AGENDA REPORT
February 12, 2019

Adoption of the Save Our Indian River Lagoon Project Plan 2019 Update

SUBJECT:
Adoption of the Save Our Indian River Lagoon Project Plan 2019 Update

FISCAL IMPACT:
Using an inflation rate of 2.13% applied to the first 12 months of revenues received, the estimated revenue for 10 years of Sales Tax collections is $486 million.

The Board adopted 2018 Update to the Save Our Indian River Lagoon Project Plan listed projects totaling $427,460,490. Using a Construction Index rate of 3.25%, the projects and programs in the Draft 2019 Update total $478,892,568.

Due primarily to the extensive start-up time needed to design, permit and bid many of the projects, the sum of the projects funded in fiscal years 16-17, 17-18 and 18-19 is decreased by $12,019,354 (from $120,428,191 in the 2018 Update to $108,408,837 in the 2019 Update). The difference between revenues and budgeted expenses is held in the Save Our Indian River Lagoon Trust Fund Reserves.

DEPT/OFFICE:
Natural Resources Management

REQUESTED ACTION:
It is requested that the Board of County Commissioners consider the recommendation of the Save Our Indian River Lagoon Citizen Oversight Committee to approve the Save Our Indian River Lagoon Project Plan 2019 Update (attached) and authorize necessary budget change requests for the current fiscal year.

SUMMARY EXPLANATION and BACKGROUND:
Each year, in order to account for new information and opportunities, the Save Our Indian River Lagoon Citizen Oversight Committee is tasked with recommending an Update to the Save Our Indian River Lagoon Project Plan (SOIRLPP). The Committee has held monthly public meetings throughout the year to keep informed, gather ideas from the community, review potential changes, and recommend an annual plan update to the County Commission. The Committee's annually recommended SOIRLPP Updates are posted on the Committee's webpage for public access at least 15 days prior to being brought to the County Commission for consideration. The County Commission may adopt or modify the Committee's recommended Plan Update.

The County Commission is requested to consider the following major changes that are included in the 2019 Update recommended by the Citizen Oversight Committee:

1. adding $30 million for wastewater, septic and sewer projects and reprioritizing all septic and sewer projects based on new information collected and analyzed in conjunction with the septic moratorium and septic overlay ordinance;
2. adding $27 million to install stormwater treatment upstream of 230 more outfalls;
3. reducing the amount of muck to be dredged from the lagoon by $37 million, based on new field data that identified which muck areas feed algae blooms the most;
4. adding $21 million to treat the interstitial water at every muck project; plus
5. adding $3.5 million for a new wastewater project type to reduce the amount of nutrients that soak into the groundwater underneath treatment plant sprayfields and rapid infiltration basins and then migrate to the lagoon.

An executive summary of significant changes that are proposed in the 2019 Update, including the five major changes highlighted above, is attached. Pie charts are also attached to illustrate the changes proposed in the 2019 Update. In addition, to help readers find all areas of the SOIRLPP that are proposed updates or modifications in the 2019 Update, the attached Draft 2019 Update uses highlighted text, table and figure captions to indicate additions and revisions.

A workshop was held with cities on September 27th, 2018 to review the process for submitting project requests to be considered for addition in the 2019 annual update. Project requests were due November 5th. These were reviewed by the Committee during December 14th public meeting. New projects that were recommended in December, as well as other changes based on new information gathered and analyzed throughout the year, were incorporated into the attached Draft Save Our Indian River Lagoon Project Plan 2019 Update, as recommended by the Committee on January 18th.

During fiscal year 17-18, tax collections were $46.6 million instead of the 2018 estimate of $45.1 million. This growth that exceeded the consumer price index led to consideration of whether the 10 year forecast of revenue collections should be increased. Not just in Brevard, but across America last year the gross domestic project (GDP) experienced robust growth. Nonetheless, national recession probability models and yield curves suggest a recession may begin in 2020. Therefore, last year's revised estimate of 10 year collections amounting to $486 million was not increased in the 2019 Update. Revenue forecasting adjustments will continue to be considered annually as part of the Plan Update process.

The original distribution of funds between project types was guided by best available data regarding the relative significance of nitrogen loading from each major contributing source of pollution to the Indian River Lagoon. The recommended changes in the 2019 update represent a significant shift in the distribution of funds from muck dredging to human wastewater related projects and stormwater treatment. The original Save Our Indian River Lagoon Project Plan allocated 65% of the funding to muck removal projects. The 2019 Update reduces the proportion of funds for muck removal to 40% of the funds. This is illustrated in pie charts from Figure 7-1 of the 2019 Update (Attached).

Available funding is divided between projects that **reduce** the incoming load of new

pollution, **remove** accumulations of old pollution, **restore** natural stabilization and filtration systems, or facilitate processes to **respond** to new information. In the 2019 Update, $115 million is directed to projects that improve the treatment of human waste through upgraded treatment of reclaimed water, nutrient removal from treatment plant sprayfields and rapid infiltration basins, rehabilitation of privately owned leaking sewer laterals, conversion of septic neighborhoods to sewer service, connection of septic homes to adjacent sewer lines, and upgrade of high risk conventional septic to high performance nitrogen removal systems. This focus on human waste issues is illustrated in Figure 7-1 from the 2019 Update (Attached).

In sum, the recommended changes bring the total Save Our Indian River Lagoon Project Plan cost to $479 million when a Construction Index of 3.25% is factored into the project costs for years 2 through 10 as shown in attached Table 8-9b from the 2019 Update. This equals a total cost of $422 million without inflation. Approximately $7 million of projected revenues over the 10 year life of the sales tax remain available for future allocation.

A brief history of prior Board action on the Save Our Indian River Lagoon Project Plan is attached. Adoption of the Draft Save Our Indian River Lagoon Project Plan 2019 Update is recommended by the Citizen Oversight Committee. The Committee's motion included deferral to the County Commission on the amount of funding the Board may shift from public education, outreach and engagement to wastewater projects.

CLERK TO THE BOARD INSTRUCTIONS:
Please send a Clerk's memorandum of the Board action to Natural Resources.

ATTACHMENTS:

Description

- **2019 Plan Update Summary**
- **Figure 7-1**
- **Pie charts**
- **G-History of Prior Board Action**
- **Table 7-3**
- **Table 8-9b**
- **2019 Plan Update**

BREVARD County
BOARD OF COUNTY COMMISSIONERS

FLORIDA'S SPACE COAST

Tammy Rowe, Clerk to the Board, 400 South Street • P.O. Box 999, Titusville, Florida 32781-0999

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February 13, 2019

MEMORANDUM

TO: Virginia Barker, Natural Resources Management Director

RE: Item J.1., Adoption of Save Our Indian River Lagoon Project Plan 2019

The Board of County Commissioners, in regular session on February 12, 2019, directed staff to send the Plan back to the Citizen Oversight Committee (COC) for redirection of funds to infrastructure and less towards muck removal.

Your continued cooperation is greatly appreciated.

Sincerely yours,

BOARD OF COUNTY COMMISSIONERS
SCOTT ELLIS, CLERK

Tammy Rowe

Tammy Rowe, Deputy Clerk

/cmw

cc: Each Commissioner
County Attorney
County Manager

2/12/19

J New Business Development and environmental Services Group Item 1.

Adoption of the IRL Project Plan update.

Commissioners I have reviewed the updates to the plan and believe the **revised plan still has too much of the funds dedicated to MUCK removal**

. Spending **over 50% of funds for muck removal is a misuse of funds.**

The Focus should be on expenditures that get the **most bang for the buck sooner than later**. In that regard I recommend that the COUNTY COMMISSION put Focus on the **major Waste Water (Sewage) treatment plants (existing and new)**and equally important there connecting waste water network of sewer transport pipelines. I recommend that you modify the expenditures and increase waste water treatment by 20% and reduce Muck removal by an equal 20% so that **muck removal becomes only 30% of the overall Plan**

Comments to Brevard County Commission Meeting, February 12, 2019

Jim glass, Melbourne, member of the Florida Fly Fishing Association. Ret. Civil engineer

The proposed 2019 save Our Lagoon Plan has $421 million of funded projects; $225 million on Muck removal and $114 on sewage infra- structure projects. Also, the Plan has another $734 million for unfunded projects; $ 430 million on Muck removal and $314 million on sewage infra- structure. The total of the funded and unfunded projects is about $ 1.2 billion of which 57 % is to be spent on removing muck. This was approved by the Citizens Oversight Committee and has been submitted to the Commission for approval. These figures were taken from the Plan.

I take issue on spending so much on removing muck before eliminating the sewage entering the Lagoon from the sewage plant discharges from heavy rain fall events, breaks and failures in sewage collection systems, the sewage from the 41,077 septic tanks within 219 yards of Lagoon waters and from sewage plants that need extra capacity and need to be upgraded to higher standards. I know of no other Florida estuary that made removing muck a priority; however other estuaries have been restored by improving sewage and storm water infra-structure.

Governor Desantis and the Florida Legislature are on record about the need to fix Florida's sewage infra-structure and to convert septic tanks to sewage collection/treatment systems. Dade County is undertaking a $3 Billion program to convert 60,000 septic tanks to a sewer system. Sarasota County committed to a plan in the 1990's to upgrade Treatment plants to advanced waste water standards and to connect 13,000 septic tanks to a sewer system. Monroe County in 2010 competed a One Billon $ plan connecting 23,000 septic tanks and 100 package plants to a central sewage system.

In conclusion I ask the Commission to send this plan back to the Citizen's committee to re prioritize the plan on fixing the County wide sewage infra-structure first before spending $225 on Muck removal. It's a matter of making choices like Commissioner Tobia stated instead of spending $10 million on an Aquarium spend the money on sewage projects that will improve water quality in the lagoon. Some examples of the choices would be:

- Instead of spending all of the $ 225.4 million (funded) in the Plan for removing muck instead put funds toward the$ 125,520,000 for the County Utility services unfunded Capital Improvements Program
- Instead of spending the $10,108,000 on funding Oyster bars, put these funds toward the construction of holding tanks or basins to hold excess flow of untreated sewage from sewer plants during heavy rain events rather dumping the sewage into the Lagoon.
- The basic change is to make funding sewage infra-structure projects earlier in the plan then do muck removal , build oyster bars and plant mangroves after the primary source of algae blooms is removed from the Lagoon

Message on the Save Our Indian River Lagoon 2019 Update

The 2019 Update to the Save Our Indian River Lagoon Project Plan is the third annual update since the plan was adopted in 2016. The 2019 Plan Update includes major revisions based on citizen input, new data, lessons learned from projects implemented to date, and new project opportunities submitted by the community. The 2019 Update continues to use a multi-pronged approach to **Reduce** pollutant and nutrient inputs to lagoon, **Remove** the accumulation of muck from the lagoon bottom, and **Restore** water-filtering oysters and related lagoon ecosystem services. This plan also recommends funding for measuring project performance that is needed for accountability and to **Respond** to changing conditions and opportunities.

In 2018, citizens asked the County Commission and Citizen Oversight Committee to direct more of the half-cent sales tax (Save Our Indian River Lagoon Trust Fund) to projects that **Reduce** the impacts of human sewage (wastewater treatment facility upgrades, sewer lateral rehabilitation, septic system to sewer system connections, and septic system upgrades) and less funding for muck dredging projects that **Remove** accumulated pollution from the lagoon.

On January 18, 2019, the Citizen Oversight Committee recommended a plan update that included 23 new projects proposed by the community and reprioritized wastewater, septic and muck removal projects. The 2019 Update reapportions funds between project types, most notably a $30 million increase for human waste related projects, a $27 million increase for stormwater projects, and a $37 million decrease for muck removal projects offset by a $21 million increase to provide interstitial water treatment for all dredging projects.

The 2019 Plan Update will be presented to the Board of County Commissioners on February 12, 2019, for their consideration of approval. The following major modifications are included in the Save Our Indian River Lagoon Project Plan as part of the 2019 Update:

Reduce Projects

- Sewer lateral maintenance was added to the public education and outreach campaign priorities, background information on public education and outreach was streamlined in the main report, and the details were moved to an appendix.
- Wastewater treatment facilities information was updated using the latest data on reclaimed water flows and nutrient concentrations. An additional facility was added to the recommended list of upgrades reducing total reclaimed wastewater pollution by 83%.
- A new project type of upgrading spray fields and rapid infiltration basins was added for 2 public and 1 private wastewater treatment facilities to reduce groundwater pollution.
- A new but unfunded option to connect package plants to central sewer was added to the plan. More information will be gathered in 2019 to estimate costs and benefits.
- Septic system removal projects and individual septic upgrade priorities were revised using new costs as well as data from 2018 groundwater monitoring and modeling. The updated priorities reduce septic pollution by 24.9%, up from 15.7% in the 2018 plan.
- 230 stormwater treatment projects were added to reduce stormwater pollution by 34.6%, up from 15.5% in the 2018 plan.

Remove Projects

- Muck dredging area was reduced based on public sentiment and was refined using new field measurements. The updated priorities reduce the flux of bioavailable nutrients that feed algae blooms by 27%, instead of the 37% that was included in the 2018 plan.

- Clarifying language was added to allow potential acquisition of spoil management areas.

Restore Projects

- The length of shoreline to be planted is no longer a specified target of 20 miles, but will be determined annually based on project funding requests submitted by the community.

Respond

- A new section was added to the plan to map and summarize the completed projects and new information gathered from studies and project performance measurements.

New Partner Projects

- New projects submitted by the community include 1 wastewater treatment facility upgrade, 1 sewer lateral smoke testing and rehabilitation area, 15 stormwater treatment projects, 1 muck dredging project, 3 oyster bars and 2 planted shorelines. These projects reduce water quality pollution by 25,650 pounds of nitrogen per year at a cost of $9.2 million.

Unfunded Project Opportunities

- During the project prioritization process for each project type included in the plan, many projects were evaluated for cost effectiveness. Those that were not as cost effective as the funded projects are listed as unfunded and sorted from most to least cost effective. These lists provide a ready source of the next best projects, if funding allows.

Project Funding

- A timely process was added for the Citizen Oversight Committee to be able to consider and the County be able to award increased funding for contracted projects that present an opportunity between annual plan updates to reduce more pollution cost-effectively.

- A timely process was added for the Citizen Oversight Committee to consider and the County to be able to reduce funding for contracted projects that must be downsized.

- A timely process was added to accelerate the schedule of a funded project if the altered schedule is recommended by the Citizen Oversight Committee and the County, and contingent on the availability of Trust Funds.

The 2019 Plan Update reprioritizes and refines allocation of the Save Our Indian River Lagoon Trust Funds to respond to public sentiment on pollution priorities as well as new information on water quality pollution from human waste sources and muck decomposition. Funding for muck removal is reduced from two thirds to approximately half of the available funds while projects that treat human wastewater are increased by more than $30 million.

During development of the County's septic moratorium and septic overlay ordinance in 2018, the loading of 27,000 individual septic systems was modeled. These data were used to refine the amount of pollution from each subdivision county-wide to refine the cost benefit analysis for extending sewer service to these subdivisions. Highest priority septic systems located outside of highest priority subdivisions are funded for septic upgrades. Muck flux data collected at 50 of the largest muck accumulation areas in Brevard were used to improve estimates of muck impact on lagoon water quality and refine the costs and benefits of top dredging priorities.

The Save Our Indian River Lagoon Project Plan will continue to be updated annually to ensure the best available information is used to guide restoration of the Indian River Lagoon.

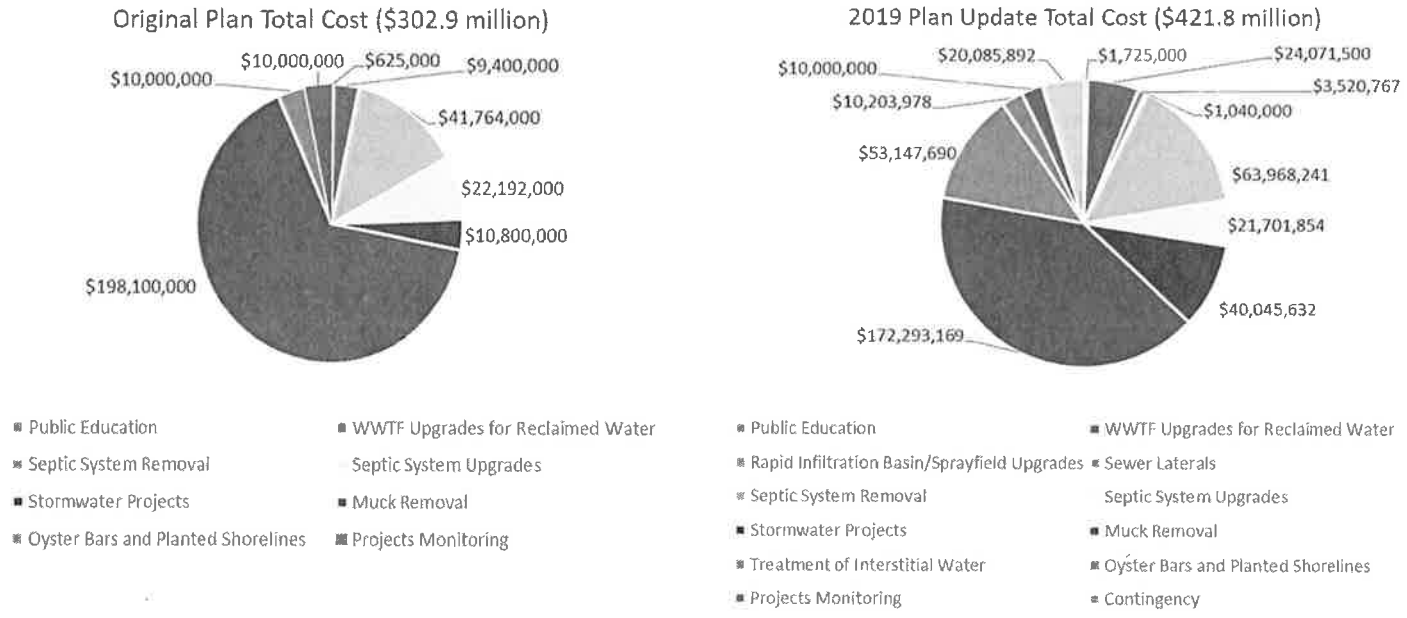
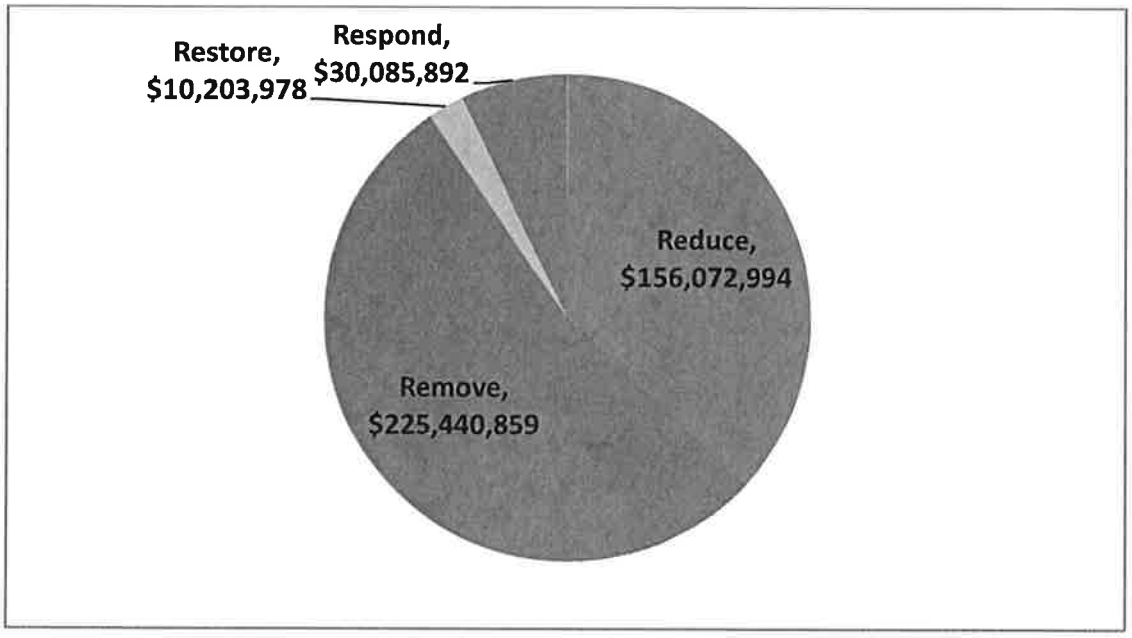
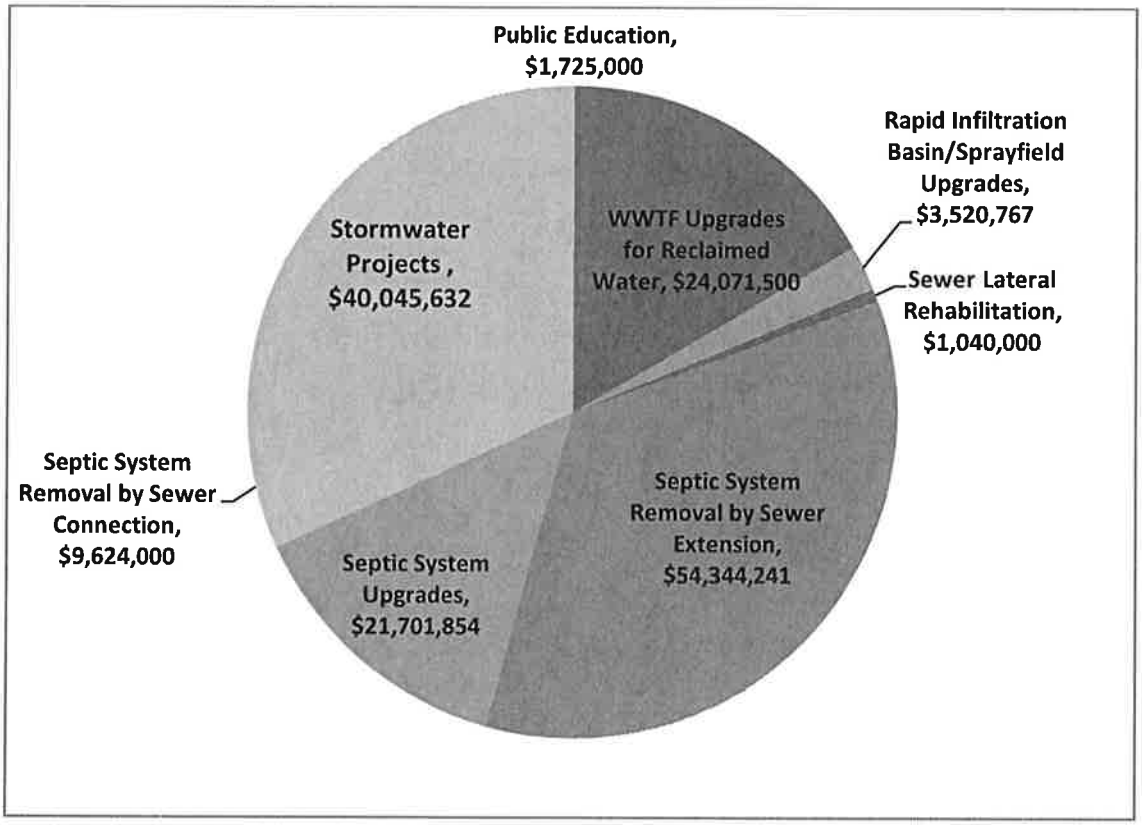


Figure 7-1: Comparison of the Original Plan Cost by Project Category (Left) versus the 2019 Plan Update Cost by Project Category (Right)

Funding Allocation in the Draft 2019 Plan Update



Funding Allocation for Projects that Reduce Pollution



History of County Commission Action on the Save Our Indian River Lagoon Program

In March 2016, Brevard County residents endured a brown tide that resulted in one of the largest fish kills recorded in the Indian River Lagoon. This fish kill followed a super bloom, several years of brown tides, and unusual mortality events for dolphins, manatees and pelicans. On March 29, 2016 the Board voted to send a letter to the Governor requesting assistance. The County was advised to develop a project plan to include a comprehensive list of projects to restore lagoon health, estimate the funding needs for those projects and determine a timetable for implementation. With such a plan, the County would be in a better position to seek dedicated cost-share from the Florida Legislature. On April 7, 2016 the County Commission directed staff to develop a Save Our Indian River Lagoon Project Plan to restore health to the lagoon and explore dedicated funding mechanisms.

On August 9, 2016 the Board adopted the Save Our Indian River Lagoon Project Plan. The Plan includes a portfolio of projects to **Reduce** primary sources of pollution (including excess fertilizer, septic systems, nutrient rich reclaimed water, and stormwater); **Remove** historical pollution that is now accumulated in muck deposits that smother seagrass, cloud the water column, release nutrients and deplete oxygen; **Restore** natural stabilization and filtration systems (including oyster bars and living shorelines); and a process to monitor project implementation, efficiency, and cost-effectiveness with a volunteer Citizen Oversight Committee to **Respond** to monitoring data, new technology, changing conditions, alternative project proposals and to recommend plan revisions to the County Commission annually.

On August 23, 2016, after considering multiple referendum options to provide dedicated funding to implement the Project Plan, and with the agreement of municipalities to work collaboratively with the County to implement a single lagoon plan rather than dividing the revenues between all the jurisdictions, the Board voted unanimously to place a 10-year, 1/2 Cent Infrastructure Sales Tax referendum on the November 8, 2016 ballot. The referendum was approved by 62.4% of Brevard County voters. On the same date, the Board adopted an ordinance that established a volunteer Citizen Oversight Committee, representing city and county residents, to provide public oversight, and a transparent process for plan updates recommended to the Board of County Commissioners annually.

When the Save Our Indian River Lagoon Project Plan was written during the summer of 2016, the Board was considering implementing a special taxing district that would have begun in fiscal year 2018. Therefore the plan was developed with a ten year implementation schedule that didn't begin until fiscal year 2018. When an infrastructure sales tax was approved, collections began January 1, 1017, making funds available nine months sooner than anticipated in the Project Plan. In order to accelerate recovery of Indian River Lagoon health and associated economic benefits, the County asked the community for shovel-ready projects that could proceed in FY 16-17, using these early revenues. In total, 42 substitute projects were recommended by the Citizen Oversight Committee and approved by the Board in 2017.

Numerous project acceleration and project substitution opportunities were reviewed by the Citizen Oversight Committee in 2017 and 2018 and their recommendations were adopted by the County Commission in the 2017 Plan Supplement and the 2018 Plan Update. A third round of project requests were solicited in the fall of 2018 and reviewed by the Citizen Oversight Committee for considered inclusion in the 2019 Update. Typically, project additions and substitutions replace the last and least cost-effective projects of the same type in the plan for the same sub-lagoon, thereby delivering comparable pollution reduction benefits, sooner, and at a reduced cost.

Table 7-1: Summary of New Projects for the Save Our Indian River Lagoon Plan 2019 Update

Year Added	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
2019	Big Muddy at Cynthia Baffle Box Expansion	City of Indian Harbour Beach	Nutrient Separating Baffle Box with Bold & Gold media. Expansion of treated area to 63.8 acres from 32 acres of previously approved project.	Banana	167	10	$25,837
2019	Basin 1304 Bioreactor	Brevard County	Installation of an upflow filter concrete box with a solar pump to treat baseflow at an existing wet detention pond.	Banana	958	127	$90,000
2019	M1 Canal Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	Central IRL	1,433	191	$66,300
2019	Fleming Grant Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	Central IRL	602	91	$16,800
2019	Espanola Baffle Box	City of Melbourne	Installation of new 2nd generation baffle box with biosorption activated media.	Central IRL	1119	148	$105,186
2019	Basin 1298 Bioreactor	Brevard County	Installation of an upflow filter concrete box with a solar pump to treat baseflow at an existing wet detention pond.	North IRL	917	116	$86,198
2019	Johns Road Pond Biosorption Activated Media	Brevard County	Wet detention pond bank retrofit with biosorption activated media.	North IRL	245	37	$23,030
2019	Burkholm Road Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	North IRL	685	104	$64,390
2019	Carter Road Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	North IRL	665	101	$62,510
2019	Wiley Road Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	North IRL	954	144	$82,735
2019	Broadway Pond Biosorption Activated Media	Brevard County	Wet detention pond bank retrofit with biosorption activated media.	North IRL	456	69	$42,864
2019	Cherry Street Baffle Box	City of Melbourne	Installation of new 2nd generation baffle box with biosorption activated media.	North IRL	980	174	$92,120
2019	Spring Creek Baffle Box	City of Melbourne	Installation of new 2nd generation baffle box with biosorption activated media.	North IRL	1057	232	$99,358
2019	Titusville High School Baffle Box	City of Titusville	Installation of 2nd generation baffle box with Bold & Gold media filter.	North IRL	1,190	166	$111,813
2019	Coleman Pond Managed Aquatic Plant System	City of Titusville	Installation of floating islands within a one-acre city-owned pond located within the Chain of Lakes basin.	North IRL	1,240	198	$35,000
2019	Cocoa Beach Water Reclamation Facility Upgrade	City of Cocoa Beach	Upgrade to systems to avoid the potential for plant overflows during power outages and/or storm flow conditions. Various improvements that include emergency power, automatic post-anoxic bypass and 6.0 million gallons per day filter upgrades.	Banana	3,278	1,092	$983,400

Year Added	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
2019	Osprey Basin Lateral Repair Project	City of Titusville	Smoke testing of gravity system and private sewer lateral repairs.	North IRL	640	0	$200,000
2019	Cocoa Beach Muck Dredging Phase II-B	City of Cocoa Beach	Dredge 12 residential canals.	Banana	6,300	840	$5,917,650
2019	Brevard Zoo Banana River Plant Project	Brevard Zoo	Plant 195 feet of qualifying shoreline vegetation within the Tortoise Island homeowners' association.	Banana	13	4	$3,120
2019	Brevard Zoo North IRL Plant Project	Brevard Zoo	Plant 50 feet of qualifying shoreline vegetation at St. Mark's School.	North IRL	3	1	$720
2019	Brevard Zoo Banana River Oyster Project	Brevard Zoo	Construct 36,894 square feet of oyster projects in the Banana River. Reached out to property owners in the project locations and have their support to move forward. The design will be site-specific and will be approved by the County before construction begins. Brevard Zoo will consult with the County to determine whether live oysters need to be added to each specific location.	Banana	1,476	37	$583,020
2019	Brevard Zoo Central IRL Oyster Project	Brevard Zoo	Construct 10,200 square feet of oyster projects in the Central IRL. Reached out to property owners in the project locations and have their support to move forward. The design will be site-specific and will be approved by the County before construction begins. Brevard Zoo will consult with the County to determine whether live oysters need to be added to each specific location.	Central IRL	408	10	$161,160
2019	Brevard Zoo North IRL Oyster Project	Brevard Zoo	Construct 21,600 square feet of oyster projects in the North IRL. Reached out to property owners in the project locations and have their support to move forward. The design will be site-specific and will be approved by the County before construction begins. Brevard Zoo will consult with the County to determine whether live oysters need to be added to each specific location.	North IRL	864	22	$341,280
-	***Total***	-	-	-	***25,650***	***3,914***	***$9,194,491***

Table 8-9b: *Timeline* for Funding Needs (Table 46 in the Original Save Our Indian River Lagoon Project Plan) with inflation

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
Public Education	-	-	-	-	-	-	-	-	-	-	-
Fertilizer Management	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$713,508	-	$125,000	$51,625	$53,303	$55,035	$56,824	$117,341	$60,577	$62,546	$64,579	$66,678
Grass Clippings	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$231,935	-	$20,000	$20,650	$21,321	$22,014	$22,730	$23,468	$24,231	$25,018	$25,832	$26,671
Excess Irrigation	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$339,919	-	$75,000	$25,813	$26,651	$27,518	$28,412	$29,335	$30,289	$31,273	$32,289	$33,339
Stormwater Pond Maintenance	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$339,919	-	$75,000	$25,813	$26,651	$27,518	$28,412	$29,335	$30,289	$31,273	$32,289	$33,339
Septic System Maintenance	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$339,919	-	$75,000	$25,813	$26,651	$27,518	$28,412	$29,335	$30,289	$31,273	$32,289	$33,339
WWTF Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Cocoa Beach	-	-	-	-	-	-	-	-
$1,015,361	-	-	$1,015,361	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	-	-	Cape Canaveral Air Force Station	-	-	-	-
$7,040,468	-	-	-	-	-	-	$7,040,468	-	-	-	-
North IRL	Titusville Osprey Design and Permitting	Titusville Osprey Design and Start Construction	Titusville Osprey Complete Construction	-	-	-	-	-	-	-	-
$8,195,000	$300,000	$1,700,000	$6,195,000	-	-	-	-	-	-	-	-
Central IRL	-	Palm Bay Permit and Engineering	Palm Bay Construction	-	-	-	-	-	-	-	-
$1,439,000	-	$200,000	$1,239,000	-	-	-	-	-	-	-	-
Central IRL	-	-	Melbourne Grant Street	-	-	-	-	-	-	-	-
$7,937,963	-	-	$7,937,963	-	-	-	-	-	-	-	-
Sewer Laterals	-	-	-	-	-	-	-	-	-	-	-
Satellite Beach Pilot	-	Satellite Beach Pilot Project	-	-	-	-	-	-	-	-	-
$840,000	-	$840,000	-	-	-	-	-	-	-	-	-
Titusville Osprey Pilot	-	-	Titusville Osprey Pilot Project	-	-	-	-	-	-	-	-
$206,500	-	-	$206,500	-	-	-	-	-	-	-	-
Rapid Infiltration Basin/ Sprayfield Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	-	-	-	Cape Canaveral Air Force Station	-	-	-
$3,031,924	-	-	-	-	-	-	-	$3,031,924	-	-	-
North IRL	-	-	-	-	Port St John	-	-	-	-	-	-
$1,078,799	-	-	-	-	$1,078,799	-	-	-	-	-	-
Central IRL	-	-	Indian River Shores Trailer Park	-	-	-	-	-	-	-	-
$39,385	-	-	$39,385	-	-	-	-	-	-	-	-
Septic Removal	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	Sykes M Engineering	-	Sykes Creek M	-	-	-	-	-	-	-	-
$1,921,444	$250,000	-	$1,671,444	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Sykes Creek N	-	-	-	-	-	-	-	-	-
$3,036,852	-	$3,036,852	-	-	-	-	-	-	-	-	-
Banana River Lagoon	Sykes T Engineering	-	-	Sykes Creek T	-	-	-	-	-	-	-
$5,248,797	$250,000	-	-	$4,998,797	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Near Gravity	Near Gravity	Near Gravity	Near Gravity	-	-	-	-	-
$1,168,628	-	-	$110,271	$341,564	$352,665	$364,127	-	-	-	-	-
Banana River Lagoon	-	-	Near Force Main	Near Force Main	Near Force Main	Near Force Main	-	-	-	-	-

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
$492,399	-	-	$46,463	$143,918	$148,595	$153,424	-	-	-	-	-
Banana River Lagoon	-	-	-	-	Merritt Island C	Merritt Island C	Merritt Island C	-	-	-	-
$3,260,750	-	-	-	-	$312,228	$1,450,688	$1,497,835	-	-	-	-
North IRL	South Central C Engineering	South Central C	-	-	-	-	-	-	-	-	-
$4,672,080	$450,000	$4,222,080	-	-	-	-	-	-	-	-	-
North IRL	Breeze Swept	-	-	-	-	-	-	-	-	-	-
$880,530	$880,530	-	-	-	-	-	-	-	-	-	-
North IRL	Merritt Island Redevelopment Agency	-	-	-	-	-	-	-	-	-	-
$320,000	$320,000	-	-	-	-	-	-	-	-	-	-
North IRL	-	-	Riverside Drive	-	-	-	-	-	-	-	-
$274,604	-	-	$274,604	-	-	-	-	-	-	-	-
North IRL	-	-	Cocoa K	-	-	-	-	-	-	-	-
$1,240,437	-	-	$1,240,437	-	-	-	-	-	-	-	-
North IRL	-	-	Roxy Avenue	-	-	-	-	-	-	-	-
$91,835	-	-	$91,835	-	-	-	-	-	-	-	-
North IRL	-	-	-	Cocoa J	-	-	-	-	-	-	-
$3,344,184	-	-	-	$3,344,184	-	-	-	-	-	-	-
North IRL	-	-	-	Rockledge	-	-	-	-	-	-	-
$533,646	-	-	-	$533,646	-	-	-	-	-	-	-
North IRL	-	-	-	Titusville A-G	-	-	-	-	-	-	-
$1,280,751	-	-	-	$1,280,751	-	-	-	-	-	-	-
North IRL	-	-	Near Gravity	Near Gravity	Near Gravity	Near Gravity	-	-	-	-	-
$3,847,280	-	-	$363,027	$1,124,476	$1,161,022	$1,198,755	-	-	-	-	-
North IRL	-	-	New Force Main	Near Force Main	Near Force Main	Near Force Main	-	-	-	-	-
$1,792,333	-	-	$169,124	$523,860	$540,885	$558,464	-	-	-	-	-
North IRL	-	-	-	-	South Central D	-	-	-	-	-	-
$2,975,346	-	-	-	-	$2,975,346	-	-	-	-	-	-
North IRL	-	-	-	-	-	South Central A	-	-	-	-	-
$3,830,574	-	-	-	-	-	$3,830,574	-	-	-	-	-
North IRL	-	-	-	-	-	-	South Central F	-	-	-	-
$1,997,113	-	-	-	-	-	-	$1,997,113	-	-	-	-
North IRL	-	-	-	-	-	-	-	Melbourne	-	-	-
$1,051,226	-	-	-	-	-	-	-	$1,051,226	-	-	-
North IRL	-	-	-	-	-	-	-	-	Sharpes A	-	-
$7,764,716	-	-	-	-	-	-	-	-	$7,764,716	-	-
Central IRL	Micco	-	-	-	-	-	-	-	-	-	-
$1,977,345	$1,977,345	-	-	-	-	-	-	-	-	-	-
Central IRL	Hoag	-	-	-	-	-	-	-	-	-	-
$86,031	$86,031	-	-	-	-	-	-	-	-	-	-
Central IRL	Penwood	-	-	-	-	-	-	-	-	-	-
$40,632	$40,632	-	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	-	Palm Bay B	-	-	-	-	-	-
$9,146,433	-	-	-	-	$9,146,433	-	-	-	-	-	-
Central IRL	-	-	Near Gravity	Near Gravity	Near Gravity	Near Gravity	-	-	-	-	-
$2,757,436	-	-	$260,190	$805,939	$832,132	$859,176	-	-	-	-	-
Central IRL	-	Sylvan Estates	-	-	-	-	-	-	-	-	-
$1,561,215	-	$1,561,215	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	-	Palm Bay A	-	-	-	-	-	-
$2,828,415	-	-	-	-	$2,828,415	-	-	-	-	-	-
Central IRL	-	-	Near Force Main	Near Force Main	Near Force Main	Near Force Main	-	-	-	-	-
$472,703	-	-	$44,604	$138,161	$142,651	$147,287	-	-	-	-	-
Septic Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-		45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	40 Upgrades
$8,463,346	-		$836,325	$863,508	$891,569	$920,546	$950,483	$981,353	$1,013,247	$1,046,178	$960,159

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North IRL	-		45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	40 Upgrades
$8,463,346	-		$836,325	$863,506	$891,569	$920,546	$950,463	$981,353	$1,013,247	$1,046,178	$960,159
Central IRL	Long Point	-	-	-	-	-	-	-	-	-	-
$101,854	$101,854	-	-	-	-	-	-	-	-	-	-
Central IRL	-		45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	40 Upgrades
$8,463,346	-		$836,325	$863,506	$891,569	$920,546	$950,463	$981,353	$1,013,247	$1,046,178	$960,159
Stormwater Projects	-	-	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	Cocoa Palms	Cape Shores Swales	-	-	-	-	-	-	-	-	-
$3,890	$1,144	$2,746	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	Carver Cove Swale	Justamere Road Swale	-	-	-	-	-	-	-	-	-
$3,344	$2,816	$528	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	Central Boulevard Baffle Box	Hitching Post Berms	-	-	-	-	-	-	-	-	-
$37,252	$34,700	$2,552	-	-	-	-	-	-	-	-	-
Banana - Indian Harbour Beach	Gleason Park Reuse	Big Muddy at Cynthia Baffle Box	Big Muddy Expansion	-	-	-	-	-	-	-	-
$72,596	$4,224	$41,695	$26,677	-	-	-	-	-	-	-	-
Banana - Cocoa Beach	-	-	Convair Cove 1 – Blakey Blvd	-	-	-	-	-	-	-	-
$4,801	-	-	$4,801	-	-	-	-	-	-	-	-
Banana - Cocoa Beach	-	-	Convair Cove 2- Dempsey Drive	-	-	-	-	-	-	-	-
$4,641	-	-	$4,641	-	-	-	-	-	-	-	-
Banana - Brevard	-	-	Basin 1304 Bioreactor	15 Projects	15 Projects	15 Projects	15 Projects	15 Projects	15 Projects	15 Projects	14 Projects
$14,545,804	-	-	$92,925	$1,838,947	$1,651,055	$1,704,714	$1,760,117	$1,817,321	$1,876,384	$1,937,366	$1,866,975
North IRL - Cocoa	Church Street Type II Baffle Box	-	-	-	-	-	-	-	-	-	-
$88,045	$88,045	-	-	-	-	-	-	-	-	-	-
North IRL - Titusville	-	St. Teresa Basin Treatment	Titusville High School Baffle Box	-	-	-	-	-	-	-	-
$388,247	-	$272,800	$115,447	-	-	-	-	-	-	-	-
North IRL - Titusville	-	South Street Basin Treatment	Coleman Pond Managed Aquatic Plant System	-	-	-	-	-	-	-	-
$122,994	-	$86,856	$36,138	-	-	-	-	-	-	-	-
North IRL - Titusville	-	La Paloma Basin Treatment	-	-	-	-	-	-	-	-	-
$208,296	-	$208,296	-	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Cliff Creek Baffle Box	Apollo/GA Baffle Box	-	-	-	-	-	-	-	-
$654,972	-	$347,781	$307,191	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Thrush Drive Baffle Box	Cherry Street Baffle Box	-	-	-	-	-	-	-	-
$417,314	-	$322,200	$95,114	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Stewart Road Dry Retrofit	Spring Creek Baffle Box	-	-	-	-	-	-	-	-
$120,931	-	$18,344	$102,587	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Kingsmill-Aurora Phase Two	Basin 1298 Bioreactor	-	-	-	-	-	-	-	-
$456,487	-	$367,488	$88,999	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Huntington Pond	Johns Road Pond	-	-	-	-	-	-	-	-
$128,498	-	$104,720	$23,778	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Flounder Creek	Burkholm Road	-	-	-	-	-	-	-	-

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		Pond									
$141,811	-	$75,328	$66,483	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Johns Road Pond	Carter Road	-	-	-	-	-	-	-	-
$170,054	-	$105,512	$64,542	-	-	-	-	-	-	-	-
North IRL - Brevard	-	-	Wiley Road	-	-	-	-	-	-	-	-
$85,424	-	-	$85,424	-	-	-	-	-	-	-	-
North IRL - Brevard	-	-	Broadway Pond	24 Projects	24 Projects	24 Projects	24 Projects	24 Projects	24 Projects	24 Projects	25 Projects
$24,171,212	-	-	$44,257	$3,597,940	$2,641,687	$2,727,542	$2,816,187	$2,907,713	$3,002,214	$3,099,786	$3,333,885
Central IRL - Palm Bay	Bayfront Stormwater Project	-	-	-	-	-	-	-	-	-	-
$30,624	$30,624	-	-	-	-	-	-	-	-	-	-
Central IRL - Melbourne	-	-	Grant Place Baffle Box	-	-	-	-	-	-	-	-
$85,162	-	-	$85,162	-	-	-	-	-	-	-	-
Central IRL - Melbourne	-	-	Espanola Baffle Box								
$108,605	-	-	$108,605								
Central - St. Johns River Water Management District	-	-	Crane Creek/M-1 Canal Flow Restoration	-	-	-	-	-	-	-	-
$2,100,047	-	-	$2,100,047	-	-	-	-	-	-	-	-
Central IRL - Brevard	-	-	M1 Canal								
$68,455	-	-	$68,455								
Central IRL - Brevard	-	-	Fleming Grant	2 Projects	2 Projects	2 Projects	2 Projects	2 Projects	-	-	-
$2,399,229	-	-	$17,346	$533,028	$440,281	$454,590	$469,385	$484,619	-	-	-
Muck Removal & Interstitial Treatment	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Cocoa Beach Phase III	Cocoa Beach Ph II-B	-	-	-	-	-	-	-
$10,312,547	-	-	$4,003,999	$6,308,548	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Merritt Island Canals								
$7,905,331	-	-	$7,905,331								
Banana River Lagoon	-	-	Indian Harbour Beach								
$9,357,816	-	-	$9,357,816								
Banana River Lagoon	-	71% Sykes Creek	29% Sykes Creek	-	-	-	-	-	-	-	-
$16,147,641	-	$10,000,000	$6,147,641	-	-	-	-	-	-	-	-
Banana River Lagoon	-	55% Grand Canal	20% Grand Canal	25% Grand Canal	-	-	-	-	-	-	-
$16,448,811	-	$10,000,000	$3,118,530	$5,330,281	-	-	-	-	-	-	-
Banana River Lagoon	-	-		-	-	-	-	25% Cocoa Beach Golf	25% Cocoa Beach Golf	25% Cocoa Beach Golf	25% Cocoa Beach Golf
$49,705,736	-	-	-	-	-	-	-	$11,836,787	$12,221,482	$12,618,680	$13,028,787
Banana River Lagoon	-	-	-	-	-	-	25% Port Canaveral South	50% Port Canaveral South	25% Port Canaveral South	-	-
$20,400,911	-	-	-	-	-	-	$4,938,425	$10,197,847	$5,264,639	-	-
Banana River Lagoon	-	-	-	-	Kent Drive	-	-		-	-	-
$1,764,733	-	-	-	-	$1,764,733	-	-		-	-	-
Banana River Lagoon	-	-	-	-	-	528 East					-
$1,594,326	-	-	-	-	-	$1,594,326					-
Banana River Lagoon	-	-	-	-	-	Patrick Air Force Base Borrow Pit-4	-	-	-	-	-
$455,521	-	-	-	-	-	$455,521	-	-	-	-	-
Banana River Lagoon		-	-	-	-	50% Patrick Air Force Base	50% Patrick Air Force Base	-	-	-	-
$9,489,941		-	-	-	-	$4,669,098	$4,820,843	-	-	-	-
Banana River Lagoon		-	-	-	-	-	50% Pineda	50% Pineda	-	-	-
$9,320,395		-	-	-	-	-	$4,585,680	$4,734,715	-	-	-
Banana River Lagoon		-	-	7.5% Canals	-	-	7.5% Canals			7.5% Canals	7.5% Canals

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$40,215,163		-	-	$8,812,983	-	-	$9,700,477			$10,677,345	$11,024,359
North IRL	Mims Outflow	-	-	-	-	-	-	-	-	-	-
$400,000	$400,000	-	-	-	-	-	-	-	-	-	-
North IRL	-	-	2% Eau Gallie Northwest	49% Eau Gallie Northwest	49% Eau Gallie Northwest	-	-	-	-	-	-
$10,845,796	-	-	$206,923	$5,234,376	$5,404,495	-	-	-	-	-	-
North IRL	-	1% Titusville East	4% Titusville East	25% Titusville East	30% Titusville East	40% Titusville East	-	-	-	-	-
$5,082,422	-	$46,094	$190,369	$1,228,476	$1,522,082	$2,095,400	-	-	-	-	-
North IRL	-	1% Titusville West	4% Titusville West	25% Titusville West	30% Titusville West	40% Titusville West	-	-	-	-	-
$3,977,547	-	$38,074	$148,985	$961,416	$1,191,194	$1,639,878	-	-	-	-	-
North IRL	-	1% National Aeronautics and Space Administration West	4% National Aeronautics and Space Administration West	25% National Aeronautics and Space Administration West	30% National Aeronautics and Space Administration West	40% National Aeronautics and Space Administration West	-	-	-	-	-
$5,524,372	-	$50,102	$206,923	$1,335,300	$1,654,437	$2,277,609	-	-	-	-	-
North IRL	-	1% National Aeronautics and Space Administration East	4% National Aeronautics and Space Administration East	25% National Aeronautics and Space Administration East	30% National Aeronautics and Space Administration East	40% National Aeronautics and Space Administration East	-	-	-	-	-
$12,595,567	-	$114,234	$471,784	$3,044,485	$3,772,116	$5,192,947	-	-	-	-	-
North IRL	-	-	-	-	50% Rockledge B	50% Rockledge B	-	-	-	-	-
$5,604,406	-	-	-	-	$2,757,395	$2,847,011	-	-	-	-	-
North IRL	-	-	-	2% Pineda	49% Pineda	49% Pineda	-	-	-	-	-
$6,718,970	-	-	-	$126,189	$3,242,697	$3,348,084	-	-	-	-	-
North IRL	-	-	-	-	-	15% Canals	-	-	15% Canals	-	-
$3,109,977	-	-	-	-		$1,480,446	-	-	$1,629,531	-	-
Central IRL	-	Turkey Creek	-	-	-	-	-	-	-	-	-
$215,000	-	$215,000	-	-	-	-	-	-	-	-	-
Central IRL	-	-	10% Mullet Creek Area	50% Mullet Creek Area	40% Mullet Creek Area	-	-	-	-	-	-
$5,609,577	-	-	$538,000	$2,777,425	$2,294,152	-	-	-	-	-	-
Central IRL	-	-	-	-	-	-	-	-	Goat Creek Area	-	-
$501,394	-	-	-	-	-	-	-	-	$501,394	-	-
Central IRL	-	-	-	-	-	-	-	-	15% Canals		15% Canals
$2,589,771	-	-	-	-	-	-	-	-	$1,253,486		$1,336,285
Oyster Bars	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Eden Isles	-	-	-	-	-	-	-	-	-
$21,805	-	$21,805	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Marina Isles	-	-	-	-	-	-	-	-	-
$26,700	-	$26,700	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Bettinger	-	-	-	-	-	-	-	-	-
$10,680	-	$10,680	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	McNabb	-	-	-	-	-	-	-	-	-
$34,056	-	$34,056	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Gitlin	-	-	-	-	-	-	-	-	-
$16,020	-	$16,020	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Brevard	-	-	-	-	-	-	-	-	-
$47,350	-	$47,350	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Brevard Zoo Banana River	-	-	-	-	-	-	-	-
$601,968	-	-	$601,968								
Banana River Lagoon	-	-	-	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,606 square feet Oysters
$4,167,930	-	-	-	$464,582	$479,681	$495,271	$511,367	$527,986	$545,146	$562,863	$581,035
North IRL	-	Bomalaski	-	-	-	-	-	-	-	-	-
$8,900	-	$8,900	-	-	-	-	-	-	-	-	-
North IRL	-	Oliver	-	-	-	-	-	-	-	-	-
$51,620	-	$51,620	-	-	-	-	-	-	-	-	-

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
North IRL	-	Indian River Drive	-	-	-	-	-	-	-	-	-
$13,258	-	$13,258	-	-	-	-	-	-	-	-	-
North IRL	-	-	Brevard Zoo North IRL	-	-	-	-	-	-	-	-
$352,372	-	-	$352,372	-	-	-	-	-	-	-	-
North IRL	-	-	-	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,894 square feet Oysters
$4,664,268	-	-	-	$519,892	$536,789	$554,234	$572,247	$590,845	$610,047	$629,874	$650,340
Central IRL	-	Coconut Point	-	-	-	-	-	-	-	-	-
$509,950	-	$509,950	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Park	-	-	-	-	-	-	-	-	-
$108,790	-	$108,790	-	-	-	-	-	-	-	-	-
Central IRL	-	Wexford	-	-	-	-	-	-	-	-	-
$31,150	-	$31,150	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Senior Resort	-	-	-	-	-	-	-	-	-
$30,304	-	$30,304	-	-	-	-	-	-	-	-	-
Central IRL	-	Turkey Creek	-	-	-	-	-	-	-	-	-
$122,055	-	$122,055	-	-	-	-	-	-	-	-	-
Central IRL	-	-	Brevard Zoo Central IRL	-	-	-	-	-	-	-	-
$166,398	-	-	$166,398	-	-	-	-	-	-	-	-
Central IRL	-	-	-	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters
$720,826	-	-	-	$80,345	$82,957	$85,653	$88,436	$91,311	$94,278	$97,342	$100,506
Planted Shorelines	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Cocoa Beach	-	-	-	-	-	-	-	-	-
$16,014	-	$16,014	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	McNabb	-	-	-	-	-	-	-	-	-
$5,760	-	$5,760	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Brevard Zoo Banana River	-	-	-	-	-	-	-	-
$3,221	-	-	$3,221	-	-	-	-	-	-	-	-
North IRL	-	Indian River Drive	-	-	-	-	-	-	-	-	-
$2,240	-	$2,240	-	-	-	-	-	-	-	-	-
North IRL	-	-	Brevard Zoo North IRL	-	-	-	-	-	-	-	-
$743	-	-	$743	-	-	-	-	-	-	-	-
Central IRL	-	Lagoon House	-	-	-	-	-	-	-	-	-
$23,961	-	$23,961	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Park	-	-	-	-	-	-	-	-	-
$18,480	-	$18,480	-	-	-	-	-	-	-	-	-
Central IRL	-	Turkey Creek	-	-	-	-	-	-	-	-	-
$24,960	-	$24,960	-	-	-	-	-	-	-	-	-
Project Monitoring	-	Year 1 Monitoring	Year 2 Monitoring	Year 3 Monitoring	Year 4 Monitoring	Year 5 Monitoring	Year 6 Monitoring	Year 7 Monitoring	Year 8 Monitoring	Year 9 Monitoring	Year 10 Monitoring
$11,596,748	-	$1,000,000	$1,032,500	$1,066,056	$1,100,703	$1,136,476	$1,173,411	$1,211,547	$1,250,923	$1,291,578	$1,333,554
Contingency	Year 0 Contingency	Year 1 Contingency	Year 2 Contingency	Year 3 Contingency	Year 4 Contingency	Year 5 Contingency	Year 6 Contingency	Year 7 Contingency	Year 8 Contingency	Year 9 Contingency	Year 10 Contingency
$22,804,408	$260,897	$1,823,628	$3,077,801	$2,962,133	$2,844,497	$2,212,386	$2,252,609	$2,080,179	$1,961,768	$1,712,032	$1,816,478
$478,892,568 (total)	***$5,478,842***	***$38,296,178***	***$64,633,817***	***$62,204,798***	***$55,534,432***	***$46,460,107***	***$47,304,787***	***$43,683,753***	***$41,197,133***	***$35,952,679***	***$38,146,044***

Draft Save Our Indian River Lagoon Project Plan 2019 Update
for
Brevard County, Florida

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Brevard COUNTY

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- **2018 Citizen Oversight Committee**:
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  - Space Coast Association of REALTORS®
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  - Brevard County Utility Services Department
  - Brevard County Property Appraiser Information Technology
  - Brevard County Budget Office

Photographs on cover:
Top from http://spacecoastdaily.com/2013/09/hands-across-lagoon-set-for-sept-28/
Bottom left from the Central Boulevard baffle box upgrade in the City of Cape Canaveral
Bottom middle from the muck dredging project in the City of Cocoa Beach
Bottom right from the Bomalaski oyster bar project in Merritt Island

List of Acronyms

IRL	Indian River Lagoon
lbs/yr	Pounds Per Year
TN	Total Nitrogen
TP	Total Phosphorus
WWTF	Wastewater Treatment Facility

Executive Summary

The Indian River Lagoon (IRL) system includes Mosquito Lagoon, Banana River Lagoon, and Indian River. This is a unique and diverse system that connects Volusia, Brevard, Indian River, St. Lucie, and Martin counties. The IRL is part of the National Estuary Program, one of 28 estuaries of National Significance, and has one of the greatest diversity of plants and animals in the nation. A large portion of the IRL system, 71% of its area and nearly half its length, is within Brevard County and provides County residents and visitors many opportunities and economic benefits.

However, the balance of this delicate ecosystem has been disturbed as development in the area has led to harmful impacts. Stormwater runoff from urban and agricultural areas, wastewater treatment facility (WWTF) discharges, septic systems, and excess fertilizer applications have led to harmful levels of nutrients and sediments entering the lagoon. These pollutants create cloudy conditions in the lagoon and feed algal blooms, both of which negatively affect the seagrass community that provides habitat for much of the lagoon's marine life. In addition, these pollutants lead to muck accumulation, which releases (fluxes) nutrients and hydrogen sulfide, depletes oxygen, and creates a lagoon bottom that is not hospitable to seagrass, shellfish, or other marine life.

Efforts have been ongoing for decades to address these sources of pollution. Despite significant load reductions, in the last five years, signs of human impact to the IRL system have been magnified. In 2011, the "superbloom" occurred, an intense algal bloom in the Mosquito Lagoon, Banana River Lagoon, and North IRL, as well as a secondary, less intense bloom in the Central IRL. There have also been recurring brown tides; unusual mortalities of dolphins, manatees, and shorebirds; and large fish kills due to low dissolved oxygen from decomposing algae.

Local governments and the St. Johns River Water Management District have been proactive in implementing projects over the last several decades. However, to restore the lagoon to health and prosperity, additional funds are needed to eliminate current excess loading and remove the legacy of previous excess loading. Therefore, the County placed a Save Our Indian River Lagoon ½ cent sales tax referendum on the ballot in November 2016, which passed and will provide a funding stream for the types of projects listed in this plan for Brevard County and its municipalities.

The Save Our Indian River Lagoon Project Plan outlines local projects planned to meet water quality targets and improve the health, productivity, aesthetic appeal, and economic value of the lagoon. Implementation of these projects is contingent upon funding raised through the ½ cent sales tax. This sales tax funding would also allow the County to leverage additional dollars in match funding from state and federal grant programs because the IRL ecosystem is valued not only in Florida but also nationally. Funding implementation of this plan would help to restore this national treasure. Lagoon ecosystem response may lag several years behind completion of nutrient reductions; however, major steps must begin now to advance progress on the long road to recovery.

In the development of this plan, Subject Matter Experts were consulted to provide feedback on the plan elements. The experts all agreed that there is a "critical mass" of nutrient reductions that must be achieved to see a beneficial result in the IRL. This critical level of nutrient reduction will be achieved through the implementation of the projects in this plan. During plan development, it was estimated that the benefit of restoring the lagoon has a present value of $6 billion and a cost of $300 million. Therefore, implementing this plan to restore the IRL is an excellent investment in the future of Brevard County's community and economy with a benefit to cost ratio of 20:1.

In order to restore the lagoon's balance, Brevard County seeks to accelerate implementation of a multi-pronged approach to **Reduce** pollutant and nutrient inputs to the lagoon from fertilizer, reclaimed water from WWTFs, septic systems, and stormwater; **Remove** the accumulation of muck from the lagoon bottom; **Restore** water-filtering oysters and related lagoon ecosystem services; and monitor progress to **Respond** to changing conditions, technologies, and new information by amending the plan to include actions that will be most successful and cost-effective for significantly improving the health, productivity, and natural resilience of the IRL.

The portfolio of projects in this plan were selected as the most cost-effective suite of options to achieve water quality and biological targets for the lagoon system. Investment has been distributed among a set of project types with complimentary benefits to reduce future risk of failure. Nearly half (originally one-third) of the effort and expense is split among multiple projects to reduce incoming load to healthy levels, restore natural filtration, measure success, and respond with annual plan updates. Slightly more than half (originally two-thirds) of the effort and expense is directed toward muck removal to address decades of past excess nutrient loading. Nitrogen and phosphorus released each year as muck decays are now larger than any current source of nutrient pollution to lagoon waters.

The plan projects have been prioritized and ordered to deliver improvements to the lagoon in the most beneficial spatial and temporal sequence so that the implementation of this plan is expected to result in a healthy IRL system. If a future project is ready to move forward earlier than scheduled in the plan, if such advancement is consistent with temporal sequencing goals in the plan and is recommended by the Citizen Oversight Committee, and if there are sufficient Trust Fund dollars available, the County Manager (for budget changes less than $100,000) or Brevard County Commission have the authority to adjust the project schedule at any time to ensure that approved projects funded in the plan move forward as soon as feasible.

This 2019 Update to the Save Our Indian River Lagoon Project Plan contains the third set of project updates, new approved projects, and schedule accelerations to the plan. Local stakeholders submitted projects to Brevard County for inclusion in the plan. The appointed Citizen Oversight Committee reviewed the submitted projects and made a recommendation to the Board of County Commissioners on which projects should be added to the Save Our Indian River Lagoon Project Plan. This update includes those projects that were reviewed by the Citizen Oversight Committee and approved for inclusion by the Board of County Commissioners.

A summary of the types of projects included in the plan, as well as the associated costs and total nitrogen (TN) and total phosphorus (TP) reduction benefits are shown in **Table ES-1**. The timing of the projects is shown in **Figure ES-1**. Despite the considerable cost of restoration, analysis demonstrates that the economic cost of inaction is double the cost of action. Furthermore, although there are many tangible and intangible benefits for saving the lagoon, the readily estimated return on investment for three benefits – tourism, waterfront property values, and commercial fisheries – is 10% to 26% depending on how quickly the actions in this plan can be completed.

Table ES-1: Summary of Project Types, Costs, and Nutrient Reductions in the 2019 Update of the Save Our Indian River Lagoon Project Plan (2016 dollars without inflation)

Project Category	Project Type	Estimated Total Project Cost	Nitrogen Reductions (lbs/yr)	Average Cost per Pound per Year of TN	Phosphorus Reductions (lbs/yr)	Average Cost per Pound per Year of TP
Reduce	Public Education	$1,725,000	35,253	$49	2,413	$715
	WWTF Upgrades for Reclaimed Water	$24,071,500	70,064	$344	10,865	$2,216
	Sewer Lateral Rehabilitation	$1,040,000	1,628	$639	188	$5,532
	Rapid Infiltration Basin/Sprayfield Upgrades	$3,520,767	48,562	$73	5,060	$696
	Septic System Removal by Sewer Extension	$54,344,241	53,682	$1,012	To be determined	To be determined
	Septic System Removal by Sewer Connection	$9,624,000	20,113	$452	To be determined	To be determined
	Septic System Upgrades	$21,701,854	25,248	$860	To be determined	To be determined
	Stormwater Projects	$40,045,632	315,490	$127	47,209	$848
Remove	Muck Removal	$172,293,169	249,226	$691	20,735	$8,309
	Treatment of Muck Interstitial Water	$53,147,690	597,441	$89	38,628	$1,376
Restore	Oyster Bars	$10,108,723	25,302	$400	1,187	$8,516
	Planted Shorelines	$95,255	397	$240	135	$706
Respond	Projects Monitoring	$10,000,000	-	-	-	-
	Contingency	$20,085,892	-	-	-	-
Total	***Total***	***$421,803,723***	***1,442,406***	***$292 (average)***	***126,420***	***$3,337 (average)***

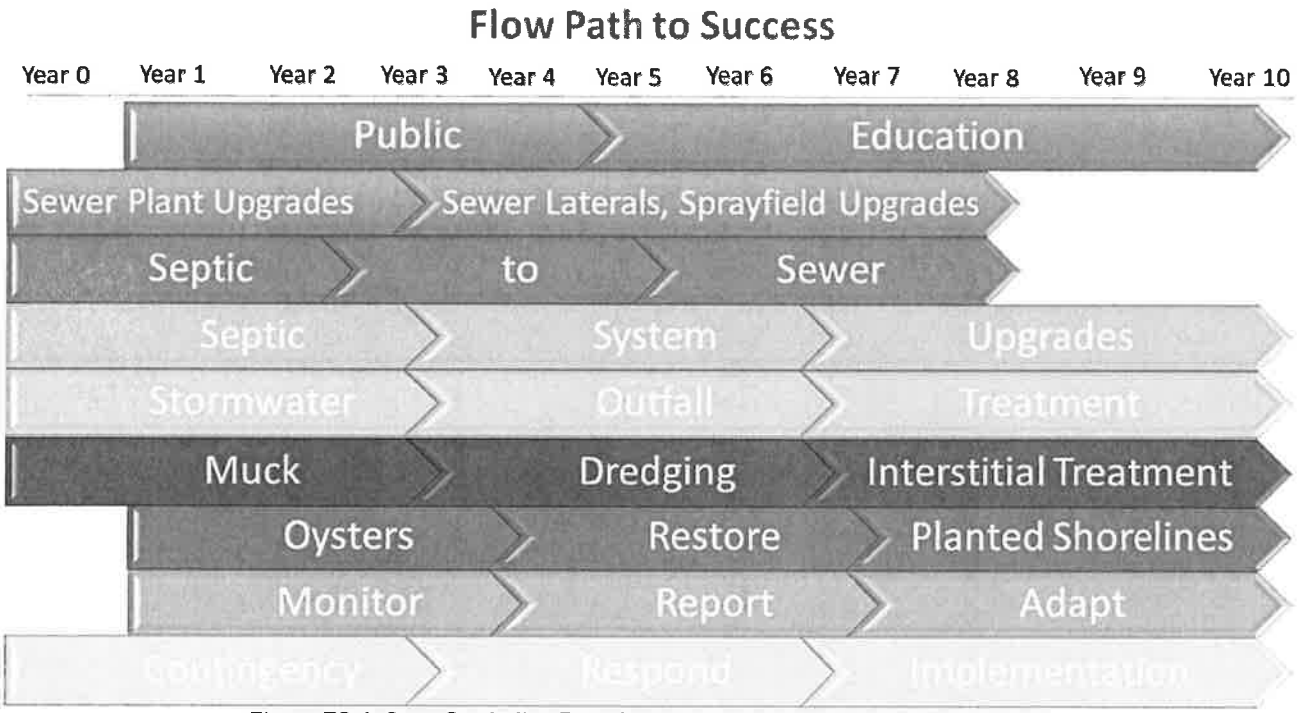


Figure ES-1: Save Our Indian River Lagoon Project Implementation Schedule

Section 1. Background

The Indian River Lagoon (IRL) system includes Mosquito Lagoon, Banana River Lagoon, and Indian River. A large portion of the IRL system, 71% of its area and nearly half its length, is within Brevard County (County) and provides County residents and visitors many opportunities.

However, the balance of this delicate ecosystem has been disturbed as development in the area has led to harmful impacts. Stormwater runoff from urban and agricultural areas, wastewater treatment facility (WWTF) discharges, septic systems, and excess fertilizer applications have led to harmful levels of nutrients and sediments entering the lagoon. In addition, these pollutants lead to muck accumulation on the lagoon bottom, which fluxes nutrients and creates a lagoon bottom that is not conducive to seagrass, shellfish, or benthic invertebrate growth.

Efforts have been ongoing to address these sources of pollution. The Indian River Lagoon System and Basin Act of 1990 (Chapter 90-262, Laws of Florida) was enacted to protect the IRL system from WWTF discharges and the improper use of septic tanks. The act includes three objectives: elimination of surface water discharges, investigation of feasibility of reuse, and centralization of wastewater collection and treatment facilities (Florida Department of Environmental Protection 2016). This act led to the removal of effluent discharges to the lagoon from more than 40 WWTFs (St. Johns River Water Management District 2016a).

Stormwater regulations were adopted in unincorporated Brevard County in 1978 and adopted statewide in 1989. Due to stormwater regulations, stormwater treatment systems were constructed along with all new development exceeding size thresholds. Privately owned and operated stormwater treatment systems have prevented more than a million pounds of sediments from entering the lagoon since 1989 (St. Johns River Water Management District 2016a). Stormwater treatment projects also reduce nutrient inputs to the lagoon. In addition, dredging projects have been ongoing since 1998 to remove muck from the lagoon and major tributaries, including Crane Creek, Turkey Creek, and St. Sebastian River (St. Johns River Water Management District 2016a). These stormwater treatment and muck removal projects contributed to significant improvements in water quality and water clarity in the lagoon, which allowed for a great expansion of seagrass from 2000-2010.

However, in the last five years, human impacts on the IRL system have been magnified. In 2011, the "superbloom" occurred, an intense algal bloom in the Mosquito Lagoon, Banana River Lagoon, and North IRL, as well as a secondary, less intense bloom in Central IRL. The extent and longevity of the bloom had a detrimental impact on seagrass. There have also been recurring brown tides; unusual mortalities of dolphins, manatees, and shorebirds; and large fish kills due to low dissolved oxygen from decomposing algae.

In 2009, to improve lagoon water quality and restore seagrass, the Florida Department of Environmental Protection adopted total maximum daily loads for total nitrogen (TN) and total phosphorus (TP) allowed to discharge to the Banana River Lagoon, North IRL, and Central IRL. The purpose of these total maximum daily loads is to reduce nutrients that lead to algae growth, which block sunlight from seagrass and create low dissolved oxygen conditions that affect fish in the lagoon. To implement these total maximum daily loads, the Florida Department of Environmental Protection adopted three basin management action plans that outline responsibilities for reductions by the local stakeholders, list projects, and stipulate a timeline for implementation. The intent of the nutrient reductions is to provide water quality conditions that should result in seagrass growth in the lagoon at historical levels. Brevard County has a major

responsibility in all three basin management action plans along with its 16 municipalities, Florida Department of Transportation District 5, Patrick Air Force Base, National Aeronautics and Space Administration – Kennedy Space Center, and agriculture.

Since 2012, Brevard County has led an effort with its municipalities, Florida Department of Transportation District 5, and Patrick Air Force Base to update the estimates of nutrient loadings to the lagoon. The County and its partners teamed with several consultants to develop the Spatial Watershed Iterative Loading model that revised the estimates of loading by source to the lagoon (refer to **Section 2** for more details) and to update the total maximum daily loads. The loading estimates and total maximum daily load targets referenced in this plan are from these efforts, as they are based on the most up-to-date data and analyses.

Damage to the lagoon has been occurring for decades and will require time and money to reverse. An important example is the accumulation of muck on the bottom of 10% of the IRL. This muck kills marine life and releases stored pollutants into the IRL. To address the damage to the IRL system, in 1990, Brevard County implemented a stormwater utility assessment, which established an annual assessment rate of $36 per year per equivalent residential unit that stayed at this level until 2014. The rate increased to $52/equivalent residential unit for 2014 and 2015 and increased to $64/equivalent residential unit in 2016. This raised collections from $3.4 million (in 2014) to $6.0 million (projected for 2016). Of the funding raised, a portion is available for capital improvement programs or other stormwater best management practices and is split between water quality improvement programs and flood control and mitigation programs. In addition, funding is spent on annual program operating expenses. Operation and maintenance includes National Pollutant Discharge Elimination System permit compliance activities (street sweeping, trap and box cleaning, and aquatic weed harvesting), outfall/ditch treatments, small scale oyster restoration, as well as harvesting and replanting of floating vegetative islands.

While revenues from this stormwater assessment, over the last 10 years, have funded many projects, a significant portion of projects have been partially funded by grants. When applicable, federal water quality grants provide up to 60% matching funds, state total maximum daily load grants provide up to 50% match, and St. Johns River Water Management District cost-share grants fund up to 33% of construction. All these grant programs are highly competitive and subject to variable state and federal appropriations, as well as changing priorities.

Due to funding limitations and the continuing degradation of key indicators of health in the IRL, such as seagrass and fish, Brevard County identified a need for additional funding to implement projects identified as critical to lagoon restoration. Therefore, the County placed a Save Our Indian River Lagoon ½ cent sales tax referendum on the ballot in November 2016. This referendum passed by more than 60% of the votes and will provide a funding mechanism for the projects listed in this plan (or future annual updates) for the County and its municipalities. Revenue collection from the sales tax began in January 2017.

This Save Our Indian River Lagoon Project Plan outlines projects planned to meet updated total maximum daily load targets and improve the health, productivity, aesthetic appeal, and economic value of the lagoon. Almost all these projects require sales tax funding for these projects to be implemented. Furthermore, the local sales tax funding could be used to leverage significantly more in match funding from state and federal grant programs. The IRL ecosystem is an asset valued not only in Florida but also nationally; therefore, implementation of this plan would help to restore this national treasure. If additional funding is provided through matching funds from other sources, additional projects may be implemented, which would increase the overall plan cost, and/or project timelines may be moved up to allow the benefits of those projects to occur earlier

than planned. Response of the lagoon ecosystem may lag for several years behind completion of nutrient reduction implementation; however, action must be accelerated now to ensure restoration succeeds over time.

1.1. Return on Investment and Economic Value

The economic value of the lagoon system was evaluated during development of this plan. It was estimated that at least a total present value of $6 billion is tied to restoration of the IRL. There is approximately $2 billion in benefits from restoration and an estimated $4 billion in damages if the IRL is not brought back to health during the next decade. If viewing this project plan purely as a financial investment that pays the $2 billion in benefits alone (i.e. not counting the avoidance of the $4 billion loss), the projected pretax internal rate of return is 10%, if the plan takes 20 years to implement. However, if the County were to bond the sales tax revenue to accelerate implementation of this plan over 5 years instead of 20 years, the return on investment rises significantly to 26% because the benefits of restoration would begin to accrue much faster. Based on the sensitivity of the rate of return to the speed of plan implementation, it would be financially responsible and beneficial for the County to borrow money at a typical 4% annual bond rate to accelerate implementation to achieve the 26% return on investment. In annualized terms, borrowing $300 million at 4% to achieve a steady 26% annual return would contribute $63 million in annual positive cash flow; making bonding an excellent investment choice.

Table 1-1 documents projections of three economic engines likely to have significant economic impacts on Brevard County residents with positive impacts if the IRL is restored versus negative impacts if the IRL is not restored. Additional detail on each of these impacts is provided in **Section 1.1.1**. The upper part of the table lists the economic benefits for restoring a healthy IRL while the lower part of the table lists the economic costs of declining IRL health in the absence of restoration through plan implementation.

Economic impacts in the table are expressed both as annual cash flows and as the discounted expected present value of those cash flows over a 30-year financial plan period. Expected present value is an economic indicator used in business to express the present monetary value of a future stream of cash flows. This expected monetary value discounts the future stream by an interest rate and discounts it further by a probability factor to account for the uncertainty of future events. Therefore, the expected present value of IRL economic benefits shown in **Table 1-1** is much less than the sum of those future cash flows.

Table 1-1: Economic Impact Scenarios Based Upon the Condition of the IRL

Economic Benefits for Restoring a Healthy IRL	Annual Cash Flow	Expected Present Value
Tourism and Recreation Growth	$95 million	$997 million
Property Value Growth	$81 million	$852 million
Rebirth of Commercial Fishing (excludes indirect benefits)	$15 million	$159 million
Healthy Residents and Tourists	Not quantified	Not quantified
Total Benefits	***$191 million***	***$2.01 billion***

Economic Costs of Declining IRL Health	Annual Cash Flow	Expected Present Value
Tourism and Recreation at Risk	-$237 million	-$3 billion
Property Value at Risk	-$92 million	-$1.2 billion
Decline of Commercial Fishing (excludes indirect impacts)	-$6 million	-$87 million
Potential Pathogen Impacts to Residents and Tourists	Not quantified	Not quantified
Total Damages	***-$335***	***-$4.29 billion***

Today there is a $6 billion decision point for the IRL. Despite unprecedented algae blooms and fish kills, conditions could become worse. If large-scale fish kills continue with increasing frequency, algae blooms continue or become toxic, or there is a pathogen outbreak, then real estate, tourism, and the quality of life and health for Brevard County residents would likely suffer.

1.1.1 Areas of Economic Value at Risk

Tourism and Recreation

Today's tourism revenue in Brevard County comes primarily from the beaches. To diversify the tourism base and increase revenue, Brevard County has developed a plan to increase ecotourism, a globally growing and high value sector of tourism that depends on restoration and maintenance of a healthy IRL. High value ecotourism relies on exceptional natural experiences including fishing, bird watching, kayaking, paddle boarding, camping, hiking, and nature tours. In the short-term, there are opportunities for tourists to participate in restoration experiences, such as collecting mangrove seeds by kayak or canoe, planting mangrove seedlings, or establishing colonies of clams, oysters, or mussels. A successful example of Brevard County ecotourism is the world famous annual Space Coast Birding and Wildlife Festival that brings $1.2 million annually to the County and attracts approximately 5,000 visitors.

Property Value

While the economic benefits of IRL restoration are likely to increase property value throughout the County, to be conservative this plan assessed the exposure only to properties with frontage on Mosquito Lagoon, IRL, Banana River Lagoon, Sykes Creek, and connected waterways. Approximately 11.2% of the County's $27 billion in taxable property value is directly on the IRL. Therefore, more than $3 billion in taxable property value is directly at risk with ongoing IRL issues, such algal blooms and fish kills. Furthermore, a weighted-average millage rate of 18.58 results in an estimated annual tax revenue of $56 million that is also at risk in the absence of IRL restoration. The $852 million of incremental expected present value assumes a 20% improvement in IRL frontage property value, which would be 90% likely after 10 years with the IRL restored.

Consultants for the County surveyed the Space Coast Association of REALTORS® to assess the likely impacts of IRL health on the waterfront property value. Approximately 170 REALTORS® most familiar with the waterfront market replied to the survey. These professionals assessed that waterfront IRL property values would increase 22% on average over five years if the IRL were healthy and would decrease by 25% over five years if the lagoon were not restored.

Commercial Fishing

IRL restoration is critical to the recovery of a once thriving, valuable, and world-class fishery, both commercial and recreational. In 1995, the commercial fish harvest in Brevard County was $22 million annually. While a 1995 ban on commercial net fishing marked economic decline, the degradation of the lagoon system contributed considerably to a severe reduction in value of only $6.7 million annually in 2015, based on Florida Fish and Wildlife Conservation Commission data (see **Figure 1-1**). These numbers do not include the many indirect benefits of a robust commercial fishing industry including fresh local fish for restaurants, employment, commerce of supplies and services for the industry, and benefits of local fresh fish for residents and visitors.

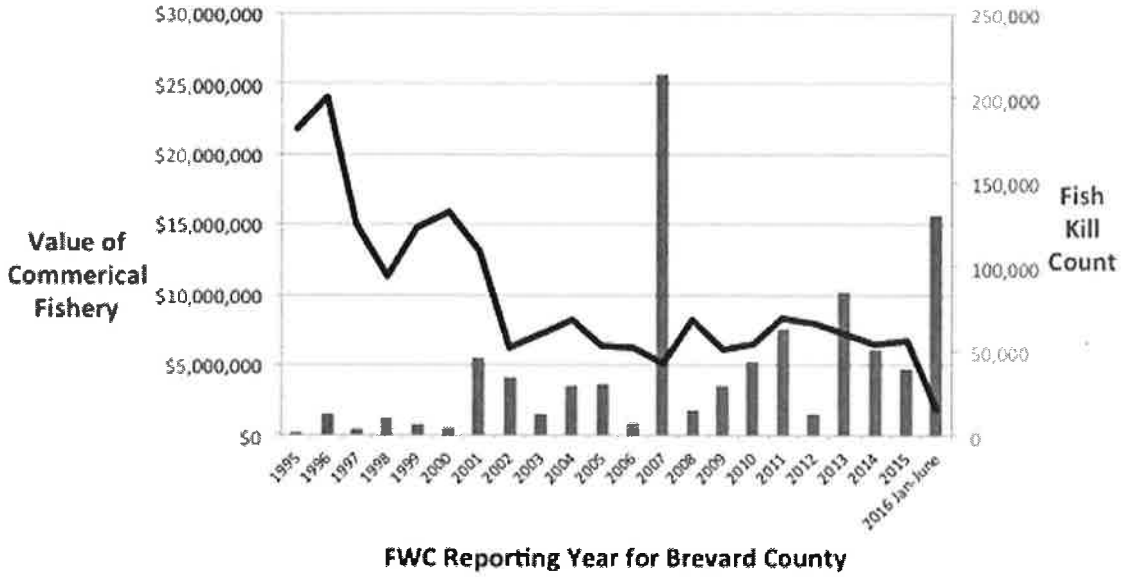


Figure 1-1: Decline of Commercial Fishing and Increasing Fish Kill Severity

In addition, a healthy fish population is critical to the brand of any coastal community. Historically Brevard County was once home to a world-class abundance and diversity of rare and widespread species of fish, crabs, shrimp, and clams that made the IRL a global brand. That brand can be restored along with the fish and shellfish of the IRL.

