

**APPENDIX C: BEST PRACTICES AND PLANS**





## ***Transportation Resiliency Master Plan***

***Data Collection and Analysis Technical Memorandum***

***Appendix: Best Practices and Plans***

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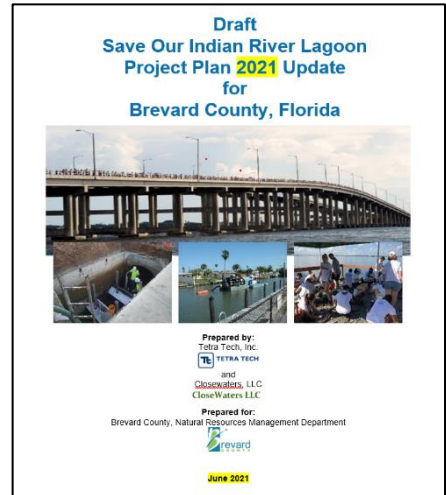
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# 1.1 Brevard County

## 1.1.1 Save our Lagoon Plan

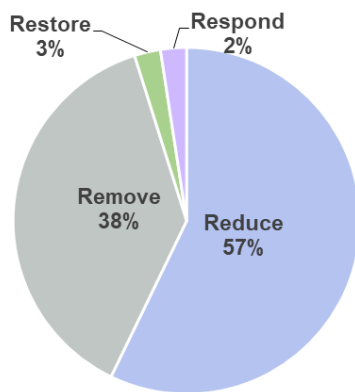
The Brevard County *Save Our Lagoon Plan* identifies specific projects with expected costs and effect on nitrogen and phosphorus loading in the Lagoon. Projects are primarily prioritized by the cost per pound of nitrogen or phosphorus removed. The *Save Our Lagoon Plan* estimates that the present value of restoring the Lagoon is \$6 Billion compared to the cost of \$300 Million. The Save Our Lagoon Plan is funded through a Brevard County 0.5 cent sales tax, which provides about \$50 Million of funding annually. Since the 2017 original plan, funding has been reallocated to diversify the approaches and projects being considered, from being primarily focused on muck removal to also considering educational campaigns, wastewater upgrades, and stormwater treatment.



Projects are categorized as **reducing** pollutants, **removing** the accumulation of muck, **restoring** water filtering oysters and lagoon ecosystem services, and **responding** to change. The funding allocated to each of these project categories is shown in **Figure 1**. The Save Our Lagoon Plan considers sources, solutions, and effects for each sub-lagoon. The division of the Indian River Lagoon into sub-lagoons is shown in **Figure 2**.

The Save Our Lagoon Plan identifies the key areas of economic value at risk as:

- *Tourism and Recreation – due to reduced ecotourism;*
- *Property Value – due to reduced waterfront property value related to fish kills and algal blooms;*
- *Commercial Fishing – due to decreasing healthy fish populations; and*
- *Healthy Residents and Tourists – due to pathogens migrating from septic systems into waterways.*



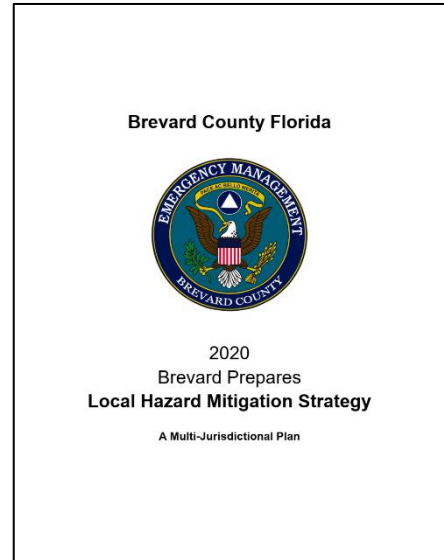
**FIGURE 1: PERCENT OF FUNDING ALLOCATION FOR REDUCE, REMOVE, RESTORE, AND RESPOND PROJECTS**



**FIGURE 2: LOCATIONS OF SUB-LAGOONS**

## 1.1.2 2020 Local Mitigation Strategy (LMS)

The Brevard County Local Mitigation Strategy is intended to provide a framework to identify potential hazards and decrease the vulnerability of the community to future disasters. The LMS includes a summary of potential hazards, an assessment of potential hazards, and the identification of critical facilities. The hazards presented in this memo that may have an impact to the transportation system are summarized in **Table 1**. Projects are identified to reduce identified vulnerabilities. Critical facilities are primarily focused on specific structures or tools, for example fire stations or sewer lift stations. While impacts to the transportation system were not directly stated in the report, the following table relates the hazards to potential impacts to transportation as inferred by the project team.



**TABLE 1: HAZARDS TO BREVARD COUNTY**

Hazard	Key Effects	Potential Impact to Transportation System
<b>Hurricane/Storm Effects</b>	<ul style="list-style-type: none"> <li>• <i>Flooding</i></li> <li>• <i>Greatest threats are storm surge along the barrier islands, wind damage, and inland flooding</i></li> <li>• <i>Evacuation of large parts of the east side of the county</i></li> <li>• <i>Disruption of power and telecommunications</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Blocked roads from debris</i></li> <li>• <i>Flooded roads, especially in low lying areas</i></li> <li>• <i>Disruption of ITS/Signals</i></li> <li>• <i>High traffic volumes due to evacuation</i></li> </ul>
<b>Sea Level Rise</b>	<ul style="list-style-type: none"> <li>• <i>Storm surge</i></li> <li>• <i>Coastal flooding</i></li> <li>• <i>Inland flooding due to increased rainfall periods</i></li> <li>• <i>Wildfire exacerbated by vegetative fuel growth in periods of higher rainfall and burn risk in drier periods</i></li> <li>• <i>Saltwater intrusion</i></li> <li>• <i>Coastal erosion</i></li> <li>• <i>Greatest impact to the west side of the barrier islands along the canals and the low-lying parts of Merritt Island</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Flooded roads, especially in low lying areas</i></li> <li>• <i>Disruption of ITS/Signals with underground infrastructure</i></li> </ul>



<b>Hazard</b>	<b>Key Effects</b>	<b>Potential Impact to Transportation System</b>
<b>Drought</b>	<ul style="list-style-type: none"> <li>• <i>Wildfire exacerbated by vegetative fuel growth in periods of higher rainfall and burn risk in drier periods</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Road closures due to smoke/wildfire</i></li> </ul>
<b>Severe Winter Storms</b>	<ul style="list-style-type: none"> <li>• <i>Unlikely damage to electric power distribution</i></li> <li>• <i>Icy road conditions</i> <ul style="list-style-type: none"> <li>• <i>Agricultural impact</i></li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <i>Disruption of ITS/Signals</i></li> <li>• <i>Icy road conditions</i></li> </ul>
<b>Wildfire</b>	<ul style="list-style-type: none"> <li>• <i>Greatest risk are areas where development has occurred or is occurring at the edge of previously undeveloped vegetated areas, prevalent between I-95 and US 1</i></li> <li>• <i>Spring 2011, Iron Horse Fire forced the closure of I-95, SR 442, and SR 46</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Road closures due to smoke/wildfire</i></li> </ul>
<b>Tsunami</b>	<ul style="list-style-type: none"> <li>• <i>Jurisdictions within danger zone include: Cape Canaveral, Cocoa Beach, Satellite Beach, Melbourne Beach, Indian Harbour Beach, Indianalantic, and Unincorporated Brevard.</i></li> <li>• <i>High risk to tourism economy, businesses, and housing within Tsunami range</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Blocked roads from debris</i></li> <li>• <i>Flooded roads, especially in low lying areas</i></li> <li>• <i>High traffic volumes due to evacuation</i></li> <li>• <i>Disruption of ITS/Signals</i></li> </ul>
<b>Space Weather/ Geomagnetic Storms</b>	<ul style="list-style-type: none"> <li>• <i>Damage to satellites, other high tech systems, radio blackouts, GPS interruptions</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Disruption of ITS/Signals</i></li> </ul>
<b>Dam/Levee Failure</b>	<ul style="list-style-type: none"> <li>• <i>127 miles of levees in the upper basin, of which 92 miles are federal flood protection levees and 35 miles are District levees. Approximately 30 miles of levees lie within Brevard County</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Flooded roads, especially in low lying areas near dam failure</i></li> </ul>
<b>Communications Systems Failure</b>	<ul style="list-style-type: none"> <li>• <i>Communications systems failure</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Disruption of ITS/Signals</i></li> </ul>
<b>Prolonged Utility Failure</b>	<ul style="list-style-type: none"> <li>• <i>Electricity generation shortfalls compared to demand</i></li> <li>• <i>"Transportation disruption"</i></li> <li>• <i>Electrical power outage</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Disruption of ITS/Signals</i></li> </ul>
<b>Terrorism</b>	<ul style="list-style-type: none"> <li>• <i>Unknown</i></li> <li>• <i>Facility specific impact</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Unknown</i></li> </ul>
<b>Transportation Accidents</b>	<ul style="list-style-type: none"> <li>• <i>Property damage</i></li> <li>• <i>Traffic, delay</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Traffic, delay</i></li> </ul>

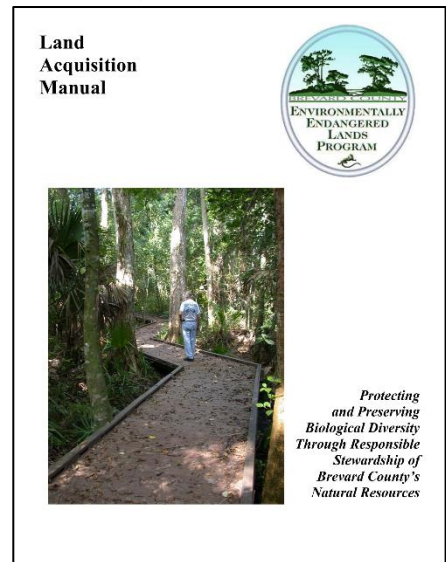
### 1.1.3 Environmentally Endangered Lands (EEL) Program

The Brevard County EEL Program partners with federal, state, and local agencies to protect natural resources through the management of EEL sanctuaries.

