Indian River County
Lagoon Management Plan
September 202

TETRA TECH

DRAFT

Table of Contents

Figures

Tables

Appendices

Acronyms and Abbreviations

ALA	Anchoring Limitation Areas
ArcNLET	ArcGIS-Based Nitrate Load Estimation Toolkit
BMAP	Basin Management Action Plan
BMP	Best Management Practices
DO	Dissolved Oxygen
FDACS	Florida Department of Agricultural and Consumer Services
FDEP	Florida Department of Environmental Protection
FIND	Florida Inland Navigation District
FP	Fibropapillomatosis
FWC	Florida Fish and Wildlife Conservation Commission
ICW	Intercoastal Waterway
IRC	Indian River County
IRFWCD	Indian River Farms Water Control District
IRL	Indian River Lagoon
IRLNEP	Indian River Lagoon National Estuary Program
LMP	Lagoon Management Plan
mgd	Million Gallons Per Day
MSD	Marine Sanitation Device
NA	Not Applicable
NOAA	National Oceanic Atmospheric Association
OSTDS	Onsite Sewage Treatment Disposal Systems
PFAS	Perfluoroalkyl Substances
PLSM	Pollutant Load Screening Model
ppt	Parts Per Thousand
SJRWMD	St. Johns River Water Management District
SWIL	Spatial Watershed Iterative Loading (model)
TBD	To Be Determined
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USACE	United States Army Corps of Engineers

1. Introduction

Goal: The Indian River County Lagoon Management Plan addresses key factors impacting the health of the Indian River Lagoon through research and the implementation of restoration projects to improve resiliency and conditions for the Indian River Lagoon and the Indian River County community.

The Indian River County (IRC) Lagoon Management Plan (LMP) identifies 17 key factors (Table 1) impacting the health of the Indian River Lagoon (IRL). The LMP creates goals and objectives for the key factors to address management and restoration of the IRL and provides a list of projects and best management practices (BMPs) for IRC managers and citizens. The LMP will be actively managed to fill data gaps and used to prioritize projects. The LMP is a living document, which will be modified based on emerging factors and research. Project updates will be made on a yearly basis with an evaluation of the key factors, goals, and objectives on a routine basis. The LMP is a necessary step in restoration and conservation of the IRL, an ecologically and economically important habitat in Florida.

Table 1. 17 Key Factors Affecting the IRL in IRC

Factor	Description
Water Quality	Degraded water quality negatively impacts IRL health and diversity, leading to widespread seagrass habitat die-offs and triggering harmful algal blooms.
Basin Management Action Plan (BMAP)	The BMAP was developed by the Florida Department of Environmental Protection (FDEP) as a framework for water quality restoration and contains metrics for projects reducing nutrient loading and monitors that progress.
Harmful Algal Blooms	Imbalances in the IRL allow certain algal species to grow unchecked, some of which can release toxins into the waters that may be detrimental to IRL health.
Organics and Sediments	Muck is black, organic-rich, high water content sediment with a high nutrient content. Muck is prevalent throughout the IRL and has a detrimental effect on Lagoon health.
Sea Level Rise	Sea level rise plays an important role in the health of the IRL in IRC due to the Lagoon's direct connections to the ocean through manmade and maintained inlets.
Marinas, Boats and Boat Ramps	Marinas, boats and boat ramps are found throughout IRC, and it is the boaters' responsibility to properly maintain and operate their vessels.
Ecosystem Functions and Habitat Use	IRL is one of the most biologically diverse estuaries in North America and is used by approximately 4,300 unique organisms at some point throughout their lifecycles.
Conservation Lands	Restoration and management of lands within the IRL watershed help to filter nutrients, conserve native habitat and create a more resilient system.
Land Use Changes	Past and future land use change evaluations are important to understand current issues in the IRL and determine resiliency measures for the future.
Hydrology and Hydrodynamics	IRL hydrology and hydrodynamics have changed over time as human influences have modified the natural flows of the system.
Annual Rainfall	Rainfall is one of the major contributors of freshwater into the IRL system.
BMPs	BMPs are practices deemed to be effective and practicable means of preventing or reducing water pollution generated from various activities and industries.
Water Consumption	Water supplies need to be sustainable for future needs as the population and demand continue to increase throughout IRC and state-wide.
Wastewater	Wastewater leaving residential and commercial properties must be properly treated and disposed of to prevent nutrients and other pollutants from impacting the IRL system.
Biosolids	Biosolids are solid, semi-solid, or liquid materials resulting from the treatment of domestic sewage sludge from wastewater treatment facilities.
Onsite Sewage Treatment and Disposal Systems (OSTDS)	OSTDS, or septic systems, are a form of waste treatment; however, proximity to surface waters and improper maintenance can lead to detrimental impacts on the environment.

Factor	Description
Sustainability and Resiliency	Sustainability and resiliency are measures taken to ensure the future of the Lagoon, its shoreline, and the surrounding infrastructure within the watershed.

A. State of the IRL in IRC

IRL Natural History

The IRL is a shallow 156-mile-long bar-built estuary covering one-third of the east coast of Florida and provides multiple benefits to the region and state (Figure 1). It is an Estuary of National Significance, one of 28 in the nation. There are four FDEP aquatic preserves located in the IRL: Banana River, Malabar to Vero Beach, Vero Beach to Fort Pierce, and Jensen Beach to Jupiter Inlet. Two of these aquatic preserves are present in IRC, which are also designated as Outstanding Florida Waters. The IRL is part of the Intracoastal Waterway (ICW) running from Massachusetts to Miami, and the channel is maintained by the U.S. Army Corps of Engineers (USACE) and Florida Inland Navigation District (FIND). The depth of the ICW channel is approximately 3 meters (12 feet), but outside the channel, the average depth of the IRL is 1.2 meters (4 feet).

Figure 1. IRL Statistics and Benefits

Six counties border the IRL (Volusia, Brevard, Indian River, St. Lucie, Martin, and Palm Beach), but the watershed also includes Okeechobee County. Currently 1.6 million people live within the watershed. In 1916, the IRL watershed was 572,000 acres; however, by 2013, development of the region and an intricate series of canals draining water to the east, increased the watershed to 1.4 million acres (Figure 2). These canals were designed to drain wetlands for agriculture and have been maintained to now allow residential and commercial development in historic wetlands. The hardening of the landscape and shifting of water to the east has increased the freshwater discharge to the IRL to five times the historical volume.

Historically, the natural exchange of water between the IRL and the Atlantic Ocean occurred through wash-over of the barrier islands and the opening and closing of inlets from hurricanes and other severe storms. This shifting of the flow of fresh and salt water has impacted the health of the Lagoon even before human management of inlets. Fish kills are documented as far back as 1894, which "killed tens of thousands of fish in such quantities that local residents shoveled them into wagons for fertilizer. The stench from the fish kill lingered for more than one year" (Newman 1953). Today, three man-made inlets (Sebastian, Fort Pierce and St. Lucie), two natural inlets (Ponce De Leon and Jupiter), and one controlled lock system (Canaveral Lock) connect the IRL to the Atlantic Ocean. The inlets are stabilized and maintained to allow for vessel traffic. While the Lagoon is connected to the Atlantic Ocean through the five inlets, it is a wind driven microtidal system.

The IRL spans two distinct biogeographical provinces, the temperate Carolinian and the subtropical Caribbean, which lends to its high biodiversity. At one time it was labeled the most biologically diverse estuaries in the United States. The IRL has

4,300 species dependent upon its ecosystem for some point of their lifecycle, of which approximately 50 are listed as threatened or endangered. In 2016, the economic value of the IRL was estimated to be $7.6 billion dollars with $30 million in revenue generated from IRL fisheries. The high biodiversity and economic benefits of the IRL are driving factors in the importance of conservation of this estuary.

Note: Map from St. Johns River Water Management District (SJRWMD).

Figure 2. Location of the IRL and its Watershed

Unique Location

IRC is located in the central portion of the IRL. IRC has an intricate series of drainage canals that historically drained the internal portions of the county for agriculture. There are three relief canals discharging freshwater from the west to the IRL, which are managed by the Indian River Farms Water Control District (IRFWCD). The St. Sebastian River, located in the northern part of IRC, and the ditches and stormwater outfalls connected to the river, are additional major sources of freshwater to the IRL. Lands adjacent to the IRL and groundwater flows also provide freshwater inputs. The Sebastian Inlet connects the IRL in

northern IRC to the Atlantic Ocean. The Fort Pierce Inlet connects the IRL south of IRC and is located in St. Lucie County approximately six miles south of IRC. The proximity to the Fort Pierce Inlet to the south and Sebastian Inlet to the north and lack of earthen causeways in IRC allows for free water exchange with reduced residence times. Current residence times for the IRL within IRC are estimated to be 2 to 16 days (Kim 2003), whereas other areas of the IRL have residence times as high as 148 days. This low residence time has a significant effect on improved water quality. Seawater exchange does not reduce nutrient loads to the IRL, but it can be beneficial to the denitrification process by improving oxygenation, stabilizing temperatures and maintaining a consistent salinity.

Impacts facing the IRL in IRC are similar to other regions, but the hydrology and hydrodynamics are different when compared to the North IRL, Banana River Lagoon and Southern IRL. The North IRL and Banana River Lagoon have reduced circulation and increased residence times, whereas the Southern IRL is impacted by Lake Okeechobee discharges. The lack of major structural features and hydrological connection to Lake Okeechobee is a major benefit to the IRL water quality within IRC.

Current Conditions

Concerns regarding IRL health began as early as the late 1970s. In 1990, the IRL System and Basin Act was created to protect the IRL from package plant wastewater discharges, investigate the feasibility of reuse water and centralize wastewater collection and treatment facilities to prevent sewage spills. In 2006, the U.S. Environmental Protection Agency and FDEP designated portions of the IRL as impaired waterbodies because water quality parameters did not meet standards set by the state of Florida. FDEP determined all segments of the IRL and Banana River Lagoon were impaired for nutrients due to impacts to seagrass (loss of acreage). In March 2009, FDEP adopted the total maximum daily loads (TMDLs) for the IRL and Banana River Lagoon, which include portions of the Central IRL within IRC. The TMDLs were established to address seagrass losses associated with excessive nitrogen and phosphorus loads to the IRL. The TMDLs were determined from linear regression models relating seagrass depth limits to annual total nitrogen (TN) and total phosphorus (TP) loading, and seagrass losses were determined based on review of a composite of seagrass maps from 1943 to 1999. BMAPs were created to establish local commitments for nutrient load reductions to restore water quality in the North IRL, Central IRL and Banana River Lagoon. IRC is located in the Central IRL and the 2013 BMAP did not include stakeholder required reductions due to seagrass extent at the time. Unfortunately, in 2011, 2012 and 2016, excessive TN and TP loading led to extensive algal blooms. These events led to fish kills, widespread seagrass die off, and raised concerns regarding the effects on wildlife dependent on the habitat.

In addition to water quality concerns, the IRL has experienced a benthic habitat shift. Historically, the Lagoon was dominated by a sandy bottom, but excessive organic matter, nutrients and fine sediments from erosion have created deposits of muck in the tributaries and in areas of the IRL. Researchers estimate muck has accumulated on approximately 10% of the Lagoon floor, reducing the sediment quality for seagrass growth and allowing for nutrient fluxes from the sediments to the water column. The reduction of healthy sediment and the decrease in water quality has resulted in massive, and in many areas total, loss of seagrass in the IRL. While the IRC areas of the IRL are holding some of the most abundant areas of seagrass in the entire IRL system, the seagrass loss in IRC remains staggering.

The issues affecting the IRL can be linked to a culmination of anthropogenic influences on the ecosystem. The excessive nutrient loading and shift in benthic habitat was not sudden, but a decades long build-up. The legacy loading of nutrients to the system increased stress and reduced resiliency, causing further degradation from both natural and anthropogenic triggers. The restoration and conservation of the IRL will not be a rapid process, but with proper management strategies to reduce nutrient loading and enhance habitats it will be possible to reduce stress and increase resiliency, while improving conditions.

B. Plan Funding

The costs of the projects and programs listed in this plan exceed the County's current funding availability. Therefore, substantial additional funding will be required to achieve plan goals and regulatory requirements for the IRL going forward. The lists below represent potential grant funding available to help meet IRC's goals and requirements. As new funding sources become available, the County will evaluate the applicability to project needs and will add pertinent sources to the plan.

Funding Sources for Research

- FDEP Section 319 Grants
- IRL National Estuary Program (IRLNEP)
- SJRWMD
- Protecting Florida Together Resilient Florida Planning Grant
- Partnerships with universities and research entities.

Funding Sources for Projects

- FDEP Section 319 Grants
- FDEP State Water Quality Assistance Grants
- FDEP Resilient Florida Grants
- Florida Fish and Wildlife Commission (FWC) Derelict Vessel Removal Grant Program
- Derelict Vessel Grant FIND Cost Share Grant
- FIND Cooperative Assistance Programs
- FIND Small-Scale Derelict Vessel Removal
- FIND Small-Scale Spoil Island Restoration & Enhancement Program
- FIND Cooperative Assistance Program
- Small-Scale Spoil Island Restoration and Enhancement Program
- Building Resilient Infrastructure and Communities grant through Federal Emergency Management Agency
- IRLNEP
- SJRWMD
- Florida Department of Economic Opportunity
- Protecting Florida Together Grants
- National Oceanic and Atmospheric Association (NOAA) Transformational Habitat Restoration and Coastal Resilience Grants
- Florida Department of Transportation
- Restore America's Estuaries National Estuary Program Coastal Watershed Grant
- Restore America's Estuaries National Estuary Program Watershed Grant
- Resilient Florida Grant Program
- American Rescue Plan Act of 2021
- Legislative budget appropriation
- Research partnerships with universities and research entities

C. County Department Reorganization

In an effort to focus County staff and resources effectively and efficiently to address the environmental challenges of today and better prepare for future needs, IRC is undergoing a departmental reorganization beginning October 1, 2023. The Natural Resources Department is being created to oversee the Coastal, Lagoon, Stormwater, Environmental Planning and Soil and Water Conservation Districts divisions. This department will fall under the County's newly reorganized Infrastructure and Development Services. The steps necessary to meet the needs of the County's restructuring will not interfere with the implementation of the current LMP. As the Lagoon Program continues to expand under the Natural Resources Department, the LMP will also continue to expand and adapt.

D. Plan Organization

This plan is organized by the 17 key factors affecting the IRL. Goals, objectives and actions are provided for each key factor. The actions are listed as short-term (within the next five years) and long-term (longer than five years). Metrics to assess projects and a project list are included in Section 3 detailing operational, under construction, designed and conceptual projects to achieve the LMP's goals, objectives and actions.

2. Key Factors

A. Water Quality

In portions of the IRL, trends in nutrient levels have been increasing over historical values. The increase in nitrogen, phosphorus and heavy metals has been linked to anthropogenic influences. Several organizations monitor water quality in the open waters of the IRL and its tributaries, and in stormwater, surface water and groundwater in the IRL watershed. These entities include IRC Stormwater and Utilities, FDEP, SJRWMD, Florida Atlantic University and Ocean Research & Conservation Association. The parameters measured include salinity, temperature, dissolved oxygen (DO), nitrogen and phosphorus. Coastal eutrophication is a risk in areas with increased urbanization and rapid population growth (Howarth 2008, Rabalais et al. 2009, Malone and Newton 2020). This risk is due to hardening of the coastline, runoff of lawn waste (fertilizer, sediment, pesticides and herbicides) and increased wastewater discharge volume and strength.

Water Quality Sampling Entities

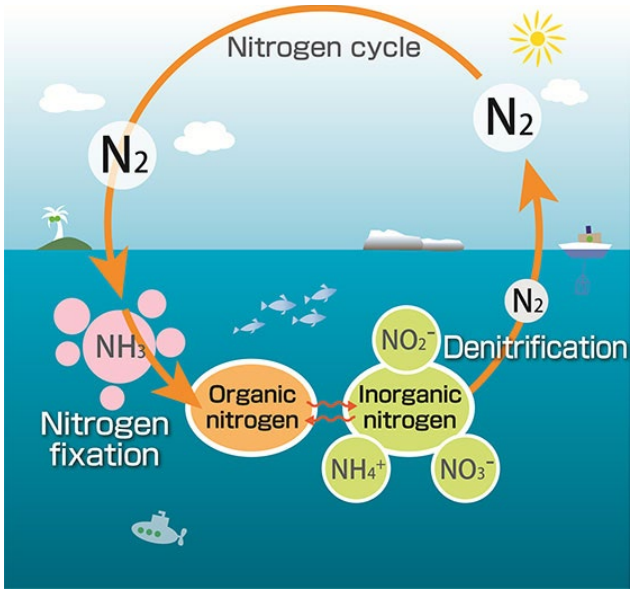
FDEP
SJRWMD
IRC
Florida Atlantic University IRL Observatory Network
Ocean Research & Conservation Association Kilroy

TN and TP

Nitrogen and phosphorus are important nutrients in an ecosystem but, when the nutrients are overabundant or out of balance, there is a risk of algal blooms, which leads to a seagrass die off, low DO and fish kills. Freshwater systems are typically limited by phosphorus since some freshwater microorganisms are effective at fixing nitrogen from the atmosphere. Marine waters are typically nitrogen limited. Estuaries, like the IRL, are locations where freshwater and marine waters mix, making the system a more complex system for determining the root cause of eutrophication. Anthropogenic sources of nitrogen and phosphorus include agriculture, fertilizer, pet waste, wastewater (septic systems), detergents and stormwater runoff. Reducing anthropogenic sources of nitrogen and phosphorus to the IRL is paramount to achieving a healthy ecosystem.

Nitrogen exists as atmospheric nitrogen gas, ammonia, ammonium, nitrite and nitrate. Ammonia, nitrite and nitrate are often anthropogenic sources of nitrogen entering the environment. During nitrogen fixation planktonic, bacteria, cyanobacteria and some algae convert atmospheric nitrogen to ammonia (Figure 3). Nitrification occurs when ammonia is converted to ammonium, nitrite and subsequently nitrate. During this process bacteria consume oxygen from the water column, which can lead to low oxygen levels and an accumulation of ammonia and nitrate in eutrophic systems. Plants and algae will take up ammonium and nitrate to grow mass. Under eutrophic conditions, algae can out compete plants for the available nitrogen and cause algal blooms.

Phosphorus is an essential nutrient for all living organisms. In the environment, phosphorus naturally occurs as phosphate in sediments and rocks, slowly leaching into ground and surface waters. Florida is naturally high in phosphates, but additional phosphate may enter the water column as a result of human activity. Phosphorus is one of the main ingredients in fertilizers used in agriculture and is common in detergents. When phosphorus enters the water, it is taken up by aquatic plants and algae. Excessive phosphorus can lead to an increase in algae causing the phosphorus to be released back into the system when the algae die.



From: www.jamstec.go.jp/e/about/press_release/20180523

Figure 3. Nitrogen Cycle

Dissolved Oxygen

The quantity and forms of nitrogen present in the IRL is closely related to DO, which is consumed during nitrification. DO is the amount of oxygen in the water available for use by aquatic organisms. Some species are adapted to lower levels of DO, but generally aquatic species require greater than 2 milligrams per liter for survival. Therefore, the DO concentration in water can be a measure of the health of the aquatic environment. DO has both a daily and seasonal cycle. Oxygen is produced by plants in the presence of sunlight via photosynthesis. DO concentrations tend to decrease at night when photosynthesis is not occurring. Light availability determines the daily cycle, but the seasonal cycle can be linked to light and temperature (Figure 4). Temperature, salinity and atmospheric pressure determine the amount of DO that can dissolve in water. When temperatures increase, the amount of DO the water can hold decreases. The same relationship is true for salinity, saltwater holds 20% less oxygen than freshwater. Wind, waves and currents mix the water column, mixing DO throughout and allowing for the dissolution of atmospheric oxygen into the water. This increases DO availability when winds and currents are high, while stagnant water will experience a decrease in DO and will often have hypoxic conditions at the lowest stratification. When a system is consistently depleted of DO, the hypoxic waters are referred to as a "dead zone." A rapid or widespread decrease in DO is often the cause of fish kills.

Note: Graph provided by SJRWMD

Figure 4. Example of the Relationship Between DO and Temperature

Salinity

Salinity is the measurement of dissolved salts in the water and is often expressed as parts per thousand (ppt). Many aquatic plants and animals are sensitive to fluctuations in salinity including seagrass and oysters. Freshwater has a salinity of 0.5 ppt or less. Estuaries can have salinities from 0.5 ppt to 30 ppt depending on freshwater inputs, flow and proximity to the ocean, in comparison ocean salinity averages 35 ppt Freshwater inputs to the IRL will lower salinity levels, while periods of drought will create hypersaline conditions. The proximity to the inlets stabilizes the salinity in IRC's region of the IRL, but major storm events may create pulsed events of low salinity. These changes in salinity are temporary, often recovering within days. On average, the IRL portion within IRC has a salinity ranging from 20 ppt to 30 ppt.

Coastal Acidification

Atmospheric carbon dioxide is absorbed by the ocean and other waterbodies, lowering the natural pH of the system. Estuaries are not only influenced by atmospheric carbon dioxide, but by excess nitrogen and organic carbon runoff from land and freshwater inputs creating coastal acidification. The pH scale is logarithmic where a pH of 5 is ten times more acidic than a pH of 6 (Figure 5). Because of a ten-fold increase, slight changes in pH can have a large impact on water chemistry and marine life. The pH of ocean water is 8.2 at a salinity of 35 ppt. The pH of estuarine water is influenced by salinity. In areas with lower salinity levels, the pH can range from 7.0 to 7.5. Areas with increased salinity have a range in pH of 8.0 to 8.6 because of the alkalizing capability of saltwater. A 2018 study examined pH, DO, temperature and salinity from ten estuaries in Florida over a 28-year period. The results from the IRL indicated decreasing pH levels and increasing coastal acidification (Robbins and Lisle 2018).

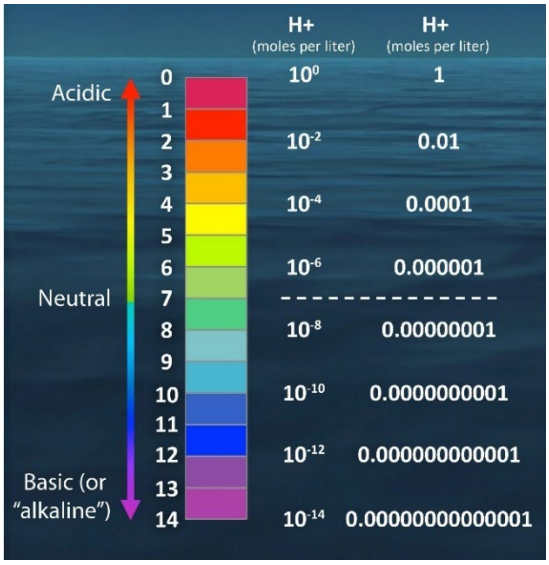


Figure 5. Logarithmic pH Scale

Changes in pH level impact marine organisms including fish and calcifying taxa (clams, mollusks, oysters, etc.). Under decreasing pH levels, invertebrates are unable to mineralize their exoskeletons. Shellfish may experience a slower growth rate, thinning shells and an increase in mortality. The impacts to fish are not as direct and many researchers believed fish species would not be impacted because they do not rely on calcium carbonate. Decreases in pH affect water chemistry. Studies have shown fish can experience metabolic stress, impacts to skeletal mineralization from acidosis and impacts to their sensory system. While some species are capable of adapting to changes in water chemistry, some studies have shown impacts to their olfactory system change larval behavior including settlement. Coastal acidification is also implicated in the die off of coral reefs across the globe. The economic impacts of coastal acidification are unknown at this time, but tourism and recreation, which includes fishing and diving, contribute $2 billion dollars annually to the region.

Heavy Metals

Copper, mercury and lead have been found at elevated concentrations in sediments and clams near marinas and urban areas adjacent to the IRL (Trefry and Trocine 2011). These trace elements are naturally found in water and sediments, but anthropogenic sources of heavy metals can increase sediment concentrations to potentially toxic levels. Anthropogenic sources of heavy metals include agriculture, manufacturing, sewage sludge, pesticides, antifouling paints, galvanized metals and chromated copper arsenate treated lumber. High levels of heavy metals, such as copper and lead, can impact survival, growth, reproduction and brain function in marine organisms. Copper is the main component in antifouling paints used to prevent organisms from settling on ship hulls. While its use is beneficial to the marine industry, it is a biocide that impacts marine organisms including oysters which are beneficial filter feeders in the IRL. Newly formulated antifouling paints without copper or other heavy metals have proven successful in inhibiting bioaccumulation and cause less damage to marine organisms.

Emerging Contaminants

Concerns regarding other contaminants remain unknown. Research by Florida International University found caffeine, opioids, antibiotics and other common drugs in redfish collected from the IRL. The impact these medications have on fish, human consumption and other marine life remains in question.

Another emerging contaminant of concern is microplastics. Plastic materials can take anywhere from 20 to 500 years to break down, creating microplastics, which are plastics measuring less than 5 millimeters. Microplastics have been found in the stomach content of fish and in the tissues of oysters in the IRL. Little is known about the impact plastics are having on the health of fish and filter feeders. There is evidence of dehydration and malnutrition in marine organisms ingesting plastics, which often leads to death.

There are also other factors impacting IRL water quality. Heavy metals and emerging contaminants such as perfluoroalkyl substances (PFAS) and glyphosate have been linked to anthropogenic sources. There is increasing concern regarding the impact of these substances on the IRL, especially since they have no current regulatory standards. To successfully improve IRL water quality, it is necessary to address all pollutants and contaminants from anthropogenic sources.

Water Quality Goals, Objectives and Actions

The goals and objectives for the Water Quality key factor include:

- Reduce inputs of pollutants to the IRL to improve water quality and meet state standards.
- Improve understanding of the impacts of emerging contaminants on IRL water quality and ecosystem health.

The following actions are proposed to be implemented in the short-term:

- Continue to improve BMPs for County facilities.
- Improve pollutant removal in the wastewater treatment facilities.
- Continue education and outreach for pollution reduction including fertilizer use and application of native plants.
- Continue to encourage regulatory oversight agencies to improve and ensure proper BMPs are in place for agricultural facilities.
- Support the existing water quality monitoring network.

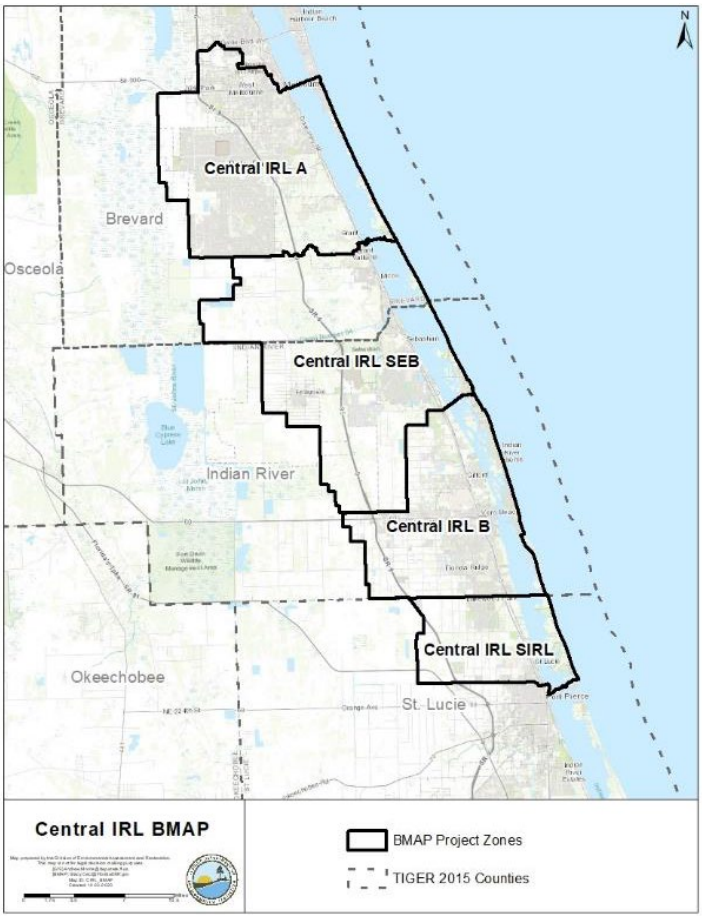
The following actions are proposed to be implemented in the longer term:

- Implement projects to slow untreated freshwater flows to the IRL to reduce pulsed loading of nitrogen and phosphorus.
- Continue to work with local research entities and agencies to better understand the presence and impacts of emerging contaminants.

B. BMAP

In 2009, FDEP established TMDLs for the IRL using years of water quality and seagrass data collected by SJRWMD and in accordance with the Clean Water Act, which was established in 1972 setting national water quality criteria for surface water pollutants. A TMDL represents the maximum amount of pollutant a surface water can assimilate without exceeding water quality standards. Once waters are determined to be impaired and TMDLs are established, FDEP may develop a BMAP. A BMAP is a framework for water quality restoration for the state and local entities to reduce pollutant loading through current and future projects. BMAPs are designed to be implemented in phases to meet the restoration goals for a particular waterbody.

The IRL system is divided into three sub-basins for the BMAPs: Banana River Lagoon, North IRL and Central IRL. IRC is located within the Central IRL BMAP. The BMAPs are further divided into project zones. IRC is located within two project zones: Central IRL SEB, from Grant Farm Island to the Wabasso Causeway, and Central IRL B, from the Wabasso Causeway to the IRC and St. Lucie County line (Figure 6). The initial Central IRL BMAP was adopted by FDEP in 2013. IRC was not required to make nutrient reductions, because the median seagrass depth limit for the area was in compliance with the parameters when the BMAP was created. Although the County did not receive reduction requirements, IRC was actively pursuing projects and reducing nutrient loading to the IRL. The 2020 BMAP update did impose TMDL required reductions for all entities within the Central IRL BMAP. IRC continues to make strides through multiple departments to meet load reductions. As a stakeholder in the Central IRL BMAP, IRC submits all applicable projects and data to FDEP's Statewide Annual Report. FDEP compiles the data collected into a summarized report of accomplishments including restoration projects and management strategies. The public may view the report and story map on the FDEP website at https://floridadep.gov/dear/water-quality-restoration/content/statewide-annual-report.



Note: From the FDEP Central IRL BMAP (2021)

Figure 6. Central IRL BMAP Project Zones

In 2020, the Central IRL BMAP was updated and shifted from the previous Pollutant Load Screening Model (PLSM) to a new Spatial Watershed Iterative Loading (SWIL) model. The SWIL model includes the acreage, land use and loading estimates, including groundwater and atmospheric deposition, to determine the reduction requirements for each entity in the BMAP area. The newly established reductions under the current BMAP must be met by 2035 with a five-year milestone of 35% and a ten-year milestone of 70%. The County has provided sufficient projects to meet the first BMAP milestone and is developing additional projects, including those in this LMP, to achieve future milestone requirements.

The SWIL model is currently being updated by FDEP, and updated allocations will be determined. IRC will revise the project list, as necessary, to achieve the revised allocations once the BMAP is updated.

IRC faces challenges in meeting the requirements set forth by the current BMAP. The greatest challenge will be the costs associated with project design and construction. To meet the BMAP reductions, it would benefit IRC to study the groundwater flow and nutrient loading of groundwater in the County since FDEP places considerable weight on groundwater in the modeling efforts. In addition, for IRC to receive BMAP credits for septic-to-sewer projects, it is necessary to use an ArcGIS-Based Nitrate Load Estimation Toolkit (ArcNLET) model of TN loading to the IRL, and that model is currently being developed.

BMAP Goals, Objectives and Actions

The goals and objectives for the BMAP key factor include:

- Identify and implement projects to meet the TN and TP required reductions for the BMAP.
- Reduce nitrogen and phosphorus loading from the three main relief canals to meet the TMDL and BMAP requirements for the Central IRL.

The following actions are recommended to be implemented in the short-term:

- Identify areas of high nutrient concentrations and/or loads and implement nutrient reduction projects in those locations.
- Develop a remediation plan to identify the most feasible options to remove traditional septic systems, either through central sewer expansion or upgrades to enhanced, nutrient removal systems.