Healthy Residents and Tourists

There are almost 82,000 permitted septic systems within Brevard County, of which nearly 59,500 septic systems pollute groundwater that migrates to the lagoon. This groundwater moves slowly toward the lagoon through soils that attenuate some but not all these pollutants. It would cost at least $1.19 billion to convert all 59,500 septic tanks to central sewage treatment. While total conversion is cost prohibitive, this plan targets the septic systems with the highest potential impacts to the lagoon. Targeted action includes connection to the central sewer system or upgrade to advanced treatment systems that remove significantly more nutrients and pathogens than traditional septic systems.

Although there are studies that have identified pathogens migrating from septic systems into waterways, it is not possible to estimate the economic impact of potential disease from these waterborne pathogens. The conversion of septic systems is expensive relative to other types of nutrient reduction projects; however, the additional health benefits associated with septic system upgrades make this option a priority beyond only the abatement of nutrients.

1.2. Maximizing Benefits and Managing Risk

There is much at stake with regard to both economic outcomes and the incremental funding critical to restoration; therefore, the County chose to address the unavoidable risks inherent in a multi-year, large-scale restoration plan in a transparent and objective manner. To help ensure objectivity, the County retained outside consultants to assess risk and to estimate potential positive or negative outcomes.

The approach for this plan to evaluate the different project options included using expected monetary value models; a decision science tool used in business to improve decision-making and

planning in a context of unavoidable uncertainty. Expected monetary value is a financial model of probability-weighted outcomes expressed in quantified financial terms that are comparable across multi-year planning periods. To compare outcomes, expected present value was used as a key metric. Expected present value has the benefit of valuing future financial costs and benefits in common present day terms to take into account the value of time and to facilitate comparisons of initiatives spanning long periods of time.

As part of this methodology, consultants engaged Subject Matter Experts to assess the uncertainties of project scenarios. Subject Matter Experts include scientists, property value experts, tourism experts, lagoon advocates, and agency staff. Subject Matter Experts brought expertise in IRL science, nutrient reduction technologies, waterborne pathogens, and relevant law or county financial and accounting parameters needed for the expected monetary value models. Information gathered during these assessments was used to document the key interdependence of initiatives, minimize risk, and maximize the likely return on investment.

1.2.1 Project Selection to Maximize Return on Investment

Assessment of risk by Subject Matter Experts determined that the amount and speed of nutrient reductions are the two most critical factors affecting the success of restoring IRL health. Therefore, those projects with the greatest nutrient reduction benefit for the least cost are recommended for funding and, of those, the projects with the greatest benefits are planned for implementation first. Three other key criteria drove this plan:

1. Achieving sufficient nutrient abatement through a blend of options was a key success factor for restoration.
2. No one type of project alone could achieve an adequate nutrient abatement.
3. The target for nutrient reduction must be sufficient to minimize the need for recurring expensive muck removal, which is important for future cost avoidance.

The plan sequences a diversity of project types, implementing the highest nutrient reduction impact early and implementing other projects concurrently to achieve a multi-pronged blend of total nutrient abatement as quickly as possible with minimal risk. Another important consideration for project sequencing was how quickly projects could produce significant nutrient pollution reduction. For decades, man-made nutrient pollution from fertilizers, septic systems, and stormwater runoff have been introduced at varying distances from the IRL. The soils are still saturated with those nutrients. Therefore, if all sources of nutrient pollution ended today, groundwater would continue to transport nutrients accumulated in the soil into the IRL with every rain event for decades in the future. However, soils next to the IRL will purge themselves quickly, in days or weeks. Septic system conversions near the lagoon or near drainage conduits into the lagoon are likely to produce water quality and reduced pathogen benefits in the lagoon in weeks or months whereas septic conversions more distant from waterways are not anticipated to generate lagoon benefits for several decades. Therefore, whenever possible, project selection and sequencing scheduled nutrient abatements closest to the IRL first.

Undoing the damage to a unique and complex biological system as large as the IRL carries inherent risk. The County made the decision to be open and transparent about that risk. Assessing that risk diligently has allowed the County to mitigate and manage risk proactively in the development of this plan.

Two subjective risk assessments were conducted by an independent consultant working with top science Subject Matter Experts most knowledgeable about the IRL. The first assessment was

conducted with individual Subject Matter Experts and occurred before plan projects were defined. These experts assessed that the likelihood of a healthy fish population in the IRL would begin to rise faster after reaching a critical point of nutrient reduction. Therefore, there is a "critical mass" of nutrient reduction needed to achieve significant and sustainable IRL health benefits. The Subject Matter Experts also assessed that the likelihood of recovery would continue to improve as more nutrients are removed from the IRL and then begin to decline if too many nutrients were removed. The result of that first risk assessment reinforced the objective of reducing nutrients in the IRL as quickly as possible through the definition and sequencing of the projects in this plan.

A second uncertainty assessment was conducted in a meeting at the Florida Institute of Technology with a group of water quality, toxicity, muck, fish, algae, invertebrates, and seagrass Subject Matter Experts. First, the experts were briefed about the projects proposed in this plan. The experts were then asked their subjective assessment of the likelihood of a healthy lagoon after this plan was implemented in each sub-lagoon. Sub-lagoons were assessed because the experts had commented previously that each sub-lagoon functioned differently. This group assessment indicated higher likelihoods of success than the first assessment. However, the scientists continued to voice concern about the restoration of the IRL in the absence of regulatory reform needed to prevent new development from adding more septic system and stormwater pollution to the lagoon. Therefore, updated regulations are needed as a complement to this plan to ensure timely and sustained success in restoring health to the IRL.

Figure 1-2 represents the input from the Subject Matter Experts.

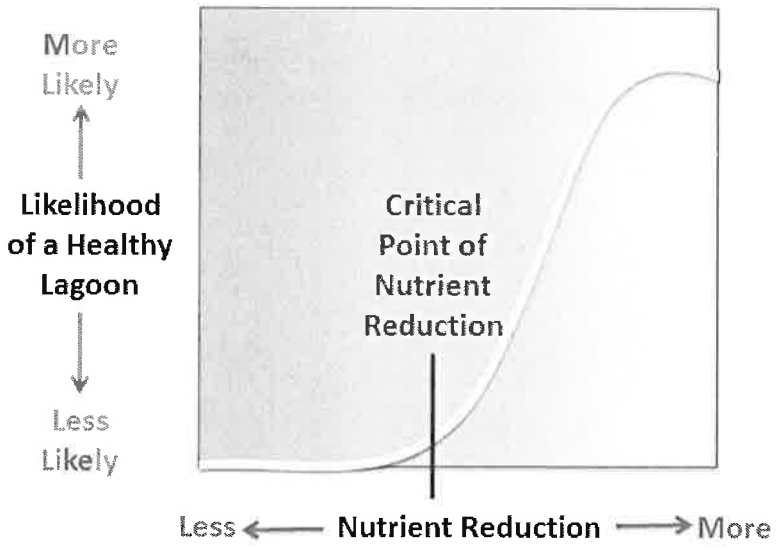


Figure 1-2: Likelihood of a Healthy IRL as Nutrients are Removed

There are other large-scale aquatic system restoration efforts that have been successful in achieving restoration. Some of these systems were damaged even more so than the IRL, but they have recovered through the implementation of extensive, multi-year, and multi-pronged restoration plans. These include the Chesapeake Bay, Cuyahoga River, Lake Erie, and Tampa Bay. These areas have reaped enormous economic and quality of life benefits as a result of dedicated investments in their restoration.

Section 2. Approach

The amount and distribution of nutrient loading from the sources described in **Section 3** were examined to determine the key locations where nutrient reduction projects are needed and the extent of reductions required from each source to achieve the County's proposed total maximum daily loads for each sub-lagoon. For each source, a reduction goal is set and projects are proposed to meet the goal. The estimated cost for each project is also included. Information on expected project efficiencies and project costs were gathered from data collected by the County in implementation of similar projects, as well as literature results from studies in Florida, where available, and across the country. The most cost-effective projects are selected and prioritized to maximize the nutrient reductions that can be achieved.

2.1. Plan Focus Area

This plan focuses on projects implemented in three sub-lagoons in the IRL system: Banana River Lagoon, North IRL, and Central IRL. **Figure 2-1** shows the locations of these sub-lagoons. All the Banana River Lagoon watershed and the majority of the North IRL watershed are located within Brevard County. However, only a portion of the Central IRL watershed is located within the County. As shown in **Figure 2-1**, Central IRL Zone A is located entirely in Brevard, whereas Zone SEB straddles Brevard and Indian River Counties. For Zone SEB, the County has completed several projects in this area and the St. Johns River Water Management District is completing projects along the C-54 Canal and on the Wheeler property to treat the Sottile Canal. The reductions from these projects (in pounds per year [lbs/yr]) should be sufficient to meet the required reductions in the Brevard County portion of Zone SEB, as shown in **Table 2-1**. This plan includes some additional beneficial projects located in Zone SEB to help ensure that the necessary reductions are achieved throughout Brevard County; however, most of the projects proposed in this plan for the Central IRL fall within Central IRL Zone A.

Table 2-1: Summary of Load Reductions and Projects in Central IRL Zone SEB

Category	TN Load (lbs/yr)	TP Load (lbs/yr)
Stormwater and Baseflow Loading	248,233	34,901
Atmospheric Deposition Loading	22,371	404
Point Sources Loading	0	0
Total Loading	270,604	35,305
5-month Total Maximum Daily Load Percent Reductions	38.0%	35.0%
Required Reductions	***102,830***	***12,357***
Completed County Projects (2010-February 2016)	29,890	9,643
C-54 Project	65,974	10,558
Wheeler Property Project	36,582	21,784
Total Project Reductions	***132,446***	***41,985***
% of Required Reductions Achieved	***128.8%***	***339.8%***

In addition, a small portion of the County is located within the Mosquito Lagoon. Brevard County does not have stormwater outfalls, septic systems, or point sources in this sub-lagoon.

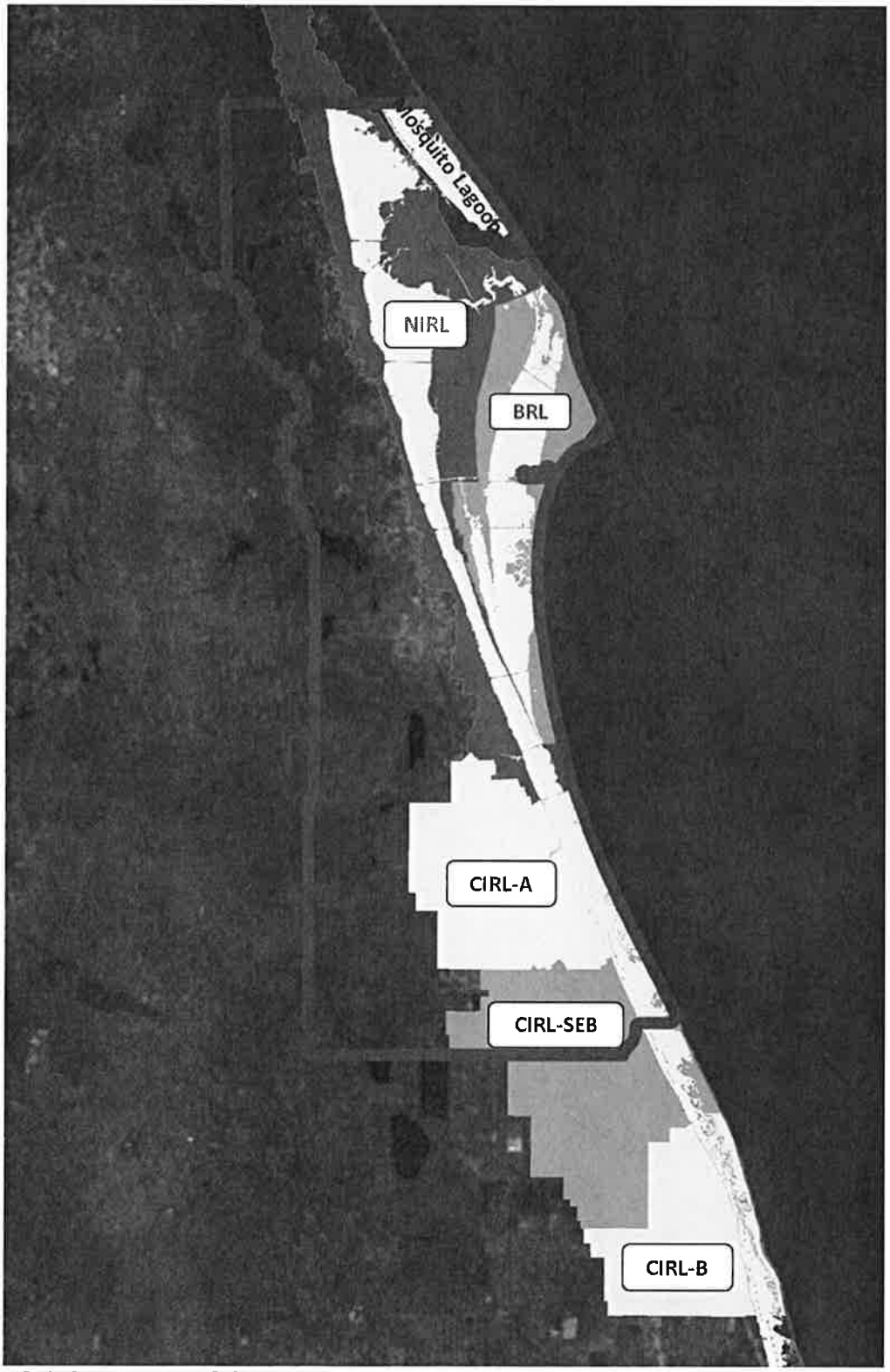


Figure 2-1: Locations of the Banana River Lagoon (BRL), North IRL (NIRL), and Central IRL (CIRL) Sub-lagoons

Section 3. Pollutant Sources in the IRL Watershed

Pollutant loads in the IRL watershed are generated from multiple external sources that discharge to the lagoon. Excess loads also accumulate in nutrient sinks within the lagoon, which release nutrients to the water column during certain conditions.

External sources fall into the following major categories:

- Stormwater runoff that occurs when rainfall hits the land and cannot soak into the ground:
  - Urban stormwater runoff is generated by rainfall and excess irrigation on impervious areas associated with urban development. Urban runoff picks up and transports nutrient loading from fertilizers, grass clippings, and pet waste, as well as other pollutants including sediments, pesticides, oil, and grease. Stormwater ponds and baffle boxes reduce the nutrient loading in stormwater; however, proper maintenance of these systems is necessary to maintain their performance.
  - Agricultural stormwater runoff occurs on agricultural land and this runoff also carries nutrients from fertilizers, as well as livestock waste, pesticides, and herbicides. This source of stormwater runoff is not addressed in this plan as the County does not have jurisdiction over agricultural use. The Florida Department of Agriculture and Consumer Services has an agricultural best management practice program, and they work with agricultural producers to control the loading from this source.
  - Natural stormwater runoff comes from the natural lands in the basin. This source is not addressed by this plan as natural loading does not need be controlled.
- Baseflow is the groundwater flow that contributes loading to the IRL. Due to the sandy soils in the basin and excess irrigation, nutrients can soak quickly into the groundwater with little removal. This groundwater can recharge surface water in ditches, canals, tributaries, or the IRL.
  - Excess fertilizer that soaks into the ground past the root zones.
  - Septic systems, both functioning and failing, contribute nutrient loading to the groundwater.
  - Leaking sewer pipes located above the water table can contribute nutrient loading to the groundwater.
- Atmospheric deposition that falls on both the land and the lagoon itself:
  - Nutrients in the atmosphere fall into the basin largely during rainfall events. The sources of these nutrients are from power plants, cars, and other sources that burn fossil fuels. However, because of atmospheric conditions and weather patterns, not all the nutrients from atmospheric deposition are generated within the watershed. Atmospheric loading is not directly addressed by this plan as air quality and air emission standards are regulated by the federal Clean Air Act and are not within the County's control. However, the stormwater projects and in-lagoon projects will treat some of the nutrient loading from atmospheric deposition that falls on the land and lagoon surface.
- Point sources that treat collected sewage and discharge treated effluent:
  - The direct WWTF discharges to the lagoon have been largely removed, and most of the facilities in the basin use the treated effluent for reclaimed water irrigation. However, depending on the level of treatment at the WWTF, the reclaimed water can have an excessive concentration of nutrients that may contribute loading to the baseflow.
  - There have been issues with inflow and infiltration into the sanitary sewer collection system. Large rain events can result in large amounts of water entering the sewer

collection system, and this additional water can cause sewer overflows that contribute nutrients and bacteria to local waterbodies.

In addition to these external sources of loading to the lagoon, nutrients from muck (muck flux) is an internal source of loading within the lagoon itself. Muck is made up of organic materials from soil erosion on the land and from decay of organic matter (leaves, grass clippings, algae, and aquatic vegetation) in the lagoon. As these organic materials decay, they constantly flux nutrients into the water column above, where they add to the surplus of nutrients coming from external sources.

Table 3-1 summarizes the estimated loading from these sources in the Banana River Lagoon (including canals), North IRL, and Zone A of the Central IRL. The stormwater runoff and baseflow/septic systems loading estimates are from the Spatial Watershed Iterative Loading model, the point source loading estimates were based on the facility monthly operating reports and discharge monitoring reports, and the atmospheric deposition loads are from measured data at nearby stations. The muck flux load estimates are calculated based on the muck area in each portion of the lagoon and flux estimates from studies in the lagoon (refer to **Section 4.2.1** for more details). The loading from these sources is also shown graphically in **Figure 3-1, Figure 3-2**, and **Figure 3-3**.

Table 3-1: Loading from Different Sources in Each Sub-lagoon

Source	Banana River Lagoon TN (lbs/yr)	Banana River Lagoon TP (lbs/yr)	North IRL TN (lbs/yr)	North IRL TP (lbs/yr)	Central IRL Zone A TN (lbs/yr)	Central IRL Zone A TP (lbs/yr)
Stormwater Runoff	119,923	15,064	328,047	45,423	279,351	43,193
Baseflow/Septic, Leaking Sewer, Reclaimed Water	164,225	22,613	344,111	47,383	370,129	50,966
Atmospheric Deposition	175,388	3,222	301,977	5,505	49,456	892
Point Sources	17,484	3,370	14,711	1,029	0	0
Muck Flux	494,490	46,520	377,011	38,142	45,776	3,141

Chart showing the total nitrogen loading to the Banana River Lagoon from different sources. Stormwater runoff contributes 119,923 pounds per year; Baseflow/Septic, Leaking Sewer, Reclaimed Water contribute 164,225 pounds per year; Atmospheric Deposition contributes 175,388 pounds per year; Point Sources contribute 17,484 pounds per year; and Muck Flux contributes 494,490 pounds per year.

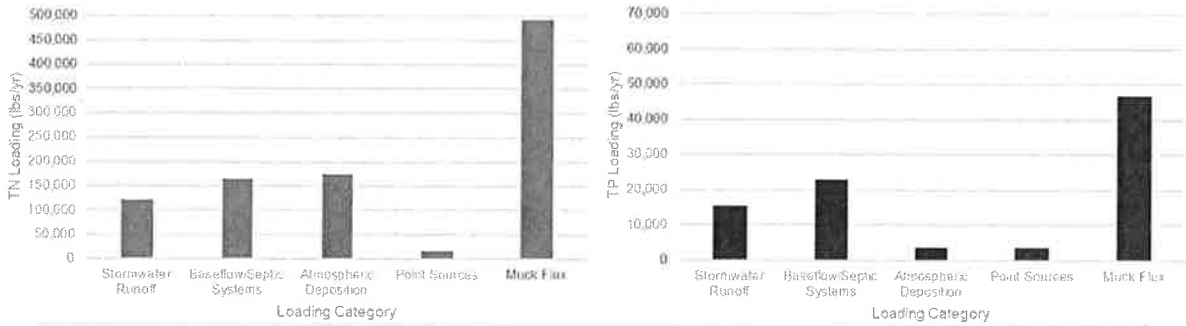


Figure 3-1: Banana River Lagoon TN (left) and TP (right) Annual Average Loads by Source

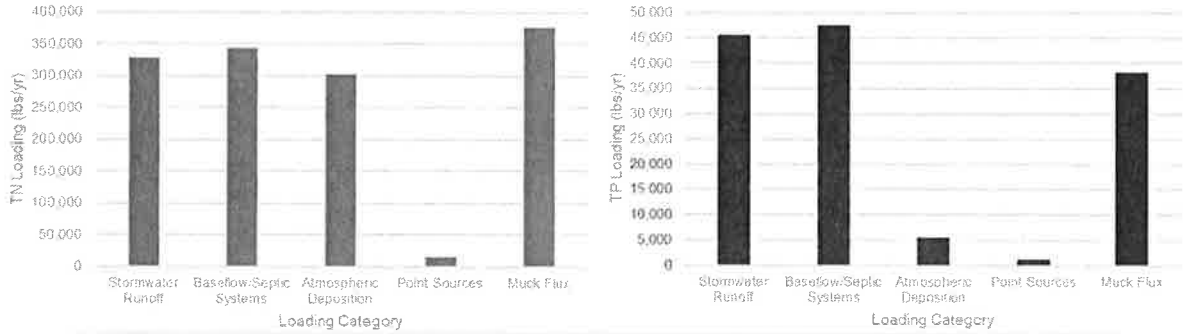


Figure 3-2: North IRL TN (left) and TP (right) Annual Average Loads by Source

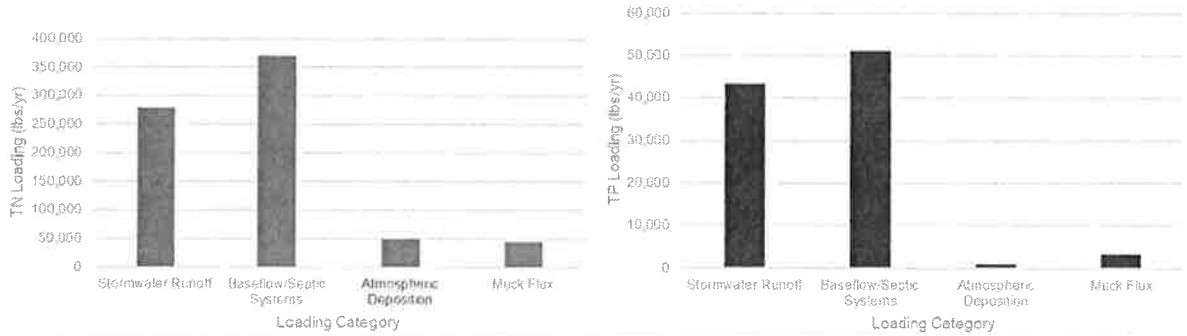


Figure 3-3: Central IRL TN (left) and TP (right) Annual Average Loads by Source

Section 4 includes information on projects to reduce the loading from urban stormwater runoff (including fertilizers and grass clippings), reclaimed water from WWTFs, and septic systems; to remove the internal cycling of loads accumulated in the muck deposits; and to restore natural filtration processes.

Section 4. Project Options

To restore the lagoon's balance, Brevard County has been implementing a multi-pronged approach to **Reduce** pollutant and nutrient inputs to lagoon, **Remove** the accumulation of muck from the lagoon bottom, and **Restore** water-filtering oysters and related lagoon ecosystem services. This plan also recommends funding for project monitoring, needed for accountability and to **Respond** to changing conditions and opportunities. Response funds will be used to track progress, measure cost effectiveness, and report on performance. Each year, a Citizen Oversight Committee (additional details are included in **Section 4.4.1**) will review monitoring reports and make recommendations to the Brevard County Board of County Commissioners to redirect remaining plan funds to those efforts that will be most successful and cost-effective. Although research is important to better understand factors that significantly impact the health, productivity, and natural resilience of the IRL, funding for research is not included in this project plan.

Several goals were set to help select the projects for this plan. The goal for the **Reduce** projects is to achieve the proposed five-month total maximum daily load for each sub-lagoon (refer to **Section 5** for additional details on the total maximum daily loads). The goal for the **Remove** projects is to achieve at least a 25% reduction in estimated recycling of internal loads. The goals for the **Restore** projects are to filter the entire volume of the lagoon annually and to reduce shoreline erosion. The most cost-effective projects in each category were selected to maximize nutrient reductions, minimize lag time in lagoon response, reduce risk, and optimize the return on investment.

Section 4.1 through **Section 4.4** provide information on the proposed projects, estimated nutrient reduction benefits, and costs, as well as the ongoing research needed to measure and assess the project efficiencies and benefits to the lagoon system.

4.1. Projects to Reduce Pollutants

An important step in restoring the lagoon system is reducing the amount of pollutants that enter the IRL through stormwater runoff and groundwater. Reduction efforts include source control (such as fertilizer reductions) to reduce the amount of pollutants generated, as well as treatment to reduce pollutants that have already been discharged before they are washed off in stormwater runoff or enter the groundwater system and ultimately discharge to the IRL. Monitoring of these projects will be performed to verify the estimated effectiveness of each project type implemented (refer to **Section 4.4**).

The benefits from fertilizer management and public education, WWTF upgrades for reclaimed water, and stormwater treatment are seen fairly quickly in the lagoon system. Public education about fertilizer and other sources of pollution addresses nutrients at their source and prevents these nutrients from entering the system. WWTF upgrades result in reduced nutrients in the treated effluent, which is then used throughout the basin for reclaimed water irrigation. The stormwater projects will capture and treat runoff, which is currently untreated or inadequately treated, before it reaches the lagoon.

While greatly beneficial, septic system removal or upgrade projects may take longer to result in a nutrient reduction to the lagoon. The septic systems in key areas must be removed or upgraded to see the full benefits. In addition, septic systems contribute nutrient loading to the lagoon through groundwater, and the travel time of the nutrient plumes through the groundwater to a waterbody vary throughout the basin depending on watershed conditions.

The following subsections summarize the fertilizer management and public education, septic system removal and upgrades, WWTF upgrades, sewer lateral rehabilitation, package plant removal or upgrades, and stormwater treatment projects that will be implemented to reduce nutrient loads to the IRL.

4.1.1 Public Outreach and Education

The education and outreach campaigns are summarized in the sections below. Additional details can be found in **Appendix C**.

Fertilizer Management

Approximately 81,700 lbs/yr of TN and 4,200 lbs/yr of TP enter the lagoon watershed from excess fertilizer application.

It is a common practice to apply fertilizer on urban and agricultural land uses. However, excessive and inappropriately applied fertilizer pollutes surrounding waters and stormwater. To help address fertilizer as a source of nutrient loading, local governments located within the watershed of a waterbody or water segment that is listed as impaired by nutrients are required to adopt, at a minimum, the Florida Department of Environmental Protection's Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes (Section 403.067, Florida Statutes). Brevard County and its municipalities adopted fertilizer ordinances that included the required items from the Model Ordinance in December 2012, as well as additional provisions in 2013 and 2014. Local fertilizer ordinances are posted online at http://sfyl.ifas.ufl.edu/brevard/lawn-and-garden/fertilizer-ordinances/. These ordinances require zero phosphorus year-round, nitrogen to be at least 50% slow release, no nitrogen use during the rainy season, and variable surface water protection buffers

Florida Department of Agriculture and Consumer Services compiles information on the fertilizer sales by county, as well as the estimated nutrients from those fertilizers. It is important to note that all fertilizer sold in a county may not be applied within that county because a portion of that fertilizer may be transported to another county. However, details on the amount of fertilizer transported between counties is not tracked. Therefore, the information in the Florida Department of Agriculture and Consumer Services reports is simply the best estimate of the amount of fertilizer used, and the associated nutrient content, in a county.

Based on the Florida Department of Agriculture and Consumer Services information, the lawn fertilizer sold in Brevard County in fiscal year 2014-2015 contained 408,220 lbs of nitrogen and 32,520 lbs of phosphorus. The fertilizer applied is attenuated through several naturally occurring physical, chemical, and biological processes including uptake by grass. The environmental attenuation/uptake for urban fertilizer is 80% for nitrogen (Florida Department of Environmental Protection 2014b) and 90% for phosphorus. The estimated nitrogen and phosphorus that is applied but is not naturally attenuated is shown in **Table 4-1**. It is important to note that not all the un-attenuated nutrients will migrate to the lagoon, either through runoff or baseflow (groundwater that enters ditches, canals, and tributaries), but these numbers provide an idea of the excess nutrients that could be reduced as a result of public education and changes in fertilizer use.

Table 4-1: Estimated TN and TP Not Attenuated in Fiscal Year 2014-2015

Parameter	Pounds Sold Fiscal Year 2014-15 (Lawn Only)	Environmental Attenuation (%)	Fiscal Year 2014-15 Pounds (Lawn Only) after Attenuation
TN	408,220	80%	81,644
TP	32,520	90%	3,252

When recent sales data are compared to the fertilizer sold in fiscal year 2013-2014, which is before adoption of the more protective amendments to the ordinance, significant reductions are observed. These reductions from the implementation of the ordinance are shown in **Table 4-2**.

Table 4-2: Reductions from Fertilizer Ordinance Compliance to Date

Parameter	Fiscal Year 2013-14 Pounds (Lawn Only) after Attenuation: Pre-Ordinance	Fiscal Year 2014-15 Pounds (Lawn Only) after Attenuation: Post-Ordinance	Reductions from Ordinance to Date (lbs/yr)
TN	127,540	81,644	45,896
TP	12,640	3,252	9,388

Based on studies by the University of Florida, approximately 0.03% of applied nitrogen ends up in runoff during establishment of sodded bermudagrass on a 10% slope. Nitrogen leaching ranged from 8% to 12% of the amount applied (Trenholm and Sartain 2010). Therefore, nitrogen leaching from fertilizer into the groundwater is 300 to 400 times as much as the nitrogen running off in stormwater. To help address the leaching issue, the Brevard County fertilizer ordinance encourages the use of slow release nitrogen fertilizer. Slow release fertilizer decreases nitrogen leaching by about 30% (University of Florida-Institute of Food and Agricultural Sciences 2012). In addition, the ordinance requires that fertilizer with zero phosphorus is used.

The public education and outreach campaign will be expanded to include focus on slow release and zero phosphorus fertilizers. An important component of this will be to reach out to stores within the County to ensure they are making slow release and zero phosphorus fertilizers more visible and to add signage to let buyers know which fertilizers are compliant with all local ordinances. This would cost approximately $125,000 per year for a period of five years. If an additional 25% of fertilizer users switch to 50% slow release nitrogen and zero phosphorus formulations, compliant with the ordinance, this would result in a reduction of 6,123.3 lbs/yr of TN and 813.0 lbs/yr of TP (see **Table 4-3**).

Table 4-3: Estimated TN and TP Reductions and Costs from Additional Fertilizer Ordinance Compliance

Project	Cost	TN Fiscal Year 2014-15 Pounds (Lawn Only) after Attenuation	TN Reductions from Additional 25% Compliance (lbs/yr)	Cost per Pound per Year of TN Removed	TP Fiscal Year 2014-15 Pounds (Lawn Only) after Attenuation	TP Reductions from Additional 25% Compliance (lbs/yr)	Cost per Pound per Year of TP Removed
Expanded Fertilizer Education*	$625,000	81,644	6,123	$102	3,252	813	$769

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

In 2018, the Citizen Oversight Committee recommended extending the fertilizer education and outreach beyond the original plan recommendation of five years to all ten years of the plan. The $625,000 for this project will be redistributed as follows: (1) $125,000 in Year 1 to create the education campaign and begin implementation, (2) $50,000 per year to continue implementation in Years 2-10, and (3) an additional $50,000 in Year 6 (for a total of $100,000 in this year) to evaluate program success and update the outreach materials, as needed.

Grass Clippings (added in 2018)

Grass clippings contain nutrients and those nutrients are released in stormwater or the lagoon as they decompose (Brevard County 2017). St. Augustine grass contains 2.5% nitrogen and 0.2-0.5% (average of 0.5%) phosphorus and Bahia grass contains 2% nitrogen (University of Florida-Institute of Food and Agricultural Sciences 2015). According to Okaloosa County Extension, a 7,500-square foot lawn produces about 3,000 pounds of clippings per year. Unfortunately, the percentage of those total clippings that end up in stormwater is not known.

To estimate the potential nutrient reduction impact of a grass clippings campaign, it was assumed that the average home size is 10,000 square feet with a 100-foot by 100-foot boundary, 2,500 square feet of built space, and 7,500 square feet of lawn. University of Florida-Institute of Food and Agricultural Sciences has estimated that 3,000 pounds of grass clippings are produced annually from a healthy lawn of this size. It was assumed that most of the grass clippings in Brevard County are from St. Augustine grass, which means that 3,000 pounds of clippings contains approximately 75 pounds of TN and 10.5 pounds of TP. It was also assumed that the standard mower size is two feet wide. From one roadside pass along 100 feet of the average lawn with a two-foot wide mower, 200 square feet or 2.6% of the total lawn clippings could be cast into the road. This equals 0.02 pounds of TN and 0.0027 pounds of TP per foot per year left in the road. With about 3,800 miles of roads in the IRL Basin within Brevard County, of which approximately 1,250 miles are paved with curb and gutter and are most likely to allow the ready transport of grass clippings to the lagoon in stormwater, the potential nutrient release from those grass clippings could be up to 260,000 lbs/yr of TN and 35,640 lbs/yr of TP from mowing along both sides of the road. If Brevard County expects a similar rate of awareness as Alachua County (24%, see **Appendix C** for details), then a potential 200,000 lbs/yr of TN and 27,000 lbs/yr of TP may be entering the stormwater. If a successful grass clippings campaign in Brevard County can capture an increase of awareness similar to Alachua County (from 24% to 69%), then there is a potential reduction of 88,920 lbs/yr of TN and 12,189 lbs/yr of TP. In addition, assuming the environmental attenuation/uptake for grass clippings is similar to the urban fertilizer uptake of 80% for nitrogen and 90% for phosphorus, the estimated reductions would be 17,800 lbs/yr of TN and 1,200 lbs/yr of TP.

This estimate assumes a simplified worst-case scenario in which everyone leaves a portion of their clippings in the road; however, it does not take into account the number of driveways, sidewalks, medians, and other impervious surfaces that grass clippings could be falling or the grass clippings being directly cast into the IRL, canals, and other waterways. Using the available information, this provides an order of magnitude estimate of the potential benefits of a grass clippings campaign for the IRL.

The Marine Resources Council has proposed a partnership between the IRL Basin counties to pursue a grass clippings campaign similar to the Alachua County campaign. The Citizen Oversight Committee recommended contributing $20,000 in Year 1 of the plan towards the research and marketing to develop the campaign. This will be followed by an annual investment of $20,000 per year for Years 2 through 10 for media and promotional materials targeting Brevard County. Therefore, the total project cost is $200,000. **Table 4-4** summarizes the costs and benefits of implementing the grass clippings campaign.

Table 4-4: Estimated TN and TP Reductions and Costs from Grass Clippings Campaign

Project	Cost	Estimated TN Reductions (lbs/yr)	Cost per Pound per Year of TN Removed	Estimated TP Reductions (lbs/yr)	Cost per Pound per Year of TP Removed
Grass Clippings Campaign*	$200,000	17,800	$11	1,200	$167

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Market research needed to guide development of a grass clipping campaign was contracted through the Marine Resources Council to a community-based social marketing firm, Uppercase Inc. Survey results from 2018 are reported in **Section 4.4.1**.

Excess Irrigation (added in 2018)

Fertilizer nutrients are more susceptible to leaching if turfgrass is overwatered, carrying nutrients beyond the reach of the turf roots. During excess watering, soluble nutrients, such as highly mobile nitrate, wash through the soil from the root zone too quickly. Excess irrigation is easy to accomplish in Florida's sandy soils as these soils typically hold no more than 0.75 inches of water per foot of soil depth (Hochmuth et al. 2016). This excess irrigation is part of the baseflow contributing nutrient loading to the IRL.

From June 2015 to May 2016, 470,737 pounds of TN in fertilizer were sold within Brevard County. Florida Department of Agriculture and Consumer Services Urban Turf Fertilizer Rule (RE-1.003[2], Florida Administrative Code) does not specify a percentage of slow-released nitrogen in fertilizer or separately track slow-release nitrogen from all nitrogen sources. However, if it is assumed that 50% of fertilizer was soluble nitrogen (compliant with local fertilizer ordinances), then the total soluble nitrogen sold in Brevard County could be as high as 235,368 lbs/yr. If 13% of soluble nitrogen were leached, up to 30,597 lbs/yr of TN could potentially be entering the groundwater. If like South Florida survey respondents (see **Appendix C** for details) 50% of irrigation users in Brevard County are not over-irrigating, and if an outreach campaign can impact half of those who do over-irrigate, fertilizer leaching could be reduced by 7,649 lbs/yr of TN. As noted above, the environmental attenuation/uptake for urban fertilizer is 80% for nitrogen (Florida Department of Environmental Protection 2014b). Therefore, the total amount of TN that could be reduced by reducing excess irrigation is 1,530 lbs/yr.

Conducting an outreach campaign with an initial $50,000 social marketing research and development investment and $25,000 in annual implementation, the total 10-year budget would be $300,000. This results in an average of $196 per pound of TN reduced per year (see **Table 4-5**).

Table 4-5: Estimated TN Reductions and Costs from Reducing Excess Irrigation

Project	Cost	Estimated TN Reductions (lbs/yr)	Cost per Pound per year of TN Removed
Irrigation Education*	$300,000	1,530	$196

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Stormwater Pond Maintenance (added in 2018)

Wet detention ponds, also known as stormwater ponds, are one method used to remove nutrients from stormwater as mandated by Florida Statutes 403.0891. Retention/detention time of water in the pond accommodates the removal of accumulated nutrients by allowing material to settle and

be absorbed. By itself, an optimally sized and properly maintained stormwater pond typically provides a 35-40% removal of nitrogen and 65% removal of phosphorus through settling (Florida Department of Environmental Protection and Water Management Districts 2010). Additional behaviors and technologies can be combined with ponds to increase removal rates. On the other hand, poor pond maintenance practices can decrease nutrient removal rates or worse yet, release nutrients to downstream waterbodies.

The stormwater pond maintenance program will initially focus on vegetative buffers and their appropriate maintenance to reduce stormwater pollution. Brevard County contains 4,175 stormwater ponds covering 13,276 acres with 6,976,338 linear feet of shoreline. The average size of a pond is 3.2 acres with 1,671 linear feet of shoreline. These numbers include ponds affiliated with both residential and commercial areas. The average load to stormwater ponds is 11.4 pounds of TN per acre of land surrounding the pond annually according to the Florida Department of Environmental Protection's Spreadsheet Tool for Estimating Pollutant Loads. Assuming that a 50-foot perimeter directly impacts the pond, there are 8,008 acres contributing 91,288 pounds of TN annually to the ponds. Of this, up to 40% of the TN is removed through retention in the pond leaving a potential 54,773 lbs/yr of TN to enter the lagoon. For TP, approximately 18,836 lbs/yr is entering the stormwater pond. Of this, up to 65% of the TP is removed through retention in the pond leaving a potential of 6,593 lbs/yr TP to enter the lagoon.

Creating a 10-foot-wide low-maintenance buffer zone of un-mowed ornamental grasses has the potential to remove about 25% of the TN and TP entering the pond (U.S Environmental Protection Agency 2005). This amount increases with the width of the buffer and the addition of woody vegetation. For the plan calculations, the assumption was made that convincing homeowners to not mow a 10-foot buffer is the easiest practice to achieve. The pond will remove up to 40% of the remaining TN. Assuming that the education campaign can reach at least half of the 48% of people unaware of what stormwater is, the reduction could be 3,286 lbs/yr of TN and 396 lbs/yr of TP.

Conducting an outreach campaign with an initial $50,000 social marketing research and development investment plus $25,000 in annual implementation, would require a 10-year total budget of $300,000. This would result in reductions at $91 per pound of TN and $750 per pound of TP (see **Table 4-6**). Additionally, during focus group research in the first year, it may be possible to identify other best management practices that homeowners' associations are willing to adopt that would further improve the performance of their stormwater pond. This would improve the cost effectiveness of this campaign.

Table 4-6: Estimated TN and TP Reductions and Costs from Stormwater Best Management Practice Maintenance

Project	Cost	Estimated TN Reductions (lbs/yr)	Cost per Pound Per Year of TN Removed	Estimated TP Reductions (lbs/yr)	Cost per Pound per Year of TP Removed
Stormwater Best Management Practice Maintenance Education*	$300,000	3,300	$91	400	$750

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Septic Systems and Sewer Laterals Maintenance (added in 2018 and 2019)
Nationwide, 10-20% of septic systems are failing from overuse, improper maintenance, unsuitable drainfield conditions, and high-water table. When septic systems are older and failing or are

installed over poor soils close to the groundwater table or open water, they can be a major contributor of nutrients and bacterial and viral pathogens to the system (De and Toor 2017, USEPA 2002).

A properly functioning septic tank and drainfield system reduces TN by 30-40%. However, the reduction has been measured at 0-20% in adverse conditions. The best available studies estimate a 10% reduction in nitrogen within a properly maintained tank versus an improperly maintained tank. The remaining 20-30% of nitrogen removal occurs in a properly functioning drainfield (Anderson 2006). If 15% of systems are failing and failing systems attenuate 30% less of the nitrogen load, these systems may pose far greater impacts to the groundwater, tributaries, and lagoon than the average impact reported for properly functioning systems. Without the 30% reduction, the potential load to the IRL and its tributaries is estimated to be 27.2 lbs/yr of TN for properties within 55 yards (instead of 19 lbs/yr of TN for functioning systems), 5.2 lbs/yr of TN for properties between 55 and 219 yards away (instead of 3.6 lbs TN/yr for functioning systems), and 1.1 lbs/yr of TN for properties more than 219 yards away (instead of 0.8 lbs/yr of TN for functioning systems).

There are an estimated 53,204 septic systems in Brevard County within the IRL Basin. As noted in **Section 4.1.6**, the total loading of septic systems within 55 yards of the IRL and its tributaries is calculated at 299,590 lbs/yr of TN, the total loading of systems between 55 and 219 yards is 86,575 lbs/yr of TN, and the total loading of septic systems further than 219 yards is 10,805 lbs/yr of TN. If the failure rate in Brevard County is about 15%, and if failing systems receive 30% less attenuation, then failing systems within 55 yards of open water are contributing 13,481 lbs/yr of TN, failing systems between 55 and 219 yards of open water are contributing 3,896 lbs/yr of TN, and failing tanks further than 219 yards are contributing 486 lbs/yr of TN. By factoring in this failure rate, the total additional loading to the IRL from failing septic systems is approximately 17,863 lbs/yr of TN.

A 10-year outreach campaign budget of $300,000, which includes $50,000 for research and campaign development and $25,000 per year for implementation to improve septic system maintenance, reduce excess use, and prevent harmful additives, would strive to reduce the number of failing systems county-wide by 25%, thereby reducing the excess loading from failing systems by 4,466 lbs/yr of TN. This would result in average cost of $67 per pound of TN (see **Table 4-7**).

Table 4-7: Estimated TN Reductions and Costs from Septic System Maintenance

Project	Cost	Estimated TN Reductions (lbs/yr)	Cost per Pound per Year of TN Removed
Septic System Maintenance Education*	$300,000	4,466	$67

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Market research needed to guide development of a septic maintenance campaign was contracted with state grant funding through the Marine Resources Council to the University of Central Florida. Survey results from 2018 are reported in **Section 4.4.1**. In reaching out to citizens to participate in the survey, it was found that many people are unsure of whether they are on central sewer or a septic system. When developing the septic system maintenance education program, Brevard County will identify opportunities to educate people who are on central sewer about proper maintenance of their sewer laterals. Adding this education component to the septic system maintenance education campaign is not anticipated to require additional funding.

4.1.2 WWTF Upgrades

88% of the reclaimed water in the County is used in public access areas and for landscape irrigation.

Upgrades for Reclaimed Water

The direct WWTF discharges to the lagoon have been largely removed, and the majority of facilities in the basin use the treated effluent for reclaimed water irrigation. While the use of reclaimed water for irrigation is an excellent approach to conserving potable water, if the reclaimed water is high in nutrient concentrations, the application of the reclaimed water for irrigation can result in nutrients leaching into the groundwater. It is important to note that there are no regulations on the concentration of nutrients in reclaimed water that is used for irrigation. However, University of Florida-Institute of Food and Agricultural Sciences studies indicate that a nitrogen concentration of 5 to 9 milligrams per liter is optimal for turfgrass growth, and each year a maximum amount of 1 pound of nitrogen can be applied per 1,000 square feet of turf (University of Florida-Institute of Food and Agricultural Sciences 2013a and 2013b). Nitrogen leaching increases significantly when irrigation is greater than 2 centimeters per week (0.75 inches per week), even if the nitrogen concentrations are half of the maximum Institute of Food and Agricultural Sciences recommendation of 9 milligrams per liter.

In Brevard County, 88% of the reclaimed water is used in public access areas and for landscape irrigation. The total reclaimed water used countywide is approximately 18.5 million gallons per day, which is applied over 7,340 acres. The unincorporated County and city WWTFs with the reclaimed water flows and TN concentrations are shown in **Table 4-8**. This table also summarizes the excess TN in the reclaimed water after environmental attenuation/uptake (75% for TN [Florida Department of Environmental Protection 2017]), for both the current TN effluent concentration and if the facility were upgraded to achieve a TN effluent concentration of 6 milligrams per liter (the City of Palm Bay Water Reclamation Facility update would achieve a TN effluent concentration of 7.5 milligrams per liter and the City of Melbourne Grant Street WWTF would achieve a TN effluent concentration of 5 milligrams per liter).

Table 4-8: TN Concentrations in WWTF Reclaimed Water

Facility	Permitted Capacity (million gallons per day)	Reclaimed Water Flow (million gallons per day)	TN Concentration (milligrams per liter)	TN After Attenuation (lbs/year)	TN After Attenuation and Upgrade (lbs/year)
City of Palm Bay Water Reclamation Facility	4.0	1.20	29.4	27,305	6,966
Cape Canaveral Air Force Station WWTF	0.8	0.80	25.8	15,974	3,714
City of Melbourne Grant Street WWTF	5.5	2.08	21.0	33,806	8,049
City of Titusville Osprey WWTF	2.75	1.67	12.7	16,415	7,755
Brevard County Port St. John WWTF	0.5	0.35	12.6	3,413	1,625
City of West Melbourne Ray Bullard Water Reclamation Facility	2.5	0.85	11.1	7,302	3,947
Brevard County Barefoot Bay Water Reclamation Facility	0.9	0.48	10.3	3,826	2,229
Brevard County South Beaches WWTF	8.0	1.12	9.3	8,061	5,201

Facility	Permitted Capacity (million gallons per day)	Reclaimed Water Flow (million gallons per day)	TN Concentration (milligrams per liter)	TN After Attenuation (lbs/year)	TN After Attenuation and Upgrade (lbs/year)
Brevard County North Regional WWTF	0.9	0.26	8.9	1,791	1,207
Rockledge WWTF	4.5	1.40	7.0	7,584	6,501
Brevard County South Central Regional WWTF	5.5	3.79	6.7	19,653	17,600
City of Titusville Blue Heron WWTF	4.0	0.84	4.8	4,993	Not applicable
City of Cape Canaveral Water Reclamation Facility	1.8	0.88	3.8	4,141	Not applicable
City of Cocoa Jerry Sellers Water Reclamation Facility	4.5	1.44	3.5	6,241	Not applicable
Brevard County Sykes Creek WWTF	6.0	1.48	3.4	3,895	Not applicable
City of Cocoa Beach Water Reclamation Facility	6.0	3.66	2.5	11,331	Not applicable

The estimated costs for the WWTF upgrade and the cost per pound of nitrogen removed as a result of the upgrade are shown in **Table 4-9**. Based on a 2007 study by U.S. Environmental Protection Agency, the cost to upgrade WWTFs to meet advanced wastewater treatment standards is approximately $4,200,000 per plant. This cost is in 2006 dollars, which, when inflated to 2016 dollars and costs are included for design and permitting, is approximately $6,000,000 per facility. Where cost estimates were available for facility upgrades, these costs were used instead of the U.S Environmental Protection Agency inflated estimated. Due to the high cost per pound of TN removed to upgrade some of these facilities compared to other projects in this plan, only those facilities highlighted in green are recommended for upgrades as part of this plan.

Table 4-9: Cost per Pound of TN Removed from WWTF Upgrades to Improve Reclaimed Water

Facility	Cost to Upgrade	TN Removed after Attenuation (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed after Attenuation (lbs/yr)	Cost per Pound per Year of TP Removed
City of Palm Bay Water Reclamation Facility *	$1,400,000	20,240	$69	102	$13,699
City of Melbourne Grant Street WWTF*	$6,000,000	25,627	$234	To be determined	To be determined
Cape Canaveral Air Force Station*	$6,000,000	12,259	$489	To be determined	To be determined
City of Titusville Osprey WWTF*	$8,000,000	8,660	$924	Not applicable	Not applicable
City of West Melbourne Ray Bullard Water Reclamation Facility	$6,000,000	3,355	$1,788	To be determined	To be determined
Brevard County South Beaches WWTF	$6,000,000	2,860	$2,098	To be determined	To be determined
Brevard County South Central Regional WWTF	$6,000,000	2,053	$2,923	To be determined	To be determined
Port St. John WWTF	$6,000,000	1,788	$3,356	To be determined	To be determined

Facility	Cost to Upgrade	TN Removed after Attenuation (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed after Attenuation (lbs/yr)	Cost per Pound per Year of TP Removed
Rockledge WWTF	$6,000,000	1,084	$3,460	To be determined	To be determined
Barefoot Bay Water Reclamation Facility	$6,000,000	1,597	$5,535	To be determined	To be determined
North Regional WWTF	$6,000,000	584	$10,282	To be determined	To be determined

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

As part of the public education and outreach efforts, customers who use reclaimed water for irrigation should be informed of the nutrient content in the reuse water because they can and should eliminate or reduce the amount of fertilizer added to their lawn and landscaping. This information can be provided to the customers through their utility bill.

4.1.3 Sprayfield and Rapid Infiltration Basin Upgrades (added in 2019)

Another opportunity to reduce the nutrient loading from the WWTFs is to upgrade the disposal locations, either sprayfields or rapid infiltration basins, for the treated effluent. The sprayfields and rapid infiltration basins could be modified to include biosorption activated media to provide additional nutrient removal. Examples of biosorption activated media include mixes of soil, sawdust, zeolites, tire crumb, vegetation, sulfur, and spodosols (Wanielista et al. 2011). Based on a pilot project in the City of DeLand, the potential removal of adding biosorption activated media to a sprayfield or rapid infiltration basin is 83% for TN and 66% for TP (City of DeLand and University of Central Florida 2018). The loads for the facilities in Brevard County that dispose of reclaimed water to a sprayfield or rapid infiltration basin were estimated base on permit and discharge monitoring report information (where available). Attenuation rates were based on ArcGIS-Based Nitrate Load Estimation Toolkit model results for each specific package plant location. Then the biosorption activated media efficiency rate was applied to determine the TN that could be removed. Costs were estimated for each upgrade and the upgrades that could be made for the least cost per pound of TN are recommended for pilot project funding as part of this plan (see **Table 4-10** and **Table 4-11**). Information on nutrient concentrations or the size of the sprayfield/rapid infiltration basin were missing from several facilities. As this information is gathered, additional upgrades may be found to be cost-effective.

Table 4-10: Cost per Pound of TN and TP Removed from Sprayfield or Rapid Infiltration Basin Upgrades for Public Facilities

Facility	Type	Reclaimed Water Flow (million gallons per day)	Estimated Cost to Upgrade	TN Concentration (milligrams per liter)	TN After Attenuation (lbs/yr)	TN Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TN Removed	TP Concentration (milligrams per liter)	TP After Attenuation (lbs/yr)	TP Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TP Removed
Cape Canaveral Air Force Station Regional WWTF*	Rapid Infiltration Basin	0.8000	$2,502,522	6.00**	47,923	39,776	$63	3.03	5,628	3,715	$674
Port St John Wastewater Treatment Plant*	Rapid Infiltration Basin	0.3560	$980,100	12.55	10,374	8,610	$114	2.32	1,918	1,266	$774
Barefoot Bay Advanced	Sprayfield	0.4800	$26,136,000	10.33	166	138	$189,391	1.80	29	19	$1,375,579

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.
** The TN concentration assumes that the facility has been upgraded to achieve an effluent concentration of 6 milligrams per liter.

Table 4-11: Cost per Pound of TN and TP Removed from Sprayfield or Rapid Infiltration Basin Upgrades for Private Facilities

Facility	Type	Reclaimed Water Flow (million gallons per day)	Estimated Cost to Upgrade	TN Concentration (milligrams per liter)	TN After Attenuation (lbs/yr)	TN Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TN Removed	TP Concentration (milligrams per liter)	TP After Attenuation (lbs/yr)	TP Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TP Removed
Indian River Shores Trailer Park WWTF*	Rapid Infiltration Basin	0.01	$38,145	17.21	212	176	$217	5.16	120	79	$483
Canebreaker Condo	Sprayfield	0.008	$36,000	11	63	52	$688	To be determined	To be determined	To be determined	To be determined
River Forest Mobile Home Park WWTF	Sprayfield	0.018	$78,405	10.56	134	111	$705	3.14	70	46	$1,704
Palm Harbor Mobile Home Park WWTF	Sprayfield	0.014	$300,564	6.18	495	411	$732	2.88	50	33	$9,108
Cove At South Beaches Condominium Association WWTF	Sprayfield	0.01	$51,480	1.28	24	20	$2,584	7.03	87	57	$903
Riverview Mobile Home and Recreational Vehicle Park	Sprayfield	0.03	$333,234	4.88	121	100	$3,318	2.99	111	73	$4,565
Treetop Villas	Sprayfield	0.0056	$105,000	11.44	27	22	$4,685	3.47	24	16	$6,563
Enchanted Lakes Estates	Sprayfield	0.0055	$36,000	1.41	1	1	$43,373	To be determined	To be determined	To be determined	To be determined
Lighthouse Cove WWTF	Sprayfield	0.024	$120,000	1.17	2	2	$72,289	1.34	40	26	$4,615
Merritt Island Utility Company WWTF	Rapid Infiltration Basin	0.07	$495,277	0.18	3	2	$198,906	To be determined	To be determined	To be determined	To be determined
River Grove Mobile Home Village WWTF	Rapid Infiltration Basin	0.03	$182,299	0.3	1	1	$219,637	0.7	49	32	$5,697

Facility	Type	Reclaimed Water Flow (million gallons per day)	Estimated Cost to Upgrade	TN Concentration (milligrams per liter)	TN After Attenuation (lbs/yr)	TN Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TN Removed	TP Concentration (milligrams per liter)	TP After Attenuation (lbs/yr)	TP Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TP Removed
Aquarina Beach Community WWTF	Sprayfield	0.099	To be determined	3.2	261	To be determined	To be determined	0.5	To be determined	To be determined	To be determined
Camelot Recreational Vehicle Park Inc	Sprayfield	0.02	To be determined	4.01	202	To be determined	To be determined	3.14	To be determined	To be determined	To be determined
Housing Authority of Brevard County WWTF	Rapid Infiltration Basin	0.0099	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Oak Point Mobile Home Park WWTF	Rapid Infiltration Basin	0.015	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
South Shores Utility	Sprayfield	0.075	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Southern Comfort Mobile Home Park WWTF	Rapid Infiltration Basin	0.0075	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Space X Launch Complex 39A	Sprayfield	0.5	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Summit Cove Condominium	Rapid Infiltration Basin	0.03	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Tropical Trail Village WWTF	Rapid Infiltration Basin	0.0125	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Wingate Reserve Demineralization Concentrate	Rapid Infiltration Basin	0.007	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Sterling House Condominium WWTF	Sprayfield	0.015	$60,000	3.63	To be determined	To be determined	To be determined	1.64	31	20	$3,000
Pelican Bay Mobile Home WWTF	Rapid Infiltration Basin	0.035	$222,156	2.76	To be determined	To be determined	To be determined	2.92	237	157	$1,415
Harris Malabar Facility	Rapid Infiltration Basin	0.066	$2,085,000	12.6	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined	To be determined
Long Point Recreational Park	Rapid Infiltration Basin	0.012	$60,000	0.22	To be determined	To be determined	To be determined	0.88	25	16	$3,750

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

4.1.4 Package Plant Removal and Upgrades (added in 2019)

Package plants are miniature wastewater treatment plants that serve small communities producing more than 2,000 gallons of effluent per day. The most common package plant treatment methods are extended aeration, sequencing batch reactors, and oxidation ditches; the same biological treatment methods used in larger wastewater treatment plants. The smallest package plants often use the same technology as advanced septic systems. Following this treatment, the effluent is disposed of in rapid infiltration basins (ponds), sprayfields, or drainfields (U.S Environmental Protection Agency 2000).

Most package plants were removed in the 1990s following the Indian River Lagoon System and Basin Act of 1990. However, opportunities still exist to address some of the worst remaining package plants by upgrading the existing plant, adding nutrient scrubbing technology, or preferably connecting them to central sewer where the wastewater will receive further treatment and disposal far from the lagoon. A few of these package plants are located along the IRL and, therefore, pose a substantial nutrient risk due to their effluent concentration and disposal methods. **Table 4-12** lists the estimated TN reductions and costs to connect the package plants to the sewer system. Based on the information in this table, the cost to connect the package plants to the sewer are higher than the cost per pound of other projects in this plan; therefore, none of the package plant projects are recommended at this time.

Table 4-12: Estimated TN Reduction and Cost for Connecting Package Plants to the Sewer System

Facility Name	Number of Units	TN Load Reduction (lbs/yr)	Cost to Connect to Sewer	Cost per Pound Per Year of TN Removed
Palm Harbor Mobile Home Park WWTF	130	495	$782,530	$1,581
River Forest Mobile Home Park	130	134	$778,713	$5,818
Riverview Mobile Home and Recreational Vehicle Park	110	121	$717,593	$5,907
Canebreaker Condo WWTF	24	63	$504,692	$8,024
Merritt Island Utility Company WWTF	198	3	$1,393,916	$556,214
Enchanted Lakes Estates	190	1	$994,448	$1,921,749
Housing Authority of Brevard County WWTF	26	0	$499,892	Not applicable
Oak Point Mobile Home Park WWTF	130	0	$842,282	Not applicable
South Shores Utility	134	0	$955,344	Not applicable
Tropical Trail Village WWTF	74	0	$645,959	Not applicable
Willow Lakes Recreational Vehicle Park WWTF	280	0	$1,270,407	Not applicable
Aquarina Utilities WWTF	392	261	Insufficient Capacity	Insufficient Capacity
Indian River Shores Trailer Park WWTF	54	212	Insufficient Capacity	Insufficient Capacity
Camelot Recreational Vehicle Park Inc.	178	202	Insufficient Capacity	Insufficient Capacity
Treetop Villas	28	27	Insufficient Capacity	Insufficient Capacity
Cove At South Beaches Condominium Association WWTF	80	24	Insufficient Capacity	Insufficient Capacity
Lighthouse Cove WWTF	80	2	Insufficient Capacity	Insufficient Capacity

Facility Name	Number of Units	TN Load Reduction (lbs/yr)	Cost to Connect to Sewer	Cost per Pound Per Year of TN Removed
River Grove I & II Mobile Home Park	200	1	Insufficient Capacity	Insufficient Capacity
Pelican Bay Mobile Home (aka Riverview) WWTF	200	0	Insufficient Capacity	Insufficient Capacity
Southern Comfort Mobile Home Park	40	0	Insufficient Capacity	Insufficient Capacity
Sterling House Condominium WWTF	45	0	Insufficient Capacity	Insufficient Capacity
Summit Cove Condominium	84	0	Insufficient Capacity	Insufficient Capacity

4.1.5 Sewer Laterals Rehabilitation (added in 2018)

Sewage overflows following heavy rainfall events are an indicator of illegal connections or inadequate sewer asset conditions. There are three major components of wastewater flow in a sanitary sewer system: (1) base sanitary (or wastewater) flow, (2) groundwater infiltration, and (3) rainfall inflow. Virtually every sewer system has some infiltration and/or inflow. Historically, small amounts of infiltration and/or inflow are expected and tolerated. However, infiltration and/or inflow becomes excessive when it causes overflows, health, and/or environmental risks. Overflows from the South Beaches WWTF sewer system have occurred 7 of the last 13 years, including significant overflows following Hurricane Matthew in 2016 and Hurricane Irma in 2017. Less frequent overflows and line breaks have occurred in other sewer service areas.

In 2012, in recognition of aging infrastructure and increasingly frequent issues, the Brevard County Utilities Services Department engaged seven professional engineering firms to perform independent field evaluations of the condition of the sewage infrastructure assets located in each of the County's seven independent sewer service areas. The output of this investigation was identification of $134 million in specific capital improvement needs required over a ten-year period to bring County-owned sewer system assets up to a fully-functional, reliable, affordable, efficient, and maintainable condition (Brevard County Utilities Services 2013). The field evaluation results and corresponding 10-year Capital Improvement Program Plan were presented to the Brevard County Commission in 2013. In response, the Commission approved financing the entire Capital Improvement Program Plan and increased the County's sewer service rates to repay the debt. Plan implementation began in 2014 and projects are progressing quickly.

Because there was already a capital improvement plan and funding mechanism for updating the County's aging sewer system infrastructure, the original Save Our Indian River Lagoon Project Plan did not include analysis or funding for sewer system repairs. Unfortunately, even in areas where capital improvements have been made, infiltration and/or inflow continues to be a problem that contributes to overflows that discharge untreated wastewater into the IRL. This indicates the probability of problems outside the County-owned assets and could include illegal connections and/or leaks in the privately owned lateral connections of homes and businesses to the County sewer system.

Identifying problems on the customer side of the connection required smoke testing each building or private residence to determine if leaks or illegal connections are present. The extent of infiltration and/or inflow on the customer side of the connections is unknown and, therefore, the nutrient loading associated with these issues are also unknown. As a first step to determine the extent of infiltration and/or inflow problems with the sewer laterals, the County partnered with the

City of Satellite Beach on a pilot project to perform smoke testing of more than 12,000 buildings and residences within the area of concern in March through July of 2018. Smoke testing results are included in **Section 4.4.2**.

Repair of privately owned portions of the sewer system is not funded in the County's adopted Capital Improvement Program Plan for the Wastewater Utility; therefore, consideration has been given to the use of the Save Our Indian River Lagoon Tax funding. The Brevard County Utilities Services Department estimates that infiltration and/or inflow due to rainfall and flooding associated with Hurricane Irma, caused 1,835 lbs/yr of TN and 350 lbs/yr of TP to enter the lagoon from sewer overflowing from the South Beaches Regional WWTF sewer system. Staff reviewed 13 years of storm-related release data (2004-2017) to estimate the average annual nutrient load to the lagoon from emergency sewage overflows. If repairing private connections could prevent similar overflows in the future, then the average annual nitrogen reduction benefit of such repairs would be approximately 988 lbs/yr of TN. The average cost effectiveness of sewer expansion projects funded in the 2017 Plan Supplement was $852 per pound of nitrogen removed, thus the cost to reduce 988 lbs/yr of TN loading by implementing septic to sewer projects would be $841,842. Therefore, the 2018 Update allocated $840,000 to assist property owners with the cost to repair leaky sewer connections expected to be found through smoke testing (**Table 4-13**).

Table 4-13: Estimated Sewer Laterals Rehabilitation TN and TP Reductions and Costs

Project	Number of Buildings	Cost	Estimated TN Reductions (lbs/yr)	Cost per Pound per year of TN Removed	Estimated TP Reductions (lbs/yr)	Cost per Pound per Year of TP Removed
Satellite Beach Pilot Area*	5,400	$840,000	988	$850	188	$4,468

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

The Save Our Indian River Lagoon Trust Fund will also be used to conduct performance monitoring to measure the nutrient reduction benefits of repairing privately-owned leaky lateral connections. In addition to documenting less groundwater leaking into pipes and overwhelming the sewer infrastructure, monitoring will also seek to document improvement in groundwater quality that may occur when the leaks are repaired. The results of performance monitoring will be used to consider expansion of this program from the Satellite Beach pilot areas to other city and county sewer service areas. The lessons learned from this pilot study and a pilot study in Titusville (added in the 2019 Update) will be applied to future sewer lateral evaluation and repair projects.

4.1.6 Septic System Removal and Upgrades (updated in 2019)

Septic systems are commonly used where central sewer does not exist. When properly sited, designed, constructed, maintained, and operated, septic systems are often a safe means of disposing of domestic waste but still add nutrients to the system. However, when septic systems are older and failing or are installed over poor soils close to the groundwater table or open water, they can be a major contributor of nutrients and bacterial and viral pathogens to the system. As of 2018, there are an estimated 53,204 septic systems in Brevard County within the IRL Basin (**Table 4-14**). To address this source, options for both septic system removal and septic system upgrades were evaluated. It is important to note that although the County is taking the lead on these projects, the Florida Department of Health is responsible for the regulation and permitting of septic systems. The County will coordinate with Florida Department of Health on the septic system projects recommended in this plan.

Table 4-14: Location of Septic Systems in Brevard County

Area	Number of Septic Systems
St. Johns River Basin	22,514
Banana River Lagoon	2,927
North IRL	13,381
Central IRL	36,896
Total	***75,718***

Septic System Removal

In 2018, Brevard County conducted a more detailed evaluation of septic system impacts to surface waters through both groundwater monitoring and modeling using the Florida Department of Environmental Protection-approved ArcGIS-Based Nitrate Load Estimation Toolkit. This evaluation found that groundwater conductance and soil types were more important for nitrogen transport from septic systems than was previously accounted for in the approach used for ranking in the original Save Our Indian River Lagoon Plan. Therefore, for the 2019 Update, the approach to prioritize areas for septic system connection to the sewer system was modified. The original approach is provided in **Appendix D**, and the updated approach and recommended projects are summarized below.

The updated approach to rank areas for septic system impacts used information on the potential nutrient contribution from the ArcGIS-Based Nitrate Load Estimation Toolkit. Potential nutrient contributions were determined based on numerous factors, but after testing model sensitivity to these factors, a simplified approach was developed for Brevard County that was based primarily on the spatial location of the septic system (i.e. Barrier Island, Merritt Island, Mainland, or Melbourne Tillman Water Control District), soil type (soil hydraulic conductance), and the minimum distance to waterbodies (Applied Ecology 2018).

A direct comparison between the previous model that adapted studies from Martin and St. Lucie counties (**Table 4-15**) and the new model tailored to Brevard County's soil and water (**Table 4-16**) is difficult. For loading, the previous study estimated TN, which is the sum of nitrate, nitrite, ammonia, and organic nitrogen, whereas the new approach using the ArcGIS-Based Nitrate Load Estimation Toolkit estimated only nitrate and ammonia. Through the detailed ArcGIS-Based Nitrate Load Estimation Toolkit analysis it was also determined that there are 6,260 fewer septic systems in the IRL basin than estimated in the original plan.

Table 4-15: Original Estimate of TN Loading and Cost to Connect for Septic Systems

Septic System Distance from Surface Water	Number of Septic Systems	TN Load Per System (lbs/yr)	TN Load (lbs/yr)	Cost per System to Connect	Total Cost	Cost per Pound per Year of TN
Less than 55 yards	15,090	27.095	408,863	$20,000	$301,800,000	$738
Between 55 and 219 yards	25,987	6.865	178,395	$20,000	$519,740,000	$2,913
Greater than 219 yards	18,361	0.001	10	$20,000	$367,220,000	$37,624,010
Total in IRL Basin	***59,438***	***9.880 (average)***	***587,268***	***$20,000***	***$1,188,760,000***	***$2,024 (average)***

Table 4-16: Updated Estimate of TN Loading based on ArcGIS-Based Nitrate Load Estimation Toolkit and Updated Cost to Connect for Septic Systems

Septic System Distance from Surface Water	Number of Septic Systems	TN Load per System (lbs/yr)	TN Load (lbs/yr)	Cost per System to Connect	Total Cost	Cost per Pound per Year of TN
Less than 55 yards	15,737	19.037	299,590	$33,372	$525,175,164	$1,753
Between 55 and 219 yards	23,969	3.612	86,575	$33,372	$799,893,468	$9,239
Greater than 219 yards	13,472	0.802	10,805	$33,372	$449,587,584	$41,611
Total in IRL Basin	***53,178***	***7.465 (average)***	***396,970***	***$33,372***	***$1,774,656,216***	***$4,471 (average)***

Those septic systems within 55 yards of surface waters were further analyzed by soil hydraulic conductivity since it was found to be a highly influential variable in nutrient loading from septic systems. Hydraulic conductance is the ability of water to move through pore space in the soil with sandy soils having a higher conductance compared to loamy and clay soils. As shown in **Table 4-17**, nitrogen loading is much higher in the very high and high conductivity soils compared to the average for all soils within 55 yards. Although only half of the septic systems are in very high and high conductance soils, these account for 76% of the nitrogen loading.

Table 4-17: Septic Systems by Soil Hydraulic Conductance Class within 55 Yards of Surface Waters

Hydraulic Conductivity of Septic Systems Within 55 yards of Surface Water	Number of Septic Systems	TN Load per System (lbs/yr)	TN Load (lbs/yr)	Cost per System to Connect	Total Cost	Cost per Pound per Year of TN
Very High	1,899	34.926	66,324	$33,372	$63,373,428	$956
High	6,304	26.021	164,039	$33,372	$210,377,088	$1,283
Medium	3,230	12.198	39,401	$33,372	$107,791,560	$2,736
Low	3,396	5.930	20,141	$33,372	$113,331,312	$5,628
Very Low	908	10.664	9,683	$33,372	$30,301,776	$3,129
Total	***15,737***	***19.037 (average)***	***299,588***	***$33,372***	***$525,175,164***	***$1,753 (average)***

Table 4-18 shows those properties with septic systems in very high and high hydraulic conductance soils distributed by distance to surface waterbodies. Waterfront properties served by septic systems, including those properties adjacent to the lagoon, tributary rivers and creeks, or on canals or drainage ditches that discharge to the lagoon contribute 48% of all septic system loading in the IRL watershed in Brevard County. Changes proposed in the 2019 Plan Update shift septic to sewer and septic upgrade projects as much as feasible to areas of high conductivity soils located adjacent to waterways that contribute the greatest loading to the IRL.

Table 4-18: Septic Systems in Very High and High Hydraulic Conductance Soils Distributed by Distance to Surface Waters

Septic System Distance from Surface Water (yards)	Number of Septic Systems	TN Load per System (lbs/yr)	TN Load (lbs/yr)	Cost per System to Connect	Total Cost	Cost per Pound per Year of TN
0-11	5,584	33.838	188,956	$33,372	$186,349,248	$986
12-22	1,207	16.404	19,799	$33,372	$40,280,004	$2,034
23-33	465	17.466	8,121	$33,372	$15,517,980	$1,911
34-44	384	12.458	4,784	$33,372	$12,814,848	$2,679
45-55	563	15.456	8,702	$33,372	$18,788,436	$2,159
Total in IRL Basin	***8,203***	***28.083 (average)***	***230,362***	***$33,372***	***$273,750,516***	***$1,188***

For the funded opportunities that were identified using the new ranking method, the number of lots that could be connected, associated cost of the connection, and estimated TN reductions are shown in **Table 4-19** for the Banana River Lagoon, **Table 4-20** for the North IRL, and **Table 4-21** for the Central IRL. **Figure 4-1**, **Figure 4-2**, and **Figure 4-3** show the location of each of these areas. The detailed septic analysis also identified 4,496 properties located within 30 feet of existing sewer infrastructure. The highest loading "quick connect" opportunities are included in the tables below based on their ability to connect to gravity or force main sewer and are shown in **Figure 4-4** through **Figure 4-6**. These funded opportunities represent the connection of approximately 4% of the septic systems in Brevard County within the IRL Basin but reduce over 17% of the nutrient load contribution attributed to existing septic systems in Brevard.

Table 4-19: Opportunities for Septic System Removal in Banana River Lagoon

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
Near Gravity*	89	$1,068,000	2,219	$481
Near Force Main*	25	$450,000	732	$615
Sykes Creek - Zone M*	56	$1,868,832	1,798	$1,040
Sykes Creek - Zone N*	91	$3,036,852	2,784	$1,091
Merritt Island - Zone C*	85	$2,836,620	2,082	$1,363
Sykes Creek - Zone T*	148	$4,939,056	3,360	$1,470

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-20: Opportunities for Septic System Removal in North IRL

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
Near Gravity*	293	$3,516,000	7,812	$450
Near Force Main*	91	$1,638,000	2,825	$580
City of Rockledge*	15	$500,580	712	$703
City of Cocoa - Zone K*	36	$1,201,392	1,663	$722
City of Titusville - Zones A-G*	36	$1,201,392	1,563	$769
South Central - Zone D*	81	$2,703,132	3,183	$849
South Central - Zone C*	140	$4,672,080	5,099	$916
South Central - Zone A*	101	$3,370,572	3,655	$922
City of Cocoa - Zone J*	94	$3,136,968	3,259	$963
City of Melbourne*	26	$867,672	878	$988
South Central - Zone F*	51	$1,701,972	1,688	$1,008
Sharpes - Zone A*	186	$6,207,192	5,248	$1,183

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-21: Opportunities for Septic System Removal in Central IRL

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
Near Gravity*	210	$2,520,000	5,825	$433
Near Force Main*	24	$432,000	700	$617
City of Palm Bay – Zone A*	77	$2,569,644	2,136	$1,203
City of Palm Bay – Zone B*	249	$8,309,628	6,809	$1,220

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-22: Summary of Funded Septic System Removal Projects by Sub-lagoon

Sub-lagoon	Number of Lots	Cost	TN Reductions (lbs/yr)	Average Cost per Pound per Year of TN
Banana River Lagoon	494	$14,199,360	12,974	$1,010
North IRL	1,150	$30,716,952	37,585	$838
Central IRL	560	$13,831,272	15,470	$868
Total	***2,204***	***$58,747,584***	***66,030***	***$890***

Additional areas evaluated for septic to sewer system connection opportunities are listed in **Table 4-23**. These additional opportunities require more funding than is currently available and some require time and expense to build WWTF capacity and service infrastructure before connections would be feasible. Therefore, these systems are not recommended for funding as part of this plan. However, these areas have a large concentration of septic systems that are impacting the lagoon, and other funding options to address the septic systems in these areas could be explored in the future, if needed.

Table 4-23: Additional (Unfunded) Opportunities for Septic System Connections

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
South Beaches - Zone F	3	$100,116	173	$579
Grant-Valkaria - Zone G	30	$1,001,160	1,418	$706
Grant-Valkaria - Zone E	128	$4,271,616	5,862	$729
Grant-Valkaria - Zone B	34	$1,134,648	1,501	$756
Grant-Valkaria - Zone F	17	$567,324	688	$824
Grant-Valkaria - Zone D	18	$600,696	690	$871
South Beaches - Zone A	37	$1,234,764	1,306	$945
Grant-Valkaria - Zone A	42	$1,401,624	1,296	$1,082
Malabar - Zone B	64	$2,135,808	1,929	$1,107
Grant-Valkaria - Zone C	30	$1,001,160	853	$1,173
Malabar - Zone A	430	$14,349,960	11,456	$1,253
Titusville - Zone H	35	$1,168,020	910	$1,283
Rockledge - Zone B	160	$5,339,520	4,037	$1,323
Valkaria - Zone I	223	$7,441,956	5380	$1,383
Valkaria - Zone J	503	$16,786,116	11,507	$1,459
Malabar - Zone C	14	$467,208	289	$1,617
South Central - Zone B	180	$6,006,960	3,700	$1,624
Sharpes - Zone B	136	$4,538,592	2,692	$1,686
South Beaches - Zone E	387	$12,914,964	7,491	$1,724
Rockledge - Zone C	91	$3,036,852	1,736	$1,749
South Beaches - Zone K	21	$700,812	397	$1,765
Sykes Creek - Zone X	9	$300,348	166	$1,814

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
City of West Melbourne	60	$2,002,320	1,041	$1,923
South Beaches - Zone L	178	$5,940,216	2973	$1,998
Sykes Creek - Zone J	63	$2,102,436	1028	$2,045
Micco - Zone B	520	$17,353,440	8416	$2,062
South Beaches - Zone G	112	$3,737,664	1764	$2,119
City of West Melbourne - Zone B	60	$2,002,320	894	$2,240
Sykes Creek - Zone Z	61	$2,035,692	862	$2,362
South Beaches - Zone N	103	$3,437,316	1,193	$2,882
Sykes Creek - Zone C	81	$2,703,132	929	$2,909
South Central - Zone I	72	$2,402,784	819	$2,932
Melbourne Village - Zone A	85	$2,836,620	918	$3,091
South Central - Zone H	165	$5,506,380	1,779	$3,096
South Central - Zone G	196	$6,540,912	2,090	$3,129
Sykes Creek - Zone S	164	$5,473,008	1,653	$3,311
Sykes Creek - Zone U	156	$5,206,032	1,532	$3,398
Total	***6,795***	***$226,762,740***	***121,596***	***$2,006 (average)***

Another opportunity for removing septic systems is to use a hybrid septic tank effluent pumping system. In this system, effluent from the septic tank is connected to sewer pressure lines. Small-diameter pipes, which can be installed relatively quickly, are used instead of the gravity sewer system. A high pressure ½ horse power pump (115 volt) pumps the effluent from the septic system to a force main or gravity sewer system. The City of Vero Beach is installing these systems and they are leaving the drainfields in place, which saves money and allows for a backup in the event that a power outage affects the septic tank effluent pumping system. If the drainfield is not left in place, a 500-gallon pump chamber is installed to allow enough reserve capacity to address power outages. Each septic tank effluent pumping system also has an emergency generator receptacle to address long-term power outages associated with hurricanes. The estimated cost per connection is $6,000 to $10,000, which includes the cost of the pipes. The City of Vero Beach maintains the septic tank effluent pumping system and pumps out the septic tank when needed. The customer pays the electrical costs to operate the pump for this system.

For highly ranked properties located within the vicinity of a pressure line or gravity sewer system, the septic tank effluent pumping system may be a good option instead of the septic system upgrades described below. If septic tank effluent pumping systems are selected as a preferred option anywhere in Brevard County, specific locations for septic tank effluent pumping system installation can be submitted for funding consideration through the annual project funding request and plan update process.