The EEL Program Land Acquisition Manual outlines the identification, feasibility, and acquisition processes used in the EEL Program. The EEL Program first determines high priority sites based on environmental criteria. These sites are reviewed to determine management requirements and expected cost for management. Subsequently the feasibility of acquisition is considered.

The EEL Program developed the Sanctuary Management Manual to guide management decisions for individual sanctuary sites managed by the EEL Program and other agencies. The Sanctuary Management Manual establishes the primary goal of the program as conservation, with public access and passive recreation available where possible.

Each sanctuary is assigned an expected level of use, ranging from education centers to no public access. The EEL Program is focused on ecosystem management and considering big picture needs, specific conservation principles for the EEL Program are identified.

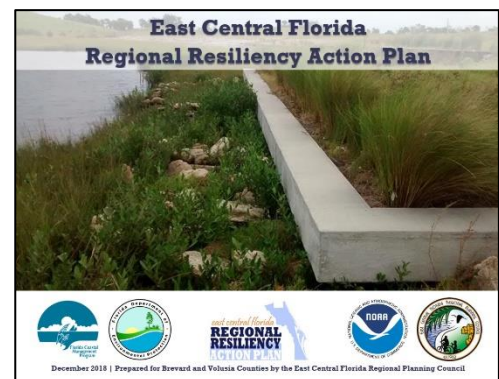


## 1.2 East Central Florida Regional Planning Council (ECFRPC)

### 1.2.1 Regional Resiliency Action Plan

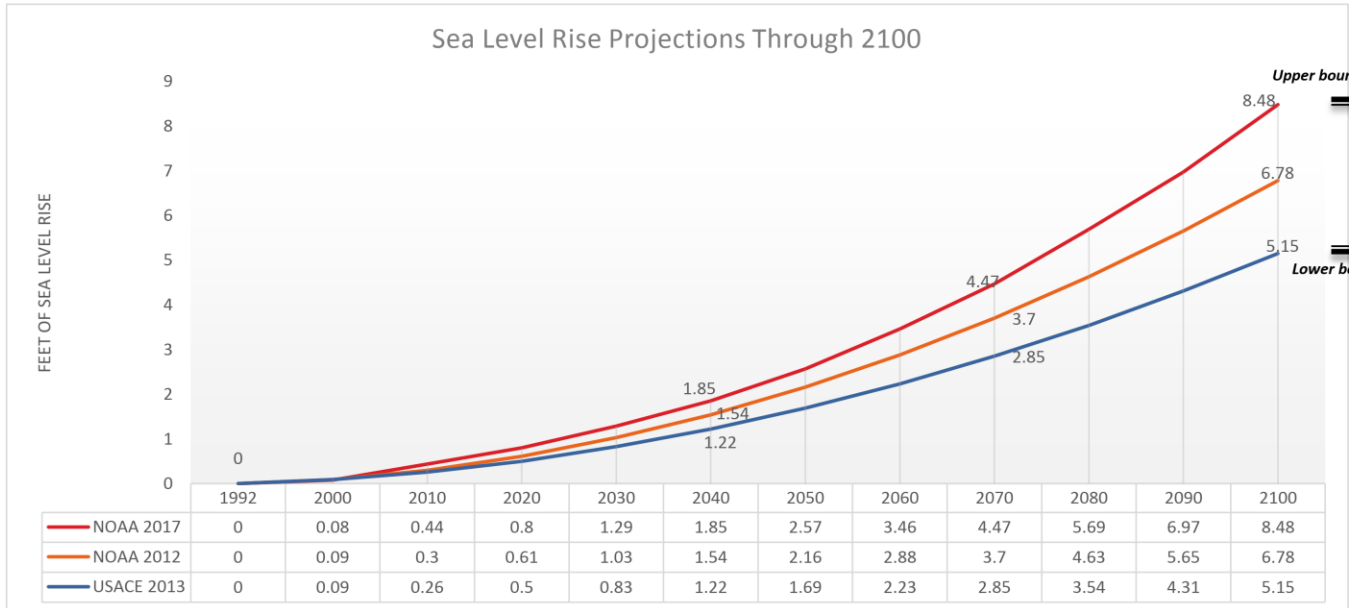
The goal of the Regional Resiliency Action Plan (RRAP) was to increase the ability of local and regional stakeholders to implement resiliency and climate adaptation strategies. The framework for the RRAP is based on the 100 Resilient Cities program. The plan considers a variety of resiliency aspects and extends to a variety of sectors, including infrastructure, using a shock and stressor approach. The plan identifies action items that can be taken at various agencies, organizations, and between partners.

The plan focuses on sea level rise as the primary stressor affecting Brevard County, specifically considering resulting inundation. The plan considers the social vulnerability of counties within Brevard County, which considers the resilience of a community confronted by external stressors.



The RRAP recommends considering a range of projected rates of sea level rise, including a lower range of 5.15 feet by 2100, defined by the 2013 USACE High model, and an upper range of 8.48 feet by 2100, defined by the 2017 NOAA High model. The RRAP recommends short term projects to consider sea level rise impacts

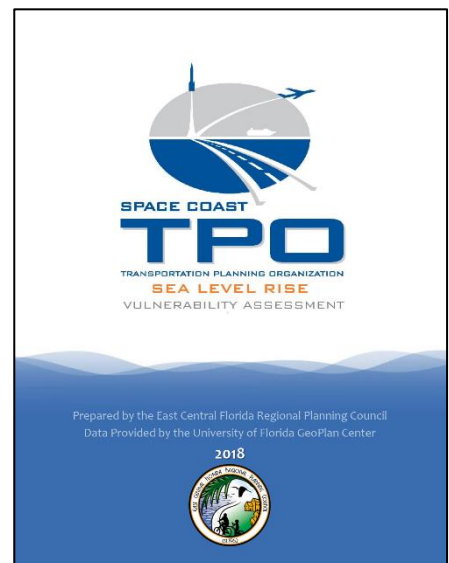
to 2040, medium term projects to consider impacts in 2070, and long term projects to consider impacts to 2100. The sea level rise projection range is shown graphically in **Figure 3**.



**FIGURE 3: RECOMMENDED BOUNDS FOR SEA LEVEL RISE**

## 1.2.2 Space Coast Transportation Planning Organization Sea Level Rise Vulnerability Assessment

The Sea Level Rise Vulnerability Assessment considers assets that contribute to transportation functionality within Brevard County. The Vulnerability Assessment considers inundation of transportation facilities. **Figure 4** shows the hurricane evacuation routes within Brevard County that will be inundated by sea level rise. Impacts to Port Canaveral, Cape Canaveral Air Force Station, Patrick Air Force Base, and NASA are anticipated to result in large scale economic hardship for the community. Stormwater management is identified as a problem that will be exasperated by rising sea levels. A series of next steps are identified for SCTPO to undertake, including turning SR A1A into a “Green Street”.



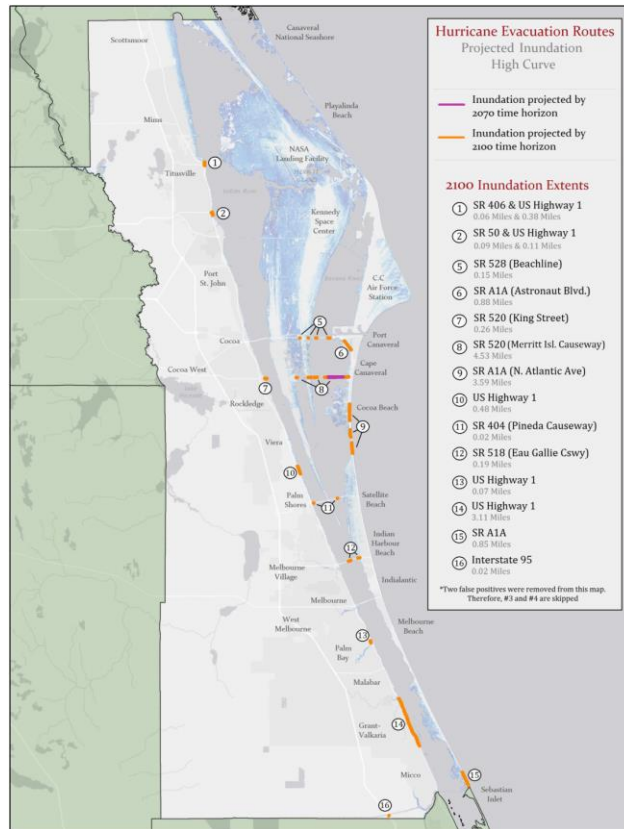


FIGURE 4: INUNDATION OF EVACUATION ROUTES DUE TO SEA LEVEL RISE

### 1.2.3 Satellite Beach Sea Level Rise Vulnerability Analysis

ECFRPC completed the Sea Level Rise Vulnerability Analysis for Satellite Beach to analyze the impacts of storm surge, flooding, coastal erosion, and sea level rise. Exposure from each of these natural hazards was considered from the perspectives of financial value, parcels by build year, land use, critical facility, and ecological value. An example of this method of categorization is shown in **Figure 5** by the financial perspective on storm surge hazard. The impact of each hazard is primarily constrained to the threat of inundation.