C. Harmful Algal Blooms

Algae is a normal component of a healthy ecosystem, but often goes unnoticed. An increase in nutrient inputs to the system can lead to excessive growth in algal species, known as an algal bloom. Algal bloom persistence is dependent upon the species and nutrients available. A limiting nutrient controls the growth of the algae or plant when it is at low levels in the ecosystem. Nitrogen is often the limiting nutrient in marine and estuarine environments, while phosphorus has been considered the limiting nutrient in freshwater ecosystems. However, in an algal bloom, the limiting nutrient is also dependent upon the species of algae present. *Pseudo-nitzschia* is a diatom commonly found in the Central IRL. Under bloom conditions, the algae produce the biotoxin domoic acid, which causes amnesic shellfish poisoning. Unlike other algae, the limiting nutrient for diatom blooms is silicon. Throughout history, the IRL has experienced periodic algal blooms, but in recent years there has been an increase in frequency and duration as well as a shift in the dominant taxon making up the bloom. In 2011 and 2012, there was a persistent algal bloom, which impacted seagrass beds and caused widespread fish kills. The 2011 bloom was caused by a green microalga, while the 2012 bloom was dominated by *Aureoumbra lagunensis*, a brown alga previously unknown to the region. These algae species had not been identified in previous blooms and their size (6 micrometers) made it difficult to identify them with a standard microscope. As the seagrass beds began to rebound in the IRL, another algal bloom was experienced. In 2016, the IRL experienced another wide-spread algal bloom of *Aureoumbra lagunensis* as well as the cyanobacteria species *Microcystis aeruginosa*, which flowed from Lake Okeechobee through the St. Lucie Estuary.

Many algal species produce biotoxins, which are dangerous to aquatic organisms and humans. These toxins can cause neurological, respiratory and liver issues depending on the species. Not all algal species produce toxins yet an algal bloom can still be harmful to the aquatic environment. Extensive and persistent algal blooms block light from reaching seagrass beds, leading to seagrass loss. As the algae die and settle to the Lagoon bottom, decomposition begins. Bacteria and other microbes take up oxygen during the decomposition process leading to low DO and fish kills. In addition, the decomposition of the algae causes muck accumulation on the Lagoon bottom. The best action taken against a harmful algal bloom event is prevention of excess nitrogen and phosphorus from entering the IRL.

The IRC Harmful Algal Response Plan sets objectives, partners and response actions for the County during a harmful algal bloom event. Response efforts include sampling, public messages and cleanup of deceased organisms.

Harmful Algal Blooms Goals, Objectives and Actions

The goals and objectives for the Harmful Algal Blooms key factor include:

- Improve water quality, which is linked to algal blooms and declining seagrass.
- Coordinate with local stakeholders to respond to harmful algal blooms and conditions indicating a potential bloom.

The following actions are proposed to be implemented in the short-term:

- Monitor real time data to identify possible harmful algal blooms.
- Work with local stakeholders to provide increased monitoring when there is a potential for health concerns.

The following actions are proposed to be implemented in the longer term:

- Implement projects to reduce untreated freshwater and nutrient inputs.

D. Organics and Sediments

Historically the IRL had a sandy benthic (lagoon floor) habitat. The sandy material consisted of 7% clay and 2% organic matter. As the population along the IRL began to boom in the 1900s, an increase in runoff carried organic matter, silty sediments and nutrients. In addition, increased nutrient loads lead to algal blooms, which increase the organic material to the Lagoon floor. These inputs have caused a shift in the IRL benthic community. Sandy sediments have now been replaced with muck, which is primarily composed of water and has the consistency of mayonnaise (also known as “black mayonnaise”). The sediments are comprised of 59% clay and 10% organic matter. This high organic matter content produces hydrogen sulfide and creates a dead zone devoid of oxygen. The high-water content and the fine silty material increase turbidity and smothers the benthic habitat inhibiting seagrass growth. Muck accumulates nutrients allowing for fluxes of nitrogen and phosphorus to the water column creating a feedback loop for potential algal blooms.

Deep muck pockets are often isolated to specific sites including the ICW and other deeper holes and channels. Other regions of the IRL may contain smaller, thinner layers of muck over natural Lagoon sediments. At this time, there is limited understanding of muck locations and content within the IRL in IRC. To better understand muck locations and content, it is necessary to map the current muck locations, determine their depth and measure their nutrient fluxes. Extensive muck pockets can be managed by dredging, dewatering and disposal of the muck material at the landfill or an upland site. Muck removal by dredging is suitable for navigable areas of the IRL. Muck has also been successfully managed by trapping the material under a clean layer of sandy sediments compatible with the IRL natural sediments. Dredging and capping muck is beneficial in preventing nutrient fluxes to the water column. While these methods are available to manage the current muck within the IRL, it is necessary to prevent further accumulation of muck, as it is easier and more cost-effective. Ways to help prevent the accumulation of muck include keeping a native buffer along IRL shorelines to reduce erosion, reduce the use of fertilizer and keep lawn trimmings and plants out of canals and drains.

Organics and Sediments Goals, Objectives and Actions

The goals and objectives for the Organics and Sediments key factor include:

- Determine areas of muck accumulation for mitigation and management.
- Reduce the amount of organic material entering the IRL contributing to nutrient loading and muck accumulation.

The following actions are proposed to be implemented in the short-term:

- Map areas of muck impact.
- Implement measures to reduce sources of organic matter from entering the IRL.

The following actions are proposed to be implemented in the longer term:

- Measure nutrient flux rates associated with each pocket of muck.
- Remove and/or cap muck as necessary to reduce water quality impacts.

E. Sea Level Rise

Sea level rise is a concern for all coastal communities. It is caused by the melting of ice sheets and glaciers and expansion of water as it warms (Lindsey 2022) (Figure 7). Most of the coastal areas in IRC are less than 25 feet above sea level. Since the 1970s, seas have been rising at approximately 4.03 millimeters per year (Figure 8). This could put coastal areas of IRC at greater risk for potential flooding and inundation from sea level rise. Sebastian Inlet to the north and Fort Pierce Inlet to the south create a tidal influence within the IRL in IRC. As sea level rises, tides will also become more extreme increasing IRL water levels. The USACE Projection Summary anticipates seven of the 50 stormwater outfalls in IRC may be underwater by 2040 (USACE 2013). In addition to sea level rise, climate changes are linked to increases in storm frequency and intensity leading to an increase in potential inundation of upland areas, placing homes and infrastructure at risk.

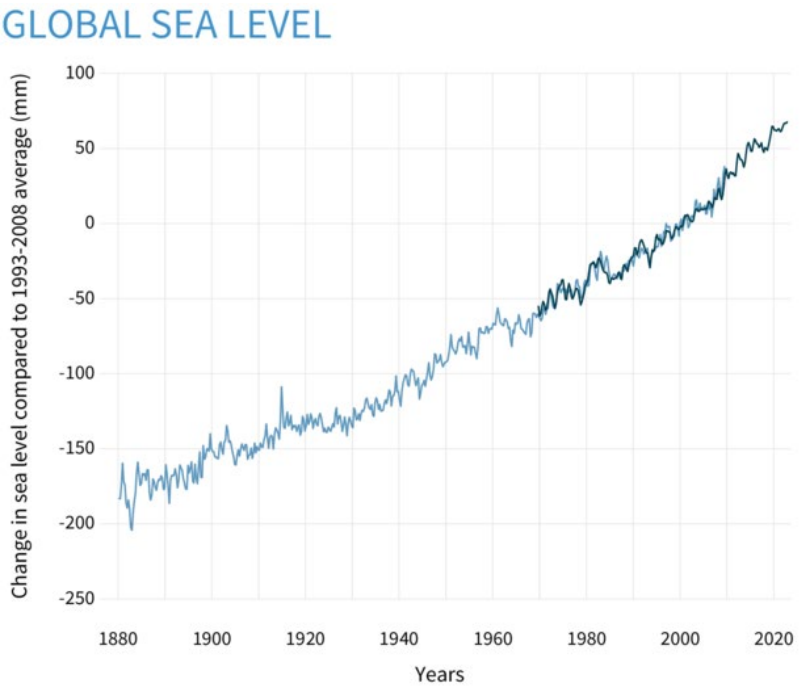


Figure 7. Global Sea Level Rise

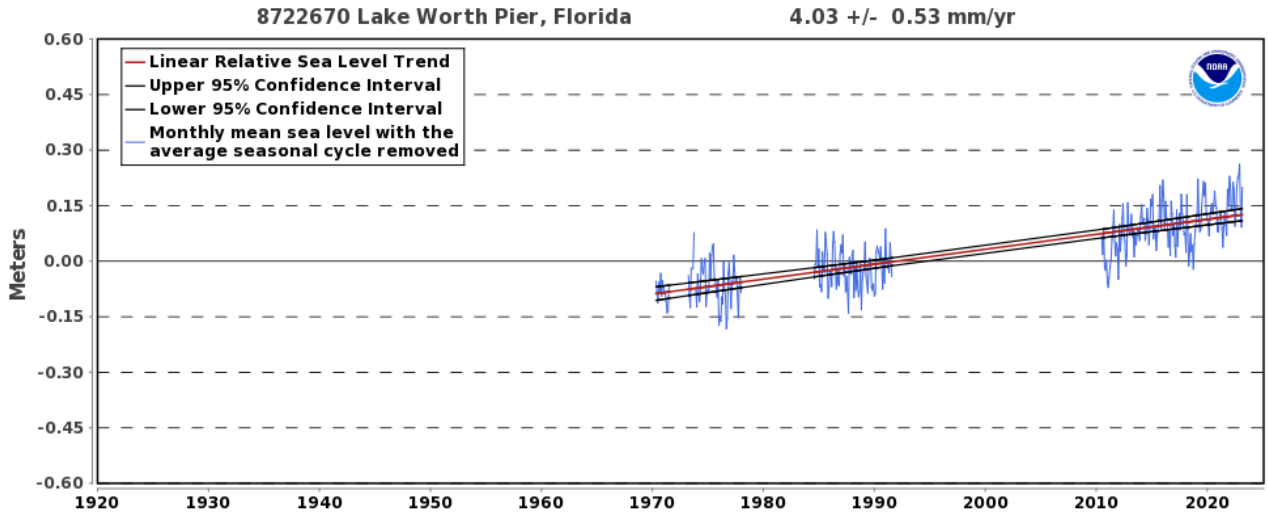


Figure 8. Sea Level Rise at Lake Worth Pier, Florida

Sea level rise will have ecological implications on the distribution of seagrass, migration of marshes, increased shoreline erosion, oyster reefs and saltwater intrusion. High marshes positioned above mean high water levels naturally protect upland structures from water inundation, prevent pollution and are an important habitat for numerous organisms. With the loss of high marsh habitat, sea level rise will increase sedimentation and nutrient releases to the IRL. Many of the remaining mangrove fringe habitat will be unable to retreat. Mangrove fringe habitats act as a carbon sink, filter nutrients, stabilize sediments and provide a vital nursery habitat within the IRL. With limited ability to retreat, mangrove fringe habitats will eventually be destroyed, releasing stored carbon creating negative feedback for climate change drivers.

The IRLNEP Climate Ready Estuary Technical Report (2021) lists sea level rise as a major stressor for impaired waters. In a risk analysis it was determined sea level rise in the IRL will increase pollutant loadings, decrease water clarity, decrease DO, reduce suitable marsh habitat resulting in decreasing biodiversity while increasing the risk of exotic and invasive species spread. Sea level rise will negatively impact habitats and organisms within the IRL. In addition, homes and infrastructure may be at risk of flooding. To gain a better understanding of the risks to the IRL and the community, it is necessary to understand the rate of sea level rise in the IRC. While data are available from NOAA, the closest station is 90 miles south in Lake Worth.

Sea Level Rise Goals, Objectives and Actions

The goals and objectives for the Sea Level Rise key factor include:

- Maintain living shoreline buffers, which outperform sea walls and bulk heads during storm events.
- Create a buffer zone allowing for retreat of key habitats from sea level rise and flooding.

The following actions are proposed to be implemented in the short-term:

- Improve resiliency for critical infrastructure and shoreline protection through future modifications to County development codes and ordinances as appropriate.
- Encourage factoring in sea level rise risks and scenarios when engineering new infrastructure.

F. Marinas, Boats and Boat Ramps

Boating

As of 2023, IRC has 10,494 registered recreational boating vessels and 313 registered commercial vessels for a total of 10,807 registered boats, with an unknown number of transient boats to the region throughout the year. Boat owners are responsible for maintaining their vessels, following safe boating practices and minimizing damage to the IRL habitat. However, boating

in the IRL is not without its impacts. There are measures in place to minimize environmental impacts to the water, but education should be at the forefront to keep boaters and those in the marine industry informed of best practices.

There are four primary impacts from recreational boating: habitat damage from propellers, petroleum products, pollutants from boat maintenance and wastewater. Florida Statute 327.53 requires vessels 26 feet or longer with an enclosed cabin and berthing facilities, any houseboat used primarily as a residence and any floating structure with enclosed living space with berthing facilities and public access to have a toilet and Marine Sanitation Device (MSD). MSDs are designed to receive, retain, treat or discharge waste. MSD I is a flow through device treating sewage by chemical or thermal means (required for vessels 26 to 65 feet). MSD II treats waste by biological means using bacteria (required for vessels over 65 feet). MSD III holds waste to prevent direct overboard discharge. Vessel sewage is highly concentrated with up to 40 times as many nutrients as raw municipal sewage (Florida Sea Grant n.d.). MSD I and II only reduce bacteria and solids, not nutrients. Federal law requires all vessels with a Y-valve to be closed while operating in all inland and coastal waters. However, vessels without a Y-valve with MSD I and II on board are able to discharge outside of No Discharge Zones, freshwater bodies with shallow entrances and exits and rivers not navigable by interstate vessel traffic. The Clean Vessel Act of 1992 provides funding for the construction of pumpout facilities to ensure proper disposal of human waste from recreational vessels. The act is administered by FDEP. Since 1994, FDEP had awarded more than $7 million funds for the construction of pumpout stations. There are currently 14 pumpout facilities located in IRC. Ten of the pumpouts are in Sebastian, while four are in Vero Beach. A recent survey of the pumpout locations determined there was limited access to facilities for transient boaters and several locations were currently out of service. Pumpout Nav is a mobile app allowing boaters to search for pump out stations throughout the state.

FDEP also administers the Clean Marina Program. This is a voluntary program encouraging marinas to implement FDEP's BMPs. The focus of the program is on the protection of sensitive habitats, waste management, stormwater control, spill prevention and emergency preparedness. To receive the designation, the marina must implement 60% of the BMPs and meet the legal regulatory requirements. There are 13 marinas located in IRC of which 10 have received the Clean Marina Program designation (https://floridadep.gov/rcp/clean-marina/content/designated-clean-marinas).

Mooring

Florida law allows boaters to moor in the IRL, outside of the ICW and mooring fields. Florida Statute 327.4109 prohibits mooring within 150 feet of a marina, boat ramp or boatyard; within 500 feet of a superyacht facility; or within 100 feet from a marked boundary of a public mooring field unless the vessel suffers from mechanical failure or there are imminent weather conditions in the vicinity. In addition to the listed mooring restrictions, counties may establish Anchoring Limitation Areas (ALAs) under Florida Statute 327.4108. ALAs require an anchored vessel to be moved at least one mile away every 45 days. An ALA must not be greater than 100 acres and may not exceed 10% of the navigable-in-fact waterways.

Derelict Vessels

The establishment of an ALA is designed to prevent the abandonment of vessels, which can increase the risk of derelict vessels. Derelict vessels have negative ecological impacts on the IRL damaging the benthic habitat, scattering debris, discharging contaminants and creating navigation hazards. Potential contaminants include fiberglass and chemicals such as paints, polystyrene, fuel and oil. Law enforcement officers follow protocols established by Florida Statute 46, Chapter 823 to determine if a vessel is derelict or at risk. If a vessel is deemed at risk, the owner is notified and given 72 hours to provide proof of repair to remove the vessel. An at-risk vessel must be ticketed three times in 18 months before it can be approved for removal. Once a vessel is cited, the owner may choose to hand over the vessel to FWC through the Vessel Turn in Program. If the vessel remains in the water, it will be at greater risk of becoming a derelict vessel. Derelict vessels are investigated by law enforcement. Once an owner has been notified a 21-day count begins. If the owner does not remove the vessel within the 21-day period or request an administrative hearing, the vessel will be released for removal. IRC is currently the lead organization coordinating efforts to remove derelict vessels from the IRL and adjacent waters after approval from FWC Boating and Waterways. County staff works directly with FWC to monitor at-risk and derelict vessels, meeting monthly to have vessels removed promptly.

Marinas, Boats and Boat Ramps Goals, Objectives and Actions

The goals and objectives for the Marinas, Boats and Boat Ramps key factor include:

- Increase boater education and awareness.
- Reduce the number of derelict vessels in the IRC's portion of the Lagoon.

The following actions are proposed to be implemented in the short-term:

- Encourage the increase in numbers and distribution of pumpout facilities throughout IRC's portion of the IRL.
- Promote the FDEP Clean Marina Program.
- Provide education to marinas and boaters on BMPs for boat care and maintenance.
- Continue to encourage local law enforcement to patrol IRL waters to ensure compliance with mooring and waste disposal.
- Evaluate establishing ALAs to aid in derelict vessel removal efficiency.

G. Ecosystem Functions and Habitat Use

The IRL is a biologically diverse estuary. It is home to over 4, 300 species of flora and fauna. Estuaries play an important role as a nursery habitat for many marine organisms spending their larval and juvenile stages in a protected shallow environment. While some species only use the IRL for a portion of their lifecycle, there are many residing within the Lagoon for their entire life. Several species in the IRL have experienced ecological changes linked to the degradation of the ecosystem. Declining water quality and sediment degradation can be implicated in many issues these organisms have experienced.

Seagrasses

Seven species of seagrasses inhabit the IRL, but the most dominant species, and particularly within the IRC region, are *Halodule wrightii* (shoal grass), *Syringodium filiforme* (manatee grass) and *Thalassia testudinum* (turtle grass). Seagrasses provide essential ecosystem services to the IRL. Seagrasses stabilize the benthic habitat, provide shelter for invertebrates and fish, take up nitrogen and phosphorus, and are an important food source for herbivorous organisms, including manatees. Because of the importance of seagrass in the IRL, it is widely studied with the most extensive dataset collected by SJRWMD. SJRWMD began bi-annual mapping of IRL seagrass in 1986. The agency conducts both aerial and transect surveys throughout the IRL. For the purposes of seagrass mapping, SJRWMD breaks the IRL into reaches. IRC is located within Reach 6 and SJRWMD monitors 15 transects in the County (Figure 9).

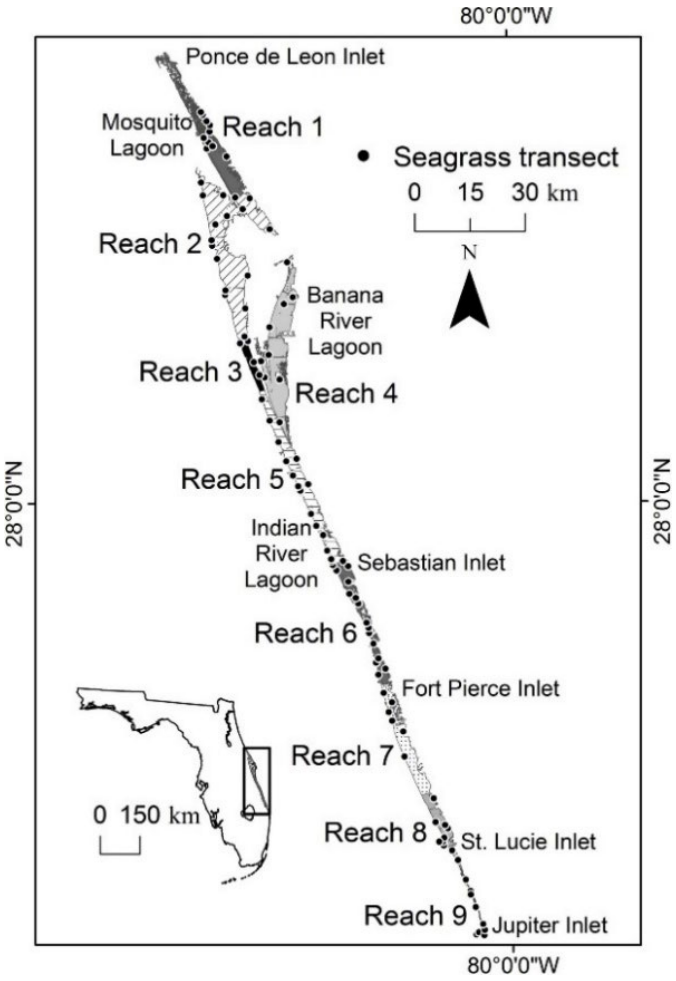


Figure 9. Locations of SJRWMD Seagrass Transects

Through their extensive mapping efforts, SJRWMD is able to determine the areal change in seagrass within each reach. From 1970 to 1992, seagrass coverage in the South Central IRL relatively remained stable. Some regions saw an increase in seagrass coverage, while areas with increasing development saw a decrease (Fletcher and Fletcher 1995). However, an overall decrease in the maximum depth of seagrass beds was observed which was linked to low light conditions. This has remained true for seagrass beds within IRC. SJRWMD continues to see the maximum depth of seagrass beds shrinking. Since 1998, the mean percent cover of the three dominant seagrasses species in IRC has steadily declined. Seagrass loss was accelerated in 2011, 2012 and 2016 with extensive losses in areal coverage and density caused by widespread algal blooms (Figure 10). Seagrass loss throughout the IRL has been linked to decreased photosynthetic active radiation, which is required for survival and growth.

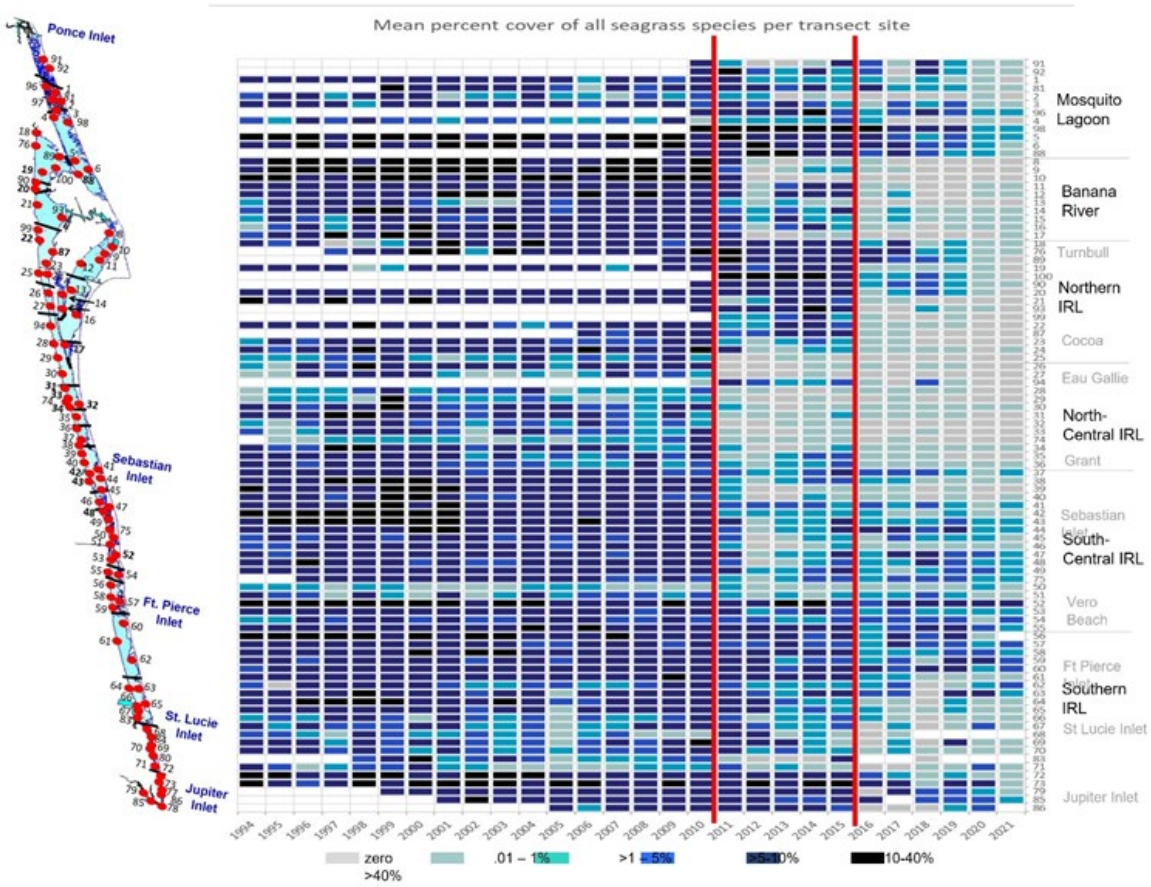
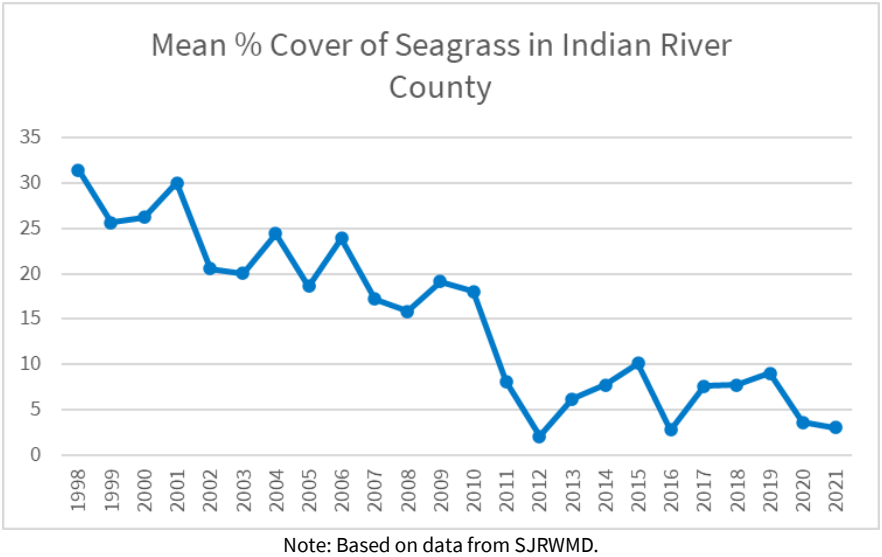


Figure 10. Changes in Seagrass Coverage over Time Throughout the IRL

Since 2016, seagrass beds have begun to show patchy recovery in IRC (Figure 11). It is important to understand that seagrass recovery will not occur rapidly. It is estimated it will take up to 16 years for areal coverage and density to return to pre-2011 coverage, but this will require continued improvement to water quality. It is not feasible to plant all the lost seagrass beds within IRC. As an effort to boost natural recovery, restoration projects at historically known seagrass sites with viable water quality, clarity, sediment quality and protection from wave action may be beneficial. The IRLNEP is working to establish a seagrass nursery network along the IRL to support restoration efforts.



Note: Based on data from SJRWMD.

Figure 11. Trend in Mean Percent Cover of Seagrass in IRC

Mangroves

Three mangrove species can be found along the shorelines of the IRL: red, black and white. In many regions of the world, mangroves often grow in succession indicating flood tolerance (Figure 12). However, mangroves in the IRL do not follow the typical progression from red mangrove in the intertidal, to black at the mean high tide line and white growing in upland, less flooded areas. Mangroves create a nursery habitat and shelter for numerous organisms, including important commercial and recreational fish species. They offer protection against tidal and wave forces, offering protection to upland structures. Mangroves stabilize and trap sediments along shorelines and have been shown to outperform seawalls and bulk heads (Timm 2017). In addition to the habitat and protection mangroves offer, they are a sink, removing excess nutrients and carbon from the environment. The greatest threat to mangroves is development. FWC estimates the IRL has lost 85% of its mangrove forest. To protect mangroves in Florida, FDEP regulates the removal and trimming of mangroves, setting guidelines and permit requirements for such activities (https://floridadep.gov/sites/default/files/Mangrove-Homeowner-Guide-sm_0.pdf).

IRC is currently working with the University of Central Florida to complete a shoreline characterization study within the county. The study will help managers better understand current shoreline conditions and establish strategies for shoreline restoration and management.

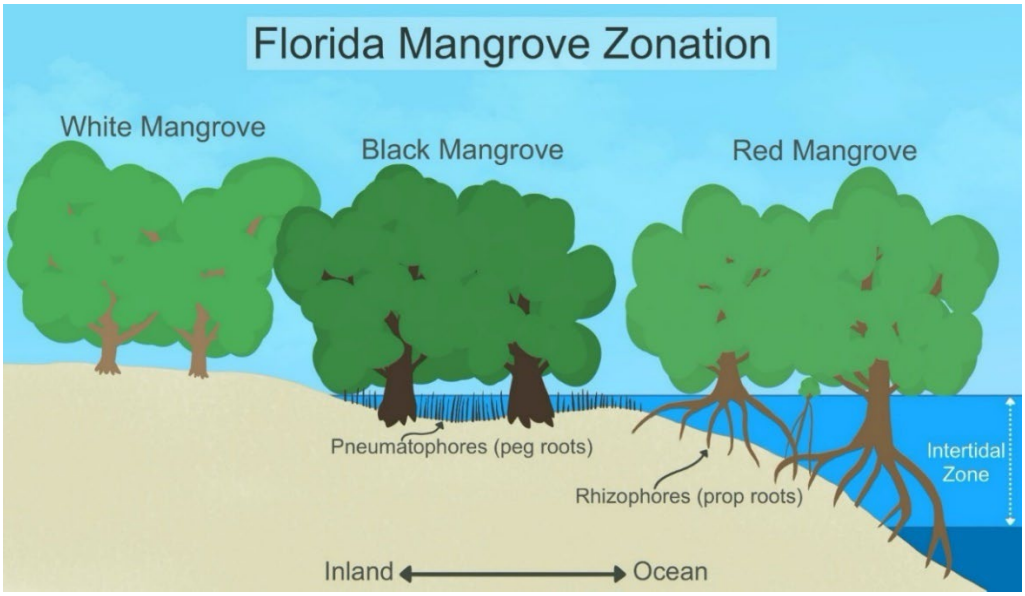


Figure 12. Florida Mangrove Zonation

Suspension Feeders

There are approximately 160 species of bivalves inhabiting the IRL. Bivalves are suspension feeders and include clams and oysters. Historical bivalve populations are not well understood in the Lagoon, although shell middens indicate oysters and clams were part of a sustainable fishery for the Ais Native Americans (historical tribal population inhabiting the IRL). World-wide, bivalve populations are declining. This decline can be contributed to disease, changes in water quality, suitable settling habitat and overharvesting.

The IRL is home to naturally occurring and man-made oyster reefs throughout IRC. Oyster growth also occurs in abundance on red mangrove prop roots, dock pilings and shallow rocky areas throughout IRC. An adult oyster is capable of filtering 30 to 50 gallons of water per day, removing sediments, small phytoplankton and particulate bound nitrogen and phosphorus. Oysters release ammonia as biological waste, but bacteria and microbes associated with established oyster reefs fix the ammonia through denitrification; therefore, the oysters do not contribute additional nitrogen loading. Estimates of oyster reef denitrification efficiency range from 20% to 100% (Piehler and Smyth 2011, Ray et al. 2019). While oysters can improve water clarity and quality, they need good water quality for growth and survival. Oysters have varying requirements of salinity, temperature and flow at different stages of their lifecycle. Minor fluctuations in these requirements can increase mortality and reduce settlement rates. In addition to their ability to improve water quality, oysters are ecosystem engineers. Oyster

reefs act as breakwaters, dissipating wave energy and decreasing shoreline erosion. Oyster reefs are readily used in living shoreline construction projects in the IRL. IRC currently has loose oyster shells ready to be used in shoreline restoration projects.