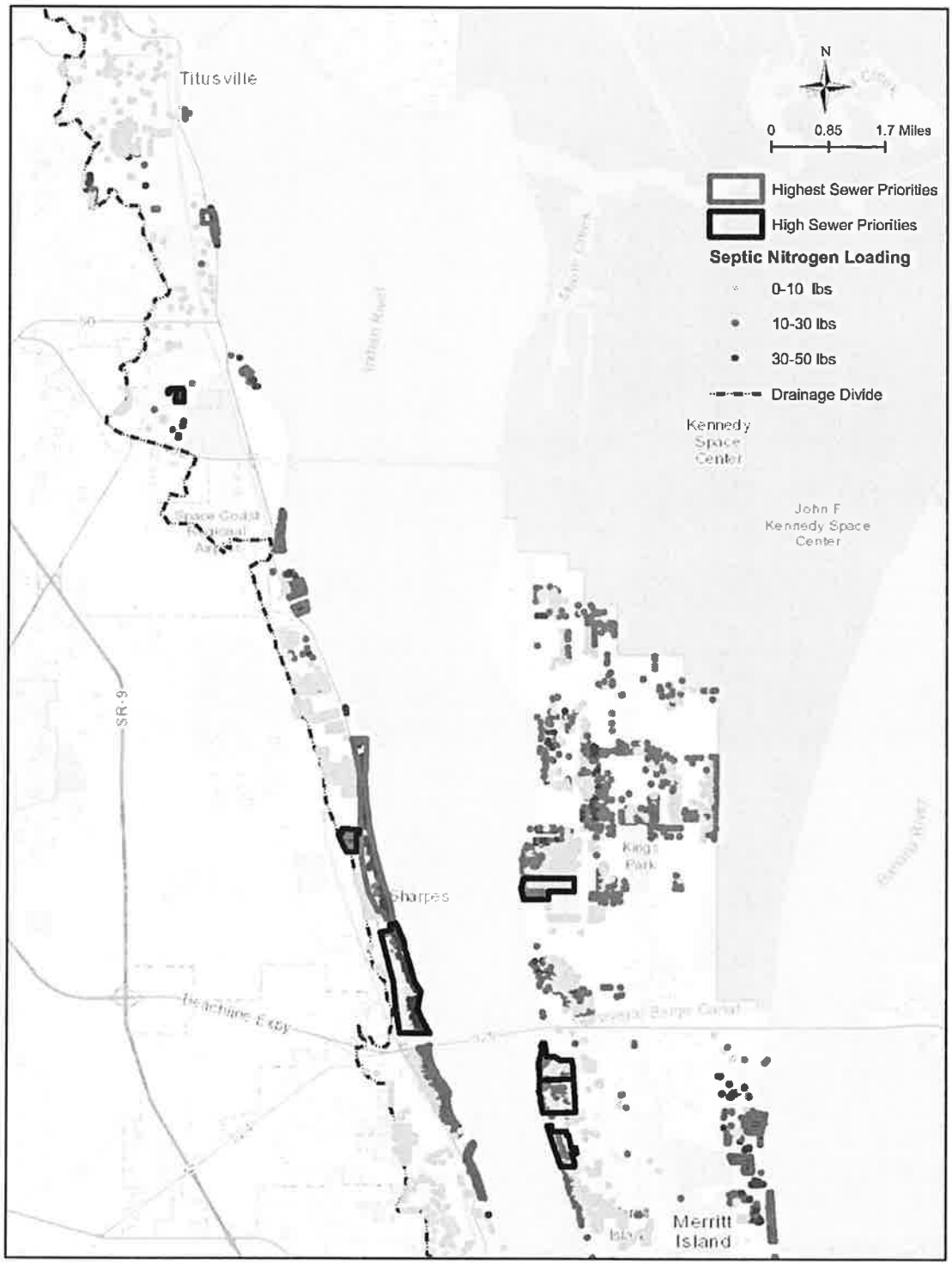


Figure 4-1: Map of Locations for Septic System Removal Projects in North Brevard County

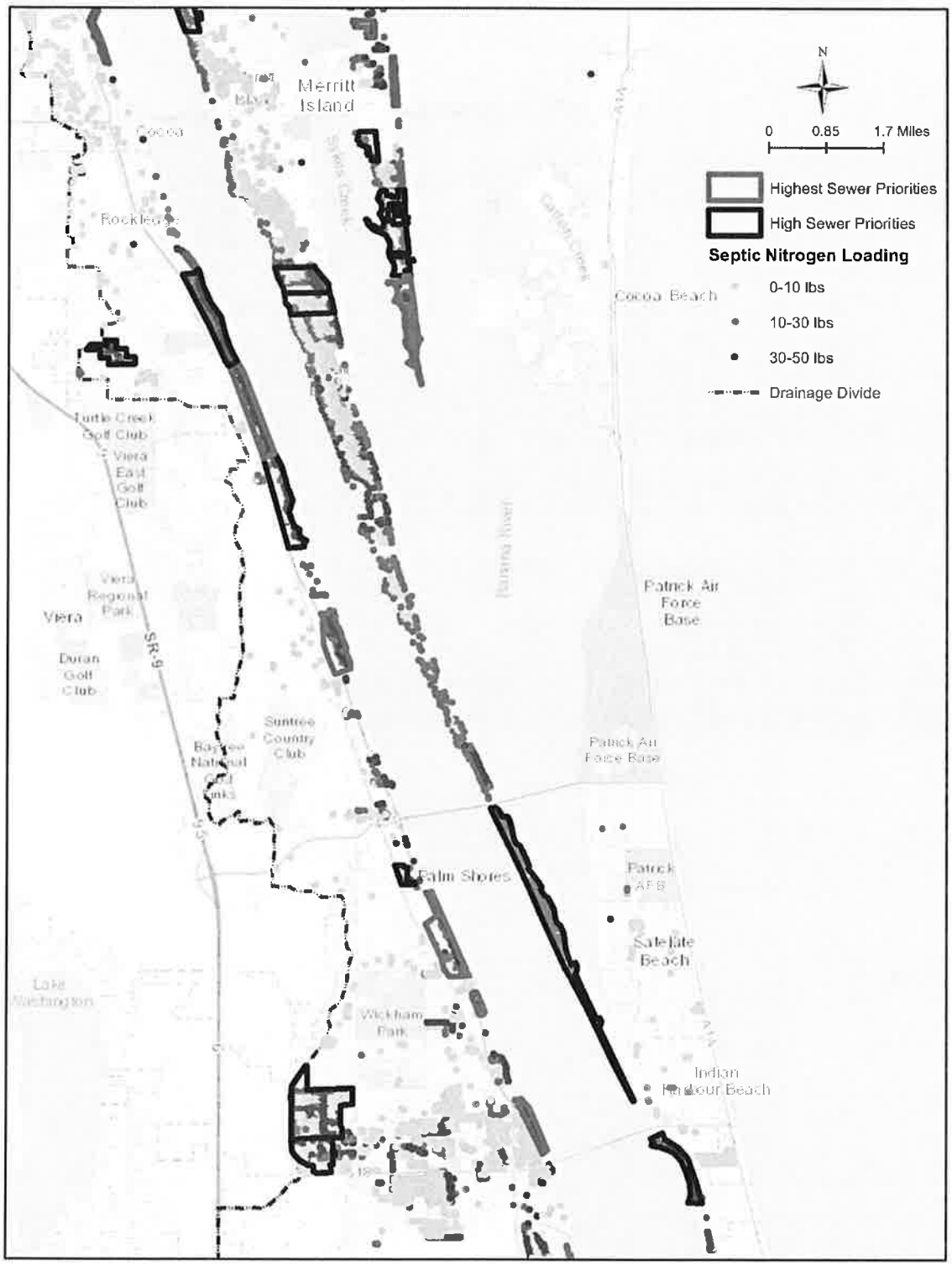


Figure 4-2: Map of Locations for Septic System Removal Projects in Central Brevard County

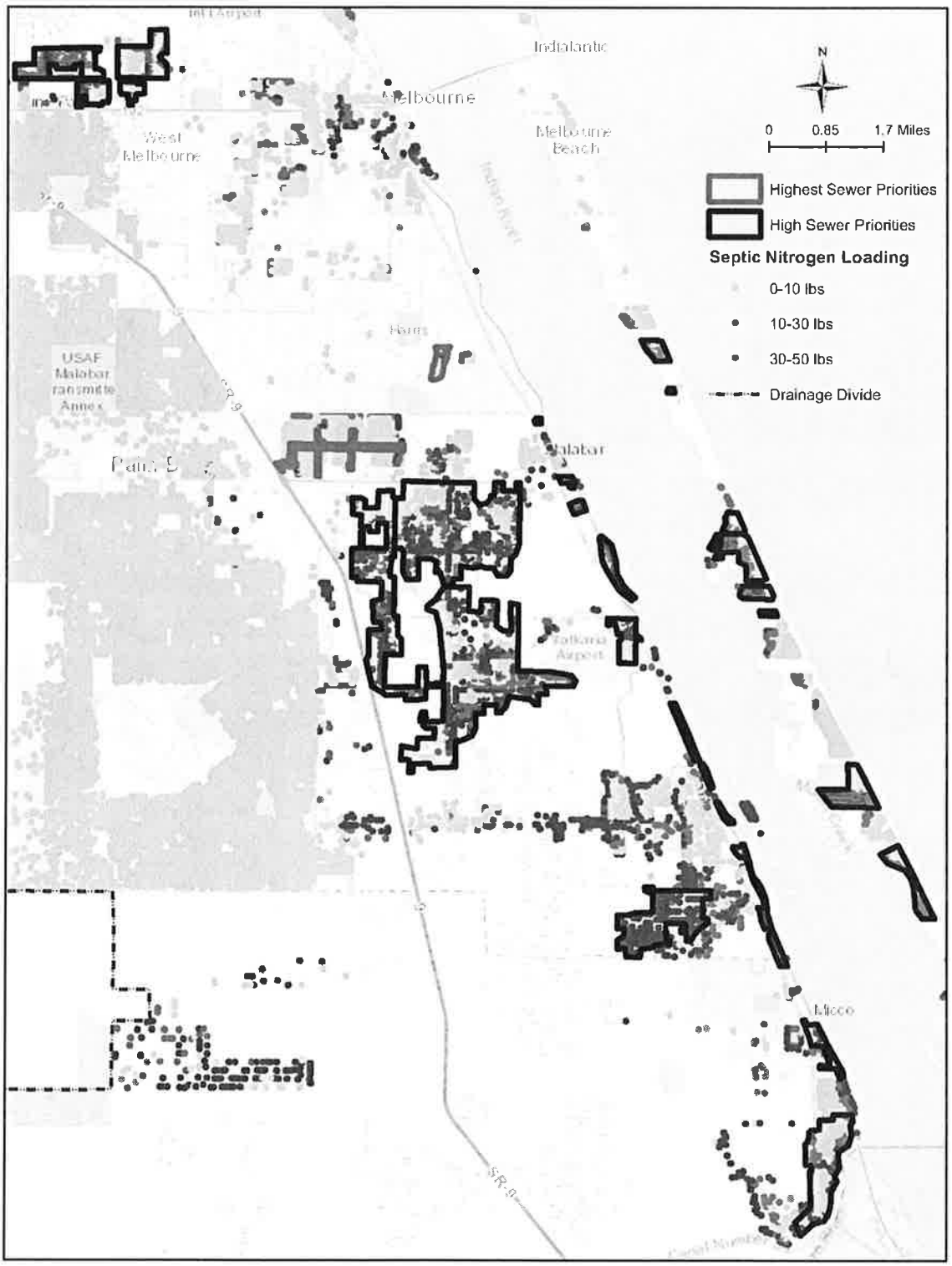


Figure 4-3: Map of Locations for Septic System Removal Projects in South Brevard County

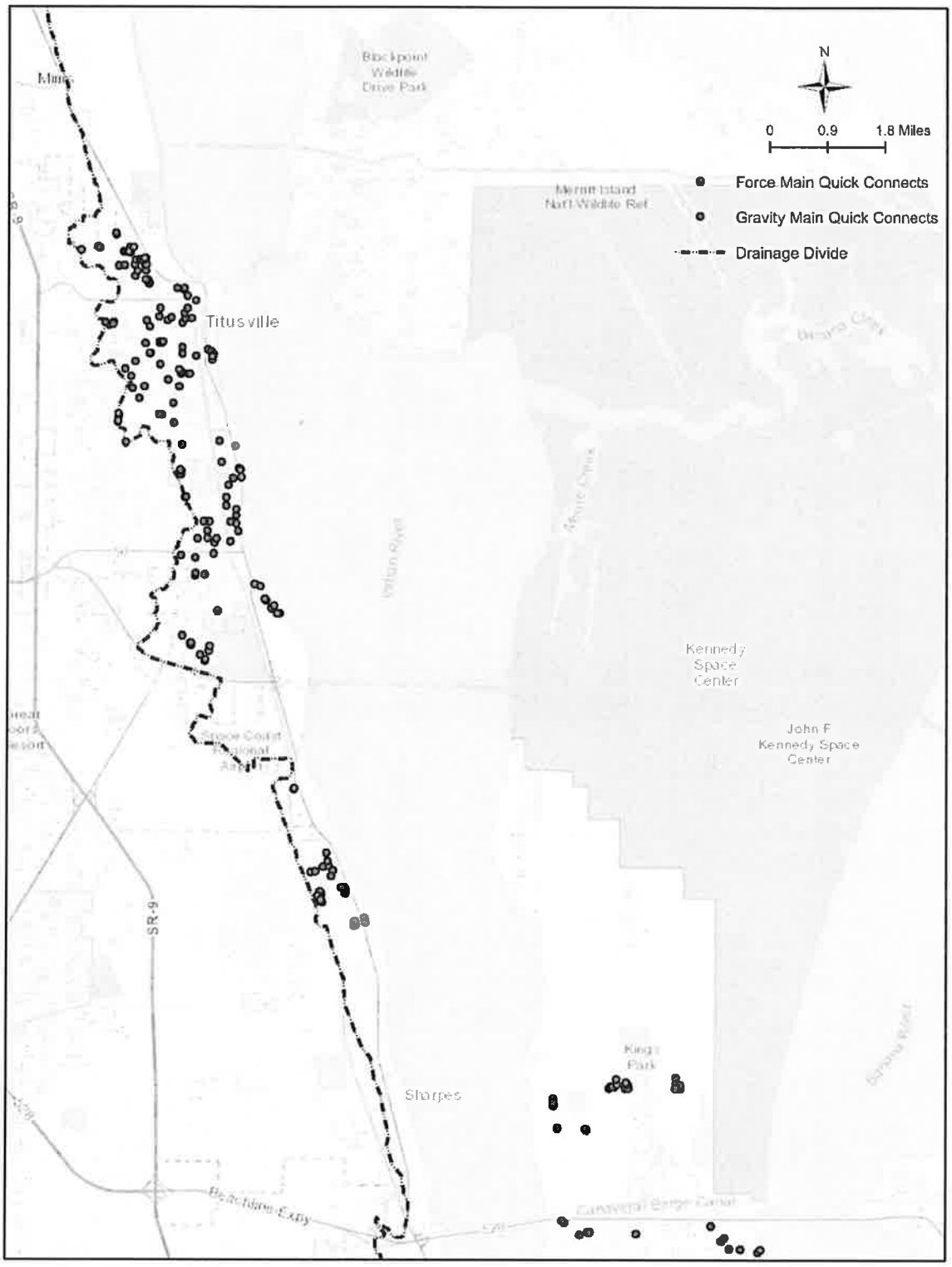


Figure 4-4: Map of the Quick Connection Septic System Removal Locations Near Gravity and Force Main Sewers in North Brevard County

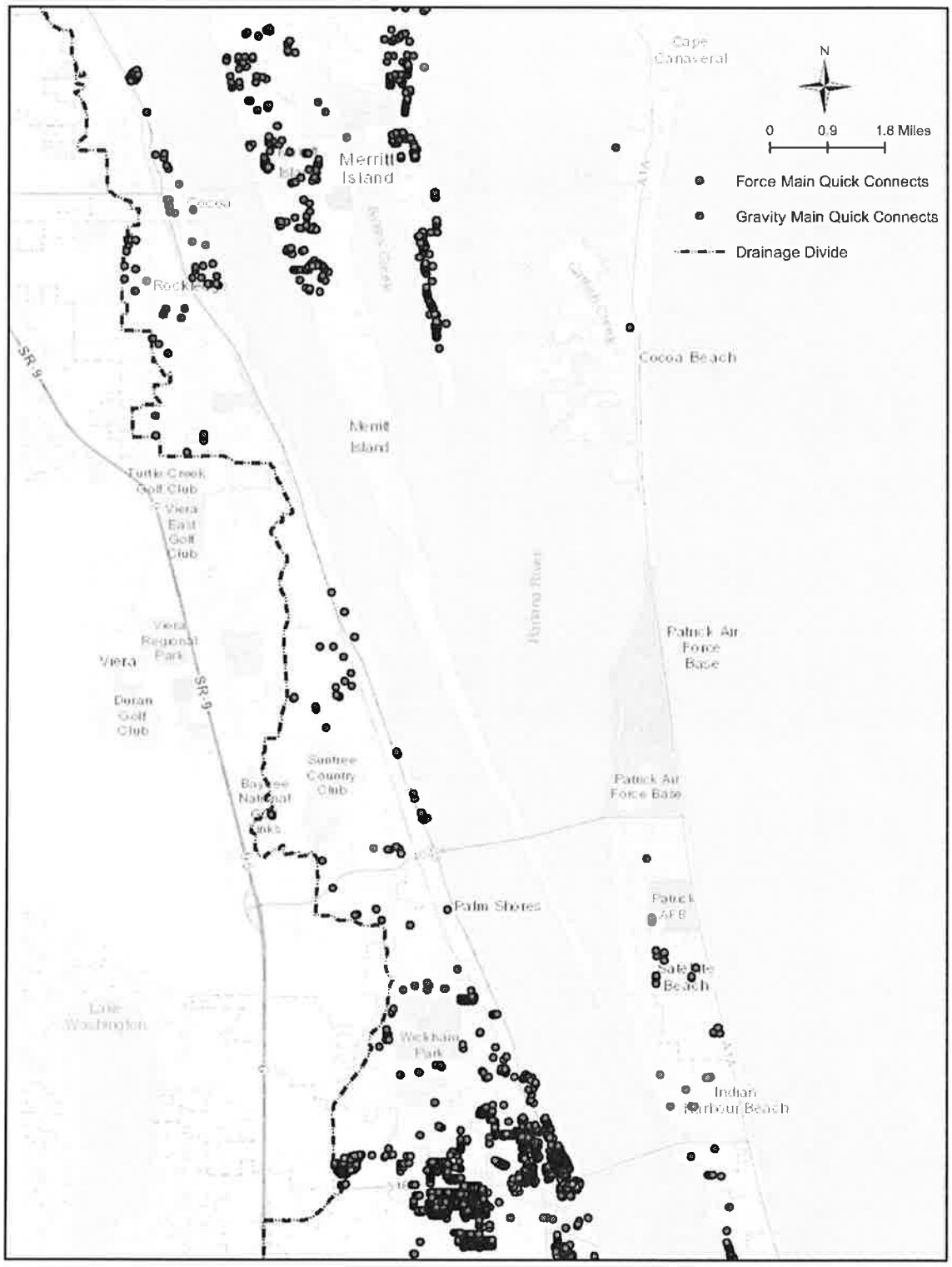


Figure 4-5: Map of the Quick Connection Septic System Removal Locations Near Gravity and Force Main Sewers in Central Brevard County

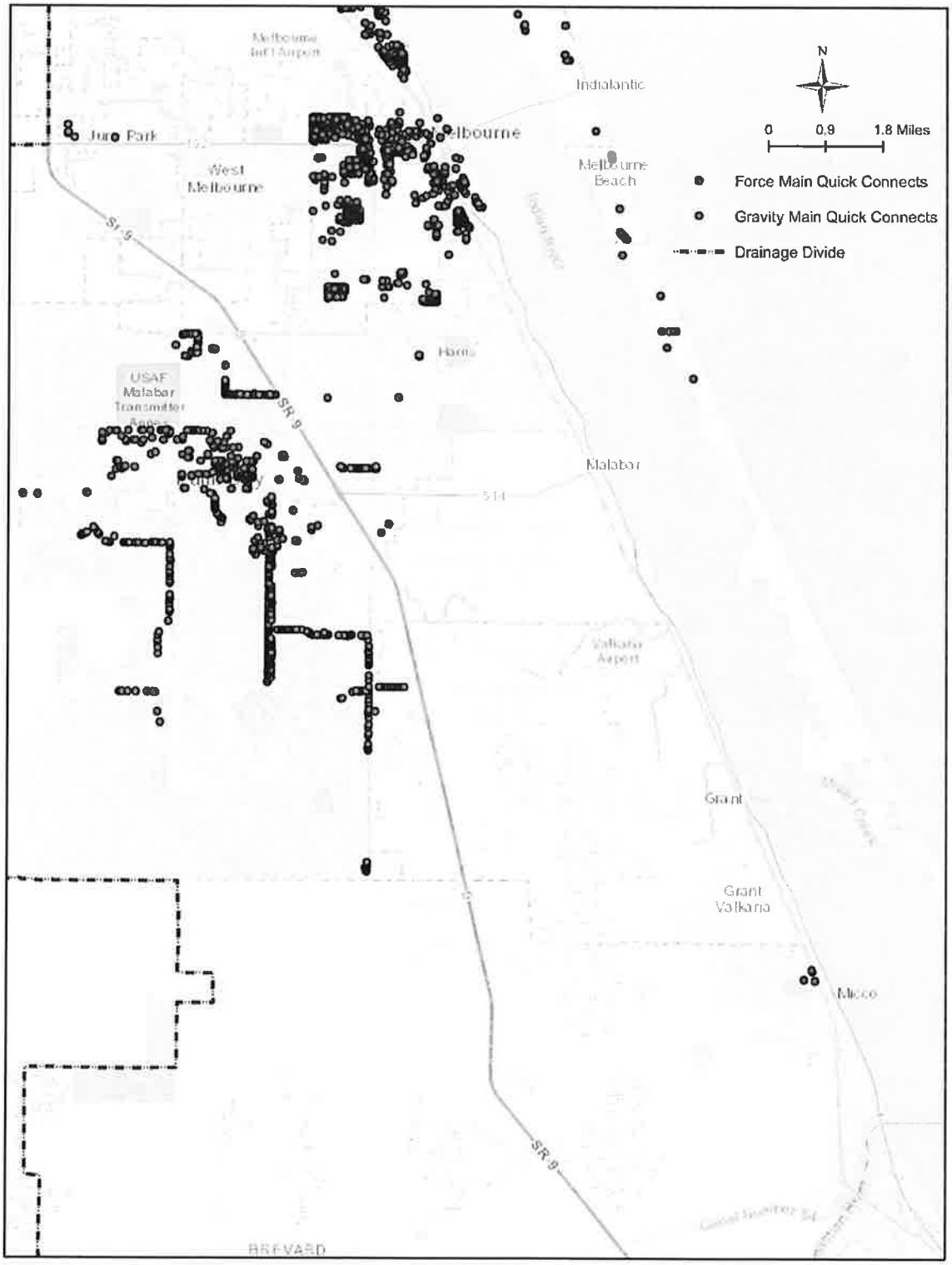


Figure 4-6: Map of the Quick Connection Septic System Removal Locations Near Gravity and Force Main Sewers in South Brevard County

Septic System Upgrades

In locations where providing sewer service is not feasible due to distance from sewer infrastructure, facility capacity, or insufficient density of high risk systems, there are options to upgrade the highest risk septic systems to increase the nutrient and pathogen removal efficiency. In recent years, research has been conducted on passive treatment systems, which provide significant treatment efficiencies without monthly sewer fees or highly complex maintenance needs for mechanical features.

In July 2018, Florida Department of Health adopted new rules that allow for In-Ground Nitrogen-Reducing Biofilters under the drainfield of septic systems (**Figure 4-7**). This passive nitrogen-reducing technology is a result of the Florida Onsite Sewage Nitrogen Reduction Strategies project and the Springs and Aquifer Protection Act. Pilot projects to install this new system are currently in progress throughout the state and Brevard County is a participating partner in these initial installations. This passive INRB is expected to remove 65% of nitrogen from the effluent and cost an extra $4,000 above the typical costs of a conventional septic system. This system requires 51" of soil above the groundwater and, therefore, may not be appropriate in areas with shallow groundwater.

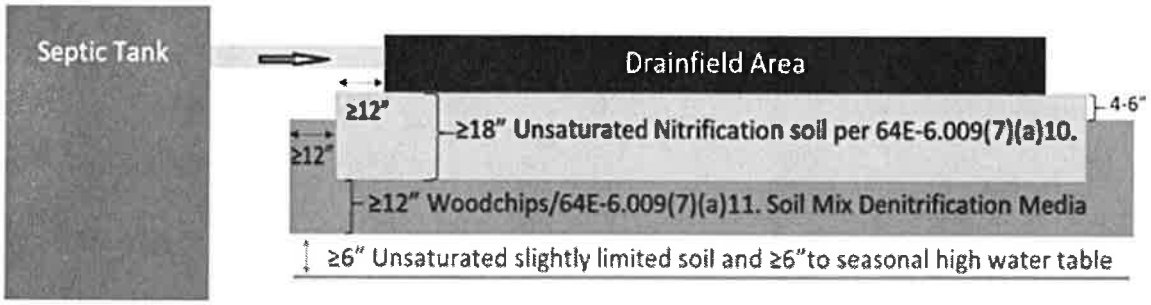


Figure 4-7: Example In-Ground Nitrogen-Reducing Biofilters Septic System

The current ruling by Florida Department of Health only allows woodchips within the denitrification layer of this system; however, other biosorption activated media can also enhance nutrient and bacterial removal before the effluent reaches the drainfield or groundwater and potentially remove more than 65% of nitrogen from effluent. A test of the biosorption activated media removal capacity was conducted at Florida's Showcase Green Envirohome in Indialantic, Florida. This test location is a residential site built with stormwater, graywater, and wastewater treatment in a compact footprint onsite (Wanielista et al. 2011). The media used in this study was Bold & Gold®, which is a patented blend of mineral materials, sand, and clay. In this study, the effluent to the septic tank was evenly divided between a sorption filter media bed/conventional drainfield (innovative system) and to a conventional drainfield. The study found that the TN and TP removal efficiencies were 76.9% and 73.6%, respectively, for the Bold & Gold plus drainfield system, which was significantly higher than the 45.5% TN removal and 32.1% TP removal from a conventional drainfield alone.

In areas where septic systems are in close proximity to a surface waterbody but are not in a location where connection to the sewer system is feasible, adding biosorption activated media to the drainfield or upgrading to the passive nitrogen removing systems could be used to retrofit the existing septic systems. The estimated cost for these retrofits was increased from $16,000 per septic system in the original plan to $18,000 each in the 2019 Plan Update. Any operations and maintenance costs associated with these upgrades, once installed, will be the responsibility of the owner. To be conservative and to match the Florida Department of Health rule, the estimates

of the TN reductions that could be achieved are based on an efficiency of 65% removal, which is the average efficiency from the two studies described above that tested biosorption activated media in the drainfield.

In areas where the In-Ground Nitrogen-Reducing Biofilters system or biosorption activated media retrofits are not appropriate, National Sanitation Foundation 245 certified aerobic treatment units would be the best option. National Sanitation Foundation 245 certification verifies that these advanced septic systems remove at least 50% of nitrogen within the septic tank, although some systems have been shown to remove up to 80% of nitrogen. The drainfield is credited with removing another 15% of nitrogen, which brings the total nitrogen removed by the advanced septic system to 65%. Due to the electrical plumbing requirements of aerobic treatment units, the owner is required to have a maintenance agreement with a septic company and an operating permit from the Florida Department of Health.

There are options for other types of distributed onsite sewage treatment systems that are approved by the Florida Department of Environmental Protection as miniature sewage treatment plants sized for residential and commercial use. These systems provide additional opportunities to improve nutrient removal from sites where connection to central sewer is not feasible and are eligible options for septic system upgrades as part of this plan. Both the Save Our Indian River Lagoon Project Plan and Springs and Aquifer Protection Act have highlighted the need for other wastewater options that have less impact on surface water and groundwater. Brevard County will continue to vet these options as they become available in Florida.

To prioritize the septic systems for upgrade, the scoring matrix used in the original Save Our Indian River Lagoon Project Plan (see **Appendix D**) was replaced in the 2019 Update based on ArcGIS-Based Nitrate Load Estimation Toolkit modeling performed during determination of the Nitrogen Reduction Overlay area adopted in the County-wide Septic Ordinance, as noted above.

The 400 septic systems with the highest loading in each sub-lagoon are recommended for retrofit upgrades to reduce the impacts of these septic systems on the waterbodies. The costs and nutrient reductions by sub-lagoon are shown in **Table 4-24**. The locations of these septic system upgrades are shown in **Figure 4-8**, **Figure 4-9**, and **Figure 4-10**. This upgrade opportunity addresses 2% of the septic systems in the IRL drainage basin.

In some circumstances, properties qualified for septic system upgrade funding may be near a sewer line. These septic upgrade funds can be used to connect the qualified property to sewer as this option results in a greater reduction in nitrogen loading to the lagoon.

Table 4-24: Septic Tank Upgrades and Costs for Highest Priority Septic Systems

Sub-lagoon	Number of Lots	Cost	TN Load (lbs/yr)	TN Reductions (lbs/yr)	Cost per Pound per Year of TN
Banana River Lagoon*	400	$7,200,000	12,384	6,192	$1,163
North IRL*	400	$7,200,000	18,926	9,463	$761
Central IRL*	400	$7,200,000	18,932	9,466	$761
Total	***1,200***	***$21,600,000***	***50,242***	***25,121***	***$860 (average)***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

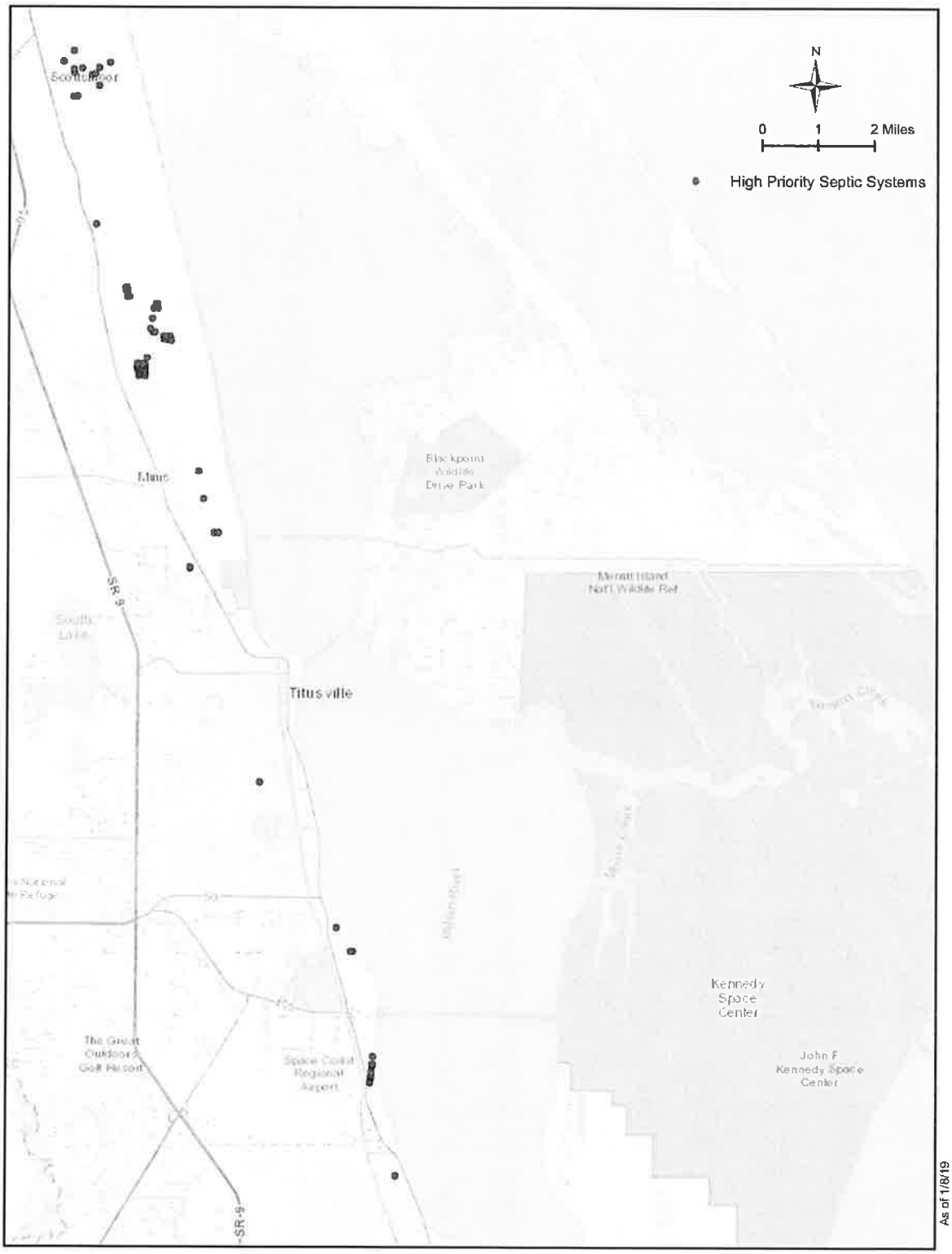


Figure 4-8: Map of Locations for Septic System Upgrades in North Brevard County

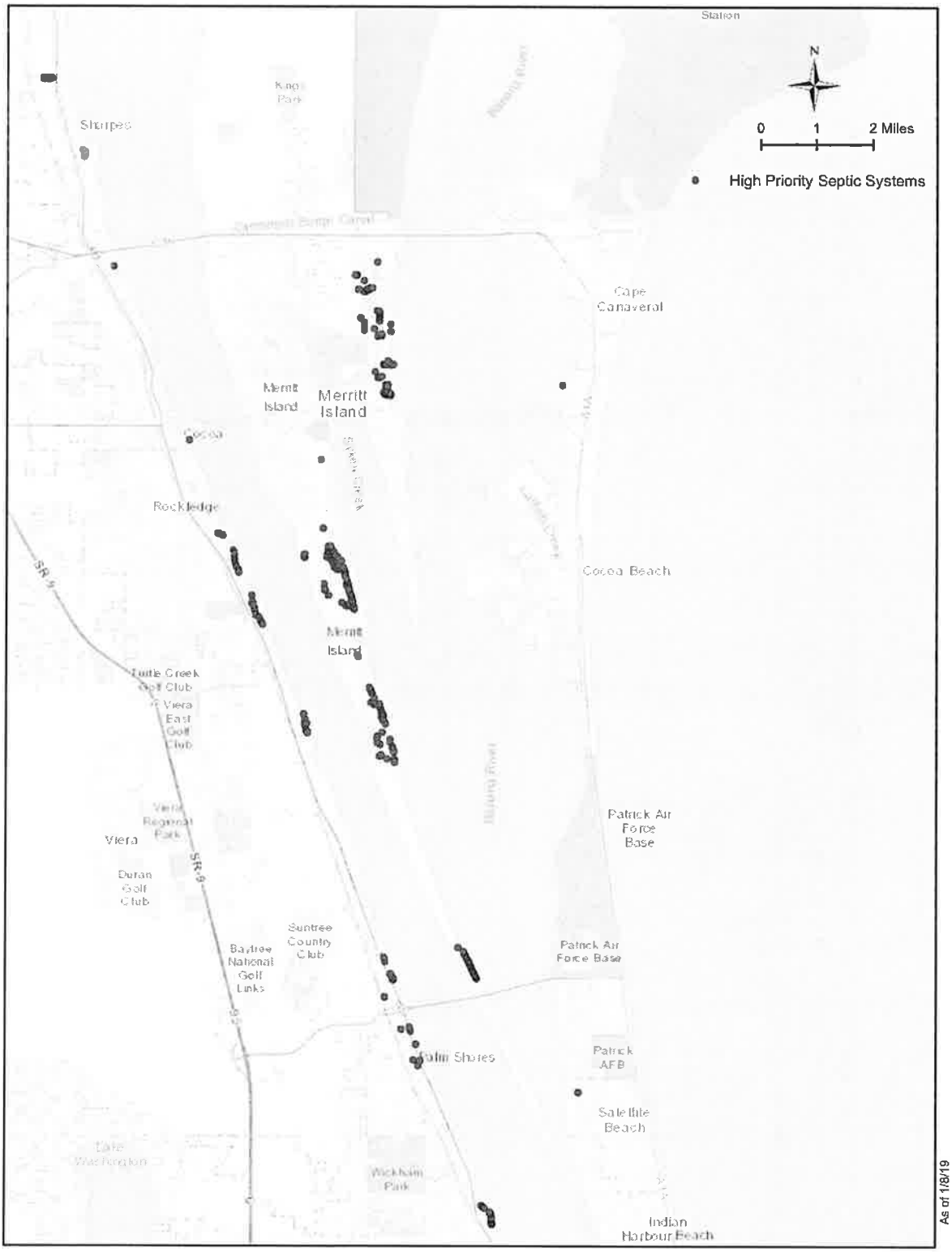


Figure 4-9: Map of Locations for Septic System Upgrades in Central Brevard County

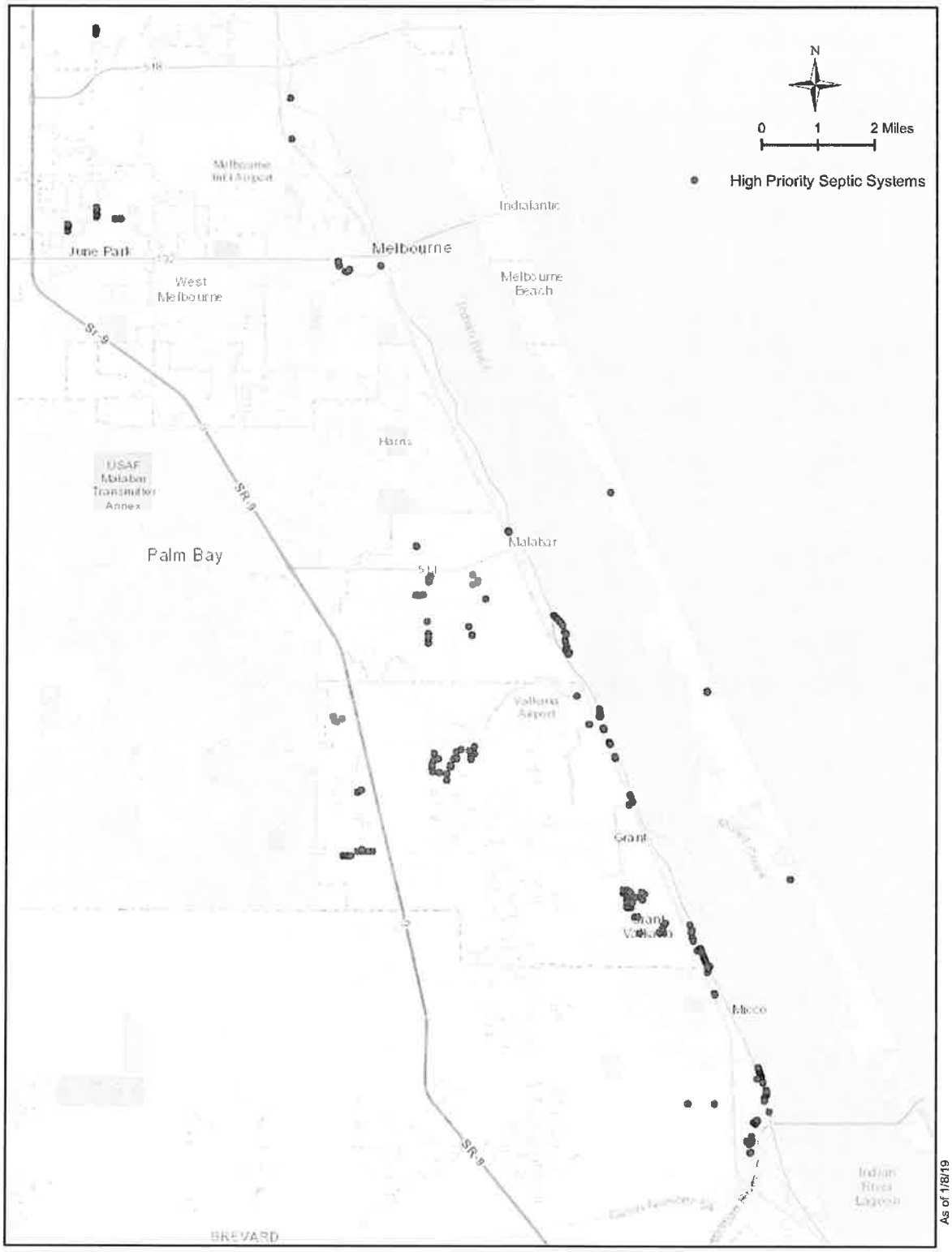


Figure 4-10: Map of Locations for Septic System Upgrades in South Brevard County

4.1.7 Stormwater Treatment

Stormwater runoff contributes 33.6% of the external TN loading and 43.4% of the external TP loading to the lagoon annually.

Stormwater runoff from urban areas carries pollutants that affect surface waters and groundwater. These pollutants include nutrients, pesticides, oil and grease, debris and litter, and sediments. In Brevard County, there are more than 1,500 stormwater outfalls to the IRL.

There are a variety of best management practices that can be used to capture and treat stormwater to remove or reduce these pollutants before the stormwater runoff reaches a waterbody or infiltrates to the groundwater. Potential stormwater best management practices that could help restore the IRL system include:

- Traditional best management practices – These best management practices are the typical practices that are used to treat stormwater runoff and include wet detention ponds, retention, swales, dry detention, baffle boxes, stormwater reuse, alum injection, street sweeping, catch basin inserts/inlet filters, floating islands/managed aquatic plant systems. Descriptions of these traditional best management practices and expected TN and TP efficiencies are shown in **Table 4-25**.
- Low impact development/green infrastructure – These types of best management practices use natural stormwater management techniques to minimize runoff and help prevent pollutants from getting into stormwater runoff. These best management practices address the pollutants at the source so implementing them can help decrease the size of traditional retention and detention basins and can be less costly than traditional best management practices (Institute of Food and Agricultural Sciences 2016). Descriptions of low impact development and green infrastructure best management practices and estimated efficiencies are shown in **Table 4-26**.
- Denitrification best management practices – These best management practices use a soil media, known as biosorption activated media to increase the amount of denitrification that occurs, which increases the amount of TN and TP removed. Biosorption activated media includes mixes of soil, sawdust, zeolites, tire crumb, vegetation, sulfur, and spodosols. Additional details about denitrification best management practices are included below.
- Best management practices to reduce baseflow intrusion – These projects are modifications to existing best management practices help reduce intrusion of captured groundwater baseflow into stormwater drainage systems. These best management practices include backfilling canals so that they do not cut through the baseflow, modifying canal cross-sections to maintain the same storage capacity while limiting the depth, installing weirs to control the water levels in the best management practice, or adding a cutoff wall to prevent movement into the baseflow.
- Re-diversion to the St. Johns River – There are portions of the current IRL Basin that historically flowed towards the St. Johns River. By re-diverting these flows back to the St. Johns River, the excess stormwater runoff, as well as the additional freshwater inputs, to the IRL would be removed. The re-diversion projects would include a treatment component so that the runoff is treated before being discharged to the St. Johns River. The St. Johns River Water Management District has taken the lead on large-scale projects while the County has re-diverted more than 400 acres in the Crane Creek basin and partnered with the St. Johns River Water Management District to increase re-diversion from the Melbourne-Tillman Water Control District canal system.

Table 4-25: Traditional Stormwater Best Management Practices with TN and TP Removal Efficiencies

Best Management Practice	Definition	TN Removal Efficiency	TP Removal Efficiency	Source
Wet detention ponds	Permanently wet ponds that are designed to slowly release a portion of the collected stormwater runoff through an outlet structure. Recommended for sites with moderate to high water table conditions. Provide removal of both dissolved and suspended pollutants through physical, chemical, and biological processes.	8%-44%	45%-75%	Florida Department of Environmental Protection et al. 2010
Off-line retention	Recessed area that is designed to store and retain a defined quantity of runoff, allowing it to percolate through permeable soils into the groundwater aquifer. Runoff in excess of the specified volume of stormwater does not flow into the retention system storing the initial volume of stormwater.	40%-84%	40%-84%	Harper et al. 2007
On-line retention and swales	Recessed area that is designed to store and retain a defined quantity of runoff, allowing it to percolate through permeable soils into the groundwater aquifer. Runoff in excess of the specified volume of stormwater does flow through the retention system that stores the initial volume of stormwater.	30%-74%	30%-74%	Harper et al. 2007
Dry detention	Designed to store a defined quantity of runoff and slowly release it through an outlet structure to adjacent surface waters. After drawdown of the stored runoff is completed, the storage basin does not hold any water. Used in areas where the soil infiltration properties or seasonal high-water table elevation will not allow the use of a retention basin.	10%	10%	Harper et al. 2007
2nd generation baffle box	Box chambers with partitions connected to a storm drain. Water flows into the first section of the box where most pollutants settle out. Overflows into the next section to allow further settling. Water ultimately overflows to the stormwater pipe. Floating trays capture leaves, grass clippings, and litter to prevent them from dissolving in the stormwater.	19.05%	15.5%	GPI 2010
Stormwater reuse	Reuse of stormwater from wet ponds for irrigation. Compare volume going to reuse to total volume of annual runoff to pond.	Amount of water not discharged annually	Amount of water not discharged annually	Not applicable
Alum injection	Chemical treatment systems that inject aluminum sulfate into stormwater systems to cause coagulation of pollutants.	50%	90%	Harper et al. 2007
Street sweeping	Cleaning of pavement surfaces to remove sediments, debris, and trash deposited by vehicle traffic. Prevents these materials from being introduced into the stormwater system.	TN content in dry weight of material collected annually	TP content in dry weight of material collected annually	University of Florida 2011
Catch basin inserts/inlet filters	Devices installed in storm drain inlets to provide water quality treatment through filtration of organic debris and litter, settling of sediment, and adsorption of hydrocarbon by replaceable filters.	TN content in dry weight of material collected annually	TP content in dry weight of material collected annually	University of Florida 2011

Best Management Practice	Definition	TN Removal Efficiency	TP Removal Efficiency	Source
Managed Aquatic Plant System	Aquatic plant-based best management practices that remove nutrients through a variety of processes related to nutrient uptake, transformation, and microbial activities.	20%	20%	Florida Department of Environmental Protection et al. 2010

Table 4-26: Low Impact Development and Green Infrastructure Best Management Practices and TN and TP Removal Efficiencies

Best Management Practice	Definition	TN Removal Efficiency	TP Removal Efficiency	Source
Permeable pavement	Hard, yet penetrable, surfaces reduce runoff by allowing water to move through them into groundwater below (Institute of Food and Agricultural Sciences 2016).	30%-74%	30%-74%	Harper et al. 2007
Bioswales	An alternative to curb and gutter systems, bioswales convey water, slow runoff, and promote infiltration. Swales may be installed along residential streets, highways, or parking lot medians (Institute of Food and Agricultural Sciences 2016). Must be designed for conveyance, greater in length than width, have shallow slopes, and include proper landscaping.	38%-89%	9%-80%	Florida Department of Environmental Protection 2014
Green roofs	These systems can significantly reduce the rate and quantity of runoff from a roof and provide buildings with thermal insulation and improved aesthetics (Institute of Food and Agricultural Sciences 2016). Retention best management practice covered with growing media and vegetation that enables rainfall infiltration and evapotranspiration of stored water. Including a cistern capture, retain, and reuse water adds to effectiveness.	45% (without cistern) 60%-85% (with cistern)	Not applicable	Florida Department of Environmental Protection 2014
Bioretention basins/rain gardens	Small vegetated depressions in the landscape collect and filter stormwater into the soil (Institute of Food and Agricultural Sciences 2016). Constructed adjacent to roof runoff and impervious areas.	30%-50%	30%-90%	Florida Department of Environmental Protection 2014
Tree boxes	Bioretention systems with vertical concrete walls designed to collect/retain specified volume of stormwater runoff from sidewalks, parking lots and/or streets. Consists of a container filled with a soil mixture, a mulch layer, under-drain system, and shrub or tree (Florida Department of Environmental Protection 2014).	38%-65%	50%-80%	Florida Department of Environmental Protection 2014

Due to the importance of treating dry season baseflow to the lagoon, Brevard County has found that ditch denitrification is the most cost-effective best management practice. Biosorption activated media can be added in existing best management practices or to new best management practices to improve the nutrient removal efficiency. The removal efficiencies of using biosorption activated media in various stormwater treatment projects (Wanielista 2015) are summarized in **Table 4-27**.

Table 4-27: TN and TP Removal Efficiencies for Biosorption Activated Media

Location in Best Management Practice Treatment Train	Material	TN Removal Efficiency	TP Removal Efficiency
Bold & Gold as a first best management practice, example up-flow filter in baffle box and a constructed wetland	Expanded Clay Tire Chips	55%	65%
Bold & Gold in up-flow filter at wet pond and dry basin outflow	Organics Tire Chips Expanded Clay	45%	45%
Bold & Gold in inter-event flow using up-flow filter at wet pond and down-flow filter at dry basin	Expanded Clay Tire Chips	25%	25%
Bold & Gold down-flow filters 12-inch depth at wet pond or dry basin pervious pavement, tree well, rain garden, swale, and strips	Clay Tire Crumb Sand and Topsoil	60%	90%

Note: From Wanielista 2015

The County's proposed total maximum daily loads include two components: (1) a total maximum daily load for the five-month period (January – May) that is critical for seagrass growth, and (2) a total maximum daily load for the remaining seven months of the year to avoid algal blooms and protect healthy dissolved oxygen levels. The stormwater project benefits were estimated, as follows, to ensure both components of the total maximum daily load are adequately addressed. The five-month total maximum daily load covers the dry season in this area when there is minimal rainfall and stormwater runoff; therefore, the benefits of stormwater biosorption activated media projects during this period were based only on January – May baseflow loading estimates from the Spatial Watershed Iterative Loading model. The estimated project treatment efficiencies used for January to May are 55% for TN and 65% for TP. For the remaining seven months, the baseflow and stormwater loading estimates from the Spatial Watershed Iterative Loading model were used with a project efficiency of 45% for TN and 45% for TP. The estimated TN and TP reductions accomplished by using biosorption activated media upstream of these priority outfalls are summarized in **Table 4-28**, as well as the estimated cost per pound of TN or TP removed. A detailed list of stormwater projects, which was revised as part of this 2019 Update, is included in **Appendix E**. The locations of the basins to be treated are shown in **Figure 4-11**, **Figure 4-12**, and **Figure 4-13**.

Table 4-28: Estimated TN and TP Reductions and Costs for Biosorption Activated Media Projects

Sub-lagoon	Number of Basins	Estimated Total Project Cost	TN Reductions (lbs/yr)	Cost per Pound Per Year of TN	TP Reductions (lbs/yr)	Cost per Pound per Year of TP
Banana River Lagoon*	119	$12,125,000	72,788	$167	10,600	$1,144
North IRL*	193	$20,275,000	154,555	$131	23,750	$854
Central IRL*	10	$2,100,000	24,099	$87	3,614	$581

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

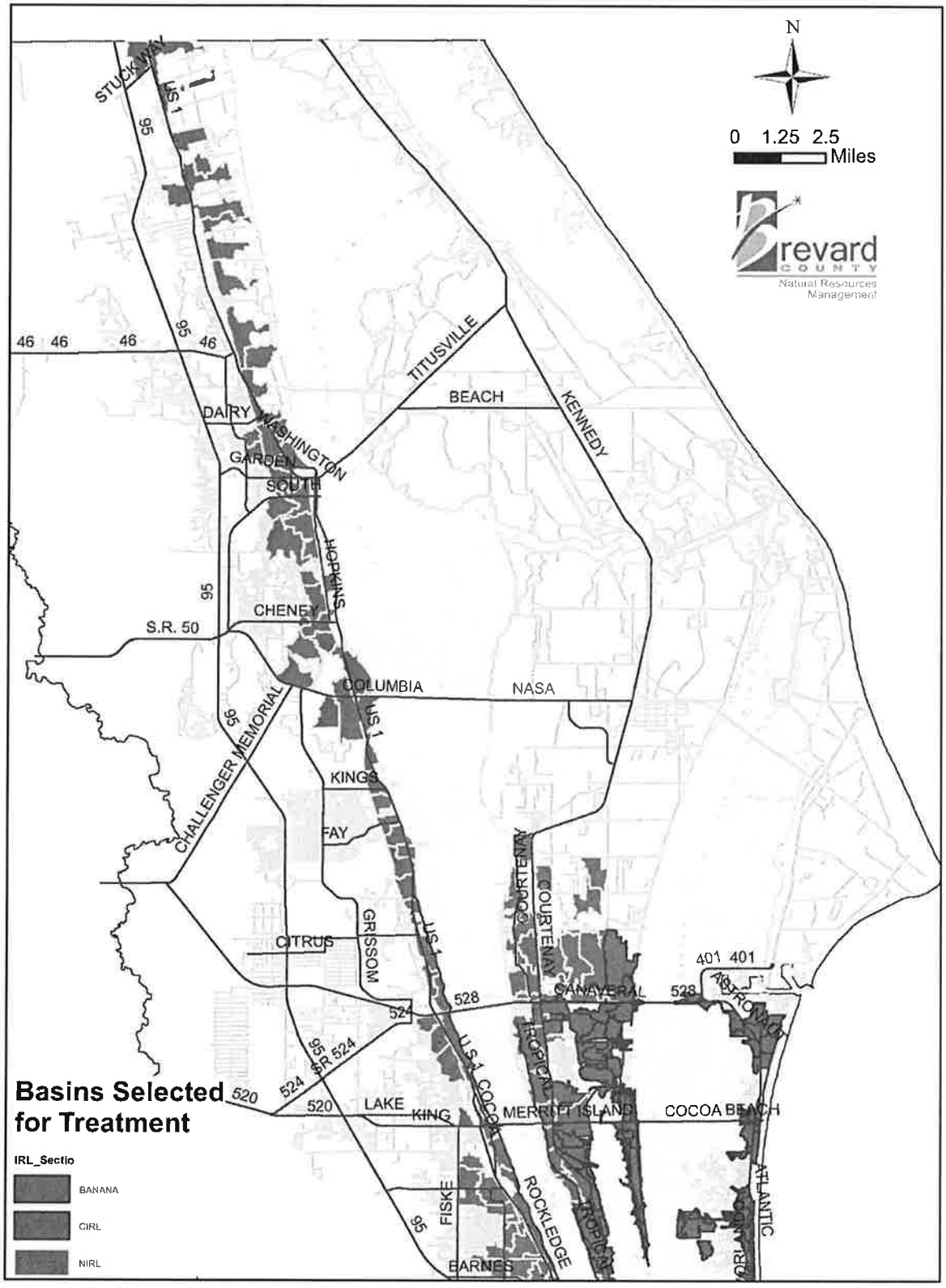


Figure 4-11: Map of Selected Stormwater Projects in North Brevard County

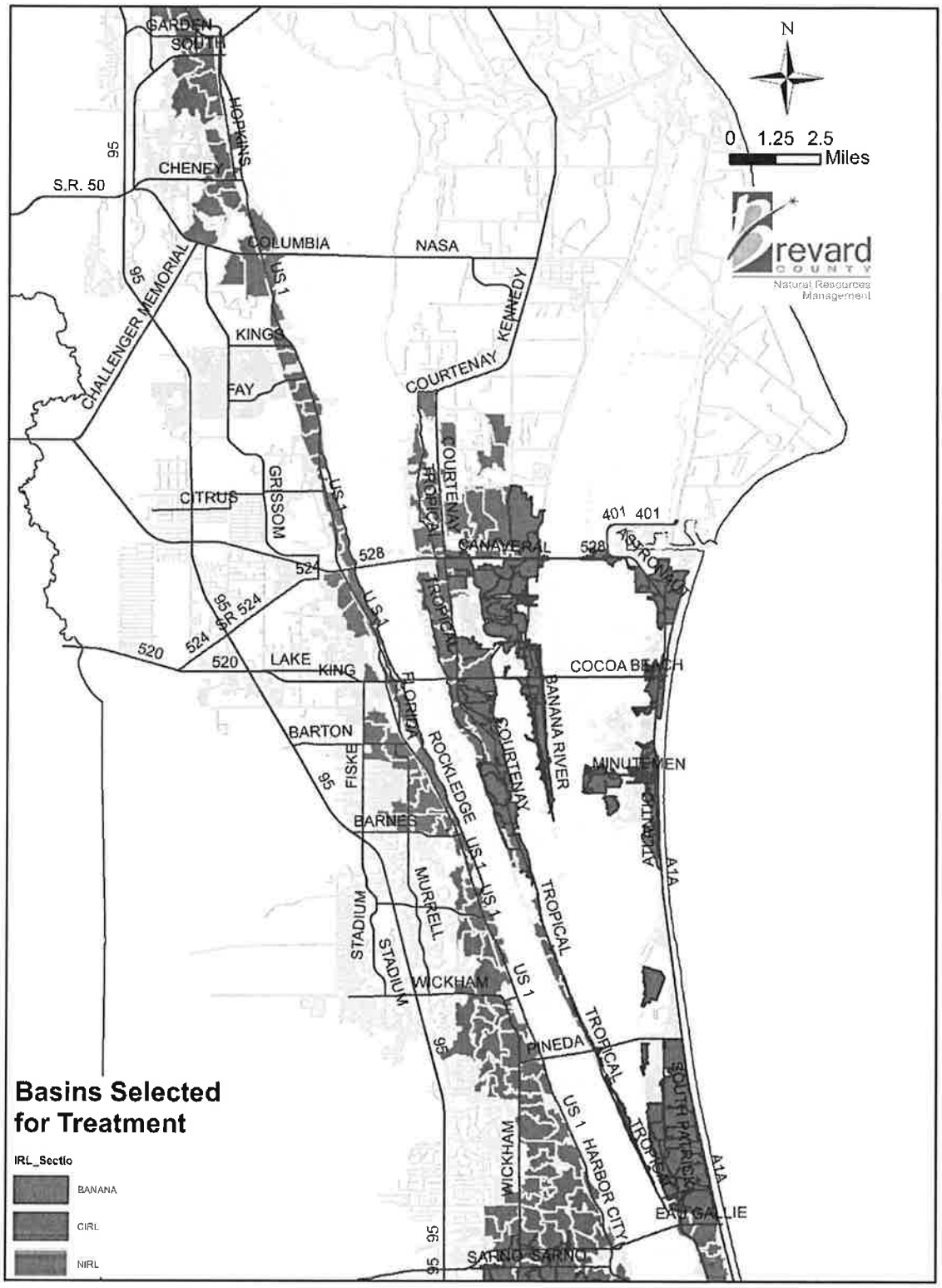


Figure 4-12: Map of Selected Stormwater Projects in Central Brevard County

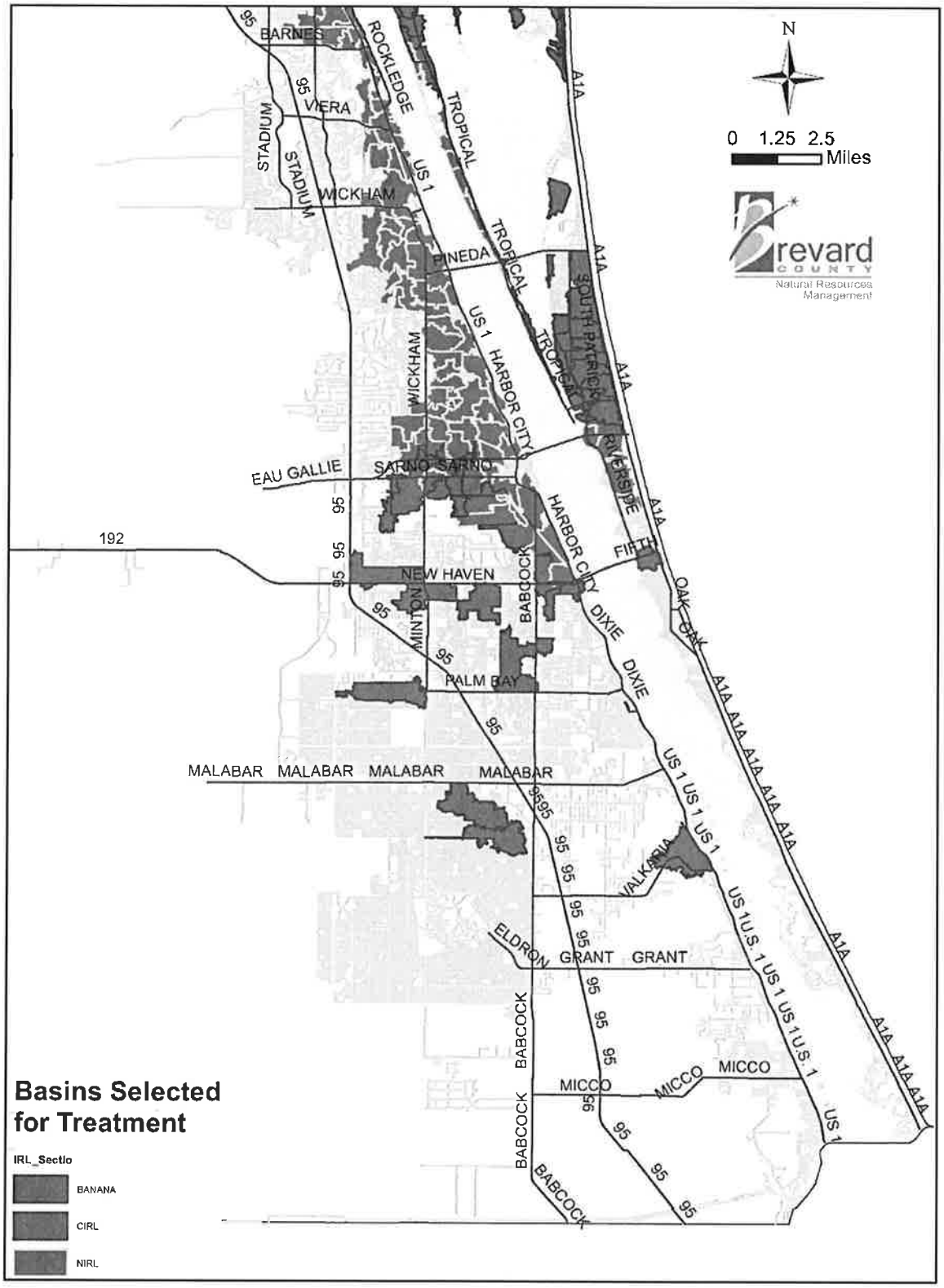


Figure 4-13: Map of Selected Stormwater Projects in South Brevard County

4.2. Projects to Remove Pollutants

The purpose of the projects in this section is to remove pollutants that have accumulated in the lagoon. Brevard County has already begun to remove deep accumulations of muck from the lagoon bottom. Dredging to remove muck in other locations of the lagoon will continue, as well as treatment of the interstitial water when feasible. These muck removal projects have more immediate benefits on the lagoon water quality than external reduction projects because the nutrient flux is reduced as soon as muck is dredged from the system whereas it takes time for the external load reduction benefits to reach the lagoon. The County is also evaluating opportunities to use new treatment technologies to provide surface water remediation. In addition, the St. Johns River Water Management District and IRL National Estuary Program are evaluating opportunities for enhanced circulation projects, which will allow additional water to flow into the lagoon system to help remove the built-up sediments and muck.

The following sections describe the County's proposed muck removal projects, scrubbing of muck interstitial water, as well as potential surface water remediation and potential circulation enhancement projects.

4.2.1 Muck Removal (updated in 2019)

Muck flux contributes 917,000 lbs/yr of TN and 87,800 lbs/yr of TP to the lagoon each year.

The muck in the lagoon increases turbidity, inhibits seagrass growth, promotes oxygen depletion in sediments and the water above, stores and releases nutrients, covers the natural bottom, and destroys healthy communities of benthic organisms (Trefry 2013). When muck is suspended within the water column due to wind or human activities such as boating, these suspended solids limit light availability and suppress seagrass growth. Even for deeper water areas without seagrass growth, muck remains a nutrient source that potentially affects a broader area of the lagoon through nutrient flux and resuspension of fine sediments and their subsequent transport. As shown in **Table 3-1,** the annual release of nutrients from decaying muck is almost as much as the annual external loading delivered by stormwater and groundwater baseflow combined. The muck deposits cover an estimated 6,700 acres of the lagoon system bottom in Brevard County (Trefry 2018).

The muck deposits in the lagoon flux nutrients that enter the water column and contribute to algal blooms and growth of macroalgae. Muck flux rates for nitrogen and phosphorus have been estimated through studies in the IRL system. For this plan, the average flux rates used are 150 pounds of TN per acre per year and 20 pounds of TP per acre per year (Trefry 2018) except where specific measurements indicate otherwise.

The focus of the muck removal projects for this plan was on large deposits of muck in big, open water sites within the lagoon itself. Several of the canal systems that directly connect to the lagoon are also included for muck removal. The goal of the muck removal is to reduce TN and TP muck flux loads by 25%, which should result in a significant improvement in water quality and seagrass extent, as well as a reduced risk of massive algal blooms and fish kills. A 70% efficiency for muck removal projects was applied. This efficiency accounts for two factors: (1) each target dredge area has less than 100% muck cover, and (2) some pockets of muck within dredged areas will inevitably be left behind regardless of the dredge technology used. In 2018, the Florida Institute of Technology conducted evaluations of the muck deposits throughout the lagoon system for Brevard County. The updated muck acreage estimates are shown in **Table 4-29**.

Table 4-29: Muck Acreages in the IRL System

Muck Reduction Targets	Open Banana	Banana Canals	North IRL	North IRL Canals	Central IRL	Central IRL Canals	Mosquito Lagoon
Muck area (acres)	1,442	752	4,339	51	96	37	398
Muck flux (pounds of TN per year)	381,690	112,800	369,361	7,650	40,226	5,550	7,164
Funded dredging sites (acres)	273	182	313	15	58	10	0
Flux from funded dredging sites (pounds of TN per year)	173,312	27,300	82,078	2,250	7,200	1,500	0
Flux reduction from funded sites (pounds of TN per year)	121,319	19,110	57,455	1,575	5,040	1,050	0
Percent of total flux reduced by dredging the funded sites	32%	17%	16%	21%	13%	19%	0%

Using the information from the Florida Institute of Technology, Brevard County reevaluated the priority muck locations for dredging. The costs, estimated TN and TP reductions using average flux rates for Brevard County or site-specific data collected by the Florida Institute of Technology where available, and cost per pound of nutrient removed for the proposed muck dredging projects are shown in **Table 4-30** for the Banana River Lagoon, **Table 4-31** for the North IRL, and **Table 4-32** for the Central IRL. The locations of these projects are shown in **Figure 4-14** through **Figure 4-16**.

As dredging proceeds, upland input of muck components must be reduced to prevent new muck accumulation. Therefore, land-based source control measures for nutrients, organic waste, and erosion are needed. Without source controls, muck removal will need to be frequently repeated, which is neither cost-effective nor beneficial to the lagoon's health. Public awareness and commitment is needed to control future muck accumulation. Activities that contribute organic debris and sediment to stormwater and open water must be curtailed. Additional scientific assessment should be carried out to evaluate and optimize the dredging process.

Table 4-30: Banana River Lagoon Estimated Costs and Nutrient Reductions for Muck Removal Project Areas

Location	Cubic Yards	Acres	Cost Estimate	TN Flux (pounds per acre per year)	TN Flux Reduction (lbs/yr)	Cost per Pound per Year of TN Removed	TP Flux (pounds per acre per year)	TP Flux Reduction (lbs/yr)	Cost per Pound per Year of TP Removed
Port Canaveral South*	420,000	55	$14,700,000	892	34,342	$428	50	1,925	$7,636
Pineda Banana River Lagoon*	195,000	28	$6,825,000	813	15,935	$428	35	686	$9,949
Cocoa Beach Golf*	975,000	140	$34,125,000	629	61,642	$554	21	2,058	$16,582
Kent Drive*	40,000	13	$1,400,000	150	1,365	$1,026	20	182	$7,692
Patrick Air Force Base*	205,000	26	$7,175,000	378	6,880	$1,043	21	382	$18,783
Patrick Air Force Base Borrow Pit-4*	10,000	3	$350,000	150	315	$1,111	20	42	$8,333
528 East*	35,000	8	$1,225,000	150	840	$1,458	20	112	$10,938
30% of Venetian Canals/Channels*	825,000	182	$28,875,000	150	19,010	$1,511	20	2,548	$11,332
Newfound Harbor East	45,000	10	$1,575,000	150	1,050	$1,500	20	140	$11,250
70% of Banana Venetian Collector Canals/Channels	2,575,000	570	$90,125,000	150	59,580	$1,506	20	7,980	$11,294
Patrick Air Force Base Borrow Pit-2	135,000	29	$4,725,000	150	3,045	$1,552	20	406	$11,638
Newfound Harbor South	135,000	29	$4,725,000	150	3,045	$1,552	20	406	$11,638
Newfound Harbor North	90,000	19	$3,150,000	150	1,995	$1,579	20	266	$11,842
Cocoa Beach High School	195,000	41	$6,825,000	150	4,305	$1,585	20	574	$11,890
National Aeronautics and Space Administration Area	2,800,000	657	$98,000,000	150	68,985	$1,421	20	9,198	$10,654
Brightwaters	235,000	48	$8,225,000	150	5,040	$1,632	20	672	$12,240
520 Borrow Pit-2	20,000	4	$700,000	150	420	$1,667	20	56	$12,500
520 Borrow Pit-7	20,000	4	$700,000	150	420	$1,667	20	56	$12,500
520 Borrow Pit-1	40,000	8	$1,400,000	150	840	$1,667	20	112	$12,500
520 Borrow Pit-4	40,000	8	$1,400,000	150	840	$1,667	20	112	$12,500

Location	Cubic Yards	Acres	Cost Estimate	TN Flux (pounds per acre per year)	TN Flux Reduction (lbs/yr)	Cost per Pound per Year of TN Removed	TP Flux (pounds per acre per year)	TP Flux Reduction (lbs/yr)	Cost per Pound per Year of TP Removed
Sunset Cafe	110,000	22	$3,850,000	150	2,310	$1,667	20	308	$12,500
Cape Canaveral Hospital	60,000	12	$2,100,000	150	1,260	$1,667	20	168	$12,500
520 Borrow Pit-3	15,000	3	$525,000	150	315	$1,667	20	42	$12,500
520 Borrow Pit-5	30,000	6	$1,050,000	150	630	$1,667	20	84	$12,500
520 Borrow Pit-6	15,000	3	$525,000	150	315	$1,667	20	42	$12,500
Mathers Bridge Area	350,000	75	$12,250,000	150	7,875	$1,556	20	1,050	$11,667
Port Canaveral	265,000	25	$9,275,000	221	3,868	$2,398	14	245	$37,857

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-31: North IRL Estimated Costs and Nutrient Reductions for Muck Removal Project Areas

Location	Cubic Yards	Acres	Cost Estimate	TN Flux (pounds per acre per year)	TN Flux Reduction (lbs/yr)	Cost per Pound per Year of TN Removed	TP Flux (pounds per acre per year)	TP Flux Reduction (lbs/yr)	Cost per Pound per Year of TP Removed
Titusville West*	90,000	70	$3,150,000	236	11,564	$272	12	588	$5,357
National Aeronautics and Space Administration Causeway East*	285,000	34	$9,975,000	756	17,993	$554	44	1,047	$9,527
Rockledge B*	125,000	38	$4,375,000	278	7,302	$599	31	814	$5,375
Titusville East*	115,000	36	$4,025,000	196	4,939	$815	9	227	$17,731
Eau Gallie Northwest*	250,000	73	$8,750,000	156	7,972	$1,098	29	1,482	$5,904
Pineda*	150,000	37	$5,250,000	169	4,377	$1,199	19	492	$10,671
National Aeronautics and Space Administration Causeway West*	125,000	25	$4,375,000	189	3,308	$1,323	11	193	$22,668
30% of Venetian Canals/Channels*	65,000	15	$2,275,000	150	1,575	$1,444	20	210	$10,833
Eau Gallie Northeast	547,000	188	$19,145,000	159	20,924	$915	6	790	$24,234
Pineda to Eau Gallie	875,000	1,110	$30,625,000	37	28,749	$1,065	3	2,331	$13,138
520 to Pineda	900,000	1,120	$31,500,000	37	29,008	$1,086	3	2,352	$13,393
70% of North IRL Venetian Collector Canals/Channels	160,000	36	$5,600,000	150	3,780	$1,481	20	504	$11,111
Max Brewer Causeway	80,000	17	$2,800,000	150	1,785	$1,569	20	238	$11,765
Crab Shack	20,000	4	$700,000	150	420	$1,667	20	56	$12,500
Cocoa South	150,000	30	$5,250,000	136	2,856	$1,838	10	210	$25,000
Eau Gallie South	1,150,000	525	$40,250,000	57	20,948	$1,921	15	5,513	$7,301
Rockledge A	845,000	259	$29,575,000	73	13,235	$2,235	12	2,176	$13,591
Cocoa 520 to 528	110,000	36	$3,850,000	37	932	$4,131	3	76	$50,568
National Aeronautics and Space Administration Causeway to 528	475,000	149	$16,625,000	37	3,859	$4,308	3	313	$53,115
Warwick Drive	20,000	4	$700,000	37	104	$6,731	3	8	$87,500

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-32: Central IRL Estimated Costs and Nutrient Reductions for Muck Removal Project Areas

Location	Cubic Yards	Acres	Cost Estimate	TN Flux (pounds per acre per year)	TN Flux Reduction (lbs/yr)	Cost per Pound per Year of TN Removed	TP Flux (pounds per acre per year)	TP Flux Reduction (lbs/yr)	Cost per Pound per Year of TP Removed
Goat Creek*	10,000	7	$350,000	150	735	$476	20	98	$3,571
Mullet Creek Islands Area*	130,000	41	$4,550,000	150	4,305	$1,057	20	574	$7,927
30% of Venetian Canals/Channels*	50,000	10	$1,750,000	150	1,050	$1,667	20	140	$12,500
70% of Central IRL Venetian Collector Canals/Channels	130,000	27	$4,550,000	150	2,835	$1,605	20	378	$12,037
Trout Creek	5,000	1	$175,000	150	105	$1,667	20	14	$12,500
Melbourne Causeway North	25,000	5	$875,000	150	525	$1,667	20	70	$12,500
Front Street Park	25,000	5	$875,000	150	525	$1,667	20	70	$12,500

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

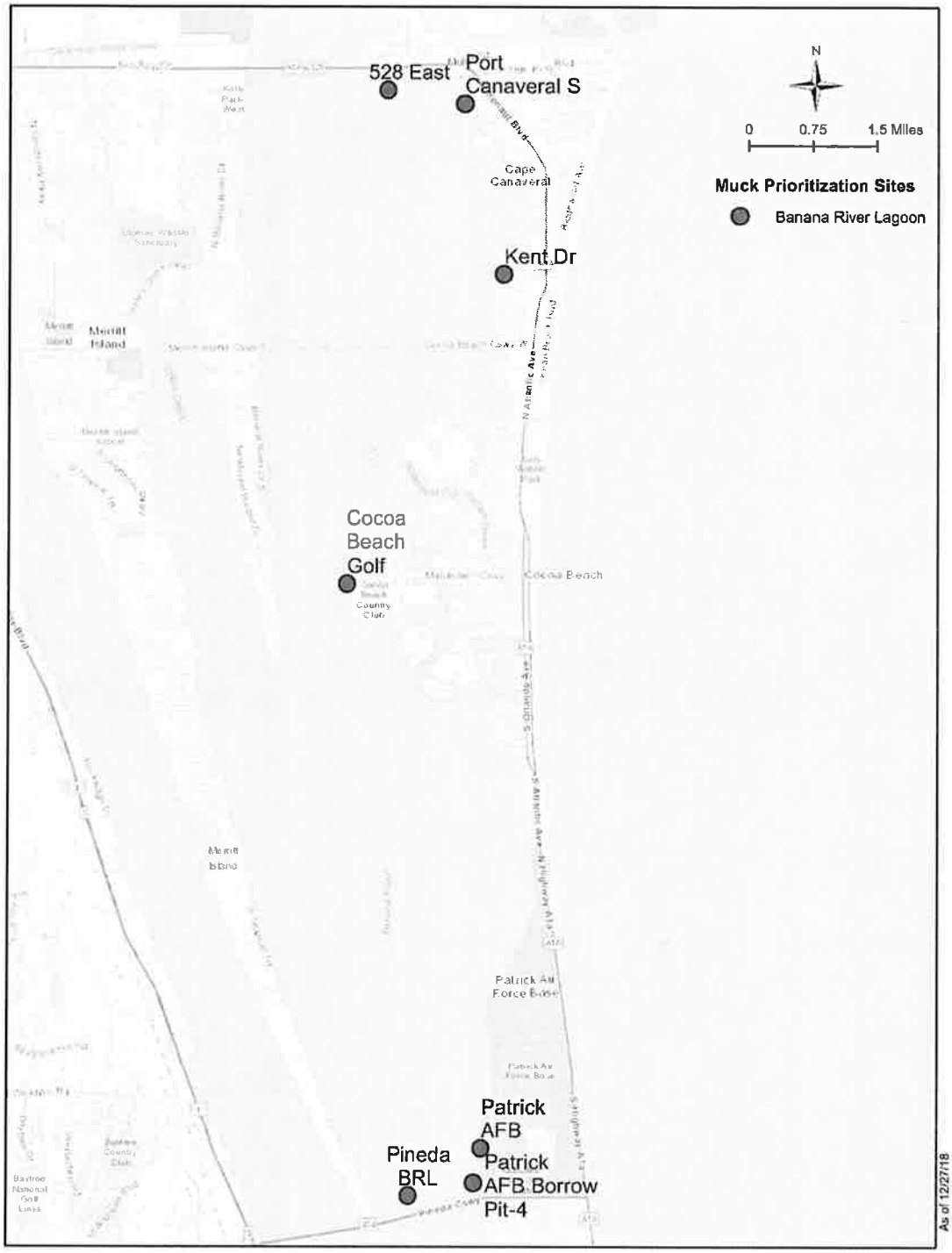


Figure 4-14: Location of Muck Removal Projects in Banana River Lagoon

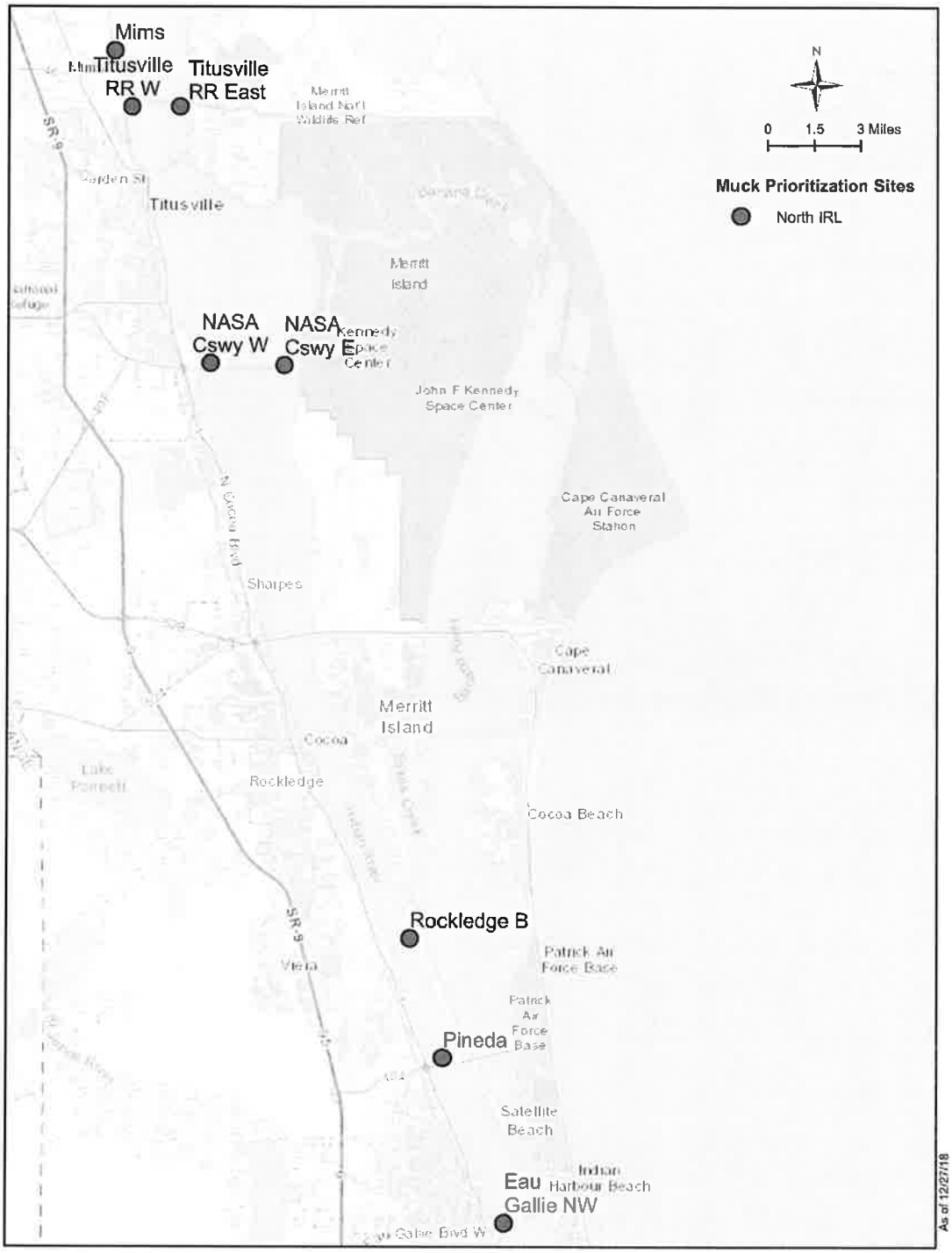


Figure 4-15: Location of Muck Removal Projects in North IRL

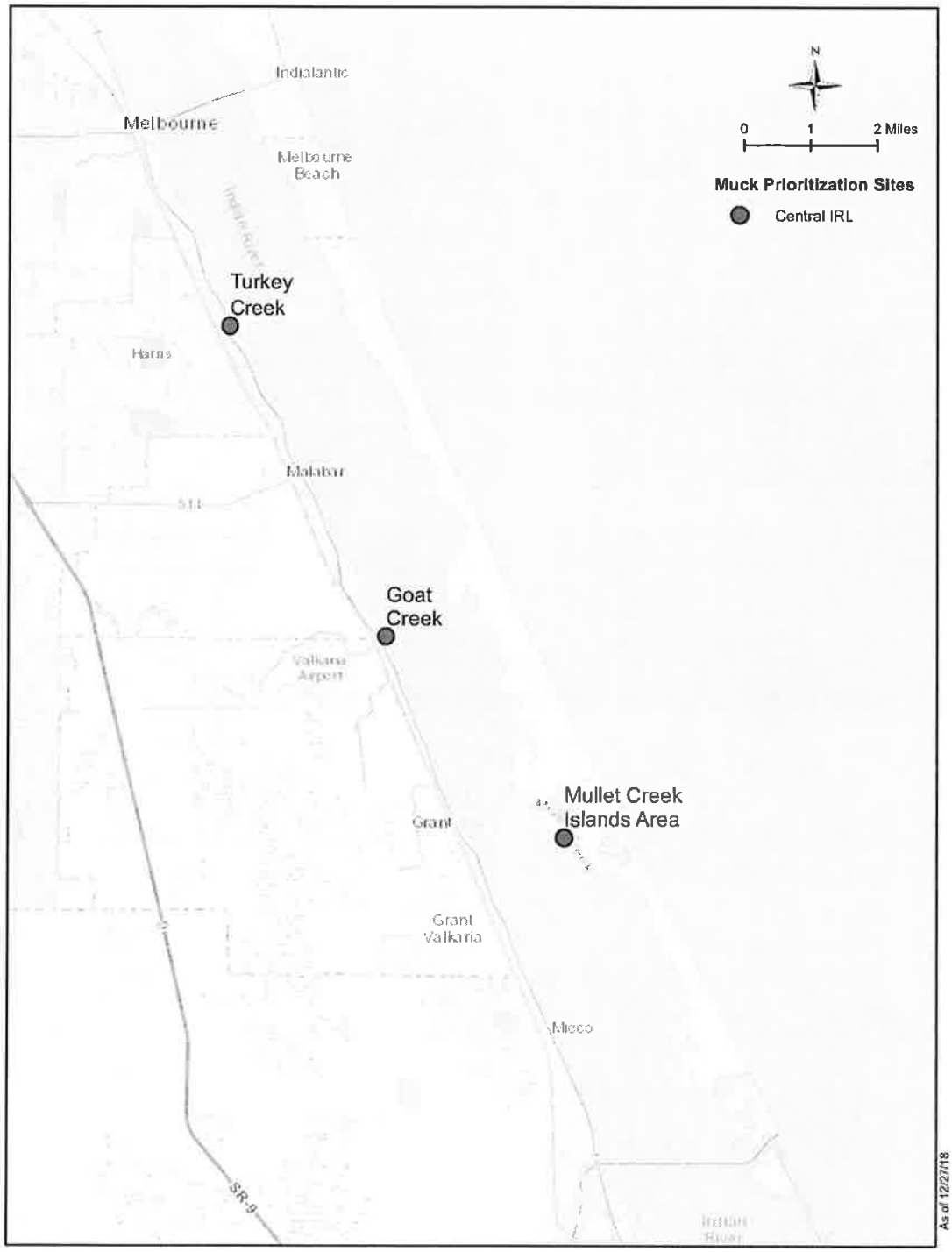


Figure 4-16: Locations of Muck Removal Projects in Central IRL

Treatment of Muck Interstitial Water (added in 2018)

Interstitial water refers to the water content that is present within the muck material. Sampling and testing conducted by Florida Institute of Technology researchers has shown that the majority of nutrients are bound to solid particles in the muck; however, the interstitial water also contains a significant amount of dissolved nutrients. When the muck material is dredged, interstitial water nutrients are pumped with the muck and lagoon water in a slurry to the dredged material management area. At the dredged material management area, the muck slurry is processed in a settling pond where sediments settle out and overflow water is returned to the IRL. Treatment of this overflow water represents a significant opportunity to prevent return of these nutrients to the IRL.