**TABLE 1: 2014 Satellite Beach Parcel Exposure to Storm Surge Zones**

Financial Exposure to Hazard Zones – Cumulative Financial Values within Zones (*Built % of Built Parcels in Specific Hazard Zone)						
Hazard Zone	Parcels in Zone	Built Parcels*	Land Value	Building Value	Assessed Value	Taxable Value
Category 1	323 7.2%	283 87.6% built	\$72,739,510	\$54,239,780	\$181,378,740	\$131,356,490
Category 2	1,904 42.5%	1,636 85.9% built	\$168,511,090	\$172,305,380	\$561,803,770	\$351,630,330
Category 3	4,455 99.4%	4,007 89.9% built	\$324,793,540	\$379,398,120	\$993,705,020	\$634,952,640
Category 4	4,480 100.0%	4,026 89.9% built	\$327,668,670	\$382,240,860	\$999,306,190	\$639,261,090
Category 5	4,480 100.0%	4,026 89.9% built	\$327,668,670	\$382,240,860	\$999,306,190	\$639,261,090

**FIGURE 5: SATELLITE BEACH EXPOSURE TO STORM SURGE**

## 1.2.4 Community Resiliency in the City of Satellite Beach

ECFRPC and Satellite Beach conducted the Satellite Beach Resilient Community Survey to prioritize best practices to consider in resiliency planning. Recommended policies for the City of Satellite Beach to implement are identified. In addition to providing a comprehensive list of feedback from community members, a clip of which is shown in **Figure 6**, a few recommendations were emphasized including:

- **Move pole-mounted utilities underground;**
- **Plant native coastal vegetation to reduce coastal erosion;**
- **Direct development away from high-risk areas; and**
- **Manage stormwater.**

Vulnerability	Strategy	Number of 1 Star Rankings	Number of 2 Star Rankings	Number of 3 Star Rankings	Number of 4 Star Rankings	Number of 5 Star Rankings	% of Total Survey Respondents Who Support Strategy (rated with 4-5 Stars)	% of Total Survey Respondents Who Oppose Strategy (rated with 1-2 Stars)	% of Total Survey Respondents who were Neutral (rated with 3 stars)	Total % of Total Respondents who Ranked Strategy	Rank of Strategy within Specific Vulnerability based on #pos/#neg	Total Weighted Sum	Weighted Rank Across all Strategies
Loss of Utilities/ Power	Work with utility companies to determine the feasibility of moving pole-mounted utilities underground.	7	4	32	49	179	48%	2%	7%	57%	1	1202	1
Coastal Erosion	Plant native coastal vegetation such as sea oats	3	4	15	45	176	46%	1%	3%	51%	1	1116	2
Flooding	Install larger drainage pipes and structures as the system undergoes maintenance and repair.	4	6	31	83	123	43%	2%	6%	52%	1	1056	3
Storm Surge	Increase construction setbacks from the shoreline	13	29	42	58	111	36%	9%	9%	53%	1	984	4

**FIGURE 6: COMMUNITY SURVEY RESPONSE TO STRATEGIES**



## 1.2.5 Resilient Titusville

ECFRPC completed Resiliency Plans with the City of Titusville. The Resiliency Plan seeks to identify specific coastal vulnerabilities due to sea level rise and potential mitigating actions. The Resiliency Plan primarily focused on the inundation of properties, critical facilities, and roadways under different hazards including sea level rise, storm surge from a hurricane, and flooding. A map of the impacts to the transportation network in Titusville from a 100-year and 500-year flood is shown in **Figure 7**. A Draft Resiliency Plan was developed for Titusville, based on the ECFRPC Regional Resiliency Action Plan, to identify specific action items for Titusville.



100-Year and 500-Year Flood Zones - Impact to Transportation Network

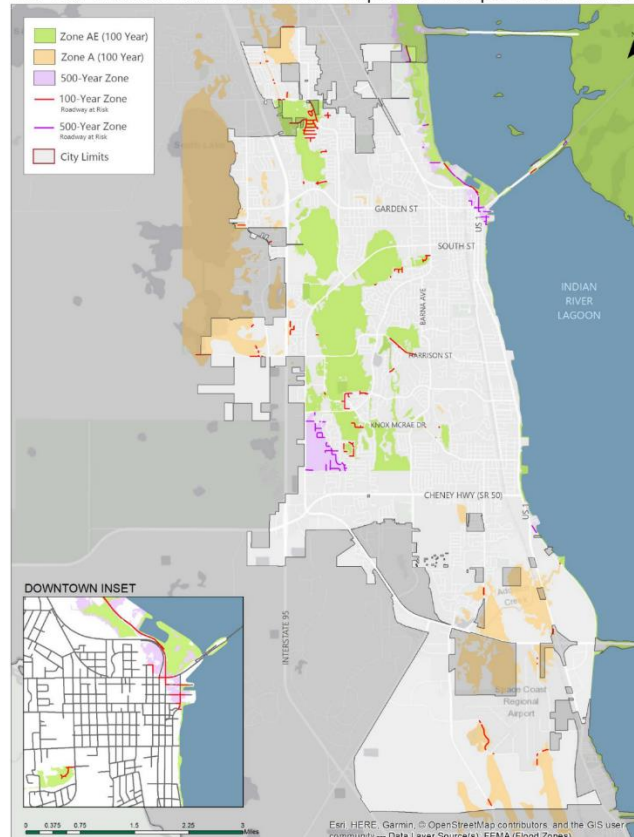


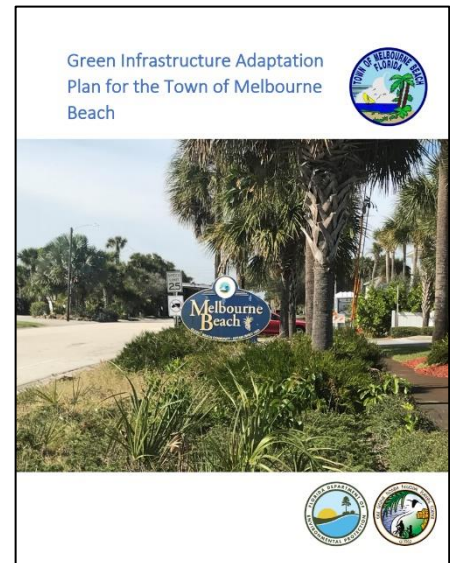
FIGURE 7: CRITICAL FACILITIES EXPOSED TO INUNDATION IN TITUSVILLE

## 1.2.6 Green Infrastructure Adaptation Plan for the Town of Melbourne Beach

The Town of Melbourne Beach was awarded a grant to conduct a case study in how to improve stormwater management, improve water quality, and provide recreational/aesthetic amenities. Through this grant the Town developed the Green Infrastructure Adaptation Plan, which identifies potential projects. Lessons learned from other case studies are summarized in the plan, including:

- *Use of pervious pavement for roads and sidewalks;*
- *Buyout program to convert structures with repetitive flood claims into passive public spaces;*
- *Development of a Master Plan to outline incremental small green infrastructure projects; and*
- *Use of town-owned properties to demonstrate green infrastructure.*

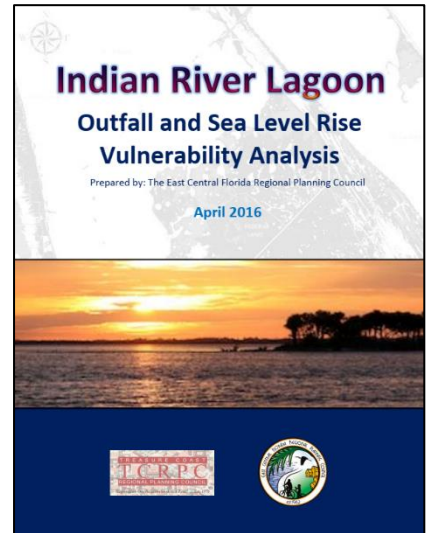
Green infrastructure and low impact development may be applied to retrofitting existing developments. These strategies may address issues related to water quality, stormwater management, and recreational amenities. Concepts for green infrastructure are developed for specific sites in the town, as shown in **Figure 8**.



**FIGURE 8: SITES FOR GREEN INFRASTRUCTURE OPPORTUNITIES**

## 1.2.7 Indian River Lagoon Outfall and Sea Level Rise Vulnerability Analysis

The Outfall and Sea Level Vulnerability Analysis considers the effects of sea level rise on the outfalls within the lagoon system, some of which are within Brevard County. Considering the USACE High Model, 11% of outfalls in Brevard County are expected to be inundated by 2040. Areas around Cape Canaveral, Cocoa Beach, and Grant Valkaria are expected to be especially impacted.



## 1.2.8 Indian River Lagoon Storm Water Outfall Best Maintenance Report

This report is intended to provide a stormwater outfall best maintenance plan for the Indian River Lagoon (IRL). Street sweeping was identified as the most cost effective approach for mitigating nutrient enrichment in the IRL, with priority areas identified in **Figure 9**.

Eutrophic conditions (excess of nutrients) reduce the availability of light to aquatic vegetation like seagrass, which reduces the health of seagrass. Seagrass provides habitat, settles sediments, oxygenates water, and absorbs dissolved nutrients. Eutrophic conditions can deprive the water of oxygen and result in fish kills.

Several best management practices were reviewed, summarized in **Figure 10**, including:

- *Baffle boxes – Poor performance of reducing suspended solids, phosphorus, and fecal coliform. Additionally, require frequent maintenance.*
- *Street sweeping – Roads should be prioritized based on land use and seasonal rain events.*
- *Catch basin – Effective, however maintenance is needed to clean based on stormwater inflow volume.*

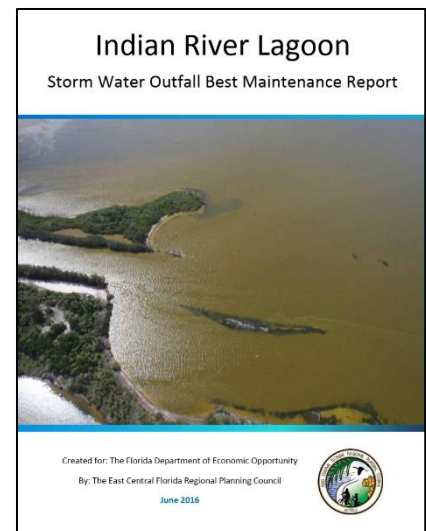






FIGURE 9: PRIORITY AREAS FOR STREET SWEEPING

BMP	Mean (\$/lb.)	TN	Mean (\$/lb.)	TP
Desoto Baffle Boxes: Brevard County (Satellite Beach 2015)	13,944		120,364	
Catch Basin (FSAEF)	1,016		1,656	
Street Sweeping(Satellite Beach 2015)	79		175	

FIGURE 10: COST COMPARISON OF BEST PRACTICES

## 1.3 Florida Department of Environmental Protection (FDEP)

### 1.3.1 Basin Management Action Plans (BMAP) and Alternative Restoration Plans

In general, the following process is followed by FDEP to evaluate waterbodies for impairments related to water quality.