Mercenaria mercenaria is a large hard-shelled clam, burrowing in soft sediments including sand and mud flats throughout Florida. Similar to the benefits of filtration by oysters, *Mercenaria* also filter out particulate matter and phytoplankton. The waste by-product is passed directly to nitrifying bacteria found in the sediments. The hard clam was an important commercial fishery in the IRL. Between 1987 and 2001, 10.5 million pounds of *Mercenaria* were harvested from Volusia County to Martin County. The commercial fishery was valued at $70.3 million, ranking the hard clam the most valuable commercial fishery in the IRL. Unfortunately, the commercial fishery has seen a drastic decrease in the number of harvestable clams because of overharvesting, sediment quality and declining water quality. Currently, hard clams are farmed commercially from Volusia County to IRC. Clam seeding has taken place throughout the IRL to increase the density of clams and reestablish clam beds, including in IRC. Clams are reared by the University of Florida's Whitney Lab using spawning stock referred to as "super clams." The stock is believed to be superior and able to survive the changing conditions experienced by the Lagoon. The Brevard Zoo has established *Mercenaria* clam beds in the north end of IRC. In addition, the IRLNEP includes clam bed restoration as an important action in the Comprehensive Conservation and Management Plan. In the pursuit of improving Lagoon water quality and habitat restoration, IRC should consider partnering with organizations working toward the establishment of clams in the IRL.

The Florida Department of Agriculture and Consumer Services (FDACS) has two aquaculture leases in the northern end of IRC with conditionally approved harvesting (Figure 13). Harvesting from this area is closed when two-day cumulative rainfall measured by NOAA exceeds 2.54 inches. An additional approved bivalve harvesting area is #70, spanning from IRC to St. Lucie County. The area within IRC was previously open but is currently closed to harvesting year-round (Figure 14).

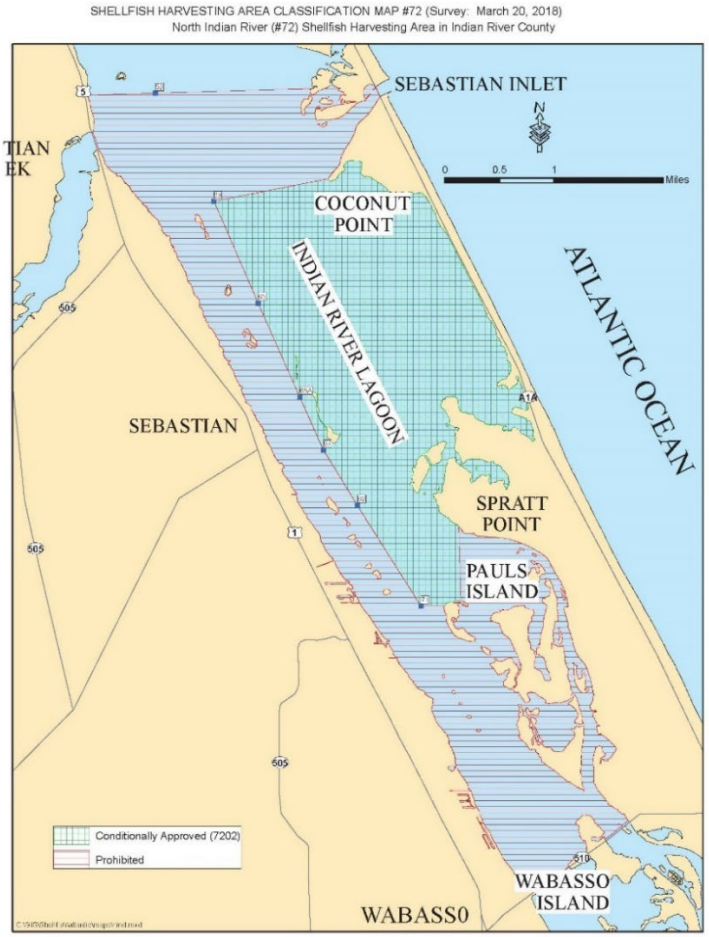


Figure 13. FDACS Aquaculture Leases in IRC

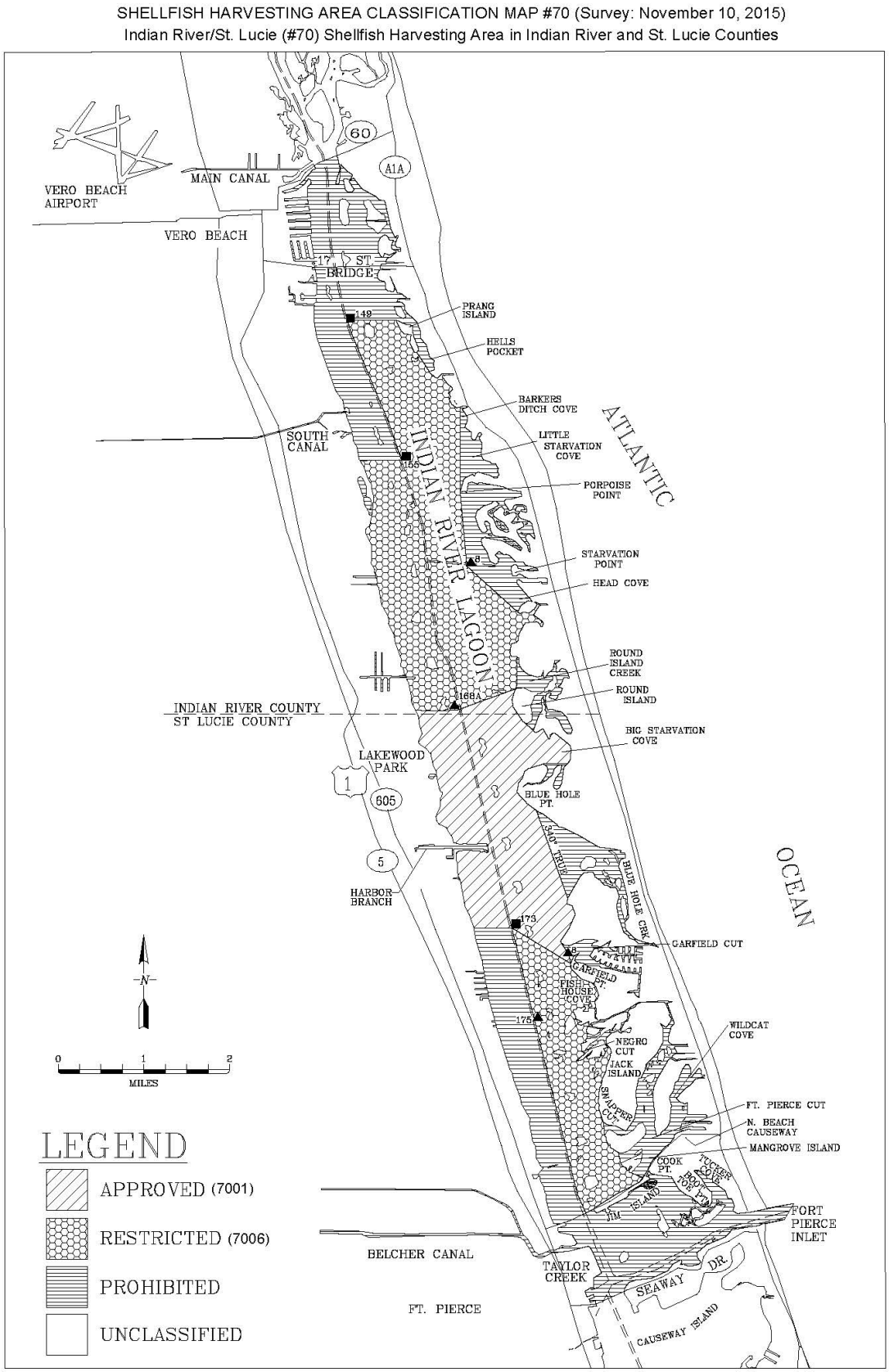


Figure 14. FDACS Approved Bivalve Harvesting Area in IRC

Fisheries

The IRL supports a valuable recreational fishery with tourism and recreation contributing $2 billion annually to the economy. The IRL fish population biodiversity provides a wide variety of species including snapper, sea trout, black drum and sheepshead, in addition to big gamefish such as snook, tarpon and redfish (Figure 15).

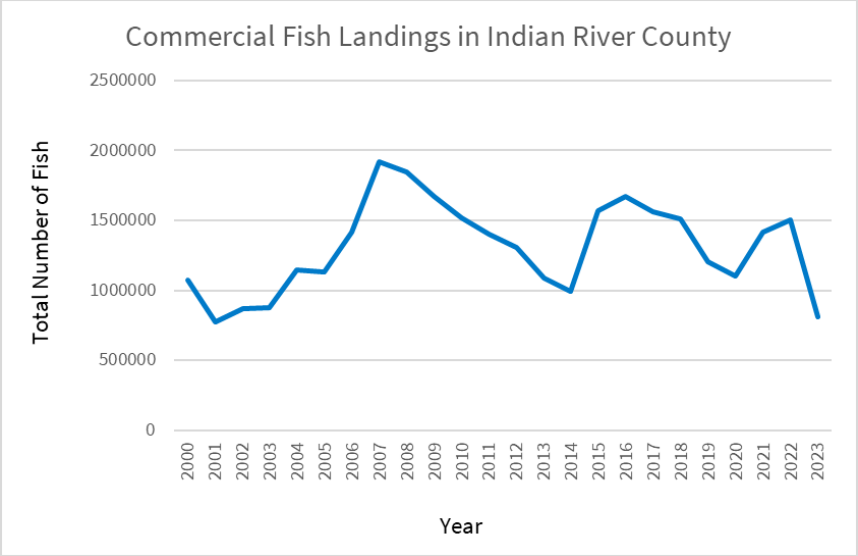
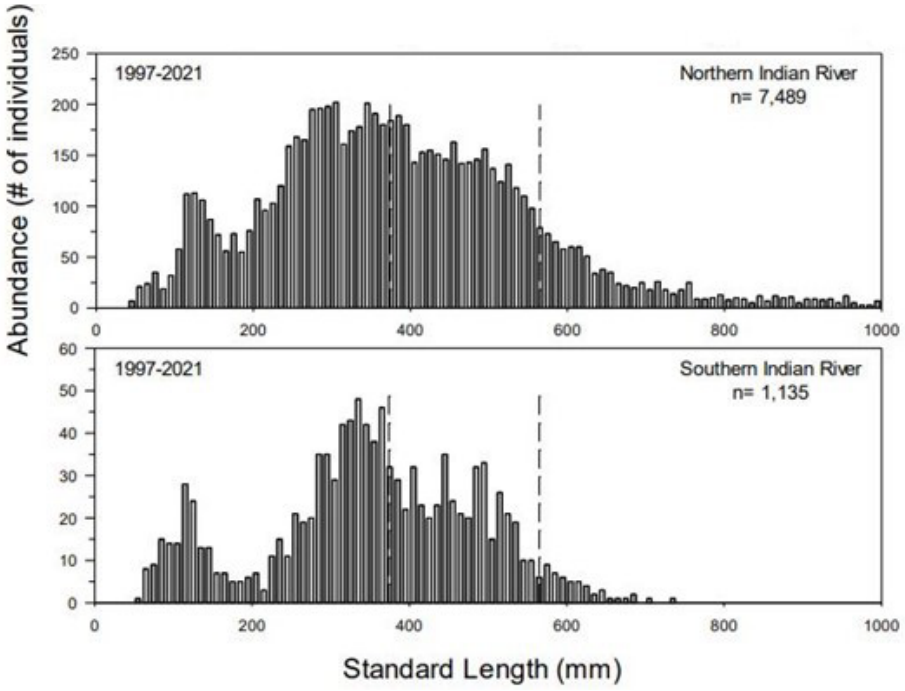


Figure 15. Commercial Fish Landings in IRC

FWC conducts both fisheries dependent and independent monitoring in the IRL. According to the fisheries independent monitoring, fishing stocks appear relatively stable, but overall fish length is decreasing (Figure 16). This phenomenon has been observed worldwide and has been attributed to 1) size selective harvesting, 2) earlier age at maturation from size selective harvesting or climate change, and 3) smaller growth rates linked to warming waters and decreasing DO (Garcia et al. 2012, Enberk et al. 2012). Even small decreases in the body size of fish can lead to increased mortality and a decrease in catch regardless of fishing effort (Audzijonyte et al. 2013).



Note: This figure is from the FWC Fisheries Independent Monitoring data. The Northern IRL ends at Vero Beach and the Southern begins at Vero Beach.

Figure 16. Red Drum Abundance and Size Class

The economic importance of fish to the region cannot be ignored. The algal bloom of 2016 led to Lagoon-wide fish kills linked to low DO. Larger gamefish are dependent upon forage fishes to thrive, and forge fishes are more susceptible to low DO. Many commercially and recreationally valuable fish species use the IRL as a nursery habitat. These species are dependent upon seagrass, saltmarsh and mangrove habitats for their survival. Seagrass loss from algal blooms in the IRL was a driving factor in the closure of the red drum fishery in the fall of 2022. FWC took proactive measures to maintain fish stocks under increasing environmental and fishing pressure. Increasing development and habitat loss will directly impact IRL fisheries and the local economy. Preventing further seagrass, saltmarsh and mangrove loss from development, habitat degradation and declining water quality is beneficial in maintaining fish stocks.

Megafauna

Several species of charismatic megafauna inhabit the IRL, drawing visitors to the region. Dolphins, manatees and marine turtles contribute to the local tourism economy and are federally protected species (Figure 17). Habitat loss including seagrass, water quality degradation from emerging contaminants and human recreation activities are impacting their health and survival.

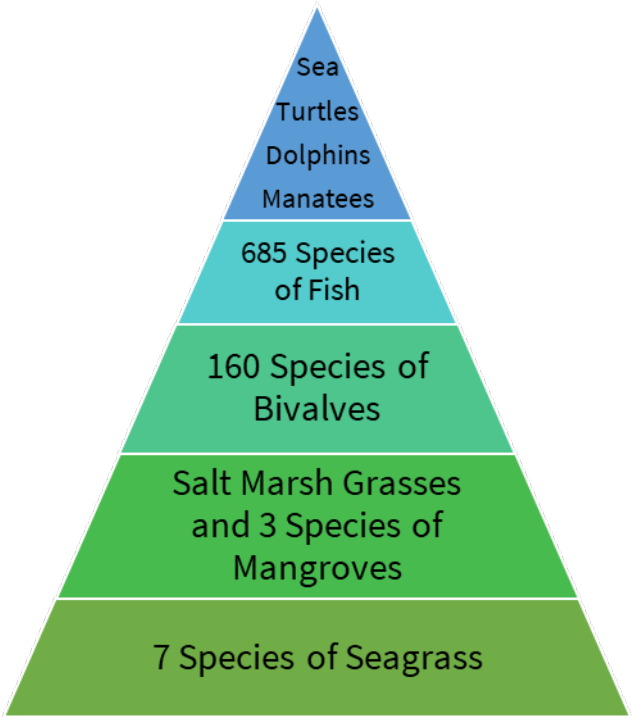


Figure 17. Megafauna, Fish and Bivalve Species and Key Habitats within the IRL

The common bottlenose dolphins found in the IRL have strong site fidelity, only migrating an average of 17 miles. Unlike other coastal populations of common bottlenose dolphins, IRL dolphins rarely form strong family pods except during calving. While other dolphins may enter and leave the IRL through the inlets, the IRL dolphins remain in the Lagoon for their entire lifecycle and do not migrate to the Atlantic Ocean. Hubbs Sea World estimates there are approximately 1,032 dolphins residing in the IRL. This number has remained relatively stable over the last decade.

Research on the IRL dolphin populations has identified environmental stressors as an indicator of dolphin health. In recent years, IRL dolphins have experienced an unusual mortality event. Researchers found even in the absence of a harmful algal bloom, saxitoxin, a neurotoxin associated with the bioluminescent dinoflagellate *Pyrodinium*, was present in their systems. In addition to known pollutants, such as mercury impacting dolphin health and immune function, emerging contaminants are an increasing concern for the health of the populations in the IRL. A study by Florida Atlantic University found that 88% of the dolphins tested contained antibiotic resistant bacteria. The most common antibiotic identified was erythromycin, which is used in human and veterinary medicine (Schaefer 2019).

The IRL is designated critical habitat for the West Indian Manatee. On average 3,000 manatees use the IRL annually. Manatees are slow moving marine mammals vulnerable to cold stress, thermal pollution, seagrass loss and boat strikes. FWC monitors the IRL manatee population, including mortality, population size and movements. From 2000 to 2020, with the exception of two cold stress events in 2010 and 2011, manatee mortality in IRC ranged from 5 to 19 per year. During 2021 and 2022, manatees in the IRL experienced an unusual mortality event caused by starvation. IRC experienced an increase in manatee deaths with 25 in 2021 and 21 in 2022, but neither year came close to the cold stress mortality event in 2010. Seagrass has steadily declined in the IRL, including the loss of the deep edge in IRC, but areal coverage of seagrass has been satisfactory for the release of rehabilitated manatees. While manatees have been blamed for seagrass loss, it is important to note that manatees do not pull seagrass up by the root system. Manatees grasp the upper blades of grass similar to bovine grazing. Low light availability from decreased water clarity along with algal bloom events led to seagrass decline in the IRL.

IRC created a Manatee Protection and Boating Safety Comprehensive Management Plan in 2000, with revisions in 2002 and 2004. Since its adoption, additional objectives and policies addressing the general aspects of manatee protection, boating safety and marina facility siting have been incorporated. The IRC Community Development Department uses this plan to review proposals for new and expanded multi-slip docking. The plan is available for the public to review on the IRC website (https://www.ircgov.com/boards/manwac/mpp_2004.pdf). To further assist the protection of manatee population in IRC, the County should continue to support the work of FWC, assisting in rescue efforts of injured or sick manatees, assisting in the release of rehabilitated manatees and encourage the regulation of designated manatee speed zones.

The Lagoon provides food and protection for juvenile loggerhead and green sea turtles. A current proposal for green sea turtle critical habitat designation includes the IRL. Juvenile green sea turtles consume macro algae and seagrasses, while loggerheads consume crustaceans and mollusks. Growth rates of juveniles in the IRL are greater than other areas of southeast Florida. While the IRL provides significant feeding opportunities important for juvenile marine turtles, overall sea turtle health in the IRL is concerning. Sea turtles can suffer from fibropapillomatosis (FP), a disease-causing cauliflower-like tumors to form on the body, including internal organs. Green sea turtles are most commonly and severely affected by FP (NOAA n.d.). FP is caused by *Chelonid Herpesvirus 5*, but the development of tumors has been linked to aquatic pollution. Approximately 22% of green turtles suffer from FP statewide, in comparison to approximately 50% of the green turtles in the IRL. FP is a serious condition impacting juvenile green turtles in the IRL, but sea turtles in the IRL face additional threats including boat strikes, harmful algal blooms and emerging contaminants. IRC's Habitat Conservation Plan assists in the protection of sea turtles on IRC beaches but does not address sea turtle populations in the IRL. IRC does play an important role in FWC's permitted stranding and salvage network. In addition, IRC participates in sea turtle education and awareness to educate the public on the implications of their actions on sea turtle populations within the IRL.

The IRL is also home to a brackish aquatic turtle, the diamondback terrapin. Little is known about the diamondback terrapin population in the IRL. At one time the terrapin was commercially overharvested for turtle soup. The commercial harvest was closed in the 1940s and populations have slightly recovered. The International Union for Conservation of Nature's Red List classifies the diamondback terrapin as vulnerable, the equivalent of a threatened listing under the Endangered Species Act. State laws do govern the collection and possession of terrapins. Current populations are experiencing anthropogenic impacts with the greatest threat being habitat loss caused by coastal development. Protecting sandy and natural vegetative shorelines is important for the nesting habitat of the terrapin.

Ecosystem Functions and Habitat Use Goals, Objectives and Actions

The goals and objectives for the Ecosystem Functions and Habitat Use key factor include:

- Improve ecosystem function through the protection of existing habitats and restoration of declining habitats.
- Monitor sea level rise and its impacts on seagrasses, saltwater marshes and mangrove marshes.
- Protect, restore and sustain vital habitat within the IRL watershed.
- Protect threatened and endangered species in IRC.

The following actions are proposed to be implemented in the short-term:

- Preserve natural shorelines and plant living shorelines.

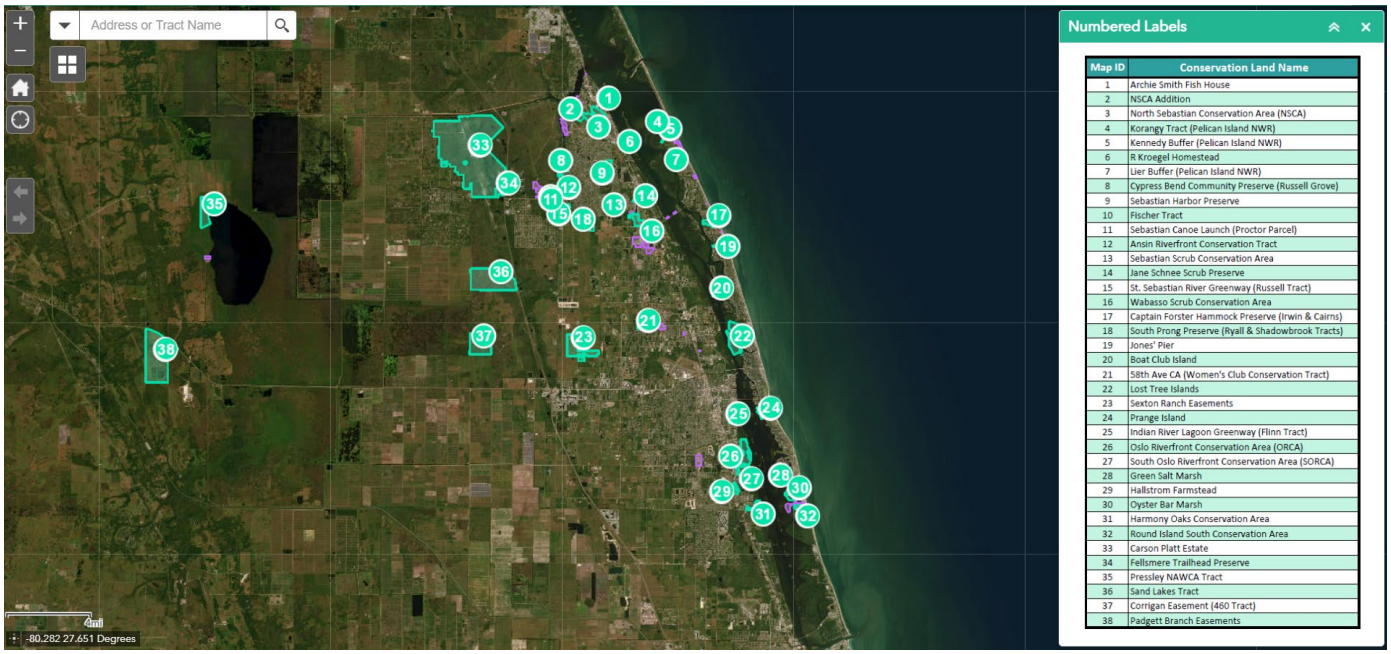
- Promote the use of living shorelines.
- Implement measures to reduce further loss of seagrass, saltmarsh and mangrove habitats.

The following actions are proposed to be implemented in the longer term:

- Identify and install seagrass beds in viable locations to initiate recovery.

H. Conservation Lands

IRC began an effort to restore and preserve vital habitats in 1992 with the issue of the County's initial Environmental Bond Referendum and development of the Environmental Lands Program Guide. IRC has worked with local partners to acquire 11,900 acres of sensitive habitat. The County's Conservation Lands manages 2,600 acres, while 5,622 acres are managed through leases and management agreements. IRC manages 27 conservation areas with 13 conservation areas adjacent to the IRL, totaling 12 miles of shoreline (Figure 18). Additionally, the Indian River Land Trust, a nonprofit conservation organization, has 1,200 acres and 12 miles of shoreline, some adjoining IRC Conservation Lands. Oyster Bar Marsh and Lagoon Greenway are jointly managed by IRC and Indian River Land Trust, providing two public trail systems.



Map ID	Conservation Land Name
1	Archie Smith Fish House
2	NSCA Addition
3	North Sebastian Conservation Area (NSCA)
4	Korangy Tract (Pelican Island NWR)
5	Kennedy Buffer (Pelican Island NWR)
6	R Kroegel Homestead
7	Lier Buffer (Pelican Island NWR)
8	Cypress Bend Community Preserve (Russell Grove)
9	Sebastian Harbor Preserve
10	Fischer Tract
11	Sebastian Canoe Launch (Proctor Parcel)
12	Ansin Riverfront Conservation Tract
13	Sebastian Scrub Conservation Area
14	Jane Schnee Scrub Preserve
15	St. Sebastian River Greenway (Russell Tract)
16	Wabasso Scrub Conservation Area
17	Captain Forster Hammock Preserve (Irwin & Cairns)
18	South Prong Preserve (Ryall & Shadowbrook Tracts)
19	Jones' Pier
20	Boat Club Island
21	58th Ave CA (Women's Club Conservation Tract)
22	Lost Tree Islands
23	Sexton Ranch Easements
24	Prange Island
25	Indian River Lagoon Greenway (Flinn Tract)
26	Oslo Riverfront Conservation Area (ORCA)
27	South Oslo Riverfront Conservation Area (SORCA)
28	Green Salt Marsh
29	Hallstrom Farmstead
30	Oyster Bar Marsh
31	Harmony Oaks Conservation Area
32	Round Island South Conservation Area
33	Carson Platt Estate
34	Fellsmere Trailhead Preserve
35	Pressley NAWCA Tract
36	Sand Lakes Tract
37	Corrigan Easement (460 Tract)
38	Padgett Branch Easements

Figure 18. IRC Conservation Lands

Not all the acreage acquired or managed by IRC is along the IRL, but a large percentage of the land is within the IRL watershed. Conservation lands acquisition is a crucial aspect of IRL restoration and management. As IRC has seen exponential population growth since the 1970s, so has the watershed, increasing stormwater flow, nutrient loading and loss of natural buffers and shoreline habitat. Natural habitats allow for the absorption of nutrients and metals by plant communities, as well as the percolation of water through the soil (Figure 19). This is necessary as much of the wetland habitats in Florida have been altered or lost through development. Wetlands slow the flow of stormwater, allowing for retention leading to nutrient abatement. In addition, the 12 miles of shoreline removed from future development ensures the protection of salt marsh and mangrove marsh communities. Natural shorelines are an important habitat for many juvenile species. They create a buffer from runoff and lead to sediment accretion, reducing erosion developed shorelines experience. Research by the University of Miami has shown natural shorelines or living shorelines outperform sea walls and bulk heads during storm events (Timm 2017).

Additional bond referendums were passed by IRC in 2004 and 2022. The Environmental Lands Program Guide is under revision as part of the current bond. The guide is a suite of policies and guidelines set forth in the acquisition of environmentally sensitive land and management activities. The guide incorporates numerous aspects of the IRC 2030 Comprehensive Plan coastal and conservation elements, which will continue to benefit the protection of essential habitat and species in the IRL. In addition to the acquisition, restoration and management of critical habitats, Conservation Lands plays an important role in

the education and engagement of IRC citizens. The Conservation Lands Division's community outreach and education events engage citizens through cleanups, restoration and maintenance of habitats. Engaging citizens promotes stewardship and citizen involvement, ultimately leading to lifestyle changes benefiting the environment and improving their quality of life.

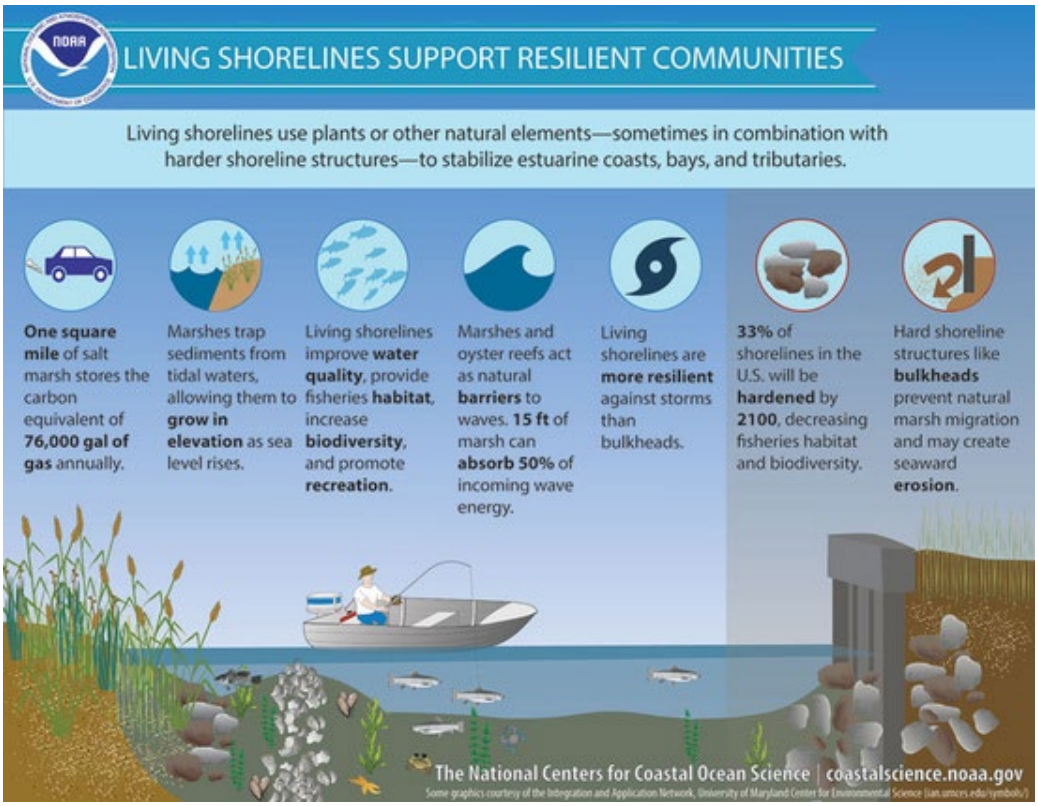


Figure 19. Benefits of Natural Shorelines

Islands

The IRL has numerous natural and spoil islands, many of which are important rookery habitats. Located within IRC is the Pelican Island National Wildlife Refuge, which contains both natural and spoil islands in the IRL. Pelican Island National Wildlife Refuge is a mosaic over more than 5,400 acres. IRC owns or shares ownership of approximately 200 acres with the refuge working closely with the U.S. Fish and Wildlife Service to manage the areas. Conservation Lands also owns and manages Lost Tree Islands Conservation Area, Prange Island Conservation Area and Green Salt Marsh, which are natural islands in the IRL. There are additional natural islands in IRC; some of the natural islands are owned by private entities, while others are owned by the Indian River Mosquito Control District, Indian River Land Trust or fall under the jurisdiction of municipalities.

A unique characteristic of the IRL is the spoil islands, which were created from material dredged during the creation of the ICW channel. IRC has 55 spoil islands created between 1951 and 1961. Most of the spoil islands are located along the longitudinal axis of the IRL and are often more than one acre in size (Figure 20). Although the islands were created from left-over spoil, they have become important habitats for native species. Most are owned by the state of Florida and managed by FDEP Aquatic Preserves.