Working with the dredging industry, sewage treatment industry, stormwater treatment entrepreneurs and industrial waste treatment engineers, feasible and reasonably cost-effective concentration targets for return water to the IRL have been identified as 2,000–3,000 parts per billion for TN and 75–100 parts per billion for TP. Treatment options for TP were demonstrated during the state-funded initial dredging of Turkey Creek, with Florida Institute of Technology researchers providing independent third-party verification of performance levels. These targets can be achieved through a variety of technologies including, but not limited to, coagulants, polymers, biosorption activated media, or a combination of these technologies. Costs associated with these technologies vary by technology, target nutrient reduction levels, and interstitial nutrient concentrations. Open market costs were collected through two bid solicitations: (1) Mims Boat Ramp muck removal project and (2) Sykes Creek muck removal project.

To encourage partnering entities and applicants for Save Our Indian River Lagoon Trust Fund dollars to take advantage of this opportunity to enhance the performance of muck removal projects by removing interstitial water nutrients from the dredge slurry during muck dredging operations whenever project configuration allows, a separate cost-share has been developed to account for this added cost and associated nutrient reduction benefit. Using available cost information from Turkey Creek, Mims, and Sykes Creek, County staff considered how to incentivize the addition of this processing step as soon as possible into permitted muck removal projects, as well as future projects. When the substitute project request form was distributed to the public in 2018, staff estimated that a cost-share of $200 per pound of TN removed would be sufficient to entice most partners to agree to stipulate a specific condition in their bids and dredging contracts that return water not exceed 3,000 parts per billion of TN nor 100 parts per billion of TP. However, based on recent bids for nutrient mitigation alternatives for sediment dewatering for Sykes Creek (Tetra Tech 2015), the cost-share used for County projects in the 2019 Plan Update was reduced to $50 per pound of TN removed. This cost will remain volatile until a contractor meets the concentration targets long enough to more accurately determine cost.

The recommended locations for interstitial water treatment are show in **Table 4-33** for Banana River Lagoon, **Table 4-34** for North IRL, and **Table 4-35** for Central IRL.

Table 4-33: Banana River Lagoon Treatment of Interstitial Water Estimated Costs and Nutrient Reductions

Location	Cubic Yards	Liters of Water Treated	Cost Estimate	TN Removed (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed (lbs/yr)	Cost per Pound per Year of TP Removed
528 East*	35,000	24,083,478	$177,868	3,557	$50	324	$549
Port Canaveral South*	420,000	289,001,736	$2,134,419	42,688	$50	3,887	$549
Kent Drive*	40,000	27,523,975	$203,278	4,066	$50	370	$549
Cocoa Beach Golf*	975,000	670,896,888	$4,954,900	99,098	$50	9,022	$549
Patrick Air Force Base Borrow Pit-4*	10,000	6,880,994	$50,819	1,016	$50	93	$549
Patrick Air Force Base*	205,000	141,060,371	$1,041,800	20,836	$50	1,897	$549
Pineda*	195,000	134,179,378	$990,980	19,820	$50	1,804	$549
30% Venetian Canals/Channels*	825,000	567,681,982	$4,192,608	83,852	$50	7,634	$549
Banana River Total	***2,705,000***	***1,861,308,802***	***$13,746,672***	***274,933***	***$50***	***25,031***	***$549***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-34: North IRL Treatment of Interstitial Water Estimated Costs and Nutrient Reductions

Location	Cubic Yards	Liters of Water Treated	Cost Estimate	TN Removed (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed (lbs/yr)	Cost per Pound per Year of TP Removed
Titusville East*	115,000	79,131,428	$584,424	11,688	$50	1,064	$549
Titusville West*	90,000	61,928,943	$457,375	9,148	$50	833	$549
National Aeronautics and Space Administration Causeway West*	125,000	86,012,422	$635,244	12,705	$50	1,157	$549
National Aeronautics and Space Administration Causeway East*	285,000	196,108,321	$1,448,355	28,967	$50	2,637	$549
Rockledge B*	125,000	86,012,422	$635,244	12,705	$50	1,157	$549
Pineda*	150,000	103,214,906	$762,292	15,246	$50	1,388	$549
Eau Gallie Northwest*	250,000	172,024,843	$1,270,487	25,410	$50	2,313	$549
30% Venetian Canals/Channels*	65,000	44,726,459	$330,327	6,607	$50	601	$549
North IRL Total	***1,205,000***	***829,159,744***	***$6,123,748***	***122,475***	***$50***	***11,151***	***$549***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

Table 4-35: Central IRL Treatment of Interstitial Water Estimated Costs and Nutrient Reductions

Location	Cubic Yards	Liters of Water Treated	Cost Estimate	TN Removed (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed (lbs/yr)	Cost per Pound per Year of TP Removed
Goat Creek*	10,000	6,880,994	$50,819	1,016	$50	93	$549
Mullet Creek Islands Area*	130,000	89,452,918	$660,653	13,213	$50	1,203	$549
30% Venetian Canals/Channels*	50,000	34,404,969	$254,097	5,082	$50	463	$549
Central IRL Total	***190,000***	***130,738,881***	***$965,570***	***19,311***	***$50***	***1,758***	***$549***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.
^ Project previously funded.

Spoil Management Areas (added in 2019)

As Brevard County seeks to execute a growing number of muck dredging projects, the availability of upland processing areas for the treatment of dredge spoils has become a growing concern. These working sites, referred to as temporary spoil management areas or in the industry as dredged material management areas, are upland parcels of land that can be used as needed for the temporary processing of dredge spoils until such time as the materials can be moved offsite to a permanent beneficial use or disposal location.

To move muck dredging projects forward in a timely manner, initial project locations were selected to make use of existing dredged material management areas through the County's long-standing partnership with the Florida Inland Navigation District. The Florida Inland Navigation District manages Florida's Intracoastal Waterway for which it has acquired eight dredged material management area sites distributed from north to south along the 72 miles of the IRL (not the Banana River) in Brevard County. Only three of these Florida Inland Navigation District dredged material management areas are presently developed; however, the County is working on partnership agreements with the Florida Inland Navigation District to construct dredged material management area facilities at their remaining sites.

The eight Florida Inland Navigation District sites are insufficient to meet the volume and timing of muck dredging projects included in this plan. As the distance between dredging sites and dredged material management areas increase, more booster pumps are required. Booster pumps can complicate project operations and increase cost, particularly as multiple boosters become necessary. Booster pumps are required as project pump distances approach one-mile and are required at one-mile intervals thereafter. Each booster pump adds approximately $1 per cubic yard of material dredged. Pump distances for the Eau Gallie and Sykes Creek projects have five- to seven-mile pump distances to the Florida Inland Navigation District sites and project amounts in excess of 400,000 cubic yards each.

As a supplement to the Florida Inland Navigation District sites, Brevard County staff investigated lease and purchase options for the development of additional multi-use spoil management areas. Lease options for parcels of interest resulted in unfavorable cost-benefit ratios on these short-term investments due to the up-front costs of site development including design, permitting, mitigation, and construction. Similar cost effectiveness issues arise from depending on private sector contractors to provide a temporary dredged material management area as part of construction costs. The contractor passes along most or all the costs of providing a dredged material management area, but the County does not have the benefit of using the site multiple times over the 10-year timespan of this plan or thereafter.

Fee simple purchase and development of spoil management areas, designed with multi-use options for the implementation of regional surface water or stormwater treatment projects, emerges as the most cost-effective long-term option. Through fee simple site acquisition and a prescribed site use and management plan, investments in acquisition and development costs, including required mitigation, can be recovered. For example, the acquisition of a spoil management site four miles closer than the nearest Florida Inland Navigation District site could reduce booster pump costs by $1.6 million dollars on a single 400,000 cubic yard muck removal project. This savings can offset site acquisition and development costs associated with the parcel.

Publicly owned dredged material management area sites could be used for stormwater or surface water treatment, when not being used for dredging. These additional uses can be factored into site selection and design to provide supplementary lagoon benefits. Therefore, land acquisition shall be considered an eligible muck management project cost, particularly when the site can be

designed to provide multi-use regional surface water or stormwater treatment alongside or intermittently between usages for muck management. A preliminary project design and construction layout with cost evaluation (comparison to an existing, more distant dredged material management area) shall be part of the site selection and land acquisition decision process.

Another factor to consider when evaluating long-term operations and the feasibility of muck dredging projects is the strategy for final disposal and the development of permanent beneficial use or disposal locations. Often left to the contractor as part of their construction and implementation plan, a final disposition strategy is in many cases not part of the dredging project plan. The dependency on private sector contractors to provide a final disposition strategy and permanent material disposal site can have consequences that a managed permanent disposal site can avoid. These consequences can increase the contractor's risk and drive up project costs.

A managed disposal site would consider the fiscal, environmental, and social implications of the site. A final disposition strategy evaluates the appropriateness of the disposal site in terms of the local community and future development, the environmental proximity to surface waters and runoff potential, groundwater protection, hauling costs, and minimizing risk by providing a defined disposal site. A defined material disposal site, laid-out in the project design, provides a level of security at the time of project bidding that reduces risk to the contractor and potentially lowers the project cost. Staff investigation into the purchase, use and reclamation of existing borrow pits are an example of final disposal areas that are being considered. Similar to what is seen with the development of temporary spoil management areas, the most cost-effective long-term option for the disposal of muck material should include the evaluation of fee simple purchase options and the development of spoil disposal areas.

4.2.2 Surface Water Remediation System

AquaFiber Technologies Corporation has a technology that would treat up to 25 cubic feet per second (16 million gallons per day) of water from Turkey Creek, which is a major tributary to the Central IRL. This project would reduce total suspended solids by more than 90%, remove algal blooms and cyanobacteria to improve the lagoon's color and clarity, improve the dissolved oxygen concentration by returning water with near 100% oxygen saturation, and produce a biomass that can be processed into fertilizer pellets or used as a feedstock for waste-to-energy utilities to produce electricity.

This project would remove an estimated 35,633 lbs/yr of TN and 2,132 lbs/yr of TP from the watershed. The facility would cost $19,720,760 for design, permitting, construction, and use of a technology to destroy the biomass onsite. The cost to operate and maintain the remediation facility is estimated to be $6,271,200 per year. **Table 4-36** summarizes the benefits and the costs of nutrient removal for this project for a 10-year period. On an annual basis, the yearly costs would be $8,243,276, which would result in an annual cost per pound per year of TN removed of $231 and cost per pound per year of TP removed of $3,867.

Brevard County also received information from Phosphorus Free Water Solutions, which has a pay for performance treatment technology to reduce phosphorus, nitrogen, color, and turbidity in surface waters. Phosphorus Free evaluated a project to treat 50 cubic feet per second of water from Turkey Creek. Based on the measured concentrations in Turkey Creek, Phosphorus Free Water Solutions provided two options for treating nitrogen. The measured phosphorus concentration in Turkey Creek is very low and it would not be cost-effective to remove additional phosphorus from the system through this technology. The first option would use the basic nitrogen removal process, which would remove a portion of the dissolved organic nitrogen. This option

would reduce TN by 53% or 50,353 lbs/yr at a cost of $6,797,000 or $135 per pound of TN removed. The second option would include an additional treatment step to increase the removal of dissolved organic nitrogen. This option would reduce TN by 86% or 81,469 lbs/yr at a cost of $13,035,000 or $160 per pound of TN removed (**Table 4-36**). The costs for each scenario do not include the capital costs to construct the treatment facility, only the annual pay for performance cost estimates for a ten-year contract for treatment.

Table 4-36: Summary of Annual Benefits and Ten-Year Costs of a Surface Water Remediation System

Project	Ten-Year Project Cost	TN Reduction (lbs/yr)	Cost per pound per Year of TN Removed	TP Reduction (lbs/yr)	Cost per Pound per Year of TP Removed
AquaFiber	$82,432,760	35,633	$2,313	2,132	$38,665
Phosphorus Free Option 1	$67,970,000	50,353	$1,350	To be determined	To be determined
Phosphorus Free Option 2	$130,350,000	81,469	$1,600	To be determined	To be determined

These technologies have not yet been tested in estuarine systems; therefore, these remediation systems are not recommended at this time. However, these types of treatment technologies offer additional benefits that should be more thoroughly explored to better assess the total value to restoring and maintaining lagoon health. Brevard County continues to investigate potential surface water remediation technologies and a portion of the Respond funding may be used to incentivize pilot testing. As feasible technologies are proven, projects may be added to future plan updates.

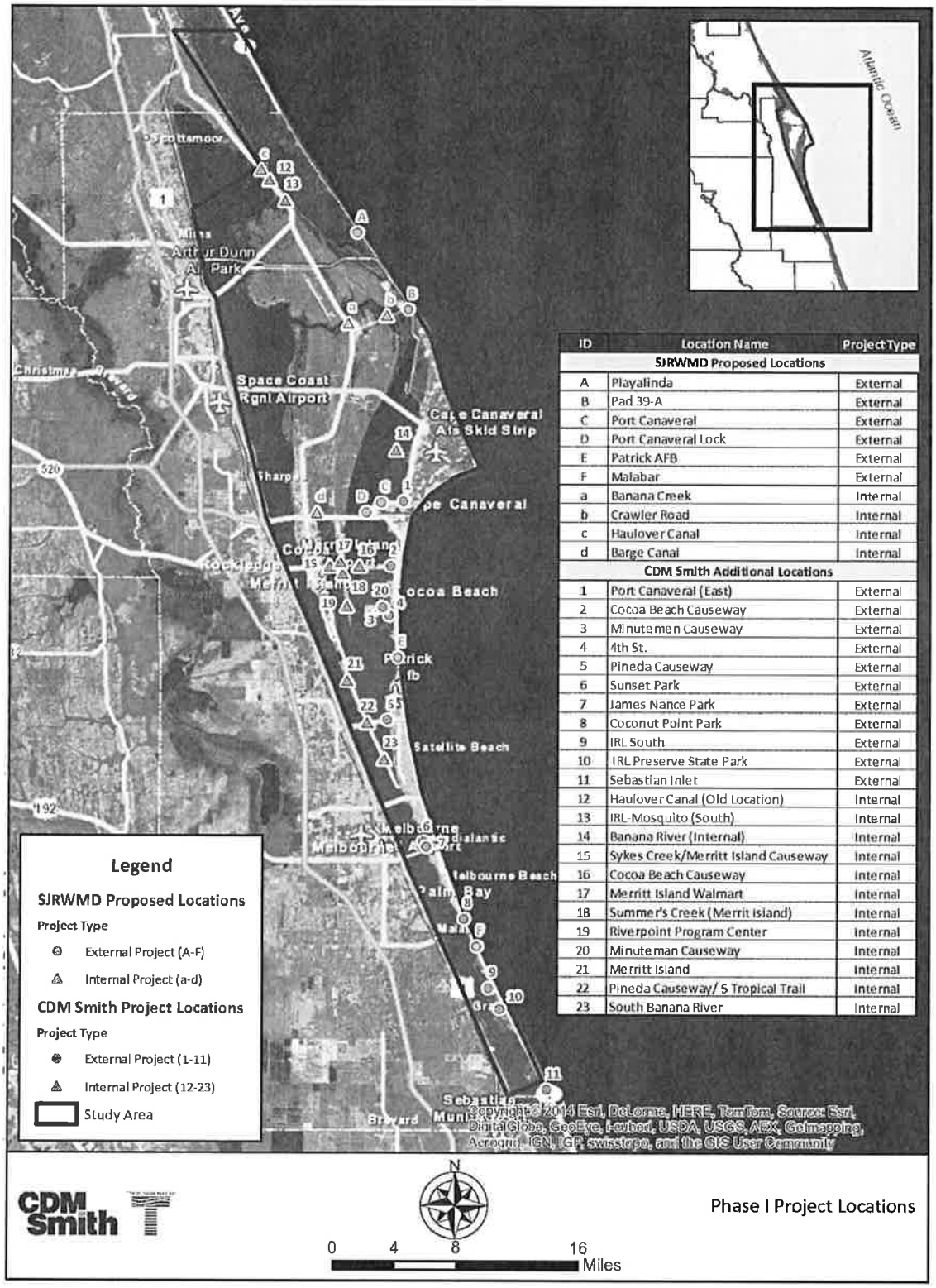
4.2.3 Enhanced Circulation

The 2011 superbloom occurred in the Banana River Lagoon, North IRL, and southern Mosquito Lagoon. These areas have long residence times, which means that water in these areas stagnates and nutrients can build up leading to additional algal blooms. Options to address this condition are to increase circulation by replacing causeways with bridges, installing culverts under causeways, or increasing ocean exchange by adding culverts, pump stations, or inlets to provide new connections to the ocean. Addressing manmade causeways that interfere with natural circulation should be beneficial without unintended consequences and modeling can help prioritize actions, but implementation is costly and requires participation by the Florida Department of Transportation.

New artificial ocean exchange projects introduce a lot of unknowns. While the residence time of water in the IRL system would decrease, the input ocean water with its complement of marine life has the potential to alter the lagoon ecosystem. Whether the amount of ocean exchange needed to have a beneficial impact on the system can be achieved without causing unintended harm to the lagoon is unknown. Artificial ocean exchange projects are costly with significant social implications and permitting hurdles to overcome. For these reasons, causeway replacements are encouraged while ocean exchange projects are not a recommended component of this plan. Other entities are taking the lead on evaluating options. The results of evaluations by the St. Johns River Water Management District and the IRL National Estuary Program are summarized below.

The St. Johns River Water Management District contracted with CDM Smith and Taylor Engineering to identify potential locations where enhanced circulation projects would be beneficial. The first phase of the project (CDM Smith et al. 2014) involved a literature review and

geographic information system desktop analysis. All the locations considered in Phase I, including the top ranked locations, are shown in **Figure 4-17**. From this first phase, ten locations were identified for future evaluation as shown in **Table 4-37**. The external projects are those that could potentially connect the IRL system with the Atlantic Ocean whereas internal projects are connections within the IRL (CDM Smith et al. 2015).



ID	Location Name	Project Type
	SJRWMD Proposed Locations	
A	Playalinda	External
B	Pad 39-A	External
C	Port Canaveral	External
D	Port Canaveral Lock	External
E	Patrick AFB	External
F	Malabar	External
a	Banana Creek	Internal
b	Crawler Road	Internal
c	Haulover Canal	Internal
d	Barge Canal	Internal
	CDM Smith Additional Locations	
1	Port Canaveral (East)	External
2	Cocoa Beach Causeway	External
3	Minuteman Causeway	External
4	4th St.	External
5	Pineda Causeway	External
6	Sunset Park	External
7	James Nance Park	External
8	Coconut Point Park	External
9	IRL South	External
10	IRL Preserve State Park	External
11	Sebastian Inlet	External
12	Haulover Canal (Old Location)	Internal
13	IRL-Mosquito (South)	Internal
14	Banana River (Internal)	Internal
15	Sykes Creek/Merritt Island Causeway	Internal
16	Cocoa Beach Causeway	Internal
17	Merritt Island Walmart	Internal
18	Summer's Creek (Merrit Island)	Internal
19	Riverpoint Program Center	Internal
20	Minuteman Causeway	Internal
21	Merritt Island	Internal
22	Pineda Causeway/ S Tropical Trail	Internal
23	South Banana River	Internal

Source: CDM Smith et al. 2015.

Figure 4-17: Phase I Potential Enhanced Circulation Project Locations

Table 4-37: Phase I Top Ranked Potential Enhanced Circulation Project Locations

Project Site	Project Description	Zone	Project Type	Rank
D	Canaveral Lock*	Banana River Lagoon	External	1
C	Port Canaveral*	Banana River Lagoon	External	2
15	Sykes Creek/Merritt Island Causeway*	Banana River Lagoon	Internal	3
B	Pad 39-A*	Banana River Lagoon	External	4
16	Cocoa Beach Causeway	Banana River Lagoon	Internal	5
23	South Banana River	Banana River Lagoon	Internal	6
E	Patrick Air Force Base *	Banana River Lagoon	External	7
20	Minuteman Causeway	Banana River Lagoon	Internal	8
1	Port Canaveral (East)	Banana River Lagoon	External	9
8	Coconut Point Park*	Central and Southern Portion of IRL Study Area	External	10

Source: CDM Smith et al. 2015.
* Sites evaluated in Phase 2 of the CDM Smith and Taylor Engineering project for the St. Johns River Water Management District.

As part of the second phase of the project, six of the top ranked sites were further evaluated to assess the water volumes. These sites are noted in **Table 4-37**. Based on the initial evaluation of the sites, CDM Smith and Taylor Engineering determined that a project at the Sykes Creek/Merritt Island Causeway was not feasible. This location had a relatively new bridge crossing with built-up abutment protection that precludes construction of culverts and the increase of bridge openings. In addition, this connection would only provide an internal connection in the IRL and would not increase the tidal exchange. The five remaining sites were evaluated for the following types of connections (additional information in **Table 4-38**):

- Port Canaveral (Project Site C) – Culvert connection
- Pad 39-A (Project Site B) – Culvert connection
- Patrick Air Force Base (Project Site E) – Culvert connection
- Canaveral Lock (Project Site D) – Open channel flow by keeping the Canaveral Lock open over extended periods. Additional maintenance dredging may be needed to remove sediment deposition near the gates.
- Coconut Point Park (Project Site 8) – Culvert connection
- Coconut Point Park (Project Site 8) – Inlet connection with an inlet that is at least 1,350-feet long, with an average depth of about 25 feet below mean sea level.

Table 4-38: Computed Hydraulics for Connections at Select Locations

Site/Potential Project	Flood Prism (million cubic feet)	Ebb Prism (million cubic feet)	Maximum Flow (cubic feet per second)	Estimated Impacted Area for 0.27 Foot Tide Range (acres)
Port Canaveral Culvert (Project Site C)	1.51	-1.08	89	92 to 128
Pad 39-A Culvert (Project Site B) (estimated)	1.38 to 1.51	-1.08 to -1.59	Not applicable	92 to 135
Patrick Air Force Base Culvert (Project Site E) (estimated)	1.38 to 1.51	-1.08 to -1.59	Not applicable	92 to 135
Canaveral Lock Open Channel Flow (Project Site D)	68.67	-83.03	-4,670	5,839 to 7,060
Coconut Point Park Culvert (Project Site 8)	1.38	-1.59	-94	117 to 135
Coconut Point Park Inlet (Project Site 8)	1,890	Not applicable	111,000	160,698

Source: CDM Smith et al. 2015.
Note: Positive flow is towards the IRL.

A screening matrix was used to evaluate the costs and benefits of the project based on the criteria for the tidal prism, area affected, land acquisition, relative costs, ease of construction, seagrass loss, and benefit to cost ratio. The top ranked project from this evaluation is the Port Canaveral culvert (CDM et al. 2015). It is important to note that a culvert will likely not provide the amount of exchange needed to provide a significant benefit to the lagoon. The size of the lagoon in Brevard County is more than 150,000 acres. The second ranked project is the Canaveral Lock open channel. This option may have challenges moving forward based on past experience with sediment blocking submarines from using the port after the lock was held open for an extended period of time. In addition, there are limited data for estimating the water quality benefits and unintended ecological consequences that could result from keeping the lock open.

Another potential option for ocean exchange is when a large storm creates an opening. Instead of immediately filling in the new opening, an evaluation should be completed using available models to determine the potential benefits of temporarily stabilizing the opening long enough to provide significant ocean exchange for short-term water quality benefits, but not long enough to excessively alter beach erosion and sand transport into the lagoon.

In 2018, the IRL National Estuary Program, in partnership with the Canaveral Port Authority, worked with the Florida Institute of Technology to assess the potential for modifications of the State Road 528 and State Road 520 causeways and bridge structures to enhance circulation in the northern portion of the Banana River Lagoon and adjacent North IRL. The Florida Institute of Technology used the U.S. Army Corps of Engineers Coastal Modeling System for this evaluation (Zarillo 2018).

The model was set up to reproduce the physical conditions of 2015 to ensure the model was well calibrated. Measured data, including water levels, freshwater inflows, wind velocity, and topography, were used to drive the model. Nine model tests were performed to represent current conditions and scenarios with hypothetical bridge spans over the Banana River Lagoon and North IRL. Three of the model tests included flow relief structures embedded in the State Road 528 and State Road 520 causeways. The tests were run using numerical tracer dye concentration throughout the model domain to track the dye concentration reduction throughout the model

simulation. Circulation in the model occurred through ocean exchanges though the Sebastian Inlet, freshwater inflows, and wind (Zarillo 2018).

The model results indicated that modifying the bridge and causeway structures would have a detectible influence on exchange rates within the Banana River Lagoon and North IRL. Longer bridge spans over the Banana River Lagoon along State Road 528 combined with longer bridge spans over State Road 520 resulted in a 17% reduction in the dye concentration in the Banana River Lagoon between State Road 528 and State Road 520 at the end of the 340-day model run. In the existing condition, there was a 7.7% reduction of simulated dye in the same portion of the lagoon. The net improvement in exchange was predicted to be about 10% for model tests that combined bridge spans for both roads. The net improvement in exchange in the Banana River Lagoon immediately to the north of State Road 528 was predicted to be 5%, if bridge spans are present on both state roads. The study concluded that a significant improvement in exchange in the Banana River Lagoon study area and adjacent North IRL would require bridge spans on both State Road 520 and State Road 528 (Zarillo 2018). Implementation of these modifications to the State Road 520 and State Road 528 bridges and causeways would be the responsibility of the Florida Department of Transportation.

4.3. Projects to Restore the Lagoon

Another component of this plan is to implement projects that will restore important, filtering ecosystem services within and adjacent to the lagoon to improve water quality and resilience. Creating oyster bars and planted shorelines made up of oysters and natural vegetation will help to filter excess nutrients and suspended solids from the lagoon, which will improve water quality, allowing for seagrass growth and reducing the number and severity of algal blooms in the lagoon system. Oyster bars and planted shorelines also create habitat for more than 300 different lagoon species. These types of projects take a few years before the full benefits are seen in the lagoon as it takes some time for the oysters and vegetation to grow and become established. As water quality improves, oysters will filter a greater volume annually, increasing natural resilience to extreme events and algal blooms.

The sections below summarize the oyster restoration and planted shoreline projects that are proposed, as well as considerations for seagrass planting.

4.3.1 Oyster Restoration

In addition to the fisheries value of oysters, they provide a variety of nonmarket ecosystem services. Restored oyster bars have been shown to result in a positive net effect on the removal and sequestration of nitrogen compared to unrestored sites. As nitrogen is a major contributor to algal blooms and turbidity, removal of nitrogen from the system often yields water quality benefits. The nitrogen is removed through three pathways: (1) assimilation of the nitrogen in the shell and tissues of the oysters, (2) enhanced burial of nitrogen into the sediments surrounding oyster bars, and (3) conversion to gaseous form with return to the atmosphere through microbe-related denitrification (zu Ermgassen 2016).

The primary mechanism by which oyster bars remove nitrogen is by increasing local denitrification rates.

The primary mechanism by which oysters remove nitrogen from the system is by increasing local denitrification rates (Grabowski et al. 2012). While oyster bars have a relatively small impact on average nutrient concentrations for an entire waterbody, their local impact may be much larger. For example, in a study by Kroeger (2012), it was noted that the eastern section of Mobile Bay

had experienced harmful algal blooms that caused fish kills. These conditions occur in the summer months when denitrification by restored oysters would be highest. Therefore, the nitrogen removal associated with the oyster bar project in the bay may make a noticeable contribution to the local water quality by avoiding peak nitrogen concentrations that may trigger algal blooms. In a study by Kellogg et al. (2013), the denitrification rates associated with oyster bars from various studies were documented. Based on these studies, the average effect of denitrification rate is 291 micromoles of TN per square meter per hour, which equates to 0.04 pounds of per square meter per year (161.9 pounds of TN per acre per year). A more recent study was conducted in the Mosquito Lagoon to determine the local benefits from oyster bed restoration. This study found that the average denitrification rate is 450 kilograms of TN per hectare per year (401.5 pounds of TN per acre per year) and measured nitrogen sequestration in oyster tissues and shells is 0.04 pounds of TN per square foot, which equates to 4,741.1 pounds of TN per acre per year (Schmidt and Gallagher 2017).

The focus for oyster restoration in the IRL system is to provide filtration, sequestration, denitrification, and scour protection along the shoreline (see **Section 4.3.2** for details on scour protection). The goal is not to restore historic oysters in the system because information is not available on where oysters were historically located. In addition, large-scale bars would compete for space with seagrass, and seagrass are a more critical component of the system. Therefore, the oyster bars that may be constructed in submerged areas deeper than seagrass or as narrow bars along the shoreline to act as a living wave break to reduce erosion. The benefits of oyster bars are shown in **Section 4.3.2**.

Most of the IRL system in Brevard County no longer has a sufficient oyster population to allow for natural recruitment of oysters to suitable substrate (Futch 1967). Therefore, to create the oyster bars, the oysters must be grown and then carefully placed on appropriate substrate in the selected locations. To help grow the oyster population, in fiscal year 2013-2014, the Board of County Commissioners approved $150,000 to launch the Oyster Gardening Program. This program is a citizen-based oyster propagation program where juvenile oysters are raised under lagoon-front homeowners' docks and eventually used to populate constructed oyster bar sites. Oyster Gardening participants receive spat-on-shell oysters plus all supplies needed to care for their oysters until six to nine months later when they are placed at new oyster bar sites in the lagoon. The Oyster Gardening Program is executed in partnership with the Brevard Zoo. The project continued during fiscal year 2014-2015 with funding from the state and in fiscal year 2015-2016 with funding from the County. The County plans to continue funding this program annually.

The oysters from the Oyster Gardening Program have been used to develop several pilot bars and demonstration sites in the IRL. In fiscal year 2014-2015, the County received a $410,000 appropriation from the Florida Legislature for the Indian River Lagoon Oyster Restoration Project. This pilot study was completed in fall 2016. The design of oyster wave breaks funded by the Save Our Indian River Lagoon tax is based on monitoring results from the pilot bars and wave tank studies at Florida Institute of Technology that tested the oyster bar stability and wave attenuation of different designs.

4.3.2 Planted Shorelines

Typically, efforts to protect shorelines have involved hardened structures, such as seawalls, rock revetments, or bulkheads, to dampen or reflect wave energy. Although these types of structures may mitigate shoreline retreat, they accelerate scour and the ecological damages that result can be great (Scyphers et al. 2011). The planted shoreline approach incorporates natural habitats into a shoreline stabilization design; maintains the connectivity between aquatic, intertidal, and

terrestrial habitats; and minimizes the adverse impacts of shoreline stabilization on the estuarine system. These efforts range from maintaining or transplanting natural shoreline vegetation without additional structural components to incorporating shoreline vegetation with hardened features, such as rock sills or oyster bars, in settings with higher wave energy (Currin et al. 2010). Selection of the most appropriate management system begins with a site analysis to evaluate the type of shoreline, amount of energy that a shoreline experiences, sediment transport forces, type and location of ecological resources, and adjacent land uses (Restore America's Estuaries 2015).

Oyster bars can function as natural breakwaters, in addition to providing nutrient removal benefits through denitrification, as noted in **Section 4.3.1**. The rate of vertical oyster bar growth on unharvested bars is far greater than any predicted sea-level rise rate; therefore, bars could serve as natural protection against shoreline erosion, intertidal habitat loss, and property damage and loss along many estuarine shorelines. Oyster bars reduce erosion of other estuarine habitats such as salt marshes and submerged aquatic vegetation by serving as a living breakwater that attenuates wave energy and stabilizes sediments (Grabowski et al. 2012).

As part of a study for the Chesapeake Bay, Forand et al. (2014) evaluated the pollutant load reductions from planted shoreline projects in the area. The results of this evaluation are shown in **Table 4-39**, and were used to update the U.S. Environmental Protection Agency Chesapeake Bay Program Office estimate of the TN and TP reductions per foot of planted shoreline. It is important to note that the information in this table is from states up north where temperatures become much cooler for longer periods of time than what occurs in Brevard County. Therefore, the benefits associated with planted shorelines in the IRL system will likely be greater than those estimated here.

Table 4-39: Pollutant Load Reductions for Shoreline Management Practices

Source	TN (pounds per foot per year)	TP (pounds per foot per year)	Study Location
Ibison 1990	1.65	1.27	Virginia
Ibison 1992	0.81	0.66	Virginia
Proctor 2012	Not applicable	0.38 or 0.29	Virginia
Maryland Department of the Environment 2011	0.16	0.11	Maryland
Baltimore County mean (Forand 2013)	0.27	0.18	Maryland
Chesapeake Bay Program Office Scenario Builder 2012	0.02	0.0025	Chesapeake Bay Program policy threshold that comes from one stream restoration site in Maryland
New Interim Chesapeake Bay Program Office Rate (Expert Panel, 2013)	***0.20***	***0.068***	***Chesapeake Bay Program Office policy thresholds that comes from six stream restoration sites***

Note: Table is from Forand et al. 2014.

Brevard County

To create enough oyster bar area to filter the volume of lagoon water annually, approximately 20 miles (105,600 feet) of oyster bars is needed with a width of six feet. These bars will be placed throughout the IRL system along mosquito impoundments, parks, and private properties where owners want to participate. Based on the pilot project costs and knowing that larger bars will be constructed more efficiently (using information from the pilot projects), it is estimated that the 20 miles of oyster bars could be constructed at a cost of $10 million.

With the recent study on oyster bars in the IRL system (Schmidt and Gallagher 2017), the benefits associated with oyster bars versus planted shorelines could be delineated. For the proposed oyster bar along 20 miles (105,600 feet) of shoreline with a width of six feet (total of 633,600 square feet of oyster bar, the estimated reductions are 25,344 lbs/yr of TN and 906 lbs/yr of TP (see **Table 4-40**). These estimates are based on the estimated TN reduction rate of 0.04 pounds of TN per square foot of oyster bar from Schmidt and Gallagher 2017 and the estimated TP reduction rate of 0.001 pounds of TP per square foot of oyster bar from Kellogg et al. 2013.

Table 4-40: 2018 Updated Estimated Oyster Bar TN and TP Reductions and Costs

Project	Total Area (square feet)	Cost Estimate	TN Reductions (lbs/yr)	Cost per Pound per Year of TN Reduction	TP Reductions (lbs/yr)	Cost per Pound per Year of TP Reduction
Oyster bars*	633,600	$10,000,000	25,344	$395	906	$11,034

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

The estimated nutrient reductions from planted shorelines can be calculated using Chesapeake Bay Program Office recommended rates of 0.02 pounds of TN per linear foot and 0.068 pounds of TP per linear foot (Forand et al. 2014.), which is for an average planting width of 24 feet. These values were adjusted for the proposed average planting width of eight feet, which results in a reduction of 0.067 pounds of TN per linear foot and 0.023 pounds of TP per linear foot. Shoreline planting projects can be combined with oyster bar breakwater projects or they may be conducted along separate stretches of shoreline. At this time, the plan does not recommend a total length of planted shoreline. Planted shoreline projects will be considered for funding annually as partners submit projects for the plan.

The County conducted a survey of the shorelines, in conjunction with the University of Central Florida, to determine if the shoreline included a bulkhead/seawall, hardened slope/riprap, or no structure to help identify potential locations for future oyster bars and planted shorelines (Donnelly et al. 2018) (**Figure 4-18**).

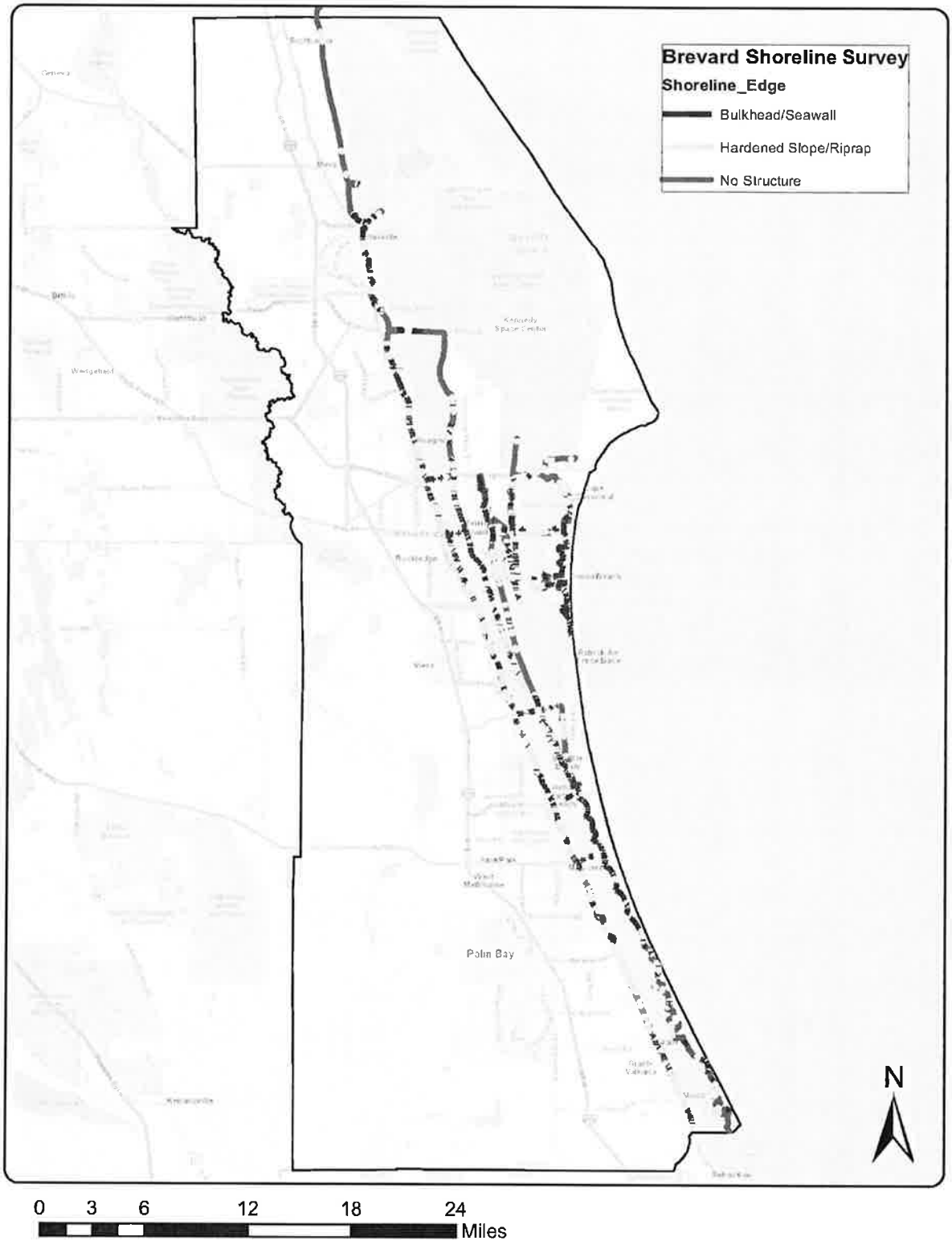
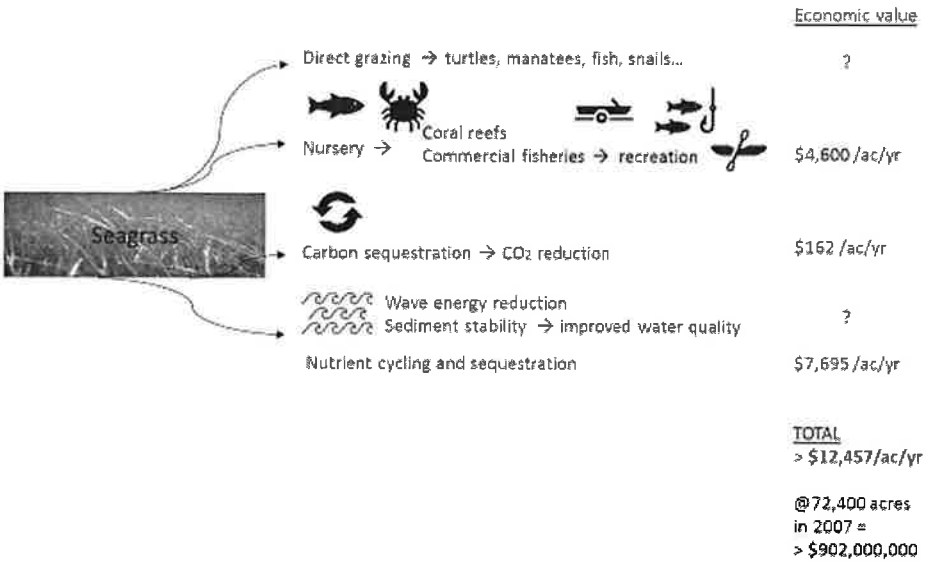


Figure 4-18: Shoreline Survey to Identify Locations Appropriate for Oyster Bars and Planted Shorelines

4.3.3 Seagrass Planting (added in 2018)

The original IRL Surface Water Improvement and Management Plan of 1989, as well as subsequent management plans up to and including the current basin management action plans, target a healthy, estuarine ecosystem populated by seagrasses. Seagrasses provide crucial benefits to Florida's estuaries by providing food and shelter to a variety of animals, improving water quality, and preventing erosion of sediment. In total, the lagoon's 72,000 acres of seagrass could provide an economic benefit of more than $900 million per year (**Figure 4-19**, Dewsbury et al. 2016).



Note: Adapted from Dewsbury et al. 2016

Figure 4-19: Estimated Economic Value of Some Seagrass Services

One key ecological role for seagrasses is to absorb and cycle nitrogen and phosphorus. Seagrasses do not remove these nutrients permanently, but they compete for them against phytoplankton and macroalgae and hold them longer. By stabilizing the cycling of nutrients, seagrasses can increase a system's ability to absorb nutrient loads without the initiation of detrimental blooms of phytoplankton or macroalgae. The contribution of seagrasses can be evaluated by examining the quantity of nutrients bound in its aboveground and belowground structures (its mass of biological material or biomass), with this approach treating uptake and release of nutrients as offsetting components of the nutrient cycle (**Table 4-41**).

Table 4-41: Average Nutrients in Seagrass from 1996-2009

Sub-lagoon	Acres	Seagrass (pounds per 100 acres)	Nitrogen (pounds per 100 acres)	Phosphorus (pounds per 100 acres)
Southern Mosquito Lagoon	14,000	45,000	1,000	100
Banana River Lagoon	21,000	45,000	1,000	100
North IRL	19,000	37,000	900	90
Central IRL	7,000	36,000	900	90

Seagrass restoration may be necessary because more than 30,000 acres of seagrasses were shaded to the point of loss during the superbloom in 2011, recovery has been limited, and the brown tide in 2016 exacerbated the situation. In fact, the Banana River Lagoon in Brevard County

experienced the largest initial losses of seagrass. Beyond the reduction in light arising from repeated, intense phytoplankton blooms, the absence of seagrasses has made the sediments less stable, which will hamper future colonization and spread. After the loss of seagrass, nitrogen and phosphorus became available to phytoplankton, drift algae, and other primary producers (**Table 4-42**). In summary, seagrasses may need some help to recover in the short-term, with more rapid recovery helping to stabilize nutrient cycling in the IRL and reducing the amount of nutrients available to phytoplankton. Measures that could help seagrasses recover could include protecting existing seagrass to promote expansion or protecting areas from waves to reduce the movement of sediment and allow seagrasses to colonize. Planting *Halodule wrightii* would be the initial focus because planting may accelerate recovery, as *Halodule wrightii* is the most common species in the lagoon (Dawes et al. 1995), and this species is a successful pioneer due to its relatively rapid growth and tolerance of varying conditions.

Table 4-42: Average Seagrass Lost and Nutrients Made Available to Other Primary Producers in 2015

Sub-lagoon	Reduction in Acres	Seagrass Reduction* (pounds per 100 acres)	Nitrogen Reduction (pounds per 100 acres)	Phosphorus Reduction (pounds per 100 acres)
Southern Mosquito Lagoon	0	15,000	300	30
Banana River Lagoon	12,000	37,000	900	90
North IRL	1,000	8,000	200	20
Central IRL	4,000	20,000	500	50

* Changes in seagrass cover yield changes in biomass of seagrass within the same number of acres.

Planting seagrass is not a trivial undertaking; it requires considerable planning, resources, and time. For example, having suitable conditions is critical as shown in Tampa Bay where stakeholders invested more than $500 million in projects to reduce nutrient pollution before they saw any return from planting seagrass (Lewis et al. 1999). Costs documented during a workshop on seagrass restoration ranged upward of $1.4 million per acre for larger scale projects (Treat and Lewis 2006). Some of the lessons learned from past projects are selecting sites that will support seagrass growth, employing optimal methods for planting (e.g., type of planting units, use of chemicals to enhance growth, and density of initial planting), and protecting newly planted seagrass from disturbance (e.g., grazing, waves, exposure, and low salinity) until it is established. These factors must be tailored to a specific location; therefore, one or more robust pilot studies are needed prior to attempting full-scale seagrass restoration in the IRL.

A proposed two-year pilot study would evaluate 10 acres of seagrass using three planting techniques with the goal of sequestering 80 lbs/yr of TN and 8 lbs/yr of TP. The costs for this pilot study are summarized in **Table 4-43**, and the three planting techniques that would be evaluated are shown in **Figure 4-20**. The first technique is the Jeb unit in which approximately three to five shoots with their rhizomes in a biodegradable pellet filled with a growth medium would be installed by hand or planted mechanically. The encapsulated rhizomes resist uprooting, and they can be produced in large quantities relatively quickly and transported easily. The second technique is the peat pot in which approximately 25 shoots will be rooted in a four-inch pot. The relatively large pot and well-rooted shoots yield protection from uprooting due to grazing or loss due to moving sediment. However, the units take more time to grow and plant. The third technique is the safe pot in which approximately 25 shoots will be wrapped in a three-inch coconut coir pot. The unit provides protection from grazing pressure and sediment transport.

Similar or more complex pilot studies could be designed to investigate other key components of successful restoration. Overall, the success planting of seagrass at the scale of tens of thousands

of acres will benefit from strategic investment in optimizing techniques. **Appendix F** includes additional details about seagrass. The seagrass planting pilot project is not recommended at this time due to inadequate water quality conditions throughout much of the lagoon. As conditions improve, opportunities to test seagrass planting techniques will be evaluated.

Table 4-43: Costs for Pilot Study to Evaluate Seagrass Planting Techniques

Task	Quantity	Unit Cost	Total Cost
Design and permit	1	$50,000	$50,000
Install linear feet of breakwater	100	$550	$55,000
Deploy planting units	-	-	-
Technique 1: Jeb units	30,000	$4	$120,000
Technique 2: Peat pots	1,940	$5	$9,700
Technique 3: Safe pots	2,420	$9	$21,780
Herbivore excluders	220	$369	$81,180
Install herbivore excluders	1	$37,000	$37,000
Remove herbivore excluders	220	$44	$9,680
Maintain sites and enhance sediment monthly	24	$14,080	$337,920
Monitor quarterly	8	$1,000	$8,000
Final report	1	$3,000	$3,000
Total	***Not applicable***	***Not applicable***	***$733,260***

Figure 4-20: Types of Seagrass Planting Units for Pilot Study, Jeb Unit (left), Peat Pot (middle), and Safe Pot (right)

4.4. Respond

The funding raised from the Save Our Indian River Lagoon sales tax will go towards the projects listed in the sections above that will reduce or remove pollutants and restore the lagoon. In addition, $10 million of the funding, over a period of 10 years, will go towards monitoring efforts to measure the success, nutrient removal efficiency, and cost effectiveness of projects included in this plan or in future updates of this plan. Measuring effectiveness is important for reporting progress toward total load reduction targets and for refining project designs to be more effective with each iteration. The monitoring data will be used to determine which projects are providing the most benefit in the most cost-effective manner so that the plan can be updated, as needed. The data will also be used to ensure the lagoon is responding as anticipated to the reductions made so that changes to the plan can be implemented if the lagoon is not responding as expected.

4.4.1 Adaptive Management to Report, Reassess, and Respond

The IRL is located along the Space Coast, which is also known as a global center for exploration, innovation, and development of cutting edge technology. With a dedicated funding source and a brilliant community dedicated to meeting the challenges of today and tomorrow, it is wise to have

a process that allows this plan to be updated and revised as new opportunities and better solutions are developed. The intent of the proposed adaptive management strategy is to provide a process that not only allows but also fosters the development and implementation of better tools and techniques and allows the tax rate to be reduced accordingly or retired ahead of schedule.

Although this plan was developed with the best information available in 2016, identifying the sources of water quality pollution and pairing those problems with the most timely and cost-effective solutions is a rapidly changing field of knowledge. To respond to change and take advantage of future opportunities, monitoring is necessary. Even without change in the industry, monitoring will provide data to support and refine the application of existing technology. An adaptive management approach will be used to provide a mechanism to make adjustments to the plan based on new information. As projects from this plan are implemented, the actual costs and nutrient reduction benefits will be tracked, and the plan will be modified, as needed, as project performance in the lagoon basin is better understood.

This plan will be updated approximately annually with information from implemented projects and adjustments to the remaining projects. A volunteer committee of diversely skilled citizens has been assembled to assist the County with the annual plan updates. The Citizen Oversight Committee consists of seven representatives and seven alternates that represent the following fields of expertise: science, technology, economics/finance, real estate, education/outreach, tourism, and lagoon advocacy. The League of Cities nominated representatives for three fields of expertise and nominated alternates for the remaining four fields of expertise. The Brevard County Board of County Commissioners nominated representatives for the other four fields of expertise and alternates for the remaining three fields of expertise. All Citizen Oversight Committee representatives and alternates were appointed by the Brevard County Board of County Commissioners. Appointees serve for two-year terms, after which time they may be considered for reappointment or replacement. The first term ends in February 2019. The Committee's recommendations for plan updates will be presented at least annually to the Board of County Commissioners, and changes to the plan will be approved by the Board of County Commissioners.

Brevard County staff will provide project monitoring reports to the Citizen Oversight Committee and will work with them to recommend adjusting the planned projects, as needed. The adaptive management process allows for alternative projects to be submitted by the county, municipalities, and other community partners to be reviewed by the Citizen Oversight Committee for inclusion in the next annual update to this plan. Projects that deliver comparable nutrient removal benefits may be approved for inclusion in the plan. If a new approved project costs more than the average cost per pound of TN for that project type listed in this plan at the time of project submittal, the requesting partner must provide the balance of the costs. The requesting partner will be allowed reasonable overhead cost to manage the project from design and permitting through construction completion.

As projects are implemented, progress toward meeting the five-month and full-year total maximum daily loads are being tracked. Adjustments to the types and locations of projects implemented will be made to ensure that total maximum daily loads can be achieved in all Brevard County portions of the lagoon.

4.4.2 Responding to Implemented Projects

During the first years of plan implementation, several projects have been completed throughout the IRL system as shown in **Figure 4-21** and **Figure 4-22**. The implementation of these projects

provided new cost information that was used to update the cost-share for the 2019 Plan Update. In addition, public outreach surveys, project monitoring, and water quality monitoring efforts have occurred, as described in the sub-sections below, which will help to improve the projects in this plan and its implementation.

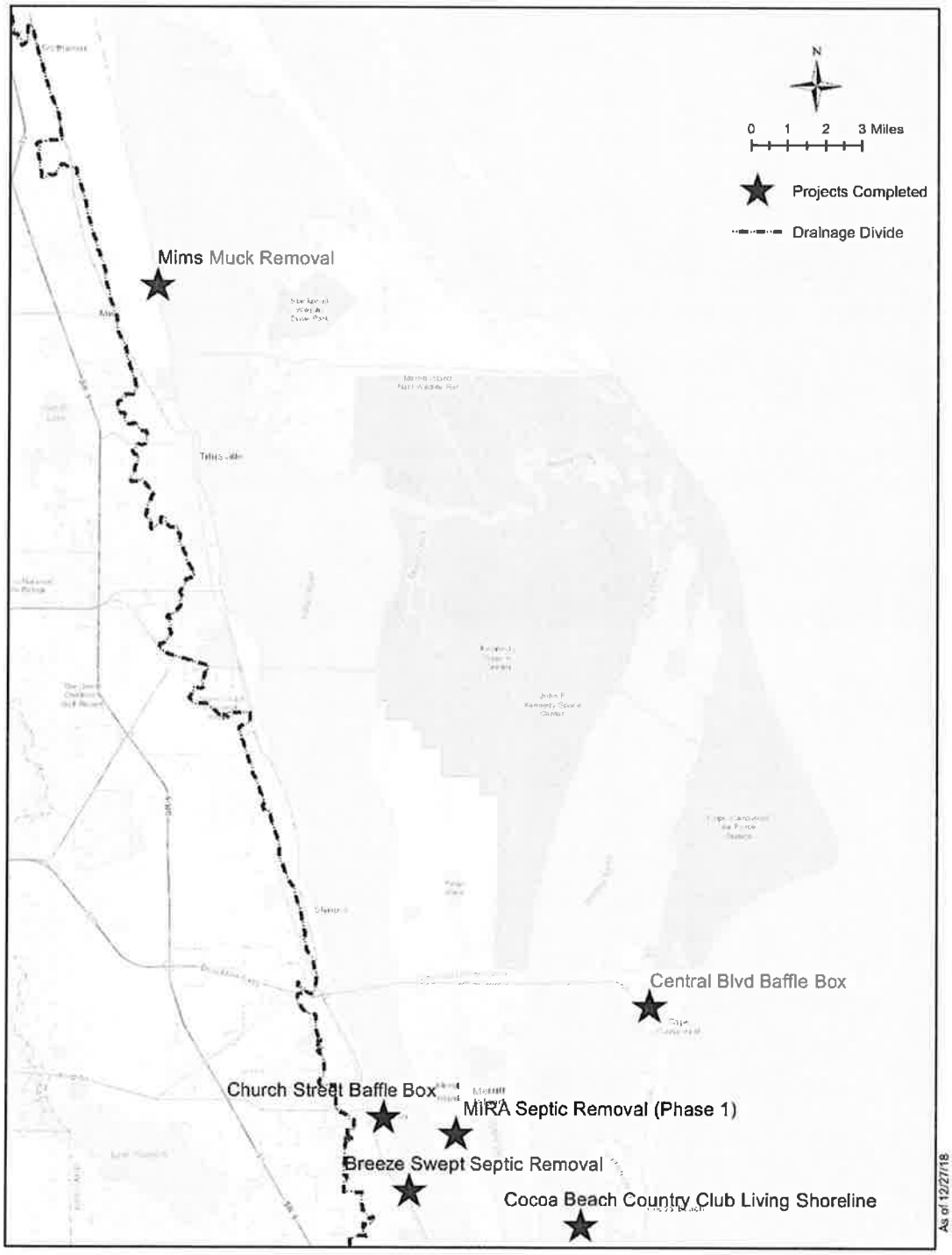


Figure 4-21: Completed Projects in North Brevard County

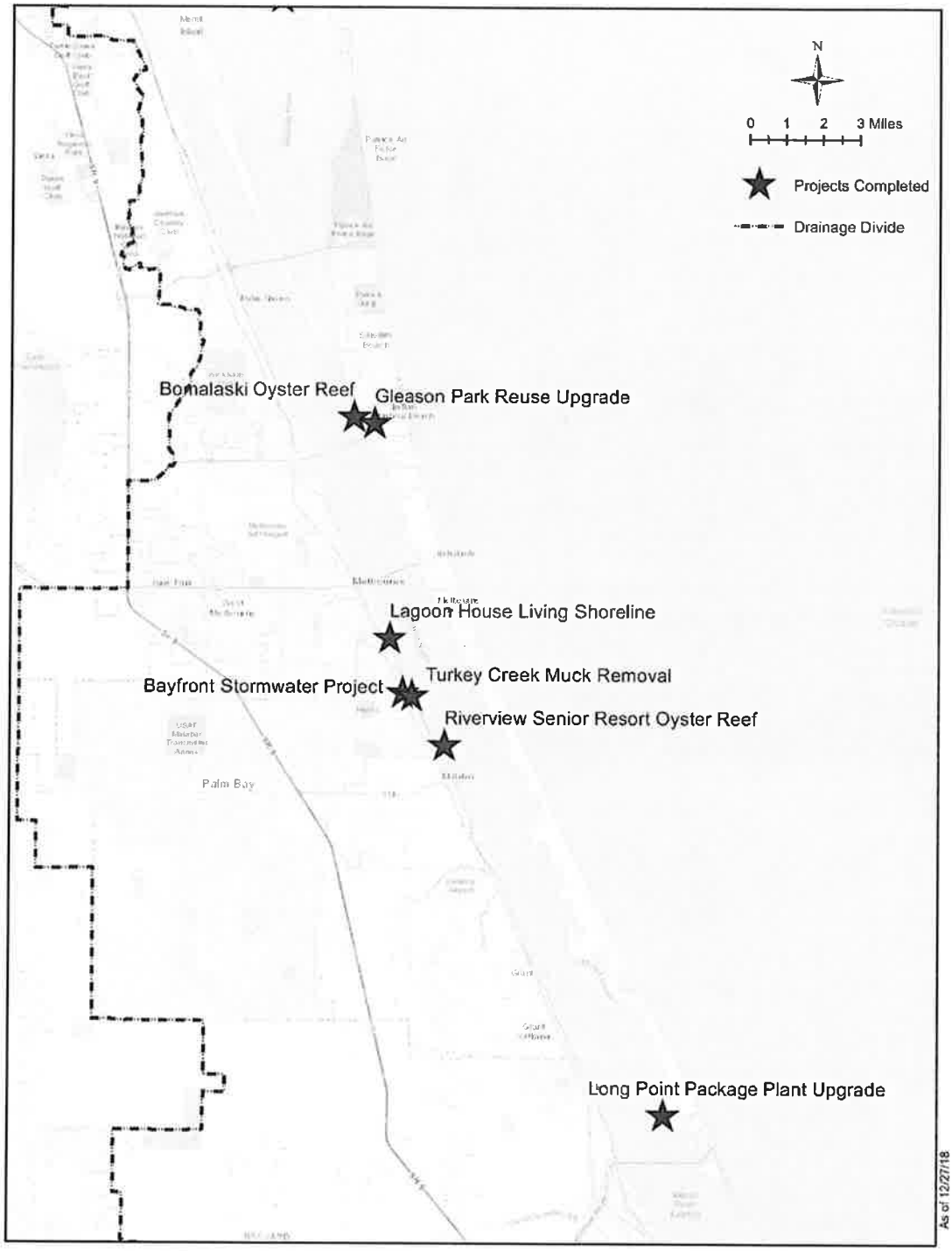


Figure 4-22: Completed Projects in South Brevard County

Grass Clipping Outreach

Uppercase, Inc. conducted a survey between September 9, 2018 and November 11, 2018 reaching out to citizens of Brevard, Martin, and Volusia Counties through ads on social media sites, in popular mobile apps, on google ads, in instant messenger and other online and app

platforms, as well as on the counties' social media pages. The survey received 733 responses from the three counties. When asked which items in the list provided are pollutants, 61% of respondents said grass clippings were a pollutant and 50% said leaves were a pollutant. Landscape professionals were more likely to say grass clippings were a pollutant (65%). About 48% of respondents maintained their own yards and 36% used a lawn care company. When asking those respondents who maintain their own yards what they do with grass clippings, 68% say they "seldom" or "never" leave the clippings where they land. 70% of respondents say they "always" or "usually" blow clippings back into their yard, 94% said they "never" or "seldom" blow clippings into the middle of the road, 97% said they "seldom" or "never" blow clippings toward a storm drain, and 97% say they "never" or "seldom" blow grass clippings toward a waterbody. The survey also tested taglines and images to encourage keeping grass clippings out of the street and waterbodies, and the best communication channels to provide this information (Uppercase 2018). The results from this survey will be used to guide the grass clipping campaign.

Septic System and Sewer Lateral Maintenance Outreach

The University of Central Florida conducted a survey of Brevard County residents to gather information on septic system-related topics. The survey was conducted between May 2018 and September 2018 through phone calls and door-to-door visits, resulting in a total of 404 completed surveys. Most respondents (70%) said that they have had their septic system pumped out, of which most (39.1%) had their system pumped out in the last 2-4 years or within the last 12 months (38%). Most respondents (51%) answered that they have had their current septic system inspected although many (42%) answered that they have not had their septic system inspected. Of those who responded that their septic systems had been inspected, most were inspected within the past 12 months (41.8%) followed by within the past 2-4 years (37.2%). Most residents (53%) did not receive any information regarding the home's septic system when they moved into the home. Of the total respondents, 55.8% strongly agreed with the statement "I restrict what I flush in toilets to prevent damage." The participants strongly agree (44.8%) and agree (42.8%) with the statement "I avoid pouring chemicals and solvents down the sink" (Olive et al. 2018). The results from this survey will be used to help guide implementation of the septic system maintenance education program.

Sewer Lateral Rehabilitation

Brevard County Utilities hired Kimley-Horn to conduct a sanitary sewer system smoke testing pilot study within the South Beaches service area in Satellite Beach. The intent of the study was to use smoke testing to identify major contributors of stormwater into the sanitary sewer system and identify the necessary repairs. A smoke blowing machine that produces a non-toxic artificial "smoke" is used to pump smoke into the sewer system through an open manhole. As the smoke travels through the sanitary sewer system, it rises to the surface through any deficiencies in the lateral lines, such as cracks, leaks, and breaks. The South Beaches service area was selected because it had been experiencing elevated sanitary flow rates during storm events due to stormwater flow into the sanitary sewer through broken or missing infrastructure. Smoke testing was performed for the Phase 1 area in April and May 2018 for 5,165 properties. The testing identified 99 deficiencies of which there were 87 broken/missing cleanout caps, 9 broken lateral pipes, 2 damaged gravity sewer pipes, and 1 damaged manhole. Smoke testing was performed for the Phase 2 area in May and July 2018 for 7,592 properties. The testing identified 190 deficiencies of which there were 163 broken or missing cleanout caps, 21 broken lateral pipes, 1 storm connection, and 5 damaged manholes/gravity mains. The County purchased cleanout caps and replaced the damaged or missing caps that were identified, and which were accessible and had no damage to the cleanout port (Kimley Horn 2018a and 2018b).

Based on the data collected during the pilot study, the Save Our Indian River Lagoon Trust Fund will cover the costs to repair up to 250 broken cleanout ports and 30 broken private lateral lines. The estimated cost is well below the $840,000 budgeted for this project. The lessons learned from this pilot study will be applied to future sewer lateral evaluation and repair projects. In the meantime, a second pilot area in Titusville is proposed for funding in 2019.

Septic System Removal

Breeze Swept septic-to-sewer project in the City of Rockledge removed 143 septic systems installed between 1958 and 1967. This project is a partnership with funding and services provided by the City of Rockledge, Brevard County, and the state of Florida. Breeze Swept was identified as a high priority project because it is a high-density residential neighborhood overlaying very sandy soil that quickly conducts nutrients towards the North IRL. During construction, the contractor noticed that many septic systems were already falling. Failing tanks pose an increased health and environmental risk to our waters. Post-construction monitoring is continuing through summer 2019, but preliminary results show a decrease in nitrogen and fecal coliform in the groundwater.

Construction costs for septic-to-sewer projects increased significantly since the original plan was developed in 2016. At that time, the estimated cost per lot for connection to gravity sewer was $20,000. This estimate included construction of the public and private side of the sewer, abandonment of the septic tank, connection fee, and restoration of the site. Based on actual and budgeted costs from within Brevard County and surrounding counties, the new estimated cost per lot is $33,372.

Costs vary widely depending on the conditions of the specific area. This is exhibited by two projects currently in design. The Micco project is estimated at $82,000 per lot, while the West Melbourne project is estimated at $28,800 per lot. The project in the Breeze Swept community in the City of Rockledge, completed in 2017, cost $23,800 per lot. Indian River County experienced a similar increase in costs for a sewer project in West Wabasso. Phase 1 of West Wabasso was approved in 2011 with an estimated cost of $20,348 per lot. Following construction in 2014, actual costs were $22,942 per lot. For phase 2 of West Wabasso, cost estimates are $46,269 per lot.

There are many opportunities to remove septic systems in areas with existing sewer lines. The plan currently allocates $12,000 to these connection opportunities. Connection costs to gravity were found to be consistent with this estimate; however, connection to force main sewer costs more. In the 2019 Plan Update, connection costs to force main sewer have been increased to $18,000 to more accurately cover the cost of a grinder pump, the pump's electrical connection, directional drilling of the lateral line, abandonment of the septic tank, connection fee, and restoration of the site.

The average cost of an upgraded septic system has been increased from $16,000 to $18,000 to more accurately reflect the cost to safely decommission the old tank and install the new tank and drainfield, electrical costs, and restoration of the site. Many of the oldest septic systems that are contributing the most loading to the lagoon do not comply with modern setbacks established by the Florida Department of Health. Bringing these septic systems to current standards in small lots is contributing to the higher average upgrade costs. The estimate of $16,000 is more accurate for new construction.

Measuring Performance

Groundwater monitoring wells have been installed to measure the pre-project pollution levels in multiple project areas. This includes areas where upgrades are underway for the reduction of

nutrients in the reclaimed water supplied by two wastewater treatment plants, in several septic areas where permitting is underway to provide sewer service, in sewer areas to estimate pollution from leaky infrastructure, and at three septic upgrade pilot projects. Sampling continues at a pilot stormwater project that is comparing the performance of three denitrification media types. Pre-project muck flux data have been collected by researchers at Florida Institute of Technology for more than 20 potential muck dredging sites. These data were considered with other available data to reprioritize muck dredging areas in the 2019 Plan Update. The University of Central Florida is collecting data at completed living shoreline projects to measure the success of oyster bar and planted shoreline projects.

4.4.3 Research Needs

Although this project plan does not fund research, it should be recognized that many important research questions need attention. Universities, state agencies, and non-profit organizations are currently leading lagoon research efforts. This plan acknowledges the research needs identified in the Florida Department of Environmental Protection basin management action plans, St. Johns River Water Management District 2011 Superbloom Report, and IRL National Estuary Program Comprehensive Conservation and Management Plan Update, which are summarized below.

- Research needs identified in the basin management action plans (Florida Department of Environmental Protection 2013a, 2013b, and 2013c):
  - Collect new bathymetry data for the IRL Basin, which would be used in the seagrass depth limit evaluations.
  - Continue and increase the frequency of the monitoring along the existing seagrass transects to track seagrass composition, density, and extent.
  - Implement phytoplankton, drift algae, and macroalgae monitoring in the basin.
  - Track watershed loads by monitoring inflow and outflow nutrient concentrations for each jurisdiction.
  - Verify the best management practice effectiveness values used in the basin management action plans, as needed.
  - Test/verify the TN, TP, and seagrass depth regression equations using the seagrass data collected since 1999.
  - Collect groundwater load contribution data and conduct groundwater modeling.
  - Implement storm event monitoring at the major outfalls.
  - Assess potential impacts to seagrass from sediment resuspension due to high boat traffic in parts of the lagoon.
  - Collect data on nutrient flux/internal recycling of legacy nutrient loads held within the IRL sediments and exchanged with the water column.

- Research needs identified in 2011 Superbloom Report (St. Johns River Water Management District 2016b):
  - Garner an improved understanding of the ideal biological and physiological conditions and tolerances of picocyanobacteria (small cyanobacteria) and Pedinophyceae (green microflagellate), including their ability to use organic forms of nutrients, their ability to fix nitrogen, their nutrient uptake rates, their reproductive rates, and their defenses against grazers.
  - Maintain or expand water quality sampling to ensure spatiotemporal variations are captured adequately, which could include continuous monitoring of various parameters to fill gaps between monthly samples.

- Develop an improved understanding of the physiological tolerances of drift algae and seagrasses, especially manmade conditions that could be mitigated to improve health or natural resilience.
- Maintain or expand surveys of drift algae and seagrasses to improve the capacity to evaluate their role in nutrient cycles.
- Improve the ability to model bottom-up influences from external and internal nutrient loads, including atmospheric deposition, surface water runoff, groundwater inputs, diffusive flux from muck, decomposition of drift algae, and cycling and transformation of nitrogen and phosphorus.
- Enhance surveys of bacterioplankton to improve the understanding of nutrient cycling.
- Improve surveys of potential zooplanktonic, infaunal, epifaunal, and fish grazers to enhance the understanding of spatiotemporal variation in top-down control of phytoplankton blooms.
- Evaluate grazing pressure exerted by common species to enhance the understanding of top-down control of phytoplankton blooms.

- Research needs identified in the draft Comprehensive Conservation and Management Plan revision (IRL National Estuary Program 2018):
  - Research, identify, and recommend funding sources and alternatives for upgrading WWTF infrastructure and to reduce or remove domestic and industrial effluents.
  - Undertake further studies to quantify the impacts of septic systems on the IRL with a focus on identifying high priority "problem" and "potential problem" areas.
  - Develop, improve, and implement best management practices and education programs for stormwater management and freshwater discharges.
  - Determine the impacts of atmospheric deposition of nutrients and other pollutants on the nutrient budget, water quality, and resources of the IRL.
  - Support implementation, review, and update of IRL total maximum daily loads as needed and as best available science evolves.
  - Evaluate opportunities to incentivize, monetize, and expedite nutrient reduction policies and actions including water quality credit trading.
  - Work to continue, expand, update, and improve the IRL species inventory.
  - Develop a Habitat Restoration Plan for the IRL system.
  - Research and develop new and improved wetland best management practices with a focus on understanding wetland responses to sea level rise and climate change.
  - Continue to support and expand research initiatives and coordinated finfish and shellfish management strategies specific to the IRL.
  - Prepare a Risk-Based Vulnerability Assessment and Adaptation Plan for the IRL.
  - Develop and implement an IRL National Estuary Program Communication Plan.
  - Implement public education programs including the "One Community - One Voice" initiative to promote community place-based identities and Lagoon-Friendly behaviors.
  - Develop a finance plan for Comprehensive Conservation and Management Plan development and implementation, project and program funding, and program delivery with a focus on restoration, scientific research, monitoring, and citizen engagement.
  - Develop a comprehensive IRL monitoring plan.
  - Advance the ten research priorities in the 2018 Looking Ahead – Science 2030 Report.
  - Provide support for a "State of the Lagoon Technical Report."
  - Update the IRL economic analysis produced by the Treasure Coast and East Central Florida Regional Planning Councils every five years.
  - Support advancements in hydrological model development, verification, and application.

- Continue evaluation of options to enhance water flow through engineering solutions that have well defined water quality and ecological outcomes.
- Complete muck mapping of the entire IRL, prioritize muck dredging projects and site selection for seagrass and filter feeder restoration projects, and reduce source contributions of sediment and biomass that result in muck formation.
- Track emerging technologies, innovative approaches or alternatives to dredging, muck capping, upstream controls of muck transport, more efficient approaches to dewatering, enhanced pollutant removal in post-dredge water, and enhanced muck management to improve process efficiency and identify beneficial uses of muck.
- Monitor and research to better understand contaminants of emerging concern within the IRL system.
- Research spatially explicit data on the extent and condition of existing filter feeder habitat.
- Research and report on science-based siting, planning, design, and construction criteria for living shorelines.
- Support research and assessment to identify and map suitable habitats and spawning habitats for forage fishes and track population size and health.

Section 5. 2017 Plan Update

Local municipalities and partners were invited to submit new projects for inclusion in the Save Our Indian River Lagoon Project Plan. The projects submitted were required to deliver comparable nutrient removal benefits at similar costs as those projects listed in the original plan for each sub-lagoon. To determine the amount of funding that a project would be eligible to receive from the Save Our Indian River Lagoon Trust Fund, the estimated TN reductions from the project were multiplied by the allowable cost per pound per year of TN shown below in **Table 5-1** for that project type. The costs shown in **Table 5-1** are an average of the cost per pound of TN removed from the projects listed in the original plan.

The requesting partners each submitted a "Save Our Indian River Lagoon Project Plan Project Submittal Request Form" to Brevard County for review of the proposed projects. The project forms were provided to the Citizen Oversight Committee to evaluate the potential for inclusion in the plan. The projects recommended by the Citizen Oversight Committee were presented to the Brevard County Board of County Commissioners for approval to include in this plan supplement.

Table 5-1: Cost-share per Pound of TN Removed by Project Type for the 2017 Plan Supplement

Project Type	Average Cost per Pound per Year of TN
WWTF Upgrades for Reclaimed Water	$214
Septic System Removal	$852
Septic System Upgrades	$802
Stormwater Projects	$88
Muck Removal	$408
Oyster Bar/Planted Shorelines	$473

5.1. New Projects in the 2017 Plan Supplement

The approved projects for inclusion in the 2017 Save Our Indian River Lagoon Supplement are summarized in **Table 5-2**. This table lists the responsible entity, project description, sub-lagoon location, TN and TP reductions, and the amount of Save Our Indian River Lagoon Trust Fund funding that is being applied to each project.

Of the 42 projects approved for funding, 13 were later withdrawn by the project applicants. Projects were withdrawn for a variety of reasons including adverse site conditions and insufficient matching funds. Withdrawn projects are noted with an asterisks (*) and are further discussed in **Section 6.4**. Funding from the Save Our Indian River Lagoon Trust Fund that were not used by the withdrawn projects are available to restore funding to the most cost-effective or shovel-ready approved projects of the same type currently in the unfunded projects list (**Table 5-3**).