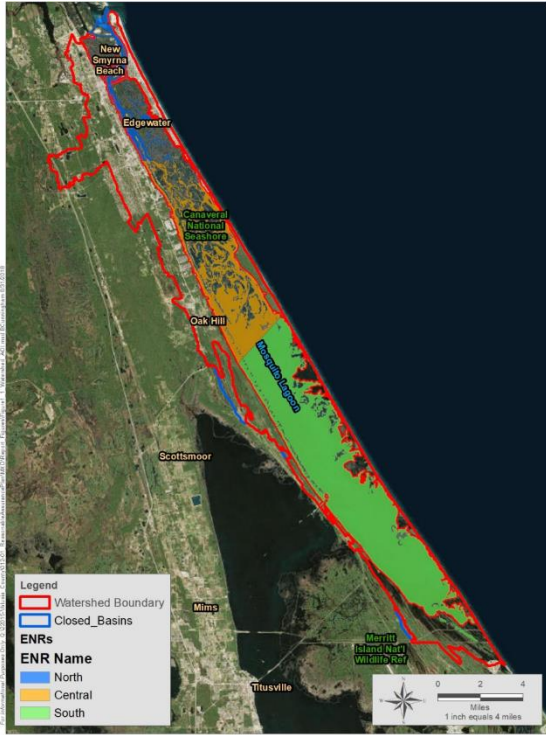
1. **Review:** Waterbodies are reviewed every 5 years to identify if they are impaired. A waterbody is impaired if it does not meet the water quality standards required for its designated use.
  - a. **Comprehensive Study List:** If additional study is needed to confirm the attainment of water quality standards, a waterbody is added to the Comprehensive Study List. These waterbodies

- are considered to not be attaining water quality standards, however they are not included on the Verified List or prioritized for TMDL development.*
2. **Verified List:** *If the waterbody is impaired, it is added to the Verified List of Impaired Waters. Waterbodies on the Verified List get prioritized and scheduled for Total Maximum Daily Load (TMDL) development.*
  3. **Develop TMDL:** *The TMDL is the maximum amount of pollutant loading that can be discharged to a waterbody and have its designated uses met. The designated use is delineated by the Waterbody Class, which ranges from Class 1 to Class 5, with Class 1 affording the most protection. TMDLs are developed for 28 unique waterbodies in Brevard County. TMDLs are most often established for a parameter of Nutrients or Dissolved Oxygen and Nutrients, and a pollutant of Total Nitrogen (TN) or Total Phosphorus (TP).*
    - a. *Prior to the implementation of a BMAP, Strategic Monitoring Plans (SMPs) collect data in preparation of establishing TMDLs and implementing BMAPs. The SMPs also verify the impairment of waterbodies.*
  4. **Implement TMDL:** *The TMDL is implemented through a BMAP, Alternative Restoration Plan, or another program.*

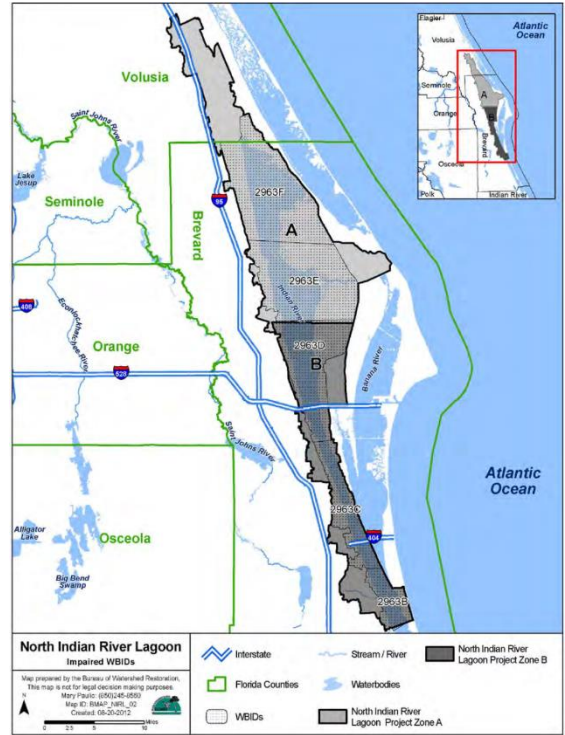
Basin Management Action Plans (BMAPs) are part of FDEP's effort to go beyond the required USACE's National Pollutant Discharge Elimination System (NPDES) process and follow a statewide watershed management approach to restore and protect Florida's water quality. The BMAP provides an enforceable framework to define an appropriate Total Maximum Daily Load (TMDL) for specific pollutants and identify specific actions to restore water quality.

Early implementation of restoration activities is more cost effective and may allow the FDEP to forgo the regulatory steps of establishing TMDL and BMAPs. 4b and 4e restoration plans are the two types of Alternative Restoration Plans (ARPs). An example of an Alternative Restoration Plan is the Reasonable Assurance Plan completed for Mosquito Lagoon. Waterbodies may be considered for a 4b or 4e restoration plan if they have control programs in place for restoring water quality or have ongoing/recently completed restoration activities.

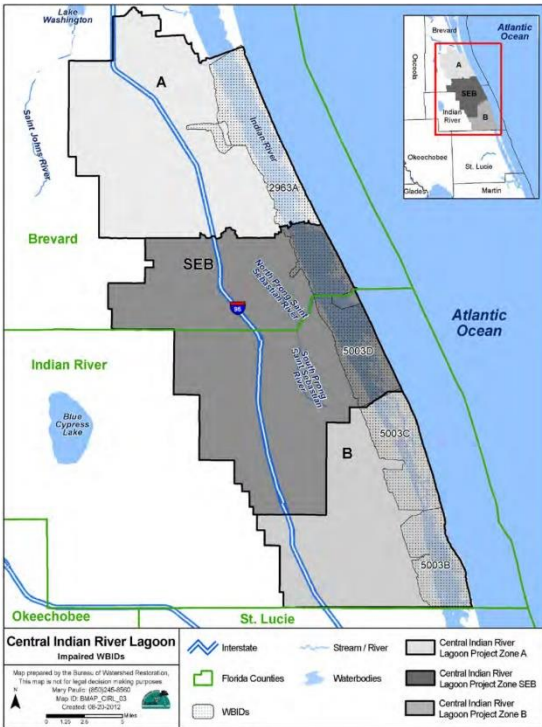
BMAPs and ARPs identify specific best management practices (BMPs) and systemic solutions for stakeholders to complete to increase water quality. Three BMAPs and one ARP have been developed in Brevard County. The considered areas are shown in **Figure 11**, followed by the details of the plans.



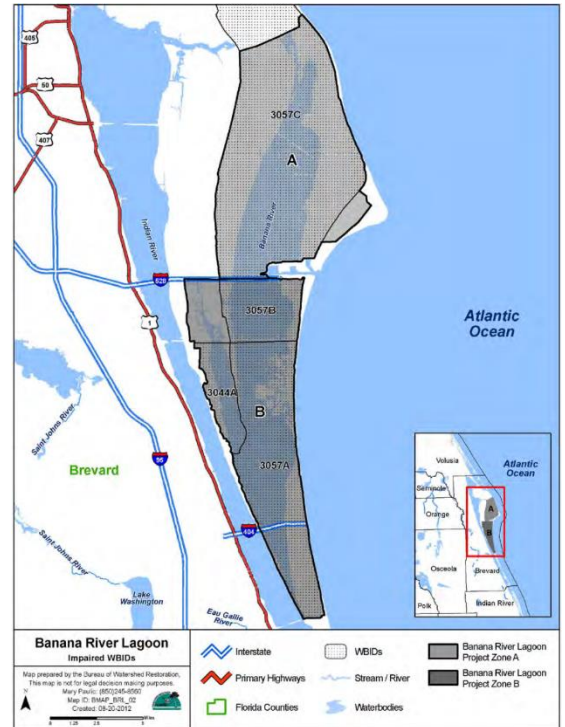
Mosquito Lagoon RAP



North Indian Lagoon BMAP



Central Indian River Lagoon BMAP

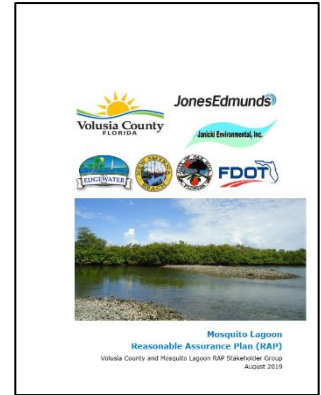


Banana River Lagoon BMAP

FIGURE 11: BREVARD COUNTY BMAP AND ARP STUDY AREAS

### 1.3.1.1 Mosquito Lagoon RAP

The Mosquito Lagoon Reasonable Assurance Plan (RAP), which overlaps with Cape Canaveral in Brevard County, was adopted in September 2019 to restore water quality in the Mosquito Lagoon within 15 years. The RAP specifically seeks to protect seagrasses by addressing impairments from chlorophyll a, Total Nitrogen, and Total Phosphorus. A majority of the planned projects are stormwater or base flow retrofit projects. Metrics will be assessed every 5 years to determine if additional corrective actions need to be taken.

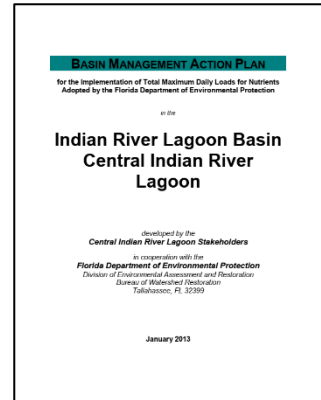


### 1.3.1.2 North Indian River Lagoon (NIRL) BMAP

The BRL BMAP, which includes Merritt Island and the northern portion of Brevard County, was adopted in February 2013 to implement the total nitrogen and total phosphorous Total Maximum Daily Loads (TMDLs). Elevated levels of nitrogen and phosphorus can cause algal blooms and reduce the growth of seagrass in the lagoon. A variety of potential actions were identified including stormwater retention and street sweeping.