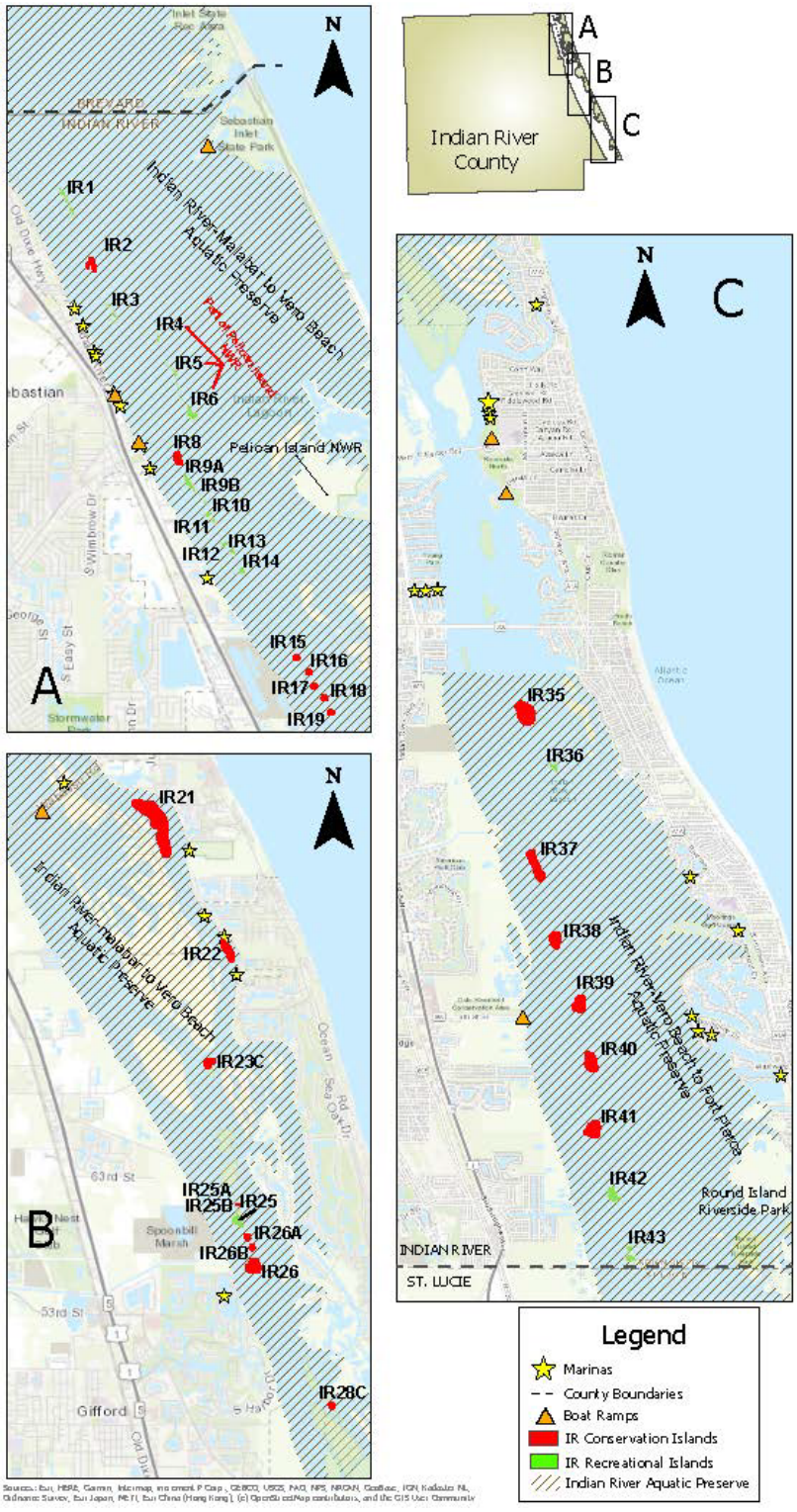


Figure 20. Locations of the IRC Spoil Islands

Not all the islands are available for recreational use. Some islands are designated as conservation areas to preserve critical habitat and protect vulnerable species (Table 2). Islands open for recreation use are available for boaters to enjoy for activities such as picnicking, camping, fishing and exploration. FDEP Aquatic Preservers promotes a Leave No Trace program, encouraging users to remove all waste created on the island. FDEP partners with Friends of the Spoil Islands in public

involvement projects including clean-ups, campsite maintenance, sign installation and bird nesting habitat creation (https://www.fosifl.org/get-involved/volunteer/).

Table 2. Islands with Active Nesting and/or Rookeries
Note: Information from the FDEP Aquatic Preserves

Island	Nesting Type	Listed
Pelican	Wading Bird Colony, Rookery	Wood Stork, Tricolored & Little Blue Heron, Reddish Egret, Roseate Spoonbill
IR15	Wading Bird Rookery	No
IR16	Solitary Shorebird	American Oystercatcher
IR17	Solitary Shorebird	American Oystercatcher
IR18	Solitary Shorebird	American Oystercatcher
IR19	Solitary Shorebird	American Oystercatcher
IR26B	Rookery, Colony	Tricolored & Little Blue Heron and Roseate Spoonbill
IR37	Rookery, Colony, Solitary Shorebird	Wood Stork, Tricolored & Little Blue Heron, Reddish Egret, Roseate Spoonbill

Spoil islands are important ecological communities, including shore bird nesting habitat. In addition, they are used by reptiles, invertebrates and small mammals. Unfortunately, many have been colonized by invasive plants including Brazilian pepper and Australian pine trees. These invasive plants replace native species and create an overgrowth taking over essential ground space for nesting shorebirds. It leaves the islands vulnerable to erosion, because the roots of the Brazilian pepper and Australian pine do not efficiently trap sand. This is especially true on the side facing the ICW. This loss of nesting habitat drives birds to nest on rooftops of business and homes. Based on this information, IRC should continue to work with the IRL Aquatic Preserves to protect spoil islands and monitor nesting bird populations using them. As part of the management strategies, IRC should work with the IRL Aquatic Preserves to remove invasive species and the planting of native species.

Conservation Lands Goals, Objectives and Actions

The goals and objectives for the Conservation Lands key factor include:

- Create education and natural spaces for the public to enjoy and observe.
- Coordinate with local stakeholders and agencies to identify and acquire additional conservation lands in key locations along the IRL and throughout the watershed.

The following actions are proposed to be implemented in the short-term:

- Support the private and public acquisition of new lands along the IRL shoreline and in key watershed locations for restoration, preservation and hydrologic connection.
- Work with FDEP Aquatic Preserves to preserve natural and spoil islands and actively remove invasive vegetation.

I. Land Use Changes

As a widespread agricultural community, it is important to examine historical land use and potential nutrient loads remaining in the soil from previous applications, which are referred to as legacy loads. Legacy loads can be a source of nutrient loading to ground and surface waters. By gathering data about legacy loads, this information can be incorporated into management strategies and recommendations. In addition to understanding legacy loading and historical land use, it is necessary to identify areas of potential development and plan accordingly. The 2030 Comprehensive Plan designates the appropriate location for future land uses and establishes policies regulating growth and development, limiting the density and intensity appropriate for the land. As the County continues to develop and makes changes to meet the needs of a growing population, there will be increased stormwater runoff from the watershed to the IRL.

To develop land within IRC, permits must be obtained from various agencies including the County. There are three types of stormwater management permits administered through the Public Works Engineering Division, Land Development Section. Type A permits encompass projects not located in flood hazard zones, but Types B and C permits involve projects in flood hazard zones, as well as areas west of US 1 located between County Road 512 and State Road 60. Types B and C require the submittal of hydraulic data and calculations to ensure they meet local ordinances for protection. Staff review the application and plans to ensure appropriate nutrient levels are being removed via retention and to ensure proper water volumes are being treated by the stormwater system. Smart growth management and development will be essential to reduce impacts to the IRL from habitat loss and stormwater. One way stormwater impacts can be minimized is through the initiation of green infrastructure and low impact development by IRC.

In addition to the permit review, IRC has multiple ordinances developers must meet to protect native vegetation, protect wetlands and shorelines. Chapter 926 addresses Landscape and Buffer regulations for new development requiring the protection of native vegetation and tree canopy. Section 928.07 addresses native vegetation requirements around wetlands and deepwater habitats, requiring the use of native vegetation only. Section 929.07 directly addresses the need to protect the natural shoreline along the St. Sebastian River and IRL Aquatic Preserve. Hardened shorelines reduce habitat and increase stormwater runoff through the removal of native vegetation. Under the ordinance, IRC enforces a 100-foot shoreline buffer along the St. Sebastian River for parcels created after June 18, 1991. For parcels existing prior to this time, a 50-foot shoreline protection buffer for un-platted parcels and a 25-foot buffer for existing platted lots measured from the mean high-water line for land parcels bordering the St. Sebastian River or IRL Aquatic Preserve. Buffers should not exceed more than 20% of the parcel or lot depth. The buffer zone allows for the construction of docks, boat ramps, pervious and elevated walkways. The buffer zone does not allow for additional development, and native vegetation must remain unaltered to protect the shoreline. There are exceptions if it is in the best interest of the public, prevents erosion damage or provides reasonable access to the water. Hardened shorelines include seawalls, bulk heads, revetments and rip rap are the primary method of shoreline hardening. Studies have shown living shorelines outperform hardened shorelines in major storm events, in combating flooding and have a greater long-term survival compared to the life expectancy of a hardened structure. As part of the protection and restoration of the IRL, IRC staff is working with the University of Central Florida on a shoreline characterization study, prioritizing potential shoreline restoration sites to improve habitat and resiliency. This information will be beneficial for managers and homeowners wishing to establish living shorelines benefiting the IRL.

Land Use Changes Goals, Objectives and Actions

The goals and objectives for the Land Use Changes key factor include:

- Identify past and projected land use changes.
- Promote low impact development.
- Maintain current buffer zones under IRC ordinances, preventing shoreline development and hardening.

The following actions are proposed to be implemented in the short term.

- Maintain land use restrictions.
- Evaluate existing County codes and ordinances and identify potential revisions to promote low impact development as appropriate.

J. Hydrology and Hydrodynamics

The IRL is influenced by rain, surface water, groundwater and ocean inputs. The total flow entering the IRL and water movement within the system are important factors influencing its health. Hydrology is the study of the movement, distribution and properties of the Earth's waters, which includes surface and ground waters. Hydrodynamics is the study of the internal circulation of water and its effects on water quality. Historical records have shown human habitation along the IRL for over 7,000 years, but it was not until the late 1800s that human activity began to drastically shift the hydrology and hydrodynamics. The alteration of natural system flows includes hardened shorelines, drainage canals, dredging, mosquito impoundments, causeway development, and creation of artificial islands and inlets, which occurred over time as humans populated the region. The demand for agricultural land required the drainage of wetlands, creating three relief canals and

ultimately increasing the freshwater drainage to the IRL. The amount of freshwater flow has continued to increase through additional navigable canals for property owners and continued development.

In 1912, the ICW was completed creating a 10- to 12-foot-deep channel for vessel navigation. The spoil from the dredging of the channel created 55 spoil islands in IRC (see Figure 20 above), which shifted the wind-driven flow. In addition to dredging and spoil deposition, the need for access across the IRL increased as the region continued to develop. The filling in of land masses and creation of causeways caused a narrowing of open water and affected wind-driven circulation. Along with channelization and man-made canals, the creation of dead-end spaces has increased retention time in specific regions, making the system more vulnerable to pollutants, the trapping of sediments and anoxic conditions.

In 1925, the IRC Mosquito Control District was established. To control the mosquito population, mosquito impoundments were created through the channelization and diking of high marshes westward of the fringing marshes of Spartina and red mangroves. By the 1960s, 2,600 acres out of 4,500 acres of IRC coastal marsh habitat were impounded along the IRL. Impoundments created several issues relating to nursery connectivity, shifts in biodiversity and allowed for an overgrowth of both native and invasive species eliminating the high marsh habitat. These impoundments prevent connectivity from the marsh to the IRL, which isolates important sport fisheries from critical nursery habitat. In addition, the consistent flooding of impoundments can create hypersaline conditions and vegetation loss. Management practices for mosquito impoundments have changed with increasing knowledge regarding the impacts to sport fisheries. Many mosquito impoundments remain open for extended periods to allow for greater connectivity and are only flooded during a small period of the year. The extensive drainage for development and agriculture, as well as the creation of impoundments for mosquito control eliminated natural wetlands and changed the water flow, as well as the connectivity between important nursery habitat and the IRL.

The IRL had two natural inlets, Ponce and Jupiter, with temporary inlets over narrow areas of the barrier island. Temporary inlets allowed for the movement of sand from the east to west bank of the IRL, creating a shallow sandy bottom. Temporary inlets would persist for days to years, but the often shallow and narrow inlets prevented vessel traffic from moving between the IRL and Atlantic Ocean. To increase navigable access from the IRL to Atlantic Ocean, three man-made inlets and Port Canaveral and locks were created in the IRL. The natural movement of sand continually fills in the inlets, which requires managed dredging to remain open. Even with five inlets, the tidal nature of the IRL is limited to a few miles north or south of an inlet limiting saltwater flow and making the IRL sensitive to fluctuations in land-based discharge. IRC is bordered by two inlets, Sebastian and Fort Pierce, which help to stabilize salinities in the Central IRL and reduce residence times when compared to more isolated regions of the IRL.

The development on and along the IRL has changed circulation patterns, impacting coastal marsh habitat, influencing salinity and altering flushing rates. The IRL hydrodynamic changes ultimately impact water quality and sedimentation within the system. While having two inlets in close proximity benefits the IRC region of the IRL, increased development has altered shorelines reducing resilience and impacting water quality and sedimentation rates.

Hydrology and Hydrodynamics Goals, Objectives and Actions

The goals and objectives for the Hydrology and Hydrodynamics key factor include:

- Slow untreated freshwater flows and nutrient inputs to the IRL.
- Restore historical connections, as feasible, to improve hydrological and hydrodynamic flow within the IRL and its watershed.

The following actions are proposed to be implemented in the short-term:

- Identify and implement projects to reduce untreated freshwater flows and nutrient inputs to the IRL.

The following actions are proposed to be implemented in the longer term:

- Evaluate programs to increase circulation and/or increase DO in areas with limited flushing.

K. Annual Rainfall

The amount of rainfall IRC receives is decreasing by 0.27 inches per year, but the region receives on average 52 inches per year making it an important source of freshwater to the IRL. Rainfall enters the IRL through stormwater runoff directly from land, canals and groundwater flow, which impacts the IRL by carrying sediments, nutrients and contaminants. IRC has been proactive through the creation of three stormwater parks designed to remove excess nutrients and trap sediments from the IRFWCD canals. Egret Marsh and Osprey Acres use algal turf scrubbers to remove nitrogen and phosphorus from water in the IRFWCD canals, which includes both stormwater and groundwater discharge. It is estimated IRC removes 80,170 pounds per year of TN and 12,123 pounds per year of TP, based on projects provided for the Central IRL BMAP. The third stormwater park, Moorhen Marsh, uses water lettuce basins to remove nutrients before the water is discharged back to the North Relief Canal. In addition to the stormwater parks, IRC actively removes water lettuce, trash and debris from the Main Relief Canal using the PC Main Screening System, which began operating in 2008. The removal of water lettuce from the canals before discharging into the IRL is important because water lettuce is capable of rapidly growing by fragmentation, it is a nonnative aquatic plant and while it is beneficial in the removal of nutrients, it releases nutrients back into the ecosystem upon its demise and contributes to muck accumulation as it settles to the IRL benthos.

The three relief canals, St. Sebastian River and groundwater discharge in IRC represent most of the freshwater flow to the IRL. Freshwater flow can directly impact the salinity levels lowering or raising them. The freshwater flow rate from the St. Sebastian River remains relatively stable with the exception of major storm events. Rainfall in Florida is often seasonal and can be influenced by climate patterns. Low levels of rain can lead to increases in salinity, while increased rainfall leads to lower salinity levels. Lower salinity levels have been observed in the region but are often associated with storm events and are transient in nature. As previously stated, salinity levels can influence DO levels impacting marine life. Salinity is an important water quality parameter for both seagrass and oysters.

IRC is proactive in reducing nutrient inputs and suspended solids from stormwater through the operation of nutrient removal stormwater parks and mechanical removal of water lettuce. Weekly water quality monitoring of the three relief canals has shown the effectiveness of the parks at removing TN and TP to reduce nutrient loads entering the IRL. However, it is important to note that IRC does not maintain the three main relief canals or control water flow through them. The canals are the property of IRFWCD who, through an agreement with IRC, allows the County to pull water from the canals for the three stormwater parks and mechanically harvest water lettuce. It is important to maintain this partnership for the benefit of the IRL.

Annual Rainfall Goals, Objectives and Actions

The goals and objectives for the Annual Rainfall key factor include:

- Develop a stormwater master plan for the County.
- Acquire lands within the floodplain for stormwater treatment prior to discharge to the IRL.

The following actions are proposed to be implemented in the short-term:

- Identify opportunities to improve absorption of rainwater to recharge aquifers and reduce untreated freshwater flows to the IRL.

L. BMPs

Stormwater is an important conveyance of nonpoint source freshwater and pollutants to the IRL. Water flow from urban areas, suburban neighborhoods and agricultural lands can carry nitrogen, phosphorus, heavy metals and other pollutants. To reduce stormwater impacts on the IRL, BMPs have been identified by FDEP and FDACS. BMPs are practices deemed by the scientific community to be an effective means of preventing or reducing water pollution generated by various activities and industries. When BMPs are effectively implemented, they should reduce nutrient loading and achieve the TMDLs. IRC has been proactive in the implementation of BMPs in the Stormwater Division, Utilities and Community Development Departments, including several local ordinances, such as the fertilizer, irrigation and landscape ordinances, established to reduce nutrients and improve IRL health.

Stormwater is regulated under the National Pollutant Discharge Elimination System Stormwater Program. As part of this program, IRC has a municipal separate storm sewer system permit (MS4). For the permit, IRC has adopted a stormwater management program including treatment, enforcement and education. IRC has three large-scale regional stormwater facilities designed to remove nutrients from the IRFWCD canals before discharge to the IRL. The design, construction and implementation of two of these projects began before mandatory reductions were implemented in IRC. The third stormwater treatment facility began operating in the summer of 2023.

Stormwater Treatment

Osprey Acres – Open to the Public
Egret Marsh
Moorhen Marsh
Long Reach Harvesting of Water Lettuce from the Canals
Create Habitat
Filter Millions of Gallons of Canal Water per Day
Reduce TN and TP to the IRL

County stormwater enforcement monitors illegal discharge, construction sites and fertilizer application with the authority to issue citations, which can lead to fines or a site shutdown if standards are not met. IRC has a full-time Stormwater Educator who conducts public outreach and education through public events, mailings, in school education lessons and summer camps. Education and community outreach are important aspects, which are often overlooked when making a beneficial impact on IRL health. These educational opportunities not only inform citizens of the efforts being undertaken by IRC, but also provide them with proactive measures they can make at home and in their daily lives to reduce their impacts on the IRL.

FDACS develops and adopts BMPs for the agricultural industry. If an agricultural business is located within a BMAP, BMP enrollment is required by Florida Statute 373.4595 and 403.067. Agricultural producers are required to retain fertilizer records showing they are following the BMPs set for their agricultural commodity, or they must demonstrate compliance through water quality monitoring at the owner's expense. FDACS is responsible for conducting onsite inspections at least every two years of all enrolled agricultural operations within the BMAP. Site visits require a review of the nitrogen and phosphorus fertilizer application or water quality monitoring results. FDACS reports the TN and TP results to FDEP for use in the BMAP and enforcement of non-compliance issues. As of April 2023, current agricultural enrollment in the Central IRL BMAP is 25% with enrollment in project zones Central IRL SEB at 30% and Central IRL B at 11%. FDACS is making efforts to transmit enrollment notifications to producers in the BMAP to increase compliance levels. FDEP anticipates additional enrollment and implementation of frequent site visits by FDACS to ensure BMPs are met and reduce nutrient loading from agricultural nonpoint sources. The Central IRL BMAP states the reductions under FDACS BMPs may not be adequate to achieve the TMDLs, but FDACS is committed to regularly updating BMPs based on scientific research and review.

BMP Goals, Objectives and Actions

The goals and objectives for the BMPs key factor include:

- Educate the public on point and nonpoint sources of stormwater runoff including what they can do to prevent nutrients and contaminants from entering the IRL.
- Enforce BMPs at construction sites to prevent materials and sediments from entering storm drains.

The following actions are proposed to be implemented in the short-term:

- Continue to identify and implement projects to reduce nutrient loading to achieve BMAP compliance.
- Continue to work with regulatory agencies to ensure compliance with FDACS BMPs.
- Develop a plan to expand the County's public education and outreach efforts to provide information on actions the public can take to reduce their impacts on the Lagoon.

The following actions are proposed to be implemented in the longer term:

- Retrofit the nearly 100 outfalls to the IRL with baffle boxes, screens or vortex units to provide pollutant removal, where appropriate.

M. Water Consumption

There is increasing concern regarding water supplies with rapid population growth throughout Florida. As more people move to Florida, the demand for water will force agencies to seek alternative sources to meet the needs of the population. SJRWMD releases an annual report of water use within the district. In the 2021 report, the total freshwater use was 1% higher than the five-year average and 1% lower than 2020. From 2012 to 2021, public water use increased from 540.07 million gallons per day (mgd) to 569.47 mgd, an increase of 5%. This number is tied to a 22% increase in the population. While the amount of water used increased, the gallons per person per day decreased from 131 to 115. Changes in use can be attributed to economic factors, conservation strategies and increased use of reclaimed water. Figure 21 shows the change in IRC population over time and the corresponding change in water consumption.

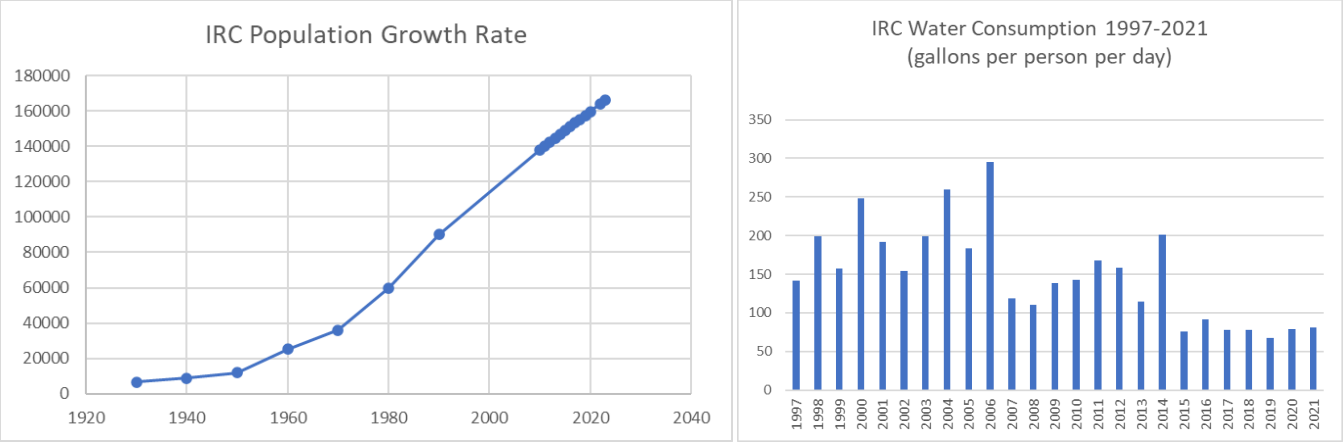


Figure 21. IRC Population Growth (left) Versus Water Consumption (right)

District-wide, decreases in use were also observed in agriculture, landscape and recreation, because of a reduced demand based on increased rainfall in 2021. Overall, IRC had the largest consumption for agriculture with 49.40 mgd, which is 24% of the SJRWMD total for agricultural use (Figure 22). In addition, IRC had the greatest freshwater use for landscape and recreational irrigation with 11.11 mgd. IRCs total freshwater use was 80.94 mgd, 6.18 mgd of reuse water. While much of the district experienced increased rainfall during 2021 with a mean of 52.33 inches, rainfall in IRC was down 6.47 inches, which increased consumptive use in the agricultural and irrigation categories.

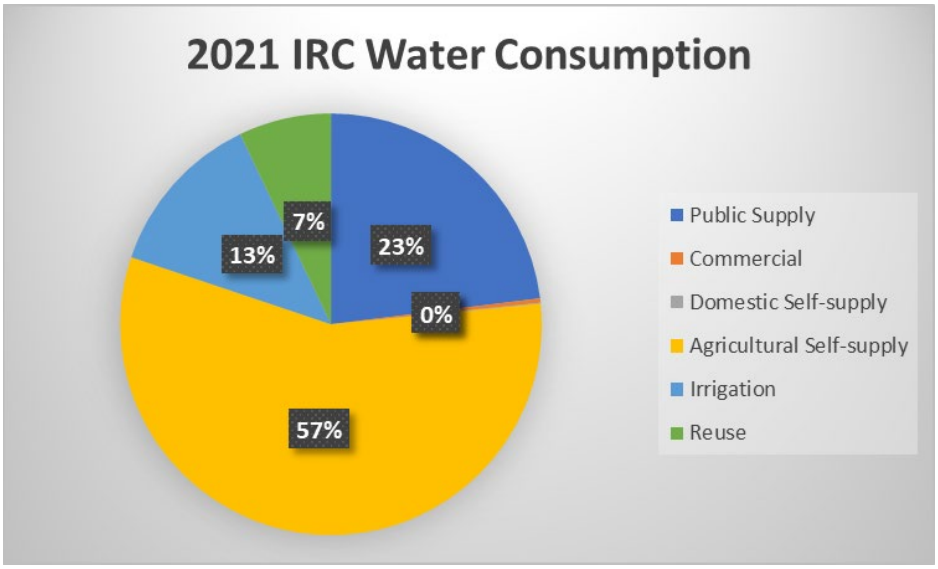


Figure 22. IRC Water Consumption by Source in 2021

IRC Utilities provides consumers with potable water acquired from the Upper Floridan Aquifer. Water is treated through reverse osmosis plants in the south and central portions of the County. The concentrate by-product produced by the water treatment process is then filtered through Osprey Marsh or Spoonbill Marsh. Osprey Marsh combines the concentrate from the water plant with stormwater pulled from the south relief canal. The water is passed over an algal turf scrubber to remove nutrients before moving to the wetlands and ultimately to the Osprey Acres Stormwater Park where it passes through natural habitat before returning to the canal. Spoonbill Marsh is located on a former mosquito impoundment area. The dikes and ditches remain, but the system is open allowing for direct water interchange with the IRL. The water flows through the natural system allowing the grasses and mangroves to remove excess nutrients before flowing back to the IRL. These systems are unique ways to manage the concentrate by-product from water treatment, while removing excess nutrients from stormwater and the IRL.

Freshwater supply and use are important to IRL health. Freshwater contributes to the hydrology of the system and potential load of nutrients and contaminants. IRC has established several programs to promote water conservation, which aligns with BMPs (Figure 23). In 2022, IRC adopted SJRWMD's water conservation regulations to ensure efficient use of water for landscape irrigation by homeowners and businesses (Chapter 319). The regulations do not apply to agricultural crops, nurseries, cemeteries, golf courses and athletic fields. The ordinance prohibits watering between the hours of 10:00 am and 4:00 pm, which improves absorption and reduces evaporation. Irrigation days are based on the season and address number (Table 3). The ordinance not only protects the water supply by preventing excessive watering, but it also prevents excess water runoff carrying nutrients and organic material to the IRL.

Another strategy for conserving water is the partnership between IRC and SJRWMD capping free flowing artesian wells. The wells were once used by farmers for agricultural purposes, but Florida law requires owners to control the discharge from artesian wells limiting the flow for its intended use. If a well cannot be controlled, it must be permanently plugged. Between 2017 to 2020, numerous wells have been plugged within IRC in the IRL basin, saving millions of gallons per year.

Water conservation begins with the property owner. The IRC Utilities Department website provides information promoting water conservation. Additional education and community outreach are valuable in changing consumptive use behaviors.

Figure 23. SJRWMD Recommendations for Water Savings

Table 3. SJRWMD Irrigation Restrictions

Time of Year	Homes with Odd Numbered or No Addresses	Homes with Even Numbered Addresses	Nonresidential Properties
Daylight Saving Time	Wednesday/Saturday	Thursday/Sunday	Tuesday/Friday
Eastern Standard Time	Saturday	Sunday	Tuesday

Water Consumption Goals, Objectives and Actions

The goals and objectives for the Water Consumption key factor include:

- Educate and promote BMPs for efficient water consumption.

The following actions are proposed to be implemented in the short-term:

- Identify and implement alternative reuse.
- Continue to promote water conservation actions by water users throughout IRC.

The following actions are proposed to be implemented in the longer term:

- Evaluate the quantity of water needed to support future County growth.

N. Wastewater

All water leaving residential and commercial properties and entering the County's centralized sewer system must be treated and disposed of through one of three wastewater treatment facilities operated by IRC. The Clean Waterways Act, Senate Bill 53, Senate Bill 64 and House Bill 1379 have placed new requirements on local governments. Senate Bill 53 required utilities departments to conduct a 20-year infrastructure needs analysis for wastewater by July 31, 2022. Senate Bill 64 places restrictions on the discharge of treated wastewater, requiring the elimination of nonbeneficial surface water discharges by January 1, 2032. The goal is to reduce surface water discharges of treated effluent and promote beneficial uses of the treated water, such as for irrigation or hydration of wetlands. Currently, treated wastewater from IRC's regional advanced wastewater treatment facilities discharges into the reclaimed water system, a treatment wetland or a rapid infiltration basin. Additional options include the increase of used of reclaimed water for irrigation, absorption fields and deep well injection. Deep well injection is routinely used in Florida as a means of wastewater disposal.

In May 2023, House Bill 1379 was signed into law creating the Indian River Lagoon Protection Program and including sweeping implications for wastewater in the IRL. By 2033 all wastewater facilities discharging to the IRL will be required to meet advanced wastewater treatment. All existing conventional septic systems in the IRL basin must connect to central sewer or upgrade to enhanced nutrient removal septic systems by July 1, 2030. New construction within the IRL basin will be required to connect to sewer or use enhanced nutrient reducing septic systems effective January 2024. This bill also expanded the Wastewater Grants program, to provide a source of funding to complete these projects.

Wastewater Goals, Objectives and Actions

The goals and objectives for the Wastewater key factor include:

- Implement a plan to eliminate nonbeneficial surface water discharges by January 1, 2032, in accordance with Senate Bill 64.
- Pursue new wastewater advanced treatment technologies as they become available.

The following actions are proposed to be implemented in the short-term:

- Improve levels of treatment in the wastewater plants to achieve statutory requirements.
- Identify new disposal options for beneficial use of treated wastewater.

O. Biosolids

Biosolids result from the treatment of domestic sewage sludge from wastewater treatment facilities. There are two major classifications of biosolids allowing for land application, Class B and A/AA. Biosolids, regardless of the classification, contain varying levels of nitrogen and phosphorus depending on the influent of wastewater and processing steps at the treatment facility. Class B are the least processed and require a FDEP permit for land application, while Class A/AA are considered fertilizer and can be applied without a permit or tracking of the quantity applied. The most recent statistics on biosolids produced and applied in Florida are from 2018. In 2018, 412,000 dry tons of biosolids were produced with 19.5% disposed at authorized landfills, 56% processed into Class A/AA fertilizer and 24% applied to agricultural lands as Class B. There are approximately 130 permitted land application sites for Class B. Permitted sites require nutrient management plans including, setbacks, groundwater depth provisions, signage, public access, grazing and harvesting restrictions. Management plans require record keeping and reporting to track the amount of biosolids applied. On June 21, 2021, revisions were made to Chapter 62-640, Florida Administrative Code, to minimize the migration of nutrients with an emphasis on phosphorus and preventing impairment to waterbodies. Two key provisions to Florida Statute 403.0855 became effective on July 1, 2022, which require all biosolids land application sites to enroll in the FDACS BMPs program and prohibit application on lands with seasonal high-water table (within six inches of the soil or depth of the biosolid placement).

Biosolids applications rates increased in the St. Johns River Basin in 2013, after restrictions were placed in South Florida by the National Everglades Protection Act. In 2017, 73% of the biosolids applied were spread across IRC, Osceola County and Brevard County. Biosolids application introduced 740,000 pounds of nitrogen and 239,000 pounds of phosphorus to IRC. The following year, Blue Cypress Lake experienced a *Microcystis* algal bloom. SJRWMD long-term monitoring sites within the lake showed an increasing trend in phosphorus levels. When evaluated against other factors, it was determined the spike in phosphorus and algal bloom were directly linked to Class B biosolids application. In response to the algal bloom, IRC passed an ordinance placing a moratorium on the application of Class B biosolids, which ceased all new and existing applications in the unincorporated County. While biosolids application took place within the St. Johns River Basin, the runoff from biosolids application could transport nutrients through tributaries, canals and groundwater to the IRL.