Table 5-2: Summary of New Projects Added in the 2017 Save Our Indian River Lagoon Project Plan Supplement

Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Breeze Swept Septic to Sewer Connection	City of Rockledge	Breeze Swept is a neighborhood that consists of 143 single family lots that were constructed between 1958 and 1967. The City of Rockledge has undertaken the process of converting the entire neighborhood from septic to sewer. All the major infrastructure has been installed and the sewer pipe has been stubbed out to each lot. The next phase will be to abandon the septic tanks and hook up to sewer. Most homes have two tanks that need to be abandoned. While the contractor has been laying the sewer lines, it has been evident that the septic tanks have been failing.	North IRL	2,002	Not applicable	$880,530
Merritt Island Septic Phase Out Project	Merritt Island Redevelopment Agency	This project consists of three phases: (1) septic phase out in South Tropical Trail, (2) sanitary sewer construction along Cone Road, and (3) septic phase out in the Cone Road Industrial Park. This project proposes to connect approximately 80 properties to a central sewer system. In the Phase 1 area, there are approximately 20 properties that remain on septic systems and are experiencing financial difficulties in paying for the construction and connection costs associated with the hook up to the existing public sanitary sewer system. Many of these remaining properties contain commercial and/or multi-family apartments that require multiple hook ups and higher impact fees. Phase 2 includes the design and construction of the roadway improvements that allow for the installation of the sanitary sewer gravity system and stormwater treatment. Phase 3 consists of the connection of approximately 60 heavy commercial and industrial parcels to the newly constructed public sewer system. A large majority of the existing septic systems were constructed between 1950 and 1985, and the property owners will experience financial hardships relating to the cost of hook up. The funding will assist with the impact fees associated with hook up.	North IRL	2,501	Not applicable	$320,000

Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Micco Sewer Line Extension	Sebastian Inlet Marina	Connecting 34 businesses and homes to sewer.	Central IRL	1,633	Not applicable	$1,391,316
Hoag Sewer Conversion	City of Melbourne	Installation of 4-inch force main to allow for 7 existing homes and potential 5 others to tie into municipal sewer and either come off existing septic tanks or, once lots are built, never install septic tanks.	Central IRL	101	Not applicable	$86,031
Penwood Sewer Conversion	City of Melbourne	Installation of 4-inch force main to allow for 4 existing homes and 8 potential homes to tie into municipal sewer and either come off existing septic tanks or, once lots are built, never install septic tanks.	Central IRL	48	Not applicable	$40,632
Long Point Park Upgrade	Brevard County Parks Department	This will be a denitrification wall to remove nitrogen from the groundwater flowing from the Long Point campground rapid infiltration wet pond to the IRL. An 18-inch to 24-inch denitrification wall will be constructed around the outside perimeter fence of the existing system.	Central IRL	127	Not applicable	$101,854
Cocoa Palms Low Impact Development	City of Cape Canaveral	Exfiltration with treatment train.	Banana	13	10	$1,144
Carver Cove Swale	City of Cape Canaveral	Dry retention with treatment train.	Banana	32	9	$2,816
Holman Road Baffle Box*	City of Cape Canaveral	Upgrade first generation boxes to 2nd generation baffle boxes.	Banana	71	2	$6,248
Center Street Baffle Box*	City of Cape Canaveral	Upgrade first generation boxes to 2nd generation baffle boxes.	Banana	297	9	$26,136
International Drive Baffle Box*	City of Cape Canaveral	Upgrade first generation boxes to 2nd generation baffle boxes.	Banana	443	4	$34,700
Angel Isles Baffle Box*	City of Cape Canaveral	Upgrade first generation boxes to 2nd generation baffle boxes.	Banana	131	3	$11,528
Central Boulevard Baffle Box	City of Cape Canaveral	Upgrade first generation boxes to 2nd generation baffle boxes.	Banana	481	14	$34,700
Church Street Type II Baffle Box	City of Cocoa	Retrofitting the Church Street discharge point with a Type 2 Nutrient Separating Baffle Box will be the third component of a complete neighborhood restoration and water quality project. The Church Street outfall currently discharges untreated, urban stormwater from a total area of approximately 73 acres.	North IRL	237	29	$20,856

Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Bayfront Stormwater Project	City of Palm Bay	The project will construct wet detention pond to provide treatment and attenuation of stormwater runoff from U.S. 1 (a state roadway) and a 311-acre watershed. The project is a component of the treatment train for the watershed with existing wet detention and check dam conveyance channel constructed upstream. The project will reduce detrimental effects of untreated stormwater on the IRL seagrasses. The land has been purchased and the site is located 1,063 feet from the waters of Palm Bay and 2,077 feet from the convergence with the IRL. This project provides for the retrofit of 311 acres in added retention treatment. Currently the basin flows untreated into the IRL.	Central IRL	348	83	$30,624
Gleason Park Reuse	City of Indian Harbour Beach	Gleason Park is a central recreational feature and includes a large wet detention pond that treats the runoff from 128.9 acres. The City initiated an effort to reuse the stormwater from this wet pond in 2014 and installed three systems with the ability of drawing 58,200 gallons per week. The proposed project will expand the reuse potential of Gleason Park by adding two additional systems and rerouting the water to the south and southwestern portions of the surrounding park. This project should double the current capacity of the reuse in the park and draw an additional 9.29 acre-feet per year. This project would remove an additional 4.53% of TN and TP loading from several large stormwater basins.	Banana	48	9	$4,224
Denitrification Retrofit of Johns Road Pond	Brevard County	Retrofit of existing stormwater pond bleed-down to flow through denitrification media.	North IRL	1,199	Not applicable	$105,512
St. Teresa Basin Treatment	City of Titusville	Stormwater treatment in the St. Teresa basin before discharging to the IRL.	North IRL	3,100	459	$272,800

Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
South Street Basin Treatment	City of Titusville	This project includes the installation of three 2nd generation baffle boxes fitted with nutrient reducing media within the 235-acre South St. basin prior to the IRL outfall. Three boxes within this basin are needed due to the high flow along the main pipe line. By installing these boxes within sections prior to the main 72-inch pipe line, the nutrient reducing media will have more contact with the stormwater providing more removal.	North IRL	987	156	$86,856
La Paloma Basin Treatment	City of Titusville	This project includes the installation of an 2nd generation baffle box fitted with nutrient reducing media within a 60-foot stormwater pipe run at the end of the 488 acre La Paloma basin prior to the IRL outfall.	North IRL	2,367	346	$208,296
Kingsmill-Aurora Phase Two	Brevard County	A traditional stormwater pond on major tributary to Eau Gallie River. The project prevents nutrients and sediment from reaching the lagoon.	North IRL	4,176	814	$367,488
Denitrification Retrofit of Huntington Pond	Brevard County	Retrofit of existing stormwater pond bleed-down to flow through denitrification media.	North IRL	1,190	Not applicable	$104,720
Denitrification Retrofit of Flounder Creek Pond	Brevard County	Retrofit of existing stormwater pond bleed-down to flow through denitrification media.	North IRL	856	Not applicable	$75,328
L1 Canal Bank Stabilization*	Brevard County	Repair and stabilize channel banks to prevent further bank erosion with associated sediment and nutrient load.	North IRL	995	383	$87,560
Norwood Baffle Box Retrofit*	City of Palm Bay	The project will retrofit or replace two existing baffle box structures for the existing drainage canal serving approximately 507 acres, improving treatment of the drainage basin by enhancing the treatment train with these structures. The structures will improve nutrient removal process from entering the Melbourne Tillman Canal C-1, which leads to Turkey Creek and IRL.	Central IRL	1,631	254	$143,528
Victoria Pond*	City of Palm Bay	The project will install a baffle box structure for the existing drainage canal serving approximately 122 acres, improving treatment of the drainage basin by enhancing the treatment train with this structure. The structures will improve nutrient removal process from entering the IRL.	Central IRL	267	42	$23,486

Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Goode Park*	City of Palm Bay	The project will retrofit or replace the existing outfall weir structure for the existing basin drainage which drains two drainage ponds serving approximately 254 acres, improving treatment of the drainage basin by enhancing the treatment train with this structure. The structures will improve nutrient removal upstream of Turkey Creek and IRL.	Central IRL	794	121	$69,872
Florin Pond*	City of Palm Bay	The project will retrofit or replace the existing outfall structure for the existing drainage pond serving approximately 18.28 acres, improving treatment of the drainage basin by enhancing the treatment train with this structure. The structure will improve nutrient removal upstream of Turkey Creek and IRL.	Central IRL	75	11	$6,600
Cherie Down Park Swale*	City of Cape Canaveral	Construction of swale system with Bold & Gold media filter.	Banana	27	9	$2,376
Cape Shores Swales	City of Cape Canaveral	Construction of swale system with Bold & Gold media filter.	Banana	31	15	$2,746
Justamere Road Swale	City of Cape Canaveral	Construction of swale system with Bold & Gold media filter.	Banana	6	3	$528
Hitching Post Berms	City of Cape Canaveral	Construction of a berm/swale system with Bold & Gold filter media.	Banana	29	22	$2,552
Cliff Creek Baffle Box	City of Melbourne	Installation of a 2nd generation baffle box with biosorption activated media.	North IRL	3,952	797	$347,781
Thrush Drive Baffle Box	City of Melbourne	Installation of a 2nd generation baffle box with biosorption activated media.	North IRL	3,661	773	$322,200
Airport Boulevard Dry Retrofit*	City of Melbourne	Installation of Bold & Gold under an existing dry retention pond.	North IRL	99	23	$8,718
Nasa Boulevard Pond Retrofit*	City of Melbourne	Installation of Bold & Gold under an existing dry retention pond.	Central IRL	1,097	157	$96,532
General Aviation Drive Retrofit*	City of Melbourne	Installation of Bold & Gold under an existing dry retention swale.	Central IRL	158	10	$13,937
Stewart Road Dry Retrofit	City of Melbourne	Installation of Bold & Gold under an existing dry retention swale.	North IRL	208	47	$18,344
Mims Muck Removal: Outflow Water Nutrient Removal	Brevard County	The treatment of muck dredging spoil site out-flow water for the removal of nitrogen and phosphorus.	North IRL	2,803	244	$400,000

Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Grand Canal Muck Dredging	Brevard County	Dredging and outflow nutrient reduction of approximately 605,000 cubic yards of muck sediments from an area of 97 acres within the Grand Canal system.	Banana	27,802	2,447	$10,000,000
Sykes Creek Muck Dredging	Brevard County	Dredging and outflow water nutrient reduction of approximately 660,000 cubic yards of muck sediments from an area of 187 acres within Sykes Creek.	Banana	30,693	2,722	$10,000,000
Turkey Creek Shoreline Restoration	City of Palm Bay	Construct a planted shoreline of 1,200 linear feet.	Central IRL	240	82	$113,500
Total	-	-	-	***96,956***	***10,109***	***$25,874,599***

* Projects withdrawn as part of 2018 Update. See **Section 6.4**.

5.2. Unfunded Projects in the 2017 Plan Supplement

To include the new projects approved as part of the 2017 Supplement, the funding had to be shifted from the least cost-effective or shovel-ready projects of the same or similar type that were listed in the original plan. This balance is shown in **Figure 5-1**. The projects listed in **Table 5-3** were unfunded in the 2017 annual update process. However, if additional funding is obtained from other sources, such as grants or legislative appropriations, these projects could be added back to the plan tables through a streamlined approval process. Since these projects were previously approved for inclusion in the Save Our Indian River Lagoon Project Plan, if additional funds become available during the fiscal year, individual projects in **Table 5-3** could be funded with Trust Fund dollars, if their reinsertion is recommended by the Citizen Oversight Committee and if a budget change request for such projects is approved by the Board of County Commissioners. This accelerated process would not need to wait for the next annual plan update. Reinsertion of these projects into the funded Save Our Indian River Lagoon Project Plan would be reflected retroactively in the next annual update to the plan.

Table 5-3: Summary of Unfunded Projects from the 2017 Save Our Indian River Lagoon Project Plan Supplement

Sub-lagoon	Project Name	Cost	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
North IRL	Sykes Creek C septic system removal	$1,700,000	1,426	Not applicable
Central IRL	112 septic system upgrades	$1,792,000	2,233	Not applicable
Banana River Lagoon	Stormwater project in Basin 754	$100,000	734	95
Banana River Lagoon	Stormwater project in Basin 602	$100,000	1,068	109
North IRL	Stormwater project in Basin 1434	$125,000.00	932	112
North IRL	Stormwater project in Basin 1151	$125,000.00	1,057	141
North IRL	Stormwater project in Basin 1078	$125,000.00	1,250	187
North IRL	Stormwater project in Basin 1399	$125,000.00	1,570	256
North IRL	Stormwater project in Basin 1301	$125,000.00	1,025	154
North IRL	Stormwater project in Basin 1368	$125,000.00	1,311	200
North IRL	Stormwater project in Basin 408	$125,000.00	1,179	170
North IRL	Stormwater project in Basin 338	$125,000.00	1,902	188
North IRL	Stormwater project in Basin 1367	$100,000.00	1,042	146
North IRL	Stormwater project in Basin 1384	$100,000.00	923	142
North IRL	Stormwater project in Basin 1318	$100,000.00	1,124	148
North IRL	Stormwater project in Basin 155	$100,000.00	1,149	122
North IRL	Stormwater project in Basin 289	$100,000.00	1,112	223
North IRL	Stormwater project in Basin 193	$100,000.00	1,316	198
North IRL	Stormwater project in Basin 1441	$100,000.00	1,034	149
North IRL	Stormwater project in Basin 660	$100,000.00	844	212
North IRL	Stormwater project in Basin 952	$100,000.00	1,251	212
Banana River Lagoon	29% Sykes Creek dredging	$7,000,000	12,536	1,112
Banana River Lagoon	38% Cape Canaveral Area dredging	$10,000,000	33,051	5,026
North IRL	29% Grand Canal dredging	$7,000,000	11,356	1,000
North IRL	38% Eau Gallie dredging	$10,000,000	33,512	5,023
Total	***Total***	***$39,592,000***	***115,937***	***15,325***

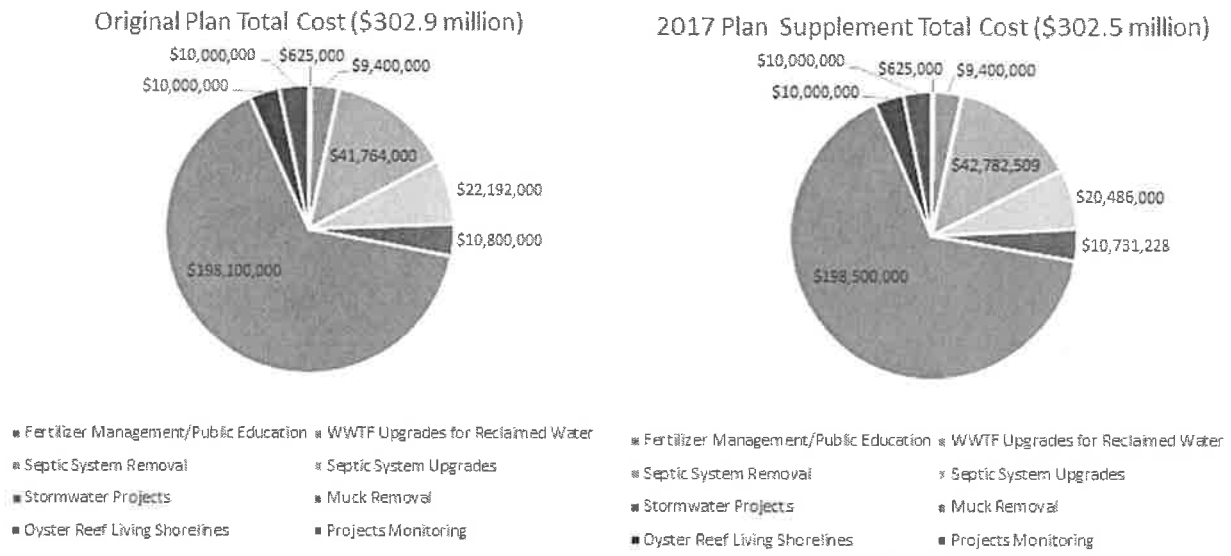


Figure 5-1: Comparison of the Original Plan Cost by Project Category (Left) versus the 2017 Plan Supplement Cost by Project Category (Right)

Section 6. 2018 Plan Update

For the 2018 Plan Update, local municipalities and partners were once again invited to submit new projects for inclusion in the Save Our Indian River Lagoon Project Plan. The projects submitted were required to deliver comparable nutrient removal benefits at similar costs as those projects listed in the original plan for each sub-lagoon.

To determine the amount of funding that a project would be eligible to receive from the Save Our Indian River Lagoon Trust Fund, the estimated TN reductions from the project were multiplied by the allowable cost per pound per year of TN shown below in **Table 6-1** for that project type. The costs shown in **Table 6-1** are an average of the cost per pound of TN removed from the projects listed in the Save Our Indian River Lagoon Project Plan, as amended. Based on a recommendation from the Citizen Oversight Committee, instead of having one allowable cost per pound per year of TN for stormwater projects, as was the case for the 2017 Plan Supplement, there are now three allowable costs based on the project location. Separate allowable costs are now provided for septic system removal by sewer extension (expanding the sanitary sewer collection system to connect septic systems) and by sewer connection (connecting septic systems to existing sanitary sewer collection system infrastructure). Cost-share for a new project, muck interstitial water treatment, was also added. In addition, based on new information about the reductions associated with oyster bars versus planted shoreline, separate allowable costs are included for each of these types of living shorelines.

The requesting partners each submitted a "Save Our Indian River Lagoon Project Plan Project Submittal Request Form" to Brevard County for review of the proposed projects. The project forms were provided to the Citizen Oversight Committee to evaluate the potential for inclusion in the plan. The projects recommended by the Citizen Oversight Committee were presented to the Brevard County Board of County Commissioners for approval to include in this plan update.

Table 6-1: Costs-share per Pound of TN Removed by Project Type for the 2018 Plan Update

Project Type	Average Cost per Pound per Year of TN
WWTF Upgrades for Reclaimed Water	$231
Septic System Removal by Sewer Extension	$872
Septic System Removal by Sewer Connection	$443
Septic System Upgrades	$802
Stormwater Projects	-
Mainland	$88
Merritt Island	$89
Barrier Island	$99
Muck Removal	$403
Treatment of Muck Interstitial Water	$175
Oyster Bar	$392
Planted Shorelines	$180

6.1. Additional Project Benefits

Although the eligible Save Our Indian River Lagoon Trust Fund contribution to new projects is determined based on the amount of TN removed, the benefits of implementing these projects

include reductions in other pollutant sources, as well. These projects will reduce a multitude of different contaminates to meet water quality targets and improve the health, productivity, aesthetic appeal, and economic value of the lagoon. These additional benefits vary according to project design and site-specific conditions but often include significant reduction of pathogenic bacteria, viruses, human and animal wastes, chemicals, metals, plastics, and sediments (see **Table 6-2**).

Table 6-2: Pollutants Removed by Different Project Types

Stormwater	Septic System Removal	Septic System Upgrade	Muck Removal
Nitrogen	Nitrogen	Nitrogen	Nitrogen
Phosphorus	Phosphorus	Phosphorus	Phosphorus
Sediments	Escherichia coli	Escherichia coli	Clay sediments
Escherichia coli	Viruses	Viruses	Hydrogen sulfide
Viruses	Fecal coliform	Fecal coliform	Biochemical Oxygen
Fecal coliform	Pharmaceuticals	Biochemical Oxygen Demand	Demand
Pesticides	Biochemical Oxygen Demand		
Metals			
Oil			
Litter			

This Save Our Indian River Lagoon Project Plan is an adaptable document informed by science and under supervision of the community. As monitoring updates our understanding of IRL pollutants, the plan projects will target funds to the most successful and cost-effective projects.

6.2. Project Funding

6.2.1 Revenue Projection Update

The County calculated a new estimate for Save Our Indian River Lagoon Sales Tax revenues based on the median of collections in the first 12 months of the sales tax with the current consumer price index for inflation of 2.13% compounded over the life of the tax. The new estimate for the period of 2017 through 2026 is $486,392,368.53, or on average $48.6 million per year. This current estimate is $14.6 million per year more than the $34 million per year estimate in the original Save Our Indian River Lagoon Plan, which was based on 2016 dollars. This new estimate allows for the implementation of additional projects each year.

6.2.2 Contingency Fund Reserve

A Contingency Fund Reserve will be included with the development and adoption of the County's budget each fiscal year and will amount to 5% of the total Trust Fund dollars that are budgeted for all approved projects scheduled to occur or move ahead in that fiscal year. This includes projects in the Save Our Indian River Lagoon Project Plan, including additions captured in annual updates or Plan Supplements. The purpose of the reserve is to fund emergency response to harmful algal blooms and major fish kills or to cover reasonable funding shortfalls that may occur during project implementation and would delay implementation or completion of that project unless a ready source of funds is on hand.

If the cost increase for an individual project is less than 10% of the estimated cost or eligible amount of Trust Fund cost-share stated in the Save Our Indian River Lagoon Project Plan or update, then additional funding from the contingency reserve may be allocated to the project, as needed, in accordance with Brevard County policies and administrative orders. For projects that are contracted with municipalities or other partners and encounter cost overruns, the cost-share agreement may be increased up to 10% over the eligible cost-share amount stated in Attachment E of the cost-share contract. This amendment will be executed by the Chairman of the County

Commission and the appropriate municipal representative or authorized agent of a partnering organization.

For project cost increases that are more than 10% above the estimated cost or eligible amount of Trust Fund cost-share stated in the Save Our Indian River Lagoon Project Plan or update, County staff will evaluate the project circumstances and present findings and a recommendation to the Citizen Oversight Committee. The Committee will make a recommendation to the County Manager or County Commission (based on respective signature authority adopted in County contracting policy) on whether the project should proceed.

6.3. New Projects in the 2018 Plan Update

The approved projects for inclusion in the 2018 Plan Update are summarized in **Table 6-3**. This table lists the responsible entity, project description, sub-lagoon location, TN and TP reductions, and the amount of Save Our Indian River Lagoon Trust Fund funding that is being applied to each project. Once the 2018 Plan Update is approved by the County Commission, the projects are part of the Save Our Indian River Lagoon Project Plan, and are reflected in the updated plan tables shown in **Section 7**.

New project types added as part of the 2018 Update include:

- Expanded public education and outreach to address grass clippings, excess irrigation, stormwater pond maintenance, and septic system maintenance.
- Sewer laterals rehabilitation.
- Treatment of muck interstitial water.
- Refinement of benefits for oyster bars versus planted shorelines.

Table 6-3: Summary of New Projects for the Save Our Indian River Lagoon Plan 2018 Update

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
1-10	Expanded Outreach	Brevard County	See details in **Section 4.1.1**.	All	105,165	To be determined	$1,100,000
2	Grant Street Water Reclamation Facility Nutrient Removal Improvements	City of Melbourne	Biological nutrient removal processes added at Water Reclamation Facility by replacing the trickling filter and oxidation ditch with biological nutrient removal process with anoxic/aerobic tankage.	Central IRL	25,627	9,671	$5,919,837
2	Sylvan Estates Septic-to-Sewer Conversion	City of West Melbourne	Connection of 59 residences (currently on septic) to new sewer extension.	Central IRL	1,073	Not applicable	$935,656
1	Riverside Drive Septic-to-Sewer Conversion	City of Melbourne	Installation of force main to tie into an existing manhole. Each home would be required to install a small grinder pump system and then connect to the City's force main.	North IRL	305	Not applicable	$265,960
2	Roxy Avenue Septic-to-Sewer Conversion	City of Melbourne	Installation of force main to tie into an existing manhole. Each home would be required to install a small grinder pump system and then connect to the City's force main.	North IRL	102	Not applicable	$88,944
1	Sewer Lateral Repair/ Replacement	Brevard County	See details in **Section 4.1.5**.	All	To be determined	To be determined	$840,000
2	Stormwater Low Impact Development Convair Cove 1 – Blakey Boulevard	City of Cocoa Beach	Stormwater-low impact development treatment train consisting of high infiltration PaveDrain permeable pavers flowing to a native plant bioswale along a residential road discharging to the Banana River Lagoon. There is currently no treatment for stormwater in this basin, developed in the late 1950s. System reduces runoff volume (thereby reducing pollutants) as stormwater flows downstream over a high infiltration paver system, which then flows to the native landscape bioswale. The bioswale will use native grasses and oak tree canopy to provide additional runoff and pollutant reduction through vegetative nutrient uptake. Design will evaluate whether biosorption activated media will improve efficiency of this treatment train system. Monitoring will be evaluated as a means of determining actual built TN and TP removal of system. Adjacent neighborhood park provides an excellent opportunity for public education and outreach.	Banana	30	3	$2,922

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
2	Stormwater Low Impact Development Convair Cove 2- Dempsey Drive	City of Cocoa Beach	Stormwater-low impact development treatment train consisting of high infiltration PaveDrain permeable pavers flowing to a native plant bioswale along a residential road discharging to the Banana River Lagoon. There is currently no treatment for stormwater in this basin, developed in the late 1950s. System reduces runoff volume (thereby reducing pollutants) as stormwater flows downstream over a high infiltration paver system, which then flows to the native landscape bioswale. The bioswale will use native grasses and oak tree canopy to provide additional runoff and pollutant reduction through vegetative nutrient uptake. Design will evaluate whether biosorption activated media will improve efficiency of this treatment train system. Monitoring will be evaluated as a means of determining actual built TN and TP removal of system. Adjacent neighborhood park provides an excellent opportunity for public education and outreach.	Banana	29	3	$2,842
1	Big Muddy at Cynthia Baffle Box	City of Indian Harbour Beach	Nutrient separating baffle box with Bold & Gold media.	Banana	269	248	$26,637
2	Grant Place Baffle Box	City of Melbourne	Installation of 2nd generation baffle box with Bold & Gold.	Central IRL	937	193	$82,481
2	Crane Creek/M-1 Canal Flow Restoration	St. Johns River Water Management District	Treat and restore flows from an approximately 5,300-acre watershed, which was diverted from the Upper St. Johns River Basin to the IRL when the M-1 Canal was constructed in the early 20th century. Work will include construction of an operable water control structure in the M-1 Canal near Evans Road, a pump station and pipeline near I-95, and a stormwater treatment area west of I-95, to remove nutrients prior to discharge to the Upper St. Johns River.	Central IRL	23,113	2,719	$2,033,944
2	Apollo/GA Baffle Box	City of Melbourne	Installation of 2nd generation baffle box with Bold & Gold within the existing ditch line that runs parallel to Apollo Boulevard near General Aviation Drive.	North IRL	3,381	479	$297,522
1	Cocoa Beach Muck Dredging – Phase III	City of Cocoa Beach	Dredge muck from 13 residential canals (39 acres of muck).	Banana	2,435	366	$981,305
1	Cocoa Beach Muck Dredging – Phase III Interstitial*	City of Cocoa Beach	Scrub nutrients from the return water associated with dredging 13 canal areas in the City of Cocoa Beach, which have extensive muck accumulated and are impacting the Banana River Lagoon's water quality. The sites include all canals that are directly connected to the Banana River Lagoon. Survey of muck area and depths has been completed and a permit has been approved for the muck dredging.	Banana	2,942	To be determined	$514,809

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
1	Merritt Island Muck Removal – Phase 1	Brevard County	The removal of accumulated muck from 30 canals on central Merritt Island.	Banana	4,805	722	$1,936,415
1	Muck Removal of Indian Harbour Beach Canals	City of Indian Harbour Beach	Dredge muck from 12 canal areas (36 acres of muck).	Banana	2,257	339	$909,571
1	Muck Interstitial Water Treatment for Indian Harbour Beach Canals	City of Indian Harbour Beach	Scrub nutrients from the return water associated with dredging 12 canal areas in the City of Indian Harbour Beach, which have extensive muck accumulated and are impacting the Banana River Lagoon's water quality. The sites include all canals that are directly connected to the Banana River Lagoon, including all the Grand Canal located within the City. Survey of muck area and depths has been completed and permitting is ongoing.	Banana	27,418	To be determined	$4,798,197
1	Muck Re-dredging in Turkey Creek	Brevard County	Dredge 11 acres of Turkey Creek where muck was re-deposited after Hurricane Irma.	Central	981	147	$215,000
1	Muck Interstitial Water Treatment for Turkey Creek	Brevard County	Scrub nutrients from the return water associated with the re-dredging of Turkey Creek.	Central	Not applicable	688	Not applicable
1	Eden Isles Lane Oyster Bar	Brevard Zoo	Three adjacent properties on Eden Isles Lane on Merritt Island have some mangroves in place and a low sloping, sandy shoreline. The water depth 10 feet from shore is shallow, so the design may need to be modified somewhat to obtain the same reduction benefits to the water quality. The project will construct a 245-foot oyster bar along the three properties. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Banana	49	17	$21,805
1	Marina Isles Oyster Bar	Brevard Zoo	The gated community of Marina Isles is in Indian Harbour Beach. The property manager is interested in adding an oyster bar to the existing mangrove shoreline. The water depth 10 feet from shore varies from about 1-2 feet. The project will construct 300 feet of oyster bar on this property. The bar will be constructed using a proven design research and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Banana	60	20	$26,700

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
1	Bettinger Oyster Bar	Brevard Zoo	The Bettingers own property on Bali Road in Cocoa Beach. There is a seawall on the property and the project would construct an oyster bar of 120 feet in front of the seawall. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Banana	24	8	$10,680
1	Cocoa Beach Country Club Planted Shoreline	Marine Resources Council	Planting three-year-old mangroves on 5-foot centers along western lagoon shoreline with Spartina in two rows. Additional native plants will be added, as needed, to fill in areas.	Banana	67	23	$16,014
1	Lagoon House Shoreline Restoration Planting	Marine Resources Council	Planting three-year-old mangroves on 5-foot centers along western lagoon shoreline with Spartina in two rows. Additional native plants will be added, as needed, to fill in areas.	Central IRL	100	34	$23,961
1	McNabb Park Oyster Bar	City of Cocoa Beach	Construct 360 feet of living shoreline comprised of oyster shell bags. Location is on an arterial waterway at the end of a residential canal in the North Thousand Islands. This will be a pilot project to test the suitability for oyster restoration in this portion of the lagoon. McNabb Park is a neighborhood park/playground that will provide an opportunity for a public education kiosk on living shorelines and stormwater management.	Banana	72	24	$34,056
1	McNabb Park Planted Shoreline	City of Cocoa Beach	Construct 360 feet of living shoreline comprised of red mangrove and Spartina. Location is on an arterial waterway at the end of a residential canal in the North Thousand Islands. McNabb Park is a neighborhood park/playground that will provide an opportunity for a public education kiosk on living shorelines and stormwater management.	Banana	24	8	$5,760
1	Gitlin Oyster Bar	Brevard Zoo	Ms. Gitlin owns canal property on Cinnamon Court. There is a seawall with a water depth of about 3 feet. The project would construct an oyster bar of 180 feet in front of the seawall. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Banana	36	12	$16,020

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
1	Coconut Point/Environmentally Endangered Lands Oyster Bar	Brevard Zoo	The Environmentally Endangered Lands properties at Coconut Point Sanctuary, Hog Point Cove Sanctuary, and Maritime Hammock Sanctuary all have shorelines that are good candidates for an oyster bar. The project would be three phases and to construct an oyster bar in a total of 5,425 feet. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Central IRL	1,085	369	$509,950
1	Wexford Oyster Bar	Brevard Zoo	Wexford is a gated community located in Melbourne Beach. The property has a seawall with a water depth of about one to two feet. The project would construct an oyster bar of 350 feet in front of the seawall. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	Central IRL	70	24	$31,150
1	Riverview Park Oyster Bar	City of Melbourne	Retrofitting approximately 1,150 linear feet of existing shoreline by means of a living shoreline oyster bar.	Central IRL	230	78	$108,790
1	Riverview Park Planted Shoreline	City of Melbourne	Retrofitting approximately 1,150 linear feet of existing shoreline by means of a vegetated living shoreline.	Central IRL	77	26	$18,480
1	Bomalaski Oyster Bar	Brevard Zoo	Ms. Bomalaski owns property on Dragon Point Drive on Merritt Island. The property has a steep shoreline made up of coquina riprap. The water depth at 10 feet from the shoreline is about 3 feet. The project will construct a 100-foot oyster bar. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	North IRL	20	7	$8,900

Plan Year	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
1	Oliver Oyster Bar	Brevard Zoo	The Olivers, Swanns, and Hermanson own property on Swann Grove Lane on Merritt Island. All three want an oyster bar built along their shorelines on their three adjacent properties. The shoreline is made up mostly of coquina riprap and has a depth of about one foot at 10 feet from the shoreline. The project will build 580 feet of oyster bar on these adjoining properties. The bar will be constructed using a proven design researched and tested by Florida Tech's IRL Research Institute. The design uses both blank shell bags and spat on shell bags, which provide a structure for free-swimming oyster larvae to attach.	North IRL	116	39	$51,620
1	RiverView Senior Resort Oyster Bar	Brevard County	320 linear feet of oyster bar.	Central IRL	77	2	$30,304
1	Indian River Drive Oyster Bar**	Brevard County	1,900 linear feet (11,400 square feet) of oyster bar.	North IRL	456	11	$179,930
1	Indian River Drive Planted Shoreline**	Brevard County	1,900 linear feet of planted shoreline.	North IRL	127	44	$22,860
1	Oyster Bar	Brevard County	500 linear feet of oyster bar.	Banana	120	3	$47,350
	Total	-	-	-	***203,679***	***16,327***	***$21,116,372***

* Project withdrawn as part of 2019 Update. See **Section 7.2.1**.
** Projects modified as part of 2019 Update. See **Section 7.2.1**.

6.4. Project Changes

6.4.1 Withdrawals

Some of the projects submitted by the local governments as part of the 2017 Plan Supplement were determined to not be cost-effective and/or feasible to implement after further investigation. Therefore, the local governments requested that these projects be removed from the Save Our Indian River Lagoon Project Plan so that the funding could be used for other projects. **Table 6-4** lists the projects that have been removed from the plan at the request of the responsible entity.

Table 6-4: Summary of Year 0 and Year 1 Project Withdrawals

Project Name	Responsible Entity	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Holman Road Baffle Box	City of Cape Canaveral	Banana	71	2	$6,248
Center Street Baffle Box	City of Cape Canaveral	Banana	297	9	$26,136
International Drive Baffle Box	City of Cape Canaveral	Banana	443	4	$34,700
Angel Isles Baffle Box	City of Cape Canaveral	Banana	131	3	$11,528
Cherie Down Park Swale	City of Cape Canaveral	Banana	27	9	$2,376
Norwood Baffle Box Retrofit	City of Palm Bay	Central IRL	1,631	254	$143,528
Victoria Pond	City of Palm Bay	Central IRL	267	42	$23,486
Goode Park	City of Palm Bay	Central IRL	794	121	$69,872
Florin Pond	City of Palm Bay	Central IRL	75	11	$6,600
Airport Boulevard Dry Retrofit	City of Melbourne	North IRL	99	23	$8,718
Nasa Boulevard Pond Retrofit	City of Melbourne	Central IRL	1,097	157	$96,532
General Aviation Drive Retrofit	City of Melbourne	Central IRL	158	10	$13,937
L-1 Canal Bank Stabilization	Brevard County	North IRL	995	383	$87,560
Total	-	-	***6,085***	***1,028***	***$531,221***

In addition, Brevard County reviewed the basins proposed for stormwater treatment in the original plan and identified those basins that should be removed because they could not be easily treated or are basins where the County already has projects. These basins are summarized in **Table 6-5**.

Table 6-5: Summary of Stormwater Basin Withdrawals

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Banana	Stormwater project in Basin 979	3,275	448	$225,000
Banana	Stormwater project in Basin 1280	1,735	236	$175,000
Banana	Stormwater project in Basin 1317	1,679	290	$125,000
Banana	Stormwater project in Basin 1063	1,235	192	$100,000
Banana	Stormwater project in Basin 970	1,092	185	$100,000
Banana	Stormwater project in Basin 995	1,048	169	$100,000
Banana	Stormwater project in Basin 998	1,196	189	$100,000
Banana	Stormwater project in Basin 1309	1,016	152	$100,000
Banana	Stormwater project in Basin 754	734	95	$100,000
Banana	Stormwater project in Basin 602	1,068	109	$100,000
North IRL	Stormwater project in Basin 1430	2,255	335	$175,000
North IRL	Stormwater project in Basin 327	1,999	283	$125,000
Central IRL	Stormwater project in Basin 1582	2,402	443	$200,000
Total	**-**	***20,734***	***3,126***	***$1,725,000***

6.4.2 Revisions

The Brevard County Long Point Park project was completed in Year 0 instead of Year 1. This project constructed a denitrification wall to remove nitrogen from the groundwater flowing from the Long Point campground rapid infiltration wet pond to the IRL. The City of Melbourne Stewart Road dry retention swale retrofit project was incorrectly shown in the 2017 Plan Supplement as located in the Central IRL, and the location has been corrected to the North IRL as part of the 2018 Plan Update. The Brevard County Denitrification Retrofit of Johns Road Pond was incorrectly shown in the 2017 Plan Supplement as located in the Banana River Lagoon, and the location has been corrected to the North IRL as part of the 2018 Plan Update. In addition, the Brevard County Grand Canal muck dredging project was incorrectly shown in the 2017 Plan Supplement as located in the North IRL, and the location has been corrected to the Banana River Lagoon as part of the 2018 Plan Update.

All the unfunded projects from the 2017 Plan Supplement were added back to the plan, except for Banana River Lagoon stormwater projects in basins 754 and 602 (withdrawn as noted above), as part of the 2018 Plan Update. A portion of both the Sykes Creek dredging project and Grand Canal dredging project in Banana River Lagoon were unfunded in the 2017 Plan Supplement. The funding restored as part of this plan update was revised based on updated cost estimates that include treatment of the muck interstitial water (**Table 6-6**).

In addition, the Turkey Creek muck removal project required dredging as a result of impacts caused by Hurricane Irma in September 2017. The County is pursuing Federal Emergency Management Agency reimbursement for this project where state and federal disaster recovery funding would cover 87.5% of the total cost of additional dredging and the interstitial water treatment and the Save Our Indian River Lagoon Tax Fund would cover the remaining 12.5% of the costs (see **Table 6-3**).

Table 6-6: Updates to Sykes Creek and Grand Canal Dredging Projects

Category	Sykes Creek TN Reductions (lbs/yr)	Sykes Creek TP Reductions (lbs/yr)	Sykes Creek Cost	Grand Canal TN Reductions (lbs/yr)	Grand Canal TP Reductions (lbs/yr)	Grand Canal Cost
Muck Removal	11,676	1,754	$4,705,428	6,057	910	$2,440,971
Treatment of Interstitial Water	64,278	Not applicable	$11,248,704	89,025	Not applicable	$15,579,397
Total	***75,954***	***1,754***	***$15,954,132***	***95,082***	***910***	***$18,020,368***

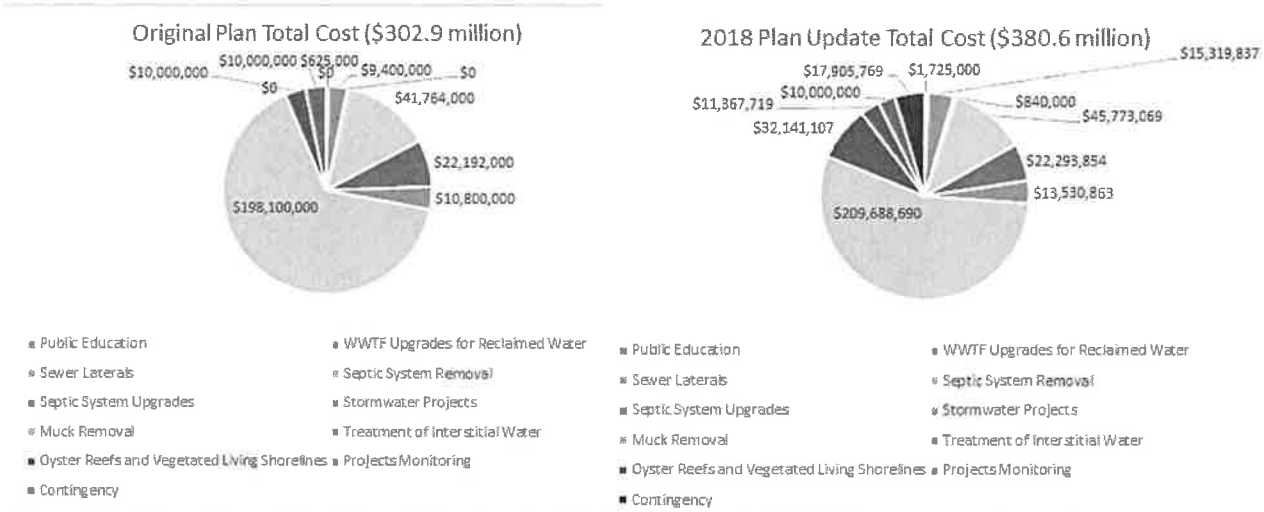


Figure 6-1: Comparison of the Original Plan Cost by Project Category (Left) versus the 2018 Plan Update Cost by Project Category (Right)

Section 7. 2019 Plan Update

For the 2019 Plan Update, local municipalities and partners were once again invited to submit new projects for inclusion in the Save Our Indian River Lagoon Project Plan. The projects submitted were required to deliver comparable nutrient removal benefits as those projects listed in the original plan for each sub-lagoon.

The requesting partners each submitted a "Save Our Indian River Lagoon Project Plan Project Submittal Request Form" to Brevard County for review of the proposed projects. The project forms were provided to the Citizen Oversight Committee to evaluate the potential for inclusion in the plan. The projects recommended by the Citizen Oversight Committee were included in the draft plan update presented to the Brevard County Board of County Commissioners for approval.

To determine the amount of funding that a project would be eligible to receive from the Save Our Indian River Lagoon Trust Fund, the estimated TN reductions from the project were multiplied by the allowable cost per pound per year of TN shown below in **Table 7-1** for that project type. The costs shown in **Table 7-1** were included in the application form provided to the partners in September 2018, and were an average of the actual or engineer's estimate of cost per pound of TN removed from the projects previously listed in the Save Our Indian River Lagoon Project Plan, as amended or comparable projects recently planned or completed elsewhere in the IRL watershed. An erroneous cost-share in the Project Submittal Request Form for muck removal was corrected from $1,609 to $957 during the application process, before projects were presented to the Citizens Oversight Committee and recommended for inclusion in the 2019 Plan Update.

Table 7-1: Cost-share Offered for Project Requests Submitted for the 2019 Plan Update

Project Type	Average Cost per Pound per Year of TN
WWTF Upgrades for Reclaimed Water	$300
Sewer Lateral Rehabilitation Pilot	$450
Septic System Removal by Sewer Extension	$1,455
Septic System Removal by Sewer Connection	$443
Septic System Upgrades	$802
Stormwater Projects	-
Mainland	$94
Merritt Island	$177
Barrier Island	$155
Muck Removal	$957
Treatment of Muck Interstitial Water	$200
Oyster Bar	$395
Planted Shorelines	$240

The application for 2019 Substitute Projects set cost-share based on the best available data at the time that the project request form was published. Additional studies and reports on project costs and nutrient removal, as well as project additions and substitutions in this plan update culminate in the modification of several values as shown in **Table 7-2**. The average cost per pound of nitrogen removed by septic systems removed by sewer extensions reduced from $1,455 to $1,070 due to swapping out some projects for more cost-effective areas. The average cost per pound of nitrogen removed by septic system connected to adjacent sewer lines increased from $443 to $478 due to selecting an additional 180 of the next most cost-effective opportunities for

quick connections. Stormwater cost-share changed from $94 to $122 on the mainland, from $177 to $163 on Merritt Island, and from $155 to $150 on the Barrier Island due to the addition of 129 stormwater basins and the deletion of seven stormwater basins in these geographic areas. The treatment of muck interstitial water decreased from $200 per pound per year based on recent bids indicating this amount may be lowered to $50 per pound per year.

Table 7-2: Average Cost-Share by Project Type in the 2019 Plan Update

Project Type	Average Cost per Pound per Year of TN
WWTF Upgrades for Reclaimed Water	$300
Sewer Lateral Rehabilitation Pilot	$450
Septic System Removal by Sewer Extension	$1,070
Septic System Removal by Sewer Connection	$478
Septic System Upgrades	$802
Stormwater Projects	-
Mainland	$122
Merritt Island	$163
Barrier Island	$150
Muck Removal	$957
Treatment of Muck Interstitial Water	$50
Oyster Bar	$395
Planted Shorelines	$240

7.1. New Projects in the 2019 Plan Update

The approved projects for inclusion in the 2019 Plan Update are summarized in **Table 7-3**. This table lists the responsible entity, project description, sub-lagoon location, TN and TP reductions, and the amount of Save Our Indian River Lagoon Trust Fund dollars allocated to each project. Once the 2019 Plan Update is approved by the County Commission, the projects are part of the Save Our Indian River Lagoon Project Plan, and are reflected in the updated plan tables shown in **Section 8**.

Table 7-3: Summary of New Projects for the Save Our Indian River Lagoon Plan 2019 Update

Year Added	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
2019	Big Muddy at Cynthia Baffle Box Expansion	City of Indian Harbour Beach	Nutrient Separating Baffle Box with Bold & Gold media. Expansion of treated area to 63.8 acres from 32 acres of previously approved project.	Banana	167	10	$25,837
2019	Basin 1304 Bioreactor	Brevard County	Installation of an upflow filter concrete box with a solar pump to treat baseflow at an existing wet detention pond.	Banana	958	127	$90,000
2019	M1 Canal Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	Central IRL	1,433	191	$66,300
2019	Fleming Grant Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	Central IRL	602	91	$16,800
2019	Espanola Baffle Box	City of Melbourne	Installation of new 2nd generation baffle box with biosorption activated media.	Central IRL	1119	148	$105,186
2019	Basin 1298 Bioreactor	Brevard County	Installation of an upflow filter concrete box with a solar pump to treat baseflow at an existing wet detention pond.	North IRL	917	116	$86,198
2019	Johns Road Pond Biosorption Activated Media	Brevard County	Wet detention pond bank retrofit with biosorption activated media.	North IRL	245	37	$23,030
2019	Burkholm Road Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	North IRL	685	104	$64,390
2019	Carter Road Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	North IRL	665	101	$62,510
2019	Wiley Road Biosorption Activated Media	Brevard County	Ditch bottom retrofit with biosorption activated media.	North IRL	954	144	$82,735
2019	Broadway Pond Biosorption Activated Media	Brevard County	Wet detention pond bank retrofit with biosorption activated media.	North IRL	456	69	$42,864
2019	Cherry Street Baffle Box	City of Melbourne	Installation of new 2nd generation baffle box with biosorption activated media.	North IRL	980	174	$92,120
2019	Spring Creek Baffle Box	City of Melbourne	Installation of new 2nd generation baffle box with biosorption activated media.	North IRL	1057	232	$99,358
2019	Titusville High School Baffle Box	City of Titusville	Installation of 2nd generation baffle box with Bold & Gold media filter.	North IRL	1,190	166	$111,813
2019	Coleman Pond Managed Aquatic Plant System	City of Titusville	Installation of floating islands within a one-acre city-owned pond located within the Chain of Lakes basin.	North IRL	1,240	198	$35,000
2019	Cocoa Beach Water Reclamation Facility Upgrade	City of Cocoa Beach	Upgrade to systems to avoid the potential for plant overflows during power outages and/or storm flow conditions. Various improvements that include emergency power, automatic post-anoxic bypass and 6.0 million gallons per day filter upgrades.	Banana	3,278	1,092	$983,400

Year Added	Project Name	Responsible Entity	Project Description	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
2019	Osprey Basin Lateral Repair Project	City of Titusville	Smoke testing of gravity system and private sewer lateral repairs.	North IRL	640	0	$200,000
2019	Cocoa Beach Muck Dredging Phase II-B	City of Cocoa Beach	Dredge 12 residential canals.	Banana	6,300	840	$5,917,650
2019	Brevard Zoo Banana River Plant Project	Brevard Zoo	Plant 195 feet of qualifying shoreline vegetation within the Tortoise Island homeowners' association.	Banana	13	4	$3,120
2019	Brevard Zoo North IRL Plant Project	Brevard Zoo	Plant 50 feet of qualifying shoreline vegetation at St. Mark's School.	North IRL	3	1	$720
2019	Brevard Zoo Banana River Oyster Project	Brevard Zoo	Construct 36,894 square feet of oyster projects in the Banana River. Reached out to property owners in the project locations and have their support to move forward. The design will be site-specific and will be approved by the County before construction begins. Brevard Zoo will consult with the County to determine whether live oysters need to be added to each specific location.	Banana	1,476	37	$583,020
2019	Brevard Zoo Central IRL Oyster Project	Brevard Zoo	Construct 10,200 square feet of oyster projects in the Central IRL. Reached out to property owners in the project locations and have their support to move forward. The design will be site-specific and will be approved by the County before construction begins. Brevard Zoo will consult with the County to determine whether live oysters need to be added to each specific location.	Central IRL	408	10	$161,160
2019	Brevard Zoo North IRL Oyster Project	Brevard Zoo	Construct 21,600 square feet of oyster projects in the North IRL. Reached out to property owners in the project locations and have their support to move forward. The design will be site-specific and will be approved by the County before construction begins. Brevard Zoo will consult with the County to determine whether live oysters need to be added to each specific location.	North IRL	864	22	$341,280
-	***Total***	-	-	-	***25,650***	***3,914***	***$9,194,491***

7.2. Project Changes

7.2.1 Withdrawals

Some of the projects submitted by the local governments as part of the 2018 Plan Update were determined to not be cost-effective and/or feasible to implement after further investigation. Therefore, the local governments requested that these projects be removed from the Save Our Indian River Lagoon Project Plan so that the funding could be used for other projects. **Table 7-4** lists the projects that have been removed from the plan at the request of the responsible entity.

Table 7-4: Summary of Project Withdrawals

Project Name	Responsible Entity	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Plan Funding
Cocoa Beach Muck Dredging – Phase III Interstitial	City of Cocoa Beach	Banana	2,942	To be determined	$514,809
Indian River Drive Oyster Bar (reduction from 1,900 to 140 feet)	Brevard County	North IRL	422	10	$166,672
Indian River Drive Planted Shoreline (reduction from 1,900 to 140 feet)	Brevard County	North IRL	118	41	$20,620
Total	**-**	**-**	***3,482***	***51***	***$702,101***

In addition, Brevard County reviewed the basins proposed for stormwater treatment in the original plan and identified those basins that should be removed because they could not be easily treated or are basins where the County already has projects. These basins are summarized in **Table 7-5**.

Table 7-5: Summary of Stormwater Basin Withdrawals

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Banana	Stormwater project in Basin 905	1,143	178	$150,000
Banana	Stormwater project in Basin 492	1,020	117	$100,000
Banana	Stormwater project in Basin 522	795	110	$125,000
Banana	Stormwater project in Basin 705	650	95	$100,000
Banana	Stormwater project in Basin 821	627	123	$100,000
Banana	Stormwater project in Basin 820	597	112	$100,000
North IRL	Stormwater project in Basin 338	4,226	188	$125,000
North IRL	Stormwater project in Basin 155	2,553	122	$100,000
North IRL	Stormwater project in Basin 47	1,348	139	$125,000
North IRL	Stormwater project in Basin 219	956	113	$125,000
Total	**-**	***13,915***	***1,297***	***$1,150,000***

7.2.2 Revisions

Two of the stormwater projects removed from the 2018 Update were determined to be viable options and are added back to the plan as part of the 2019 Update. These two projects are shown below in **Table 7-6**.

Table 7-6: Stormwater Projects Added Back into the Plan

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Banana	Stormwater project in Basin 1317	1,679	143	$125,000
Banana	Stormwater project in Basin 998	1,196	189	$100,000

In addition, the County identified additional stormwater basins to substitute for stormwater projects previously removed or withdrawn from the plan. Sufficient basins are added, as shown in **Table 7-7** through **Table 7-9**, to restore stormwater nutrient reductions in each sub-lagoon to the levels proposed in the original plan.

Table 7-7: New Banana River Lagoon Stormwater Projects Added to the Plan

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Banana	Stormwater project in Basin 1002	1,181	159	$100,000
Banana	Stormwater project in Basin 1033	1,113	152	$100,000
Banana	Stormwater project in Basin 1026	1,073	180	$100,000
Banana	Stormwater project in Basin 912	1,025	34	$100,000
Banana	Stormwater project in Basin 981	993	179	$100,000
Banana	Stormwater project in Basin 1016	920	136	$100,000
Banana	Stormwater project in Basin 997	915	149	$100,000
Banana	Stormwater project in Basin 980	836	127	$100,000
Banana	Stormwater project in Basin 940	816	106	$100,000
Banana	Stormwater project in Basin 1334	795	130	$100,000
Banana	Stormwater project in Basin 1378	744	104	$100,000
Banana	Stormwater project in Basin 1372	720	113	$100,000
Banana	Stormwater project in Basin 1039	708	104	$100,000
Banana	Stormwater project in Basin 1104	701	106	$100,000
Banana	Stormwater project in Basin 1124	681	99	$100,000
Banana	Stormwater project in Basin 1187	662	82	$100,000
Banana	Stormwater project in Basin 982	642	68	$100,000
Banana	Stormwater project in Basin 990	634	102	$100,000
Banana	Stormwater project in Basin 829	630	145	$100,000
Banana	Stormwater project in Basin 988	621	108	$100,000
Banana	Stormwater project in Basin 1328	617	89	$100,000
Banana	Stormwater project in Basin 944	614	83	$100,000
Banana	Stormwater project in Basin 1024	609	106	$100,000
Banana	Stormwater project in Basin 957	586	53	$100,000
Banana	Stormwater project in Basin 1310	583	106	$100,000
Banana	Stormwater project in Basin 984	569	60	$100,000
Banana	Stormwater project in Basin 1133	562	90	$100,000
Banana	Stormwater project in Basin 1223	561	86	$100,000
Banana	Stormwater project in Basin 977	558	59	$100,000
Banana	Stormwater project in Basin 889	539	85	$100,000
Banana	Stormwater project in Basin 960	537	80	$100,000
Banana	Stormwater project in Basin 1142	534	73	$100,000
Banana	Stormwater project in Basin 1037	533	105	$100,000
Banana	Stormwater project in Basin 969	528	78	$100,000
Banana	Stormwater project in Basin 955	522	60	$100,000
Banana	Stormwater project in Basin 975	521	75	$100,000
Banana	Stormwater project in Basin 1362	476	71	$100,000
Banana	Stormwater project in Basin 1336	470	68	$100,000
Banana	Stormwater project in Basin 1067	463	67	$100,000
Banana	Stormwater project in Basin 865	454	151	$100,000
Banana	Stormwater project in Basin 1251	448	66	$100,000
Banana	Stormwater project in Basin 1262	443	80	$100,000
Banana	Stormwater project in Basin 961	431	57	$100,000
Banana	Stormwater project in Basin 938	424	160	$100,000
Banana	Stormwater project in Basin 1001	401	54	$100,000

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Banana	Stormwater project in Basin 1220	396	61	$100,000
Banana	Stormwater project in Basin 1175	394	42	$100,000
Banana	Stormwater project in Basin 1018	389	54	$100,000
Banana	Stormwater project in Basin 1010	374	55	$100,000
Banana	Stormwater project in Basin 934	365	42	$100,000
Banana	Stormwater project in Basin 1198	365	62	$100,000
Banana	Stormwater project in Basin 1327	352	52	$100,000
Banana	Stormwater project in Basin 2421	343	49	$100,000
Banana	Stormwater project in Basin 1098	341	53	$100,000
Banana	Stormwater project in Basin 1357	338	56	$100,000
Banana	Stormwater project in Basin 1014	333	50	$100,000
Banana	Stormwater project in Basin 1120	313	50	$100,000
Banana	Stormwater project in Basin 1125	307	51	$100,000
Banana	Stormwater project in Basin 1248	306	46	$100,000
Banana	Stormwater project in Basin 929	304	41	$100,000
Banana	Stormwater project in Basin 1332	303	47	$100,000
Banana	Stormwater project in Basin 933	302	38	$100,000
Banana	Stormwater project in Basin 1231	300	58	$100,000
Banana	Stormwater project in Basin 1117	282	43	$100,000
Banana	Stormwater project in Basin 1000	277	40	$100,000
Banana	Stormwater project in Basin 1371	273	39	$100,000
Banana	Stormwater project in Basin 1041	273	47	$100,000
Banana	Stormwater project in Basin 1183	272	39	$100,000
Banana	Stormwater project in Basin 1082	264	39	$100,000
Banana	Stormwater project in Basin 925	261	20	$100,000
Banana	Stormwater project in Basin 1338	256	37	$100,000
Banana	Stormwater project in Basin 1152	245	30	$100,000
Banana	Stormwater project in Basin 1296	241	48	$100,000
Banana	Stormwater project in Basin 1346	189	28	$100,000
Banana	Stormwater project in Basin 1250	188	26	$100,000
Banana	Stormwater project in Basin 1270	187	28	$100,000
Banana	Stormwater project in Basin 1121	186	27	$100,000
Banana	Stormwater project in Basin 1167	180	28	$100,000
Banana	Stormwater project in Basin 1302	172	25	$100,000
Banana	Stormwater project in Basin 1314	170	26	$100,000
Banana	Stormwater project in Basin 1303	166	24	$100,000
Banana	Stormwater project in Basin 1188	166	29	$100,000
Banana	Stormwater project in Basin 958	164	26	$100,000
Banana	Stormwater project in Basin 1038	157	25	$100,000
Banana	Stormwater project in Basin 1159	134	20	$100,000
Banana	Stormwater project in Basin 1351	129	19	$100,000
Banana	Stormwater project in Basin 1225	122	19	$100,000
Banana	Stormwater project in Basin 1305	119	25	$100,000
Banana	Stormwater project in Basin 1319	117	16	$100,000
Banana	Stormwater project in Basin 1070	113	12	$100,000
Banana	Stormwater project in Basin 1048	107	20	$100,000
Banana	***Total***	***40,928***	***6,157***	***$9,100,000***

Table 7-8: New North IRL Stormwater Projects Added to the Plan

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
North IRL	Stormwater project in Basin 1463	1,321	195	$100,000
North IRL	Stormwater project in Basin 1081	1,281	210	$100,000
North IRL	Stormwater project in Basin 1392	1,256	197	$100,000
North IRL	Stormwater project in Basin 992	1,244	195	$100,000
North IRL	Stormwater project in Basin 911	1,238	147	$100,000
North IRL	Stormwater project in Basin 335	1,187	206	$100,000
North IRL	Stormwater project in Basin 1002	1,181	159	$100,000
North IRL	Stormwater project in Basin 1396	1,160	169	$100,000
North IRL	Stormwater project in Basin 895	1,138	122	$100,000
North IRL	Stormwater project in Basin 513	1,137	183	$100,000
North IRL	Stormwater project in Basin 1381	1,116	172	$100,000
North IRL	Stormwater project in Basin 290	1,116	193	$100,000
North IRL	Stormwater project in Basin 1387	1,113	179	$100,000
North IRL	Stormwater project in Basin 1033	1,113	152	$100,000
North IRL	Stormwater project in Basin 987	1,099	172	$100,000
North IRL	Stormwater project in Basin 1071	1,082	144	$100,000
North IRL	Stormwater project in Basin 1112	1,032	166	$100,000
North IRL	Stormwater project in Basin 1458	1,024	135	$100,000
North IRL	Stormwater project in Basin 89	1,023	147	$100,000
North IRL	Stormwater project in Basin 833	1,007	185	$100,000
North IRL	Stormwater project in Basin 1331	1,000	159	$100,000
North IRL	Stormwater project in Basin 1456	978	137	$100,000
North IRL	Stormwater project in Basin 1401	953	147	$100,000
North IRL	Stormwater project in Basin 1380	929	134	$100,000
North IRL	Stormwater project in Basin 94	925	136	$100,000
North IRL	Stormwater project in Basin 1016	920	136	$100,000
North IRL	Stormwater project in Basin 1213	904	131	$100,000
North IRL	Stormwater project in Basin 1034	902	132	$100,000
North IRL	Stormwater project in Basin 1459	895	132	$100,000
North IRL	Stormwater project in Basin 1222	888	171	$100,000
North IRL	Stormwater project in Basin 100	888	115	$100,000
North IRL	Stormwater project in Basin 1359	887	142	$100,000
North IRL	Stormwater project in Basin 1391	887	142	$100,000
North IRL	Stormwater project in Basin 1464	884	122	$100,000
North IRL	Stormwater project in Basin 832	872	147	$100,000
North IRL	Stormwater project in Basin 1080	861	134	$100,000
North IRL	Stormwater project in Basin 624	860	134	$100,000
North IRL	Stormwater project in Basin 1339	857	103	$100,000
North IRL	Stormwater project in Basin 26	854	129	$100,000
North IRL	Stormwater project in Basin 1172	852	123	$100,000
North IRL	Stormwater project in Basin 392	840	155	$100,000
North IRL	Stormwater project in Basin 980	836	127	$100,000
North IRL	Stormwater project in Basin 594	833	135	$100,000
North IRL	Stormwater project in Basin 1418	832	111	$100,000
North IRL	Stormwater project in Basin 1389	822	134	$100,000
North IRL	Stormwater project in Basin 115	821	175	$100,000
North IRL	Stormwater project in Basin 940	816	106	$100,000
North IRL	Stormwater project in Basin 1295	800	121	$100,000
North IRL	Stormwater project in Basin 597	800	142	$100,000
North IRL	Stormwater project in Basin 262	794	126	$100,000

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
North IRL	Stormwater project in Basin 894	794	116	$100,000
North IRL	Stormwater project in Basin 72	790	140	$100,000
North IRL	Stormwater project in Basin 1417	771	117	$100,000
North IRL	Stormwater project in Basin 1395	768	114	$100,000
North IRL	Stormwater project in Basin 141	761	124	$100,000
North IRL	Stormwater project in Basin 1378	744	104	$100,000
North IRL	Stormwater project in Basin 921	743	96	$100,000
North IRL	Stormwater project in Basin 288	732	78	$100,000
North IRL	Stormwater project in Basin 1214	727	84	$100,000
North IRL	Stormwater project in Basin 1348	723	102	$100,000
North IRL	Stormwater project in Basin 1372	720	113	$100,000
North IRL	Stormwater project in Basin 1426	720	116	$100,000
North IRL	Stormwater project in Basin 1032	719	115	$100,000
North IRL	Stormwater project in Basin 1363	715	123	$100,000
North IRL	Stormwater project in Basin 677	709	136	$100,000
North IRL	Stormwater project in Basin 1039	708	104	$100,000
North IRL	Stormwater project in Basin 212	693	89	$100,000
North IRL	Stormwater project in Basin 1425	690	113	$100,000
North IRL	Stormwater project in Basin 985	687	99	$100,000
North IRL	Stormwater project in Basin 644	686	94	$100,000
North IRL	Stormwater project in Basin 1029	685	93	$100,000
North IRL	Stormwater project in Basin 228	684	131	$100,000
North IRL	Stormwater project in Basin 1124	681	99	$100,000
North IRL	Stormwater project in Basin 838	658	135	$100,000
North IRL	Stormwater project in Basin 10	648	97	$100,000
North IRL	Stormwater project in Basin 805	645	94	$100,000
North IRL	Stormwater project in Basin 6	645	72	$100,000
North IRL	Stormwater project in Basin 1491	641	93	$100,000
North IRL	Stormwater project in Basin 1330	639	89	$100,000
North IRL	Stormwater project in Basin 796	639	98	$100,000
North IRL	Stormwater project in Basin 827	639	96	$100,000
North IRL	Stormwater project in Basin 1240	638	100	$100,000
North IRL	Stormwater project in Basin 903	631	88	$100,000
North IRL	Stormwater project in Basin 829	630	145	$100,000
North IRL	Stormwater project in Basin 1294	628	94	$100,000
North IRL	Stormwater project in Basin 544	624	98	$100,000
North IRL	Stormwater project in Basin 806	622	100	$100,000
North IRL	Stormwater project in Basin 1382	622	88	$100,000
North IRL	Stormwater project in Basin 840	619	84	$100,000
North IRL	Stormwater project in Basin 1313	619	92	$100,000
North IRL	Stormwater project in Basin 759	614	98	$100,000
North IRL	Stormwater project in Basin 1390	612	92	$100,000
North IRL	Stormwater project in Basin 993	611	93	$100,000
North IRL	Stormwater project in Basin 1197	609	82	$100,000
North IRL	Stormwater project in Basin 1233	605	101	$100,000
North IRL	Stormwater project in Basin 922	601	107	$100,000
North IRL	Stormwater project in Basin 1354	597	86	$100,000
North IRL	Stormwater project in Basin 1076	595	91	$100,000
North IRL	Stormwater project in Basin 510	586	92	$100,000
North IRL	Stormwater project in Basin 1241	584	83	$100,000
North IRL	Stormwater project in Basin 896	581	123	$100,000
North IRL	Stormwater project in Basin 1244	576	78	$100,000

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
North IRL	Stormwater project in Basin 1027	560	84	$100,000
North IRL	Stormwater project in Basin 1403	558	88	$100,000
North IRL	Stormwater project in Basin 1316	557	68	$100,000
North IRL	Stormwater project in Basin 354	555	115	$100,000
North IRL	Stormwater project in Basin 294	551	84	$100,000
North IRL	Stormwater project in Basin 1312	549	120	$100,000
North IRL	Stormwater project in Basin 105	549	72	$100,000
North IRL	Stormwater project in Basin 1221	545	85	$100,000
North IRL	Stormwater project in Basin 889	539	85	$100,000
North IRL	Stormwater project in Basin 960	537	80	$100,000
North IRL	Stormwater project in Basin 568	534	85	$100,000
North IRL	Stormwater project in Basin 890	533	110	$100,000
North IRL	Stormwater project in Basin 1037	533	105	$100,000
North IRL	Stormwater project in Basin 751	532	121	$100,000
North IRL	Stormwater project in Basin 1413	528	78	$100,000
North IRL	Stormwater project in Basin 962	527	75	$100,000
North IRL	Stormwater project in Basin 1361	524	79	$100,000
North IRL	Stormwater project in Basin 1291	518	79	$100,000
North IRL	Stormwater project in Basin 1219	512	60	$100,000
North IRL	Stormwater project in Basin 920	511	87	$100,000
North IRL	Stormwater project in Basin 939	502	71	$100,000
North IRL	Stormwater project in Basin 1228	501	83	$100,000
North IRL	Stormwater project in Basin 353	497	86	$100,000
North IRL	Stormwater project in Basin 1423	487	73	$100,000
North IRL	Stormwater project in Basin 291	485	82	$100,000
North IRL	Stormwater project in Basin 1498	483	74	$100,000
North IRL	Stormwater project in Basin 1429	477	55	$100,000
North IRL	Stormwater project in Basin 1150	476	57	$100,000
North IRL	Stormwater project in Basin 263	469	65	$100,000
North IRL	Stormwater project in Basin 1067	463	67	$100,000
North IRL	Stormwater project in Basin 1293	461	67	$100,000
North IRL	Stormwater project in Basin 1344	459	61	$100,000
North IRL	Stormwater project in Basin 83	452	61	$100,000
North IRL	Stormwater project in Basin 2420	450	121	$100,000
North IRL	Stormwater project in Basin 1259	450	106	$100,000
North IRL	Stormwater project in Basin 1398	449	74	$100,000
North IRL	Stormwater project in Basin 1251	448	66	$100,000
North IRL	Stormwater project in Basin 1262	443	80	$100,000
North IRL	Stormwater project in Basin 1428	440	65	$100,000
North IRL	Stormwater project in Basin 884	437	68	$100,000
North IRL	Stormwater project in Basin 1307	431	47	$100,000
North IRL	Stormwater project in Basin 578	430	68	$100,000
North IRL	Stormwater project in Basin 1073	428	61	$100,000
North IRL	Stormwater project in Basin 938	424	160	$100,000
North IRL	Stormwater project in Basin 1113	416	93	$100,000
North IRL	Stormwater project in Basin 862	416	72	$100,000
North IRL	Stormwater project in Basin 1224	401	111	$100,000
North IRL	Stormwater project in Basin 1220	396	61	$100,000
North IRL	Stormwater project in Basin 1292	386	60	$100,000
North IRL	Stormwater project in Basin 1215	382	52	$100,000
North IRL	Stormwater project in Basin 2419	381	43	$100,000
North IRL	Stormwater project in Basin 1253	379	54	$100,000

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
North IRL	Stormwater project in Basin 871	366	53	$100,000
North IRL	Stormwater project in Basin 512	364	53	$100,000
North IRL	Stormwater project in Basin 1245	356	49	$100,000
North IRL	Stormwater project in Basin 2421	343	49	$100,000
North IRL	Stormwater project in Basin 1435	328	43	$100,000
North IRL	Stormwater project in Basin 1231	300	58	$100,000
North IRL	Stormwater project in Basin 1128	279	77	$100,000
North IRL	Stormwater project in Basin 902	276	35	$100,000
North IRL	***Total***	***111,229***	***17,296***	***$16,200,000***

Table 7-9: New Central IRL Stormwater Projects Added to the Plan

Sub-lagoon	Project Name	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)	Cost
Central IRL	Stormwater project in Basin 1470	2,813	452	$200,000
Central IRL	Stormwater project in Basin 1511	2,490	381	$200,000
Central IRL	Stormwater project in Basin 1508	2,459	356	$200,000
Central IRL	Stormwater project in Basin 1803	2,227	318	$200,000
Central IRL	Stormwater project in Basin 1825	1,896	394	$200,000
Central IRL	Stormwater project in Basin 1445	1,493	198	$200,000
Central IRL	Stormwater project in Basin 1439	1,413	183	$200,000
Central IRL	***Total***	***14,791***	***2,282***	***$1,400,000***

7.2.3 Updated Cost-Share Funding

Several stakeholders requested updated cost-share funding based on the 2019 Update cost-share rates. Some stakeholders were also able to modify their project to increase the amount of nitrogen and phosphorous removed. The projects, their previous cost-share funding amount, and updated funding eligibility are shown in **Table 7-10**.

Table 7-10: Projects with Updated Cost-Share Funding

Project Name	Responsible Entity	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Original Plan Funding	Updated Plan Funding
Muck Removal of Indian Harbour Beach Canals	City of Indian Harbour Beach	Banana	3,780*	720*	$909,571	$3,579,660
Muck Interstitial Water Treatment for Indian Harbour Beach Canals	City of Indian Harbour Beach	Banana	27,418	To be determined	$4,798,197	$5,483,600
Big Muddy at Cynthia Baffle Box	City of Indian Harbour Beach	Banana	269	48	$26,637	$41,695
Cocoa Beach Muck Dredging – Phase III	City of Cocoa Beach	Banana	4,095*	780*	$981,305	$3,877,965
Stormwater Low Impact Development Convair Cove 1 – Blakey Boulevard	City of Cocoa Beach	Banana	30	3	$2,922	$4,650
Stormwater Low Impact Development Convair Cove 2- Dempsey Drive	City of Cocoa Beach	Banana	29	3	$2,842	$4,495
Merritt Island Muck Removal – Phase 1	Brevard County	Banana	8,085*	1,540*	$1,936,415	$7,656,495
Church Street Type II Baffle Box	City of Cocoa	North IRL	937*	135*	$20,856	$88,045

Project Name	Responsible Entity	Sub-lagoon	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)	Original Plan Funding	Updated Plan Funding
Sylvan Estates Septic-to-Sewer Conversion	City of West Melbourne	Central IRL	1,073	Not applicable	$935,656	$1,561,215
Grant Street Water Reclamation Facility Nutrient Removal Improvements	City of Melbourne	Central IRL	25,627	9,671	$5,919,837	$7,688,100
Micco Sewer Line Extension	Sebastian Inlet Marina	Central IRL	1,359*	Not applicable	$1,391,316	$1,977,345
Turkey Creek Shoreline Restoration – Oysters	City of Palm Bay	Central IRL	309*	8*	$113,500	$122,055
Turkey Creek Shoreline Restoration – Planted	City of Palm Bay	Central IRL	104*	36*	Included in above	$24,960
Total	**-**	**-**	***73,115***	***12,944***	***$17,039,054***	***$32,110,280***

* Updated nutrient reduction estimate.

7.3. Unfunded Projects

Throughout this plan, there are projects listed that are currently not recommended due to limited funding. If some of the recommended projects in the plan receive funding from outside sources, such as grants or legislative appropriations, additional projects could be implemented using the Save Our Lagoon Trust Fund. If funding becomes available, the projects listed in **Table 7-11** through **Table 7-15** include numerous unfunded opportunities sorted by the next most cost-effective projects available for each major type of pollution reduction strategy.

Table 7-11: Unfunded WWTF Reclaimed Water Upgrade Projects

Facility	Cost to Upgrade	TN Removed after Attenuation (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed after Attenuation (lbs/yr)	Cost per Pound per Year of TP Removed
City of West Melbourne Ray Bullard Water Reclamation Facility	$6,000,000	3,355	$1,788	To be determined	To be determined
Brevard County South Beaches WWTF	$6,000,000	2,860	$2,098	To be determined	To be determined
Brevard County South Central Regional WWTF	$6,000,000	2,053	$2,923	To be determined	To be determined
Port St. John WWTF	$6,000,000	1,788	$3,356	To be determined	To be determined
Rockledge WWTF	$6,000,000	1,084	$3,460	To be determined	To be determined
Barefoot Bay Water Reclamation Facility	$6,000,000	1,597	$5,535	To be determined	To be determined
North Regional WWTF	$6,000,000	584	$10,282	To be determined	To be determined

Table 7-12: Unfunded Package Plant Connection Projects

Facility Name	Number of Units	TN Load Reduction (lbs/yr)	Cost to Connect to Sewer	Cost per Pound Per Year of TN Removed
Palm Harbor Mobile Home Park WWTF	130	495	$782,530	$1,581
River Forest Mobile Home Park	130	134	$778,713	$5,818
Riverview Mobile Home and Recreational Vehicle Park	110	121	$717,593	$5,907
Canebreaker Condo WWTF	24	63	$504,692	$8,024
Merritt Island Utility Company WWTF	198	3	$1,393,916	$556,214
Enchanted Lakes Estates	190	1	$994,448	$1,921,749

Table 7-13: Unfunded Sprayfield or Rapid Infiltration Basin Upgrade Projects

Facility	Type	Estimated Cost to Upgrade	TN Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TP Removed
Canebreaker Condo	Sprayfield	$36,000	52	$688	To be determined	To be determined
River Forest Mobile Home Park WWTF	Sprayfield	$78,405	111	$705	46	$1,704.46
Palm Harbor Mobile Home Park WWTF	Sprayfield	$300,564	411	$732	33	$9,108.00
Cove At South Beaches Condominium Association WWTF	Sprayfield	$51,480	20	$2,584	57	$903.16
Riverview Mobile Home and Recreational Vehicle Park	Sprayfield	$333,234	100	$3,318	73	$4,564.85
Treetop Villas	Sprayfield	$105,000	22	$4,685	16	$6,562.50
Enchanted Lakes Estates	Sprayfield	$36,000	1	$43,373	To be determined	To be determined
Lighthouse Cove WWTF	Sprayfield	$120,000	2	$72,289	26	$4,615.38
Merritt Island Utility Company WWTF	Rapid Infiltration Basin	$495,277	2	$198,906	To be determined	To be determined
River Grove Mobile Home Village WWTF	Rapid Infiltration Basin	$182,299	1	$219,637	32	$5,696.84
Aquarina Beach Community WWTF	Sprayfield	To be determined	To be determined	To be determined	To be determined	To be determined
Camelot Recreational Vehicle Park Inc	Sprayfield	To be determined	To be determined	To be determined	To be determined	To be determined
Housing Authority of Brevard County WWTF	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
Oak Point Mobile Home Park WWTF	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
South Shores Utility	Sprayfield	To be determined	To be determined	To be determined	To be determined	To be determined

Facility	Type	Estimated Cost to Upgrade	TN Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TN Removed	TP Removed from Upgrade (lbs/yr)	Cost per Pound per Year of TP Removed
Southern Comfort Mobile Home Park WWTF	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
Space X Launch Complex 39A	Sprayfield	To be determined	To be determined	To be determined	To be determined	To be determined
Summit Cove Condominium	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
Tropical Trail Village WWTF	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
Wingate Reserve Demineralization Concentrate	Rapid Infiltration Basin	To be determined	To be determined	To be determined	To be determined	To be determined
Sterling House Condominium WWTF	Sprayfield	$60,000	To be determined	To be determined	20	$3,000.00
Pelican Bay Mobile Home WWTF	Rapid Infiltration Basin	$222,156	To be determined	To be determined	157	$1,415.01
Harris Malabar Facility	Rapid Infiltration Basin	$2,085,000	To be determined	To be determined	To be determined	To be determined
Long Point Recreational Park	Rapid Infiltration Basin	$60,000	To be determined	To be determined	16	$3,750.00
Barefoot Bay Advanced	Sprayfield	$26,136,000	138	$189,391.30	19	$1,375,578.95

Table 7-14: Unfunded Septic to Sewer Projects

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
South Beaches - Zone F	3	$100,116	173	$579
Grant-Valkaria - Zone G	30	$1,001,160	1,418	$706
Grant-Valkaria - Zone E	128	$4,271,616	5,862	$729
Grant-Valkaria - Zone B	34	$1,134,648	1,501	$756
Grant-Valkaria - Zone F	17	$567,324	688	$824
Grant-Valkaria - Zone D	18	$600,696	690	$871
South Beaches - Zone A	37	$1,234,764	1,306	$945
Grant-Valkaria - Zone A	42	$1,401,624	1,296	$1,082
Malabar - Zone B	64	$2,135,808	1,929	$1,107
Grant-Valkaria - Zone C	30	$1,001,160	853	$1,173
Malabar - Zone A	430	$14,349,960	11,456	$1,253
Titusville - Zone H	35	$1,168,020	910	$1,283
Rockledge - Zone B	160	$5,339,520	4,037	$1,323
Valkaria - Zone I	223	$7,441,956	5380	$1,383
Valkaria - Zone J	503	$16,786,116	11,507	$1,459
Malabar - Zone C	14	$467,208	289	$1,617
South Central - Zone B	180	$6,006,960	3,700	$1,624
Sharpes - Zone B	136	$4,538,592	2,692	$1,686
South Beaches - Zone E	387	$12,914,964	7,491	$1,724
Rockledge - Zone C	91	$3,036,852	1,736	$1,749
South Beaches - Zone K	21	$700,812	397	$1,765
Sykes Creek - Zone X	9	$300,348	166	$1,814
City of West Melbourne	60	$2,002,320	1,041	$1,923
South Beaches - Zone L	178	$5,940,216	2973	$1,998

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
Sykes Creek - Zone J	63	$2,102,436	1028	$2,045
Micco - Zone B	520	$17,353,440	8416	$2,062
South Beaches - Zone G	112	$3,737,664	1764	$2,119
City of West Melbourne - Zone B	60	$2,002,320	894	$2,240
Sykes Creek - Zone Z	61	$2,035,692	862	$2,362
South Beaches - Zone N	103	$3,437,316	1,193	$2,882
Sykes Creek - Zone C	81	$2,703,132	929	$2,909
South Central - Zone I	72	$2,402,784	819	$2,932
Melbourne Village - Zone A	85	$2,836,620	918	$3,091
South Central - Zone H	165	$5,506,380	1,779	$3,096
South Central - Zone G	196	$6,540,912	2,090	$3,129
Sykes Creek - Zone S	164	$5,473,008	1,653	$3,311
Sykes Creek - Zone U	156	$5,206,032	1,532	$3,398
Total	***6,795***	***$226,762,740***	***121,596***	***$2,006 (average)***

Table 7-15: Unfunded Muck Dredging and Interstitial Treatment Projects

Sub-Lagoon	IRL Muck Sites	Cost Estimate	Interstitial Water Treatment Cost	Total Cost	TN Reduction (lbs/yr)	Cost per Pound of TN Removed	TP Reduction (lbs/yr)	Cost per Pound of TP Removed
North IRL	Pineda to Eau Gallie	$30,625,000	$4,446,705	$35,071,705	28,749	$1,065	2,331	$13,138
North IRL	520 to Pineda	$31,500,000	$4,573,754	$36,073,754	29,008	$1,086	2,352	$13,393
Banana	National Aeronautics and Space Administration Area	$98,000,000	$14,229,457	$112,229,457	68,985	$1,421	9,198	$10,654
North IRL	North IRL Venetian Collector Canals/ Channels	$7,875,000	$1,143,439	$9,018,439	5,355	$1,471	714	$11,029
Banana	Newfound Harbor East	$1,575,000	$228,688	$1,803,688	1,050	$1,500	140	$11,250
Banana	Banana Venetian Collector Canals/ Channels	$119,000,000	$17,278,627	$136,278,627	78,960	$1,507	10,528	$11,303
Banana	Patrick Air Force Base Borrow Pit-2	$4,725,000	$686,063	$5,411,063	3,045	$1,552	406	$11,638
Banana	Newfound Harbor South	$4,725,000	$686,063	$5,411,063	3,045	$1,552	406	$11,638
Banana	Mathers Bridge Area	$12,250,000	$1,778,682	$14,028,682	7,875	$1,556	1,050	$11,667
North IRL	Cocoa South	$3,850,000	$559,014	$4,409,014	2,475	$1,556	182	$21,154
North IRL	Max Brewer Causeway	$2,800,000	$406,556	$3,206,556	1,785	$1,569	238	$11,765
North IRL	Eau Gallie South	$4,725,000	$686,063	$5,411,063	2,953	$1,600	777	$6,081
Banana	Newfound Harbor North	$3,150,000	$457,375	$3,607,375	1,995	$1,579	266	$11,842
Banana	Cocoa Beach High School	$6,825,000	$990,980	$7,815,980	4,305	$1,585	574	$11,890
Central IRL	Central IRL Venetian Collector Canals/ Channels	$6,300,000	$914,751	$7,214,751	3,885	$1,622	518	$12,162
Banana	Brightwaters	$8,225,000	$1,194,258	$9,419,258	5,040	$1,632	672	$12,240
Banana	520 Borrow Pit-2	$700,000	$101,639	$801,639	420	$1,667	56	$12,500
Banana	520 Borrow Pit-7	$700,000	$101,639	$801,639	420	$1,667	56	$12,500
Banana	520 Borrow Pit-1	$1,400,000	$203,278	$1,603,278	840	$1,667	112	$12,500
Banana	520 Borrow Pit-4	$1,400,000	$203,278	$1,603,278	840	$1,667	112	$12,500
Banana	Sunset Café	$3,850,000	$559,014	$4,409,014	2,310	$1,667	308	$12,500
Banana	Cape Canaveral Hospital	$2,100,000	$304,917	$2,404,917	1,260	$1,667	168	$12,500
Banana	520 Borrow Pit-3	$525,000	$76,229	$601,229	315	$1,667	42	$12,500
Banana	520 Borrow Pit-5	$1,050,000	$152,458	$1,202,458	630	$1,667	84	$12,500

Sub-Lagoon	IRL Muck Sites	Cost Estimate	Interstitial Water Treatment Cost	Total Cost	TN Reduction (lbs/yr)	Cost per Pound of TN Removed	TP Reduction (lbs/yr)	Cost per Pound of TP Removed
Banana	520 Borrow Pit-6	$525,000	$76,229	$601,229	315	$1,667	42	$12,500
North IRL	Crab Shack	$700,000	$101,639	$801,639	420	$1,667	56	$12,500
Central IRL	Trout Creek	$175,000	$25,410	$200,410	105	$1,667	14	$12,500
Central IRL	Melbourne Causeway North	$875,000	$127,049	$1,002,049	525	$1,667	70	$12,500
Central IRL	Front Street Park	$875,000	$127,049	$1,002,049	525	$1,667	70	$12,500
North IRL	Eau Gallie Northeast	$12,075,000	$1,753,272	$13,828,272	6,455	$1,871	244	$49,488
North IRL	Rockledge A	$14,000,000	$2,032,780	$16,032,780	7,205	$1,943	1,184	$11,824
Banana	Port Canaveral	$9,275,000	$1,346,716	$10,621,716	3,868	$2,398	245	$37,857
North IRL	Cocoa 520	$16,275,000	$2,363,106	$18,638,106	6,703	$2,428	160	$101,719
North IRL	Cocoa 520 to 528	$1,575,000	$228,688	$1,803,688	492	$3,201	40	$39,375
North IRL	National Aeronautics and Space Administration Causeway to 528	$16,625,000	$2,413,926	$19,038,926	3,859	$4,308	313	$53,115
North IRL	Warwick Drive	$700,000	$101,639	$801,639	104	$6,731	8	$87,500

7.4. Project Funding

The 2018 Plan Update added a Contingency Fund Reserve in the amount of 5% of the total Trust Fund dollars budgeted for approved projects in each fiscal year. The purpose of this reserve is to fund emergency response to harmful algal blooms, major fish kills, or to cover reasonable funding shortfalls that may occur during project implementation.