### 1.3.1.3 Central Indian River Lagoon (CIRL) BMAP

The CIRL BMAP, which includes portions of southern Brevard County, was adopted in February 2013 to implement the total nitrogen and total phosphorous Total Maximum Daily Loads (TMDLs). Elevated levels of nitrogen and phosphorus can cause algal blooms and reduce the growth of seagrass in the lagoon. Through December 31, 2019 262 projects were completed, with an additional 56 projects planned or underway. The BMAP identified a second phase to the Canal 1 (C-1) Rediversion project, which sought to redirect stormwater from the IRL to the St. Johns River. Completion of the C-1 project was expected to contribute greatly to reaching the TMDLs.



### 1.3.1.4 Banana River Lagoon (BRL) BMAP

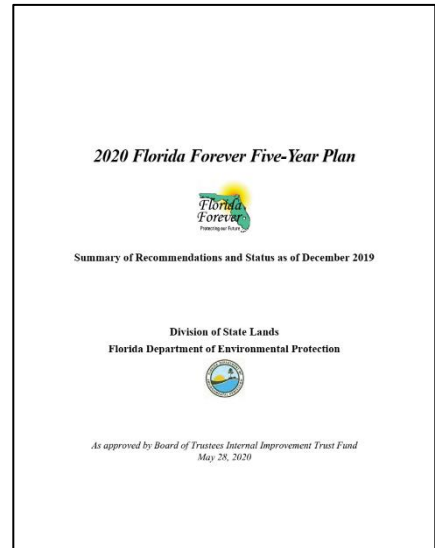
The BRL BMAP, which includes Merritt Island and the barrier island in Brevard County, was adopted in February 2013 to implement the total nitrogen and total phosphorous Total Maximum Daily Loads (TMDLs). Elevated levels of nitrogen and phosphorus can cause algal blooms and reduce the growth of seagrass in the lagoon. A variety of potential actions were identified including stopping or reducing fertilization, stormwater retention, and educational campaigns.



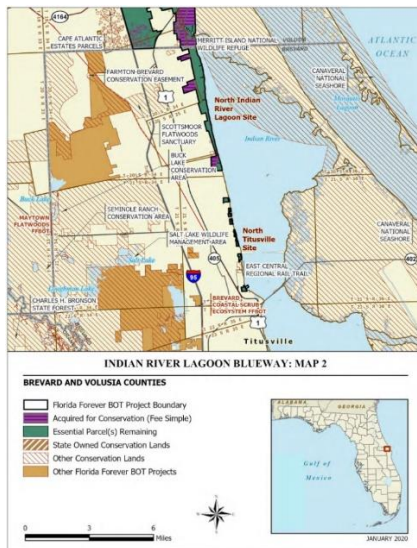
### 1.3.2 2020 Florida Forever 5 Year Plan

The Florida Forever Five-Year Plan is updated annually to add new projects or modify boundaries of previously identified projects. Five (5) Florida Forever Land Acquisition Projects are located within Brevard County. Further details for each site, including planned acquisition area, description, and purpose are included in the Florida Forever 5 Year Plan. An example of a map identifying properties remaining to be acquired for the Indian River Lagoon Blueway is shown in **Figure 12**. The five land acquisition projects located within Brevard County are:

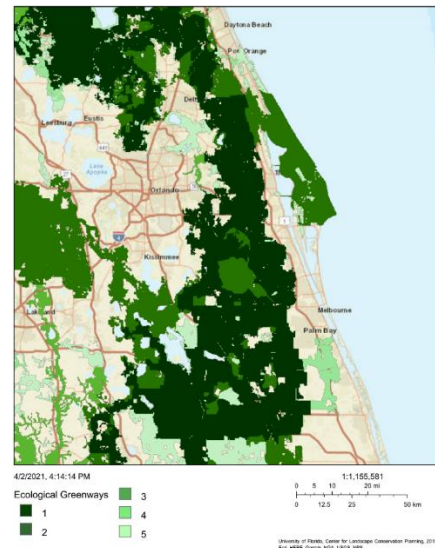
- **Partnerships and Regional Incentives Projects – Priority 4 (High): Indian River Lagoon Blueway;**
- **Partnerships and Regional Incentives Projects – Priority 6 (High): Brevard Coastal Scrub Ecosystem;**
- **Climate Change Lands Projects – Priority 8 (Low): Archie Carr Sea Turtle Refuge;**
- **Less-than-Fee Projects – Priority 16 (Low): Ranch Reserve; and**
- **Less-than-Fee Projects – Priority 24 (Low): Maytown Flatwoods.**



Lands are identified for inclusion in the Florida Forever Plan through a process of analysis and review. Florida Natural Areas Inventory (FNAI) conducts a review and makes a recommendation as part of the annual Florida Forever proposal cycle. To evaluate projects and lands, FNAI developed a Conservation Needs Assessment for each natural resource in Florida and the Florida Forever Tool for Efficient Resource Acquisition and Conservation (F-TRAC). One of the data points referenced by the Conservation Needs Assessment is the Florida Ecological Greenways Network (FEGN) developed by FDEP and the University of Florida to identify opportunities to protect large, intact landscapes, important for conserving Florida’s biodiversity and ecosystem. The prioritized Florida Ecological Greenways near Brevard County are shown in **Figure 13**.



**FIGURE 12: PROJECT MAP FOR INDIAN RIVER LAGOON BLUEWAY IN NORTHERN BREVARD COUNTY**



**FIGURE 13: PRIORITIZED ECOLOGICAL GREENWAYS**

# 1.4 Indian River Lagoon National Estuary Program (IRLNEP)

## 1.4.1 Comprehensive Conservation and Management Plan (CCMP)

The Indian River Lagoon (IRL) provides a habitat to about 4,000 documented species and provides an estimated \$10 Billion in annual economic output. The 2019 CCMP shifts emphasis to focus on active water quality and habitat restoration. Additionally, connected waterways and watersheds are more explicitly considered in the 2019 CCMP.

The CCMP defines a series of Vital Signs and Indicators that can be used to measure the health of the Indian River Lagoon (IRL). The CCMP Vital Signs are shown in **Figure 14**. For each Vital Sign, indicators are defined, which **Figure 15** provides an example of how the indicators are measured. Targets are not specifically or quantitatively set within the CCMP. Considering each Vital Sign and Indicator and in alignment with the Brevard County Save Our Lagoon Plan, the CCMP identifies actions based upon the principles of “Remove, Reduce, Restore, and Respond”. Actions are assigned to lead agencies and organizations. Two key actions include 1) implementing BMAPs and RAPs and 2) implementing stormwater best management practice (BMP) principles including reducing or delaying volume, reducing maximum flow rate, improving water quality, and following sustainable maintenance practices.

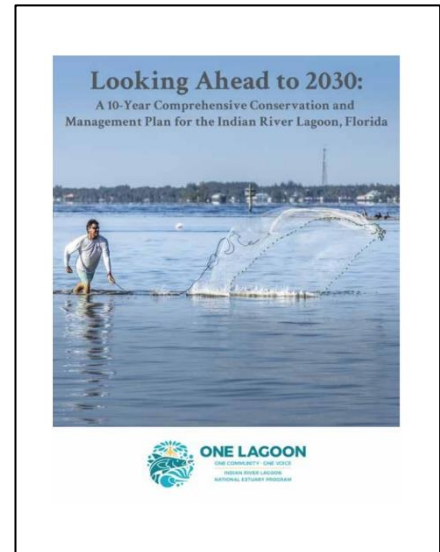


FIGURE 14: IRLNEP VITAL SIGNS AND VITAL SIGN CATEGORIES

IRL/NEP Mission	Vital Sign Category	Vital Signs	Indicators: The Measures	Targets
ONE LAGOON	Habitat Quality	Seagrasses	Coverage (acres), density, and species diversity; coverage (acres), density, and species diversity of other benthic habitats	Recovery to scientifically defensible reference target; TMDL targets for seagrass
		Filter Feeders	Coverage (acres), density, and condition of live target species in conservation and/or commercial production	Recovery to scientifically defensible reference target
		Living Shorelines	Expansion of functional living shoreline habitats based on quantitative shoreline restoration coupled with evaluation of natural habitat quality and functionality; miles of living shoreline, miles of buffer zone	Miles of eroded or hardened shoreline planted, miles of buffer zones around waterbodies
		Wetlands and Impounded and Altered Marshes	Acres in conservation and management	Acres acquired and conserved, natural wetland functions restored and managed
		Spoil Islands	Islands in conservation, management, and public use	Islands restored, enhanced, and managed
		Land Conservation	Acres in conservation, management, and public use	Acres restored and managed for ecosystem integrity
		Connected Waters and Watersheds	Regional watershed planning and project integration	Volume or area of unimpeded circulation in the IRL, restored flows to St. Johns River, volume retained to groundwater

FIGURE 15: EXAMPLE OF INDICATORS FOR VITAL SIGNS

## 1.4.2 Indian River Lagoon: Climate Ready Estuary Technical Report

The Indian River Lagoon (IRL) Climate Ready Estuary technical report was developed in alignment with USEPA guidance for being prepared for climate change. The IRL Climate Ready Estuary report focuses on actions that can be taken over the next decade to protect IRL water quality and reduce future climate-related water quality impairments. The primary climate change stressors affecting the IRL across all Vital Signs are temperature, precipitation, storminess, acidity, and sea level rise. Temperature and acidity are considered second tier risks, due to the larger scale and longer time frame at which they occur. The assessment found that climate change risks could be most effectively mitigated by decreasing nutrient and pollutant loads at the source (wastewater treatment plants, septic systems, surface water storage, and conveyance infrastructure). The nine identified adaptation actions are to reduce pollutant loadings from each identified source due to the identified key stressors, as shown in **Table 2**. Implementation of these nine adaptation actions may reduce the risks associated with climate change by 50%.