The local moratorium and state regulations focus on Class B biosolids and do not address Class A/AA, which are classified as fertilizer and are exempt from regulations. Class A/AA application rates are not tracked and do not require a permit for application making it difficult to monitor. Therefore, there is a gap in the knowledge and understanding of the impact Class A/AA application has on nutrient levels and waterbodies, particularly the IRL.

Biosolids Goals, Objectives and Actions

The goals and objectives for the Biosolids key factor include:

- Prevent the application of biosolids on vulnerable land.

P. Onsite Sewage Treatment and Disposal Systems

OSTDS or septic systems are wastewater treatment used by homes not connected to a centralized sewer system. The Florida Department of Health has identified 30,467 OSTDS in IRC. OSTDS consist of a septic tank and drainfield (soil absorption field). A properly functioning OSTDS relies on the settlement of phosphorus within the septic tank and dispersion and dilution of nitrogen containing liquid effluent. While it is believed the bulk of phosphorus is trapped within the sludge, it is not fully contained (Lowe 2007). There is increasing evidence of orthophosphate transport within drainfields located in sandy soils with high groundwater tables. In contrast, nitrogen effluent is discharged through the tank to the drainfield. The nitrogen concentration leaving the tank is significant and dependent upon the amount of wastewater moving through the system. An OSTDS generally removes 10% to 40% of the TN through dispersion, dilution and decay. FDEP estimates the IRL receives approximately 60% of its nutrient inputs from groundwater. Therefore, OSTDS has the ability to negatively impact the IRL by increasing nutrient loads in the groundwater. The location and proximity of a drainfield to the water table may not allow for adequate fixation of nitrogen and phosphorus in the drainfield before entering groundwater. Proximity of the drainfield to a conveyance or the IRL may not allow for dilution of nitrogen in the groundwater before entering surface water. Sea level rise,

changing rain patterns and elevated water tables will reduce the denitrification capacity of the drainfield and increase the likelihood of their contribution of nutrients and pathogens to groundwater. In addition, it is estimated an OSTDS has a 10% failure rate, requiring homeowners perform regular maintenance to prevent wastewater from backing up into a household, pooling of water in the drainfield and odor. Many homeowners may not be aware of the routine required maintenance or issues with their OSTDS until it is too late.

Under the Clean Waterways Act enacted by Senate Bill 712, OSTDS regulations and permitting transferred from the Florida Department of Health to FDEP in 2021, creating a temporary septic advisory committee to review policies and regulations. FDEP was directed to revise provisions relating to setback rules and the fast tracking of permits for advanced nutrient removal septic systems. The bill directed local governments to create OSTDS remediations plans for certain BMAP regions. Senate Bill 1632 became effective on July 1, 2023, mandating septic-to-sewer conversions by January 1, 2032, in areas where centralized sewer is available and installation of advanced nutrient removal OSTDS in areas where centralized sewer is not available. Beginning on January 1, 2024, new OSTDS will not be permitted in areas where centralized sewer is available. If centralized sewer is unavailable, advanced nutrient removal OSTDS will be permitted. Enhanced nutrient removal systems permitted will be required to reduce TN by 50% before disposal to the drainfield or at least 65% TN removal through both the tank and drainfield. House Bill 1379, enacted in May 2023, strengthens these requirements within the IRL Protection Program.

In 2017, IRC's Utilities Department conducted a county-wide study of 325 communities with OSTDS. Communities were ranked based on their likelihood of negatively contributing to the IRL ecosystem using the following factors: population density, proximity to surface waters, floodplain, location of the groundwater table, soil, age of the surface water management system and age of OSTDS. Many of these homes were built before 1983 when state rules and regulations regarding OSTDS went into effect. The estimated life span of a residential OSTDS is 19 years and a commercial system is 10 years. The cost to convert these communities to centralized sewer would be extensive and depend on whether the centralized sewer infrastructure existed in close proximity to the community. It may be possible to supplement these costs with grants from state and federal agencies.

The new state regulations regarding septic-to-sewer conversions and upgrades will require extensive planning and funding sources to enact, with estimates greater than $1 billion. It is also necessary to prioritize communities based upon the greatest impact to IRL water quality and BMAP requirements. To receive BMAP credits through the implementation of projects, an ArcNLET model mapping plumes of nitrogen from septic effluent for the IRC was prepared, and a draft is currently in review by the County. IRC Utilities Department has received preliminary data from an ArcNLET model, allowing the department to prioritize projects. While septic-to-sewer conversions in high priority areas are important to reduce nutrient loading to the IRL, it is necessary to point out the impact this may have on the County's advanced wastewater treatment facilities. An evaluation will be needed on whether the capacity of the existing wastewater treatment facilities needs to be expanded and/or additional facilities are needed to meet the demands from connecting OSTDS and growth in the County.

OSTDS Goals, Objectives and Actions

The goals and objectives for the OSTDS key factor include:

- Prioritize septic-to-sewer transitions based upon the ArcNLET model in accordance with the Clean Waterways Act.
- Follow new guidelines for septic-to-sewer conversion and advanced septic systems.
- Identify potential funding sources to assist homeowners with OSTDS connections and upgrades.

The following actions are proposed to be implemented in the short-term:

- Implement the priority septic-to-sewer projects based on the ArcNLET report and cost-benefit analysis for infrastructure.
- Identify locations where extending central sewer is not feasible and there is a need for septic system upgrades to enhanced, nutrient removing systems.
- Work with local organizations and state agencies to determine OSTDS funding assistance options for homeowners.
- Educate homeowners about proper OSTDS maintenance.

- Evaluate existing wastewater treatment facility capacity to accommodate OSTDS connections.

Q. Sustainability and Resiliency

Resiliency is built into every ecological system. It is the ability of a system to absorb impacts, recover and adapt to changes (Marchese 2018). Persistent anthropogenic stressors to an ecological system can lead to a tipping point, collapse in resiliency and inability to recover without extensive intervention. To re-build resiliency, the stressors must be removed but recovery will be slow. To help the IRL survive in the future, measures must be taken to lessen the anthropogenic impacts. The Treasure Coast and East Central Florida Regional Planning Council's 2016 IRL Economic Valuation Update Report determined the economic contribution of the IRL to be $7.6 billion, with a return of $33 for every $1 invested in its recovery, an investment worth making into an economically important, diverse estuary.

IRC has actively taken steps to improve IRL health, which will continue when considering new projects, infrastructure development and restoration efforts. It is equally important to involve the community in the support, management and sustainability of the IRL. One way to involve the community is through the development of a sustainability action plan setting green initiative goals and implementation periods. In conjunction with the development of a sustainability action plan, community outreach and education regarding IRL initiatives and restoration will be necessary for long-term success. As part of engaging the community, education initiatives for boaters, homeowners and homeowner associations need to be established. These education programs could be established with the support of the community engagement coordinator with the IRLNEP and the extension agents with the University of Florida Institute of Food and Agricultural Sciences.

Sustainability and Resiliency Goals, Objectives, and Actions

The goals and objectives for the Sustainability and Resiliency key factor include:

- Protect and preserve natural shorelines.
- Engage the community in the support, management and sustainability of the IRL.

The following actions are proposed to be implemented in the short-term:

- Develop and implement education and outreach on the use of native vegetation as a buffer and flood prevention.
- Encourage the use of living shorelines for shoreline restoration.
- Prepare a risk-based vulnerability assessment and adaptation plan.

The following actions are proposed to be implemented in the longer term:

- Develop a sustainability action plan with green initiative goals and implementation periods.

R. Summary of Plan Actions

The 17 key factors that affect IRC's portion of the IRL are closely interrelated. Therefore, the actions listed under one key factor may also benefit additional key factors. Table 4 summarizes the LMP actions, primary key factor (indicted with a P), and associated key factors (indicated with an a).

Table 4. LMP Actions and Associated Key Factors

Note: The primary key factor for the action is noted with a P, and associated key factors are noted with an a.

Actions	Water Quality	BMAP	Harmful Algal Blooms	Organics and Sediments	Sea Level Rise	Marinas, Boats, and Boat Ramps	Ecosystem Functions and Habitat Use	Conservation Lands	Land Use Changes	Hydrology and Hydrodynamics	Annual Rainfall	BMPs	Water Consumption	Wastewater	Biosolids	OSTDS	Sustainability and Resiliency
Improve pollutant removal in the wastewater treatment facilities.	P	a	a	a									a	a		a	
Continue education and outreach for pollution reduction including the fertilizer use and application of native plants.	P	a	a	a								a			a		
Continue to encourage regulatory oversight agencies to improve and ensure proper BMPs are in place for agricultural facilities.	P	a	a	a								P					
Continue to improve BMPs for County facilities.	P		a	a													
Implement projects to slow untreated freshwater flows to the IRL to reduce pulsed loading of nitrogen and phosphorus.	P		P							P	a	a					
Support the existing water quality monitoring network.	P	a	a							a		a					
Continue to work with local research entities and agencies to better understand the presence and impacts of emerging contaminants.	P													a			
Identify and implement projects to meet the TN and TP required reductions for the BMAP.	a	P	a														
Reduce nitrogen and phosphorus loading from the three main relief canals to meet the TMDL and BMAP requirements for the Central IRL.	a	P	a														
Develop a remediation plan to identify the most feasible options to remove traditional septic systems, either through central sewer	a	P														a	

Actions	Water Quality	BMAP	Harmful Algal Blooms	Organics and Sediments	Sea Level Rise	Marinas, Boats, and Boat Ramps	Ecosystem Functions and Habitat Use	Conservation Lands	Land Use Changes	Hydrology and Hydrodynamics	Annual Rainfall	BMPs	Water Consumption	Wastewater	Biosolids	OSTDS	Sustainability and Resiliency
expansion or upgrades to enhanced, nutrient removal systems.																	
Identify areas of high nutrient concentrations and/or loads and implement nutrient reduction projects in those locations.	a	P	a									a					
Monitor real time data to identify possible harmful algal blooms.	a	a	P		a									a			
Work with local stakeholders to provide increased monitoring when there is a potential for health concerns.			P														
Implement projects to reduce untreated freshwater and nutrient inputs.	a	a	P				a			a							
Map areas of muck impact.	a		a	P													
Implement measures to reduce sources of organic matter from entering the IRL.	a	a	a	P													
Measure nutrient flux rates associated with each pocket of muck.	a		a	P													
Remove and/or cap muck as necessary to reduce water quality impacts.	a		a	P													
Improve resiliency for critical infrastructure and shoreline protection through modifications to County development codes and ordinances as appropriate.					P												a
Encourage engineering sea level rise risks and scenarios into new infrastructure.					P												a
Encourage the increase in numbers and distribution of pumpout facilities throughout IRC's portion of the IRL	a		a			P											
Promote the FDEP Clean Marina Program.	a		a			P											
Provide education to marinas and boaters on BMPs for boat care and maintenance.	a		a			P											

Actions	Water Quality	BMAP	Harmful Algal Blooms	Organics and Sediments	Sea Level Rise	Marinas, Boats, and Boat Ramps	Ecosystem Functions and Habitat Use	Conservation Lands	Land Use Changes	Hydrology and Hydrodynamics	Annual Rainfall	BMPs	Water Consumption	Wastewater	Biosolids	OSTDS	Sustainability and Resiliency
Continue to encourage local law enforcement to patrol IRL waters to ensure compliance with mooring and waste disposal.						P	a										
Evaluate establishing ALAs to aid in derelict vessel removal efficiency.						P											
Implement measures to reduce further loss of seagrass, saltmarsh and mangrove habitats.							P	a									a
Identify and install seagrass beds in viable locations to initiate recovery.							P	a									
Preserve natural shorelines and plant living shorelines.					a		P	a									P
Promote the use of living shorelines.							P	a									
Work with FDEP Aquatic Preserves to preserve natural and spoil islands and actively remove invasive vegetation.							a	P									
Support the private and public acquisition of new lands along the IRL shoreline and in key watershed locations for restoration, preservation and hydrologic connection.							a	P	a	a							
Maintain land use restrictions.							a		P								
Evaluate existing County codes and ordinances and identify potential revisions to promote low impact development where appropriate.	a								P								a
Evaluate programs to increase circulation and/or increase DO in areas with limited flushing.	a		a			a				P	a	a					
Identify and implement projects to reduce untreated freshwater flows and nutrient inputs to the IRL.	a		a							a	P	a					

Actions	Water Quality	BMAP	Harmful Algal Blooms	Organics and Sediments	Sea Level Rise	Marinas, Boats, and Boat Ramps	Ecosystem Functions and Habitat Use	Conservation Lands	Land Use Changes	Hydrology and Hydrodynamics	Annual Rainfall	BMPs	Water Consumption	Wastewater	Biosolids	OSTDS	Sustainability and Resiliency
Continue to work with regulatory agencies to ensure compliance with FDACS BMPs.	a											P					
Continue to identify and implement projects to reduce nutrient loading to achieve BMAP compliance.	a		a								a	P					
Develop a plan to expand the County's public education and outreach efforts to provide information on actions the public can take to reduce their impacts on the Lagoon.	a	a	a				a	a				P					a
Retrofit the nearly 100 outfalls to the IRL with baffle boxes, screens or vortex units to provide pollutant removal, where appropriate.	a	a	a									P					a
Identify and implement alternative reuse.													P				
Continue to promote water conservation actions by water users throughout IRC.													P				
Evaluate the quantity of water needed to support future County growth.													P				
Improve levels of treatment in the wastewater plants to achieve statutory requirements.														P			
Identify new disposal options for beneficial use of treated wastewater.														P			
Implement the priority septic-to-sewer projects based on the ArcNLET report and cost-benefit analysis for infrastructure.																P	
Identify locations where extending central sewer is not feasible and there is a need for septic system upgrades to enhanced, nutrient removing systems.																P	

Actions	Water Quality	BMAP	Harmful Algal Blooms	Organics and Sediments	Sea Level Rise	Marinas, Boats, and Boat Ramps	Ecosystem Functions and Habitat Use	Conservation Lands	Land Use Changes	Hydrology and Hydrodynamics	Annual Rainfall	BMPs	Water Consumption	Wastewater	Biosolids	OSTDS	Sustainability and Resiliency
Work with local organizations and state agencies to determine OSTDS funding assistance options for homeowners.																P	
Educate homeowners about proper OSTDS maintenance.	a	a														P	
Evaluate existing wastewater treatment facility capacity to accommodate OSTDS connections.														a		P	
Develop and implement education and outreach on the use of native vegetation as a buffer and flood prevention.	a				a		a			a							P
Develop a sustainability action plan with green initiative goals and implementation periods.					a		a										P
Prepare a risk-based vulnerability assessment and adaptation plan.					a												P
Encourage the use of living shorelines for shoreline restoration.					a		a			a							P

3. Projects

A. Project Prioritization Framework and Evaluation Metrics

Projects listed in Table 6 through Table 9 of the LMP are broken down by the IRC department in charge of the design, implementation and operation. Project prioritization is set by each department and will vary based on the type of project being implemented. Projects designed to reduce TN and TP loading to the IRL and meet BMAP requirements will be weighed heavily by all departments. A cost-benefit analysis may be used to determine reductions, success and value of the project to assist in the ranking. While projects may be ranked with the greatest TN and TP reductions taking priority, funding may dictate the order and time scale in which projects are completed. The importance of the TN and TP reductions is not only necessary to achieve water quality standards set by the TMDLs and implemented in the BMAP, but also the success of in-water restoration projects.

Metrics will be dependent upon the type of project being implemented. A few examples of applicable metrics that may be used by each County department to prioritize projects are shown in Table 5.

Table 5. Example Project Prioritization Metrics by County Department

Stormwater	Coastal	Conservation Lands	Utilities
TN and TP Reductions	Closing Data Gaps	Resource Enhancement	Proximity to IRL
BMAP/TMDLs	TN and TP Reductions	Habitat Protection	OSTDS Density
Funding Availability	Habitat Restoration	TN and TP Reductions	Total Pollutant Reduction
Operational Expenses	Site Feasibility	Site Feasibility	Infrastructure Cost
Site Feasibility	Funding Availability	Funding Availability	Water Service Availability
Freshwater Flow Reduction	Permitting	Land Acquisition	Underserved Community

B. Current County Projects

Table 6 through Table 9 detail the operational, under construction, designed, and conceptual projects, respectively, to achieve the LMP goals and objectives. This list of projects will be updated annually to reflect the latest information and data regarding project effectiveness and feasibility of implementation within IRC. Metrics of success will be dependent upon the type of project and the goals. Key metrics to track may include stable water quality parameters, reduced incidences of harmful algal bloom events, reductions in TN and TP, improved water clarity, increases in seagrass density, number of properties connected to sewer, total area of protected and restored habitat and upland acreage within the IRL watershed.

Table 6. Operational Projects to Achieve LMP Goals and Objectives

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Coastal Engineering	Jungle Trail Shoreline Enhancement	This site offers the opportunity for living shoreline projects which naturally protect the historical Jungle Trail	$178,234	Not applicable (NA)	NA	NA	NA	NA
Conservation Lands	Jones' Pier Conservation Area	The County purchased this area in 2011 and committed to implementing a management plan for the site that revitalizes ecological value, while utilizing the site for public access and display of educational and historical exhibits.	To be determined (TBD)	NA	TBD	TBD	TBD	TBD
Conservation Lands	Captain Forster Hammock Preserve	Captain Forster Hammock Preserve consists of 111 acres acquired by the County and Trustee of the Internal Improvement Trust Fund (TIITF) in 1996 and 1998. The preserve includes several different community types such as sandy dunes and coastal scrub along the eastern portions of the preserve, and maritime hammock and mangroves within the western portion. The section of the preserve abutting the Lagoon was damaged from saltwater inundation as a result of Hurricane Matthew and may have the potential to be Revitalized in a manner that will provide significant benefits to the Lagoon.	TBD	NA	NA	NA	NA	NA
Conservation Lands	Round Island Living Shoreline Project	Planting of native vegetation to stabilize the shoreline and provide water quality benefits.	$27,000	$0	NA	NA	NA	NA
Conservation Lands	Oyster Bar Marsh	Approximately 96 acres of maritime hammock and impounded wetland, located between State Road A1A and the IRL on the barrier island. The site is approximately one-half mile north of Round Island County Park. The County has been working in partnership with the Indian River Land Trust and with the Indian River County Mosquito Control District to install culverts connecting the impoundment to the Lagoon that will improve flushing.	$28,500	$0	NA	NA	NA	NA

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Stormwater	System Maintenance	The Road & Bridge Division provides maintenance throughout the county in support of a healthy Indian River Lagoon. This maintenance includes street sweeping and a ditch cleaning program. Increase street sweeping and O&M to capture nutrients.	$0	$22,050	365	NA	234	NA
Stormwater	Stormwater Education	The Stormwater Educator conducts many methods of education and outreach to Indian River County to inform students and adults about the importance of pollution prevention including fertilizer, pet waste, illicit discharge of chemicals, erosion, construction pollution, agricultural runoff, litter, and more. Currently the Stormwater Division presents to students throughout the school district, the Audubon Afterschool Advocates, Environmental Learning Center visitors, County employees, homeowner associations County-wide, and local professional groups such as Kiwanis and Rotary.	$0	$52,000	21,435	NA	3,114	NA
Stormwater	PC Main Screening System	This project removes freshwater plants and trash from the Main Relief Canal before the canal empties into the Lagoon.	$5,331,908	$75,000	1,631	$3,269	431	$12,371
Stormwater	Osprey Acres Flowway and Nature Preserve	The flowway continues to filter water from Osprey Marsh along with unfiltered water from the South Relief Canal. Filtering occurs through a system of treatment cells using aquatic plans to remove nutrients and then to a serpentine flowway for final polishing, eventually released further down the canal and into the Lagoon	$7,500,000	$87,000	4,790	$1,566	624	$12,019
Stormwater	North Relief Canal LEAPS™	The unique LEAPS™ will remove nutrients through a system of plants that absorb nutrients from the canal water, filtering the stormwater before returning it to the canal and IRL.	$12,000,000	$85,000	4,900	$2,449	690	$17,391
Stormwater	Egret Marsh	This project removes nutrients from approximately 10 mgd of canal stormwater. The filtered stormwater flows through a large polishing pond and shallow marsh and returns to the canals and flows through the Main Relief Canal, eventually emptying into the Lagoon.	$7,563,274	$200,189	8,550	$885	2,331	$3,245

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Stormwater	County Fertilizer and Landscape Management Ordinance	In 2013, the Indian River County Board of County Commissioners passed the Fertilizer and Landscape Management Ordinance that restricts the use of fertilizer and helps prevent excess nutrients (nitrogen and phosphorous) from entering the Lagoon. The ordinance states that no fertilizer containing phosphorous is to be used and no fertilizer containing nitrogen can be applied during the rainy summer season. The ordinance also includes other best management landscape practices such as blowing grass clippings back into the yard.	$100,000	$100,000	21,434	$5	3,114	$32
Stormwater	Vero Lake Estates Stormwater Improvements - Phase 1	Series of swales and canals in a large development leading to large stormwater detention ponds.	$1,572,829	$0	7,655	$205	1,993	$789
Stormwater	East Roseland Stormwater Improvements	A stormwater detention pond receiving water from swale systems in a subdivision.	$433,134	$2,176	216	$2,005	58	$7,468
Stormwater	East Gifford Stormwater Improvements	A stormwater detention pond receiving water from swale systems in a subdivision.	$686,136	$2,471	129	$5,319	39	$17,593
Stormwater	Moorhen Marsh Low Energy Aquatic Plant System	This is a managed aquatic plant system that will remove sediment and suspended solids through settling and filtration by aquatic plant roots. The aquatic plants will be harvested on a regular basis.	$8,705,000	$84,000	4,941	$1,762	687	$12,671
Utilities	Spoonbill Marsh Wetland Treatment System	This 67-acre man-made habitat uses nature's own treatment techniques for the removal of both nitrogen and phosphorus from the demineralization concentrate by-product and from the waters of the Indian River Lagoon itself. The vegetation and aquatic organisms seen throughout the marsh play an active role in efficiently removing the nitrogen and phosphorus from the blended waters.	$4,200,000	$667,442	7,129	$589	357	$11,765

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Utilities	Osprey Marsh	This project is an algal nutrient removal facility system that removes dissolved nutrients from up to 10 million gallons per day (mgd) of stormwater and from up to 1.5 mgd of reverse osmosis reject water known as demineralization concentrate. The algal turf scrubber system uses a water treatment technology that was developed specifically to enhance water quality of polluted waters through the active cultivation of attached algae upon an engineered surface.	$10,000,000	$740,000	10,392	$962	1,301	$7,686
Utilities	West WWTF Nutrient Reduction	Carbon dosing to reduce Nitrogen and Phosphorus beyond permit limits.	$350,000	$250,000	5,673	$62	1,871	$187
Utilities	Sebastian Septic-to-sewer - Phase I	The Sebastian Septic-to-sewer – Phase 1 area is presently served by an arterial sanitary sewer collection and conveyance system constructed in the early 1990s. However, there remains a large population of residential and commercial entities that use septic systems. The project includes an area of 73 acres with an assumption of one septic system per acre.	$3,283,000	N/A	TBD	TBD	NA	NA
Utilities	West Wabasso Septic-to-sewer Phase II	Convert 57 septic systems to central sewer and construct stub-outs for 47 vacant properties for future connection.	$2,250,984	NA	TBD	TBD	NA	NA

Table 7. Under Construction Projects to Achieve LMP Goals and Objectives

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Conservation Lands	Lost Tree Island Conservation Area	The Lost Tree Islands Conservation Area (LTICA) was purchased in 2003 by Indian River County with funding assistance from the Florida Communities Trust and in partnership with the City of Vero Beach (COVB) and the Town of Indian River Shores (TIRS). The 508-acre conservation area includes upland, wetland and submerged landforms located in in the central portion of the County's section of the Indian River Lagoon. The three larger islands (cumulative acreage of 177.4 acres) and the wetlands within the LTICA were likely formed through natural processes, however, the topography of these islands has been modified by placement of spoil dredged from the Intracoastal Waterway channel and is dominated by Australian pines (*Casuarina equisetifolia*) and Brazilian pepper (*Schinus terebinthifolius*). The County received an IRLNEP grant to develop a restoration and enhancement plan. The plan includes the construction of flow-through wetlands, maritime hammocks, and transitional wetlands which will provide diverse wildlife habitat. baseline surveys show that there are seagrasses along the shoreline - there is a goal of expanding seagrass cover into the interior wetland areas, if feasible.	TBD	NA	NA	NA	NA	NA
Conservation Lands	Archie Smith Fish House	The Archie Smith Fish House is part of the historical working waterfront in Sebastian along Indian River Drive. The property includes a small tract (0.07 acres) on the east side of Indian River Drive with two buildings and the dock structure extending approximately 240 feet into the IRL. There are several historically significant structures on the property: the historical residence just east of the public road, the dock, and the icehouse near the end of the pier. West of Indian River Drive, the property consists of approximately 1.1 acres of developed and undeveloped lands. The County plans to Revitalize these facilities as part of the management plan for the site. Part of this Revitalization may include identifying opportunities to enhance seagrass or oyster habitat in proximity to the site or evaluating the shoreline to determine if there are opportunities for creating a living shoreline.	TBD	NA	NA	NA	NA	NA

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Conservation Lands	CORE Modules Pilot Project	Enhancement of natural oyster reefs using a plastic-free substrate.	TBD	NA	NA	NA	NA	NA
Stormwater	Artesian Well Plugging	Cost share plugging of free-flowing Artesian Wells.	$10,998	$10,000	NA	NA	NA	NA
Utilities	ArcNLET Modeling	Identify priority areas/neighborhoods and evaluate the potential for septic system removal or upgrade in the highest priority areas using ArcNLET. Prepare and implement a plan for prioritized septic system removal or upgrades. Use ArcNLET data to obtain grant funds and TMDL/BMAP credits.	$65,000	NA	NA	NA	NA	NA
Utilities	Sebastian Septic-to-sewer - Phase II	This project will connect the existing septic systems to the sewer system which will allow for environmentally sound infrastructure growth to the area and Lagoon. Convert approximately 180 septic systems to central sewer.	TBD	NA	4,266	TBD	NA	NA
Utilities	West Wabasso Septic-to-sewer Phase III	Convert approximately 31 septic systems to central sewer and construct approximately 61 stubouts for current and future connections.	$3,700,000	NA	961	$3,850	NA	NA
Utilities	North County (Roseland) Septic-to-sewer	Project has the potential to connect up to 200 residents to the sewer system. A little over 40 residents have already connected.	$7,141,291	NA	3,881	$1,840	NA	NA

Table 8. Designed Projects to Achieve LMP Goals and Objectives

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Coastal Engineering	Seagrass Restoration	Seagrass restoration at Big Slough at Preacher's Hole	$128,540–$1,400,000	NA	NA	NA	NA	NA
Coastal Engineering	Seagrass Restoration	Seagrass restoration at Big Slough, south of Sebastian Inlet	$128,540–$1,400,000	NA	NA	NA	NA	NA

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Coastal Engineering	Muck Removal Evaluation	Muck is black, organic-rich (greater than 10% organic matter), mud-rich (greater than 60% silt and clay), high water content (greater than 75% water by weight, greater than 90% water by volume) sediments. The muck sediment contains nutrients and serves as an internal "legacy load" of nutrients that releases (fluxes) nutrients back into the water column. These sediments inhibit the growth of natural benthic communities and flux nutrients to overlying water. Research will include the review of available muck mapping data to evaluate the presence and quantities of muck. Evaluate costs and benefits for additional surveys to provide a data set that will allow the County to prioritize for muck removal. Evaluate nutrient flux from muck deposits to determine the nutrient loading to the IRL.	$102,275	NA	NA	NA	NA	NA
Coastal Engineering	Lauren's Island Reef and Living Shoreline	Installation of an oyster reef structure around the perimeter of Lauren's Island to increase oyster density and reduce erosion.	$300,000	NA	NA	NA	NA	NA
Utilities	Floravon Shores Subdivision	Septic-to-sewer 18 homes	TBD	NA	468	TBD	NA	NA

Table 9. Conceptual Projects to Achieve LMP Goals and Objectives

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Coastal Engineering	Round Island Riverside Park	To the north of Round Island South Conservation Area, the County owns two spoil islands that are part of Round Island Park. A boardwalk has been constructed to connect the smaller of the two islands to the barrier island. This approximately 7.5-acre island is dominated by exotic species and would be a potential site for habitat revitalization and water quality improvements such as creation of wetlands along the shoreline, creation of sand flats for avian habitat, and creation of native uplands.	TBD	NA	NA	NA	NA	NA
Coastal Engineering	Oyster/Benthic Community Survey (current and historical)	Identify current and historical locations and coverage of benthic organisms including seagrass, clams, and oysters. Determine the area necessary for revitalization of the Lagoon and implement efforts.	TBD	NA	NA	NA	NA	NA
Coastal Engineering	A1A Shoreline Enhancement	Living shoreline project to naturally protect State Road A1A and the pedestrian sidewalk for approximately two miles south of Sebastian Inlet.	TBD	NA	NA	NA	NA	NA
Conservation Lands	South Oslo Riverfront Conservation Area	South Oslo Riverfront Conservation Area (SORCA) is a 143-acre site that abuts the IRL. The site consists of a mixture of mangrove impoundment, maritime hammock, and pine flatwoods. SORCA's eastern impoundment is no longer part of a rotational impoundment management (RIM) network. the SJRWMD has received a grant from FDEP (to be coordinated with IRC) to remove the majority of the impoundment dike to re-connect natural flow to the IRL. The project will remove 1,100-foot-long perimeter dike to improve exchange between impounded mangroves and the Indian River Lagoon (IRL). Restoration of a more natural hydroperiod in the impoundment will benefit wildlife that use the mangroves, the coastal hammock, adjacent seagrass beds, and habitat for species that support fisheries.	TBD	NA	NA	NA	NA	NA
Conservation Lands	Spoil Island Enhancement Opportunities	Potential to create living shorelines, oyster bars, and wetland habitats.	TBD	NA	NA	NA	NA	NA

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Conservation Lands	Round Island South Conservation Area	Approximately 65 acres of maritime hammock and impounded wetlands located between State Road A1A and the IRL on the barrier island. The southern boundary of the site is the Indian River County line. The large wetland impoundment contains a mixture of herbaceous saltmarsh flats and mangroves and is one of the more diverse estuarine wetlands in the area. There are potential opportunities for establishment of a more diverse living shoreline along some sections of the impoundment, there also is potential for increased connection between the impoundment and the IRL, which would improve habitat and water quality within the impounded wetlands. This area is known to be extensively used by manatees; therefore, all proposed activities would need to be consistent with manatee protection guidelines.	TBD	NA	NA	NA	NA	NA
Conservation Lands	Prange Island Conservation Area	Located in the Lagoon just south of the 17th Street Causeway Bridge, and immediately north of the southern Vero Beach city limit, there are two undeveloped islands that comprise the project: the larger (southern) island, known as Prange Island, containing approximately 16.6 acres above mean high water, and the smaller (northern) island, known as Little Prange Island, containing approximately 5.8 acres above mean high water. Prange Island is located near an Ais Indian village site called Jece on the adjacent barrier island. A prehistoric shell-midden is reported on Prange Island, but the precise location of the site is unknown at this time. The island's name comes from the Prange family who homesteaded there in the late 1800s. In areas where there is heavy exotic invasion, there is potential to create a mixture of upland and wetland communities that may benefit the Lagoon from both a habitat and a water quality perspective.	TBD	NA	NA	NA	NA	NA

