicants	Eligible Use of Funds	Loan or Grant Maximum	Terms/Requirements/ Notes	Funding Cycle	Contact	Website
10	Grant	U.S. Treasury Department - Gulf Coast Restoration Trust Fund	Resources and Ecosystems and Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE)	To restore and protect the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, coastal wetlands, and economy of the Gulf Coast region	Gulf Coast states; County governments submit proposals to the Florida Department of Environmental Protection and the Department submits proposals to the Gulf Coast Ecosystem Restoration Council, which administers the Gulf Coast Restoration Trust Fund.	Large-scale projects and programs that are projected to substantially contribute to restoring and protecting the natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast ecosystem. Projects may be included in existing Gulf Coast State comprehensive plans for the restoration and protection of natural resources, ecosystems, fisheries, marine and wildlife habitats, beaches, and coastal wetlands of the Gulf Coast region.	None specified	The Florida Department of Environmental Protection has requested funds for the Florida Water Quality Improvement Program (WQIP) the next round of funding (FPL3b), which is included on the Council's current Draft Funded Priorities list, the comment period for which closed on January 5, 2021. Collier County is included among locations listed for potential projects and reducing nutrients in fresh and estuarine waters is proposed as part of this feasibility study and Florida Bay and the Everglades are included in the watersheds listed in the proposal. The Project Criteria Justification Section of FDEP's current proposal, which is included in the Draft Funded Priorities list (FPL3b) reads as follows: "WQIP meets Priority Criteria II, large-scale projects and programs, and Priority Criteria III, projects contained in existing Gulf Coast State comprehensive plans... The WQIP will fund a suite of intrinsically linked restoration or conservation water resource improvement projects with the primary goal of reducing excess nutrients and other pollutants to the Gulf of Mexico. Project selection criteria will prioritize projects included in other state or federal restoration planning documents, such as BMAPs, SWIM plans, the SEP, and FL TIG restoration plans that identify both the need and benefits of such projects and which are based on strong science... The WQIP is one such collaboration and would enable Florida to increase funding of critical projects that would make significant, measurable improvements to water quality and thus help restore or maintain natural resources, ecosystems, fisheries, beaches, and coastal wetlands..."	Approximately every two years	FloridaCoasts@FloridaDEP.gov	https://floridadep.gov/wra/deepwater-horizon/content/restore
1 - 10	Grant	Florida Department of Environmental Protection	Florida Communities Trust Parks and Open Space Florida Forever Grant Program	Protecting important natural resources, providing recreational opportunities and preserving Florida's traditional working waterfronts.	Local governments and eligible nonprofit organizations.	Acquire land for parks, open space, greenways and projects supporting Florida's seafood harvesting and aquaculture industries.	$5 Million max	Funding emphasized in low-income or disadvantaged communities and projects that provide areas for direct water access and water dependent facilties that are open to the public and offer public access by vessels to waters of the state, including boat ramps and parking. Acquisition of lands for recreational trail systems.	Application cycle is October 1 - December 15	Bill.Bibby@dep.state.fl.us	FCT Florida Communities Trust Home | Florida Department of Environment
1	Grant	US Fish and Wildlife Service	National Coastal Wetlands Grant Program	Protect, restore and engance coastal habitats.	States	Acquisition of real property interest in coastal lands or waters and the restoration, enhancement, or management of coastal wetlands ecosystems.	25-50% match requirement based on type of project.	Restrictions:"No pipes or ditches" - Section 319(h) Grants cannot be used for any project that EPA considers a point source. Or rather the project must meet EPA's definition of a nonpoint source as defined in section 502(14) of the Clean Water Act. Any project listed as a requirement under an MS4 permit is not eligible for Federal funding. If the project is not listed as required under the permit or is well above and beyond requirements, it may be eligible for funding. Federal funding requires an evaluation of project effectiveness. For structural construction projects, this typically involves water quality monitoring of the installed BMPs to verify pollutant load reductions. For nonstructural projects such as educational program implementation, this can involve tracking of behavior change and validation of knowledge gained by outreach to the target audience(s).For further information on all Federal requirements, check out the EPA Guidelines for States and Tribes on the 319(h) Grant Program: https://www.epa.gov/sites/production/files/2015-09/documents/319-guidelines-fy14.pdf.	April - June proposals due.	mike_piccirilli@fws.gov	USFWS-WSFR National Coastal Wetlands Grant Program

Rank	Category	Agency	Program	Purpose / Goals	Eligible Applicants	Eligible Use of Funds	Loan or Grant Maximum	Terms/Requirements/ Notes	Funding Cycle	Contact	Website
10	Grant	USDA - Natural Resources Conservation Service	Environmental Quality Incentives Program (EQIP)	The Environmental Quality Incentives Program (EQIP) provides technical and financial assistance to producers to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, increased soil health and reduced soil erosion and sedimentation, improved or created wildlife habitat, and mitigation against drought and increasing weather volatility.	Agricultural producers and water management entities when they are supporting a water conservation or irrigation efficiency project. These entities are defined as State, irrigation district, ground water management district, acequia, land grant-merced, or similar entity. Participants must have an income below $900,000, averaged over the previous three years, to be eligible. If the participant is a lessee rather than an owner, the lessee's income applies.	