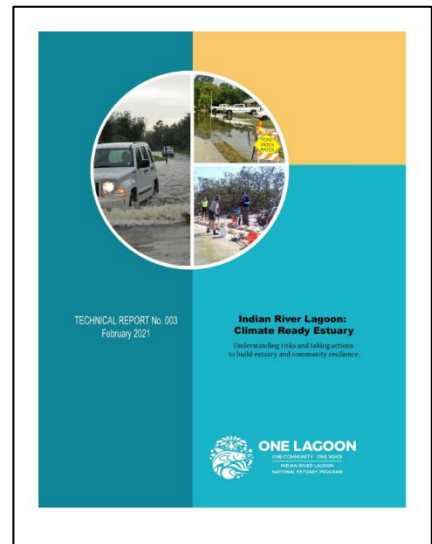


TABLE 2: ADAPTATION ACTIONS

Stressor	Adaptation Action
Precipitation	Reduce pollutant loadings from WWTP during high rainfall events
Precipitation	Reduce pollutant loadings from OSTDS during high rainfall events
Precipitation	Reduce pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events
Storms	Reduce pollutant loadings from WWTP due to more frequent and intense storms
Storms	Reduce pollutant loadings from OSTDS due to more frequent and intense storms
Storms	Reduce pollutant loadings from surface water storage and conveyance infrastructure due to more frequent and intense storms
Sea Level Rise	Reduce pollutant loadings from WWTP caused by rising water table and sea level (inundation, erosion)
Sea Level Rise	Reduce pollutant loadings from OSTDS caused by rising water table and sea level (inundation, erosion)
Sea Level Rise	Reduce pollutant loadings from surface water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)

# 1.5 St. Johns Water Management District (SJRWMD)

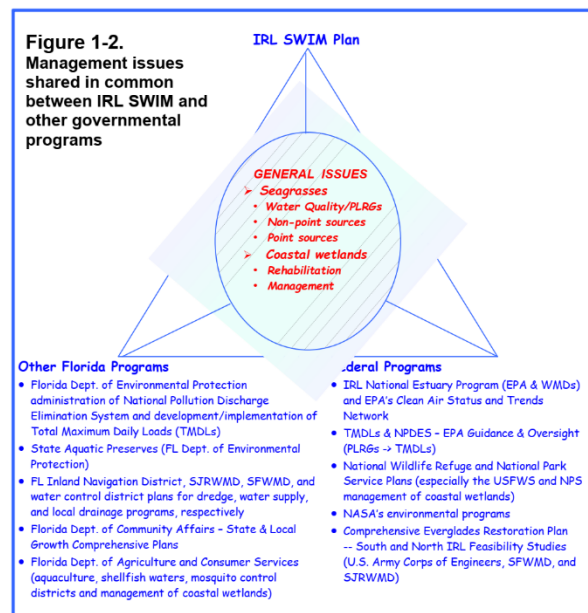
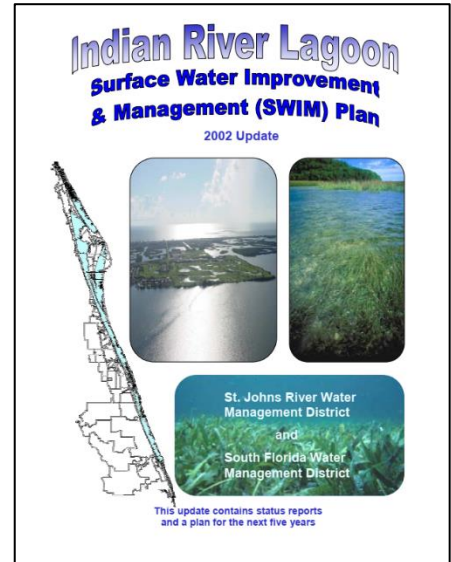
## 1.5.1 Surface Water Improvement and Management (SWIM)

The SWIM program focuses on water quality and natural systems restoration projects for priority waterbodies. A SWIM Plan must be approved before State SWIM funds can be applied to a waterbody. The SWIM plans in Brevard County include Indian River Lagoon SWIM Plan Update (2002) and Upper St. Johns River Basin SWIM Plan (2007).

### 1.5.1.1 Indian River Lagoon

The Indian River Lagoon SWIM Plan was first adopted in 1989 and has been updated twice, most recently in 2002. The goals of the IRL SWIM Plan are to: 1) Attain and maintain water quality to support the ecosystem. 2) Attain and maintain a macrophyte-based (water plant-based, in this case seagrass) ecosystem which supports species and fisheries. 3) Heighten public awareness and coordinate interagency management. The most immediate improvement has been the reconnection of impounded wetlands, which increases fisheries utilization of wetlands and increases the diversity of the supported plant and animal communities.

The IRL SWIM Plan identifies management issues, shown in **Figure 16**, shared between various federal and local agencies, including protection of seagrasses through water quality and pollutant sources and the rehabilitation and management of coastal wetlands.



**FIGURE 16: SHARED MANAGEMENT ISSUES**



### 1.5.1.2 Upper St. Johns River

Historically, a significant portion of the Upper St. Johns River Basin (USJRB) flood plain was drained for farming and flood control. However, these efforts also prevented the land from functioning in its role as a natural provider for flood control and water quality. The USJRB SWIM Plan is focused on restoring acquired land in the basin. The US Army Corps of Engineers (USACE) and SJRWMD have been completing an ongoing USJRB project, seeking to balance flood control and environmental health. The USJRB and associated levees and conserved lands are shown in **Figure 17**. Water that used to drain to the St. Johns was diverted to IRL, but recently projects have been undertaken to re-divert the water to the St. Johns River. These re-diversion projects are included in the IRL plans and are also recommended for the St. Johns River ecology. A series of Action Steps are identified to improve water quality and habitat, with a 5 year timeline. Although a BMAP is identified as an Action Step, it has not been completed to date.

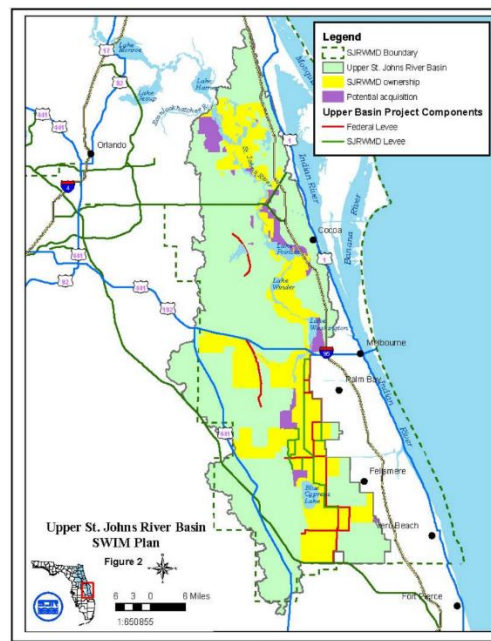
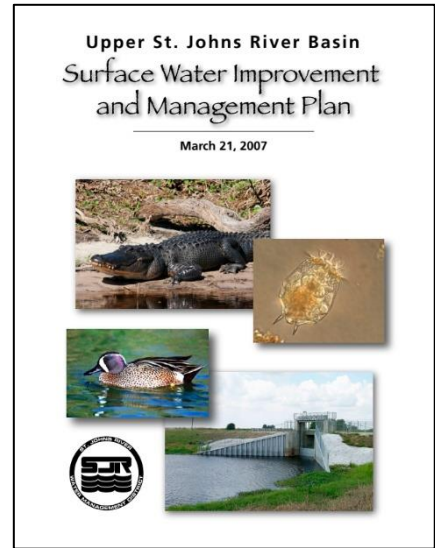


FIGURE 17: UPPER ST. JOHNS RIVER BASIN

## 1.5.2 Levee System Summaries and Emergency Action Plans

SJRWMD provides Levees System Summary which includes the inundation areas, as shown in **Figure 18**, expected, risk, and emergency management plan for the Jane Green Detention Levee System and the Upper St. Johns River Basin Levee System, both of which overlap with Brevard County. Each levee has a low risk rating. Areas that could be inundated during a levee failure are identified in the summary documents.