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Conservation Lands	Pelican Island National Wildlife Refuge	The Pelican Island National Wildlife Refuge contains a mosaic of over 5,400 acres of wildlife habitat along the barrier island in northern Indian River County. The refuge is designated as a National Historic Landmark, a Wetland of International Importance, and a candidate Marine Protected Area. The original holdings within the refuge have expanded over time through acquisition efforts by the United States Fish and Wildlife Service (USFWS), state of Florida, and local governments. Indian River County owns, or shares ownership, on approximately 200 acres within the refuge. The County works closely with the USFWS to ensure that management of the areas is targeted at maximizing the potential wildlife habitat. The County intends to continue this collaboration to identify opportunities for projects that can enhance conditions within the Lagoon.	TBD	NA	NA	NA	NA	NA
Stormwater	Stormwater Masterplan	Create a stormwater masterplan to evaluate water quality in each basin and identify areas where funding opportunities would be most advantageous. Inform decision making for conceptual projects.	$500,000	NA	NA	NA	NA	NA
Stormwater	Rockridge	Install Backflow prevention devices to protect the Subdivision from tidal influences.	$150,000	$5,000	TBD	TBD	TBD	TBD
Stormwater	Outfall Upgrades	Upgrade outfalls to the Indian River Lagoon with baffles, screens or infiltration media to ensure that the runoff reaching the Lagoon has been pretreated to remove sediment, debris and possible nutrient loads depending on funding and measurable loads in those areas.	$5,000,000	$200,000	TBD	TBD	TBD	TBD
Stormwater	North and South Relief Canal Mechanical Water Lettuce Removal Systems	This project will use a long reach excavator to remove water lettuce from the North and South Relief canals to prevent excess nutrient loading to the Lagoon. Two locations in these canals have already been identified for accumulating a large amount of water lettuce annually	$1,000,000	$50,000	5,900	$68	1,400	$286
Stormwater	Historical Subdivision Retrofits	After a Flood Study has been performed, design and construct improvements to prevent future flooding and damage in older subdivisions created prior to master drainage systems.	$10,000,000	$25,000	TBD	TBD	TBD	TBD

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Stormwater	Flood Studies	Analysis of flooding areas to determine best solutions to prevent repeated substantial damage.	$500,000	NA	NA	NA	NA	NA
Stormwater	CRS Rating Evaluation and Improvement	Improving Community Rating System (CRS) class can reduce flood insurance premium rates and make community infrastructure more resilient.	TBD	NA	NA	NA	NA	NA
Stormwater	Baffle Boxes	Baffle boxes could be installed in areas with a lot of organic material, such as leaf litter, or trash to capture those materials before they enter the stormwater system. Baffle boxes could also be installed on County, municipality, and FDOT outfalls to major tributaries, canals, and the Lagoon to reduce the amount of pollutants discharged to surface waters.	TBD	TBD	TBD	TBD	TBD	TBD
Stormwater	8th St Parcel	Stormwater management and treatment pond to store large influxes of canal water to slowly release in times when flows are low. Protects the Lagoon from large releases of flow.	$16,000,000	$100,000	163	$98,160	37	$432,432
Stormwater	Storm Drain Cleaning with Vacuum Trucks	Clean out of storm drains to improve nutrient removal.	$0	$19,067	TBD	TBD	TBD	TBD
Stormwater	Floating Aquatic Plant Islands in County Stormwater Ponds and Lakes	Adding floating aquatic plants to stormwater ponds and lakes to achieve additional nutrient removal.	TBD	TBD	TBD	TBD	TBD	TBD
Stormwater, Utilities, Parks	4th St Nutrient Reduction	Providing nutrient reductions from WWTP effluents and canals. Also providing additional storage of canal pulse discharges while providing water quality improvements.	$15,000,000	$25,000	TBD	TBD	TBD	TBD
Utilities	Hobart Landing Unit 2	Septic-to-sewer 53 homes	TBD	NA	1,400	TBD	NA	NA
Utilities	Orchid Island No. 1 and No. 2	Septic-to-sewer 90 homes	TBD	NA	3,600	TBD	NA	NA
Utilities	Sebastian Highlands Unit 02 Collier	Septic-to-sewer 27 homes	$576,305	NA	1,028	$561	NA	NA
Utilities	Sebastian Highlands Unit 05	Septic-to-sewer 404 homes	$8,623,235	NA	13,577	$635	NA	NA

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Utilities	Sebastian Highlands Unit 04	Septic-to-sewer 432 homes	$5,473,025	NA	10,018	$546	NA	NA
Utilities	Ambersand Beach Sub No. 1 & 2	Septic-to-sewer 73 homes	$1,838,644	NA	2,802	$656	NA	NA
Utilities	Sebastian Highlands Unit 01	Septic-to-sewer 754 homes	$9,552,456	NA	17,256	$554	NA	NA
Utilities	Sebastian Highlands Unit 03	Septic-to-sewer 432 homes	TBD	NA	10,018	TBD	NA	NA
Utilities	Hobart Landing Unit 3	Septic-to-sewer 7 homes	$135,951	NA	270	$503	NA	NA
Utilities	Hallmark Ocean Subdivision	Septic-to-sewer 3 homes	$197,013	NA	116	$1,701	NA	NA
Utilities	Naranja TR Shellmound Bch Replat of POR	Septic-to-sewer 8 homes	$330,674	NA	327	$1,011	NA	NA
Utilities	River Shores Estates Units 1-4	Septic-to-sewer 120 homes	$2,933,294	NA	1,663	$1,764	NA	NA
Utilities	Rain Tree Corner Subdivision	Septic-to-sewer 16 homes	$468,796	NA	445	$1,054	NA	NA
Utilities	Hobart Landing Unit 1	Septic-to-sewer 17 homes	$447,727	NA	136	$3,282	NA	NA
Utilities	Orchid Isles Estates Subdivision	Septic-to-sewer 63 homes	$1,345,995	NA	2,429	$554	NA	NA
Utilities	Kanahwah Acres	Septic-to-sewer 12 homes	$485,688	NA	165	$2,949	NA	NA
Utilities	Verona Estates Subdivision	Septic-to-sewer 7 homes	$199,287	NA	106	$1,882	NA	NA
Utilities	Indian River Heights Units 1-9	Septic-to-sewer 772 homes	$10,492,885	NA	5,759	$1,822	NA	NA
Utilities	Diana Park Subdivision	Septic-to-sewer 21 homes	$599,085	NA	588	$1,020	NA	NA

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Utilities	Dales Landing Subdivision	Septic-to-sewer 7 homes	$247,302	NA	169	$1,460	NA	NA
Utilities	Stevens Park Unit 1&2	Septic-to-sewer 303 homes	$4,582,060	NA	1,658	$2,764	NA	NA
Utilities	Pine Tree Park Units 1-4	Septic-to-sewer 488 homes	$7,136,717	NA	6,222	$1,147	NA	NA
Utilities	Little Portion Subdivision Replat OF	Septic-to-sewer 21 homes	$582,324	NA	201	$2,895	NA	NA
Utilities	Winter Grove Subdivision	Septic-to-sewer 25 homes	$709,615	NA	632	$1,123	NA	NA
Utilities	Tropic Colony Subdivision	Septic-to-sewer 145 homes	$3,065,568	NA	1,115	$2,750	NA	NA
Utilities	Halleluiah Acres	Septic-to-sewer 6 homes	$306,376	NA	232	$1,323	NA	NA
Utilities	Sebastian Highlands Unit 13	Septic-to-sewer 574 homes	$8,107,515	NA	5,988	$1,354	NA	NA
Utilities	Sebastian Highlands Unit 02	Septic-to-sewer 1,052 homes	$13,327,830	NA	17,845	$747	NA	NA
Utilities	Sebastian Highlands Unit 02 Replat page 2	Septic-to-sewer 66 homes	$836,157	NA	1,268	$659	NA	NA
Utilities	Sebastian Highlands Unit 02 Replat page 3	Septic-to-sewer 129 homes	$1,634,306	NA	3,320	$492	NA	NA
Utilities	Sebastian Highlands Unit 02 Replat page 4	Septic-to-sewer 56 homes	$709,466	NA	893	$794	NA	NA
Utilities	Heritage Trace at Hobart	Septic-to-sewer 7 homes	$209,629	NA	TBD	TBD	NA	NA
Utilities	Central WWTF Nutrient Reduction (Permit No. FLA010431)	Nitrogen and phosphorus project in effluent which goes to the County's Reuse Program.	$300,000	NA	5,673	$53	1,871	$160

Primary Responsible Department	Project Name	Project Description	Estimated Capital Cost	Estimated Annual Operations and Maintenance Cost	TN Reductions (pounds per year)	TN Reductions (cost per pound)	TP Reductions (pounds per year)	TP Reductions (cost per pound)
Utilities	West WWTF Nutrient Reduction (Permit No. FL0041637)	Nitrogen and phosphorus project in effluent which goes to the County's Reuse Program.	$300,000	NA	19,239	$16	3,106	$97

4. References

Audzijonyte, A. et al. 2013. Ecological Consequences of Body Size Decline in Harvested Fish: Positive feedback loops in trophic interaction amplify human impact. Biology Letters 9(2): 20121103.

Enberk, K. et al. 2012. Fishing-induced Evolution of Growth: Concepts, mechanisms and empirical evidence. Marine Ecology 33: 1-25.

Garcia, SM. et al. 2012. Reconsidering the Consequences of Selective fisheries. Science 335: 1045-1047.

FDEP. 2021. Indian River Lagoon Basin: Central Indian River Lagoon Basin Management Action Plan.

Fletcher, S.W. and Fletcher, W.W. 1995. Factors Affecting Changes in Seagrass Distribution and Diversity Patterns in the Indian River Lagoon Complex Between 1940 and 1992. Bulletin of Marine Science 57(1): 49-58.

Florida Sea Grant. N.d. Sewage Solutions. Accessed at: https://www.flseagrant.org/clean-boating/sewage-solutions/.

Howarth, R.W. 2008. Coastal Nitrogen Pollution: A review of the sources and trends globally and regionally. Harmful algae 8(1):14-20.

IRLNEP. 2021. Indian River Lagoon: Climate Ready Estuary. Technical Report No. 003.

Kim, Y.T. 2003. Water Balance and Flushing Time in the Restricted Indian River Lagoon (IRL), Florida USA. Ocean and Polar Research 25(1):75-87.

Lindsey, R. 2022. Climate Change: Global Sea Level. NOAA Climate.gov. Accessed at: https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level.

Lowe, K.S. et al. 2007. Influent Constituent Characteristics of the Modern Waste Stream from Single Sources: Literature Review. Water Environment Research Foundation. Technical Report.

Malone, T.C. and Newton, A. 2020. The Globalization of Cultural Eutrophication in the Coastal Ocean: Causes and Consequences. Frontiers in Marine Science 7: 670.

Marchese, D. et al. 2018. Resilience and Sustainability: Similarities and Differences in Environmental Management Applications. Science of the Total Environment 613-614, 1275-1283.

Newman, A.P.L. 1953. Stories of Early Life Along Beautiful Indian River.

NOAA. N.d. Fibropapillomatosis and Sea Turtles – Frequently Asked Questions. Accessed at: https://www.fisheries.noaa.gov/national/marine-life-distress/fibropapillomatosis-and-sea-turtles-frequently-asked-questions.

NOAA. Lake Worth Pier Tides and Currents. Accessed at: Lake Worth Pier: https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8722670.

Piehler, M.F. and Smyth, A.R. 2011. Habitat-Specific Distinctions in Estuarine Denitrification Affect Both Ecosystem Function and Services. Ecosphere 2(1): 1-16.

Rabalais, N.N. 2009. Global Change and Eutrophication of Coastal Waters. ICES Journal of Marine Science. 66(7):1528-1537.

Ray, N.E. et al. 2019. Nitrogen and Phosphorus Cycling in the Digestive System and Shell Biofilm of the Eastern Oyster Crassostrea virginica. Marine Ecology Progress Series 621:95-105.

Robbins, L.L. and Lisle, J.T. 2018. Regional Acidification Trends in Florida Shellfish Estuaries: A 20+ year look at pH, oxygen, temperature and salinity. Estuaries and Coasts 41:1268-1281.

Schaefer, A.M. 2019. Temporal Changes in the Antibiotic Resistance Among Bacteria Isolated from the Common Bottlenose Dolphins (Tursiops truncates in the Indian River Lagoon, Florida 2003-2015. Aquatic Mammals 45(5):533-542

SJRWMD. 2022. 2021 Report of Annual Water Use for St. Johns River Water Management District. Technical Fact Sheet SJ2022-FS1.

Timm, M. R. 2017. Structural Comparisons of Natural versus Seawall Shoreline Mangrove Stands. University of Miami. Accessed at: https://scholarship.miami.edu/esploro/outputs/graduate/Structural-Comparisons-of-Natural-versus-Seawall/991031448064102976.

Trefry, J.H. and Trocine, R.P. 2011. Metals in Sediments and Clams from the Indian River Lagoon, Florida: 2006-7 versus 1992. Florida Scientists 74: 43-62.

USACE. June 28, 2013. Strategic Sustainability Performance Plan.

Appendix A. Operational County Project Descriptions

EGRET MARSH STORMWATER PARK

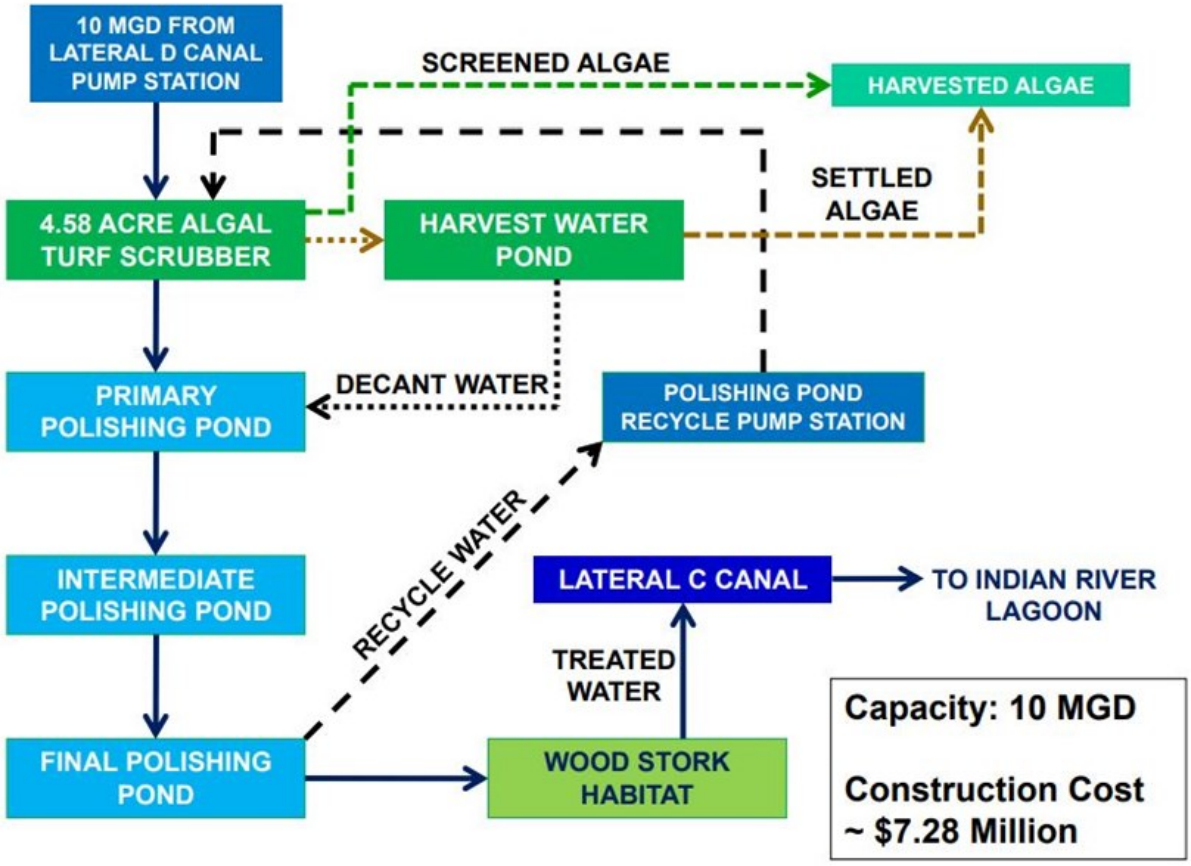
7295 4th Street, Vero Beach 32968

Egret Marsh Stormwater Park is an algal turf scrubber treatment system protecting the Lagoon by removing thousands of pounds of nitrogen and phosphorus per year from storm-water, while providing vital wetland habitat for protected species.

Egret Marsh Stormwater Park was designed by IRC staff to filter excess nutrients from the canal system before entering the Main Relief Canal and the IRL. Egret Marsh utilizes an algal turf scrubber treatment system to take up nitrogen and phosphorus from the stormwater, while providing a wetland habitat. Water from the canal system flows over a gently sloped algal covered concrete surface. After the stormwater is naturally filtered by the algae, gravity moves the water through a series of polishing ponds and a wetland habitat before returning to the canal system.

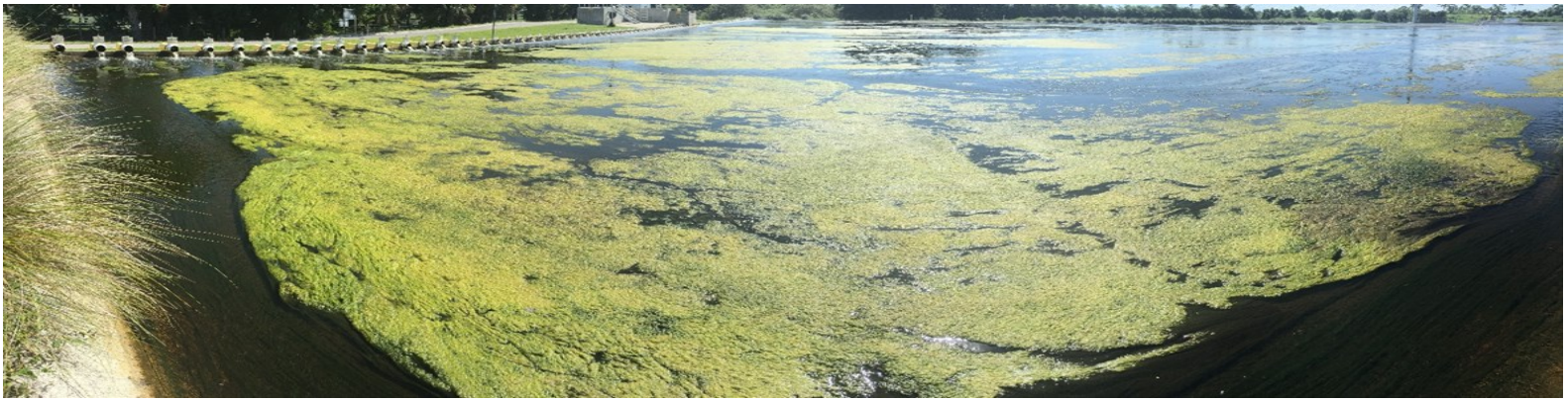
For more information and educational videos visit: *www.ircgov.com/stormwater*

Department of Public Works



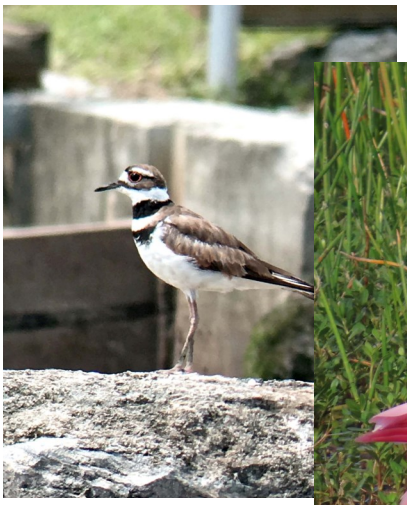
EGRET MARSH STORMWATER PARK FLOW SCHEMATIC

Egret Marsh began operating in April 2010. The site includes a 4.58 acre algal turf scrubber, three polishing ponds and a wetland habitat. The site cost approximately $7.28 million to construct., with additional operating costs an nually. Water is pumped from the Lateral D Canal to the site and is returned to the Lateral C Canal. The site is capable of filtering 10 million gallons of canal water per day (MGD). The algal is periodically harvested, dried and disposed of at the landfill preventing nitrogen and phosphorus taken up by the algae from entering the system.



Since its construction in 2012, Egret Marsh has become a specialized habitat for many protected bird species including the threatened wood stork, roseate spoonbill, and limpkin. The created wetland habitat provides shelter and foraging grounds for birds, amphibians, insects, and reptiles alike. One area of the facility was purposefully designed for wood stork foraging, as they only feed at particular depths. The shallow marsh area has varying elevations to accommodate their particular needs no matter the water level, providing the perfect habitat that this previously endangered bird can flock to.

Killdeer

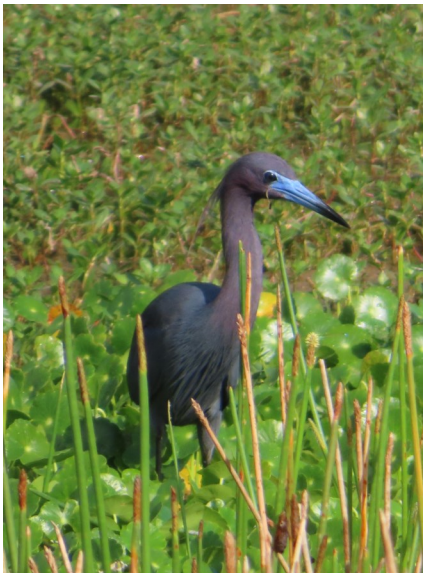


Roseate Spoonbill

Green Heron

Wood Stork

Little Blue Heron



Limpkin

For more information and educational videos visit: *www.ircgov/stormwater*

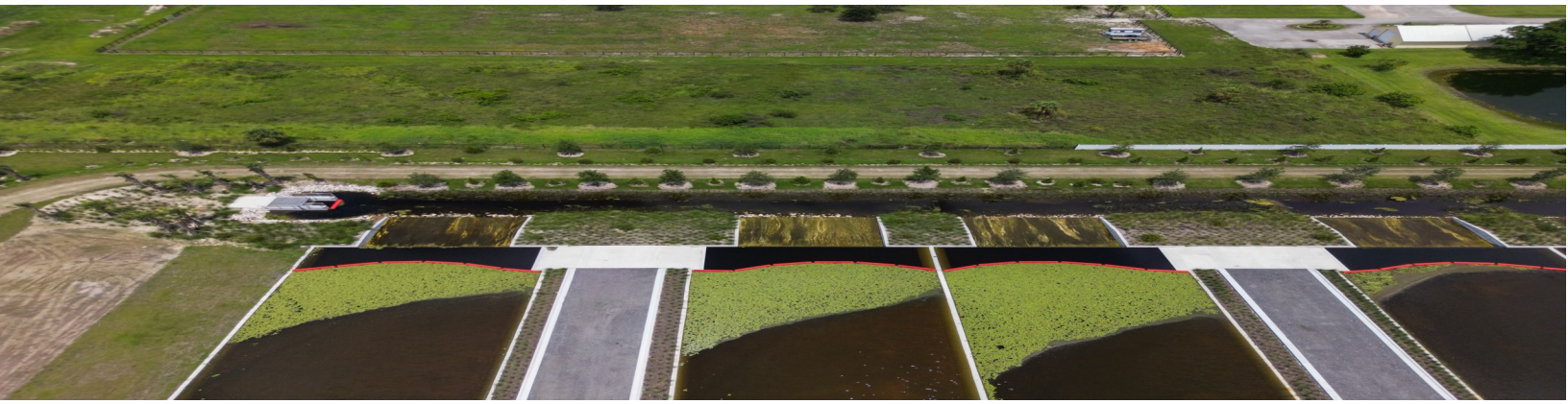
Department of Public Works

MOORHEN MARSH STORMWATER PARK

6520 53rd Street, Vero Beach 32967

Moorhen Marsh Stormwater Park is a low-energy aquatic plant system using water lettuce to absorb nitrogen and phosphorus from the North Relief Canal before making its way to the Indian River Lagoon.

Moorhen Marsh Stormwater Park was designed by IRC staff to filter excess nutrients from the North Relief Canal before entering the IRL. Egret Marsh utilizes a series of water lettuce basins to take up nitrogen and phosphorus from the stormwater. Water lettuce is a floating aquatic plant proven to absorb up to 83% of Nitrogen and 81% Phosphorus. After the stormwater is naturally filtered by the water lettuce it moves out of the basins to a flow way returning to the canal.



For more information and educational videos visit: *www.ircgov.com/stormwater*

Department of Public Works

Moorhen Marsh began operating in Summer 2023. The 18 acre site includes eight water lettuce basins, a spillway and flow way to the canal. The site cost approximately $11 million to construct with additional operating costs. The site is capable of filtering 10 million gallons of canal water per day (MGD) and estimated to remove up to 10,000 lbs of nitrogen and 1,530 lbs of phosphorus annually. The water lettuce is periodically harvested using a long reach excavator, dried and disposed of at the landfill preventing nitrogen and phosphorus taken up by the plants from en tering the system.

For more information and educational videos visit: *www.ircgov.com/stormwater*

Department of Public Works

INDIAN RIVER COUNTY FLORIDA

OSPREY ACRES STORMWATER PARK

925 5th ST SW Vero Beach 32962

Open from 8:00am – 4:00pm daily.
Closed Tuesdays and County Holidays

-Over 4 miles of nature trails
-Habitats include uphill pine hammock oak, and manmade marshland

Osprey Acres Stormwater Park is an 83.7 acre-property with hiking trails, dedicated to preserving natural Florida habitat, while providing stormwater treatment protecting our local waterways.

Protecting the Indian River Lagoon through Nutrient Removal

Excess nutrients such as nitrogen and phosphorus are cited to be a cause of algal blooms within the Indian River Lagoon. Osprey Acres' goal is to filter these nutrients from the stormwater before entering the Lagoon.

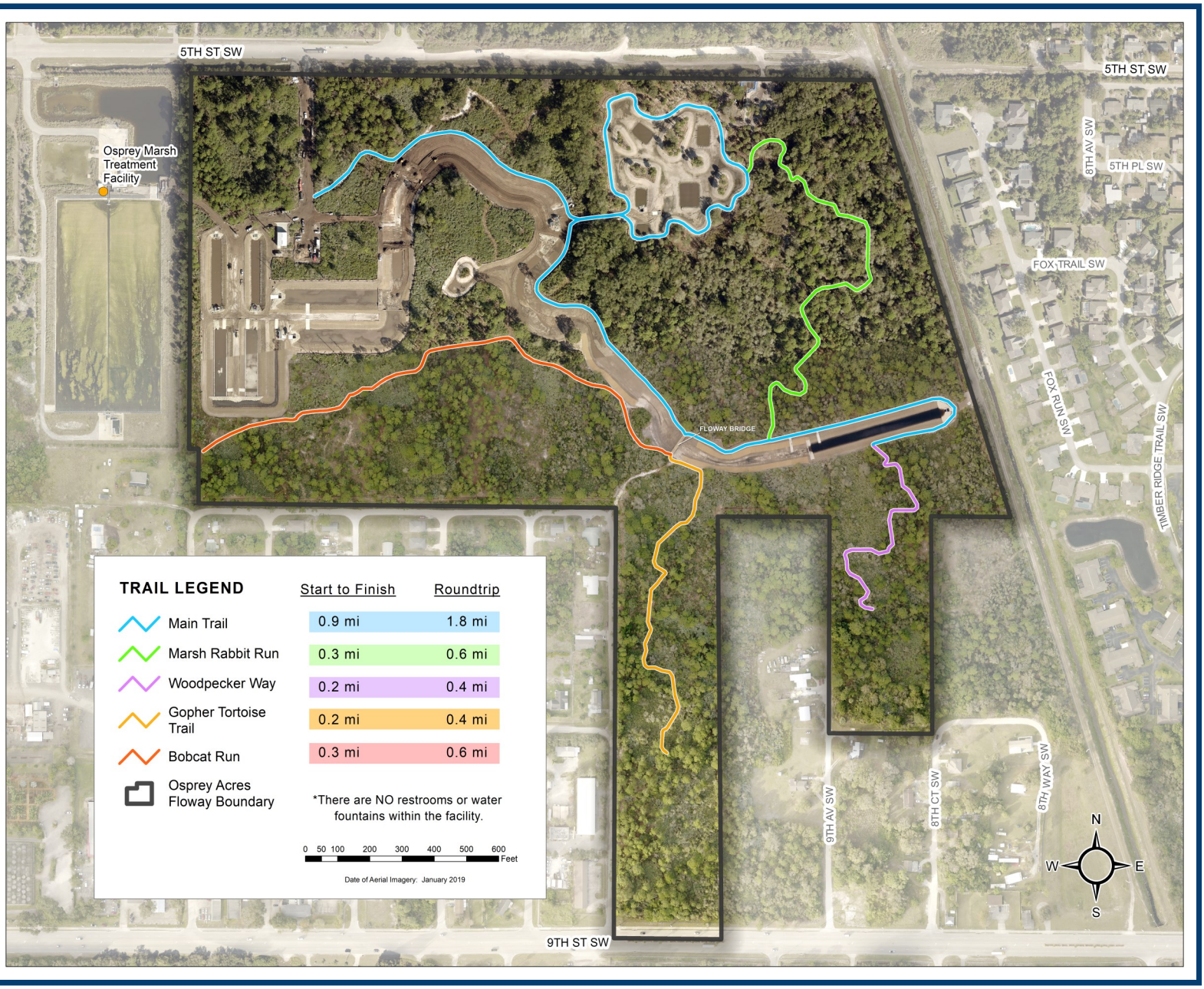
Osprey Acres is estimated to remove a total of 4,000 lbs of Nitrogen and 600 lbs of Phosphorus annually

Data based on the FDEP STAR report

For more information and educational videos visit:

www.ircgov.com/publicworks/stormwater

Department of Public Works



Osprey Acres is a stormwater treatment system filtering 2 million gallons of untreated canal stormwater a day along with water filtered through Osprey Marsh next door. In order for the water to be treated, it first flows through settling basins, removing sediments and solids, then through two managed aquatic plant systems; the first with water lettuce scrubbers and the second with filter marshes. The presence of the plants allows nutrients to be naturally filtered out of the water. The long serpentine flow-way wrapping through the park works with the adjoining shallow marsh to provide polishing as the water flows back into the canals eventually ending in the Indian River Lagoon.

Designed by County staff, this $7.4 million project contains several hiking trails through unspoiled Florida uplands and along the serpentine flow-way.

Most of the property is a dedicated nature preserve and is home to an abundance of native wildlife. As the planted aquatic portions of the preserve and treatment areas mature, they will become havens for many waterfowl and aquatic animals. The park is intended for passive use only to preserve the safety of the wildlife; therefore only foot travel is permitted past the parking lot, and no dogs (except handicap assist) are allowed to enter the property. There are also no restroom facilities.

Juvenile Little Blue Heron

Water Lily

Pickerel Weed

Six-lined Racerunner

Black-necked Stilt

Osprey

Gopher Tortoise

For more information and educational videos visit: *www.ircgov.com/publicworks/stormwater*

Department of Public Works

INDIAN RIVER COUNTY FLORIDA

OSPREY MARSH
WETLAND TREATMENT SYSTEM
1225 5th Street SW, Vero Beach

ENVIRONMENTAL BENEFITS

(ATS) Algal Turf Scrubber system removes nutrients and other pollutants through the cultivation and harvesting of algae upon an engineered surface.