The previously approved Contingency Fund Reserve may also be used to increase funding for approved projects that encounter cost-effective opportunities for value added modifications that could occur swiftly if funding could be made available before the next plan update. If a project can be expanded or altered to provide greater nutrient reduction benefits than planned, contingency funds can be allocated at the rate for that project type established in the most recently adopted plan update in the table titled "Cost-share per Pound of TN Removed by Project Type." In no case shall the total cost-share from the Trust Fund exceed the total project costs, minus other grants or donations for that project. Amendment approvals would follow one of the three approval processes below:

1. If the amount of funds to be added to the cost-share contract exceeds the signature authority of the County Manager, the funding request will be brought to the Citizen Oversight Committee for a recommendation and to the County Commission for authorization to execute a contract amendment.
2. If the amount of funds to be added to the cost-share contract is within the signature authority of the County Manager but exceeds 10% of the original contract amount, the funding request will be brought to the Citizen Oversight Committee for a recommendation to the County Manager to process a contract amendment.
3. If the amount of funds to be added to the cost-share contract is within the signature authority for the County Manager and less than 10% over the original contract amount, staff will process a contract amendment in accordance with Brevard County contracting policies and administrative orders.

In addition to the Contingency Fund Reserve, if a future project is ready to move forward earlier than scheduled in the plan, if such advancement is consistent with temporal sequencing goals in the plan and is recommended by the Citizen Oversight Committee, and if there are sufficient Trust Fund dollars available, the County Manager (for budget changes less than $100,000) or Brevard County Commission have the authority to adjust the project schedule at any time to ensure that approved projects funded in the plan move forward as soon as feasible. This authority allows projects to move forward as soon as they are ready and funding is available without waiting for an annual plan update to modify the schedule. If a project schedule is updated between plan updates, this schedule change will be reflected in the next annual plan update.

If a project is not able to be completed as initially approved in the plan due to extenuating circumstances, such as permitting restrictions, loss of additional funding, or other situations beyond the managing entity's control, but is able to be downsized instead of fully withdrawn and is recommended by the Citizen Oversight Committee, then the County Manager (for budget changes less than $100,000) or Brevard County Commission have the authority to reduce the project funding. The revised funding amount will be based on the pounds of nitrogen removal estimated for the reduced project multiplied by the eligible cost-share per pound of TN removed that is adopted for that project type in the most recent Save Our Indian River Lagoon Project Plan. If a project is downsized between plan updates, the revised plan costs and nutrient load reductions will be reflected in the next annual plan update.

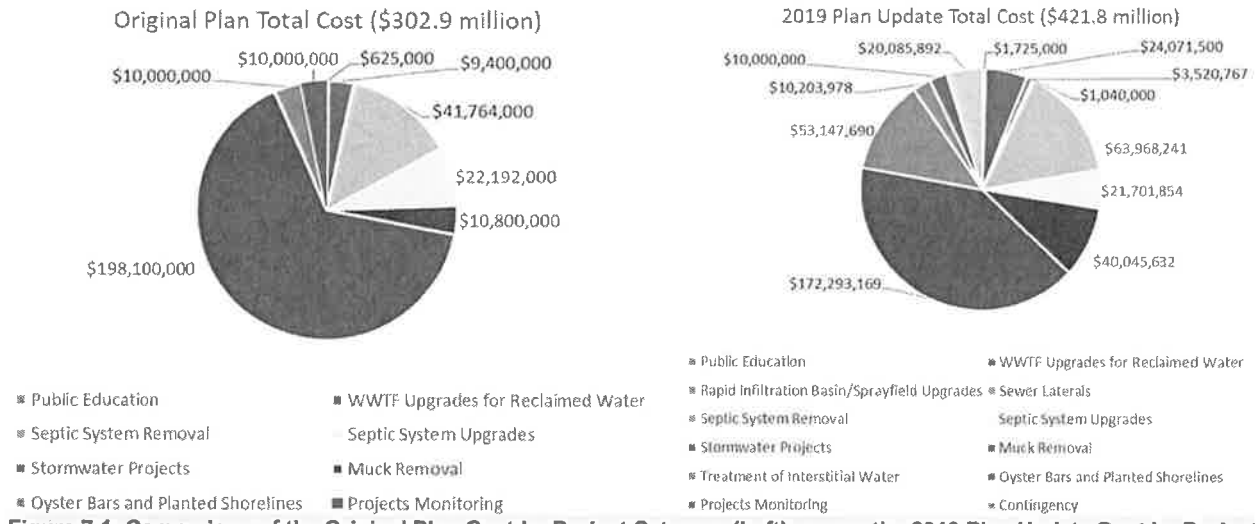


Figure 7-1: Comparison of the Original Plan Cost by Project Category (Left) versus the 2019 Plan Update Cost by Project Category (Right)

Section 8. Summary of the Plan through the 2019 Update

8.1. Plan Outputs and Outcomes

There are several outcomes expected from implementation of the plan. The plan outputs represent the project types included to Reduce external loads to the lagoon, Remove internal sources from the lagoon, Restore the natural filtration systems, and Respond to the changing conditions and opportunities. The outcomes from these outputs are the results, impacts, and accomplishments that will occur due to plan implementation (**Figure 8-2**). The timeframes for reaching various outcomes may be impacted by many factors outside Brevard County control, including federal and state legislation and weather; however, division of outcomes into short-term, mid-term, and long-term categories is meant to illustrate the sequence and approximate schedule of anticipated natural recovery.

8.2. Progress Toward the Total Maximum Daily Loads

The County has been working with its municipalities, Florida Department of Transportation District 5, and Patrick Air Force Base to update total loading estimates to the lagoon and revise the total maximum daily loads for nitrogen and phosphorus using the best available data and more detailed modeling than previously available. Based on this process, five-month total maximum daily loads, which target the load reductions needed during the seagrass growing period (January – May), were proposed in addition to annual total maximum daily loads that protect water quality year-round. These load reductions specifically target water quality conditions needed for restoring lagoon seagrass beds to provide crucial habitat for fish and other marine life. Therefore, as this Save Our Indian River Lagoon Project Plan was developed, the TN and TP reductions from the project types that **Reduce** incoming load were compared to the proposed five-month total maximum daily loads for each sub-lagoon. After satisfying the five-month total maximum daily loads, annual load reductions for each project were compared to the 12-month total maximum daily loads. In all cases, the projects identified to meet the five-month total maximum daily loads were sufficient to meet the proposed 12-month total maximum daily loads. As projects are implemented, progress toward meeting the five-month and full-year total maximum daily loads are being tracked.

Figure 7-1 shows the distribution of funding in the original plan versus the 2019 update for each type of project that reduces incoming loading. Most of the funds dedicated to reducing incoming load are directed at projects that improve the treatment of human waste (**Figure 8-1**). These projects include several types such as greater treatment of reclaimed water, upgrade of septic systems onsite, conversion from septic to sewer when feasible, and repair of leaky sewer laterals.

Figure 8-1: Funding for Reduce Projects

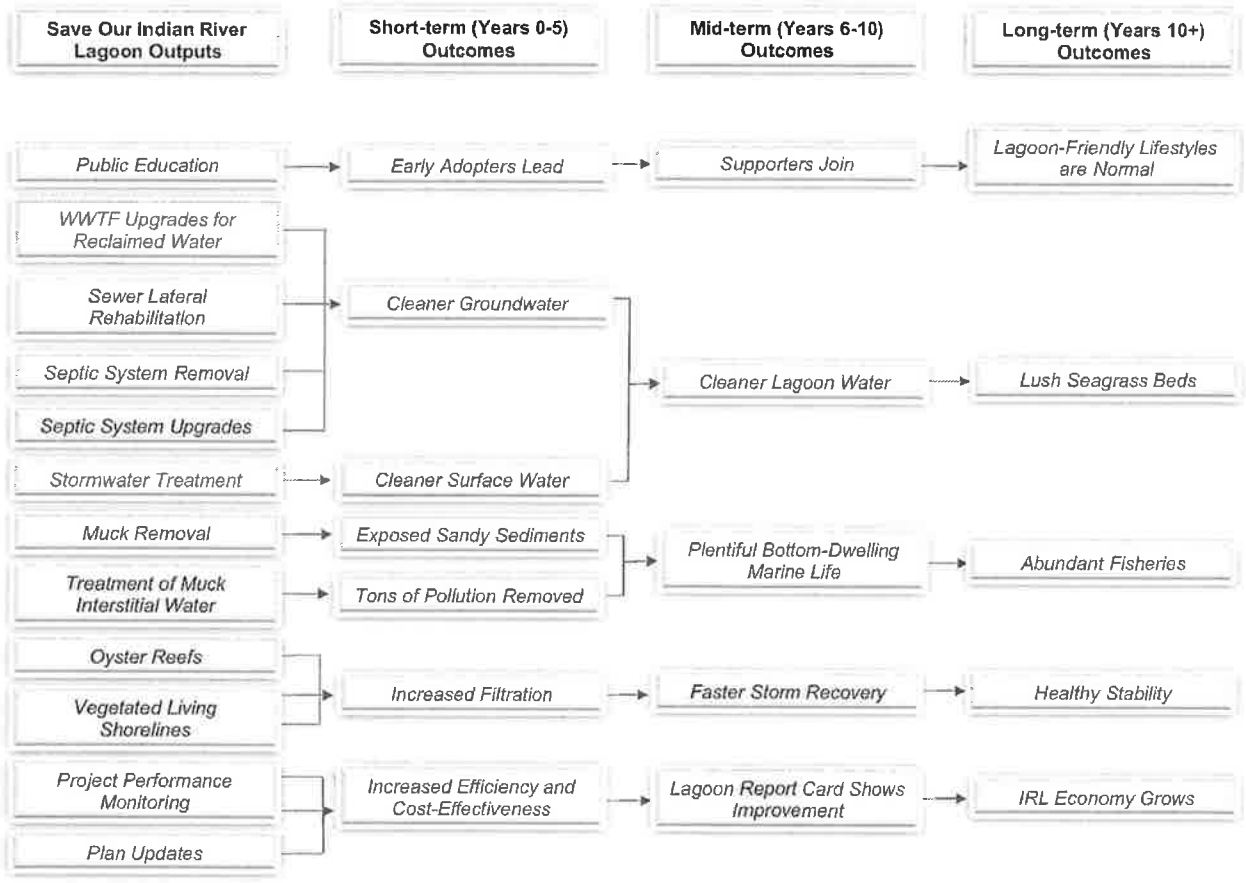


Figure 8-2. Summary of the Save Our Indian River Lagoon Outputs and Outcomes

Only the projects that reduce external loading to the lagoon, not muck removal or living shorelines, were used to meet the total maximum daily loads. Even though decades of treatment projects to reduce nutrient loads have been completed to date, only the reductions associated with basin management action plan projects that were completed between January 1, 2010 (the last year of the Spatial Watershed Iterative Loading model period) and February 29, 2016 (the end of the last basin management action plan reporting period when the Save Our Indian River Lagoon Project Plan was developed) were included in the load reduction calculations as these projects also provide nutrient load reductions that have occurred after the period of record used to develop the proposed total maximum daily load updates. In Zone A of the Central IRL, the reductions from the St. Johns River Water Management District's C-1 re-diversion project, which was implemented with cost-share funding from the Florida Department of Environmental Protection and Brevard County, were also included as this project results in significant load reductions that were not included in the February 29, 2016 basin management action plan annual progress report. As shown in **Table 8-1**, **Table 8-3**, and **Table 8-5**, the projects proposed in this plan plus the recently completed basin management action plan projects and C-1 re-diversion project exceed the five-month reductions called for by the proposed total maximum daily load updates.

The total project reductions were also compared to the full year estimated loading to the lagoon from the Spatial Watershed Iterative Loading model. As shown in **Table 8-2**, **Table 8-4**, and **Table 8-6**, the proposed projects in this plan, as well as the recently completed basin management action plan projects and C-1 re-diversion project, achieve significant reductions of the overall loading to the lagoon and exceed the full year reductions called for by the proposed total maximum daily load updates.

Table 8-1: Banana River Lagoon Project Reductions to Meet Five-Month Total Maximum Daily Load

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	2,945	603
Future Education	2,262	155
WWTF Upgrade for Reclaimed Water	6,474	455
Sewer Laterals	412	78
Rapid Infiltration Basin/Sprayfield	16,573	1,548
Septic System Removal	5,406	0
Septic System Upgrade	2,580	0
Stormwater Projects	15,675	2,408
Basin Management Action Plan Projects (2010-February 2016)	5,303	1,440
Total	***57,630***	***6,687***
Proposed Total Maximum Daily Load Reductions (five-month)	***30,337***	***2,737***
Percent of Proposed Total Maximum Daily Load Reductions Achieved	***190.0%***	***244.3%***

Table 8-2: Banana River Lagoon Project Reductions Compared to Full Year Loading

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	7,068	1,446
Future Education	5,429	372
WWTF Upgrade for Reclaimed Water	15,537	1,092
Sewer Laterals	988	188
Rapid Infiltration Basin/Sprayfield	39,776	3,715
Septic System Removal	12,975	0
Septic System Upgrade	6,192	0
Stormwater Projects	74,881	11,073
Basin Management Action Plan Projects (2010-February 2016)	12,726	3,456
Total	***175,572***	***21,342***
Starting Load (full year)	***477,020***	***44,269***
Percent of Starting Load Reduced	***36.8%***	***48.2%***
Proposed Full-Year Total Maximum Daily Load Percent Reductions	***9.0%***	***9.6%***

Table 8-3: North IRL Project Reductions to Meet Five-Month Total Maximum Daily Load

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	8,070	1,651
Future Education	6,199	424
WWTF Upgrade for Reclaimed Water	3,608	To be determined
Sewer Laterals	267	0
Rapid Infiltration Basin/Sprayfield	3,588	528
Septic System Removal	17,706	0
Septic System Upgrade	3,943	0
Stormwater Projects	47,624	7,645
Basin Management Action Plan Projects (2010-February 2016)	16,983	3,180
Total	***107,988***	***13,428***
Proposed Total Maximum Daily Load Reductions (five-month)	***61,447***	***7,410***
Percent of Proposed Total Maximum Daily Load Reductions Achieved	***175.7%***	***181.2%***

Table 8-4: North IRL Project Reductions Compared to Full Year Loading

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	19,368	3,962
Future Education	14,877	1,018
WWTF Upgrade for Reclaimed Water	8,660	To be determined
Sewer Laterals	640	0
Rapid Infiltration Basin/Sprayfield	8,610	1,266
Septic System Removal	42,495	0
Septic System Upgrade	9,463	0
Stormwater Projects	188,958	29,097
Basin Management Action Plan Projects (2010-February 2016)	40,758	7,632
Total	***333,829***	***42,975***
Starting Load (full year)	***988,847***	***99,340***
Percent of Starting Load Reduced	***33.8%***	***43.3%***
Proposed Full-Year Total Maximum Daily Load Percent Reductions	***11.4%***	***11.4%***

Table 8-5: Central IRL Project Reductions to Meet Five-Month Total Maximum Daily Load

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	8,108	1,659
Future Education	6,228	426
WWTF Upgrade for Reclaimed Water	19,111	4,072
Rapid Infiltration Basin/Sprayfield	73	33
Septic System Removal	7,635	0
Septic System Upgrade	3,997	0
Stormwater Projects	16,853	2,301
C-1 Re-Diversion	53,892	6,295
Basin Management Action Plan Projects (2010-February 2016)	378	243
Total	***116,275***	***15,029***
Proposed Total Maximum Daily Load Reductions (five-month) *	***67,547***	***8,151***
Percent of Proposed Total Maximum Daily Load Reductions Achieved	***172.1%***	***184.4%***

* The total maximum daily load reductions are for Zone A only; however, some of the septic system projects are in Zone SEB. There are sufficient projects to achieve the Zone A reductions without the Zone SEB projects (refer to **Section 2.1**).

Table 8-6: Central IRL Project Reductions Compared to Full Year Loading

Project	TN Reductions (lbs/yr)	TP Reductions (lbs/yr)
Fertilizer Ordinance Implementation	19,460	3,981
Future Education	14,947	1,023
WWTF Upgrade for Reclaimed Water	45,867	9,773
Rapid Infiltration Basin/Sprayfield	176	79
Septic System Removal	18,325	0
Septic System Upgrade	9,593	0
Stormwater Projects	51,651	7,039
C-1 Re-Diversion	129,341	15,108
Basin Management Action Plan Projects (2010-February 2016)	908	582
Total	***290,268***	***37,585***
Starting Load (full year) *	***698,937***	***95,051***
Percent of Starting Load Reduced	***41.5%***	***39.5%***
Proposed Full-Year Total Maximum Daily Load Percent Reductions	***17.8%***	***16.3%***

* The total maximum daily load reductions are for Zone A only; however, some of the septic system are in Zone SEB. There are sufficient projects to achieve the Zone A reductions without the Zone SEB projects (refer to **Section 2.1**).

In addition to the projects that address the external nutrient loading summarized above, the plan includes muck flux, interstitial water treatment, oyster bars, and planted shoreline projects that will significantly reduce internal nutrient loading within the lagoon itself. The annual reductions from these projects are summarized in **Table 8-7**, along with the percentage of nutrients from 2018 estimates of muck flux that would be reduced by these projects.

Table 8-7: Annual Muck Flux, Muck Interstitial Water, Oyster Bar, and Planted Shoreline Project Benefits Compared to Annual Nutrient Loadings from Muck Flux

Project Type	Banana River Lagoon TN (lbs/yr)	Banana River Lagoon TP (lbs/yr)	North IRL TN (lbs/yr)	North IRL TP (lbs/yr)	Central A TN (lbs/yr)	Central A TP (lbs/yr)
Muck Flux Reduction	180,322	14,479	61,833	5,297	7,071	959
Average Annual Removal of Nutrients from Interstitial Water	45,565	2,503	12,248	1,115	1,931	245
Oyster Bars	10,673	342	10,922	316	3,707	529
Planted Shorelines	104	35	417	142	281	96
Total Project Reductions	***236,664***	***17,359***	***85,420***	***6,870***	***12,990***	***1,829***
Estimated Muck Flux Loading	***494,490***	***46,520***	***377,011***	***38,142***	***45,776***	***3,141***
Percent of Muck Flux Reduced	***47.9%***	***37.3%***	***22.7%***	***18.0%***	***28.4%***	***58.2%***

8.3. Plan Summary

Table 8-8 summarizes all the project types, as well as their estimated costs, TN and TP reductions, and costs per pound of TN and TP removed. The information from this table on the project reductions and cost effectiveness was used to determine the schedule for implementing the projects (see **Table 8-9**). Projects that could achieve large reductions quickly, such as fertilizer

reductions and WWTF upgrades, as well as the most cost-effective septic to sewer, and stormwater projects were prioritized for earliest implementation. This prioritization allows for the reductions to occur as quickly as possible while best using available funding sources. Project scheduling also considered the timing of upstream reductions with downstream removals, where feasible.

The timeline in **Table 8-9** is shown in years after funding from the Save Our Indian River Lagoon sales tax became available. Each year corresponds to the County's fiscal year, which is October 1st through September 30th. Year 1 started on October 1, 2017, which was just before revenues would have begun to accrue if the funding source had been a property tax, as initially considered. When the referendum approved by the voters was a sales tax, collections began in January 2017 and the first revenue check was received by the County in March 2017. Therefore, a plan update was adopted in March 2017 to begin plan implementation in Year 0. **Table 8-9a** includes the cost estimates based on 2016 dollars, which were used to develop the plan. **Table 8-9b** includes the original cost estimates with inflation starting in Year 2 of the plan. The construction index of 3.25% was used for the inflation value.

As noted in **Section 4.4.1**, an adaptive management approach is being used in the implementation of this plan. As projects are completed and information on the actual construction costs, timeline, and reductions are obtained, the plan will continue to be adjusted, as needed, to ensure that the most cost-effective projects are being used to meet the IRL restoration goals.

Table 8-8: Summary of Projects, Estimated TN and TP Reductions, and Costs (no inflation)

Project	Estimated Total Project Cost	TN Reductions (lbs/yr)	Cost per Pound per Year of TN	TP Reductions (lbs/yr)	Cost per Pound per Year of TP
Public Education	$1,725,000	35,253	$49	2,413	$715
WWTF Upgrades for Reclaimed Water	-	-	-	-	-
Cocoa Beach Water Reclamation Facility Upgrade	$983,400	3,278	$300	1,092	$901
Cape Canaveral Air Force Station WWTF	$6,000,000	12,259	$489	To be determined	To be determined
City of Titusville Osprey WWTF	$8,000,000	8,660	$924	To be determined	To be determined
City of Palm Bay Water Reclamation Facility	$1,400,000	20,240	$69	102	$13,725
City of Melbourne Water Reclamation Facility	$7,688,100	25,627	$300	9,671	$795
Sewer Laterals	-	-	-	-	-
Satellite Beach Pilot Project	$840,000	988	$850	188	$4,468
Osprey Basin Lateral Repair Project	$200,000	640	$313	To be determined	To be determined
Rapid Infiltration Basin/Sprayfield Upgrades	-	-	-	-	-
Cape Canaveral Air Force Station Regional WWTF	$2,502,522	39,776	$63	3,715	$674
Port St John Wastewater Treatment Plant	$980,100	8,610	$114	1,266	$774
Indian River Shores Trailer Park WWTF	$38,145	176	$217	79	$483
Septic System Removal by Sewer Extension	-	-	-	-	-
Banana River Lagoon Septic System Extensions	$12,681,360	10,024	$1,265	To be determined	To be determined
North IRL Septic System Extensions	$27,118,386	31,858	$851	To be determined	To be determined
Central IRL Septic System Extensions	$14,544,495	11,800	$1,233	To be determined	To be determined
Septic System Removal by Sewer Connection	-	-	-	-	-
Banana Septic System Connections	$1,518,000	2,951	$514	To be determined	To be determined
North IRL Septic System Connections	$5,154,000	10,637	$485	To be determined	To be determined
Central IRL Septic System Connections	$2,952,000	6,525	$452	To be determined	To be determined
Septic System Upgrades	-	-	-	-	-
Banana River Lagoon Septic System Upgrades	$7,200,000	6,192	$1,163	To be determined	To be determined
North IRL Septic System Upgrades	$7,200,000	9,463	$761	To be determined	To be determined
Central IRL Septic System Upgrades	$7,301,854	9,593	$761	To be determined	To be determined
Stormwater Projects	-	-	-	-	-
Banana River Lagoon Stormwater Projects	$12,340,387	74,881	$165	11,073	$1,114
North IRL Stormwater Projects	$23,269,910	188,958	$123	29,097	$800
Central IRL Stormwater Projects	$4,435,335	51,651	$86	7,039	$630
Muck Removal	-	-	-	-	-
Banana River Lagoon Muck Removal	$122,853,169	180,322	$681	14,479	$8,485
North IRL Muck Removal	$42,575,000	61,833	$689	5,297	$8,038
Central IRL Muck Removal	$6,865,000	7,071	$971	959	$7,158

Project	Estimated Total Project Cost	TN Reductions (lbs/yr)	Cost per Pound per Year of TN	TP Reductions (lbs/yr)	Cost per Pound per Year of TP
Treatment of Interstitial Water	-	-	-	-	-
Banana River Lagoon Interstitial Water	$46,058,373	455,654	$101	25,031	$1,840
North IRL Interstitial Water	$6,123,748	122,476	$50	11,150	$549
Central IRL Interstitial Water	$965,569	19,311	$50	2,447	$395
Oyster Bars	-	-	-	-	-
Banana River Lagoon	$4,225,900	10,673	$396	342	$12,356
North IRL	$4,316,478	10,922	$395	316	$13,660
Central IRL	$1,566,345	3,707	$423	529	$2,961
Planted Shorelines	-	-	-	-	-
Banana River Lagoon	$24,894	104	$239	35	$711
North IRL	$2,960	12	$247	4	$740
Central IRL	$67,401	281	$240	96	$702
Projects Monitoring	$10,000,000	-	-	-	-
Contingency	$20,085,892	-	-	-	-
Total	***$421,803,723***	***1,442,406***	***$292 (average)***	***126,420***	***$3,337 (average)***

Table 8-9a: Timeline for Funding Needs (Table 46 in the Original Save Our Indian River Lagoon Project Plan)

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
Public Education	-	-	-	-	-	-	-	-	-	-	-
Fertilizer Management	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$625,000	-	$125,000	$50,000	$50,000	$50,000	$50,000	$100,000	$50,000	$50,000	$50,000	$50,000
Grass Clippings	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$200,000	-	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
Excess Irrigation	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$300,000	-	$75,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
Stormwater Pond Maintenance	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$300,000	-	$75,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
Septic System Maintenance	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$300,000	-	$75,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
WWTF Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Cocoa Beach	-	-	-	-	-	-	-	-
$983,400	-	-	$983,400	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	-	-	Cape Canaveral Air Force Station	-	-	-	-
$6,000,000	-	-	-	-	-	-	$6,000,000	-	-	-	-
North IRL	Titusville Osprey Design and Permitting	Titusville Osprey Design and Start Construction	Titusville Osprey Complete Construction	-	-	-	-	-	-	-	-
$8,000,000	$300,000	$1,700,000	$6,000,000	-	-	-	-	-	-	-	-
Central IRL	-	Palm Bay Permit and Engineering	Palm Bay Construction	-	-	-	-	-	-	-	-
$1,400,000	-	$200,000	$1,200,000	-	-	-	-	-	-	-	-
Central IRL	-	-	Melbourne Grant Street	-	-	-	-	-	-	-	-
$7,688,100	-	-	$7,688,100	-	-	-	-	-	-	-	-
Sewer Laterals	-	-	-	-	-	-	-	-	-	-	-
Satellite Beach Pilot	-	Satellite Beach Pilot Project	-	-	-	-	-	-	-	-	-
$840,000	-	$840,000	-	-	-	-	-	-	-	-	-
Titusville Osprey Pilot	-	-	Titusville Osprey Pilot Project	-	-	-	-	-	-	-	-
$200,000	-	-	$200,000	-	-	-	-	-	-	-	-
Rapid Infiltration Basin/ Sprayfield Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	-	-	-	Cape Canaveral Air Force Station	-	-	-
$2,502,522	-	-	-	-	-	-	-	$2,502,522	-	-	-
North IRL	-	-	-	-	Port St John	-	-	-	-	-	-
$980,100	-	-	-	-	$980,100	-	-	-	-	-	-
Central IRL	-	-	Indian River Shores Trailer Park	-	-	-	-	-	-	-	-
$38,145	-	-	$38,145	-	-	-	-	-	-	-	-
Septic Removal	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	Sykes M Engineering	-	Sykes Creek M	-	-	-	-	-	-	-	-
$1,868,832	$250,000	-	$1,618,832	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Sykes Creek N	-	-	-	-	-	-	-	-	-
$3,036,852	-	$3,036,852	-	-	-	-	-	-	-	-	-
Banana River Lagoon	Sykes T Engineering	-	-	Sykes Creek T	-	-	-	-	-	-	-
$4,939,056	$250,000	-	-	$4,689,056	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Near Gravity	Near Gravity	Near Gravity	Near Gravity	-	-	-	-	-
$1,068,000	-	-	$106,800	$320,400	$320,400	$320,400	-	-	-	-	-
Banana River Lagoon	-	-	Near Force Main	Near Force Main	Near Force Main	Near Force Main	-	-	-	-	-
$450,000	-	-	$45,000	$135,000	$135,000	$135,000	-	-	-	-	-
Banana River Lagoon	-	-	-	-	Merritt Island C	Merritt Island C	Merritt Island C	-	-	-	-
$2,836,620	-	-	-	-	$283,662	$1,276,479	$1,276,479	-	-	-	-
North IRL	South Central C Engineering	South Central C	-	-	-	-	-	-	-	-	-
$4,672,080	$450,000	$4,222,080	-	-	-	-	-	-	-	-	-

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
North IRL	Breeze Swept	-	-	-	-	-	-	-	-	-	-
$680,530	$680,530	-	-	-	-	-	-	-	-	-	-
North IRL	Merritt Island Redevelopment Agency	-	-	-	-	-	-	-	-	-	-
$320,000	$320,000	-	-	-	-	-	-	-	-	-	-
North IRL	-	-	Riverside Drive	-	-	-	-	-	-	-	-
$265,960	-	-	$265,960	-	-	-	-	-	-	-	-
North IRL	-	-	Cocoa K	-	-	-	-	-	-	-	-
$1,201,392	-	-	$1,201,392	-	-	-	-	-	-	-	-
North IRL	-	-	Roxy Avenue	-	-	-	-	-	-	-	-
$88,944	-	-	$88,944	-	-	-	-	-	-	-	-
North IRL	-	-	-	Cocoa J	-	-	-	-	-	-	-
$3,136,968	-	-	-	$3,136,968	-	-	-	-	-	-	-
North IRL	-	-	-	Rockledge	-	-	-	-	-	-	-
$500,580	-	-	-	$500,580	-	-	-	-	-	-	-
North IRL	-	-	-	Titusville A-G	-	-	-	-	-	-	-
$1,201,392	-	-	-	$1,201,392	-	-	-	-	-	-	-
North IRL	-	-	Near Gravity	Near Gravity	Near Gravity	Near Gravity	-	-	-	-	-
$3,516,000	-	-	$351,600	$1,054,800	$1,054,800	$1,054,800	-	-	-	-	-
North IRL	-	-	Near Force Main	Near Force Main	Near Force Main	Near Force Main	-	-	-	-	-
$1,638,000	-	-	$163,800	$491,400	$491,400	$491,400	-	-	-	-	-
North IRL	-	-	-	-	South Central D	-	-	-	-	-	-
$2,703,132	-	-	-	-	$2,703,132	-	-	-	-	-	-
North IRL	-	-	-	-	-	South Central A	-	-	-	-	-
$3,370,572	-	-	-	-	-	$3,370,572	-	-	-	-	-
North IRL	-	-	-	-	-	-	South Central F	-	-	-	-
$1,701,972	-	-	-	-	-	-	$1,701,972	-	-	-	-
North IRL	-	-	-	-	-	-	-	Melbourne	-	-	-
$867,672	-	-	-	-	-	-	-	$867,672	-	-	-
North IRL	-	-	-	-	-	-	-	-	Sharpes A	-	-
$6,207,192	-	-	-	-	-	-	-	-	$6,207,192	-	-
Central IRL	Micco	-	-	-	-	-	-	-	-	-	-
$1,977,345	$1,977,345	-	-	-	-	-	-	-	-	-	-
Central IRL	Hoag	-	-	-	-	-	-	-	-	-	-
$86,031	$86,031	-	-	-	-	-	-	-	-	-	-
Central IRL	Penwood	-	-	-	-	-	-	-	-	-	-
$40,632	$40,632	-	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	-	Palm Bay B	-	-	-	-	-	-
$8,309,628	-	-	-	-	$8,309,628	-	-	-	-	-	-
Central IRL	-	-	Near Gravity	Near Gravity	Near Gravity	Near Gravity	-	-	-	-	-
$2,520,000	-	-	$252,000	$756,000	$756,000	$756,000	-	-	-	-	-
Central IRL	-	Sylvan Estates	-	-	-	-	-	-	-	-	-
$1,561,215	-	$1,561,215	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	-	Palm Bay A	-	-	-	-	-	-
$2,569,644	-	-	-	-	$2,569,644	-	-	-	-	-	-
Central IRL	-	-	Near Force Main	Near Force Main	Near Force Main	Near Force Main	-	-	-	-	-
$432,000	-	-	$43,200	$129,600	$129,600	$129,600	-	-	-	-	-
Septic Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-		45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	40 Upgrades
$7,200,000	-		$810,000	$810,000	$810,000	$810,000	$810,000	$810,000	$810,000	$810,000	$720,000
North IRL	-		45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	40 Upgrades
$7,200,000	-		$810,000	$810,000	$810,000	$810,000	$810,000	$810,000	$810,000	$810,000	$720,000
Central IRL	Long Point	-	-	-	-	-	-	-	-	-	-
$101,854	$101,854	-	-	-	-	-	-	-	-	-	-
Central IRL	-		45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	40 Upgrades
$7,200,000	-		$810,000	$810,000	$810,000	$810,000	$810,000	$810,000	$810,000	$810,000	$720,000
Stormwater Projects	-	-	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	Cocoa Palms	Cape Shores Swales	-	-	-	-	-	-	-	-	-
$3,890	$1,144	$2,746	-	-	-	-	-	-	-	-	-

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
Banana - Cape Canaveral	Carver Cove Swale	Justamere Road Swale	-	-	-	-	-	-	-	-	-
$3,344	$2,816	$528	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	Central Boulevard Baffle Box	Hitching Post Berms	-	-	-	-	-	-	-	-	-
$37,252	$34,700	$2,552	-	-	-	-	-	-	-	-	-
Banana - Indian Harbour Beach	Gleason Park Reuse	Big Muddy at Cynthia Baffle Box	Big Muddy Expansion	-	-	-	-	-	-	-	-
$71,756	$4,224	$41,695	$25,837	-	-	-	-	-	-	-	-
Banana - Cocoa Beach	-	-	Convair Cove 1 – Blakey Blvd	-	-	-	-	-	-	-	-
$4,650	-	-	$4,650	-	-	-	-	-	-	-	-
Banana - Cocoa Beach	-	-	Convair Cove 2- Dempsey Drive	-	-	-	-	-	-	-	-
$4,495	-	-	$4,495	-	-	-	-	-	-	-	-
Banana - Brevard	-	-	Basin 1304 Bioreactor	15 Projects	15 Projects	15 Projects	15 Projects	15 Projects	15 Projects	15 Projects	14 Projects
$12,215,000	-	-	$90,000	$1,725,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,400,000
North IRL - Cocoa	Church Street Type II Baffle Box	-	-	-	-	-	-	-	-	-	-
$88,045	$88,045	-	-	-	-	-	-	-	-	-	-
North IRL - Titusville	-	St Teresa Basin Treatment	Titusville High School Baffle Box	-	-	-	-	-	-	-	-
$384,613	-	$272,800	$111,813	-	-	-	-	-	-	-	-
North IRL - Titusville	-	South Street Basin Treatment	Coleman Pond Managed Aquatic Plant System	-	-	-	-	-	-	-	-
$121,856	-	$86,856	$35,000	-	-	-	-	-	-	-	-
North IRL - Titusville	-	La Paloma Basin Treatment	-	-	-	-	-	-	-	-	-
$208,296	-	$208,296	-	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Cliff Creek Baffle Box	Apollo/GA Baffle Box	-	-	-	-	-	-	-	-
$645,303	-	$347,781	$297,522	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Thrush Drive Baffle Box	Cherry Street Baffle Box	-	-	-	-	-	-	-	-
$414,320	-	$322,200	$92,120	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Stewart Road Dry Retrofit	Spring Creek Baffle Box	-	-	-	-	-	-	-	-
$117,702	-	$18,344	$99,358	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Kingsmill-Aurora Phase Two	Basin 1298 Bioreactor	-	-	-	-	-	-	-	-
$453,686	-	$367,488	$86,198	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Huntington Pond	Johns Road Pond	-	-	-	-	-	-	-	-
$127,750	-	$104,720	$23,030	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Flounder Creek Pond	Burkholm Road	-	-	-	-	-	-	-	-
$139,718	-	$75,328	$64,390	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Johns Road Pond	Carter Road	-	-	-	-	-	-	-	-
$168,022	-	$105,512	$62,510	-	-	-	-	-	-	-	-
North IRL - Brevard	-	-	Wiley Road	-	-	-	-	-	-	-	-
$82,735	-	-	$82,735	-	-	-	-	-	-	-	-
North IRL - Brevard	-	-	Broadway Pond	24 Projects	24 Projects	24 Projects	24 Projects	24 Projects	24 Projects	24 Projects	25 Projects
$20,317,664	-	-	$42,664	$3,375,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$2,500,000
Central IRL - Palm Bay	Bayfront Stormwater Project	-	-	-	-	-	-	-	-	-	-
$30,624	$30,624	-	-	-	-	-	-	-	-	-	-
Central IRL - Melbourne	-	-	Grant Place Baffle Box	-	-	-	-	-	-	-	-
$82,481	-	-	$82,481	-	-	-	-	-	-	-	-
Central IRL - Melbourne	-	-	Espanola Baffle Box								
$105,186	-	-	$105,186								

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
Central - St. Johns River Water Management District	-	-	Crane Creek/M-1 Canal Flow Restoration	-	-	-	-	-	-	-	-
$2,033,944	-	-	$2,033,944	-	-	-	-	-	-	-	-
Central IRL - Brevard	-	-	M1 Canal								
$66,300	-	-	$66,300								
Central IRL - Brevard	-	-	Fleming Grant	2 Projects	2 Projects	2 Projects	2 Projects	2 Projects	-	-	-
$2,116,800	-	-	$16,800	$500,000	$400,000	$400,000	$400,000	$400,000	-	-	-
Muck Removal & Interstitial Treatment	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Cocoa Beach Phase III	Cocoa Beach Ph II-B	-	-	-	-	-	-	-
$9,795,615	-	-	$3,877,965	$5,917,650	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Merritt Island Canals								
$7,656,495	-	-	$7,656,495								
Banana River Lagoon	-	-	Indian Harbour Beach								
$9,063,260	-	-	$9,063,260								
Banana River Lagoon	-	71% Sykes Creek	29% Sykes Creek	-	-	-	-	-	-	-	-
$15,954,132	-	$10,000,000	$5,954,132	-	-	-	-	-	-	-	-
Banana River Lagoon	-	55% Grand Canal	20% Grand Canal	25% Grand Canal	-	-	-	-	-	-	-
$18,020,368	-	$10,000,000	$3,020,368	$5,000,000	-	-	-	-	-	-	-
Banana River Lagoon	-	-		-	-	-	-	25% Cocoa Beach Golf	25% Cocoa Beach Golf	25% Cocoa Beach Golf	25% Cocoa Beach Golf
$39,079,000	-	-	-	-	-	-	-	$9,769,975	$9,769,975	$9,769,975	$9,769,975
Banana River Lagoon	-	-	-	-	-	-	25% Port Canaveral South	50% Port Canaveral South	25% Port Canaveral South	-	-
$16,834,419	-	-	-	-	-	-	$4,208,605	$8,417,209	$4,208,605	-	-
Banana River Lagoon	-	-	-	-	Kent Drive	-	-		-	-	-
$1,603,278	-	-	-	-	$1,603,278	-	-		-	-	-
Banana River Lagoon	-	-	-	-	-	528 East					-
$1,402,868	-	-	-	-	-	$1,402,868					-
Banana River Lagoon	-	-	-	-	-	Patrick Air Force Base Borrow Pit-4	-	-	-	-	-
$400,819	-	-	-	-	-	$400,819	-	-	-	-	-
Banana River Lagoon		-	-	-	-	50% Patrick Air Force Base	50% Patrick Air Force Base	-	-	-	-
$8,216,800		-	-	-	-	$4,108,400	$4,108,400	-	-	-	-
Banana River Lagoon		-	-	-	-	-	50% Pineda	50% Pineda	-	-	-
$7,815,980		-	-	-	-	-	$3,907,990	$3,907,990	-	-	-
Banana River Lagoon		-	-	7.5% Canals	-	-	7.5% Canals			7.5% Canals	7.5% Canals
$33,067,608		-	-	$8,266,902	-	-	$8,266,902			$8,266,902	$8,266,902
North IRL	Mims Outflow	-	-	-	-	-	-	-	-	-	-
$400,000	$400,000	-	-	-	-	-	-	-	-	-	-
North IRL	-	-	2% Eau Gallie Northwest	49% Eau Gallie Northwest	49% Eau Gallie Northwest	-	-	-	-	-	-
$10,020,488	-	-	$200,410	$4,910,039	$4,910,039	-	-	-	-	-	-
North IRL	-	1% Titusville East	4% Titusville East	25% Titusville East	30% Titusville East	40% Titusville East	-	-	-	-	-
$4,609,424	-	$46,094	$184,377	$1,152,356	$1,382,827	$1,843,770	-	-	-	-	-
North IRL	-	1% Titusville West	4% Titusville West	25% Titusville West	30% Titusville West	40% Titusville West	-	-	-	-	-
$3,607,375	-	$36,074	$144,295	$901,844	$1,082,212	$1,442,950	-	-	-	-	-
North IRL	-	1% National Aeronautics and Space Administration West	4% National Aeronautics and Space Administration West	25% National Aeronautics and Space Administration West	30% National Aeronautics and Space Administration West	40% National Aeronautics and Space Administration West	-	-	-	-	-
$5,010,244	-	$50,102	$200,410	$1,252,561	$1,503,073	$2,004,098	-	-	-	-	-
North IRL	-	1% National Aeronautics and Space Administration East	4% National Aeronautics and Space Administration East	25% National Aeronautics and Space Administration East	30% National Aeronautics and Space Administration East	40% National Aeronautics and Space Administration East	-	-	-	-	-
$11,423,355	-	$114,234	$456,934	$2,855,839	$3,427,006	$4,569,342	-	-	-	-	-
North IRL	-	-	-	-	50% Rockledge B	50% Rockledge B	-	-	-	-	-
$5,010,244	-	-	-	-	$2,505,122	$2,505,122	-	-	-	-	-

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
North IRL	-	-	-	2% Pineda	49% Pineda	49% Pineda	-	-	-	-	-
$6,012,292	-	-	-	$120,246	$2,946,023	$2,946,023	-	-	-	-	-
North IRL	-	-	-	-	-	15% Canals	-	-	15% Canals	-	-
$2,605,327	-	-	-	-		$1,302,664	-	-	$1,302,663	-	-
Central IRL	-	Turkey Creek	-	-	-	-	-	-	-	-	-
$215,000	-	$215,000	-	-	-	-	-	-	-	-	-
Central IRL	-	-	10% Mullet Creek Area	50% Mullet Creek Area	40% Mullet Creek Area	-	-	-	-	-	-
$5,210,653	-	-	$521,065	$2,605,327	$2,084,261	-	-	-	-	-	-
Central IRL	-	-	-	-	-	-	-	-	Goat Creek Area	-	-
$400,819	-	-	-	-	-	-	-	-	$400,819	-	-
Central IRL	-	-	-	-	-	-	-	-	15% Canals		15% Canals
$2,004,097	-	-	-	-	-	-	-	-	$1,002,049		$1,002,048
Oyster Bars	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Eden Isles	-	-	-	-	-	-	-	-	-
$21,805	-	$21,805	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Marina Isles	-	-	-	-	-	-	-	-	-
$26,700	-	$26,700	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Bettinger	-	-	-	-	-	-	-	-	-
$10,680	-	$10,680	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	McNabb	-	-	-	-	-	-	-	-	-
$34,056	-	$34,056	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Gitlin	-	-	-	-	-	-	-	-	-
$16,020	-	$16,020	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Brevard	-	-	-	-	-	-	-	-	-
$47,350	-	$47,350	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Brevard Zoo Banana River	-	-	-	-	-	-	-	-
$583,020	-	-	$583,020								
Banana River Lagoon	-	-	-	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,606 square feet Oysters
$3,486,269	-	-	-	$435,795	$435,795	$435,795	$435,795	$435,795	$435,795	$435,795	$435,704
North IRL	-	Bomalaski	-	-	-	-	-	-	-	-	-
$8,900	-	$8,900	-	-	-	-	-	-	-	-	-
North IRL	-	Oliver	-	-	-	-	-	-	-	-	-
$51,620	-	$51,620	-	-	-	-	-	-	-	-	-
North IRL	-	Indian River Drive	-	-	-	-	-	-	-	-	-
$13,258	-	$13,258	-	-	-	-	-	-	-	-	-
North IRL	-	-	Brevard Zoo North IRL	-	-	-	-	-	-	-	-
$341,280	-	-	$341,280	-	-	-	-	-	-	-	-
North IRL	-	-	-	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,894 square feet Oysters
$3,901,420	-	-	-	$487,678	$487,678	$487,678	$487,678	$487,678	$487,678	$487,678	$487,674
Central IRL	-	Coconut Point	-	-	-	-	-	-	-	-	-
$509,950	-	$509,950	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Park	-	-	-	-	-	-	-	-	-
$108,790	-	$108,790	-	-	-	-	-	-	-	-	-
Central IRL	-	Wexford	-	-	-	-	-	-	-	-	-
$31,150	-	$31,150	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Senior Resort	-	-	-	-	-	-	-	-	-
$30,304	-	$30,304	-	-	-	-	-	-	-	-	-
Central IRL	-	Turkey Creek	-	-	-	-	-	-	-	-	-
$122,055	-	$122,055	-	-	-	-	-	-	-	-	-
Central IRL	-	-	Brevard Zoo Central IRL	-	-	-	-	-	-	-	-
$161,160	-	-	$161,160	-	-	-	-	-	-	-	-
Central IRL	-	-	-	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,770 square feet Oysters
$602,936	-	-	-	$75,367	$75,367	$75,367	$75,367	$75,367	$75,367	$75,367	$75,367

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
Planted Shorelines	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Cocoa Beach	-	-	-	-	-	-	-	-	-
$16,014	-	$16,014	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	McNabb	-	-	-	-	-	-	-	-	-
$5,760	-	$5,760	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Brevard Zoo Banana River	-	-	-	-	-	-	-	-
$3,120	-	-	$3,120	-	-	-	-	-	-	-	-
North IRL	-	Indian River Drive	-	-	-	-	-	-	-	-	-
$2,240	-	$2,240	-	-	-	-	-	-	-	-	-
North IRL	-	-	Brevard Zoo North IRL	-	-	-	-	-	-	-	-
$720	-	-	$720	-	-	-	-	-	-	-	-
Central IRL	-	Lagoon House	-	-	-	-	-	-	-	-	-
$23,961	-	$23,961	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Park	-	-	-	-	-	-	-	-	-
$18,480	-	$18,480	-	-	-	-	-	-	-	-	-
Central IRL	-	Turkey Creek	-	-	-	-	-	-	-	-	-
$24,960	-	$24,960	-	-	-	-	-	-	-	-	-
Project Monitoring	-	Year 1 Monitoring	Year 2 Monitoring	Year 3 Monitoring	Year 4 Monitoring	Year 5 Monitoring	Year 6 Monitoring	Year 7 Monitoring	Year 8 Monitoring	Year 9 Monitoring	Year 10 Monitoring
$10,000,000	-	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
Contingency	Year 0 Contingency	Year 1 Contingency	Year 2 Contingency	Year 3 Contingency	Year 4 Contingency	Year 5 Contingency	Year 6 Contingency	Year 7 Contingency	Year 8 Contingency	Year 9 Contingency	Year 10 Contingency
$20,085,891	$260,897	$1,823,626	$2,980,921	$2,778,590	$2,402,552	$1,945,707	$1,919,709	$1,716,960	$1,568,257	$1,325,538	$1,362,134
$421,803,723 (total)	***$5,478,842***	***$38,296,178***	***$62,599,338***	***$58,350,390***	***$50,453,599***	***$40,880,854***	***$40,313,897***	***$36,056,168***	***$32,933,400***	***$27,830,253***	***$28,604,804***

Table 8-9b: Timeline for Funding Needs (Table 46 in the Original Save Our Indian River Lagoon Project Plan) with inflation

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
Public Education	-	-	-	-	-	-	-	-	-	-	-
Fertilizer Management	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$713,508	-	$125,000	$51,625	$53,303	$55,035	$56,824	$117,341	$60,577	$62,546	$64,579	$66,678
Grass Clippings	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$231,935	-	$20,000	$20,650	$21,321	$22,014	$22,730	$23,468	$24,231	$25,018	$25,832	$26,671
Excess Irrigation	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$339,919	-	$75,000	$25,813	$26,651	$27,516	$28,412	$29,335	$30,289	$31,273	$32,289	$33,339
Stormwater Pond Maintenance	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$339,919	-	$75,000	$25,813	$26,651	$27,516	$28,412	$29,335	$30,289	$31,273	$32,289	$33,339
Septic System Maintenance	-	Year 1 of Program	Year 2 of Program	Year 3 of Program	Year 4 of Program	Year 5 of Program	Year 6 of Program	Year 7 of Program	Year 8 of Program	Year 9 of Program	Year 10 of Program
$339,919	-	$75,000	$25,813	$26,651	$27,516	$28,412	$29,335	$30,289	$31,273	$32,289	$33,339
WWTF Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Cocoa Beach	-	-	-	-	-	-	-	-
$1,015,361	-	-	$1,015,361	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	-	-	Cape Canaveral Air Force Station	-	-	-	-
$7,040,468	-	-	-	-	-	-	$7,040,468	-	-	-	-
North IRL	Titusville Osprey Design and Permitting	Titusville Osprey Design and Start Construction	Titusville Osprey Complete Construction	-	-	-	-	-	-	-	-
$8,195,000	$300,000	$1,700,000	$6,195,000	-	-	-	-	-	-	-	-
Central IRL	-	Palm Bay Permit and Engineering	Palm Bay Construction	-	-	-	-	-	-	-	-
$1,439,000	-	$200,000	$1,239,000	-	-	-	-	-	-	-	-
Central IRL	-	-	Melbourne Grant Street	-	-	-	-	-	-	-	-
$7,937,963	-	-	$7,937,963	-	-	-	-	-	-	-	-
Sewer Laterals	-	-	-	-	-	-	-	-	-	-	-
Satellite Beach Pilot	-	Satellite Beach Pilot Project	-	-	-	-	-	-	-	-	-
$840,000	-	$840,000	-	-	-	-	-	-	-	-	-
Titusville Osprey Pilot	-	-	Titusville Osprey Pilot Project	-	-	-	-	-	-	-	-
$206,500	-	-	$206,500	-	-	-	-	-	-	-	-
Rapid Infiltration Basin/ Sprayfield Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	-	-	-	-	-	Cape Canaveral Air Force Station	-	-	-
$3,031,924	-	-	-	-	-	-	-	$3,031,924	-	-	-
North IRL	-	-	-	-	Port St John	-	-	-	-	-	-
$1,078,799	-	-	-	-	$1,078,799	-	-	-	-	-	-
Central IRL	-	-	Indian River Shores Trailer Park	-	-	-	-	-	-	-	-
$39,385	-	-	$39,385	-	-	-	-	-	-	-	-
Septic Removal	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	Sykes M Engineering	-	Sykes Creek M	-	-	-	-	-	-	-	-
$1,921,444	$250,000	-	$1,671,444	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Sykes Creek N	-	-	-	-	-	-	-	-	-
$3,036,852	-	$3,036,852	-	-	-	-	-	-	-	-	-
Banana River Lagoon	Sykes T Engineering	-	-	Sykes Creek T	-	-	-	-	-	-	-
$5,248,797	$250,000	-	-	$4,998,797	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Near Gravity	Near Gravity	Near Gravity	Near Gravity	-	-	-	-	-
$1,168,628	-	-	$110,271	$341,504	$352,665	$364,127	-	-	-	-	-
Banana River Lagoon	-	-	Near Force Main	Near Force Main	Near Force Main	Near Force Main	-	-	-	-	-
$492,309	-	-	$46,463	$143,918	$148,595	$153,424	-	-	-	-	-
Banana River Lagoon	-	-	-	-	Merritt Island C	Merritt Island C	Merritt Island C	-	-	-	-
$3,260,750	-	-	-	-	$312,226	$1,450,688	$1,497,835	-	-	-	-

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
North IRL	South Central C Engineering	South Central C	-	-	-	-	-	-	-	-	-
$4,672,080	$450,000	$4,222,080	-	-	-	-	-	-	-	-	-
North IRL	Breeze Swept	-	-	-	-	-	-	-	-	-	-
$880,530	$880,530	-	-	-	-	-	-	-	-	-	-
North IRL	Merrill Island Redevelopment Agency	-	-	-	-	-	-	-	-	-	-
$320,000	$320,000	-	-	-	-	-	-	-	-	-	-
North IRL	-	-	Riverside Drive	-	-	-	-	-	-	-	-
$274,604	-	-	$274,604	-	-	-	-	-	-	-	-
North IRL	-	-	Cocoa K	-	-	-	-	-	-	-	-
$1,240,437	-	-	$1,240,437	-	-	-	-	-	-	-	-
North IRL	-	-	Roxy Avenue	-	-	-	-	-	-	-	-
$91,835	-	-	$91,835	-	-	-	-	-	-	-	-
North IRL	-	-	-	Cocoa J	-	-	-	-	-	-	-
$3,344,184	-	-	-	$3,344,184	-	-	-	-	-	-	-
North IRL	-	-	-	Rockledge	-	-	-	-	-	-	-
$533,646	-	-	-	$533,646	-	-	-	-	-	-	-
North IRL	-	-	-	Titusville A-G	-	-	-	-	-	-	-
$1,280,751	-	-	-	$1,280,751	-	-	-	-	-	-	-
North IRL	-	-	Near Gravity	Near Gravity	Near Gravity	Near Gravity	-	-	-	-	-
$3,847,280	-	-	$363,027	$1,124,476	$1,161,022	$1,196,755	-	-	-	-	-
North IRL	-	-	Near Force Main	Near Force Main	Near Force Main	Near Force Main	-	-	-	-	-
$1,792,333	-	-	$169,124	$523,860	$540,885	$558,464	-	-	-	-	-
North IRL	-	-	-	-	South Central D	-	-	-	-	-	-
$2,975,346	-	-	-	-	$2,975,346	-	-	-	-	-	-
North IRL	-	-	-	-	-	South Central A	-	-	-	-	-
$3,830,574	-	-	-	-	-	$3,830,574	-	-	-	-	-
North IRL	-	-	-	-	-	-	South Central F	-	-	-	-
$1,997,113	-	-	-	-	-	-	$1,997,113	-	-	-	-
North IRL	-	-	-	-	-	-	-	Melbourne	-	-	-
$1,051,226	-	-	-	-	-	-	-	$1,051,226	-	-	-
North IRL	-	-	-	-	-	-	-	-	Sharpes A	-	-
$7,764,716	-	-	-	-	-	-	-	-	$7,764,716	-	-
Central IRL	Micco	-	-	-	-	-	-	-	-	-	-
$1,977,345	$1,977,345	-	-	-	-	-	-	-	-	-	-
Central IRL	Hoag	-	-	-	-	-	-	-	-	-	-
$86,031	$86,031	-	-	-	-	-	-	-	-	-	-
Central IRL	Penwood	-	-	-	-	-	-	-	-	-	-
$40,632	$40,632	-	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	-	Palm Bay B	-	-	-	-	-	-
$9,146,433	-	-	-	-	$9,146,433	-	-	-	-	-	-
Central IRL	-	-	Near Gravity	Near Gravity	Near Gravity	Near Gravity	-	-	-	-	-
$2,757,436	-	-	$260,190	$805,939	$832,132	$859,176	-	-	-	-	-
Central IRL	-	Sylvan Estates	-	-	-	-	-	-	-	-	-
$1,561,215	-	$1,561,215	-	-	-	-	-	-	-	-	-
Central IRL	-	-	-	-	Palm Bay A	-	-	-	-	-	-
$2,828,415	-	-	-	-	$2,828,415	-	-	-	-	-	-
Central IRL	-	-	Near Force Main	Near Force Main	Near Force Main	Near Force Main	-	-	-	-	-
$472,703	-	-	$44,604	$138,161	$142,651	$147,287	-	-	-	-	-
Septic Upgrades	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-		45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	40 Upgrades
$8,463,346	-		$836,325	$863,506	$891,569	$920,546	$950,463	$981,353	$1,013,247	$1,046,178	$960,159
North IRL	-		45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	40 Upgrades
$8,463,346	-		$836,325	$863,506	$891,569	$920,546	$950,463	$981,353	$1,013,247	$1,046,178	$960,159
Central IRL	Long Point	-	-	-	-	-	-	-	-	-	-
$101,854	$101,854	-	-	-	-	-	-	-	-	-	-
Central IRL	-		45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	45 Upgrades	40 Upgrades
$8,463,346	-		$836,325	$863,506	$891,569	$920,546	$950,463	$981,353	$1,013,247	$1,046,178	$960,159

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
Stormwater Projects	-	-	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	Cocoa Palms	Cape Shores Swales	-	-	-	-	-	-	-	-	-
$3,890	$1,144	$2,746	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	Carver Cove Swale	Justamere Road Swale	-	-	-	-	-	-	-	-	-
$3,344	$2,816	$528	-	-	-	-	-	-	-	-	-
Banana - Cape Canaveral	Central Boulevard Baffle Box	Hitching Post Berms	-	-	-	-	-	-	-	-	-
$37,252	$34,700	$2,552	-	-	-	-	-	-	-	-	-
Banana - Indian Harbour Beach	Gleason Park Reuse	Big Muddy at Cynthia Baffle Box	Big Muddy Expansion	-	-	-	-	-	-	-	-
$72,506	$4,224	$41,605	$26,677	-	-	-	-	-	-	-	-
Banana - Cocoa Beach	-	-	Convair Cove 1 – Blakey Blvd	-	-	-	-	-	-	-	-
$4,801	-	-	$4,801	-	-	-	-	-	-	-	-
Banana - Cocoa Beach	-	-	Convair Cove 2- Dempsey Drive	-	-	-	-	-	-	-	-
$4,641	-	-	$4,641	-	-	-	-	-	-	-	-
Banana - Brevard	-	-	Basin 1304 Bioreactor	15 Projects	15 Projects	15 Projects	15 Projects	15 Projects	15 Projects	15 Projects	14 Projects
$14,545,604	-	-	$92,925	$1,836,947	$1,651,055	$1,704,714	$1,760,117	$1,817,921	$1,876,384	$1,937,366	$1,868,975
North IRL - Cocoa	Church Street Type II Baffle Box	-	-	-	-	-	-	-	-	-	-
$88,045	$88,045	-	-	-	-	-	-	-	-	-	-
North IRL - Titusville	-	SL Teresa Basin Treatment	Titusville High School Baffle Box	-	-	-	-	-	-	-	-
$388,247	-	$272,800	$115,447	-	-	-	-	-	-	-	-
North IRL - Titusville	-	South Street Basin Treatment	Coleman Pond Managed Aquatic Plant System	-	-	-	-	-	-	-	-
$122,994	-	$86,856	$36,138	-	-	-	-	-	-	-	-
North IRL - Titusville	-	La Paloma Basin Treatment	-	-	-	-	-	-	-	-	-
$208,296	-	$208,296	-	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Cliff Creek Baffle Box	Apollo/GA Baffle Box	-	-	-	-	-	-	-	-
$654,972	-	$347,781	$307,191	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Thrush Drive Baffle Box	Cherry Street Baffle Box	-	-	-	-	-	-	-	-
$417,314	-	$322,200	$95,114	-	-	-	-	-	-	-	-
North IRL - Melbourne	-	Stewart Road Dry Retrofit	Spring Creek Baffle Box	-	-	-	-	-	-	-	-
$120,931	-	$18,344	$102,587	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Kingsmill-Aurora Phase Two	Basin 1298 Bioreactor	-	-	-	-	-	-	-	-
$456,487	-	$367,488	$88,999	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Huntington Pond	Johns Road Pond	-	-	-	-	-	-	-	-
$128,496	-	$104,720	$23,776	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Flounder Creek Pond	Burkholm Road	-	-	-	-	-	-	-	-
$141,811	-	$75,328	$66,483	-	-	-	-	-	-	-	-
North IRL - Brevard	-	Denitrification Retrofit of Johns Road Pond	Carter Road	-	-	-	-	-	-	-	-
$170,054	-	$105,512	$64,542	-	-	-	-	-	-	-	-
North IRL - Brevard	-	-	Wiley Road	-	-	-	-	-	-	-	-
$85,424	-	-	$85,424	-	-	-	-	-	-	-	-
North IRL - Brevard	-	-	Broadway Pond	24 Projects	24 Projects	24 Projects	24 Projects	24 Projects	24 Projects	24 Projects	25 Projects
$24,171,212	-	-	$44,257	$3,597,940	$2,641,687	$2,727,542	$2,816,107	$2,907,713	$3,002,214	$3,099,786	$3,333,885

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
Central IRL - Palm Bay	Bayfront Stormwater Project	-	-	-	-	-	-	-	-	-	-
$30,624	$30,624	-	-	-	-	-	-	-	-	-	-
Central IRL - Melbourne	-	-	Grant Place Baffle Box	-	-	-	-	-	-	-	-
$85,182	-	-	$85,182	-	-	-	-	-	-	-	-
Central IRL - Melbourne	-	-	Espanola Baffle Box								
$108,605	-	-	$108,605								
Central - St. Johns River Water Management District	-	-	Crane Creek/M-1 Canal Flow Restoration	-	-	-	-	-	-	-	-
$2,100,047	-	-	$2,100,047	-	-	-	-	-	-	-	-
Central IRL - Brevard	-	-	M1 Canal								
$68,455	-	-	$68,455								
Central IRL - Brevard	-	-	Fleming Grant	2 Projects	2 Projects	2 Projects	2 Projects	2 Projects	-	-	-
$2,399,229	-	-	$17,346	$533,028	$440,281	$454,590	$469,365	$484,619	-	-	-
Muck Removal & Interstitial Treatment	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Cocoa Beach Phase III	Cocoa Beach Ph II-B	-	-	-	-	-	-	-
$10,312,547	-	-	$4,003,999	$6,308,548	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Merritt Island Canals								
$7,905,331	-	-	$7,905,331								
Banana River Lagoon	-	-	Indian Harbour Beach								
$9,357,816	-	-	$9,357,816								
Banana River Lagoon	-	71% Sykes Creek	29% Sykes Creek	-	-	-	-	-	-	-	-
$16,147,641	-	$10,000,000	$6,147,641	-	-	-	-	-	-	-	-
Banana River Lagoon	-	55% Grand Canal	20% Grand Canal	25% Grand Canal	-	-	-	-	-	-	-
$18,448,811	-	$10,000,000	$3,118,530	$5,330,281	-	-	-	-	-	-	-
Banana River Lagoon	-	-		-	-	-	-	25% Cocoa Beach Golf	25% Cocoa Beach Golf	25% Cocoa Beach Golf	25% Cocoa Beach Golf
$49,705,736	-	-	-	-	-	-	-	$11,836,787	$12,221,482	$12,618,680	$13,028,787
Banana River Lagoon	-	-	-	-	-	-	25% Port Canaveral South	50% Port Canaveral South	25% Port Canaveral South	-	-
$20,400,911	-	-	-	-	-	-	$4,938,425	$10,197,847	$5,264,639	-	-
Banana River Lagoon	-	-	-	-	Kent Drive	-	-	-	-	-	-
$1,764,733	-	-	-	-	$1,764,733	-	-		-	-	-
Banana River Lagoon	-	-	-	-	-	528 East					-
$1,594,326	-	-	-	-	-	$1,594,326					-
Banana River Lagoon	-	-	-	-	-	Patrick Air Force Base Borrow Pit-4	-	-	-	-	-
$455,521	-	-	-	-	-	$455,521	-	-	-	-	-
Banana River Lagoon		-	-	-	-	50% Patrick Air Force Base	50% Patrick Air Force Base	-	-	-	-
$9,489,941		-	-	-	-	$4,669,098	$4,820,843	-	-	-	-
Banana River Lagoon		-	-	-	-	-	50% Pineda	50% Pineda	-	-	-
$9,320,395		-	-	-	-	-	$4,585,680	$4,734,715	-	-	-
Banana River Lagoon		-	-	7.5% Canals	-	-	7.5% Canals			7.5% Canals	7.5% Canals
$40,215,163		-	-	$8,812,983	-	-	$9,700,477			$10,677,345	$11,024,359
North IRL	Mims Outflow	-	-	-	-	-	-	-	-	-	-
$400,000	$400,000	-	-	-	-	-	-	-	-	-	-
North IRL	-	-	2% Eau Gallie Northwest	49% Eau Gallie Northwest	49% Eau Gallie Northwest	-	-	-	-	-	-
$10,845,706	-	-	$206,923	$5,234,376	$5,404,495	-	-	-	-	-	-
North IRL	-	1% Titusville East	4% Titusville East	25% Titusville East	30% Titusville East	40% Titusville East	-	-	-	-	-
$5,082,422	-	$46,094	$190,369	$1,228,476	$1,522,082	$2,095,400	-	-	-	-	-
North IRL	-	1% Titusville West	4% Titusville West	25% Titusville West	30% Titusville West	40% Titusville West	-	-	-	-	-
$3,977,547	-	$36,074	$148,985	$961,416	$1,191,194	$1,639,878	-	-	-	-	-

Project Name/Total Project Cost	Year 0 (Fiscal Year 2016-2017)	Year 1 (Fiscal Year 2017-2018)	Year 2 (Fiscal Year 2018-2019)	Year 3 (Fiscal Year 2019-2020)	Year 4 (Fiscal Year 2020-2021)	Year 5 (Fiscal Year 2021-2022)	Year 6 (Fiscal Year 2022-2023)	Year 7 (Fiscal Year 2023-2024)	Year 8 (Fiscal Year 2024-2025)	Year 9 (Fiscal Year 2025-2026)	Year 10 (Fiscal Year 2026-2027)
North IRL	-	1% National Aeronautics and Space Administration West	4% National Aeronautics and Space Administration West	25% National Aeronautics and Space Administration West	30% National Aeronautics and Space Administration West	40% National Aeronautics and Space Administration West	-	-	-	-	-
$5,524,372	-	$50,102	$206,923	$1,335,300	$1,654,437	$2,277,609	-	-	-	-	-
North IRL	-	1% National Aeronautics and Space Administration East	4% National Aeronautics and Space Administration East	25% National Aeronautics and Space Administration East	30% National Aeronautics and Space Administration East	40% National Aeronautics and Space Administration East	-	-	-	-	-
$12,595,567	-	$114,234	$471,784	$3,044,485	$3,772,116	$5,192,947	-	-	-	-	-
North IRL	-	-	-	-	50% Rockledge B	50% Rockledge B	-	-	-	-	-
$5,604,406	-	-	-	-	$2,757,395	$2,847,011	-	-	-	-	-
North IRL	-	-	-	2% Pineda	49% Pineda	49% Pineda	-	-	-	-	-
$6,718,970	-	-	-	$128,189	$3,242,697	$3,348,084	-	-	-	-	-
North IRL	-	-	-	-	-	15% Canals	-	-	15% Canals	-	-
$3,109,977	-	-	-	-	-	$1,480,446	-	-	$1,629,531	-	-
Central IRL	-	Turkey Creek	-	-	-	-	-	-	-	-	-
$215,000	-	$215,000	-	-	-	-	-	-	-	-	-
Central IRL	-	-	10% Mullet Creek Area	50% Mullet Creek Area	40% Mullet Creek Area	-	-	-	-	-	-
$5,809,577	-	-	$538,000	$2,777,425	$2,294,152	-	-	-	-	-	-
Central IRL	-	-	-	-	-	-	-	-	Goat Creek Area	-	-
$501,394	-	-	-	-	-	-	-	-	$501,394	-	-
Central IRL	-	-	-	-	-	-	-	-	15% Canals		15% Canals
$2,589,771	-	-	-	-	-	-	-	-	$1,253,486		$1,336,285
Oyster Bars	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Eden Isles	-	-	-	-	-	-	-	-	-
$21,805	-	$21,805	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Marina Isles	-	-	-	-	-	-	-	-	-
$26,700	-	$26,700	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Bettinger	-	-	-	-	-	-	-	-	-
$10,680	-	$10,680	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	McNabb	-	-	-	-	-	-	-	-	-
$34,056	-	$34,056	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Gitlin	-	-	-	-	-	-	-	-	-
$16,020	-	$16,020	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Brevard	-	-	-	-	-	-	-	-	-
$47,350	-	$47,350	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Brevard Zoo Banana River	-	-	-	-	-	-	-	-
$601,966	-	-	$601,966								
Banana River Lagoon	-	-	-	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,612 square feet Oysters	27,606 square feet Oysters
$4,167,930	-	-	-	$464,582	$479,681	$495,271	$511,367	$527,986	$545,146	$562,863	$581,035
North IRL	-	Bomalaski	-	-	-	-	-	-	-	-	-
$8,900	-	$8,900	-	-	-	-	-	-	-	-	-
North IRL	-	Oliver	-	-	-	-	-	-	-	-	-
$51,620	-	$51,620	-	-	-	-	-	-	-	-	-
North IRL	-	Indian River Drive	-	-	-	-	-	-	-	-	-
$13,258	-	$13,258	-	-	-	-	-	-	-	-	-
North IRL	-	-	Brevard Zoo North IRL	-	-	-	-	-	-	-	-
$352,372	-	-	$352,372	-	-	-	-	-	-	-	-
North IRL	-	-	-	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,900 square feet Oysters	30,894 square feet Oysters
$4,664,266	-	-	-	$519,892	$536,780	$554,234	$572,247	$590,845	$610,047	$629,874	$650,340
Central IRL	-	Coconut Point	-	-	-	-	-	-	-	-	-
$509,950	-	$509,950	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Park	-	-	-	-	-	-	-	-	-
$108,790	-	$108,790	-	-	-	-	-	-	-	-	-
Central IRL	-	Wexford	-	-	-	-	-	-	-	-	-
$31,150	-	$31,150	-	-	-	-	-	-	-	-	-

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Central IRL	-	Riverview Senior Resort	-	-	-	-	-	-	-	-	-
$30,304	-	$30,304	-	-	-	-	-	-	-	-	-
Central IRL	-	Turkey Creek	-	-	-	-	-	-	-	-	-
$122,055	-	$122,055	-	-	-	-	-	-	-	-	-
Central IRL	-	-	Brevard Zoo Central IRL	-	-	-	-	-	-	-	-
$166,398	-	-	$166,398	-	-	-	-	-	-	-	-
Central IRL	-	-	-	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,776 square feet Oysters	4,770 square feet Oysters
$720,829	-	-	-	$80,345	$82,957	$85,653	$88,436	$91,311	$94,278	$97,342	$100,506
Planted Shorelines	-	-	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	Cocoa Beach	-	-	-	-	-	-	-	-	-
$16,014	-	$16,014	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	McNabb	-	-	-	-	-	-	-	-	-
$5,760	-	$5,760	-	-	-	-	-	-	-	-	-
Banana River Lagoon	-	-	Brevard Zoo Banana River	-	-	-	-	-	-	-	-
$3,221	-	-	$3,221	-	-	-	-	-	-	-	-
North IRL	-	Indian River Drive	-	-	-	-	-	-	-	-	-
$2,240	-	$2,240	-	-	-	-	-	-	-	-	-
North IRL	-	-	Brevard Zoo North IRL	-	-	-	-	-	-	-	-
$743	-	-	$743	-	-	-	-	-	-	-	-
Central IRL	-	Lagoon House	-	-	-	-	-	-	-	-	-
$23,961	-	$23,961	-	-	-	-	-	-	-	-	-
Central IRL	-	Riverview Park	-	-	-	-	-	-	-	-	-
$18,480	-	$18,480	-	-	-	-	-	-	-	-	-
Central IRL	-	Turkey Creek	-	-	-	-	-	-	-	-	-
$24,960	-	$24,960	-	-	-	-	-	-	-	-	-
Project Monitoring	-	Year 1 Monitoring	Year 2 Monitoring	Year 3 Monitoring	Year 4 Monitoring	Year 5 Monitoring	Year 6 Monitoring	Year 7 Monitoring	Year 8 Monitoring	Year 9 Monitoring	Year 10 Monitoring
$11,696,748	-	$1,000,000	$1,032,500	$1,066,056	$1,100,703	$1,136,476	$1,173,411	$1,211,547	$1,250,923	$1,291,578	$1,333,554
Contingency	Year 0 Contingency	Year 1 Contingency	Year 2 Contingency	Year 3 Contingency	Year 4 Contingency	Year 5 Contingency	Year 6 Contingency	Year 7 Contingency	Year 8 Contingency	Year 9 Contingency	Year 10 Contingency
$22,804,408	$260,897	$1,823,628	$3,077,801	$2,982,133	$2,644,497	$2,212,388	$2,252,609	$2,080,179	$1,981,768	$1,712,032	$1,816,476
$478,892,568 (total)	***$5,478,842***	***$38,296,178***	***$64,633,817***	***$62,204,798***	***$55,534,432***	***$46,460,107***	***$47,304,787***	***$43,683,753***	***$41,197,133***	***$35,952,670***	***$38,140,044***

Appendix A: Funding Needs and Leveraging Opportunities

Brevard County explored a variety of possible mechanisms to fund the IRL projects in this plan, including:

- Special Taxing District approved by referendum to allow an ad valorem tax levy and bonds
- Special Act by the legislature allowing ad valorem tax levy by referendum to issue bonds
- Local government surtax (0.5 cent sales tax)
- Altering legislation to allow for Tourist Development Council funding to be used for lagoon restoration
- Municipal Service Taxing Unit/Special District
- Increased stormwater utility assessment

The County placed a referendum on the November 8, 2016 ballot for the 0.5 cent sales tax, and this referendum passed by more than 60% of the vote. The Save Our Indian River Lagoon 0.5 cent sales tax will generate approximately $34 million per year. The proposed 1 mill increase would have generated approximately $32 million per year, whereas the proposed increase in 0.5 mill would have only generated $16 million per year. To implement the projects in a timely manner according to the schedule in **Table 8-9**, and to accelerate the projects where possible, the County will seek to use funds generated from the sales tax to leverage matching funding from grants and appropriations and/or pay debt service on bonds. If additional funding is provided through matching funds from other sources, additional projects may be implemented, which would increase the overall plan cost, and/or project timelines may be moved up to allow the benefits of those projects to occur earlier than planned.

Examples of other funding programs (many from Florida Department of Environmental Protection 2015) are:

- Section 319 grant program – The Florida Department of Environmental Protection administers funds received from U.S Environmental Protection Agency to implement projects or programs that reduce nonpoint sources of pollution. Projects or programs must benefit Florida's impaired waters, and local sponsors must provide at least a 40% match or in-kind contribution. Eligible activities include demonstration and evaluation of urban and agricultural stormwater best management practices, stormwater retrofits, and public education.
- Total maximum daily load grants – Funding for projects related to the implementation of total maximum daily loads may be available through periodic legislative appropriations to the Florida Department of Environmental Protection. When funds are available, the program prioritizes stormwater retrofit projects to benefit impaired waters, similar to the Section 319 grant program.
- Water management district funding - Florida's five regional water management districts offer financial assistance for a variety of water-related projects, for water supply development, water resource development, and surface water restoration. Assistance may be provided from ad valorem tax revenues or from periodic legislative appropriations for alternative water supply development and Surface Water Improvement and Management projects. The amount of funding available, matching requirements, and types of assistance may vary from year to year.
- IRL National Estuary Program – The IRL Council funds projects each year through their work plan process (http://www.irlcouncil.com/irl-council.html).

- Budget Appropriation – The Florida Legislature may solicit applications directly for projects, including water projects, in anticipation of upcoming legislative sessions. This process is an opportunity to secure legislative sponsorship of project funding through the state budget.
- Clean Water State Revolving Fund loan program – This program provides low-interest loans to local governments to plan, design, and build or upgrade wastewater, stormwater, and nonpoint source pollution prevention projects. Discounted assistance for small communities is available. Interest rates on loans are below market rates and vary based on the economic wherewithal of the community. The Clean Water State Revolving Fund is Florida's largest financial assistance program for water infrastructure.
- Florida Rural Water Association Loan Program – This program provides low-interest bond or bank financing for community utility projects in coordination with the Florida Department of Environmental Protection's State Revolving Fund program. Other financial assistance may also be available.
- Rural Development Rural Utilities Service Guaranteed and Direct Loans and Grants – The U.S. Department of Agriculture's program provides a combination of loans and grants for water, wastewater, and solid waste projects to rural communities and small incorporated municipalities.
- Small Cities Community Development Block Grant Program – The Florida Department of Economic Opportunity makes funds available annually for water and sewer projects that benefit low- and moderate-income persons.
- State Housing Initiatives Partnership Program – Florida Housing administers the program, which provides funds to local governments as an incentive to create partnerships that produce and preserve affordable homeownership and multifamily housing. The program is designed to provide very low, low and moderate income families with assistance. Funding may be used for emergency repairs, new construction, rehabilitation, down payment and closing cost assistance, impact fees, construction and gap financing, mortgage buy-downs, acquisition of property for affordable housing, matching dollars for federal housing grants and programs, and homeownership counseling (http://www.floridahousing.org/HousingPartners/LocalGovernments/).
- Rural Development Funding – The U. S. Department of Agriculture provides funds that will cover the repair and maintenance of private septic systems. The amount of funds available, as well as the specific purposes for which grants are intended, changes from year to year. Additional details are posted on the Department of Agriculture's website (http://www.rurdev.usda.gov/Home.html).