Implementation of agricultural BMPs to reduce water use and/or improve water quality, reduce soil erosion and sedimentation, improvement or creation of wildlife habitat and mitigation against drought and increasing weather volatility. Florida prioritiy uses include implementation of BMPs that addres water quality degradation, insufficient water, soil health, plant and animal health and inadequate habitat for fish and widllife.	Varies by BMP types, funding allocation per year, number of applicants, ranking, Historically Underfunded status. Local District Conservationist should be consulted for current conditions. Costs are calculated based on NRCS established costs and an absolute maximum of $450,000 per participant for all USDA programs applies for the period of 2019-2023.	Funding allocated for this program varies by year and applicants are approved through a competitve ranking process that is determined by priorities identified by a working group each year. There are generally more applications than can be funded. A 5-10 year contract is typically required.	Continuous enrollment throughout the year but total funds assigned to each NRCS region is allocated at the state level once per year, i.e applications are accepted throughout the year but are ranked and approved for funding once per year, the exact month that the funding decisions are made varies widely by year.	Mitchell Aman, Acting District Conservationist; 3434 Hancock Bridge Parkway, Suite 209B North Ft. Myers, FL 33903 239-997-7331 Ext 3 /855-464-1972 (FAX); mitchell.aman@usda.gov	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
10	Grant	USDA - Natural Resources Conservation Service	Conservation Stewardship Programs (CSP)	The goal of this program is to reward farmers for undertaking additional conservation activities and continuing to implement BMPs that they are already using.	CSP is available on Tribal and private agricultural lands and non-industrial private forest land in all 50 States and the Caribbean and Pacific Islands Areas. The program provides equitable access to all producers, regardless of operation size, crops produced, or geographic location. Participants must have an income below $900,000, averaged over the previous three years, to be eligible. If the participant is a lessee rather than an owner, the lessee's income applies.	Annual payment for installing and adopting additional activities, and improving, maintaining, and managing existing activities.Supplemental payment for the adoption of resource-conserving crop rotations.	Varies by year.	Funding allocated for this program is typically very limited and therefore typically only allows for small scale use to promote use of BMPs. EQIP funding is generally going to be more appropriate for larger scale projects.Beginning in 2020, States may provide increased payment rates for high-priority practices. In consultations with the State Technical Committee, State Conservationists may designate up to 10 practices to be eligible for increased payments. Eligible high-priority practices include those that address specific causes of ground or surface water impairment relating to excessive nutrients, address the conservation of water to advance drought mitigation and declining aquifers, meets other environmental priorities and other priority resource concerns identified in habitat or other area restoration plans, or is geographically targeted to address a natural resource concern in a specific watershed.	Continuous enrollment throughout the year but total funds assigned to each NRCS region is allocated at the state level once per year, i.e applications are accepted throughout the year but are ranked and approved for funding once per year, the exact month that the funding decisions are made varies widely by year.	Mitchell Aman, Acting District Conservationist; 3434 Hancock Bridge Parkway, Suite 209B North Ft. Myers, FL 33903 239-997-7331 Ext 3 /855-464-1972 (FAX); mitchell.aman@usda.gov	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/

Rank	Category	Agency	Program	Purpose / Goals	Eligible Applicants	Eligible Use of Funds	Loan or Grant Maximum	Terms/Requirements/ Notes	Funding Cycle	Contact	Website
10	Grant	Florida Department of Agriculture and Consumer Services	Cost Share BMP Programs	Protect water resources through reduction of water use and improvement of water quality in waters leaving farms.	Agricultural producers willing to sign a Notice of Intent to Implement BMPs and a contract that outlines BMP implementation and maintenance requirements.	Implementation of agricultural BMPs to reduce water use and/or improve water quality.	Can vary by year. FDACS does not sign agreements directly with growers, money is typically funnelled through Soil and Water Conservation Districts (or similar entities), who then sign the agreement with the farmer and administer the contract. Programs vary by region and can change from one year to the next.	Cost share agreement between an agricultural producer and FDACS; Farmer must sign a Notice of Intent to implement BMPs, which the farmer adjacent to the project site had already done.	Funds are allocated to FDACS annually and can be dispersed throughout the year (July 1-June 30); however, funds typically have been assigned to farmers on a waiting list prior to July 1st and can often run out early in the state's fiscal year.	AgBMPHelp@FDACS.gov; Alan Brock, Regional Director for Central Florida, including Collier County - (850) 688-2082, alan.brock@fdacs.gov	https://www.fdacs.gov/Agriculture-Industry/Water/Agricultural-Best-Management-Practices
5	Loan	Florida Department of Environmental Protection	Clean Water State Revolving Fund	Build or upgrade wastewater, stormwater, and nonpoint source pollution prevention projects.	Local governments and special districts.	Construction of wastewater collection system, replacing or expanding reclaimed water lines, upgrading a wastewater or reuse treatment facility, construction of stormwater treatment system, rehabilitating lift stations, installation of solar panels at wastewater treatment facility, drafting a wastewater facilities plan, designing a wastewater system, etc.	Depends on availability.	Interest rates on loans are below market rates and vary based on the economic wherewithal of the community.	Submit a Request for Inclusion Form any time of the year to be placed on the state priority list which is used for placement on the funding list at the next quarterly public meeting.	Tim Banks, Program Administrator, 850-245-2969	https://floridadep.gov/wra/srf