- Natural treatment processes to remove Nitrogen and Phosphorus from waters heading to the Lagoon by cultivating and harvesting algae
- Enhances Dissolved Oxygen content of treated water
- Beneficial use of the Potable Water by-product
- Compliant with FDEP permit requirements

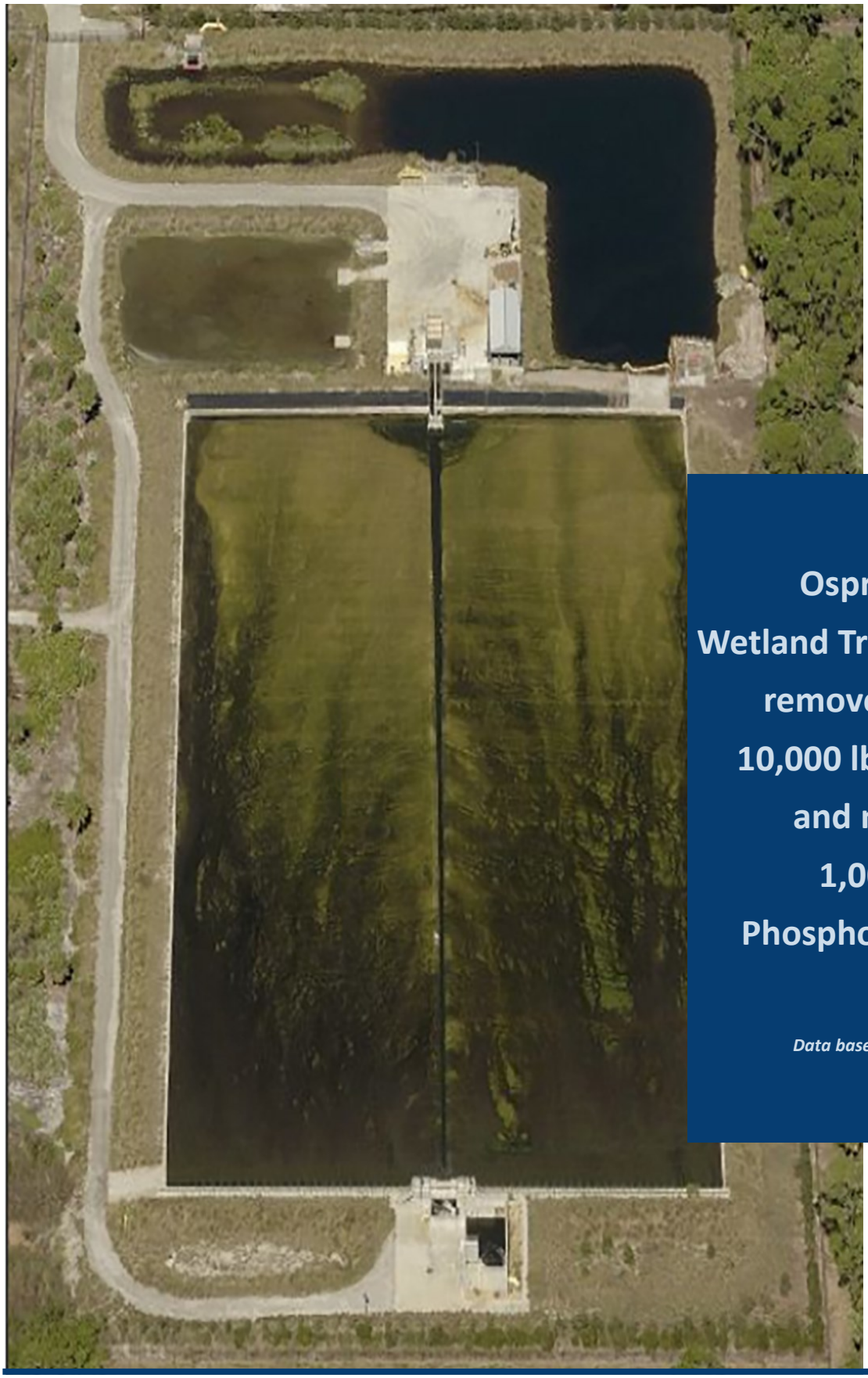
Osprey Marsh receives up to 1.5 Million Gallons per Day (MGD) of Demineralization Concentrate (DC), the mineral rich by-product created from the Reverse Osmosis Water Treatment Process from the South County Water Treatment Plant, and brings in up to 10 MGD of storm water daily from the South Relief Canal to blend with the DC at specified ratios. The blended waters flow through the site where nutrients and other pollutants are removed through natural processes.

Since the project went on line in 2015 through December 2018, the Osprey Marsh has **removed Nitrogen and Phosphorus** from more than **8 billion gallons** stormwater destined for the Indian River Lagoon.

For more information and educational videos visit: *www.ircgov.com/utilities*

Department of Utility Services

The Osprey Marsh Wetland Treatment System (OMWTS) is an Algal Nutrient Removal Facility system that removes dissolved nutrients from up to 10 Million Gallons per Day (MGD) of stormwater and from up to 1.5 MGD of Reverse Osmosis reject water known as Demineralization Concentrate (DC). The Algal Turf Scrubber System (ATS) uses a patented water treatment technology developed specifically to enhance water quality of polluted waters through the active cultivation of attached algae upon an engineered surface. Cultivation is the production and periodic harvesting of the attached algae (epiphytic and periphytic) and the community of organisms established on and around the algae. This living community of plants and organisms is known as algal turf, and includes the algal biomass, but associated invertebrates, bacteria, fungi, organic residues, and inorganic precipitants. Through the community's biological and chemical dynamics, nutrient pollutants are removed from the water column, dissolved oxygen is increased, and oxidation of reduced substances is facilitated. The result is a treated effluent reduced in nutrients, high in dissolved oxygen and relieved of many potentially biologically deleterious and toxic substances.



Osprey Marsh Wetland Treatment System remove more than 10,000 lbs of Nitrogen and more than 1,000 lbs of Phosphorus annually.

Data based on the FDEP STAR

For more information and educational videos visit: *www.ircgov.com/utilities*

Department of Utility Services

SPOONBILL MARSH
WETLAND TREATMENT SYSTEM
61st Street on the Indian River Lagoon

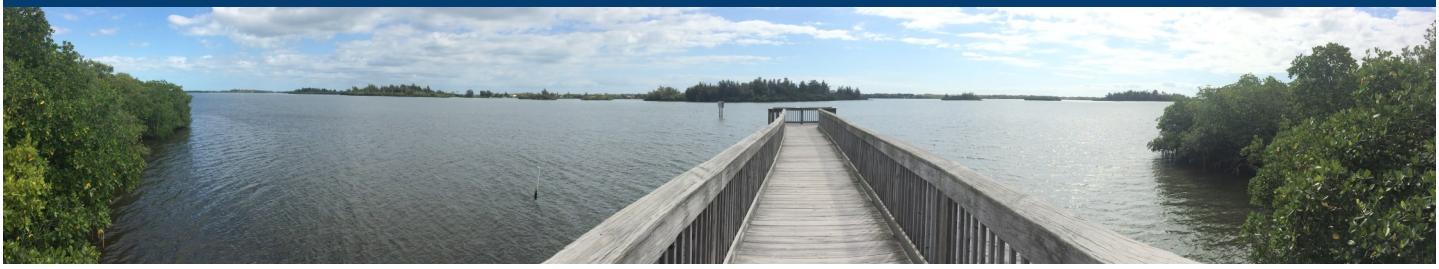
ENVIRONMENTAL BENEFITS

- Natural treatment processes remove Nitrogen and Phosphorus
- Designed to dispose of by-product in an environmentally beneficial manner

Protecting the Indian River Lagoon through Nutrient Removal

Approximately 7,000 lbs of Nitrogen and 357 lbs of Phosphorus are removed annually.

Data based on the FDEP STAR report



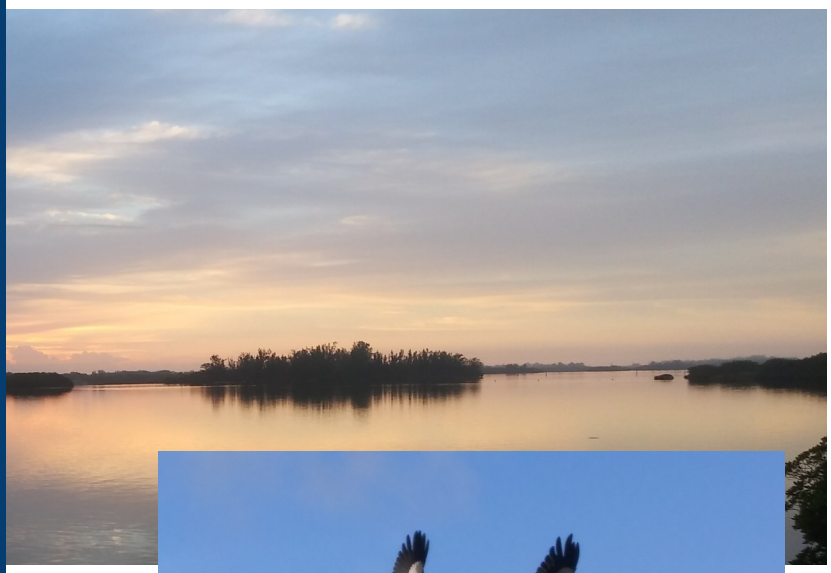
For more information and educational videos visit:
www.ircgov.com/utilities

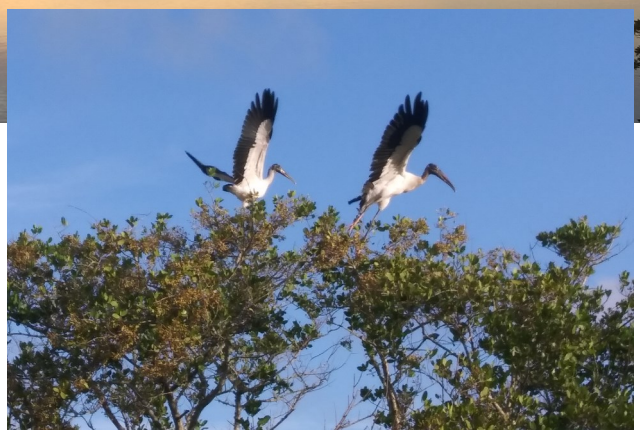
Department of Utility Services

Spoonbill Marsh represents a unique approach to handling the by product created during reverse osmosis drinking water purification. The 67 acre man made habitat uses natural proven treatment techniques for the removal of nutrients. The vegetation and aquatic organisms throughout Spoonbill Marsh play an active role in efficiently removing the nitrogen and phosphorus from the waters brought to the site. After passing through Spoonbill Marsh, the water exits back to the Lagoon in a cleaner state than when introduced.

Since the project went on line in late 2010, Spoonbill Marsh has passed more than 10 billion gallons of Indian River Lagoon water through its treatment processes and treated mineral rich by product created from the billions of gallons of potable water produced by the County's North County Reverse Osmosis Water Treatment Plant.

Spoonbill Marsh provides a home to a variety of wildlife including gopher tortoises, otters, bobcats, manatees, eagles, spoonbill, and osprey.





Spoonbill Marsh naturally filters up to 1.5 million gallons every day of by product created from the reverse osmosis treatment system. Spoonbill Marsh not only creates a natural and unrefined filter through a beautiful system of ponds and mangroves, but it also provides essential habitat to many threatened species.

For more information and educational videos visit:
www.ircgov.com/utilities

Department of Utility Services

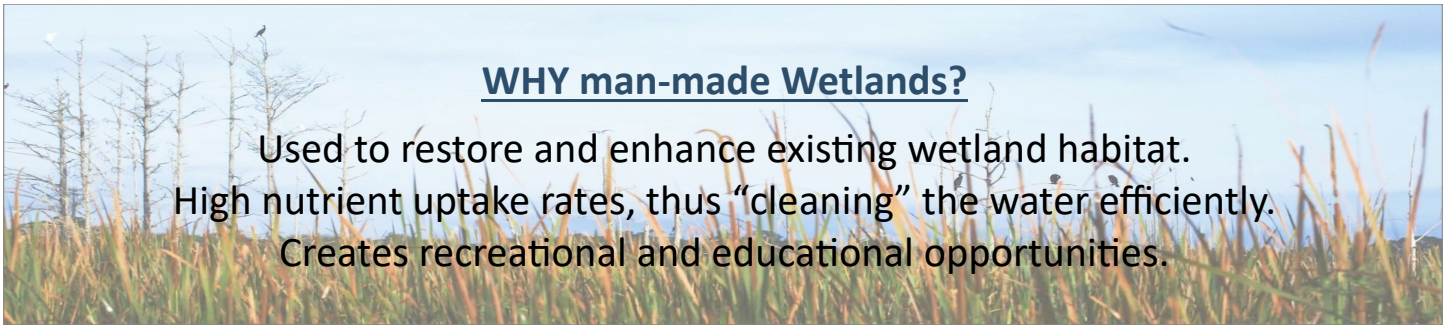
WEST WETLANDS
WEST REGIONAL WASTEWATER TREATMENT FACILITY WETLANDS
8405 8th Street, Vero Beach

ENVIRONMENTAL BENEFITS

Open from: Monday to Friday
7:00 am to 3:00 pm
Saturday to Sunday
7:00 am to 2:00 pm

- Natural treatment processes remove Nitrogen and Phosphorus
- Designed to dispose of wastewater in an environmentally beneficial manner

The West Wetlands are listed in the "Great Birding Trails of America" well-known to bird lovers all over. It is home to many terrestrial, aquatic and avian species.



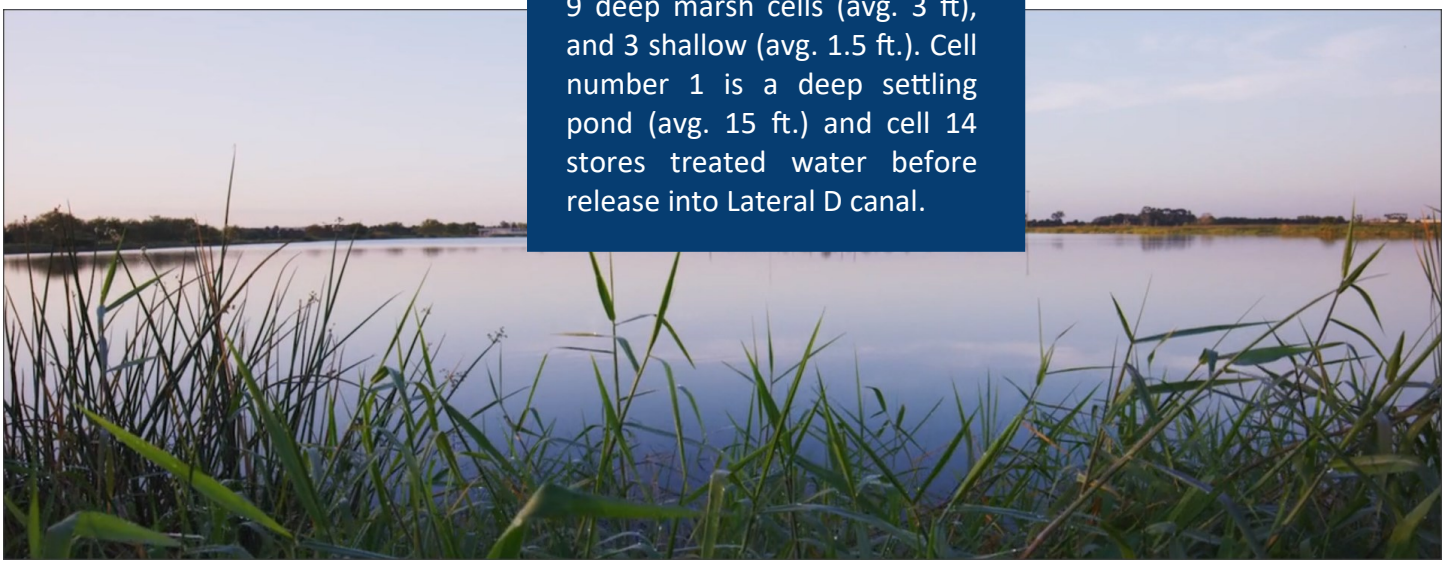
For more information and educational videos visit:
www.ircgov.com/utilities

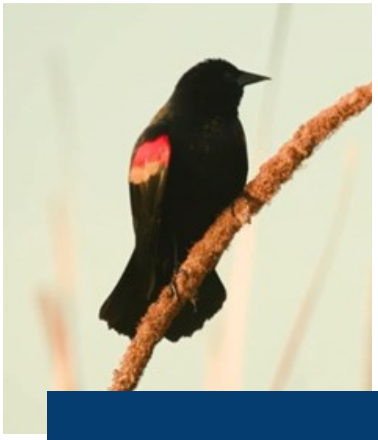
Department of Utility Services

The Wetland serves as a treatment system for wastewater that has been processed through the South County Wastewater Facility or the West Regional Wastewater Facility. Arriving at the Wetlands, the effluent first flows into the deep settling pond, then through a series of deep and shallow marsh cells. As the water passes through, the aquatic plant communities filter and clean it by removing nutrients, bringing it to a quality surpassing that of the waterways into which it flows. The remaining water enters a final storage cell before being released into Lateral D canal.

14 cells make up the Wetlands:

9 deep marsh cells (avg. 3 ft), and 3 shallow (avg. 1.5 ft.). Cell number 1 is a deep settling pond (avg. 15 ft.) and cell 14 stores treated water before release into Lateral D canal.





The West Wetlands has removed thousands of pounds of Nitrogen and Phosphorus from well over 4 billion gallons of highly treated wastewater passing through the system since it went on line in 1998.

For more information and educational videos visit:
www.ircgov.com/utilities

Department of Utility Services

Appendix B. Comments Received on the Draft LMP

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
7/17/2023	Stormwater	He thinks stormwater is the biggest issue with all the development.	Actions to address this source are included throughout the plan.
7/17/2023	Stormwater	He proposed a project for the 4th Street Canal, which ties into the Main Canal. The project would take water out of the canal and move it through the spillway to the west into the Blue Cypress basin. The County met with SJRWMD and they liked the idea of moving water to the west but would need to test the water quality. Another option would be a water farm in the Sebastian River Improvement District.	Based on previous evaluations, this project is not feasible but similar opportunities can be explored.
7/17/2023	Stormwater	Storage could also be added at the 260-acre property near the WWTF or by purchasing additional property near the Moorehen project.	This project can be evaluated for future implementation.
7/17/2023	Water Quality	He would like to remove muck in the IRL but there is the issue of where to dispose of the material. If we can attack the muck where comes into the lagoon, that will help over time.	A new action to address sources of organic matter were added to the Organics and Sediments section.
7/17/2023	Overall	The missing part of the equation is funding and he hopes the funding stream will be continual.	Additional details about funding were added to the plan.
7/17/2023	Stormwater	There are outfalls into the lagoon that need treatment.	Noted. This can be evaluated for a future project.
7/17/2023	Utilities	Septic-to-sewer projects are needed, especially along the coast.	Agreed. A plan for septic-to-sewer projects will be developed based on the results of multiple studies, availability of infrastructure and funding.
7/17/2023	Water Quality	There are channels filled with muck that should be removed and then we need to figure out what to do with the material once it is removed.	Noted. This can be evaluated for a future project.
7/17/2023	Water Consumption	One of the topics that interest her the most is water consumption. She would like a firm number on the quantity of water needed in the future.	Added an action to evaluate the quantity of water needed.
7/17/2023	Water Consumption	She would like to update the 1988 USGS geohydrologic report.	I believe this will fall under the Comprehensive Plan.
7/17/2023	Overall	She would like a hard number on how much development can occur before we really impact the lagoon. She is also very interested in low impact development and how that may help with the quantity of water needed.	This can be evaluated and be added in future updates.
7/17/2023	Overall	She wants to make sure the County develops smartly. A portion of the property should be reserved for preservation (“reserve to preserve”) and the use of native plants should be encouraged.	There are ordinances and conservation easements in place. Ordinances can be evaluated and updated as necessary
7/17/2023	Marinas, Boats and Boat Ramps	There are issues with derelict vessels in the lagoon.	A section on Derelict Vessels is included in the Marinas, Boats and Boat Ramps section
7/17/2023	Overall	She would like the plan to be surprising, tell us something we do not know and have not thought about, and provide positive suggestions. We understand there are challenges but we need good actions.	Additional actions were detailed in the plan.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
7/17/2023	Overall	The current version of the plan is very narrative with a lot of background information but there needs to be more directive for a plan.	Additional goals, objectives, actions and metrics were added to the plan.
7/17/2023	Overall	The department who developed the plan has a lot of actions and other departments do not. There is also overlap in the actions.	The actions are now organized by key factor and a cross-walk table was added to show other associated factors.
7/17/2023	Overall	There needs to be a deeper dive into how to prioritize and evaluate future projects. The plan can provide an evaluation methodology and the County can update it every 2 to 3 years with more details. She likes how the Brevard County plan has an evaluation methodology for the projects and timeline, as well as information on why projects are on the list and the goals they are trying to accomplish.	A new section added to provide a project prioritization framework for the plan.
7/17/2023	Water Quality	The plan talks a lot about how all ditches going into the IRL are owned by special districts, but maybe we could use the canals as a giant littoral system. There are also salinity issues so a reservoir could be added or additional storage in the canals to hold water in the rainy season and release it in the dry season.	The County has some existing treatment projects on the canals. Additional projects can be evaluated for the future.
7/17/2023	Overall	She would like them to think longer term about how County ordinances, especially related to stormwater and buffer zones, impact the ability to do TMDL remediation and how they could impact the lagoon. She noted that there is a need to evaluate the County regulations to see where to make things easier or harder since growth and development are causing some of these problems.	Actions were added to evaluate codes and ordinances for potential revisions.
7/17/2023	Community Development	She does not see information about public education and outreach to educate the community about best practices.	Actions related to public education and outreach were added throughout the plan.
7/25/2023	Overall	Overall, CWC believes that the Lagoon Management Plan is a good working document that serves as a roadmap for Lagoon Restoration.	Thank you!
7/25/2023	Introduction/ Page 1	Citizen responsibility – boats, septic systems – disagree. Most citizens only do what is required (think about the good old days of auto inspections). We need better regulation and enforcement. Pump outs at all marinas, Anchoring Limitation Areas, more frequent marine patrol for enforcement.	Actions for these items were added to the Marinas, Boats and Boat Ramps section.
7/25/2023	Introduction/ Page 1	Stormwater via the 3 main canals. Brevard County study indicated that 60% of all their N pollution sourced from groundwater flow. The canals pick up a lot of rain runoff but groundwater flow is a truer measure to determine the source of the loading.	Contributions from groundwater are discussed in the Water Quality, BMAP, Hydrology and Hydrodynamics, Annual Rainfall, and OSTDS sections.
7/25/2023	Introduction/ Page 1	Toxins – How about herbicides, pesticides, pharmaceuticals and other toxins?	The toxins in this table refer to harmful algal blooms. Other pollutants are discussed in the Water Quality section under Emerging Contaminants.
7/25/2023	Unique Location/Page 4	Low residence time in IRC beneficial to denitrification process – really? Or is it just that we send our pollution to the ocean with outgoing tides? Dilution is NOT the solution to pollution.	Low residence time is a benefit because nutrients