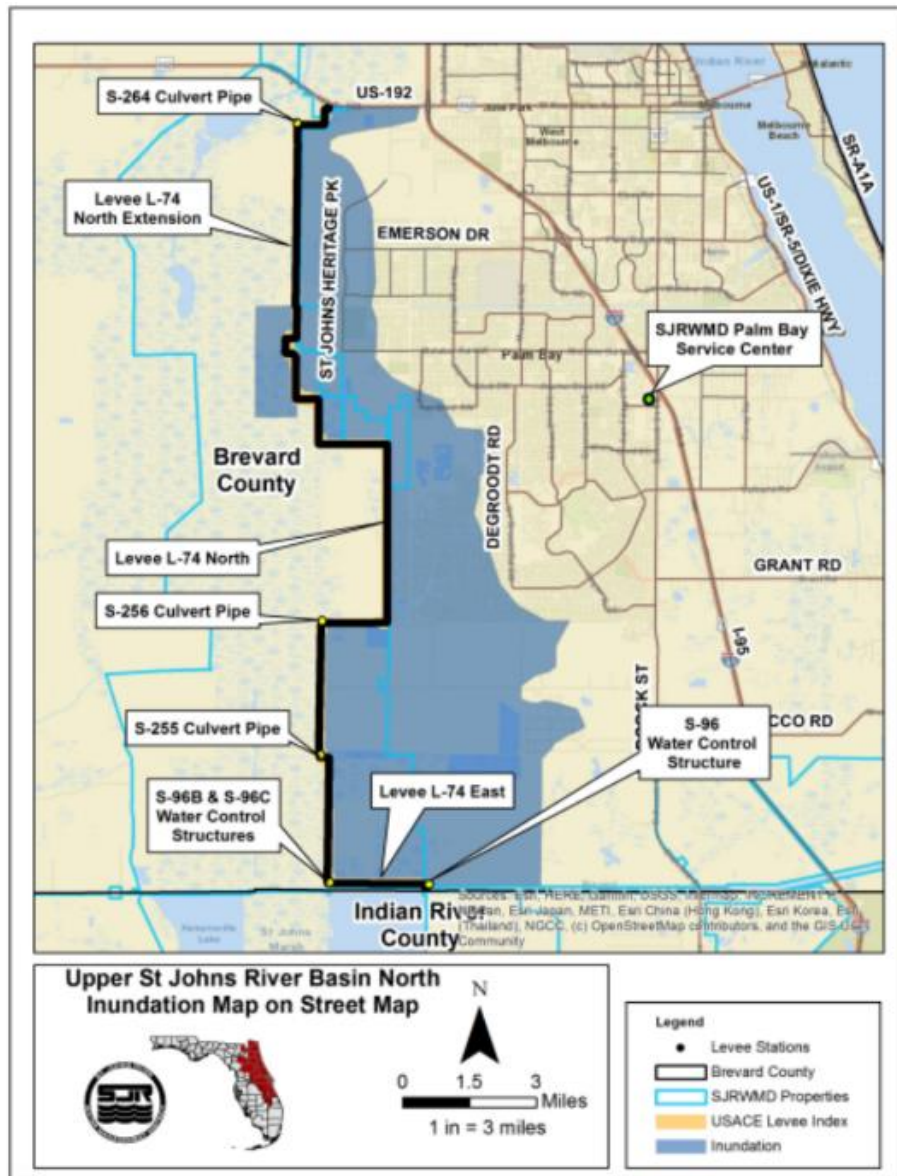
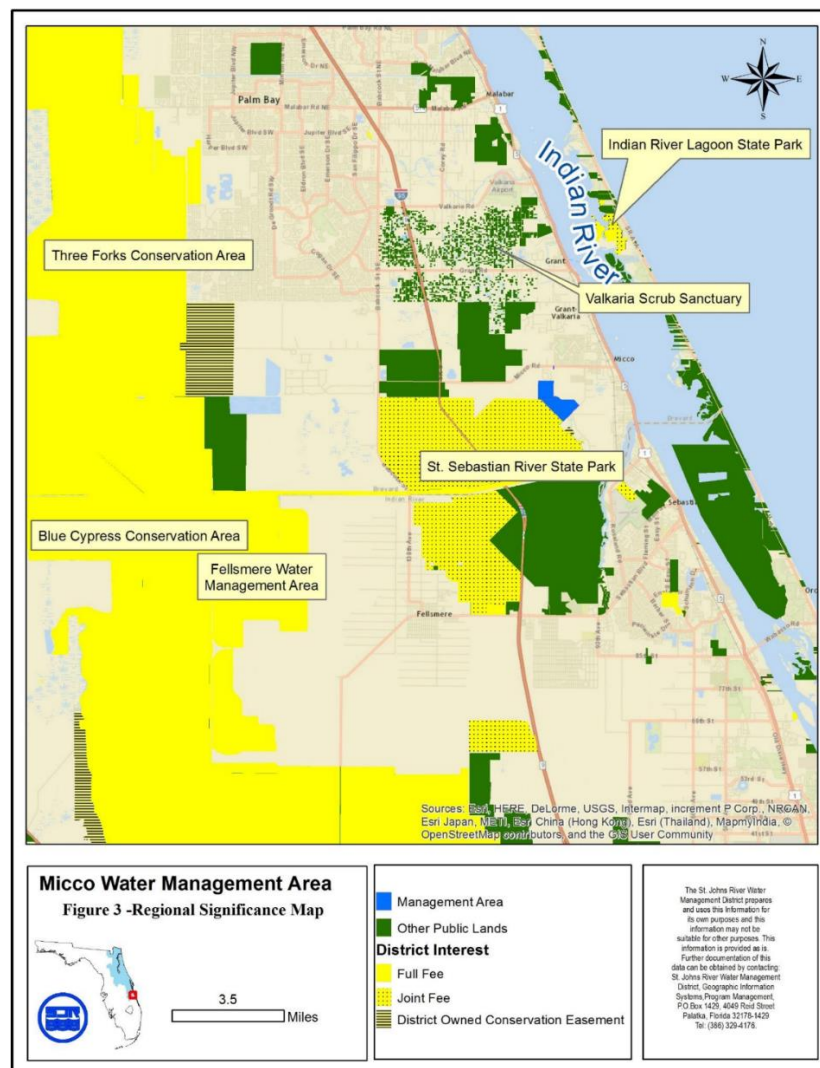


FIGURE 18: LEVEES SYSTEM INUNDATION MAP

### 1.5.3 Land Management Plans

SJRWMD prepares a land management plan for district-owned land. An example map showing the Micco Water Management Area in relationship to other conservation lands is shown in **Figure 19**. Land management plans consider a range of actions addressing resource management issues including water resources, fire management, forest management, wildlife, exotic species, and cultural and historical resources. In addition to resource management, land management plans also identify public access, security, and recreational use of the property.

SJRWMD conducts prescribed burns at regular intervals as part of the land management plan for each property, dependent on the ecological system. Prescribed burns seek to restore fire to ecosystems requiring fire, while protecting homes and communities. The Southern Wildfire Risk Assessment ranks Florida as a high risk of wildfire.



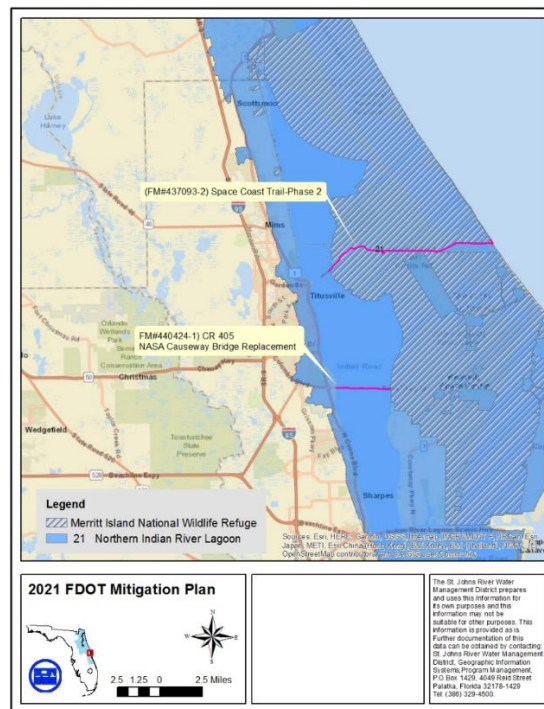
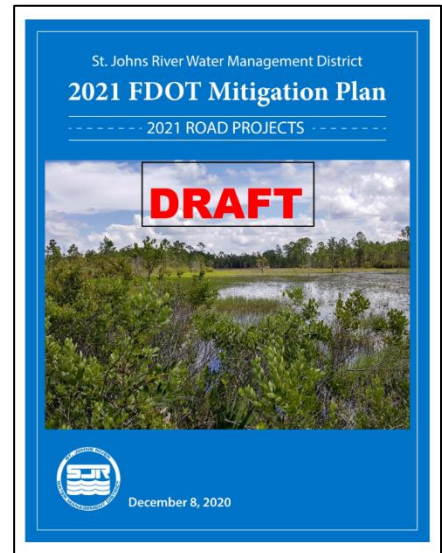
**FIGURE 19: MICCO WATER MANAGEMENT AREA**

# 1.6 Florida Department of Transportation (FDOT)

## 1.6.1 2021 FDOT Mitigation Plan

FDOT updates a mitigation plan annually to provide wetland mitigation for planned projects in the FDOT Work Program. Before developing mitigation projects through the Mitigation Plan, FDOT considers using credits from permitted mitigation banks. The goal of funding mitigation banks is to mitigate environmental costs more effectively through regional long-term planning, rather than considering mitigation on a project by project basis. If permitted mitigation banks cannot provide the required mitigation, a project can be identified for inclusion in the Mitigation Plan. Projects in the Mitigation Plan must focus on land acquisition, restoration or enhancement, or SWIM projects. Projects are organized by regulatory mitigation basin, and impacts are typically offset within the same basin.

The 2021 FDOT Mitigation Plan includes one new project and one modified project, both within Regulatory Basin 21, which overlaps Cape Canaveral and the Indian River Lagoon in Brevard County. The projects are shown in **Figure 20**. Although mitigation banks service Regulatory Basin 21, the type of mitigation required by these projects is not available in the existing mitigation banks. Therefore, the FDOT Mitigation Plan includes proposed projects for mitigating both of these planned roadway projects.



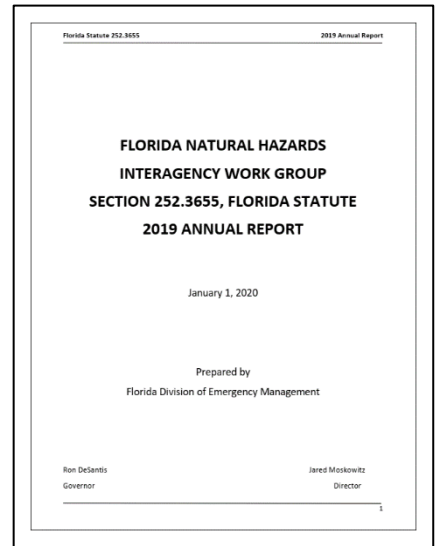
**FIGURE 20: NEW PROJECTS INCLUDED IN THE FDOT 2021 MITIGATION PLAN IN REGULATORY BASIN 21**



# 1.7 Florida Division of Emergency Management

## 1.7.1 Florida Natural Hazards Interagency Work Group 2019 Annual Report

The Florida Natural Hazards Interagency Work Group produces an annual progress report on the implementation of Florida’s hazard mitigation plan. This report includes potential impacts to each agency, agency efforts to address the impacts of natural hazards, and a prioritization of efforts to address the impacts of natural hazards. An example of a summary of agency mitigation efforts is provided in **Figure 21**.