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Appendix C: Public Education and Outreach Supporting Information

Fertilizer Management

It is a common practice to apply fertilizer on urban and agricultural land uses. However, excessive and inappropriately applied fertilizer pollutes surrounding waters and stormwater. Florida Department of Agriculture and Consumer Services compiles information on the fertilizer sales by county, as well as the estimated nutrients from those fertilizers. It is important to note that all fertilizer sold in a county may not be applied within that county because a portion of that fertilizer may be transported to another county. However, details on the amount of fertilizer transported between counties is not tracked. Therefore, the information in the Florida Department of Agriculture and Consumer Services reports is simply the best estimate of the amount of fertilizer used, and the associated nutrient content, in a county.

Table C-1 and **Figure C-1** summarize the nutrients in the lawn fertilizer sold in Brevard County, according to Florida Department of Agriculture and Consumer Services records. This information was organized by fiscal year. The figure shows a decrease in the amount of nitrogen and phosphorus fertilizer being sold in the County after the fertilizer ordinance was adopted in 2013.

Table C-1: Nutrients in Lawn Fertilizer Sold in Brevard County by Fiscal Year

Fiscal Year	Lawn Fertilizer Nitrogen (tons per year)	Lawn Fertilizer Nitrogen (lbs/yr)	Lawn Fertilizer Phosphorus (tons per year)	Lawn Fertilizer Phosphorus (lbs/yr)
2012-2013	1,673	3,346,140	61	122,740
2013-2014	319	637,700	63	126,400
2014-2015	204	408,220	16	32,520

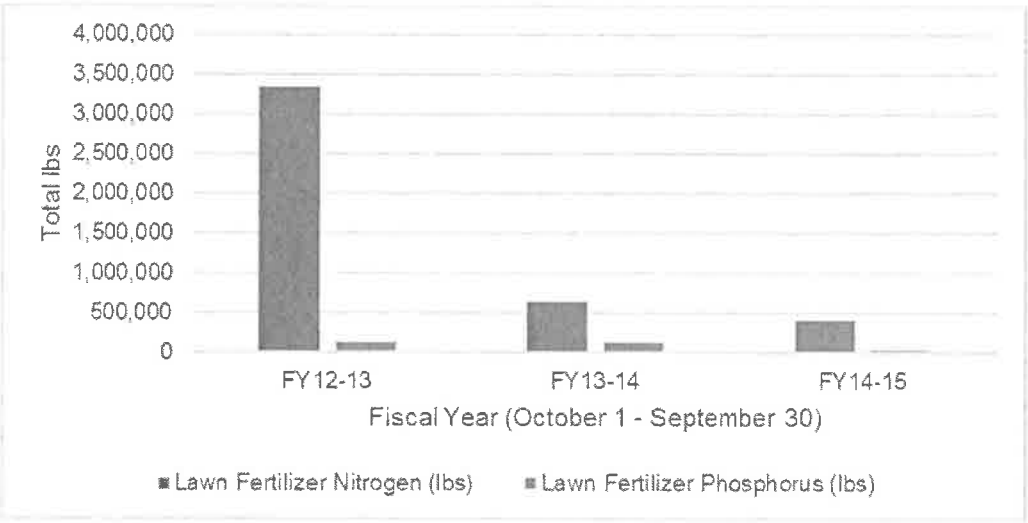


Figure C-1: TN and TP in Lawn Fertilizer Sold in Brevard County by Fiscal Year

To help address fertilizer as a source of nutrient loading, local governments located within the watershed of a waterbody or water segment that is listed as impaired by nutrients are required to adopt, at a minimum, the Florida Department of Environmental Protection's Model Ordinance for Florida-Friendly Fertilizer Use on Urban Landscapes (Section 403.067, Florida Statutes). Brevard County and its municipalities adopted fertilizer ordinances that included the required items from the Model Ordinance in December 2012, as well as additional provisions in 2013 and 2014. The County's fertilizer ordinance is found in Chapter 46, Article VIII, Section 46-335 through Section 46-349. This ordinance "regulates and promotes the proper use of fertilizers by any applicator; requires proper training of commercial and institutional fertilizer applicators; establishes training

and licensing requirements; establishes a prohibited application period; specifies allowable fertilizer application rates and methods; fertilizer-free zones; low maintenance zones; and exemptions. The Ordinance requires the use of best management practices which provide specific management guidelines to minimize negative secondary and cumulative environmental effects associated with the misuse of fertilizers."

The County's ordinance prohibits the application of fertilizer that contains nitrogen and/or phosphorus during the period of June 1 through September 30, as well as when heavy rain is likely (including a watch or warning for a flood, tropical storm, or hurricane). Fertilizer application is also prohibited within 15 feet of any surface waterbodies, to limit the likelihood that fertilizer will run off into a waterbody. Fertilizer applied within the County must not contain phosphorus, unless a soil or plant tissue test indicates a need. Fertilizer with nitrogen should contain at least 50% in the form of slow release, controlled release, timed release, slowly available, or water insoluble nitrogen. When applying fertilizer, the ordinance requires deflectors on broadcast spreaders and removal of any fertilizer spilled on an impervious surface, which can then runoff into the stormwater system.

The ordinance also requires grass and vegetation clippings not to be swept, washed, or blown off into surface waterbodies or the stormwater system. Commercial applicators, must complete a training program and carry evidence that they have completed the training. The ordinance only applies to use of urban fertilizer, and not fertilizer applied to a bona fide farm operation.

In addition to the fertilizer ordinance, Brevard County, nine municipalities, Good Education Solutions, and the Brevard Zoo created a public education campaign called "Blue Life" in 2012. The purpose of this campaign is to provide information to the public about sources of pollution and what actions people can take to protect and improve water quality. The campaign is a combination of public service announcements; TV, radio, and billboard advertisements; social media; community forums and talks; workshops; school programs; and other printed informational materials. The information includes details on fertilizer and pesticide use and management, proper lawn and garden maintenance, pet waste management, proper car washing and maintenance, waste management, and litter control.

To determine the effectiveness of this educational campaign on behavior changes, the County contracted with Praecipio Economics Finance Statistics to conduct a survey before the campaign implementation in 2012 and after the campaign was in place for two years in 2015. A similar survey was used in both 2012 and 2015, although the 2015 survey included additional questions about the Blue Life campaign, fertilizer bans, and state of the IRL. The survey was mailed to about 50,000 households who receive water from the City of Melbourne utility. A total of 1,470 usable surveys were obtained for 2012 and 1,572 usable surveys were obtained for 2015. The results were tabulated and analyzed to compare the pre- versus post-Blue Life campaign responses (Praecipio Economics Finance Statistics 2016).

When comparing the results from the 2012 and 2015 surveys, Praecipio Economics Finance Statistics (2016) found that the study unambiguously showed that people in 2015 were better informed about stormwater issues than in 2012, and that behavior that affects water quality in the area has, in general, improved:

- The 2015 population received more information about stormwater runoff and were better informed about stormwater runoff issues. The proportion of respondents who received "a lot" or "some" information about stormwater runoff issues increased by 6% and 19%, respectively. Perceptions about water quality became much more negative, increasing by

10% for "very poor" and 18% for "poor." Lawn and garden fertilizer was identified as the single biggest source of water pollution by 7.6% more respondents.

- Significant improvements in behavioral traits associated with lawn maintenance (lawn clippings, fertilizer application, pesticide application, frequency of fertilizer applications, and fertilizer types) occurred between 2012 and 2015. The percentage of people who leave the lawn clippings on their grass after it is mowed rose by 3.5% (from 77% in 2012). The percentage of people who report that they do not apply fertilizer and/or pesticides increased by 6.4% and 6.5%. Of those who do fertilize their lawns, the proportion who fertilize their lawn once or twice a year rose by 5.3%. Persons who used desirable fertilizer types (no phosphorus, slow release, and/or dry/granulated fertilizer) rose by 7.6%.
- Significant improvements in where a vehicle is washed and the pickup of dog waste occurred between 2012 and 2015. There was a 5.1% increase in the proportion of people who take their vehicle to a commercial car wash (instead of washing their car at home) and a 5.9% increase in the proportion of people who "always" pick up their dog's waste.

Praecipio Economics Finance Statistics (2016) also included an evaluation of the 2015 survey results for those people who were exposed to the Blue Life campaign versus those who had not seen campaign materials. The people who were exposed to the Blue Life campaign were more familiar with the environmental problems of the IRL and were knowledgeable about the fertilizer ordinances:

- People in the Blue Life subgroup reported greater familiarity with the pollution problems in the IRL (17.4% higher) and recently enacted fertilizer ordinances (11.6% higher) than persons in the non-Blue Life subgroup.
- About 25% of the 2015 sample population remembered being exposed to Blue Life promotional materials, with water bill inserts and farmer's market outreach representing the two largest pathways.

The results of the surveys show that the Blue Life campaign, as well as other educational efforts in the County, had a beneficial impact on people's behaviors and knowledge of the IRL problems. Continuation of this campaign, or other similar public education and outreach efforts, would have a benefit in reducing sources of the pollution to the lagoon (fertilizers, pesticides, pet waste, oil and grease from cars).

The County, city, and grant funding spent on the Blue Life campaign is summarized in **Table C-2**. This funding helped contribute to the results seen in the survey.

Table C-2: Brevard County Funding for the Blue Life Campaign by Fiscal Year

Fiscal Year (October 1 – September 30)	Costs
2012-2013	$83,124
2013-2014	$112,812
2014-2015	$182,482
2015-2016	$83,412
2016-2017	$83,412
2017-2018	$98,791
Total	***$644,033***

The Blue Life campaign is continuing its education and outreach efforts including digital billboards (see **Figure C-2**), radio advertisements, *Florida Today* sticky note (see **Figure C-3**), and water bill insert for the City of Cocoa and City of Melbourne customers.

Figure C-2: Blue Life Digital Billboard

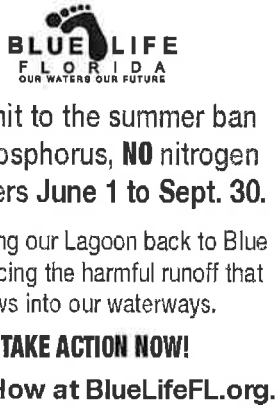


Figure C-3: *Florida Today* Sticky Note

The University of Florida-Institute of Food and Agricultural Sciences Extension Office in Brevard County also implements programs and activities that focus on proper fertilizer application and water quality/conservations measures. The anticipated outcomes of these programs are that participants will gain knowledge, and most importantly, will adopt practices that result in behavior change.

Two horticultural faculty plan, implement, and evaluate the Florida Friendly Landscaping™ program, which includes the following:

My Brevard Yard – This is a hands-on program delivered through classroom training and/or one-on-one onsite consultations. In the classroom training, participants learn about their local fertilizer ordinance, how their lawn practices impact the IRL, and how to implement fertilizer and irrigation best management practices for turfgrass management. The site consultations involve a trained Master Gardener volunteer or Extension faculty visit to the participants' home to conduct an analysis of the lawn. Turf issues are addressed, problem areas are identified, and solutions are offered. Fertilizer spreaders are calibrated and fertilizer recommendations are made after the soil test results are received. If the homeowner uses a landscape service, the faculty member will work with the landscaper to develop a fertilizer program that meets the fertilizer ordinance requirements and follows best management practices.

Master Gardener Volunteer Program – Master Gardeners are University of Florida-Institute of Food and Agricultural Sciences Extension trained volunteers who educate

participants about Florida Friendly Landscaping™ principles. Master Gardeners deliver educational programs, My Brevard Yard program site consultations, exhibits at events and festivals, and by speaking to community groups.

Brevard Botanical Garden –A five-acre garden is being developed on the Extension campus. The garden will be an outdoor, hands-on laboratory for educating homeowners, green industry professionals, government employees, Master Gardeners, and youth.

University of Florida-Institute of Food and Agricultural Sciences Space Coast Golf and Turf Association Workshops – This program is targeted to golf course superintendents and turfgrass managers, especially athletic field managers. The commercial horticulture faculty member collaborates with University of Florida scientists to provide the latest research on turf management such as weed management, fertilizer, and irrigation.

Landscape Management Program – Green industry professionals and government employees are the primary target audiences for this program. The program provides the state mandated Green Industry Best Management Practice Certification training, pesticide license exam preparation, and pesticide applicators' continuing education units. Many of the program participants are contracted with homeowner associations throughout the county, so their practices usually impact a significant amount of square footage.

Homeowner Association and Property Manager Education Program – This program began in 2016. The target audience is property managers, realtors, homeowner/condominium association boards, and developers. This program educates the participants about best management practices for lawns and ponds.

Retail Garden Center Employee Education – This program began in 2016. The target audience for this program is retail garden center employees and managers. Employees typically lack the training needed to make decisions that positively impact water quality, and they are often unfamiliar with fertilizer ordinances. Participants in this program will learn the basics of fertilizers and ordinances and will be given resources to share with their customers that will help them make good decisions. This will be part of the upcoming fertilizer education focus, as described in the section below.

University of Florida-Institute of Food and Agricultural Sciences also provides education to the agriculture industry including the following:

Urban and Sustainable Agricultural Production – The 2012 Agriculture Census reported more than 500 small farms in Brevard County. This program works with small farms to educate producers on water quality best management practices, technical production assistance, and pesticide management.

Livestock and Pasture Management – This program works with livestock operations on best management practices and technical expertise. Participants learn how to manage pastures and horse manure to reduce runoff pollution, as well as backyard chicken education.

University of Florida-Institute of Food and Agricultural Sciences participates in programs through the Florida Sea Grant:

Oyster Gardening – University of Florida-Institute of Food and Agricultural Sciences partners with Brevard County Natural Resources and the Brevard Zoo to implement the oyster gardening program (**Section 4.3.1** has more details).

Microplastic Awareness – This is a new program that raises participants' awareness of microplastic pollution in waterbodies. Citizens learn how to collect samples and filter the water to view the microplastics. The goal is help citizens make better choices when selecting health and beauty products to reduce microplastic pollution.

Florida Master Naturalist Program – This program is a collection of modules that educate participants about natural resources and the environment. After completing all the modules, participants are awarded a certificate from the University of Florida. Once certified, participants are encouraged to become involved in the Space Coast Chapter of Florida Master Naturalist, which provides outreach and educational programs to Brevard County residents.

Ecotourism Certification (new program in 2016) – University of Florida-Institute of Food and Agricultural Sciences partnered with the Tourism Development Office and Parks and Recreation to provide a certification program for ecotourism organizations. Through this certification, participants will learn about their impact on waterways, as well as how to educate their customers about the County's natural resources, protecting water quality, and reducing their environmental footprint.

In addition, there are several community development programs:

Sustainable Floridians[SM] Program – This 10-week program teaches participants about conserving energy and water, climate change science, local food systems, recycling, and transportation issues. The IRL is a major focus of the program.

Brevard Water Summit – The summit was a collaborative effort between Brevard County Natural Resources, Marine Resources Council, and City of Melbourne. The target audience is elected officials, decision makers, and community leaders. Participants learned from local and University of Florida experts about Brevard County-specific water issues such as water supply, water quality, agricultural water, wastewater, and low impact development.

Grass Clippings (added in 2018)

The Brevard County fertilizer ordinance includes a paragraph concerning the management of grass clippings: "In no case shall grass clippings, vegetative material, and/or vegetative debris be washed, swept, or blown off into surface waters, stormwater drains, ditches, conveyances, watercourses, water bodies, wetlands, sidewalks or roadways. Any material that is accidentally so deposited shall be immediately removed to the maximum extent practicable" (Brevard County Section 46-343. Management of grass clippings and vegetative matter). Most municipalities have the exact or nearly similar wording for their local ordinances (Cape Canaveral, Cocoa, Cocoa Beach, Grant-Valkaria, Indian Harbour Beach, Malabar, Melbourne, Palm Bay, Palm Shores, Rockledge, Titusville, and West Melbourne). A few municipalities have altered the language slightly, including Indialantic, Melbourne Beach, and Satellite Beach.

The enforcement language for all local jurisdictions in Brevard County is identical: "Whenever in this Code any act is prohibited or is made or declared to be unlawful or an offense, or whenever the doing of any act is required or the failure to do any act is declared to be unlawful, where no specific penalty is provided therefor, the violation of any such provision of this Code shall be punished by a fine not exceeding $500.00 or imprisonment for a term not exceeding 60 days, or by both such fine and imprisonment. Each day a violation of any provision of this Code shall continue shall constitute a separate offense, and each act in violation of the provisions of this Code shall be considered a separate and distinct offense."

Current enforcement efforts are mostly reactive and educational. However, there are good examples in the state that can be followed by Brevard County to improve compliance with the grass clippings portion of the fertilizer ordinance.

The Green Industries-Best Management Practice Course is a science-based educational program developed by University of Florida-Institute of Food and Agricultural Sciences, Florida Department of Environmental Protection, and industry representatives for green industry workers. This program teaches environmentally safe landscaping practices and is required for professionals to obtain and maintain a Commercial Fertilizer Applicator license in the State of Florida. The best management practices are wide in scope and cover the importance of removing grass clippings from hard surfaces; however, management of yard waste and grass clippings is included as a small lesson in the program. The lesson includes pictures and the statement: "Clippings contain nutrients and should be recycled on the lawn. The nutrients in clippings are pollutants when they end up in stormwater systems and waterbodies (Florida Department of Environmental Protection 2010)." Another principle that is taught in the course is "Right Plant, Right Place," which recommends replacing grass with plants and mulch in areas where grass may be inappropriate. Highway medians are an example of where grass poses safety challenges associated with preventing grass clippings from being left in the pavement.

Another example is the Alachua County Public Outreach program, which includes radio spots, videos, posters, yard signs, and vehicle magnets. Alachua County has partnered with University of Florida-Institute of Food and Agricultural Sciences staff to present their campaign during the Green Industries-Best Management Practice Course. Alachua County attempted to estimate an increase in ordinance compliance due to their campaign by through phone surveys conducted before and after the first year of the campaign. The phone surveys showed an increase in the awareness of grass clippings as pollution from 24% to 69% of respondents. The Alachua County program cost $40,000 for the initial setup with a recurring annual cost of $20,000.

Excess Irrigation (added in 2018)

Current scientific consensus attributes most nitrogen leaching to quick release fertilizer applied to unhealthy and poorly managed sod. Nutrients are more susceptible to leaching if turfgrass is overwatered, as these nutrients need to inhabit the upper few inches of soil to be available to the turf roots. During excess watering, soluble nutrients, such as highly mobile nitrate, wash through the soil from the root zone too quickly. Excess irrigation is easy to accomplish in Florida's sandy soils as these soils typically hold no more than 0.75 inches of water per foot of soil depth (Hochmuth et al. 2016). This excess irrigation is part of the baseflow contributing nutrient loading to the IRL.

A survey of water users in south Florida found that 85% of homeowners have their own irrigation system and 50% reported that they follow water restrictions (Odera et al. 2015). The University of Florida identifies several factors that contribute to improper residential irrigation:

- Lack of understanding about urban soils.
- No familiarity with the different water requirements of landscape plants, including the water required during plant establishment and the water needs based on species, season, soil type, shade in the landscape, etc.
- Lack of attention to proper design, maintenance, and management of the irrigation system.

For St. Augustine turfgrass in Brevard County, University of Florida-Institute of Food and Agricultural Sciences recommends 2 to 5 pounds of nitrogen per 1,000 square feet per year. Florida Department of Agriculture and Consumer Services rules allow for 2 pounds of nitrogen per 1,000 square feet per application in summer and spring and 1 pound of nitrogen per 1,000 square feet, with no more than 0.7 pounds of nitrogen per 1,000 square feet of quick release soluble nitrogen per application. Local city and county ordinances along the IRL ban the application of nitrogen during the wet season (June – September) to reduce the risk that fertilizer will be washed off or leached through turf by frequent heavy rainfall events.

Established St. Augustine turfgrass maintained at University of Florida recommendations has typical nitrogen leaching of 1%. Other grass species and landscaping types can have far higher rates of leaching. A few studies have measured increased leaching with excessive irrigation. Overwatered bermudagrass resulted in an 8-12% nitrogen loss through leaching (Trenholm and Sartain, 2010). A study in sandy loam soil of Rhode Island measured a five-fold increase in soluble nitrogen leaching due to overwatering. In that study, the overwatered turf leached 13% of applied nitrogen, whereas the turf watered on an as-needed basis leached 2% of applied nitrogen (Morton et al. 1988).

Stormwater Pond Maintenance (added in 2018)
Wet detention ponds, or stormwater ponds, are one method used to remove nutrients from stormwater as part of stormwater management mandated by Florida Statute 403.0891. These areas often have one or more stormwater pipes that drain into the pond with a smaller diameter outflow to increase retention/detention time of water in the pond. The retention time increases removal of accumulated nutrients by allowing material to settle and be absorbed. By itself, an optimally sized and properly maintained stormwater pond typically has a 35-40% removal of nitrogen through settling (Florida Department of Environmental Protection and Water Management Districts 2010). Additional behaviors and technologies can be combined with ponds to increase removal rates.

University of Florida-Institute of Food and Agricultural Sciences Extension researchers conducted focus groups assessments and found that 48% of respondents "don't know where runoff goes" or "don't know what runoff is" (Seevers, Graham, Gamon, and Conklin 1997). Pollution prevention programs promoting best management practices are more cost effective than restoration or stormwater treatment but require residents to make changes in their lifestyles to reduce their personal contribution to nutrient impacts. Education regarding stormwater best management practices has been shown to increase adoption of best management practices and improve water quality (Brehm, Pasko, and Eisenhauer 2013; Deitz, Clasen, and Filchak 2004; Swann 2000). University of Florida-Institute of Food and Agricultural Sciences outlined many best management practices related to stormwater in their Florida Friendly Landscaping Program™. Examples of recommended best management practices include (Ott, Monaghan, Wells, et al. 2015):

- Creating a low-maintenance buffer of at least 10 feet along water features that requires no mowing, fertilizer, or pesticide.
- Following University of Florida-Institute of Food and Agricultural Sciences recommendations for fertilizer rate, application, and timing.

- Avoiding the application of fertilizer on hard surfaces like curbs, sidewalks, and roads.
- Cleaning up any spilled fertilizer.
- Avoiding fertilizer application before heavy rainfall.
- Keeping grass clippings on lawns and off streets and sidewalks (where they wash into drains and enter ponds).
- Picking up pet waste to prevent harmful bacteria and organisms from entering waterways.
- Adjusting fertilizer amount to account for the nutrients in reclaimed water.

Many of these stormwater best management practices are promoted by existing programs like Blue Life™ or will be covered by other individual education and outreach included in this plan. Therefore, the stormwater pond maintenance program will focus on vegetative buffers and their appropriate maintenance to reduce stormwater pollution.

Appendix D: Septic System Removal and Upgrade Areas Identified in the Original Plan

Septic System Removal

To identify potential locations for septic system removal through connection to the central sewer system, the County prioritized those areas with septic systems in close proximity to surface waters (ditches, canals, creeks, and the IRL). As shown below in **Table D-3**, septic systems within 55 yards of a surface water have the greatest impact and systems more than 219 yards from a surface water contribute very little TN loading. In addition, the County also inventoried existing sewer service areas for available capacity. The existing service areas include:

- Brevard County North Brevard (Mims)
- Brevard County Port St. John
- Brevard County Sykes Creek (Merritt Island)
- Brevard County South Central (Suntree and Viera)
- Brevard County South Beaches (Patrick Air Force Base to Melbourne Beach)
- Brevard County Barefoot Bay
- City of Cape Canaveral
- City of Cocoa
- City of Cocoa Beach
- City of Melbourne
- City of Palm Bay
- City of Rockledge
- City of Titusville
- City of West Melbourne

The estimated cost per lot for connection to central sewer lines is $20,000 and includes electrical work, plumbing, removing the septic tank, and sewer connection fees. The actual cost per lot will vary depending on site conditions. This amount of funding would offset most, if not the entire, cost per customer.

The estimated nutrient loads from the septic systems that will travel through the groundwater and intersect with a surface waterbody (tributaries, canals, and the lagoon itself) were estimated using typical septic system effluent concentrations and decay rates from U.S Environmental Protection Agency (2002) (**Table D-1**). This information is for a single family residential property. For projects with septic systems for other buildings (apartments, commercial, etc.), loading estimates can be scaled by comparing the flow data for that property to the average flow volume for single family residential. The estimated travel times based on the distance from the septic system to a waterbody are shown in **Table D-2** and is based on an interpretation of the results from a recent study in the City of Port St. Lucie by Sayemuzzaman and Ye 2015. The concentration of each parameter for each buffer zone was calculated using the effluent concentration and decay rates in **Table D-1** and the travel times in **Table D-2**. The concentrations used in the estimates for this plan are shown in **Table D-3**.

Table D-1: Septic System Effluent Concentrations and Decay Rates

Parameter	Effluent Concentration (milligrams per liter)	Decay Rate (1/day)
TN	70	0.1
Organic N	0.458	0.1
Ammonia	10.5	0.1
Nitrate + Nitrite	59.3	0.0011
Organic P*	0.3	0.014
Orthophosphate*	0	0.014

* Assumes that 90% of phosphorus is sorbed to sediment.

Table D-2: Travel Time Based on Distance from Septic System to Waterbody

Buffer Zone	Travel Distance (yards)	Average Velocity (yards/day)	Average Travel Time (days)	Average Travel Time (years)
1	Less than 55	0.199	137.6	0.4
2	Between 55 and 219	0.138	1,385.7	3.8
3	More than 219	0.066	9,641.0	26.4

Table D-3: Parameter Concentrations from Each Buffer Zone

Parameter	Buffer Zone 1 Concentration (milligrams per liter)	Buffer Zone 2 Concentration (milligrams per liter)	Buffer Zone 3 Concentration (milligrams per liter)
Organic N	0.000	0.000	0.000
Ammonia	0.000	0.000	0.000
Nitrate + Nitrite	50.971	12.914	0.001
Organic P	0.044	0.000	0.000
Orthophosphate	0.000	0.000	0.000

The cost for connection of all the septic systems in the County within the IRL watershed would be approximately $1.2 billion (see **Table D-4**). Therefore, this plan focuses on the locations where reductions through septic system removal are the most cost-effective.

Table D-4: Cost to Remove Septic Systems Based on Distance from a Surface Waterbody

Septic System Distance from Surface Water	Number of Septic Systems	TN (lbs/yr per system)	TN (lbs/yr)	Cost per System to Connect	Total Cost	Cost per Pound per Year of TN
Less than 55 yards	15,090	27.095	408,863	$20,000	$301,800,000	$738
Between 55 and 219 yards	25,987	6.865	178,395	$20,000	$519,740,000	$2,913
Greater than 219 yards	18,361	0.001	10	$20,000	$367,220,000	$37,624,010
Total in IRL Basin	***59,438***	***Not applicable***	***587,268***	***$20,000***	***$1,188,760,000***	***$2,024 (average)***

Short-term and long-term opportunities for septic system removal were then identified. Short-term opportunities are neighborhoods with more than 50% of the septic systems being less than 55 yards from a surface water directly connected to the lagoon, and that only require limited extensions of infrastructure from existing service areas to connect to sewer service. In addition, short-term opportunities included areas where there are existing sewer lines and the buildings on septic systems only needed to be connected to the sewer system. The County identified these locations using data from the Florida Department of Health, which were updated using the most current information from the cities. The Florida Department of Health data likely still require updates and corrections; therefore, this plan provides the flexibility for projects to address field verified septic systems that are having the greatest impact on the lagoon (within 55 yards of a surface waterbody).

For the short-term opportunities, the number of lots that could be connected, associated cost of the connection, and estimated TN reductions are shown in **Table D-5** for the Banana River Lagoon, **Table D-6** for the North IRL, and **Table D-7** for the Central IRL. Based on the cost per pound of TN removed, it was determined that the most cost-effective sewer connection projects were those that cost less than $1,200 per pound. The areas that could be connected for this cost are highlighted in green, and these highlighted areas are recommended for connection as part of

the plan. These short-term opportunities represent the connection of approximately 3.9% of the septic systems in Brevard County within the IRL Basin. In Palm Bay, an opportunity exists to hook up many lots to existing sewer lines for $12,000 per connection. This is recommended for high priority septic systems located within 55 yards of an open water connection to the lagoon.

Table D-5: Short-Term Opportunities for Septic System Removal in Banana River Lagoon

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
Sykes Creek - Zone N	86	$1,720,000	2,330	$738
Sykes Creek - Zone M	58	$1,160,000	1,572	$738
Sykes Creek - Zone T	139	$2,780,000	3,685	$754
Sykes Creek - Zone X	14	$280,000	359	$780
Sykes Creek - Zone V	98	$1,960,000	1,927	$1,017
Sykes Creek - Zone U	145	$2,900,000	2,573	$1,127
Sykes Creek - Zone Z	73	$1,460,000	1,290	$1,132
Sykes Creek - Zone W	142	$2,840,000	1,923	$1,477
Sykes Creek - Zone R	206	$4,120,000	2,686	$1,534
Sykes Creek - Zone Q	186	$3,720,000	2,319	$1,604
Sykes Creek - Zone S	163	$3,260,000	1,407	$2,317

Note: The projects highlighted in green are the most cost-effective and are recommended as part of this plan.

Table D-6: Short-Term Opportunities for Septic System Removal in North IRL

Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
City of Cocoa – Zone K	34	$680,000	921	$738
City of Melbourne	12	$240,000	325	$738
City of Rockledge	16	$320,000	434	$738
South Beaches - Zone A	42	$840,000	1,098	$765
City of Titusville	33	$660,000	833	$792
City of Cocoa – Zone J	78	$1,560,000	1,891	$825
South Central - Zone C	132	$2,640,000	3,132	$843
South Central - Zone A	115	$2,300,000	2,239	$1,027
South Central - Zone D	94	$1,880,000	1,730	$1,087
Sykes Creek - Zone C	85	$1,700,000	1,426	$1,192
Sykes Creek - Zone B	207	$4,140,000	3,038	$1,363
Port St. John - Zone B	197	$3,940,000	2,849	$1,383
South Central - Zone B	190	$3,800,000	2,486	$1,528
Sykes Creek - Zone H	77	$1,540,000	992	$1,552
Sykes Creek - Zone I	31	$620,000	386	$1,605
Sykes Creek - Zone G	53	$1,060,000	632	$1,679
Sykes Creek - Zone J	55	$1,100,000	503	$2,186
Sykes Creek - Zone K	170	$3,400,000	1,539	$2,210
Sykes Creek - Zone O	161	$3,220,000	1,158	$2,782
Sykes Creek - Zone A	247	$4,940,000	1,767	$2,796
Sykes Creek - Zone Y	168	$3,360,000	1,083	$3,102
Sykes Creek - Zone F	24	$480,000	95	$5,051
Sykes Creek - Zone L	175	$3,500,000	687	$5,098
Sykes Creek - Zone P	342	$6,840,000	1,074	$6,372
Sykes Creek - Zone E	86	$1,720,000	217	$7,934
Sykes Creek - Zone D	85	$1,700,000	183	$9,279
Port St. John - Zone C	82	$1,640,000	96	$17,058
South Beaches - Zone B	170	$3,400,000	123	$27,742
Port St. John - Zone A	55	$1,100,000	7	$159,571

Note: The projects highlighted in green are the most cost-effective and are recommended as part of this plan.

Table D-7: Short-Term Opportunities for Septic System Removal in Central IRL

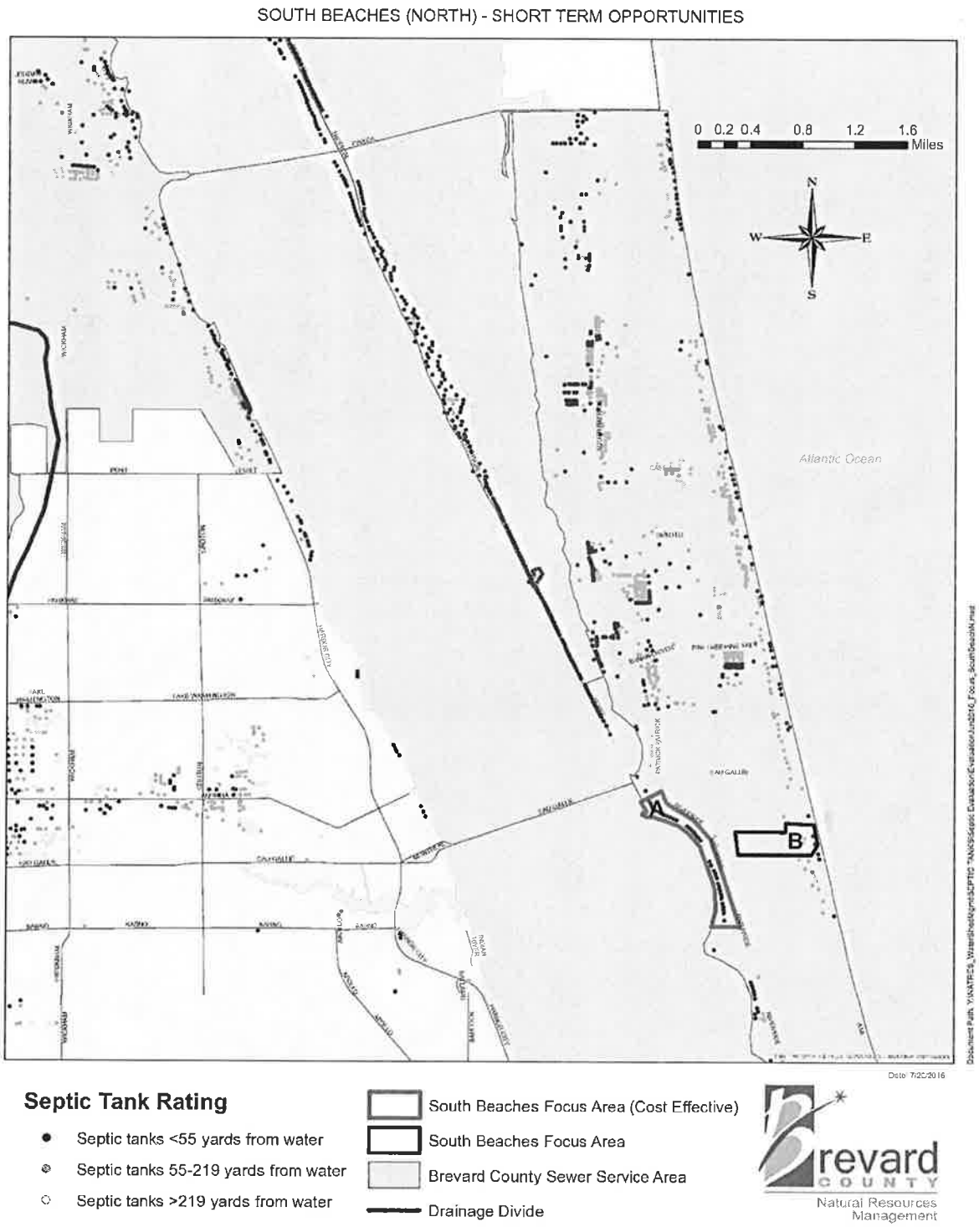
Service Area	Number of Lots	Cost	TN Reduction (lbs/yr)	TN Cost per Pound per Year
City of Palm Bay – near sewer lines	647	$7,764,000	17,530	$443
City of Palm Bay – Zone B	235	$4,700,000	6,347	$741
City of West Melbourne	112	$2,240,000	2,974	$753
City of Palm Bay – Zone A	99	$1,980,000	1,893	$1,046
South Beaches - Zone D	62	$1,240,000	558	$2,221
South Beaches - Zone C	124	$2,480,000	579	$4,282

Table D-8: Summary of Septic System Removal Projects by Sub-Lagoon

Sub-lagoon	Number of Lots	Cost	TN Reductions (lbs/yr)	Average Cost per Pound per Year of TN
Banana River Lagoon	613	$12,260,000	13,736	$898
North IRL	641	$12,820,000	14,029	$875
Central IRL	446	$8,920,000	11,214	$795
Total	***1,700***	***$34,000,000***	***38,979***	***$872***

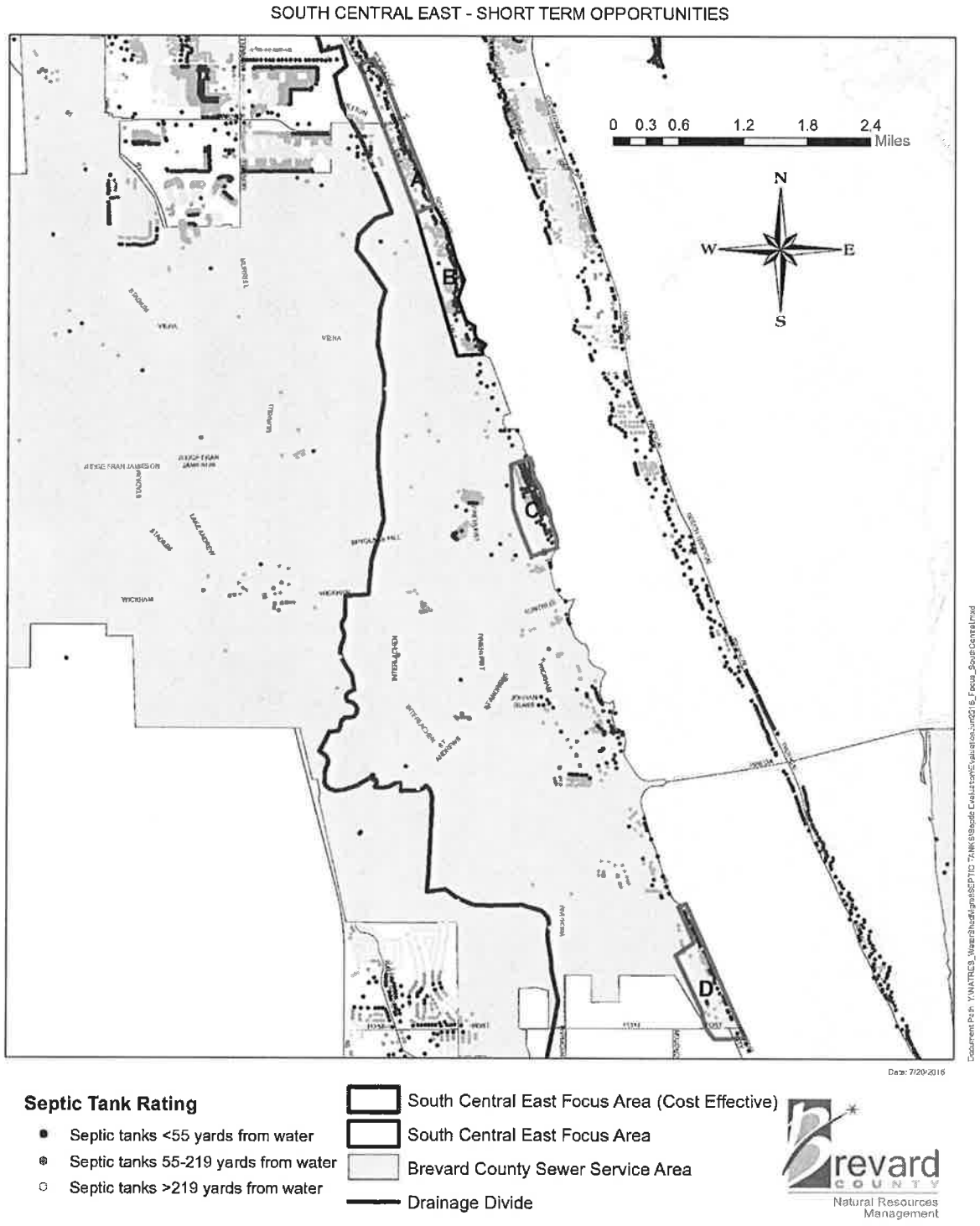
Note: This summary does not include the connection of septic systems near existing sewer lines in Palm Bay.

In **Figure D-1** through **Figure D-10**, the septic systems located within 55 yards of a surface waterbody are shown in the darkest blue and those systems that are further than 219 yards from a surface waterbody are shown in the lightest blue. On each map, the neighborhood focus areas that were evaluated for potential septic system removal are outlined in black. Those focus areas that were determined to be the most cost-effective for connection, and are therefore recommended for funding in this plan, are outlined in green.



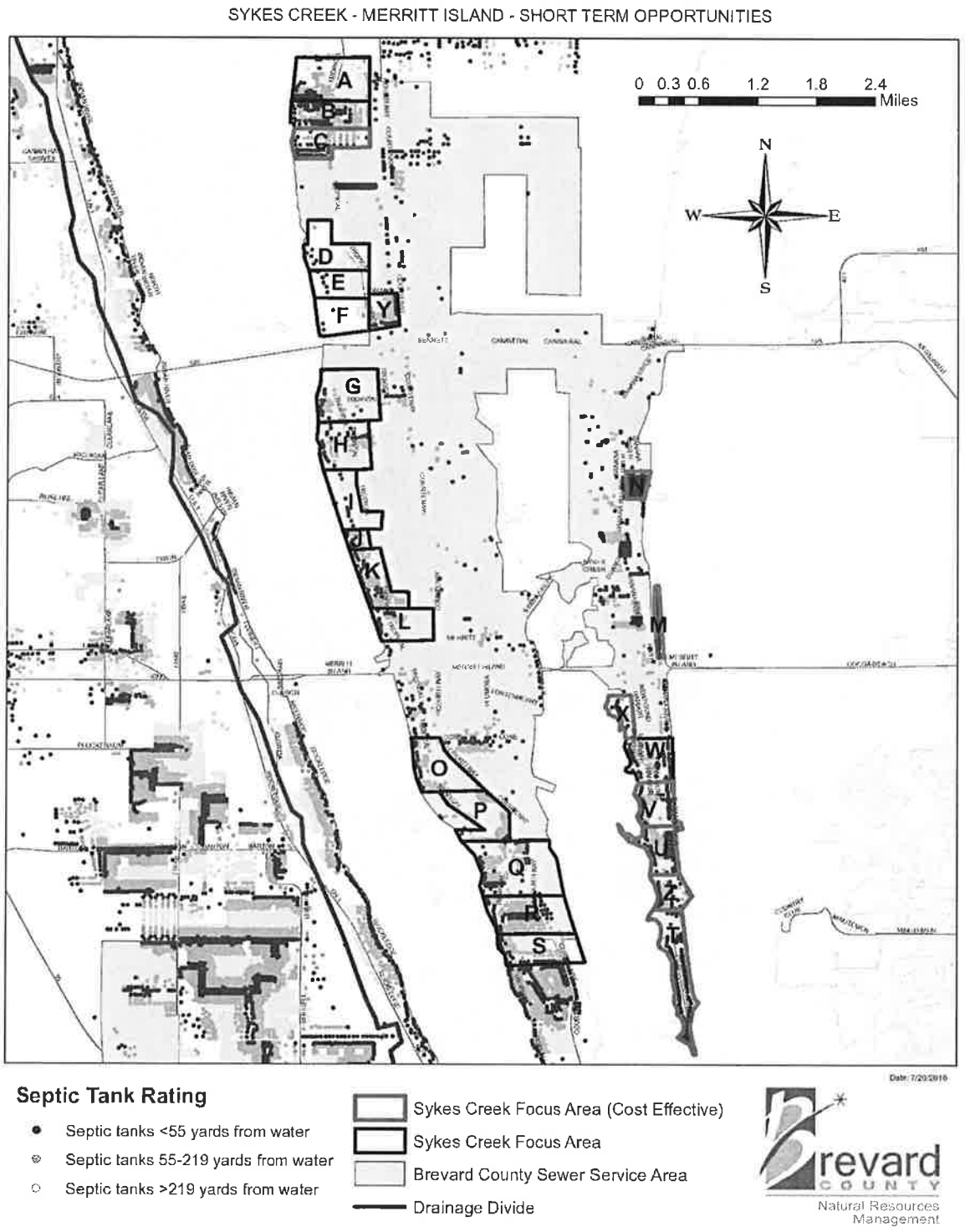
Notes: The focus areas outlined in green are the most cost-effective and are recommended as part of this plan. The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-1: Map of South Beaches Priority Septic System Areas



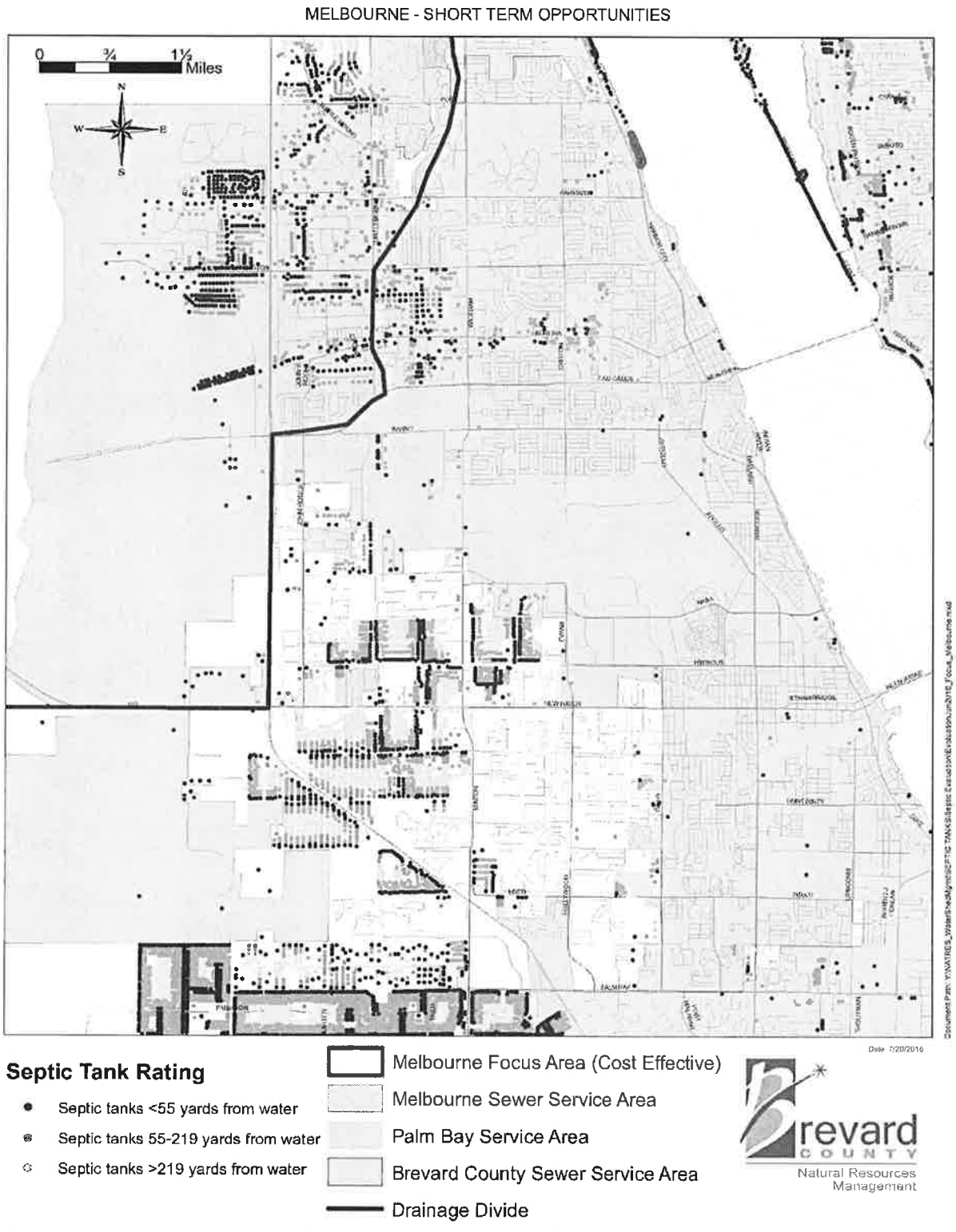
Notes: The focus areas outlined in green are the most cost-effective and are recommended as part of this plan. The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-2: Map of South Central Priority Septic System Areas



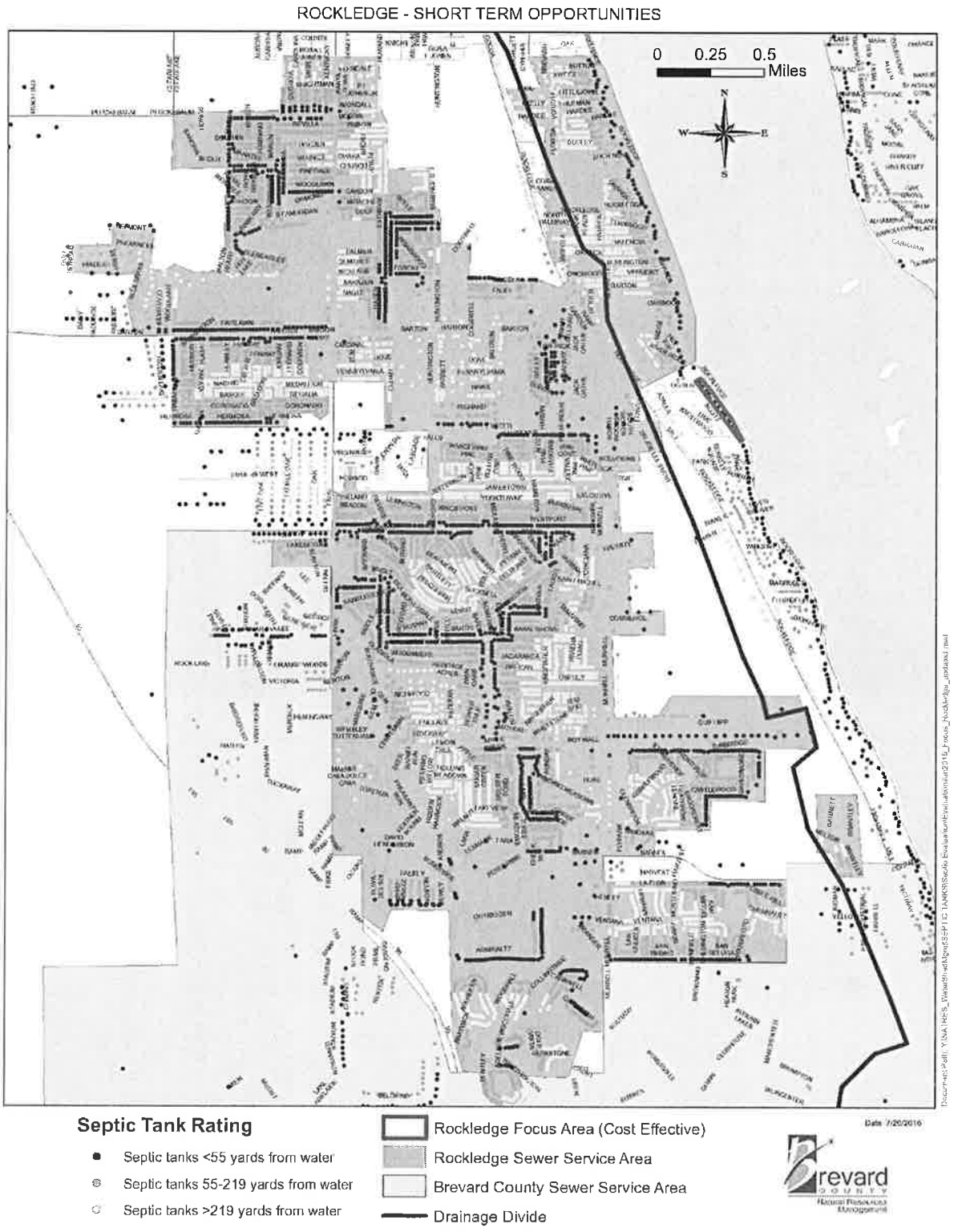
Notes: The focus areas outlined in green are the most cost-effective and are recommended as part of this plan. The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-3: Map of Sykes Creek Priority Septic System Areas



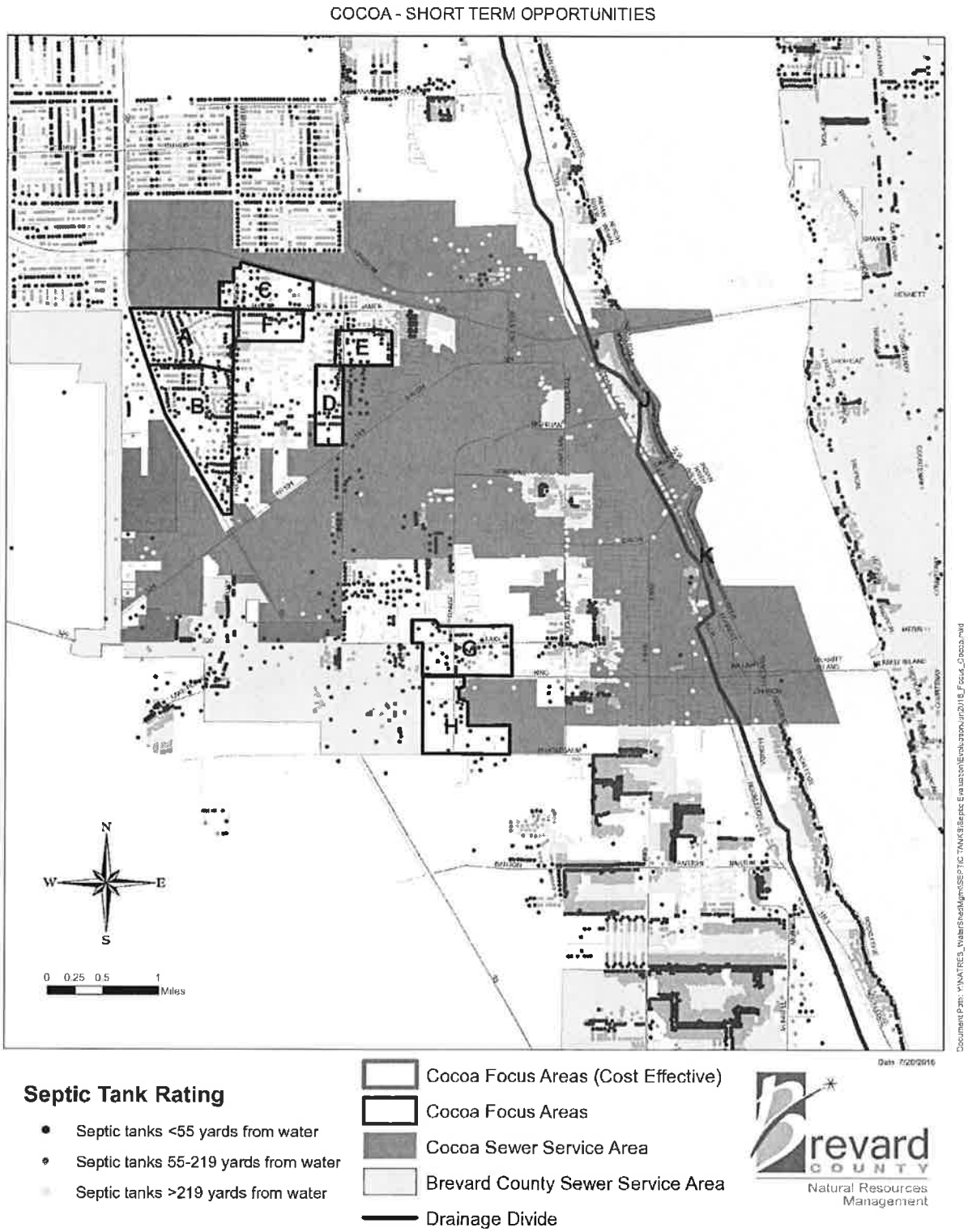
Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-4: Map of City of Melbourne Priority Septic System Areas



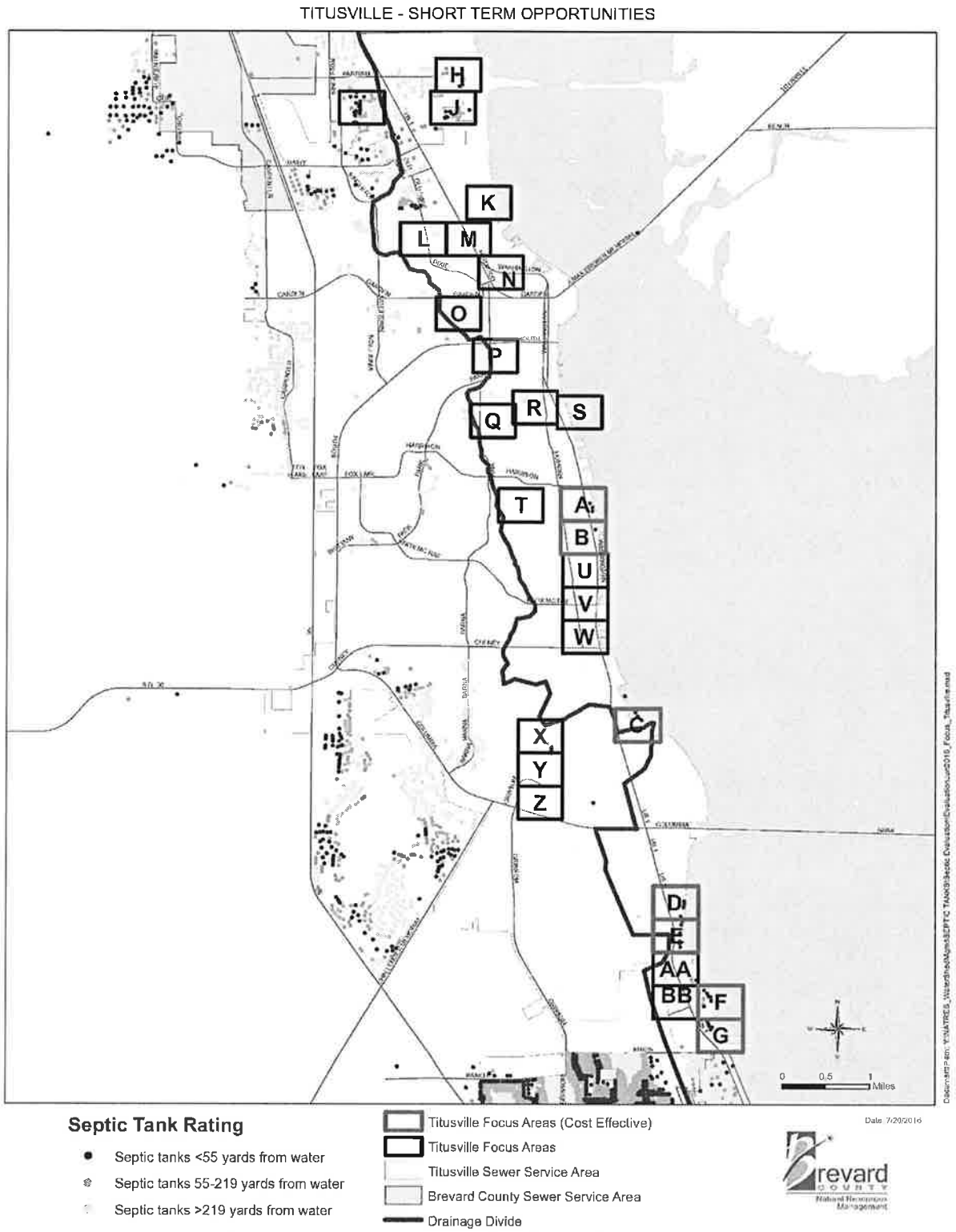
Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-5: Map of City of Rockledge Priority Septic System Areas



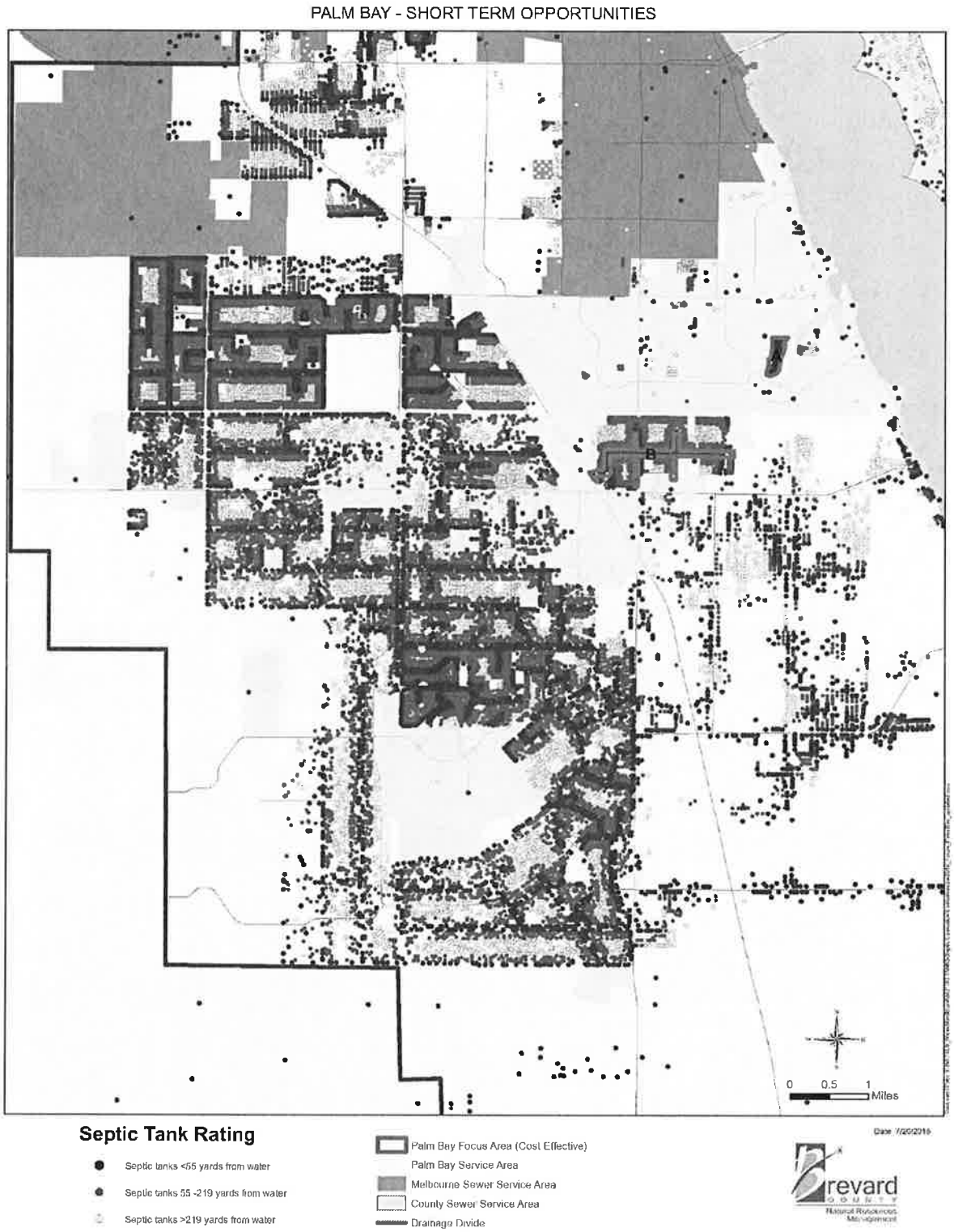
Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-6: Map of City of Cocoa Priority Septic System Areas



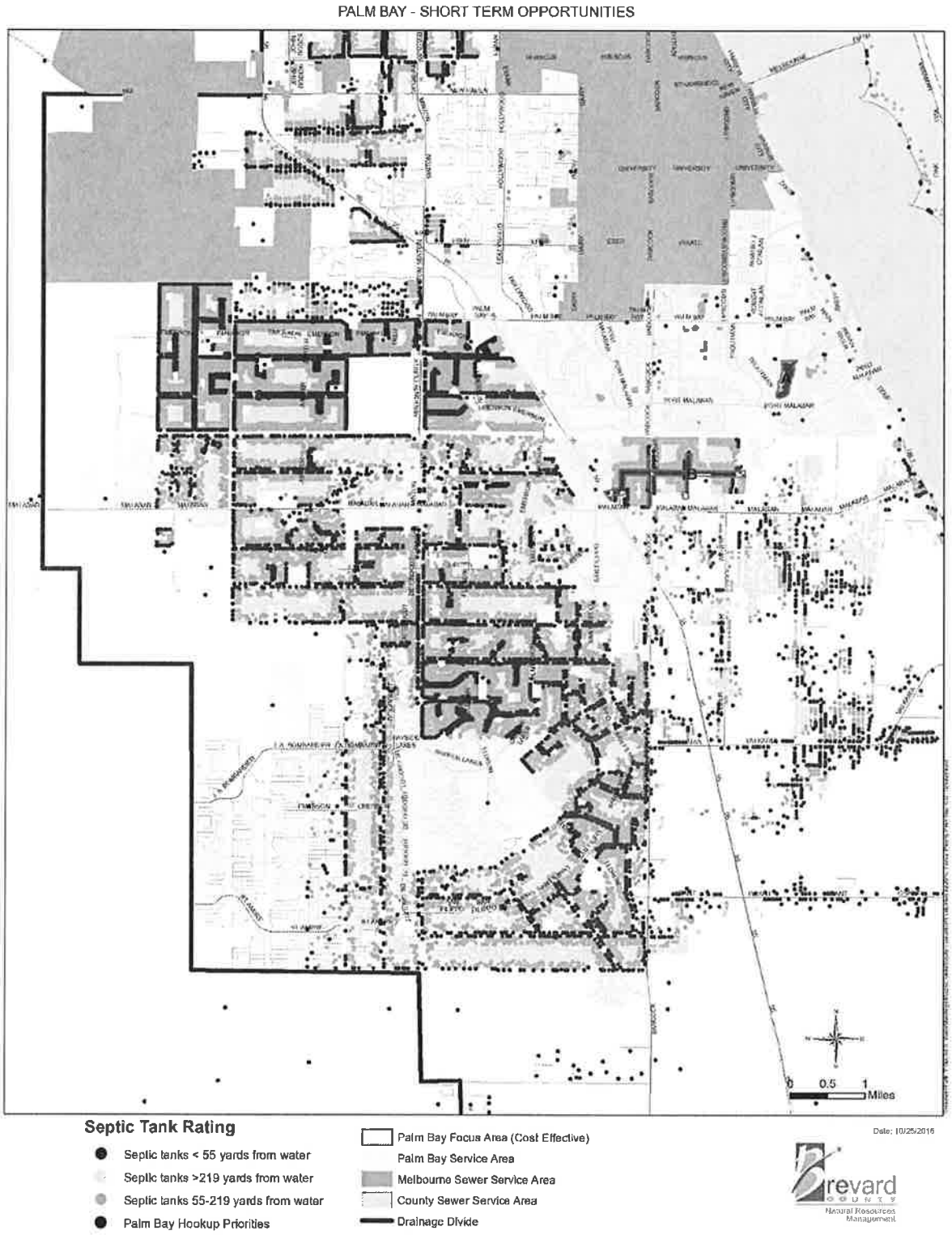
Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-7: Map of City of Titusville Priority Septic System Areas



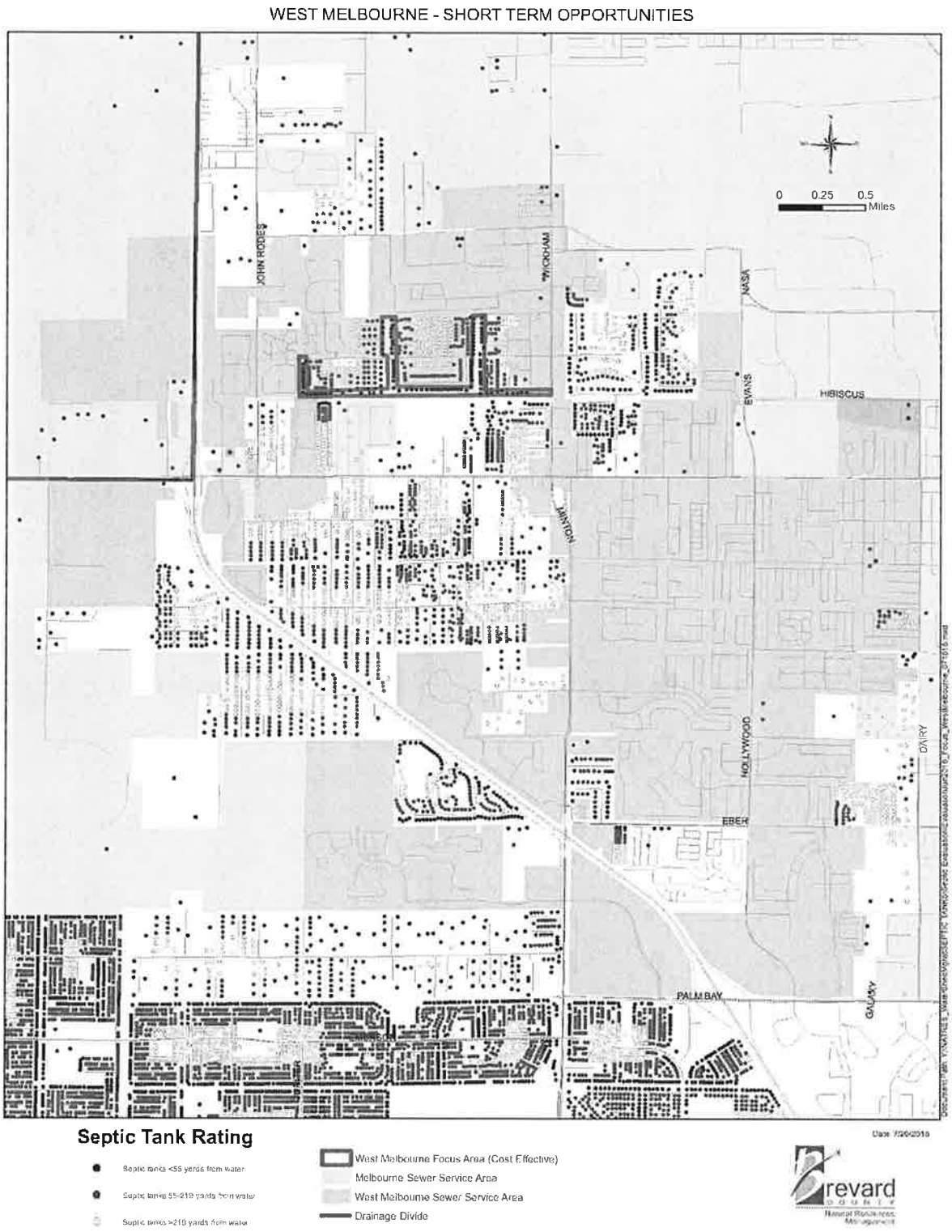
Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-8: Map of City of Palm Bay Priority Septic System Areas



Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-9: Map of City of Palm Bay Septic System Areas Near Sewer Lines



Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time.

Figure D-10: Map of City of West Melbourne Priority Septic System Areas

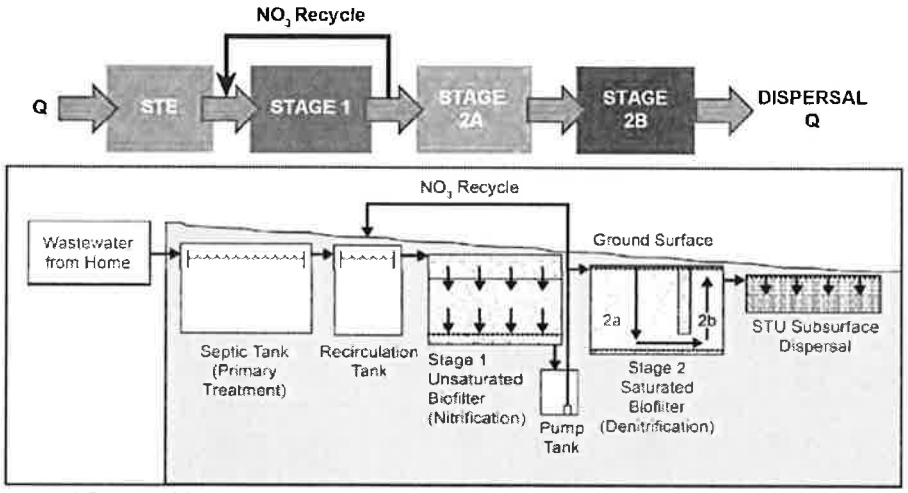
Septic System Upgrades

One option for a septic system upgrade is to add a biosorption activated media to enhance nutrient and bacterial removal before the effluent reaches the drainfield or groundwater. Examples of biosorption activated media include mixes of soil, sawdust, zeolites, tire crumb, vegetation, sulfur, and spodosols (Wanielista et. al. 2011). A test of the biosorption activated media removal capacity was conducted at Florida's Showcase Green Envirohome in Indialantic, Florida. This test location is a residential site built with stormwater, graywater, and wastewater treatment in a compact footprint onsite (Wanielista et. al. 2011). The media used in this study was Bold & Gold, which is a patented blend of mineral materials, sand, and clay. In this study, the effluent to the septic tank was evenly divided between a sorption filter media bed/conventional drainfield in series (innovative system) and to a conventional drainfield. The study found that the TN and TP removal efficiencies were 76.9% and 73.6%, respectively, for the Bold & Gold plus drainfield system, which was significantly higher than the 45.5% TN removal and 32.1% TP removal from a conventional drainfield alone.

Another pilot study was conducted at the University of Central Florida using wastewater from the 15-person BPW Scholarship House, which contains a kitchen and living quarters. The wastewater is pumped to septic tanks from where the effluents are divided into the test Bold & Gold drainfield and the standard drainfields. The Bold & Gold system was designed to provide aerobic and anoxic environments, which allowed for nitrification and denitrification to occur. In this study, the media used was a sand layer on top of a mixture of approximately 68% fine sand, 25% tire crumbs, and 7% sawdust by volume. Overall, TN was reduced by 70.2% and TP was reduced by 81.8%. In addition, the removal efficiency of *Escherichia coli* was 99.93% (Chang et al. 2010).

Another option for a septic system upgrade is the use of passive nitrogen removing systems, and the Florida Department of Health recently completed a study on the efficiency and costs of these systems. The Florida Department of Health defines a passive system as, "A type of enhanced conventional onsite sewage treatment and disposal system that excludes the use of aerator pumps, includes no more than one effluent dosing pump with mechanical and moving parts, and uses a reactive media to assist in nitrogen removal." This definition of passive includes the use of up to one pump because of Florida's flat topography and the need to move water to allow for treatment (Florida Department of Health 2015).

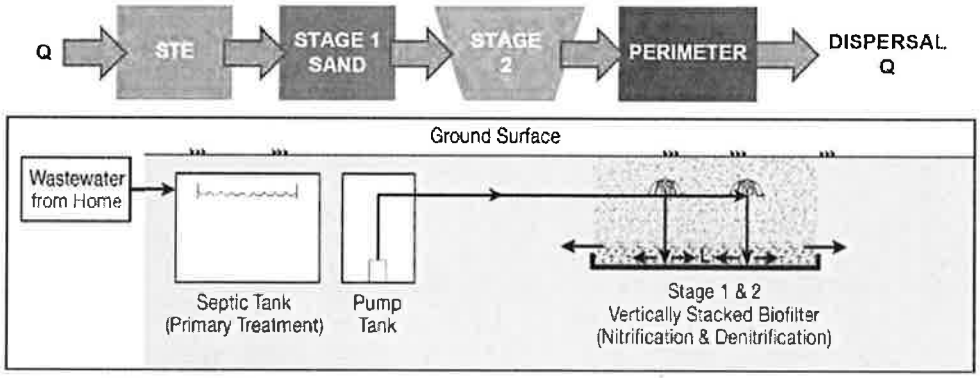
To determine the feasibility of using passive nitrogen removing system, Florida Department of Health contracted with Hazen and Sawyer. The types of passive systems that were tested fell into two general categories: (a) in-tank system and (b) in-ground system. In the in-tank system concept, wastewater flows through the septic tank (STE) to a tank filled with an unsaturated layer of expanded clay (lignocellulosic material) (Stage 1). The wastewater is then sent to a pump tank (NO_3 Recycle), which recycles a portion back to the top of Stage 1. The rest of the wastewater is pumped into a tank with two sections: a saturated layer of wood-chip material (Stage 2A), and a saturated mixture of sulfur and oyster shells (Stage 2B). The wastewater then flows by gravity to the existing drainfield or soil treatment unit (STU) (Dispersal). This concept is shown in **Figure D-11.**



Note: from Hazen and Sawyer 2015

Figure D-11: Example Diagram of an In-Tank Two Stage Biofilter

In the in-ground system concept, wastewater flows through the septic tank (STE) to a pump tank which pressure doses a lined drainfield to spread the sewage throughout the drainfield. Under the drainfield, within the liner, are two layers: an unsaturated layer of regular drainfield sand (Stage 1) above a saturated layer of wood-chip material (Stage 2). The treated wastewater flows over the rim of the liner (Perimeter) into the soil (Dispersal). This concept is shown in **D-12**.



Note: from Hazen and Sawyer 2015

Figure D-12: Example Diagram of an In-Ground Stacked Biofilter

In the test systems, the media depth ranged from 10 inches to 30 inches. The tanks used in the systems at the test sites ranged from 1,050 gallons to 2,800 gallons (Hazen and Sawyer 2015). System longevity could not be directly determined in these systems due to the very low use of media over the two-year study period. Theoretical calculations and literature review suggest that these systems could have a media life of 25 years or longer. For the in-tank Stage 2 biofilters, it would be relatively easy to replace reactive media, helping to extend the life of the system. The study systems were all retrofits of existing septic systems, which have a higher cost than new construction. In addition, these were prototype systems that were being constructed for the first time in Florida. The costs of these systems are expected to decrease with more widespread implementation. The estimated cost to retrofit a septic system to an in-tank passive system is $15,500 and the cost to retrofit to an in-ground system is $12,000. The results of the study found that the TN removal efficiency ranged from 65% to 98%, with an average removal of 90%. The

TP removal efficiency ranged from 12% to 96%, with an average removal of 64% (Florida Department of Health 2015).

The cost to upgrade all 15,090 septic systems within 55 yards of an open water connection to the lagoon, which were not recommended for connection to sewer, would be $241,440,000. Therefore, these systems were further evaluated to prioritize those posing the greatest risk to IRL water quality. The criteria used in the original Plan were the distance from the groundwater table, soil types, year the property was developed, population density, and proximity to surface waters. These scoring criteria were a variation on the method used by Martin County to evaluate their septic systems. Brevard County Natural Resources Management, Utilities, and Department of Health staff met and agreed on how to modify the Martin County criteria to best fit Brevard County. Additional details about the scoring criteria are shown in **Table D-9**. The results of this scoring provided information used to prioritize septic systems for upgrades.

Table D-9: Summary of Septic System Scoring Criteria

Evaluation Factors	Scores	Explanation
A - Groundwater Table	0 points: less than 48 inches 8 points: 48 inches 12 points: greater than 48 inches	These data were pulled from the U.S. Geological Survey Soil Survey for Brevard County using Table 9 - Estimates of Soil Properties, Column titled "Depth to - Seasonal High-Water Table."
B - Soil Types	0 points: Most ideal soils for drainfield performance 8 points: Moderate drainfield performance 12 points: Excessively or poorly drained soils	These data were scored by using the 2013 U.S. Geological Survey Soil Survey for Brevard County using an average of scores from a table created by County staff. The scoring was based on an average of permeability following the Martin County example.
C - Surface Water Management Systems	4 points: Property developed after 1986 8 points: Property developed between 1980 and 1986 12 points: Property developed before 1980	These scores were derived by joining the property appraiser data to the scoring table and scoring based on the year built field.
D - Population Density	4 points: Low Density less than 2 units per acre 8 points: Medium Density great than 2 to 5 units per acre 12 points: High Density greater than 5 units per acre	The population density is the zoning of the parcel collected from Municode using "minimum expected density" for unincorporated county areas. Low Density is less than 2 units per acre, Medium Density is 2 to 5 units per acre, High Density is greater than 5 units per acre. Areas outside of unincorporated Brevard were scored using the size of the parcel (less than 0.2 acres is High Density, 0.2 to 0.5 is Medium Density and Greater than 0.5 acres is Low Density).
E - Proximity to Surface Waters	4 points: Properties greater than 219 yards from an open channel 8 points: Properties within 55 yards of any open channel 12 points: Properties with boundary along the Lagoon or within 20 feet of IRL shoreline	Identified parcels within 20 feet of the IRL; parcels between 55 yards and 219 yards of an open channel polyline; parcels greater than 219 yards from an open channel polyline.