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
7/25/2023	Coastal Goals and Objectives/Page 7	Initiate/Advocate for stronger regulations to protect water quality – protect environmentally sensitive areas, consider stronger regulation on zoning changes	The plan goals, objectives, and actions were updated throughout the document.
7/25/2023	Water Quality Nitrogen and Phosphorus/ Page 7	Next to last paragraph – typo – complete should be compete	Corrected
7/25/2023	Water Quality Nitrogen and Phosphorus/ Page 7	Last paragraph – studies have now shown that phosphorus is also a polluting component of septic effluent.	Information about potential phosphorus contributions from septic systems is included in the OSTDS section.
7/25/2023	Water Quality Actions/Page 10	Eliminate septic systems and leaking WWT infrastructure (I and O)	Actions to address septic systems and wastewater treatment are included in the OSTDS and Wastewater sections.
7/25/2023	Organics and Sediments/Page 12	We have been told by John Trefry that hydraulic dredging, deposited into a recognized muck dewatering facility, is the way to go to prevent resuspending nutrients in the water column. Should that be specified?	The County is still evaluating the location and extent of muck deposits in this portion of the IRL. Once that assessment has been completed, recommendations for how to address muck removal can be determined.
7/25/2023	Marina, Boats and Boat Ramps Actions/Page 22	Establish an Anchoring Limitation Area to be enforced by local marine patrol vessels.	An action was added to evaluate establishing ALAs.
7/25/2023	Marinas, Boats and Boat Ramps Actions/Page 23	Require Pump Out Facilities to be added when improvements are permitted to Marina Facilities	An action was added to encourage an increase the number and distribution of pumpout facilities.
7/25/2023	Marinas, Boats and Boat Ramps Actions/Page 23	Encourage Sebastian to use a pump out vessel to service the sailboats within their waters since there is insufficient depth for the vessels to utilize the existing pump out facilities.	An action was added to encourage an increase the number and distribution of pumpout facilities.
7/25/2023	Annual Rainfall/Page 23	Water lettuce also removes suspended solids	Added this information to the plan.
7/25/2023	Best Management Practices/Page 25	Other ordinances to improve stormwater: native landscaping, landscaping buffers along waterfronts, % sod coverage reduction	Additional ordinances were added to the text.
7/25/2023	Best Management Practices/Page 25	Question: are landscapers still required to take a class prior to licensing?	Yes, this is a state requirement for licensed landscapers.
7/25/2023	Stormwater Actions/Page 26	1st bullet – insure compliance through water testing	Compliance with FDACS BMPs are determined through a variety of methods, not only water testing.
7/25/2023	Stormwater Actions/Page 26	New Regulation? Increase the amount of stormwater retention in new development?	New development must provide stormwater treatment required by the state stormwater rule.
7/25/2023	Stormwater Actions/Page 26	typo – last line of stormwater actions	Revised the language of this action.
7/25/2023	Utilities/Page 30	Define non-beneficial surface water discharge	Additional information about what is meant was added to the plan.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
7/25/2023	OSTDS/Page 31	The definition of failure below is from the old Health DOH definition rather than the new FDEP definition of failure based on nutrient pollution: In addition, it is estimated an OSTDS has a 10% failure rate, requiring homeowners perform regular maintenance to prevent wastewater from backing up into a household, pooling of water in the drainfield and odor. Many homeowners may not be aware of the routine required maintenance or issues with their OSTDS until it is too late.	The sentence in the plan is referring to failure of the system to operate properly, which requires maintenance by the homeowner. Traditional septic systems do not provide for nutrient treatment, which is why FDEP is requiring that traditional systems in the IRL be connected to sewer or upgraded to nutrient removal systems.
7/25/2023	OSTDS/Page 31	Enhanced nutrient removal systems must achieve 65% rather than 50% removal according to HB1379.	This sentence was updated to clarify the requirements.
7/25/2023	OSTDS/Page 32	The IRC S2S study has gaps in areas of high priority. For example – the lagoon front properties in Sebastian have not been addressed due to the high cost of connection due to the line being a force main.	A plan for septic-to-sewer projects will be developed based on the results of multiple studies, the availability of infrastructure and funding.
7/25/2023	Community Development/Page 35	Prevent sprawl; Reduce upzoning	This would require an evaluation by Community Development at the direction of the Board.
7/25/2023	Sustainability and Resiliency/Page 36	Enforce Land Use Regulations – We get calls frequently from residents who feel that regulations are being broken. South Florida began a program called “1000 Eyes on the Bay” where they educated residents about proper procedures (fertilizer regs, construction practices, dumping, etc.) then there was a hotline where residents could take pics and file complaints anonymously. Public involvement in regulation compliance.	New goals, objectives and actions were added to include community engagement.
7/25/2023	Project List/Page 40	Rockridge – what is a backflow preventer?	A backflow preventer is a device installed on a pipe that allows water to only flow in one direction. In the case of Rockridge, the purpose would be to reduce tidal flooding effects.
7/25/2023	Project List/Page 41	Long Reach Removal of Water Lettuce – what are we waiting for? The equipment is already available	The long reach is used to remove water lettuce as necessary from the three canals, but each canal does not have one in place.
7/25/2023	Project List/Page 41	Baffle Boxes – How does the County service these and what is the frequency schedule	When baffle boxes are installed, there will be required maintenance.
7/25/2023	Utilities	S2S Phase I – this project has been competed for years (2018). How many homeowners are not connected? What is the cost per property? At one time the capital costs could be borrowed at low interest and repaid on property taxes? Is the County planning to apply for additional grants to assist? The riverfront properties are not included due to force main and are the most impactful.	Due to new regulations regarding traditional septic systems in the IRL basin, the County will continue to implement projects and look for funding to connect or upgrade septic systems.
7/25/2023	Utilities	The Clean Water Coalition is funding connections for low-income folks within the City where sewer lines are in place. This is a pilot program but seems to have broad appeal in the community and is attracting donations. This seems like an approach for the “Quick Connects” that the County has identified. The Quick Connects are not on the Project List.	An action was added to work with local organizations to provide funding for projects.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
7/25/2023	Utilities	I would like to see the latest ArcNLET report. When will that be public information?	The ArcNLET model report is under review by the County and will be made available once finalized.
8/3/2023	Islands/Page 29	Typo in first paragraph where "and" should be "than"	Corrected.
8/3/2023	Islands/Page 29	Most of the spoil islands in Indian River County are greater than one acre. DEP Map Direct has a GIS layer of surface area and management land ownership. Layer is RCP Island Assessment Program.	Updated the description of the spoil island size.
8/3/2023	Islands/Page 29	Opportunity for public involvement with debris removal projects on the recreation islands. Look on the FOSI website.	Information about this involvement was added to the plan.
8/3/2023	Aquatic Ecosystem Functions/Page 19	There is diamondback terrapin research in IRL. DEP can provide information on the graduate student doing the research.	Information was not received but can be added in future plan updates.
8/3/2023	Aquatic Ecosystem Functions	DEP can send data on birds in the IRL.	Information provided was included in the plan.
8/3/2023	Utilities	There is a recent study from FAU Harbor Brach about the amount of sewage going into the Preserve. The County should expand on septic-to-sewer in the plan.	Additional actions for septic-to-sewer were added to the plan.
8/3/2023	Hydrology and Hydrodynamics/Figure 7	Highlight the spoil islands that are open for recreation.	The figure shows recreational islands in green.
8/3/2023	Community Development	There should be an education campaign focused on HOAs and maintenance of their stormwater ponds.	A new action was added under BMPs to develop an education plan to expand the County's current outreach efforts.
8/10/2023	Utilities	Dr. Brian LaPointe's study on septic systems shows that more than 70% of the pollutants to the lagoon are from human waste. The Lagoon Management Plan has a list of septic-to-sewer projects, which are all conceptual. The County lacks the ability to get homeowner to connect to sewer. There are no funding mechanisms although the state has funding.	Additional goals, objectives, and actions were added related to funding needed for OSTDS projects.
8/10/2023	Utilities	Will the County just treat HB1379 as a mandate and make homeowners connect or will the County try to incentivize connecting? The County really needs to look at how to make those connections occur. There is funding available at the state level but it has to go through a county to the homeowners.	Additional goals, objectives, and actions were added related to funding needed for OSTDS projects.
8/10/2023	Utilities	The Indian River Land Trust and Clean Water Coalition have a program in Vero Beach to help lower income homes connect to STEP systems, which costs about $6,000 to $7,000 per home. The County should look into opportunities for a similar effort.	An action was added to work with local organizations to provide funding for projects.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/10/2023	Overall	The County is not on track to meet the total maximum daily load (TMDL) and this plan does not discuss progress towards the TMDL. The Indian River Lagoon is impaired for nutrients and we legally have to meet the TMDL. The County has met the reductions for the next milestone but there is no plan in the future. There will likely be a lawsuit in the future for noncompliance, similar to the Everglades and Lake Okeechobee. How do we put ourselves on a path for success? The work done to date is phenomenal with wastewater and stormwater projects but we need to be bold moving forward. We all love the lagoon and everyone is a yes for lagoon restoration.	Several of the under construction, designed, and conceptual projects will achieve nutrient reductions to help achieve the County's next BMAP milestone.
8/10/2023	Overall	We want to be thoughtful about this and it is going to be expensive. We will have to acknowledge that this will be expensive, and the County should not be afraid to say it will cost money. So many people rely upon lagoon. Until we have projects, the County will not be able to get money.	Additional details on the expense of implementing the plan and meeting regulatory requirements was added in the Plan Funding section.
8/10/2023	Overall	There was a recent study that showed about 6 million lbs/yr of TN enters the lagoon and a transition to native plant landscaping would reduce this load by about 2.4 million lbs/yr.	Information about native plant landscaping was added to the Water Quality, Land Use Changes, and Sustainability and Resiliency sections.
8/10/2023	Community Development	I encourage the County to have funding for an educator/outreach coordinator to tell people about lessons learned in other locations. Using native plants is something people can do and feel good about so the County can provide videos and presentations to get people passionate about these things. It is important to have a communication/engagement plan.	A new action was added under BMPs to develop an education plan to expand the County's current education and outreach efforts.
8/10/2023	Conservation Lands	There are goals and objectives at the beginning and then a list of actions at the end. I do not understand the relationship between the goals and objectives and the actions. I felt like the actions were not that strong and they are the end result.	The actions have been revised to better align with the goals and objectives.
8/13/2023	Overall	See nothing about immediate tasks. I fish the area from Wabasso to Vero, one of the problems that I see (it may be minor but adds up overtime} is the property maintainers blowing lawn clippings, plant trimmings and dropping palm fronds into the lagoon. I have observed areas covered with clippings, no effort by lawn mower to contain. Simple law with a hefty fine might help.	The development of an education and outreach plan is discussed in the LMP. Fines would require the implementation of an ordinance by the Board.
8/13/2023	Overall	Would like to see a section where funding would be provided to ORCA and FAU to support their monitoring of Lagoon conditions. They are local and have a very highly vested interest in the Lagoon.	The Water Quality section acknowledges the important monitoring by ORCA and FAU; however, funding from the County is not allocated to this monitoring.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/14/2023	Overall	The plan lacks clear, measurable targets for improving water quality. I would like to see specific goals for reducing nutrients, sediments, emerging contaminants etc. and a timeline for meeting those goals. Suggestion: Establish specific numeric targets for lowering nutrient, sediment, and contaminant levels in the lagoon on a 5-year interval. For example, reduce nitrogen levels by 50% by 2030. Set goals for restoring native vegetation and habitats (acres of seagrass, wetlands, mangroves, etc.) over the next decade. Aim for more ambitious pollution reductions than currently outlined in the BMAP.	Proposed metrics were added to the new Project Prioritization Framework section. General timelines for short- and long-term implementation were added to the plan actions in each of the key factors sections.
8/14/2023	Stormwater	The plan does not adequately address agricultural runoff. It mentions encouraging regulatory oversight and FDACS BMPs, but stronger requirements and enforcement are needed to reduce fertilizer and animal waste runoff from farms. Much of this could be preempted by state law, but we should do more if we can.	Oversight and enforcement for agricultural runoff are the responsibility of the state, and are outside the County's jurisdiction.
8/14/2023	Utilities	The plan lacks urgency on transitioning from septic to sewer systems. With 30,000 septic systems and a new state deadline, this should be a top priority to reduce nutrient loading. Suggestion: Create an ongoing fund to help low-income homeowners convert from septic to sewer. CWC and the Land Trust several other groups are attempting a public private partnership in COVB. See if there is something you can adapt to IRC.	An action was added to work with local organizations to provide funding for projects.
8/14/2023	Overall	Enforcement of environmental regulations seems weak. Fines for non-compliance should be increased to deter violations.	Oversight of some environmental regulations are the responsibility of the state. Additional fines under County regulations would require Board approval.
8/14/2023	Community Development	Public education efforts should go beyond just outreach events to funding for environmental education in schools and any other ways you can think of. Suggestion: Provide workshops, materials, and incentives for homeowners to adopt green landscaping practices. Launch social marketing campaigns on topics like properly disposing of pharmaceuticals, reducing use of plastics, and keeping pet waste out of waterways.	A new action was added under BMPs to develop an education plan to expand the County's current outreach efforts.
8/14/2023	Community Development	The plan is light on incentives for citizens to reduce their pollution impact - things like fertilizer-free landscaping, water conservation measures, green boating practices. Suggestion: Offer rebates for rain gardens, green roofs, rain barrels, and other green infrastructure on private property. Require more low impact development features like bioswales and permeable pavement in new construction.	The use of incentives can be explored as the LMP continues to evolve. Low impact development would require a Board approved ordinance.
8/14/2023	Water Quality	There should be more focus on emerging contaminants like microplastics, pharmaceuticals, and heavy metals. Also PFAS are a concern with the news lately out of Stuart and elsewhere.	A section on Emerging Contaminants is included in the Water Quality section.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/14/2023	Overall	Monitoring should be increased to better understand pollution sources, impacts, and trends. Increase water testing for emerging contaminants to identify pollution sources. Study muck composition and nutrient dynamics to target removal efforts. Research effects of climate change on lagoon hydrology and health. Partner with NGOs and IRSC to expand data collection efforts.	Actions to increase monitoring were included in the Water Quality and Organics and Sediments sections.
8/14/2023	Conservation Lands	More ambition is needed on conservation - acquiring available shoreline, restoring natural hydrology, establishing protected areas.	Additional goals, objectives, and actions were added for this key factor.
8/14/2023	Overall	Overall, I'd want to see stronger pollution reduction targets, more incentives over regulation, greater urgency on septic conversions, more public education, and increased conservation efforts. The plan has good elements but needs to be bolder and more innovative to achieve the level of lagoon restoration needed.	Additional details related to these items were added to the plan.
8/14/2023	Overall	How will the County define victory? What does the County think they need to do for the lagoon to be clean and when do they think it will get there?	Proposed metrics were added to the new Project Prioritization Framework section.
8/14/2023	Water Quality	There are a lot more chemical pollutants in the lagoon beyond nitrogen and phosphorus so we need to understand pharmaceuticals.	A section on Emerging Contaminants is included in the Water Quality section.
8/14/2023	Overall	We have grossly underestimated how quickly climate change is occurring. We need to look at all plan sections to see how they relate to climate change.	Additional details are included in the Sea Level Rise and Sustainability and Resiliency sections.
8/14/2023	Community Development	The public education portion of the plan is rather weak. The County has a good program for school kids but it does not go much beyond that.	A new action was added under BMPs to develop an education plan to expand the County's current outreach efforts.
8/14/2023	Utilities	There are a few places where the plan alludes to citizen responsibility to maintain septic systems. However, citizens only have to do what they are required to do. If appropriate, this plan should recommend stronger enforcement.	An action was added for this recommendation.
8/14/2023	Utilities	There are septic systems along the lagoon that are not within a subdivision so they are not prioritized for connection. A prime example is the waterfront property in Sebastian where there is already a force main down the road.	A plan for septic-to-sewer projects will be developed based on the results of multiple studies, the availability of infrastructure and funding.
8/14/2023	Utilities	The County does not have any information on quick connects but if they could add those details in the plan, there may be opportunities for funding.	A plan for septic-to-sewer projects will be developed based on the results of multiple studies, the availability of infrastructure and funding.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/14/2023	Marinas, Boats and Boat Ramps	The City of Vero Beach and the waters North to the Wabasso Bridge are well served by two pump out facilities – The Vero Beach City Marina and The Marina at Grand Harbor. In addition to dockside and in slip service the City also provides Mobile service to its mooring field. Quail Valley River Club has pump out for members and docked transients. We suggest that this comment be strengthened with more specificity. There is an urgent need for an accessible, minimum 7' draft, pump out station to service the boat traffic in the Sebastian River and Sebastian Inlet areas. Also, to the South of Vero Beach the next station is Fort Pierce. The Moorings community has over 700 boat slips and lifts but no pump out. ANY marine redevelopment or major project at the Moorings should REQUIRE the installation of an appropriately sized and accessible pump out station. Generally, any Marine Development involving the construction or major repair of docks should require in slip pump out.	An action was added to encourage an increase the number and distribution of pumpout facilities.
8/14/2023	Marinas, Boats and Boat Ramps	The current initiative to establish an Anchoring Limitation Area in the County, including proposed areas from The Cities Of Vero Beach and Indian River Shores should be vigorously pursued, and when granted strongly enforced. A new comment should be added to this effect.	An action was added to evaluate establishing ALAs.
8/14/2023	Overall	One of the best ways to address climate change is to plant trees since we are cutting down trees all over the place. Planting one tree does not cost much and they do a lot for the lagoon, air quality, and animals. We also need to think about reducing the size of lawns.	County ordinances were included in Land Use Changes
8/14/2023	Utilities	House Bill 1379 calls for conversion of all septic systems in the lagoon basin. A quick estimate of $20,000 per connection, which is probably low, means that just Indian River County needs $1.2 billion. If the plan does not comment on the amount of funding needed, that will be a big step back.	Additional information about costs were added here and in the funding portion of Section 1.
8/15/2023	Aquatic Ecosystem Functions/Fisheries	The fisheries section should be beefed up a bit. The plan seems to indicate that fisheries was not a huge problem in the lagoon. Red fish harvesting has been closed since September and sea trout are in decline.	Additional details were added to the fisheries section.
8/15/2023	Overall	Along the same line of thinking that Wayne Mills offered - we would be remiss if the gross funding shortfall is not mentioned in the Plan. We would also be remiss if the Plan doesn't mention the need for growth management.	Funding is discussed, as well as a list of funding sources.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/16/2023	Overall	Discussion came up about the need for metrics: goal and how to get there. IRC has dedicated 20% of 1cent sales tax to lagoon projects over the past 4? years. How has that money been spent? Types of projects, nutrient reductions? What is planned for current and future years? Will it be sufficient for us to reach our goal? Should we reconsider how much of the 1cent sales tax is allocated to the Lagoon Restoration? Perhaps 20% is not sufficient.	Potential metrics were added to Section 3 of the plan and metrics will continue to be developed as the plan is implemented.
8/16/2023	Overall	Do we know the % of nutrient loading coming from the various sources (the old pie chart)? This would help to determine how much emphasis to put on different types of projects?	This is mentioned in BMAP, FDEP estimates 60% is coming from groundwater.
8/17/2023	Stormwater	The Marine Resources Council (MRC) is dedicated to the preservation and restoration of the Indian River Lagoon (IRL) and we are pro-actively supporting efforts to correct past mistakes and to ensure a thriving future for our treasured lagoon. We congratulate Indian River County on an insightful, well written Lagoon Management Plan. It is an in-depth compilation of information on the IRL. MRC has advocated strongly for firm measures that will modify current development practices and standards that are the root cause of the IRL's near devastation. We believe that Low Impact Development/Green Infrastructure (LID/GI) is essential to the future of our waterway. We urge you to be more aggressive and do more than just “promote” LID. It is a site - specific development strategy that will not only reduce polluting impact on the lagoon but also reduce the cost of development. A number of Florida counties have produced detailed LID Manuals and have been effective in applying LID strategy on both commercial and government projects. MRC will hold the third of three LID Conferences on October19 & 20, 2023 in Titusville. Previous conferences were sold out and highly acclaimed. We urge you to register for and attend this conference. Details are given on the MRC website savetheirl.org.	LID is included in Land Use Changes

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/17/2023	Stormwater	While getting to know my neighbors and learning more about our Association I heard of the drainage problems that have been occurring for years at the east end of 16th Street & 3rd Ave. I have seen firsthand the blockage that was created by the development of the Bridgewater Complex on Indian River Blvd. Where there used to be a culvert connecting the main canal on 16th Street to the 3rd Ave smaller canal, which allowed constant flow of water out to the Indian River Lagoon, now is a stagnant mud filled nonmoving "swamp". There were many sightings of manatees, dolphins, otters, and an abundance of fish. Now nothing is living in this part of the canal due to the lack of moving water. I was able to kayak through this stagnant water only to be besieged by mosquitoes and the stink of the brown water. The thought of the homeowners, neighbors and now friends who live on 3rd Ave who deal with the smell, mosquitoes and the flooding caused by this blockage of the once open canal is very troubling. I have learned that many residents and counsel committee members have proposed the reopening of this section of the canal/ditch. I can only pray that our beloved community is granted the right to have this section of the canal reopened so our residents can again enjoy a clean, environmentally safe waterway to enjoy the benefits of this canal that leads out to the open Indian River Lagoon.	The concern was relayed to the appropriate parties within the County.
8/17/2023	Overall	Metrics: What percentage of the N is coming from septic systems? What percentage of the septic systems will be connected in the first year? quick connects? Projects? How much load will that reduce? Goal for the following years?	Potential metrics were added to Section 3 of the plan and metrics will continue to be developed as the plan is implemented.
8/17/2023	Organics and Sediments/Page 12	Ways to help prevent the accumulation of muck include keeping a native buffer along IRL shorelines to reduce erosion, reduce the use of fertilizer and keep lawn trimmings and plants out of canals and drains. WHY IS THIS NOT UNDER ACTIONS?	An additional action was added to implement measures to reduce muck sources from entering the Lagoon.
8/17/2023	Aquatic Ecosystems Functions and Habitat Use Actions/Page 21	The following actions are recommended to help protect aquatic ecosystems functions and habitat use in IRC's portion of the IRL: WHY NOT INCLUDE HERE emerging contaminants, AQUATIC POLLUTION?	Actions related to emerging contaminants are included in the Water Quality section.
8/17/2023	Stormwater Goals and Objectives/Page 23	Educate the public on point and nonpoint sources of stormwater runoff including what they can do to prevent nutrients and contaminants from entering the IRL. Why is this not part of the projects? Stormwater educator and FFL not doing it. ***Connect HOA's in utilities to natural systems filtration by native plant landscaping.	A new action was added under BMPs to develop an education plan to expand the County's current outreach efforts.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/17/2023	Annual Rainfall/Page 23	IRC does not maintain the three main relief canals or control water flow through them. The canals are the property of IRFWCD who, through an agreement with IRC, allows the County to pull water from the canals for the three stormwater parks and mechanically harvest water lettuce. It is important to maintain this partnership for the benefit of the IRL. WHY IS THIS A SEPARATE ENTITY? WHAT W/B THE COST SAVINGS FOR CONSOLIDATING UNDER IR COUNTY?	IRFWCD was established in 1919 for the purpose of managing these canals and operates as a designated water control district under Chapter 298, Florida Statutes. IRC coordinates with IRFWCD and owns water quality improvement projects along these canals; however the County legally does not have responsibility for these canals.
8/17/2023	Best Management Practices/Page 25	Atmospheric deposition of nitrogen is an important nutrient input to the lagoon. In the past, most atmospheric deposition was mainly in the form of nitrate. This may be shifting to ammonium in some locations. Why and how? Thankfully, data suggests that atmospheric deposition of nitrogen is reducing thanks to cleaner cars and better air pollution regulatory standards. ADD THAT Atmospheric deposition includes the chemicals we apply to yards that rain back down on us.	Regulations on atmospheric nitrate from emissions have shifted the variation of atmospheric nitrogen. This has been discovered through various studies conducted with the greatest shift seen in the farming belt.
8/17/2023	Community Development/Page 35	Goals and Objectives: Develop education and outreach on the use of native vegetation as a buffer and flood prevention. Why is this not part of the projects?	Additional actions related to this comment are included in the Water Quality, Land Use Changes, and Sustainability and Resiliency sections.
8/17/2023	Overall	The most glaring omission in this draft Plan is a section on how improvement or recovery will be assessed to determine if progress is being made. All too often, recovery or restoration plans have no metrics that are monitored to assess if efforts are working. If efforts are not assessed, how do we gauge if they are successful or need redirection? Please include a section on how progress will be monitored and assessed. I would offer that at a bare minimum, nitrogen, phosphorous, and seagrass acreage should be used as basic metrics for this.	Potential metrics were added to Section 3 of the plan and metrics will continue to be developed as the plan is implemented.
8/17/2023	Aquatic Ecosystem Functions/Fisheries	Under Aquatic Ecosystem Functions beginning on page 16, I have several comments. First, the loss of most of the salt marsh habitat in Indian River County was not stated or adequately addressed. Salt marsh is an integral part of the IRL ecosystem and diversity of habitats is an important component. The IRL in our area has become a monoculture of mangroves, largely due to sea level rise and mosquito impoundments. I recommend that creation of salt marsh habitat should be specifically mentioned as an action. I would also recommend removing mangrove nurseries as an action, since we have absolutely no shortage of mangroves.	The actions for this key factor were revised.

Date	Section/Page #	Comment	Response
8/17/2023	Aquatic Ecosystem Functions/Fisheries	The section on Fisheries (page 21) states that FWC indicates fish "stocks appear stable". As a inshore fishing guide in Vero Beach for the last 28 years and having participated in the FWC Independent Fisheries Monitoring Program, I can tell you the State is incorrect. Ask any local fisherman or guide that has fished here over the last ten to fifteen years. By my estimates we have lost 85% of the number of fish in our area of the IRL in the last fifteen years. Since 70% of Florida's fisheries depend on seagrass meadows, and we know how much they have declined, how can our fish stocks be "stable". The FWC just closed redfish permanently in the IRL and they are currently reviewing more restrictive snook regulations. Please remove any reference to fish stocks in the IRL being "stable", or redefine stable as "we really don't know".	Additional details were added to the fisheries section.
8/17/2023	Aquatic Ecosystem Functions/Seagrass	Lastly, on page 21 the Plan makes the statement that "areal coverage of seagrass in IRC has been sufficient to maintain the current manatee population". That is a great way to try and cover the County "butt" in case someone sues over manatee deaths, but impossible to legitimately make that statement. You would have to know how many manatees use IRC (impossible because they migrate), and as a former US Fish and Wildlife Service biologist here in Vero Beach (1990-1995), I would say you cannot possibly know that. What we do know is that poor water quality has killed a huge percentage of our IRL seagrasses and over a thousand manatees have starved to death as a result of it. Please remove from the Plan the claim quoted in the first sentence of this paragraph.	This sentence was revised to clarify the information presented.
8/17/2023	Hydrology and Hydrodynamics	"Reduce freshwater inputs to the IRL" is stated as a recommended action in several areas of the draft Plan. It is stated in the Seagrass section that recovery will depend on "continued improvement to water quality." I recommend that all areas referencing reduced freshwater flows would be better stated if they read "Clean and reduce freshwater inputs to the IRL." It should also be noted that flows should not be reduced too much, as freshwater inputs are a valuable part of the IRL's functionality as an estuary.	The language for this action was refined. Both reducing some of the freshwater contributions and nutrient inputs are important.

Date	Section/Page #	Comment	Response
8/18/2023	Community Development/Page 36	One way to involve the community is through the development of a sustainability action plan setting green initiative goals and implementation periods. In conjunction with the development of a sustainability action plan, community outreach and education regarding IRL initiatives and restoration will be necessary for long-term success." Green initiative goals should include HOA Developers, HOA Management companies and the residents residing within. It should be required to not only have a Conservation area, but that it must be Native Florida plantings. The requirement should also include Landscaping of HOA's to use less lawn/sod areas and more natural areas with Florida Native plantings. The reason is clearly to reduce water usage and decrease pesticide and fertilization, thereby decreasing toxic runoff into the canals. Eagle Trace HOA has initiated a Florida native plant Conservation area. We would be interested in promoting this plan to other HOA's and private homeowners.	Additional actions related to this comment are included in the Water Quality, Land Use Changes, and Sustainability and Resiliency sections.
8/18/2023	Overall	Sorry I was unable to make the meeting on the 17th, I am concerned about this blockage that has been created by the Bridgewater Complex off 16th/17th and Indian River Blvd. The blockage on 16th Street and 3rd Ave has created a disgusting smells, A Huge Breeding Ground for mosquitoes and kills our wildlife and could harm even more if not taken care of soon. This has been approved see to be done and NOTHING WAS DONE? WHY? Our waters are blocked for our Manatees and Dolphins and Fish and just all nature in general. It needs to be dredged and cleaned out of all debris that has been trapped due to no movement and stagnate nature. The parking lot of Bridgewater is draining into our water way and all the grease and gasoline from all the cars exhaust and oil pans and from the parking lot decomposition is also killing our nature. This is also causing more flooding to our subdivision as the water has no where to go as the flow has been cut off buy this blockage. Please help get this taken care of our nature preserve needs this to survive. Our homes need to survive the flooding caused by this blockage as well. It is and has been a detriment to our livelihoods and our nature conservation.	The concern was relayed to the appropriate parties within the County.
8/20/2023	Water Quality Actions/Page 10	WHY IS THERE NO ACTION IN THE ACTION PLAN FOR ADDRESSING CONTAMINANTS PER THE SECTION ABOUT EMERGING CONTAMINANTS JUST BEFORE THE ACTION SECTION?	New goals, objectives and actions were added to include this item.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/20/2023	Stormwater/Page 23	Educate the public on point and nonpoint sources of stormwater runoff including what they can do to prevent nutrients and contaminants from entering the IRL. WHY IS THIS NOT ONE OF THE PROJECTS? Stormwater educator and UF FFL not doing it. Check the number of citations for violations of the fertilizer and irrigation ordinances. It is up to the county to enforce state and WMD regs, including in HOA's. Specific education should be to utilize natural systems filtration by native plant landscaping.	An action was added to develop a plan to expand the County's current public education and outreach efforts.
8/24/2023	Overall	Generally, IRLT staff feel that there should be a more robust link between the goals/objectives at the beginning of each section and the actions at the end. In addition, some of the actions seem vague and would benefit from more specifics about methods or strategies.	The goals, objectives, and actions were modified and expanded upon throughout the plan.
8/24/2023	Introduction/Page 1, Table 1	The description for Sea Level Rise is limited to inlets and should be expanded to include potential impacts on natural areas, undeveloped shorelines, migration of rare and important habitats (e.g. salt marsh), cultural and historic resources and manmade infrastructure (e.g. roads, homes, etc.).	The Sea Level Rise description in this table was clarified and actions related to sea level rise and resiliency are included in the Ecosystem Functions and Habitat Use and Sea Level Rise sections.
8/24/2023	Section 1.C. Plan Organization/Page 6	As noted, multiple IRC divisions may share duties among some factors and projects. We suggest identifying secondary divisions in the Project List in Section 7 to make clear who is responsible for carrying out those projects.	The responsible department is included in the project list.
8/24/2023	Water Quality Actions/Page 11	We note that the action "reduce freshwater inputs to the IRL" is somewhat vague and would benefit from describing possible methods to accomplish this action. This specific action is also repeated in the Harmful Algal Blooms Actions and the Hydrology and Hydrodynamics Actions.	Clarified that projects should be implemented to reduce untreated freshwater inputs.
8/24/2023	Seagrasses/Page 16	Revision is needed in the phrase in the first paragraph "SJRWMD began mapping seagrass the IRL…". Revision is needed in the phrase in the second paragraph "Seagrass loss was accelerated in 201, 2012 and 2016…". The IRL National Estuary Program (IRL Council) is currently engaged in a significant effort to establish five seagrass nursery "hubs" throughout the Lagoon watershed in order to build capacity for growing seagrasses for future restoration efforts. While none of the "hubs" lie within IRC, they may supply seagrasses for restoration projects within IRC and we feel it is worth mentioning in this subsection.	The sentence was corrected and a note was added about the development of seagrass nurseries.
8/24/2023	Suspension Feeders/Page 19	The IRLNEP is also involved in clam restoration efforts, which may be worth mentioning in this subsection.	A sentence was added to note this.
8/24/2023	Megafauna/Page 21, 1st Paragraph	Revision is needed for the sentence "However, sea turtle health in the IRL concerning."	This sentence was revised to try and clarify the meaning.
8/24/2023	Marinas, Boats and Boat Ramps Actions/Page 23	In the last bullet, consider specifically identifying the law enforcement agencies responsible for patrolling the public waters.	All divisions of law enforcement are responsible for patrolling the IRL and are able to enforce regulations.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/24/2023	Stormwater Actions/Page 27	Consider adding an action to increase enforcement of stormwater regulations and penalties for violations.	The stormwater division handles enforcement.
8/24/2023	Terrestrial Ecosystem Function and Habitat Use, 1st Paragraph/Page 28	Note that IRC began to acquire conservation lands and habitats prior to 2004 with the use of the 1992 environmental lands bond funds. Please add after the part about County conservation lands and its 12 miles of shoreline: "Additionally, the Indian River Land Trust (IRLT), a private, nonprofit conservation organization, has acquired dozens of critically important properties to establish 12 conservation areas totaling 1,200 acres and 12 miles of shoreline. Some adjoin IRC conservation lands; two public trail systems occur on conservation lands jointly managed by IRC and IRLT, Oyster Bar Marsh and Lagoon Greenway."	The suggested text was added to the plan.
8/24/2023	Islands, 1st Paragraph/Page 29	Suggest deleting the phrase “a habitat conservation-based nonprofit located in IRC” since it would be described above on page 28 per the previous comment.	Sentence was revised.
8/24/2023	Conservation Lands Actions/Page 30	The actions should encompass the entire IRL watershed, not just the immediate shoreline. We suggest adding actions that address: 1) protection of wildlife habitat throughout the watershed; 2) shoreline buffer zones; and 3) educational and recreational opportunities.	Additional actions were added for this key factor.
8/24/2023	Utilities Actions/Page 35	We suggest adding an action to address reduction of the impacts of biosolids application on water quality in the IRL and its tributaries.	Added a new action.
8/24/2023	Community Development Goals and Objectives/Page 36	Item C needs revision as it does not seem to property convey the intent of the goal.	This item was revised to clarify the intent.
8/24/2023	Community Development Actions/Page 37	We suggest adding an action to address shoreline buffer zones per Goal C.	An action was added under the Sustainability and Resiliency section.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/25/2023	Projects - Rockridge/Pg. 41	Due to being a 30-year Rockridge property owner, a Rockridge Property Owner's Association (RPOA) past president/secretary/board member and a community activist after the 2004 hurricanes, I was asked by neighbors to provide historical information to their board as well as attend your August 17th meeting with their current board secretary. Basically, Rockridge neighbors are hoping that you will consider looking further into Rockridge ditch/canal system. Particularly in the reconnection of the 16th Street Ditch and 3rd Avenue Canal to improve water flow/drainage as well as shoreline reinforcements and sediment removal to enhance marine habitat, protect wildlife and improve navigation. The reconnection of the waterways along with maintenance by DOT of the ditch were subjects of a 2006 Resolution (2006-110) supporting the Rockridge neighborhood. Within months after the resolution passed, the reconnection was put on hold for the study of a Weir system. According to minutes from RPOA board meeting on June 2, 2008, they were informed that the system was not feasible. The above information was discussed with Matt Shelton, Project Manager/Tetra Tech. The RPOA board will be emailing him documentation in hopes that this long-standing issue may find a way of being addressed that will be beneficial to all. Please note that the meeting held at the IG Center was informative and quite enjoyable with Tetra Tech folks and IRC staff working well together. On behalf of my neighbors, we appreciate all that Indian River County has done and continues to do for our historic little eclectic community by the river. Thank you for listening. We are here.	The plan includes a proposed project in Rockridge to add a back flow preventer. The County is currently working on evaluating muck deposits in this portion of the Lagoon and may identify a project to address the sediment in Rockridge, if the muck study identifies this as a priority area.
8/29/2023	Introduction/Page 1	The Introduction establishes the baseline of history, geography, current conditions, funding and plan organization. Fairly sterile discussion on all points and fails to really hit home the rationale and need for a lagoon management plan…Nutrient loading is killing the IRL. We need to speak plainly about the issue of nutrient loading which is currently driving the lagoon into collapse. A simple introductory paragraph could assist the reader into what the issues are and why it is important to them. As an example: a. The Indian River Lagoon provides over $7.6 billion in economic value to the region, however, the lagoon is threatened by decades of nutrient loading which has resulted in harmful algal blooms, seagrass losses, reduced fisheries, reduced property values and public health risks. This Plan is designed to address risks to the lagoon within Indian River County and identify solutions to reduce these risks to maintain a healthy and productive lagoon for Indian River County.	This is discussed in the BMAP key factor, prioritizing projects and metrics.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/29/2023	Current Conditions/Page 5	The Authors spend quite a bit of time in an obtuse discussion and history of the TMDLs and BMAP process, apparently in an effort to create confusion relating to the current load reduction requirements and methodologies. This was disappointing to read since the plain fact that nutrient loading has caused the decline in water quality, seagrass habitat and our fisheries. The simple take-away here should be what the current commitment is by the County under the BMAP and our progress toward achieving interim and long-term milestones. A more robust discussion on the TMDLs and BMAP should be incorporated in the “Water Quality” section.	The details about the TMDLs and BMAPs were removed from this section and moved into the BMAP key factor section.
8/29/2023	Water Quality/Page 8	1) The authors generically establish the risk to water quality being attributed to hardening of the coastline, runoff of lawn waste (fertilizer, sediment, pesticides, and herbicides), and increased wastewater discharge volume and strength. The Plan should be more specific in identifying the site specific issues facing Indian River County. The Plan should include a nutrient load map depicting sources and quantification of Nitrogen and Phosphorous loads within Indian River County into the lagoon. It is essential that County leadership understand the sources and quantification of nutrient loads in order to prioritize solutions.	Time constraints will not allow for inclusion of a map in the current LMP, but can be completed prior to the first revision.
8/29/2023	Water Quality/Page 8	2) This plan is specific to Indian River County and should be “place based” using the data sets available to the County. In absence of site specific data, published data identifying risks should be cited. One such resource is the recent FAU study attributing human sewage released from septic systems during wet seasons is the cause of an estimated 79 percent of the nutrient load in the Lagoon.	The need for septic conversion is discussed in the plan, noting septic systems as a source of nutrients to the IRL. The FAU study acknowledges loading from septic system with the greatest impact in the NIRL.
8/29/2023	Water Quality/Page 8	3) TMDLs are a regulatory requirement for Indian River County, and the Plan discussions is silent on how specific projects will contribute to meeting regulatory requirements of meeting the County’s BMAP nutrient reduction obligation. a. This is quite disturbing since this is the only “obligation” of Indian River County associated with the Lagoon Management Plan. b. Failure to achieve TMDLs can result in regulatory action as well as citizen lawsuits to compel the county to act. c. In-water restoration efforts are unlikely to succeed (see Martin County oyster restoration efforts/failures) until water quality targets are met.	The County has and continues to pursue projects to meet TMDL requirements in the BMAP. Projects listed in the LMP are designed to reduce nutrient loading and meet BMAP requirements. This topic is covered under BMAP and the project list.

Indian River County Lagoon Management Plan Comments

Date	Section/Page #	Comment	Response
8/29/2023	Water Quality Actions/Page 11	The authors suggest the following “actions” to address water quality: Improve wastewater treatment facilities and eliminate disposal to the IRL; Continue education and outreach for pollution reduction including the fertilizer ban; Continue to encourage regulatory oversight agencies to improve and ensure proper BMPs are in place for agricultural facilities; Continue to improve BMPs for County facilities; Reduce freshwater inputs to the IRL. 1) It is unexplainable why OSTDS Conversions are not included in this action plan based on the following: a. FAU Study reporting that 79% of the wet weather nutrient load is from OSTDS; b. DEP BMAP recommendations include the need to promote onsite sewage treatment and disposal systems (OSTDS) enhanced nitrogen treatment or sewer connections; c. According to DEP, over 9 lbs of Nitrogen load are eliminated per person for each OSTDS conversion. With an average household of 2.5 persons, this equates to 25lbs of nitrogen reduction per conversion; d. The Florida Department of Health has identified 30,467 OSTDS in IRC; e. If half of these systems were converted, this would result in ~375,000 lbs of nitrogen removed from the lagoon annually.	Additional actions were added throughout the plan including actions in the OSTDS section for removal and upgrades.
8/29/2023	Onsite Treatment and Disposal Systems/Page 31	1) Good general discussion on OSTDS, but lacking in identifying solutions and strategies. The discussion on Senate Bill 1632 was factual, but lacked any dialogue on how the County plans to implement the requirement to convert over 30,000 OSTDS by January 2032.	Additional actions were added to the OSTDS section.
8/29/2023	Onsite Treatment and Disposal Systems/Page 31	2) More discussion needs to be provided on the last sentence of this section which reads: “While septic-to-sewer conversions in high priority areas are important to reduce nutrient loading to the IRL, it is necessary to point out the impact this may have on the County’s advanced wastewater treatment facilities” a. The County needs to be transparent that additional wastewater treatment facilities (or capacity expansion of existing wastewater treatment facilities) is needed to address OSTDS, growth and meeting the County’s nutrient load reduction requirements.	Additional details were added to the text and a new action was added to evaluate treatment facility capacity.
8/31/2023	Plan Funding/Page 6	pg 6 Florida Inland Navigation District grant programs are a funding source for boating access infrastructure projects. I don't believe this is the type of funding project section B is referring to. It may be best to remove FIND from the listed funding sources. Boating access and infrastructure grants: FIND Grant Program, Cooperative Assistance Program FIND	The list of FIND funding sources was refined.