*St. Johns River Water Management District*

Liaisons	Dave Dickens and Brian Emanuel
Agency Summary	<p>The mission of St. Johns River Water Management District (SJRWMD) is to protect natural resources and support Florida’s growth by ensuring sustainable use of Florida’s water for the benefit of the people of the District and the State. To meet that mission statement, the District’s work is focused on four core missions: water quality, water supply, flood protection, and natural systems protection.</p> <p>The SJRWMD Division of Regulatory Services works to protect and manage water resources by permitting in a manner that will prevent adverse flooding, manage surface water, and protect water quality, wetlands, and other surface waters. SJRWMD partners with FDOT and communities to develop annual FDOT Mitigation Plans, pursuant to section 373.4137(4), Florida Statute, for wetland impacts associated with FDOT roadway projects.</p> <p>The Office of Real Estate Services acquires lands for flood control, water quality protection, and natural resource conservation. Similarly, the Bureau of Land Management provides oversight for many district lands for water resource protection. Important activities include hydrologic restoration of altered drainage, protection of floodplains, and the use of prescribed fire for restoration and wildfire prevention.</p> <p>The Division of Projects has oversight for district-led and partnership projects that help to meet the core missions. For example, the Division is responsible for operating and maintaining more than 100 major and minor water control structures, including eleven spillways, three navigational locks, approximately 300 miles of levees, and thirty pump stations. The Division is also responsible for the construction of projects aimed at protecting water supplies, improving water quality, and restoring natural systems, as well as providing flood protection through practices such as improved stormwater drainage or storage.</p>
2019 Update	<p>SJRWMD implemented the following:</p> <ul style="list-style-type: none"> <li>Land Management: Mitigation of wildfire risk through 51 prescribed burns totaling 28,979 acres on 22 conservation areas.</li> <li>Flood Protection Partnerships: SJRWMD has utilized our cost share program to partner with many local governments to ensure the completion of shovel ready stormwater/flood protection projects designed to reduce flooding risks and improve water quality. Our government partners over the past year with flood protection projects include St. Augustine, Flagler County, Palm Coast, New Smyrna, and Volusia County. These cost share projects have allowed for the retrofitting stormwater outfalls with tidal backflow prevention valves, reconstruction of weirs, construction of watershed management collection and stormwater treatment systems, and stormwater management system expansion and reconstruction.</li> <li>Levee improvements: Improved a combined total of 11.4 miles of levees at the Lake Apopka North Shore, Taylor Creek, and C231. Provided additional protection to levees via gopher tortoise removal.</li> <li>Flood Control Structure improvements: Rehabilitated 596B, culvert maintenance, installation of new generators at five major structures, and upgraded remote operations hardware at all major structures.</li> </ul>
Relevance	The SJRWMD completes several mitigation projects each year and is therefore relevant to state mitigation. Projects include stormwater retrofits, watershed restoration, floodplain mapping, and land conservation.
Level	The level of mitigation efforts of SJRWMD is high because almost every project includes mitigation, usually to reduce flood risk.
Significance	The mitigation efforts of the SJRWMD are significant because floodplain management must be coordinated not only locally, but also regionally, based on basins and watersheds, to be successful. The agency also completes many infrastructure mitigation projects to reduce flood risk.

**FIGURE 21: EXAMPLE OF AGENCY SUMMARY OF MITIGATION EFFORTS**

# 1.8 Environmental Protection Agency (EPA)

## 1.8.1 Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans

The EPA Workbook presents a methodology for climate change adaptation planning. A two part process is presented to, 1) conduct a vulnerability assessment and 2) develop an action plan. The key steps within each of these parts are shown in **Figure 22**. The risk management process is intended to help identify risks that may have been overlooked, highlight strategies that may be effective at reducing multiple risks, and aid organizations in making better decisions. A vulnerability assessment is defined as “an evaluated set of risks that describes how climate change stressors would affect goals.” The vulnerability assessment may be treated as a standalone product; however, it is not an end to itself. Rather, an action plan should be developed to identify actions to decrease the prioritized risks.

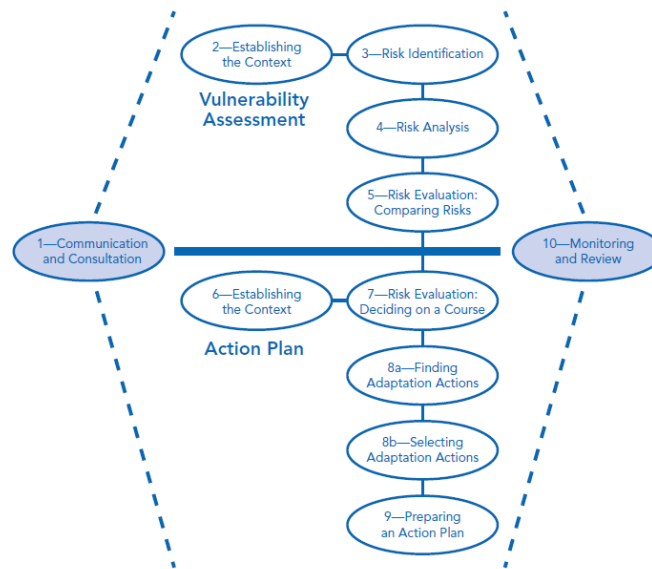
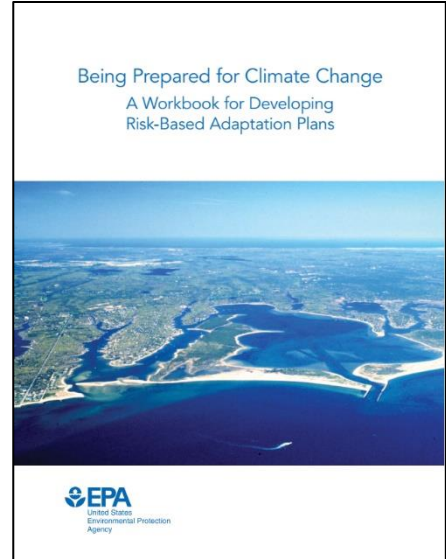


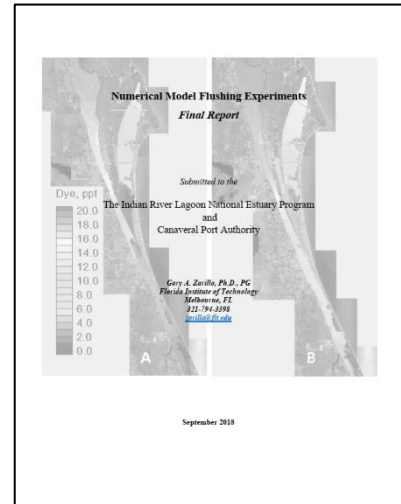
FIGURE 22: ROADMAP FOR VULNERABILITY ASSESSMENT AND ACTION PLAN

The workbook describes the process of developing a vulnerability assessment through risk management strategy based on organizations’ mission and goals. The Action Plan is based on the risks that pose the greatest threat to the mission and goals of an organization and includes steps to set up the process for tracking the status of risks and parties to lead the mitigation strategies.

# 1.9 Research and Literature

## 1.9.1 Indian River Lagoon Flushing Research Project<sup>1</sup>

In a research project conducted by Gary Zarillo at Florida Institute of Technology (FIT) for the Indian River Lagoon National Estuary Program (IRLNEP) and Canaveral Port Authority, a numerical model was used to assess the effect of modifications to the SR 528 and SR 520 bridge structures and causeways on flushing rates in the Indian River Lagoon (IRL). The analysis considered the existing conditions and a series of different hypothetical bridge spans. The model found that to achieve significant improvement in flushing, bridge spans would be required on both SR 520 and SR 528. Considering long bridge spans for both SR 528 and SR 520, flushing of the IRL increases by about 10%. Further modelling is required to understand how bridge modifications would affect the salinity, water quality, and water levels of the IRL.



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<sup>1</sup> Gary A. Zarillo (2018). Numerical Model Flushing Experiments. The Indian River Lagoon National Estuary Program and Canaveral Port Authority.

## 1.9.2 Adaptation Actions to Reduce Impairment of IRL Water Quality Caused by Climate Change<sup>2</sup>

The article identifies nine (9) adaptation actions that may reduce risks to water quality in the IRL as a result of climate change. Risks were prioritized based on severity of consequence, likelihood of occurrence, extent of impact, and time horizon. Climate change induces several stresses on the IRL with the effects summarized in **Table 3**. Risks were found to be primarily induced by changes in precipitation, increasing storminess, and sea-level rise. Adaptation actions are focused on reducing pollutant loadings from wastewater treatment plants (WWTP), on site treatment and disposal systems (OSTDS), and surface water storage and conveyance infrastructure (SWSC). Conveyance infrastructure includes the transportation system. Action Plans for each adaptation action were developed.

**TABLE 3: KEY STRESSORS FROM CLIMATE CHANGE TO IRL**

<b>Key Stressors</b>	<b>Induced Problems</b>
<b>Warmer temperatures</b>	<ul style="list-style-type: none"> <li>• <i>Increased evaporation</i></li> <li>• <i>Reduced solubility of oxygen</i></li> <li>• <i>Increased phytoplankton production</i></li> </ul>
<b>Changes in precipitation</b>	<ul style="list-style-type: none"> <li>• <i>Increased concentration of discharged pollutants</i></li> <li>• <i>Temporal and spatial salinity patterns</i></li> </ul>
<b>Increasing storminess</b>	<ul style="list-style-type: none"> <li>• <i>Fluxes of freshwater</i></li> <li>• <i>Erosion</i></li> <li>• <i>Flooding</i></li> <li>• <i>Destruction conditions</i></li> </ul>
<b>Acidification</b>	<ul style="list-style-type: none"> <li>• <i>Kill juvenile fish</i></li> <li>• <i>Increase difficulty for shell animals to maintain shell</i></li> </ul>
<b>Sea-Level Rise</b>	<ul style="list-style-type: none"> <li>• <i>Shoreline erosion</i></li> <li>• <i>Inundation</i></li> <li>• <i>Saltwater intrusion</i></li> <li>• <i>Storm surge flooding</i></li> </ul>

<sup>2</sup> Randall W. Parkinson, Valerie Seidel, Clay Henderson & Duane De Freese (2021): Adaptation Actions to Reduce Impairment of Indian River Lagoon Water Quality Caused by Climate Change, Florida, USA, Coastal Management