The septic systems with the highest (worst) scores and within 55 yards of a surface waterbody are recommended for retrofit upgrades to reduce the impacts of these septic systems on the waterbodies. The number of these lots and the costs by sub-lagoon are shown in **Table D-10**. The locations of these septic system upgrades are shown in **Figure D-13** through **Figure D-15**. It is important to note that the septic system locations shown in the figures were based on the

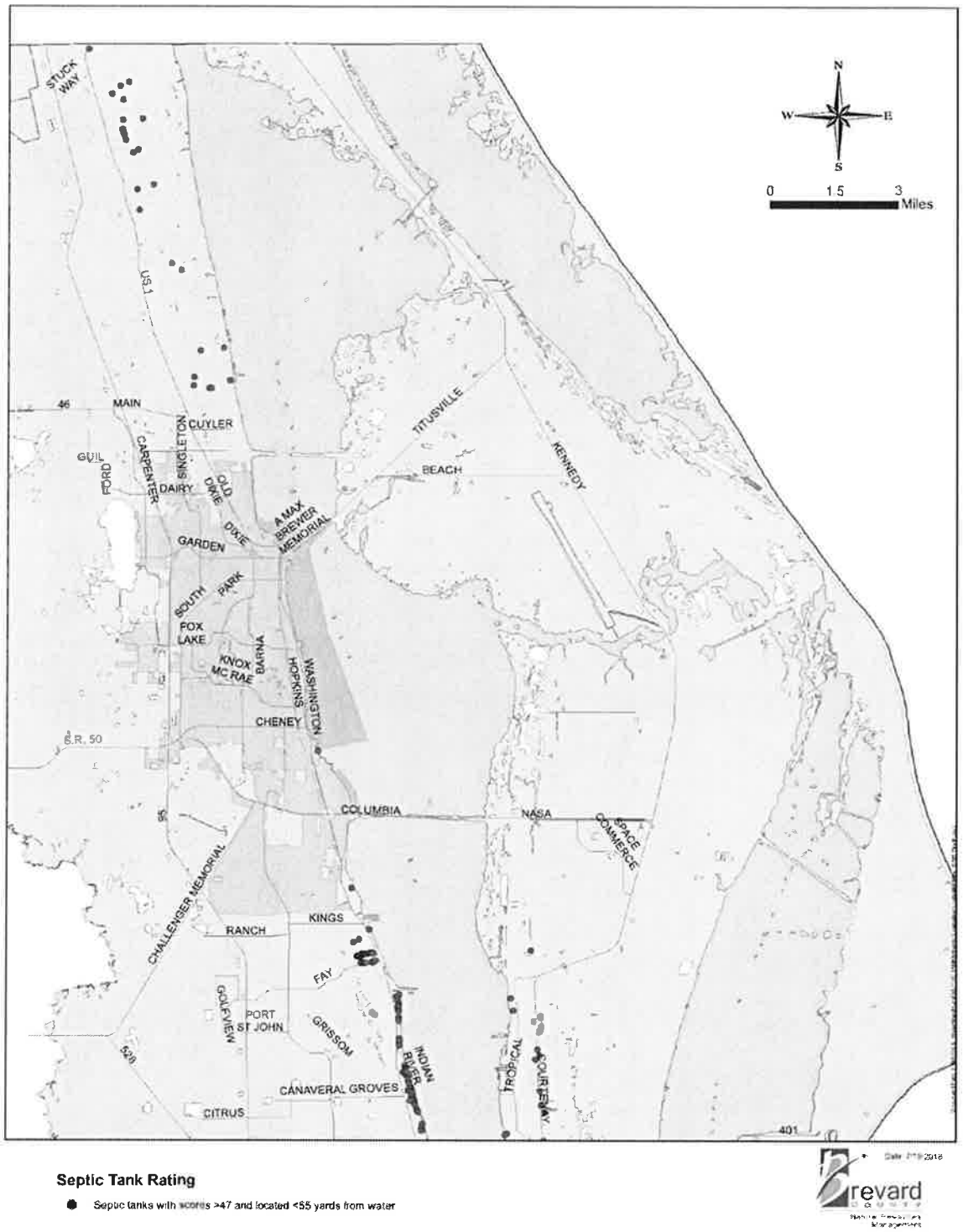
best available data from the Florida Department of Health and the cities, and additional systems may be field verified and eligible for upgrade funding. This upgrade opportunity addresses 2.3% of the septic systems in the IRL drainage basin.

Table D-10: Septic Tank Upgrades and Costs for Highest Priority Septic Systems within 55 Yards of a Surface Waterbody

Sub-lagoon	Number of Lots	Cost	TN Load (lbs/yr)	TN Removal Efficiency	TN Reductions (lbs/yr)	TN Cost per Pound per Year
Banana River*	258	$4,128,000	6,991	73.6%	5,145	$802
North IRL*	515	$8,240,000	13,954	73.6%	10,270	$802
Central IRL*^	614	$9,824,000	16,636	73.6%	12,244	$802
Total	***1,387***	***$22,192,000***	***37,581***	***73.6%***	***27,659***	***$802***

Note: The projects highlighted in green and marked with an asterisk are the most cost-effective and are recommended as part of this plan.

^ The projects in the Central IRL sub-lagoon are located both in Zone A and Zone SEB (refer to **Section 2.1**).



Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time. County staff removed nearly 10,000 locations from Florida Department of Health maps based on confirmation data from municipalities for specific lots that have connected to sewer.

Figure D-13: Map of Locations for Septic System Upgrades in North IRL

Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time. County staff removed nearly 10,000 locations from Florida Department of Health maps based on confirmation data from municipalities for specific lots that have connected to sewer.

Figure D-14: Map of Locations for Septic System Upgrades in Banana River Lagoon and North IRL

Note: The septic system locations are from the Florida Department of Health permit database. This database includes all septic systems permitted since 1980 or that have received repair permits since that time. County staff removed nearly 10,000 locations from Florida Department of Health maps based on confirmation data from municipalities for specific lots that have connected to sewer.

Figure D-15: Map of Locations for Septic System Upgrades in Central IRL

Appendix E: Summary of Stormwater Project Basins

Table E-1: Summary of Potential TN Reductions for Stormwater Project Basins in Banana River Lagoon

Basin	Five-Month TN Load (lbs/yr)	TN % Efficiency	Five-Month TN Reductions (lbs/yr)	Annual TN Load (lbs/yr)	TN % Efficiency	Annual TN Reductions (lbs/yr)	Estimated Cost	Area
~~979~~	~~1,549~~	~~55%~~	~~852~~	~~7,277~~	~~45%~~	~~3,275~~	~~Removed~~	~~Removed~~
~~1280~~	~~1,102~~	~~55%~~	~~606~~	~~3,855~~	~~45%~~	~~1,735~~	~~Removed~~	~~Removed~~
973	827	55%	455	4,552	45%	2,048	$175,000	Merritt Island
963	796	55%	438	4,649	45%	2,092	$150,000	Beaches
~~905~~	~~925~~	~~55%~~	~~509~~	~~2,540~~	~~45%~~	~~1,143~~	~~Removed~~	~~Removed~~
901	653	55%	359	3,685	45%	1,658	$150,000	Merritt Island
~~522~~	~~721~~	~~55%~~	~~397~~	~~1,766~~	~~45%~~	~~795~~	~~Removed~~	~~Removed~~
1317	555	55%	305	3,730	45%	1,679	$125,000	Beaches
650	547	55%	301	2,766	45%	1,245	$125,000	Beaches
1366	526	55%	289	3,295	45%	1,483	$100,000	Beaches
1343	483	55%	266	3,084	45%	1,388	$100,000	Beaches
~~492~~	~~613~~	~~55%~~	~~337~~	~~2,266~~	~~45%~~	~~1,020~~	~~Removed~~	~~Removed~~
476	461	55%	253	2,005	45%	902	$100,000	Beaches
1329	448	55%	246	2,916	45%	1,312	$100,000	Beaches
1350	446	55%	245	2,330	45%	1,049	$100,000	Beaches
815	432	55%	238	1,551	45%	698	$100,000	Merritt Island
992	429	55%	236	2,764	45%	1,244	$100,000	Merritt Island
388	420	55%	231	3,089	45%	1,390	$100,000	Beaches
1304	419	55%	231	2,562	45%	1,153	$100,000	Merritt Island
989	412	55%	227	2,290	45%	1,030	$100,000	Merritt Island
539	411	55%	226	2,474	45%	1,113	$100,000	Merritt Island
1071	403	55%	222	2,403	45%	1,082	$100,000	Merritt Island
350	400	55%	220	1,972	45%	888	$100,000	Beaches
1337	399	55%	220	2,492	45%	1,121	$100,000	Beaches
~~1063~~	~~513~~	~~55%~~	~~282~~	~~2,744~~	~~45%~~	~~1,235~~	~~Removed~~	~~Removed~~
1265	391	55%	215	1,652	45%	743	$100,000	Merritt Island
1222	388	55%	213	1,974	45%	888	$100,000	Merritt Island
1066	380	55%	209	2,575	45%	1,159	$100,000	Merritt Island
1172	379	55%	209	1,893	45%	852	$100,000	Merritt Island
~~820~~	~~490~~	~~55%~~	~~269~~	~~1,327~~	~~45%~~	~~597~~	~~Removed~~	~~Removed~~
~~970~~	~~488~~	~~55%~~	~~269~~	~~2,427~~	~~45%~~	~~1,092~~	~~Removed~~	~~Removed~~
~~995~~	~~477~~	~~55%~~	~~262~~	~~2,328~~	~~45%~~	~~1,048~~	~~Removed~~	~~Removed~~
998	365	55%	201	2,658	45%	1,196	$100,000	Merritt Island
451	364	55%	200	2,595	45%	1,168	$100,000	Beaches
943	363	55%	199	1,574	45%	708	$100,000	Beaches
~~821~~	~~463~~	~~55%~~	~~254~~	~~1,394~~	~~45%~~	~~627~~	~~Removed~~	~~Removed~~
~~705~~	~~460~~	~~55%~~	~~253~~	~~1,445~~	~~45%~~	~~650~~	~~Removed~~	~~Removed~~
~~1309~~	~~457~~	~~55%~~	~~251~~	~~2,257~~	~~45%~~	~~1,016~~	~~Removed~~	~~Removed~~
497	339	55%	186	2,374	45%	1,068	$100,000	Merritt Island
~~754~~	~~438~~	~~55%~~	~~578~~	~~1,631~~	~~45%~~	~~734~~	~~Removed~~	~~Removed~~
~~602~~	~~435~~	~~55%~~	~~574~~	~~2,374~~	~~45%~~	~~1,068~~	~~Removed~~	~~Removed~~
1187	332	55%	183	1,472	45%	662	$100,000	Beaches
1026	331	55%	182	2,385	45%	1,073	$100,000	Merritt Island
1002	318	55%	175	2,625	45%	1,181	$100,000	Beaches
940	308	55%	169	1,812	45%	816	$100,000	Merritt Island
981	306	55%	168	2,207	45%	993	$100,000	Merritt Island
1328	302	55%	166	1,371	45%	617	$100,000	Beaches
980	302	55%	166	1,858	45%	836	$100,000	Merritt Island
1142	296	55%	163	1,186	45%	534	$100,000	Beaches
997	276	55%	152	2,033	45%	915	$100,000	Merritt Island
944	275	55%	151	1,363	45%	614	$100,000	Beaches
1334	273	55%	150	1,766	45%	795	$100,000	Beaches
1372	271	55%	149	1,599	45%	720	$100,000	Merritt Island
1016	267	55%	147	2,045	45%	920	$100,000	Merritt Island

Basin	Five-Month TN Load (lbs/yr)	TN % Efficiency	Five-Month TN Reductions (lbs/yr)	Annual TN Load (lbs/yr)	TN % Efficiency	Annual TN Reductions (lbs/yr)	Estimated Cost	Area
1039	263	55%	145	1,573	45%	708	$100,000	Merritt Island
1378	258	55%	142	1,654	45%	744	$100,000	Beaches
1124	258	55%	142	1,514	45%	681	$100,000	Merritt Island
982	248	55%	137	1,427	45%	642	$100,000	Merritt Island
990	239	55%	131	1,409	45%	634	$100,000	Merritt Island
1104	223	55%	123	1,558	45%	701	$100,000	Beaches
984	223	55%	122	1,263	45%	569	$100,000	Beaches
1033	219	55%	121	2,473	45%	1,113	$100,000	Merritt Island
977	211	55%	116	1,241	45%	558	$100,000	Merritt Island
1251	204	55%	112	997	45%	448	$100,000	Merritt Island
961	203	55%	112	958	45%	431	$100,000	Merritt Island
938	202	55%	111	942	45%	424	$100,000	Merritt Island
969	201	55%	111	1,174	45%	528	$100,000	Beaches
960	199	55%	109	1,194	45%	537	$100,000	Merritt Island
955	197	55%	108	1,161	45%	522	$100,000	Merritt Island
1336	193	55%	106	1,045	45%	470	$100,000	Beaches
1223	188	55%	103	1,247	45%	561	$100,000	Merritt Island
1262	187	55%	103	985	45%	443	$100,000	Merritt Island
1067	187	55%	103	1,028	45%	463	$100,000	Beaches
975	182	55%	100	1,159	45%	521	$100,000	Merritt Island
988	180	55%	99	1,379	45%	621	$100,000	Beaches
1310	179	55%	99	1,295	45%	583	$100,000	Merritt Island
889	178	55%	98	1,197	45%	539	$100,000	Beaches
1037	176	55%	97	1,184	45%	533	$100,000	Merritt Island
1362	175	55%	96	1,057	45%	476	$100,000	Beaches
2421	171	55%	94	763	45%	343	$100,000	Merritt Island
1024	167	55%	92	1,353	45%	609	$100,000	Merritt Island
1133	163	55%	90	1,249	45%	562	$100,000	Beaches
1231	158	55%	87	667	45%	300	$100,000	Merritt Island
1175	155	55%	85	875	45%	394	$100,000	Beaches
1010	153	55%	84	832	45%	374	$100,000	Merritt Island
1220	151	55%	83	880	45%	396	$100,000	Merritt Island
1338	151	55%	83	568	45%	256	$100,000	Beaches
829	148	55%	82	1,399	45%	630	$100,000	Merritt Island
957	145	55%	80	1,302	45%	586	$100,000	Merritt Island
1001	144	55%	79	891	45%	401	$100,000	Merritt Island
1327	137	55%	75	783	45%	352	$100,000	Merritt Island
1248	136	55%	75	680	45%	306	$100,000	Merritt Island
934	136	55%	75	810	45%	365	$100,000	Merritt Island
933	132	55%	73	672	45%	302	$100,000	Beaches
1198	131	55%	72	811	45%	365	$100,000	Beaches
1117	130	55%	72	627	45%	282	$100,000	Beaches
929	118	55%	65	676	45%	304	$100,000	Merritt Island
1357	115	55%	63	751	45%	338	$100,000	Beaches
1000	114	55%	63	617	45%	277	$100,000	Merritt Island
1014	114	55%	63	740	45%	333	$100,000	Beaches
1120	110	55%	61	695	45%	313	$100,000	Merritt Island
1098	109	55%	60	759	45%	341	$100,000	Beaches
1371	108	55%	60	608	45%	273	$100,000	Beaches
1018	103	55%	56	864	45%	389	$100,000	Beaches
1332	102	55%	56	673	45%	303	$100,000	Merritt Island
1125	102	55%	56	683	45%	307	$100,000	Merritt Island
1152	101	55%	56	545	45%	245	$100,000	Merritt Island
1296	99	55%	54	535	45%	241	$100,000	Merritt Island
1346	98	55%	54	421	45%	189	$100,000	Beaches
1082	98	55%	54	586	45%	264	$100,000	Beaches

Basin	Five-Month TN Load (lbs/yr)	TN % Efficiency	Five-Month TN Reductions (lbs/yr)	Annual TN Load (lbs/yr)	TN % Efficiency	Annual TN Reductions (lbs/yr)	Estimated Cost	Area
1121	97	55%	53	412	45%	186	$100,000	Beaches
1183	96	55%	53	604	45%	272	$100,000	Merritt Island
1250	90	55%	49	417	45%	188	$100,000	Merritt Island
1041	84	55%	46	606	45%	273	$100,000	Beaches
925	80	55%	44	579	45%	261	$100,000	Merritt Island
912	78	55%	43	2,279	45%	1,025	$100,000	Merritt Island
1270	72	55%	40	415	45%	187	$100,000	Merritt Island
1314	68	55%	38	379	45%	170	$100,000	Merritt Island
1302	66	55%	36	382	45%	172	$100,000	Beaches
1303	64	55%	35	369	45%	166	$100,000	Merritt Island
1167	64	55%	35	400	45%	180	$100,000	Beaches
1188	62	55%	34	368	45%	166	$100,000	Beaches
958	58	55%	32	364	45%	164	$100,000	Merritt Island
1311	53	55%	29	231	45%	104	$100,000	Merritt Island
1351	52	55%	29	287	45%	129	$100,000	Beaches
1319	51	55%	28	259	45%	117	$100,000	Merritt Island
1038	51	55%	28	349	45%	157	$100,000	Merritt Island
1305	50	55%	28	263	45%	119	$100,000	Merritt Island
1159	48	55%	26	297	45%	134	$100,000	Merritt Island
1225	45	55%	25	272	45%	122	$100,000	Merritt Island
865	45	55%	25	1,008	45%	454	$100,000	Merritt Island
1070	43	55%	24	251	45%	113	$100,000	Merritt Island
1048	31	55%	17	237	45%	107	$100,000	Merritt Island

Note: Projects with strikethrough were removed as part of the 2018 and 2019 Plan Updates because they could not be easily treated or are basins where the County and local governments already have projects. Projects listed below the bold line in the table were added as part of the 2019 Plan Update as additional locations for stormwater treatment.

Table E-1: Summary of Potential TN Reductions for Stormwater Project Basins in Banana River Lagoon

Basin	Five-Month TN Load (lbs/yr)	TN % Efficiency	Five-Month TN Reductions (lbs/yr)	Annual TN Load (lbs/yr)	TN % Efficiency	Annual TN Reductions (lbs/yr)	Estimated Cost	Area
~~979~~	~~1,549~~	~~55%~~	~~852~~	~~7,277~~	~~45%~~	~~3,275~~	~~Removed~~	~~Removed~~
~~1280~~	~~1,102~~	~~55%~~	~~606~~	~~3,855~~	~~45%~~	~~1,735~~	~~Removed~~	~~Removed~~
973	827	55%	455	4,552	45%	2,048	$175,000	Merritt Island
963	796	55%	438	4,649	45%	2,092	$150,000	Beaches
~~905~~	~~925~~	~~55%~~	~~509~~	~~2,540~~	~~45%~~	~~1,143~~	~~Removed~~	~~Removed~~
901	653	55%	359	3,685	45%	1,658	$150,000	Merritt Island
~~522~~	~~721~~	~~55%~~	~~397~~	~~1,766~~	~~45%~~	~~795~~	~~Removed~~	~~Removed~~
1317	555	55%	305	3,730	45%	1,679	$125,000	Beaches
650	547	55%	301	2,766	45%	1,245	$125,000	Merritt Island
1366	526	55%	289	3,295	45%	1,483	$100,000	Beaches
1343	483	55%	266	3,084	45%	1,388	$100,000	Beaches
~~492~~	~~613~~	~~55%~~	~~337~~	~~2,266~~	~~45%~~	~~1,020~~	~~Removed~~	~~Removed~~
476	461	55%	253	2,005	45%	902	$100,000	Beaches
1329	448	55%	246	2,916	45%	1,312	$100,000	Beaches
1350	446	55%	245	2,330	45%	1,049	$100,000	Beaches
815	432	55%	238	1,551	45%	698	$100,000	Beaches
992	429	55%	236	2,764	45%	1,244	$100,000	Merritt Island
388	420	55%	231	3,089	45%	1,390	$100,000	Beaches
1304	419	55%	231	2,562	45%	1,153	$100,000	Beaches
989	412	55%	227	2,290	45%	1,030	$100,000	Merritt Island
539	411	55%	226	2,474	45%	1,113	$100,000	Merritt Island
1071	403	55%	222	2,403	45%	1,082	$100,000	Merritt Island
350	400	55%	220	1,972	45%	888	$100,000	Beaches
1337	399	55%	220	2,492	45%	1,121	$100,000	Beaches
~~1063~~	~~513~~	~~55%~~	~~282~~	~~2,744~~	~~45%~~	~~1,235~~	~~Removed~~	~~Removed~~
1265	391	55%	215	1,652	45%	743	$100,000	Beaches
1222	388	55%	213	1,974	45%	888	$100,000	Merritt Island
1066	380	55%	209	2,575	45%	1,159	$100,000	Merritt Island
1172	379	55%	209	1,893	45%	852	$100,000	Merritt Island
~~820~~	~~490~~	~~55%~~	~~269~~	~~1,327~~	~~45%~~	~~597~~	~~Removed~~	~~Removed~~
~~970~~	~~488~~	~~55%~~	~~269~~	~~2,427~~	~~45%~~	~~1,092~~	~~Removed~~	~~Removed~~
~~995~~	~~477~~	~~55%~~	~~262~~	~~2,328~~	~~45%~~	~~1,048~~	~~Removed~~	~~Removed~~
998	365	55%	201	2,658	45%	1,196	$100,000	Merritt Island
451	364	55%	200	2,595	45%	1,168	$100,000	Merritt Island
943	363	55%	199	1,574	45%	708	$100,000	Beaches
~~821~~	~~463~~	~~55%~~	~~254~~	~~1,394~~	~~45%~~	~~627~~	~~Removed~~	~~Removed~~
~~705~~	~~460~~	~~55%~~	~~253~~	~~1,445~~	~~45%~~	~~650~~	~~Removed~~	~~Removed~~
~~1309~~	~~457~~	~~55%~~	~~251~~	~~2,257~~	~~45%~~	~~1,016~~	~~Removed~~	~~Removed~~
497	339	55%	186	2,374	45%	1,068	$100,000	Merritt Island
~~754~~	~~438~~	~~55%~~	~~578~~	~~1,631~~	~~45%~~	~~734~~	~~Removed~~	~~Removed~~
~~602~~	~~435~~	~~55%~~	~~574~~	~~2,374~~	~~45%~~	~~1,068~~	~~Removed~~	~~Removed~~
1187	332	55%	183	1,472	45%	662	$100,000	Merritt Island
1026	331	55%	182	2,385	45%	1,073	$100,000	Beaches
1002	318	55%	175	2,625	45%	1,181	$100,000	Merritt Island
940	308	55%	169	1,812	45%	816	$100,000	Merritt Island
981	306	55%	168	2,207	45%	993	$100,000	Beaches
1328	302	55%	166	1,371	45%	617	$100,000	Beaches
980	302	55%	166	1,858	45%	836	$100,000	Merritt Island
1142	296	55%	163	1,186	45%	534	$100,000	Beaches
997	276	55%	152	2,033	45%	915	$100,000	Merritt Island
944	275	55%	151	1,363	45%	614	$100,000	Merritt Island
1334	273	55%	150	1,766	45%	795	$100,000	Beaches
1372	271	55%	149	1,599	45%	720	$100,000	Beaches
1016	267	55%	147	2,045	45%	920	$100,000	Merritt Island

Corrected Table E-1 & E-2

Draft Save Our Indian River Lagoon Project Plan 2019 Update, January 2019

Basin	Five-Month TN Load (lbs/yr)	TN % Efficiency	Five-Month TN Reductions (lbs/yr)	Annual TN Load (lbs/yr)	TN % Efficiency	Annual TN Reductions (lbs/yr)	Estimated Cost	Area
1039	263	55%	145	1,573	45%	708	$100,000	Merritt Island
1378	258	55%	142	1,654	45%	744	$100,000	Beaches
1124	258	55%	142	1,514	45%	681	$100,000	Merritt Island
982	248	55%	137	1,427	45%	642	$100,000	Merritt Island
990	239	55%	131	1,409	45%	634	$100,000	Merritt Island
1104	223	55%	123	1,558	45%	701	$100,000	Beaches
984	223	55%	122	1,263	45%	569	$100,000	Merritt Island
1033	219	55%	121	2,473	45%	1,113	$100,000	Merritt Island
977	211	55%	116	1,241	45%	558	$100,000	Merritt Island
1251	204	55%	112	997	45%	448	$100,000	Merritt Island
961	203	55%	112	958	45%	431	$100,000	Merritt Island
938	202	55%	111	942	45%	424	$100,000	Merritt Island
969	201	55%	111	1,174	45%	528	$100,000	Merritt Island
960	199	55%	109	1,194	45%	537	$100,000	Merritt Island
955	197	55%	108	1,161	45%	522	$100,000	Merritt Island
1336	193	55%	106	1,045	45%	470	$100,000	Beaches
1223	188	55%	103	1,247	45%	561	$100,000	Beaches
1262	187	55%	103	985	45%	443	$100,000	Merritt Island
1067	187	55%	103	1,028	45%	463	$100,000	Merritt Island
975	182	55%	100	1,159	45%	521	$100,000	Merritt Island
988	180	55%	99	1,379	45%	621	$100,000	Beaches
1310	179	55%	99	1,295	45%	583	$100,000	Beaches
889	178	55%	98	1,197	45%	539	$100,000	Merritt Island
1037	176	55%	97	1,184	45%	533	$100,000	Merritt Island
1362	175	55%	96	1,057	45%	476	$100,000	Beaches
2421	171	55%	94	763	45%	343	$100,000	Merritt Island
1024	167	55%	92	1,353	45%	609	$100,000	Merritt Island
1133	163	55%	90	1,249	45%	562	$100,000	Beaches
1231	158	55%	87	667	45%	300	$100,000	Merritt Island
1175	155	55%	85	875	45%	394	$100,000	Beaches
1010	153	55%	84	832	45%	374	$100,000	Merritt Island
1220	151	55%	83	880	45%	396	$100,000	Merritt Island
1338	151	55%	83	568	45%	256	$100,000	Beaches
829	148	55%	82	1,399	45%	630	$100,000	Merritt Island
957	145	55%	80	1,302	45%	586	$100,000	Merritt Island
1001	144	55%	79	891	45%	401	$100,000	Merritt Island
1327	137	55%	75	783	45%	352	$100,000	Merritt Island
1248	136	55%	75	680	45%	306	$100,000	Merritt Island
934	136	55%	75	810	45%	365	$100,000	Merritt Island
933	132	55%	73	672	45%	302	$100,000	Beaches
1198	131	55%	72	811	45%	365	$100,000	Beaches
1117	130	55%	72	627	45%	282	$100,000	Beaches
929	118	55%	65	676	45%	304	$100,000	Merritt Island
1357	115	55%	63	751	45%	338	$100,000	Beaches
1000	114	55%	63	617	45%	277	$100,000	Merritt Island
1014	114	55%	63	740	45%	333	$100,000	Beaches
1120	110	55%	61	695	45%	313	$100,000	Merritt Island
1098	109	55%	60	759	45%	341	$100,000	Beaches
1371	108	55%	60	608	45%	273	$100,000	Beaches
1018	103	55%	56	864	45%	389	$100,000	Beaches
1332	102	55%	56	673	45%	303	$100,000	Merritt Island
1125	102	55%	56	683	45%	307	$100,000	Merritt Island
1152	101	55%	56	545	45%	245	$100,000	Merritt Island
1296	99	55%	54	535	45%	241	$100,000	Merritt Island
1346	98	55%	54	421	45%	189	$100,000	Beaches
1082	98	55%	54	586	45%	264	$100,000	Beaches

Basin	Five-Month TN Load (lbs/yr)	TN % Efficiency	Five-Month TN Reductions (lbs/yr)	Annual TN Load (lbs/yr)	TN % Efficiency	Annual TN Reductions (lbs/yr)	Estimated Cost	Area
1121	97	55%	53	412	45%	186	$100,000	Beaches
1183	96	55%	53	604	45%	272	$100,000	Merritt Island
1250	90	55%	49	417	45%	188	$100,000	Merritt Island
1041	84	55%	46	606	45%	273	$100,000	Beaches
925	80	55%	44	579	45%	261	$100,000	Merritt Island
912	78	55%	43	2,279	45%	1,025	$100,000	Merritt Island
1270	72	55%	40	415	45%	187	$100,000	Merritt Island
1314	68	55%	38	379	45%	170	$100,000	Merritt Island
1302	66	55%	36	382	45%	172	$100,000	Beaches
1303	64	55%	35	369	45%	166	$100,000	Merritt Island
1167	64	55%	35	400	45%	180	$100,000	Beaches
1188	62	55%	34	368	45%	166	$100,000	Beaches
958	58	55%	32	364	45%	164	$100,000	Merritt Island
1311	53	55%	29	231	45%	104	$100,000	Merritt Island
1351	52	55%	29	287	45%	129	$100,000	Beaches
1319	51	55%	28	259	45%	117	$100,000	Merritt Island
1038	51	55%	28	349	45%	157	$100,000	Merritt Island
1305	50	55%	28	263	45%	119	$100,000	Merritt Island
1159	48	55%	26	297	45%	134	$100,000	Merritt Island
1225	45	55%	25	272	45%	122	$100,000	Merritt Island
865	45	55%	25	1,008	45%	454	$100,000	Merritt Island
1070	43	55%	24	251	45%	113	$100,000	Merritt Island
1048	31	55%	17	237	45%	107	$100,000	Merritt Island

Note: Projects with strikethrough were removed as part of the 2018 and 2019 Plan Updates because they could not be easily treated or are basins where the County and local governments already have projects. Projects listed below the bold line in the table were added as part of the 2019 Plan Update as additional locations for stormwater treatment.

Table E-2: Summary of Potential TP Reductions for Stormwater Project Basins in Banana River Lagoon

Basin	Five-Month TP Load (lbs/yr)	TP % Efficiency	Five-Month TP Reductions (lbs/yr)	Annual TP Load (lbs/yr)	TP % Efficiency	Annual TP Reductions (lbs/yr)	Estimated Cost	Area
~~979~~	~~213~~	~~65%~~	~~139~~	~~997~~	~~45%~~	~~448~~	~~Removed~~	~~Removed~~
~~1280~~	~~152~~	~~65%~~	~~99~~	~~525~~	~~45%~~	~~236~~	~~Removed~~	~~Removed~~
973	114	65%	74	691	45%	311	$175,000	Merritt Island
963	110	65%	71	880	45%	396	$150,000	Beaches
~~905~~	~~127~~	~~65%~~	~~83~~	~~395~~	~~45%~~	~~178~~	~~Removed~~	~~Removed~~
901	90	65%	58	435	45%	196	$150,000	Merritt Island
~~522~~	~~99~~	~~65%~~	~~65~~	~~245~~	~~45%~~	~~110~~	~~Removed~~	~~Removed~~
1317	75	65%	49	317	45%	143	$125,000	Beaches
650	75	65%	49	317	45%	143	$125,000	Merritt Island
1366	72	65%	47	537	45%	242	$100,000	Beaches
1343	66	65%	43	315	45%	142	$100,000	Beaches
~~492~~	~~84~~	~~65%~~	~~55~~	~~260~~	~~45%~~	~~117~~	~~Removed~~	~~Removed~~
476	63	65%	41	240	45%	108	$100,000	Beaches
1329	62	65%	40	469	45%	211	$100,000	Beaches
1350	61	65%	40	368	45%	165	$100,000	Beaches
815	59	65%	39	250	45%	113	$100,000	Beaches
992	59	65%	38	433	45%	195	$100,000	Merritt Island
388	58	65%	38	307	45%	138	$100,000	Beaches
1304	58	65%	38	385	45%	173	$100,000	Beaches
989	57	65%	37	244	45%	110	$100,000	Merritt Island
539	57	65%	37	258	45%	116	$100,000	Merritt Island
1071	56	65%	36	319	45%	144	$100,000	Merritt Island
350	55	65%	36	238	45%	107	$100,000	Beaches
1337	55	65%	36	413	45%	186	$100,000	Beaches
~~1063~~	~~71~~	~~65%~~	~~46~~	~~426~~	~~45%~~	~~192~~	~~Removed~~	~~Removed~~
1265	54	65%	35	219	45%	98	$100,000	Beaches
1222	53	65%	35	380	45%	171	$100,000	Merritt Island
1066	52	65%	34	413	45%	186	$100,000	Merritt Island
1172	52	65%	34	274	45%	123	$100,000	Merritt Island
~~820~~	~~67~~	~~65%~~	~~44~~	~~249~~	~~45%~~	~~112~~	~~Removed~~	~~Removed~~
~~970~~	~~67~~	~~65%~~	~~44~~	~~410~~	~~45%~~	~~185~~	~~Removed~~	~~Removed~~
~~995~~	~~66~~	~~65%~~	~~43~~	~~376~~	~~45%~~	~~169~~	~~Removed~~	~~Removed~~
998	50	65%	33	420	45%	189	$100,000	Merritt Island
451	50	65%	33	270	45%	121	$100,000	Merritt Island
943	50	65%	32	200	45%	90	$100,000	Beaches
~~821~~	~~64~~	~~65%~~	~~41~~	~~274~~	~~45%~~	~~123~~	~~Removed~~	~~Removed~~
~~705~~	~~63~~	~~65%~~	~~41~~	~~210~~	~~45%~~	~~95~~	~~Removed~~	~~Removed~~
~~1309~~	~~63~~	~~65%~~	~~41~~	~~338~~	~~45%~~	~~152~~	~~Removed~~	~~Removed~~
497	47	65%	30	249	45%	112	$100,000	Merritt Island
~~754~~	~~60~~	~~65%~~	~~39~~	~~211~~	~~45%~~	~~95~~	~~Removed~~	~~Removed~~
~~602~~	~~60~~	~~65%~~	~~39~~	~~241~~	~~45%~~	~~109~~	~~Removed~~	~~Removed~~
1187	46	65%	30	181	45%	82	$100,000	Merritt Island
1026	46	65%	30	401	45%	180	$100,000	Beaches
1002	44	65%	28	353	45%	159	$100,000	Merritt Island
940	42	65%	28	236	45%	106	$100,000	Merritt Island
981	42	65%	27	397	45%	179	$100,000	Beaches
1328	42	65%	27	198	45%	89	$100,000	Beaches
980	42	65%	27	282	45%	127	$100,000	Merritt Island
1142	41	65%	26	163	45%	73	$100,000	Beaches
997	38	65%	25	331	45%	149	$100,000	Merritt Island
944	38	65%	25	185	45%	83	$100,000	Merritt Island
1334	38	65%	24	289	45%	130	$100,000	Beaches
1372	37	65%	24	252	45%	113	$100,000	Beaches

Corrected Table E-1 & E-2

Draft Save Our Indian River Lagoon Project Plan 2019 Update, January 2019

Basin	Five-Month TP Load (lbs/yr)	TP % Efficiency	Five-Month TP Reductions (lbs/yr)	Annual TP Load (lbs/yr)	TP % Efficiency	Annual TP Reductions (lbs/yr)	Estimated Cost	Area
1016	37	65%	24	302	45%	136	$100,000	Merritt Island
1039	36	65%	24	231	45%	104	$100,000	Merritt Island
1378	36	65%	23	232	45%	104	$100,000	Beaches
1124	36	65%	23	219	45%	99	$100,000	Merritt Island
982	34	65%	22	150	45%	68	$100,000	Merritt Island
990	33	65%	21	226	45%	102	$100,000	Merritt Island
1104	31	65%	20	236	45%	106	$100,000	Beaches
984	31	65%	20	133	45%	60	$100,000	Merritt Island
1033	30	65%	20	338	45%	152	$100,000	Merritt Island
977	29	65%	19	131	45%	59	$100,000	Merritt Island
1251	28	65%	18	146	45%	66	$100,000	Merritt Island
961	28	65%	18	127	45%	57	$100,000	Merritt Island
938	28	65%	18	356	45%	160	$100,000	Merritt Island
969	28	65%	18	174	45%	78	$100,000	Merritt Island
960	27	65%	18	178	45%	80	$100,000	Merritt Island
955	27	65%	18	134	45%	60	$100,000	Merritt Island
1336	27	65%	17	151	45%	68	$100,000	Beaches
1223	26	65%	17	191	45%	86	$100,000	Beaches
1262	26	65%	17	179	45%	80	$100,000	Merritt Island
1067	26	65%	17	148	45%	67	$100,000	Merritt Island
975	25	65%	16	166	45%	75	$100,000	Merritt Island
988	25	65%	16	241	45%	108	$100,000	Beaches
1310	25	65%	16	235	45%	106	$100,000	Beaches
889	24	65%	16	189	45%	85	$100,000	Merritt Island
1037	24	65%	16	234	45%	105	$100,000	Merritt Island
1362	24	65%	16	157	45%	71	$100,000	Beaches
2421	24	65%	15	109	45%	49	$100,000	Merritt Island
1024	23	65%	15	235	45%	106	$100,000	Merritt Island
1133	22	65%	15	199	45%	90	$100,000	Beaches
1231	22	65%	14	129	45%	58	$100,000	Merritt Island
1175	21	65%	14	92	45%	42	$100,000	Beaches
1010	21	65%	14	122	45%	55	$100,000	Merritt Island
1220	21	65%	14	136	45%	61	$100,000	Merritt Island
1338	21	65%	14	82	45%	37	$100,000	Beaches
829	20	65%	13	321	45%	145	$100,000	Merritt Island
957	20	65%	13	119	45%	53	$100,000	Merritt Island
1001	20	65%	13	120	45%	54	$100,000	Merritt Island
1327	19	65%	12	116	45%	52	$100,000	Merritt Island
1248	19	65%	12	102	45%	46	$100,000	Merritt Island
934	19	65%	12	93	45%	42	$100,000	Merritt Island
933	18	65%	12	85	45%	38	$100,000	Beaches
1198	18	65%	12	138	45%	62	$100,000	Beaches
1117	18	65%	12	95	45%	43	$100,000	Beaches
929	16	65%	11	90	45%	41	$100,000	Merritt Island
1357	16	65%	10	124	45%	56	$100,000	Beaches
1000	16	65%	10	90	45%	40	$100,000	Merritt Island
1014	16	65%	10	110	45%	50	$100,000	Beaches
1120	15	65%	10	110	45%	50	$100,000	Merritt Island
1098	15	65%	10	117	45%	53	$100,000	Beaches
1371	15	65%	10	88	45%	39	$100,000	Beaches
1018	14	65%	9	121	45%	54	$100,000	Beaches
1332	14	65%	9	104	45%	47	$100,000	Merritt Island
1125	14	65%	9	113	45%	51	$100,000	Merritt Island
1152	14	65%	9	66	45%	30	$100,000	Merritt Island
1296	14	65%	9	108	45%	48	$100,000	Merritt Island
1346	13	65%	9	62	45%	28	$100,000	Beaches

Basin	Five-Month TP Load (lbs/yr)	TP % Efficiency	Five-Month TP Reductions (lbs/yr)	Annual TP Load (lbs/yr)	TP % Efficiency	Annual TP Reductions (lbs/yr)	Estimated Cost	Area
1082	13	65%	9	87	45%	39	$100,000	Beaches
1121	13	65%	9	61	45%	27	$100,000	Beaches
1183	13	65%	9	87	45%	39	$100,000	Merritt Island
1250	12	65%	8	58	45%	26	$100,000	Merritt Island
1041	12	65%	7	105	45%	47	$100,000	Beaches
925	11	65%	7	44	45%	20	$100,000	Merritt Island
912	11	65%	7	76	45%	34	$100,000	Merritt Island
1270	10	65%	6	62	45%	28	$100,000	Merritt Island
1314	9	65%	6	57	45%	26	$100,000	Merritt Island
1302	9	65%	6	56	45%	25	$100,000	Beaches
1303	9	65%	6	54	45%	24	$100,000	Merritt Island
1167	9	65%	6	62	45%	28	$100,000	Beaches
1188	9	65%	6	65	45%	29	$100,000	Beaches
958	8	65%	5	58	45%	26	$100,000	Merritt Island
1311	7	65%	5	33	45%	15	$100,000	Merritt Island
1351	7	65%	5	41	45%	19	$100,000	Beaches
1319	7	65%	5	36	45%	16	$100,000	Merritt Island
1038	7	65%	5	55	45%	25	$100,000	Merritt Island
1305	7	65%	4	57	45%	25	$100,000	Merritt Island
1159	7	65%	4	44	45%	20	$100,000	Merritt Island
1225	6	65%	4	43	45%	19	$100,000	Merritt Island
865	6	65%	4	336	45%	151	$100,000	Merritt Island
1070	6	65%	4	26	45%	12	$100,000	Merritt Island
1048	4	65%	3	45	45%	20	$100,000	Merritt Island

Note: Projects with strikethrough were removed as part of the 2018 and 2019 Plan Updates because they could not be easily treated or are basins where the County and local governments already have projects. Projects listed below the bold line in the table were added as part of the 2019 Plan Update as additional locations for stormwater treatment.

Basin	Five-Month TN Load (lbs/yr)	TN % Efficiency	Five-Month TN Reductions (lbs/yr)	Annual TN Load (lbs/yr)	TN % Efficiency	Annual TN Reductions (lbs/yr)	Estimated Cost	Area
1113	191	55%	105	925	45%	416	$100,000	Mainland
1259	189	55%	104	999	45%	450	$100,000	Mainland
512	189	55%	104	808	45%	364	$100,000	Mainland
1491	189	55%	104	1,424	45%	641	$100,000	Mainland
1312	188	55%	104	1,220	45%	549	$100,000	Mainland
1262	187	55%	103	985	45%	443	$100,000	Merritt Island
1067	187	55%	103	1,028	45%	463	$100,000	Merritt Island
2419	184	55%	101	847	45%	381	$100,000	Mainland
1224	184	55%	101	892	45%	401	$100,000	Mainland
993	184	55%	101	1,357	45%	611	$100,000	Mainland
212	182	55%	100	1,541	45%	693	$100,000	Mainland
353	554	55%	98	1,105	45%	497	$100,000	Mainland
889	552	55%	98	1,197	45%	539	$100,000	Merritt Island
1398	550	55%	97	999	45%	449	$100,000	Beaches
1413	548	55%	97	1,174	45%	528	$100,000	Mainland
1037	547	55%	97	1,184	45%	533	$100,000	Merritt Island
544	538	55%	95	1,387	45%	624	$100,000	Mainland
2421	530	55%	94	763	45%	343	$100,000	Merritt Island
871	525	55%	93	814	45%	366	$100,000	Merritt Island
105	523	55%	93	1,220	45%	549	$100,000	Mainland
578	514	55%	91	955	45%	430	$100,000	Mainland
1428	511	55%	91	978	45%	440	$100,000	Beaches
1128	506	55%	90	620	45%	279	$100,000	Mainland
6	163	55%	89	1,434	45%	645	$100,000	Mainland
510	162	55%	89	1,302	45%	586	$100,000	Mainland
884	161	55%	89	972	45%	437	$100,000	Mainland
902	161	55%	89	613	45%	276	$100,000	Merritt Island
83	158	55%	87	1,005	45%	452	$100,000	Mainland
1231	158	55%	87	667	45%	300	$100,000	Merritt Island
1073	155	55%	85	952	45%	428	$100,000	Mainland
291	155	55%	85	1,078	45%	485	$100,000	Mainland
862	154	55%	85	924	45%	416	$100,000	Mainland
1029	152	55%	84	1,522	45%	685	$100,000	Mainland
1220	151	55%	83	880	45%	396	$100,000	Merritt Island
1027	150	55%	82	1,244	45%	560	$100,000	Mainland
829	148	55%	82	1,399	45%	630	$100,000	Merritt Island

Note: Projects with strikethrough were removed as part of the 2018 and 2019 Plan Updates because they could not be easily treated or are basins where the County and local governments already have projects. Projects listed below the bold line in the table were added as part of the 2019 Plan Update as additional locations for stormwater treatment.

Table E-4: Summary of Potential TP Reductions for Stormwater Project Basins in North IRL

Basin	Five-Month TP Load (lbs/yr)	TP % Efficiency	Five-Month TP Reductions (lbs/yr)	Annual TP Load (lbs/yr)	TP % Efficiency	Annual TP Reductions (lbs/yr)	Estimated Cost	Area
1273	122	65%	80	640	45%	288	$175,000	Mainland
1298	121	65%	79	511	45%	230	$175,000	Mainland
~~1430~~	~~156~~	~~65%~~	~~102~~	~~745~~	~~45%~~	~~335~~	~~Removed~~	~~Removed~~
1349	116	65%	76	721	45%	324	$175,000	Mainland
1439	111	65%	72	407	45%	183	$175,000	Mainland
1445	111	65%	72	441	45%	198	$175,000	Mainland
626	105	65%	68	430	45%	193	$150,000	Mainland
454	98	65%	64	671	45%	302	$150,000	Mainland
1416	97	65%	63	508	45%	229	$150,000	Mainland
1324	97	65%	63	391	45%	176	$150,000	Mainland
1077	95	65%	62	641	45%	289	$150,000	Mainland
1256	93	65%	60	533	45%	240	$150,000	Mainland
1335	84	65%	55	578	45%	260	$125,000	Mainland
1419	83	65%	54	594	45%	267	$125,000	Mainland
1409	81	65%	53	455	45%	205	$125,000	Beaches
1377	76	65%	50	546	45%	246	$125,000	Mainland
~~327~~	~~98~~	~~65%~~	~~64~~	~~629~~	~~45%~~	~~283~~	~~Removed~~	~~Removed~~
1342	74	65%	48	386	45%	174	$125,000	Mainland
~~219~~	~~91~~	~~65%~~	~~59~~	~~251~~	~~45%~~	~~113~~	~~Removed~~	~~Removed~~
~~47~~	~~91~~	~~65%~~	~~59~~	~~309~~	~~45%~~	~~139~~	~~Removed~~	~~Removed~~
1434	70	65%	45	248	45%	112	$125,000	Mainland
1151	70	65%	45	314	45%	141	$125,000	Mainland
1078	70	65%	45	416	45%	187	$125,000	Merritt Island
1399	69	65%	45	569	45%	256	$125,000	Mainland
1301	69	65%	45	342	45%	154	$125,000	Mainland
1368	69	65%	45	445	45%	200	$125,000	Mainland
408	68	65%	44	378	45%	170	$125,000	Mainland
~~338~~	~~87~~	~~65%~~	~~57~~	~~418~~	~~45%~~	~~188~~	~~Removed~~	~~Removed~~
1367	66	65%	43	324	45%	146	$100,000	Mainland
1384	66	65%	43	315	45%	142	$100,000	Beaches
1318	65	65%	42	328	45%	148	$100,000	Mainland
~~155~~	~~82~~	~~65%~~	~~53~~	~~271~~	~~45%~~	~~122~~	~~Removed~~	~~Removed~~
289	63	65%	41	495	45%	223	$100,000	Mainland
193	62	65%	40	440	45%	198	$100,000	Mainland
1441	61	65%	40	331	45%	149	$100,000	Mainland
660	61	65%	40	470	45%	212	$100,000	Mainland
952	61	65%	40	471	45%	212	$100,000	Mainland
335	60	65%	39	458	45%	206	$100,000	Mainland
1081	60	65%	39	467	45%	210	$100,000	Mainland
992	59	65%	38	433	45%	195	$100,000	Merritt Island
1381	58	65%	38	383	45%	172	$100,000	Mainland
1463	58	65%	38	433	45%	195	$100,000	Mainland
290	57	65%	37	429	45%	193	$100,000	Mainland
1213	57	65%	37	292	45%	131	$100,000	Mainland
1418	56	65%	36	248	45%	111	$100,000	Mainland
513	56	65%	36	406	45%	183	$100,000	Mainland
1071	56	65%	36	319	45%	144	$100,000	Merritt Island
1359	55	65%	36	315	45%	142	$100,000	Mainland
1339	54	65%	35	228	45%	103	$100,000	Mainland
987	54	65%	35	381	45%	172	$100,000	Mainland
1348	54	65%	35	226	45%	102	$100,000	Mainland
624	54	65%	35	297	45%	134	$100,000	Mainland
1222	53	65%	35	380	45%	171	$100,000	Merritt Island

Basin	Five-Month TP Load (lbs/yr)	TP % Efficiency	Five-Month TP Reductions (lbs/yr)	Annual TP Load (lbs/yr)	TP % Efficiency	Annual TP Reductions (lbs/yr)	Estimated Cost	Area
1392	53	65%	35	438	45%	197	$100,000	Mainland
1331	53	65%	35	352	45%	159	$100,000	Mainland
594	53	65%	34	300	45%	135	$100,000	Mainland
89	53	65%	34	327	45%	147	$100,000	Mainland
1401	52	65%	34	327	45%	147	$100,000	Mainland
1172	52	65%	34	274	45%	123	$100,000	Merritt Island
644	51	65%	33	209	45%	94	$100,000	Mainland
1330	51	65%	33	198	45%	89	$100,000	Mainland
1295	50	65%	33	270	45%	121	$100,000	Mainland
1380	50	65%	32	297	45%	134	$100,000	Mainland
1112	49	65%	32	370	45%	166	$100,000	Mainland
262	49	65%	32	279	45%	126	$100,000	Mainland
597	47	65%	31	315	45%	142	$100,000	Mainland
833	47	65%	31	411	45%	185	$100,000	Mainland
1396	46	65%	30	376	45%	169	$100,000	Mainland
1387	45	65%	29	397	45%	179	$100,000	Mainland
1244	44	65%	29	174	45%	78	$100,000	Mainland
100	44	65%	29	255	45%	115	$100,000	Mainland
1002	44	65%	28	353	45%	159	$100,000	Merritt Island
1294	44	65%	28	209	45%	94	$100,000	Mainland
1214	43	65%	28	186	45%	84	$100,000	Mainland
94	43	65%	28	301	45%	136	$100,000	Mainland
1391	43	65%	28	316	45%	142	$100,000	Mainland
1458	43	65%	28	301	45%	135	$100,000	Mainland
940	42	65%	28	236	45%	106	$100,000	Merritt Island
832	42	65%	27	327	45%	147	$100,000	Mainland
840	42	65%	27	187	45%	84	$100,000	Merritt Island
1034	42	65%	27	294	45%	132	$100,000	Mainland
980	42	65%	27	282	45%	127	$100,000	Merritt Island
26	41	65%	27	287	45%	129	$100,000	Mainland
288	41	65%	27	174	45%	78	$100,000	Merritt Island
1240	41	65%	27	223	45%	100	$100,000	Mainland
677	41	65%	27	302	45%	136	$100,000	Mainland
903	40	65%	26	196	45%	88	$100,000	Merritt Island
1456	40	65%	26	304	45%	137	$100,000	Mainland
1459	40	65%	26	293	45%	132	$100,000	Beaches
115	40	65%	26	390	45%	175	$100,000	Mainland
921	39	65%	25	212	45%	96	$100,000	Merritt Island
894	39	65%	25	259	45%	116	$100,000	Merritt Island
922	39	65%	25	237	45%	107	$100,000	Mainland
1316	39	65%	25	150	45%	68	$100,000	Mainland
1197	38	65%	25	182	45%	82	$100,000	Mainland
895	38	65%	25	272	45%	122	$100,000	Merritt Island
751	38	65%	25	270	45%	121	$100,000	Mainland
1395	38	65%	25	254	45%	114	$100,000	Mainland
1313	38	65%	25	205	45%	92	$100,000	Mainland
1372	37	65%	24	252	45%	113	$100,000	Beaches
1389	37	65%	24	299	45%	134	$100,000	Mainland
1016	37	65%	24	302	45%	136	$100,000	Merritt Island
1080	37	65%	24	298	45%	134	$100,000	Mainland
985	37	65%	24	220	45%	99	$100,000	Mainland
1354	37	65%	24	192	45%	86	$100,000	Mainland
1464	37	65%	24	272	45%	122	$100,000	Mainland
1228	36	65%	24	185	45%	83	$100,000	Mainland
1039	36	65%	24	231	45%	104	$100,000	Merritt Island

Basin	Five-Month TP Load (lbs/yr)	TP % Efficiency	Five-Month TP Reductions (lbs/yr)	Annual TP Load (lbs/yr)	TP % Efficiency	Annual TP Reductions (lbs/yr)	Estimated Cost	Area
1417	36	65%	24	261	45%	117	$100,000	Mainland
1361	36	65%	23	177	45%	79	$100,000	Mainland
1378	36	65%	23	232	45%	104	$100,000	Beaches
1124	36	65%	23	219	45%	99	$100,000	Merritt Island
1426	35	65%	23	257	45%	116	$100,000	Mainland
392	35	65%	23	345	45%	155	$100,000	Mainland
1241	35	65%	22	185	45%	83	$100,000	Mainland
1219	34	65%	22	133	45%	60	$100,000	Mainland
796	34	65%	22	218	45%	98	$100,000	Mainland
806	34	65%	22	222	45%	100	$100,000	Mainland
805	34	65%	22	210	45%	94	$100,000	Mainland
294	34	65%	22	187	45%	84	$100,000	Mainland
228	34	65%	22	292	45%	131	$100,000	Mainland
911	33	65%	22	327	45%	147	$100,000	Merritt Island
1382	32	65%	21	196	45%	88	$100,000	Mainland
72	32	65%	21	312	45%	140	$100,000	Mainland
827	32	65%	21	213	45%	96	$100,000	Merritt Island
1221	31	65%	20	188	45%	85	$100,000	Mainland
1032	31	65%	20	255	45%	115	$100,000	Merritt Island
1363	31	65%	20	273	45%	123	$100,000	Mainland
939	31	65%	20	158	45%	71	$100,000	Merritt Island
1403	30	65%	20	196	45%	88	$100,000	Mainland
896	30	65%	20	274	45%	123	$100,000	Mainland
1390	30	65%	20	203	45%	92	$100,000	Mainland
1245	30	65%	20	108	45%	49	$100,000	Mainland
1033	30	65%	20	338	45%	152	$100,000	Merritt Island
1429	30	65%	20	123	45%	55	$100,000	Mainland
1425	30	65%	19	251	45%	113	$100,000	Mainland
1076	30	65%	19	203	45%	91	$100,000	Merritt Island
759	30	65%	19	217	45%	98	$100,000	Mainland
2420	30	65%	19	270	45%	121	$100,000	Mainland
263	29	65%	19	144	45%	65	$100,000	Mainland
1423	29	65%	19	162	45%	73	$100,000	Mainland
962	29	65%	19	167	45%	75	$100,000	Mainland
141	29	65%	19	275	45%	124	$100,000	Mainland
890	29	65%	19	244	45%	110	$100,000	Merritt Island
1253	28	65%	18	119	45%	54	$100,000	Mainland
838	28	65%	18	300	45%	135	$100,000	Merritt Island
1307	28	65%	18	105	45%	47	$100,000	Mainland
920	28	65%	18	193	45%	87	$100,000	Mainland
1233	28	65%	18	224	45%	101	$100,000	Mainland
1251	28	65%	18	146	45%	66	$100,000	Merritt Island
938	28	65%	18	356	45%	160	$100,000	Merritt Island
1293	28	65%	18	149	45%	67	$100,000	Mainland
1291	28	65%	18	176	45%	79	$100,000	Mainland
960	27	65%	18	178	45%	80	$100,000	Merritt Island
1150	27	65%	18	126	45%	57	$100,000	Mainland
1498	27	65%	18	166	45%	74	$100,000	Mainland
1435	27	65%	18	96	45%	43	$100,000	Mainland
1344	27	65%	18	135	45%	61	$100,000	Mainland
10	27	65%	17	216	45%	97	$100,000	Mainland
354	27	65%	17	255	45%	115	$100,000	Mainland
568	26	65%	17	190	45%	85	$100,000	Mainland
1215	26	65%	17	115	45%	52	$100,000	Mainland
1292	26	65%	17	132	45%	60	$100,000	Mainland

Basin	Five-Month TP Load (lbs/yr)	TP % Efficiency	Five-Month TP Reductions (lbs/yr)	Annual TP Load (lbs/yr)	TP % Efficiency	Annual TP Reductions (lbs/yr)	Estimated Cost	Area
1113	26	65%	17	207	45%	93	$100,000	Mainland
1259	26	65%	17	235	45%	106	$100,000	Mainland
512	26	65%	17	119	45%	53	$100,000	Mainland
1491	26	65%	17	206	45%	93	$100,000	Mainland
1312	26	65%	17	267	45%	120	$100,000	Mainland
1262	26	65%	17	179	45%	80	$100,000	Merritt Island
1067	26	65%	17	148	45%	67	$100,000	Merritt Island
2419	25	65%	16	95	45%	43	$100,000	Mainland
1224	25	65%	16	246	45%	111	$100,000	Mainland
993	25	65%	16	207	45%	93	$100,000	Mainland
212	25	65%	16	197	45%	89	$100,000	Mainland
353	25	65%	16	190	45%	86	$100,000	Mainland
889	24	65%	16	189	45%	85	$100,000	Merritt Island
1398	24	65%	16	164	45%	74	$100,000	Beaches
1413	24	65%	16	174	45%	78	$100,000	Mainland
1037	24	65%	16	234	45%	105	$100,000	Merritt Island
544	24	65%	16	219	45%	98	$100,000	Mainland
2421	24	65%	15	109	45%	49	$100,000	Merritt Island
871	23	65%	15	118	45%	53	$100,000	Merritt Island
105	23	65%	15	160	45%	72	$100,000	Mainland
578	23	65%	15	151	45%	68	$100,000	Mainland
1428	23	65%	15	145	45%	65	$100,000	Beaches
1128	22	65%	15	170	45%	77	$100,000	Mainland
6	22	65%	15	160	45%	72	$100,000	Mainland
510	22	65%	14	205	45%	92	$100,000	Mainland
884	22	65%	14	150	45%	68	$100,000	Mainland
902	22	65%	14	78	45%	35	$100,000	Merritt Island
83	22	65%	14	135	45%	61	$100,000	Mainland
1231	22	65%	14	129	45%	58	$100,000	Merritt Island
1073	21	65%	14	135	45%	61	$100,000	Mainland
291	21	65%	14	182	45%	82	$100,000	Mainland
862	21	65%	14	160	45%	72	$100,000	Mainland
1029	21	65%	14	206	45%	93	$100,000	Mainland
1220	21	65%	14	136	45%	61	$100,000	Merritt Island
1027	21	65%	13	187	45%	84	$100,000	Mainland
829	20	65%	13	321	45%	145	$100,000	Merritt Island

Note: Projects with strikethrough were removed as part of the 2018 and 2019 Plan Updates because they could not be easily treated or are basins where the County and local governments already have projects. Projects listed below the bold line in the table were added as part of the 2019 Plan Update as additional locations for stormwater treatment.

Table E-5: Summary of Potential TN Reductions for Stormwater Project Basins in Central IRL

Basin	Five-Month TN Load (lbs/yr)	TN % Efficiency	Five-Month TN Reductions (lbs/yr)	Annual TN Load (lbs/yr)	TN % Efficiency	Annual TN Reductions (lbs/yr)	Estimated Cost	Area
1562	1,527	55.0%	840	7,365	45.0%	3,314	$275,000	Mainland
1762	1,277	55.0%	703	7,061	45.0%	3,178	$225,000	Mainland
1615	1,080	55.0%	594	6,257	45.0%	2,815	$200,000	Mainland
~~1582~~	~~1,393~~	~~55.0%~~	~~766~~	~~5,338~~	~~45.0%~~	~~2,402~~	~~Removed~~	~~Removed~~
1470	1,025	55%	564	6,250	45%	2,813	$200,000	Mainland
1508	874	55%	481	5,464	45%	2,459	$200,000	Mainland
1803	831	55%	457	4,950	45%	2,227	$200,000	Mainland
1511	808	55%	444	5,534	45%	2,490	$200,000	Mainland
1439	807	55%	444	3,141	45%	1,413	$200,000	Mainland
1445	806	55%	443	3,319	45%	1,493	$200,000	Mainland
1825	733	55%	403	4,212	45%	1,896	$200,000	Mainland

Note: Projects with strikethrough were removed as part of the 2018 Plan Update because they could not be easily treated or are basins where the County and local governments already have projects. Projects listed below the bold line in the table were added as part of the 2019 Plan Update as additional locations for stormwater treatment.

Table E-6: Summary of Potential TP Reductions for Stormwater Project Basins in Central IRL

Basin	Five-Month TP Load (lbs/yr)	TP % Efficiency	Five-Month TP Reductions (lbs/yr)	Annual TP Load (lbs/yr)	TP % Efficiency	Annual TP Reductions (lbs/yr)	Estimated Cost	Area
1562	210	65.0%	137	998	45.0%	449	$275,000	Mainland
1762	176	65.0%	114	1,093	45.0%	492	$225,000	Mainland
1615	149	65.0%	97	867	45.0%	390	$200,000	Mainland
~~1582~~	~~192~~	~~65.0%~~	~~125~~	~~985~~	~~45.0%~~	~~443~~	~~Removed~~	~~Removed~~
1470	141	65%	92	1,005	45%	452	$200,000	Mainland
1508	120	65%	78	792	45%	356	$200,000	Mainland
1803	114	65%	74	707	45%	318	$200,000	Mainland
1511	111	65%	72	847	45%	381	$200,000	Mainland
1439	111	65%	72	407	45%	183	$200,000	Mainland
1445	111	65%	72	441	45%	198	$200,000	Mainland
1825	101	65%	66	877	45%	394	$200,000	Mainland

Note: Projects with strikethrough were removed as part of the 2018 Plan Update because they could not be easily treated or are basins where the County and local governments already have projects. Projects listed below the bold line in the table were added as part of the 2019 Plan Update as additional locations for stormwater treatment.

Appendix F: Seagrasses

Loss of Seagrass

In partnership, the St. Johns River Water Management District, South Florida Water Management District, and Florida Department of Environmental Protection mapped seagrass from aerial imagery taken in 1943 and every two to three years since 1986 (**Figure F-1**). Through 2009, the areal footprint of seagrass generally expanded, with some areas nearing their targets, which are benchmarks used to evaluate the success of reducing loads of nutrients to the IRL system. Unfortunately, the areal extent of seagrass in the lagoon began to decline in 2011. In 2011, mapping documented a loss of almost 43% of the acreage present in 2009. Most of this loss occurred in the reaches adjacent to Brevard County, with extensive losses in Banana River Lagoon (24,000 to 3,000 acres or an 88% reduction) and the IRL down to Sebastian Inlet (50,000 to 20,000 acres or a 60% reduction). The losses occurred during a bloom of phytoplankton (single-celled algae) that reached unprecedented concentrations for a record duration as indicated by concentrations of chlorophyll-*a* (**Figure F-2**). Beyond the shallowest water, the bloom effectively reduced the amount of light reaching seagrasses below what they required for survival. Additional intense blooms exacerbated the situation.

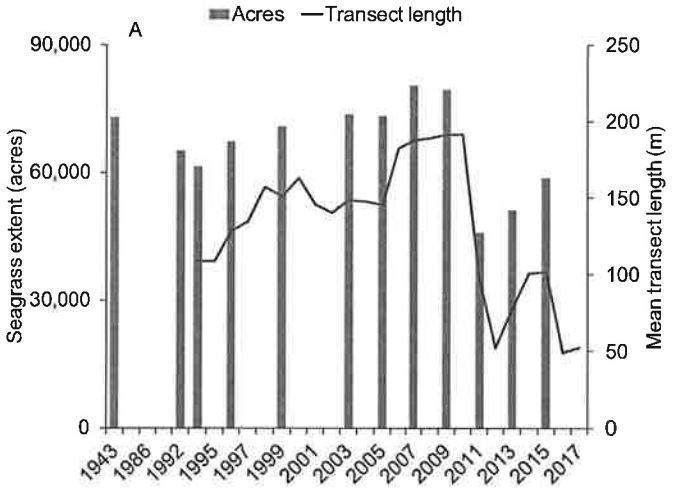


Figure F-1: Mean Areal Extent of Seagrass and Mean Length of Transects

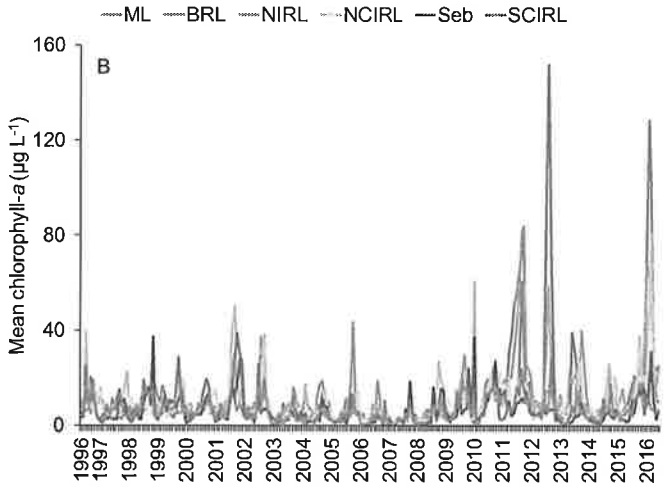
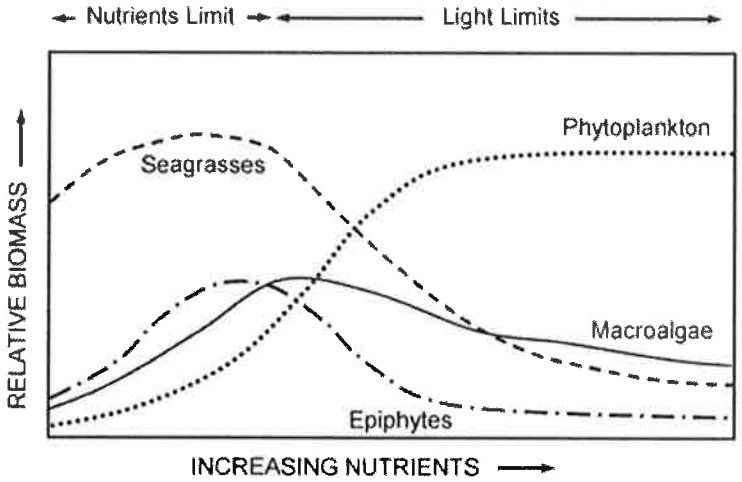


Figure F-2: Mean Chlorophyll-*a* Concentrations

Since 2011, some seagrass acreage has returned. In the IRL along Brevard County, about 9,000 acres have returned or about 30% of the 30,000 acres that were lost. In addition, there has been a similar amount of recovery in Banana River Lagoon (6,000 acres returned out of 21,000 lost or about 30% recovery). Recovery has been hampered by further blooms that include a brown tide (*Aureoumbra lagunensis*) bloom in 2016, whose effects will be apparent in maps produced from digital photography acquired in 2017. The prognosis is not good because the percentage cover of seagrass reached 5%, which is a record drop from 30–50% (**Figure F-1**).

Unfortunately, the IRL appears to be following a pattern described for systems that receive increased loads of nutrients (Duarte 1995; Burkholder et al. 2007). The pattern involves a shift in the composition of the primary producer assemblage, with higher nutrient loads differentially promoting faster growing macroalgae and ultimately phytoplankton (**Figure F-3**). The macroalgae and phytoplankton can exacerbate loss of seagrasses, especially by shading them. Loss of seagrass and macroalgae makes more nutrients available to phytoplankton, and loss of seagrass means that the sediments can be resuspended, which also reduces light penetration. Overall, the change in the system becomes self-perpetuating. Reducing nutrient loads represents a critical first step in efforts to reverse the shift in primary producers. However, a return to the previous areal coverage of seagrass may take some time, especially if too few recruits are available and sediments are too destabilized for colonization.



Note: Adapted from Burkholder et al. 2007

Figure F-3: Conceptual Model Illustrating a Shift in Biomass Among Major Primary Producers with Increasing Nutrient Enrichment

Nutrient Content of Seagrass

Halodule wrightii stores nutrients in its aboveground and belowground biological material or biomass. The biomass of this and other seagrasses changes seasonally, with peak growth of aboveground shoots occurring in April and May and the greatest aboveground biomass recorded during summer. These seasonal changes introduce uncertainty into estimates of nutrient storage, but mean values will suffice for estimating return on investment in the long-term (**Table F-1**). For example, a single shoot of *Halodule wrightii* may contain up to five or more leaves in the summer, whereas in the winter this same shoot may contain only one leaf (Dunton 1996). For this estimate of nutrient content, we will assume that spring-summer growth and fall-winter senescence are

equal. Thus, we will focus on our recent estimates of an average amount of aboveground and belowground biomass or standing stock of *Halodule wrightii* (**Table F-1** and **Table F-2**).

Table F-1: Estimates of Biomass for *Halodule* Species

Location	Total Biomass (grams dry weight per square meter)	Reference
Texas (Laguna Madre)	10–400	Zieman and Zieman 1989
North Carolina (multiple locations)	22–208	Zieman and Zieman 1989
South Florida and Tampa Bay	10–300	Zieman and Zieman 1989
IRL (Fort Pierce Inlet)	124–198	Hefferman and Gibson 1983
IRL (Grand Harbor/Vero)	45	Hefferman and Gibson 1983
IRL (Link Port)	20–140	Virnstein unpublished
IRL (Brevard County)	53*	Morris, Chamberlain, and Jacoby unpublished
Texas (Laguna Madre)	10–400	Zieman and Zieman 1989

* Mean aboveground biomass = 23 grams dry weight meters^{-2} = [(mean percent cover × 30.533) × 0.019]; mean belowground biomass = 30 grams dry weight meters^{-2} = 1.3 × aboveground biomass

Table F-2: Total Biomass in Seagrasses Along Brevard County

Sub-lagoon	Description	Total Biomass (grams dry weight per square meter)
Mosquito Lagoon	Brevard County line to southern end of sub-lagoon	74
Banana River Lagoon	National Aeronautics and Space Administration restricted area	64
Banana River Lagoon	Remainder of Banana River Lagoon	44
IRL	North of State Road 405	51
IRL	State Road 405 to Pineda Causeway	35
IRL	Pineda Causeway to Hog Point	28
IRL	Hog Point to Brevard County line	51
Mean	***Not applicable***	***50***

Duarte (1990) compared nutrient contents of 27 species of seagrass, including *Halodule wrightii*. He determined that nitrogen and phosphorus represent about 2.2% and 0.2% of the dry weight of aboveground and belowground tissue of *Halodule wrightii*, respectively. These values are similar to those calculated during a recent study in the IRL (**Table F-3**). The values can be combined with estimates of biomass to calculate how much nitrogen and phosphorus are sequestered by 100 acres of *Halodule wrightii* on average (**Table F-4**).

Table F-3: Estimates of Nutrient Content for *Halodule wrightii* (percentage of dry weight)

Location	Carbon Above Ground	Nitrogen Above Ground	Phosphorus Above Ground	Carbon Below Ground	Nitrogen Below Ground	Phosphorus Below Ground
BRL-1	29.60	2.02	0.17	30.60	1.24	0.14
BRL-2	30.60	2.36	0.24	29.08	1.47	0.27
BRL-3	29.60	2.66	0.26	28.09	1.48	0.25
IRL-1	31.74	2.39	0.18	31.69	1.42	0.15
IRL-2	30.08	2.56	0.26	30.48	1.74	0.27
IRL-3	28.26	2.08	0.25	23.86	1.36	0.20
Mean	***29.98***	***2.35***	***0.23***	***28.97***	***1.45***	***0.21***

BRL = Banana River Lagoon, IRL = Indian River Lagoon

Table F-4: Average Amount of Nutrients Contained in Seagrass from 1996–2009

Sub-lagoon	Acres	Seagrass (pounds per 100 acres)	Nitrogen (pounds per 100 acres)	Phosphorus (pounds per 100 acres)
Southern Mosquito Lagoon	14,000	45,000	1,000	100
Banana River Lagoon	21,000	45,000	1,000	100
North IRL	19,000	37,000	900	90
Central IRL	7,000	36,000	900	90

Draft Evaluation Criteria for Planting Seagrass

Part of the wisdom accumulated from past seagrass restoration projects is the importance of selecting sites that will support seagrass growth. Key information has been synthesized into an initial guide, with higher scores and more certainty indicating better sites for planting seagrass (**Table F-5**). Please note that the presence of seagrass leads to a lower score based on the premise that natural recruitment represents the most cost-effective option for restoring seagrass. In addition, a high level of uncertainty can suggest targets for further study. This guide can be refined following pilot studies to determine optimal methods for planting seagrass (e.g., type of planting units, use of chemicals to enhance growth, and density of initial planting) and protecting it from disturbance (e.g., grazing, waves, exposure, and low salinity) until it is established.

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Hefferman J.J., and R.A. Gibson. 1983. A comparison of primary production rates in Indian River, Florida seagrass systems. Florida Scientist 46: 295–306.

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Table F-5: Guide for Ranking Potential Seagrass Restoration Sites

Category	Metric	Timeframe	Attributes for Score = 0	Attributes for Score = 2	Attributes for Score = 4	Attributes for Score = 6	Score	Uncertainty (1 = low, 3 = high)
Critical Depth Zone 0.5-0.8 meters below mean sea level	Width of Critical Depth Zone (distance perpendicular to shore)	Recent	Very narrow: < 25 meters wide (< 82 feet)	Narrow: 25-50 meters (82-164 feet)	Moderately wide: 50-100 meters (164-328 feet)	Broad: > 100 meters (> 328 feet)		
Critical Depth Zone 0.5-0.8 meters below mean sea level	**Distance to seagrass (identified via the most recent map or targeted reconnaissance)**	Recent	**Continuous seagrass at site and within 1 kilometer (land use code = 9116):** seagrass is a dominant feature (restoration not needed)	Isolated: no seagrass within 1 kilometers (0.6 miles) so conditions may be unfavorable	Discontinuous seagrass at site and within 1 kilometers (land use code = 9113): seagrass is patchy, so restoration may connect patches	Seagrass nearby: seagrass within 0.5-1.0 kilometers (0.3-0.6 miles)		
Critical Depth Zone 0.5-0.8 meters below mean sea level	Percent cover in Critical Depth Zone (derived from the closest transect, paired considerations)	Past (2000-2009)	High: > 30%	Low: 10-20%	Moderate: 20-30%	High: > 30%		
Critical Depth Zone 0.5-0.8 meters below mean sea level	Percent cover in Critical Depth Zone (derived from the closest transect, paired considerations)	Last 3 Years	High: > 10% (restoration not needed)	Low: < 10% (restoration may not help)	Low: < 10% (restoration may help but ultimate gain is likely limited)	Low: < 10% (potentially optimum site for restoration)		
Potential stressors	**Water quality** (salinity and light availability derived from the closest station)	Last 3 Years	**Bad:** salinity < 10 anytime and < 18 for ³ 3 consecutive months or annual mean salinity - 1 standard deviation < 17 Secchi depth £ 0.50 meters (1.6 feet) anytime and £ 0.65 meters (2.1 feet) for ³ 3 consecutive months or annual mean Secchi depth - 1 standard deviation £ 0.65 meters	**Poor:** salinity < 18 for 3 consecutive months but never < 12 or annual mean salinity - 1 standard deviation² 17 Secchi depth £ 0.65 meters for < 3 consecutive months but never £ 0.50 meters or annual mean Secchi depth - 1 standard deviation ¹ 0.65 meters	**Supportive:** salinity always ³ 18 Secchi depth always > 0.65 meters and may be 0.65-1.0 meters (2.1-3.3 feet) for 3 consecutive months	**Good:** salinity consistently ² 23 Secchi depth consistently > 1.0 meters		
Potential stressors	**Sediment** (assessed via visits to the site or other current information)	Present	**Not supportive:** anoxic and sulfidic near the surface or easily resuspended or moved	**Minimally supportive:** hard bottom (e.g., compact sand or shells), not conducive for growth of rhizomes and roots, porewater may lack nutrients	**Generally supportive:** unconsolidated sediment that holds plants with relatively little resuspension and movement observed, porewater nutrients not limiting	**Fully supportive:** loosely consolidated sediment with firmly anchored plants if present, anoxic and sulfidic layers located below the zone occupied by roots and rhizomes, porewater rich in nutrients		
Potential stressors	**Water movement** (assessed via visits to the site or other current information)	Present	**High currents - possible scouring:** frequent and strong currents or waves that may cause ripples in the sediment and uproot new plants	**Moderate to high currents:** currents and waves bend plants, sweep fragments of seagrass away before they can gain a foothold, and cause some resuspension of sediment	**Moderate currents:** plants often stand upright, fragments of seagrass may be trapped, sediment typically not resuspended	**Low currents:** mild currents or waves, sediment not disturbed, no apparent negative effects on any seagrass that is present		
Potential stressors	**Shoreline characteristics** (assessed via visits the site or other current information)	Present	**Unnatural shoreline:** Critical Depth Zone in close proximity to urban development, including canals, and a hardened shoreline (e.g., riprap or bulkhead)	**Semi-natural shoreline:** Critical Depth Zone near moderate development and some shoreline is vegetated	**Mostly natural shoreline:** Critical Depth Zone near low to moderate development, most of the shoreline is vegetated shoreline or the site is associated with living shoreline project	**All natural shoreline:** vegetated shoreline with very limited development		
Potential stressors	**Public use** (assessed via visits to the site visits or other current information, including recent aerial photographs)	Present	**High use:** Critical Depth Zone adjacent to or within an area with frequent boating, swimming or fishing (e.g., aerial photographs show prop scars)	**Near high use:** Critical Depth Zone within 0.5 kilometers (0.3 miles) of a highly used area	**Not near high use:** Critical Depth Zone more than 0.5 kilometers from a highly used area	**Low use:** no public facilities nearby and limited signs of use		
Potential stressors	**Biota** (assessed via visits to the site or other current information on grazing or physical disturbance)	Present	**Heavy use:** site adjacent to deep water or manatee zone, power plant within 10 kilometers (6.2 miles), freshwater nearby, manatees and rays observed frequently, disturbance or grazing evident in > 50% of the area on a weekly-monthly basis	**Moderate use:** power plant > 10 kilometers away, deep water and manatee zones > 0.5 kilometers away, no freshwater nearby, disturbance or grazing evident in < 50% of the area on a monthly basis	**Intermittent use:** disturbance or grazing evident in < 25% of the area on a quarterly basis	**Rare use:** disturbance or grazing hardly evident		
Logistics	**Enhancement or protection** (assessed via visits to the site)	Present	**Extensive need:** dense planting required due to absence of seagrass, fencing or caging required due to grazing, other enhancement or protection required, including living shorelines, sediment barriers, wave baffles	**Substantial need:** moderately dense planting required because only 1-2% cover present, fencing or caging required, few additional enhancements or protections required	**Moderate need:** low density planting sufficient because at least 2% cover present, fencing or caging required for a limited time, other enhancements or protections beneficial but not critical	**Limited need:** minimal density planting or no planting required because > 2% cover present and protection from grazing may result in spread of seagrass, no other enhancements or protections required		
Logistics	**Maintenance** (assessed via visits to the site)	Anticipated	**High maintenance:** weekly cleaning	**Moderate maintenance:** monthly cleaning	**Low maintenance:** quarterly cleaning	**Minimum maintenance:** maintain as needed		
Logistics	**Staging and accessibility** (assessed via visits to the site)	Present	**Very difficult:** substantial impediments that may include boat ramps > 10 kilometer away, soft sediment that is easily disturbed, permitting and access issues	**Moderately difficult:** boat ramp within 10 kilometers, somewhat firm sediment, tractable permitting and access issues	**Relatively simple:** boat ramp nearby and few other issues	**No issues**		
Logistics	**Monitoring** (relevant past, current and future information on water quality and seagrasses available)	Present	**No external support:** no sampling of seagrass within 5 kilometers (3.1 miles), nearest water quality station not representative of conditions at the site	**Minimal external support:** seagrass surveyed within 3-5 kilometers (1.9-3.1 miles), water quality station is representative of conditions at the site	**Moderate external support:** seagrass and water quality sampled within 3 kilometers, so both are representative of conditions at the site	**Considerable external support:** seagrasses and water quality sampled at or adjacent to the site		
Total								

Notes:
Optimize potential for success by planting: a) within the Critical Depth Zone (e.g., at 0.6-0.8 meters below mean sea level) with due recognition of tides and annual changes in water levels; or b) during the spring (e.g., late March to May) when water clarity is best, water temperatures are warming, and grazing by fish is relatively low
Scoring: if conditions do not match the attributes provided, then assign a score between the two that are most applicable