



JonesEdmunds



Mosquito Lagoon Reasonable Assurance Plan (RAP) Pollutant Load-Reduction Projects Report

Volusia County and Mosquito Lagoon RAP Stakeholder Group
April 2018

**MOSQUITO LAGOON REASONABLE ASSURANCE PLAN (RAP)
POLLUTANT LOAD-REDUCTION PROJECTS REPORT**

Prepared for

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and

Mosquito Lagoon RAP Stakeholder Group

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Project No. 22015-012-01

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Appendix A	Excerpt from Volusia County Water Quality Plan
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ACRONYMS AND ABBREVIATIONS

BAM	Bio-sorption Activated Media
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
FAA	Federal Aviation Administration
FDEP	Florida Department of Environmental Protection
lb	Pound
IRL	Indian River Lagoon
SJRWMD	St. Johns River Water Management District
TN	Total Nitrogen
TP	Total Phosphorus
yr	Year

1 INTRODUCTION

The objective of this portion of the project is to develop pollutant load-reduction projects to help achieve water quality targets in the Mosquito Lagoon. Potential projects considered included stormwater, point source, and septic-to-sewer options. The focus of the project analysis was to determine where large pollutant load reductions could be achieved cost-effectively. From a non-point source load perspective, treating a large contributing area is necessary to achieve a significant load reduction. Because the contributing watershed to the Mosquito Lagoon is relatively narrow, a limited number of opportunities to treat large areas are available. Specifically, these opportunities only exist where canals serve a large portion of the watershed. Therefore, many potential projects considered in this report focus on these areas.

Once the areas served by the canals are treated, the next largest non-point source load-reduction projects will come from much smaller contributing areas generally served by small storm sewer systems. Due to space and site constraints and typically low elevations, a limited number of options are available for retrofitting these areas with treatment. Typical retrofits will involve exfiltration, bioreactors in some locations, and perhaps baffle boxes with nutrient reduction chambers. Pollutant load-reduction costs for these types of projects will typically be several times less cost-effective than the larger projects due to economies of scale and other factors. Therefore, these types of projects are not a focus for this report. However, they will contribute to the overall load-reduction requirements needed for Mosquito Lagoon and will be tracked – along with other load-reduction efforts – to document progress toward the load-reduction goals. Opportunities for these types of projects in the City of Edgewater were identified in the *Stormwater Master Plan CIP Update* (Quentin L. Hampton Associates, February 2013), and the City plans to implement projects from this Update.

As documented in the *Watershed Model Development Report* (Jones Edmunds and Janicki Environmental, June 2017), point sources are relatively small in the Mosquito Lagoon watershed. Volusia County's point source loads only come from what contributes from their small land application footprint within the watershed. New Smyrna Beach has not had a surface discharge since 2009. Edgewater's surface discharges are well under 1 million gallons per day. All three entities have clearly made significant investments already to reduce their point source loading, which minimizes the opportunity for further large reductions. Therefore, no additional point source reduction projects are currently being considered.

With nearly 3,000 septic systems still active in the watershed, there is an opportunity to reduce septic system loading. However, some septic systems are relatively dispersed and far from existing wastewater conveyance systems, making septic-to-sewer projects less cost-effective than other forms of pollutant load-reduction projects. The highest priority from the County's Water Quality Plan is Indian Harbor Estates, which would provide sewer to approximately 250 septic systems. Other phases in that part of the watershed could remove approximately 1,000 additional septic systems, depending on the final configuration of the phases.

Internal loading from legacies loads within the Mosquito Lagoon appears to be relatively small as discussed in progress meetings and will be documented in a separate report. Therefore, muck removal projects are not currently being considered as a component of the Reasonable Assurance Plan.

2 PROJECT OPTIONS

Jones Edmunds and the stakeholder group developed concepts for project options. Based on the discussion above, the project options mostly focus on retrofit treatment of large watershed areas. The subsections below provide a description of the projects, an opinion of project costs, an estimate of pollutant load reductions, and a discussion of possible project issues. The projects are generally arranged from north to south.

All planning-level opinions of costs can be considered Class 4 cost estimates as defined by the ASTM Standard Classification of Cost Estimating (ASTM E2516-11). Class 4 estimates are for conceptual projects or feasibility studies based on a 1- to 15-percent complete level of project definition. Typically, in the general construction industry this level of estimate has an expected cost accuracy range of -10 to -20 percent on the low side and +20 to +30 percent on the high side. All opinions of costs are presented as ranges (-20 to +30 percent) to estimate the variability that could be associated with the final project costs.

2.1 OPTION 1: DIVERSION TO BORROW PIT SOUTH OF NEW SMYRNA BEACH AIRPORT

Option 1 involves creating a low-flow diversion weir from the C-05 Canal into the abandoned borrow pit south of the New Smyrna Beach Municipal Airport and reconnecting from the borrow pit to the Canal with a drawdown structure. Figure 2-1 shows the general location and concept of Option 1.

Option 1 would be designed to treat base flow and storm flows from smaller storm events. Larger flows would bypass the diversion weir and borrow pit/treatment pond. From a pollutant load perspective, bypassing larger flows has only a small impact on the pollutant load-reduction capability of this alternative since the majority of pollutant loads are in the base flow and smaller storm events. The ability to bypass large flows should minimize potential peak stage increases in the C-05 Canal that would be introduced by constructing the diversion weir.

Option 1 would involve a small amount of work within wetlands. Design will need to involve avoidance and minimization of wetland impacts where possible. A small amount of mitigation may be necessary even with avoidance and minimization. Mitigation was considered in our opinion of probable cost.

The option has been discussed with the Airport Manager, the Federal Aviation Administration (FAA), and an environmental scientist representing the Airport. Their input was that due to the proximity of the option with the Airport, the design will need to involve evaluating the borrow pit, preparing a maintenance and wildlife hazard management plan specifically for the borrow pit, potentially committing money and resources to implement the plan, completing FAA Form 7460-1 (Notice of Proposed Construction or Alteration), and preparing a lease agreement and an appraisal of the property. Since Option 1 will have only small changes to conditions in the C-05 Canal and the borrow pit, we expect these needs to still make the option permittable and feasible.

Figure 2-1 shows the area served by Option 1, which is approximately 640 acres. Over 90 percent of the area served is in New Smyrna Beach, with the remainder in unincorporated Volusia County. The area is highly urbanized and contains two golf courses.

Option 1 is estimated to reduce base flow and surface runoff total nitrogen (TN) loads by approximately 30 percent, total phosphorus (TP) loads by 55 percent, and biochemical oxygen demand (BOD) loads by 60 percent. These percentages translate to average annual reductions of approximately 1,300 pounds/year (lb/yr), 320 lb/yr, and 6,900 lb/yr, respectively.

Figure 2-1 Option 1 Location and Description

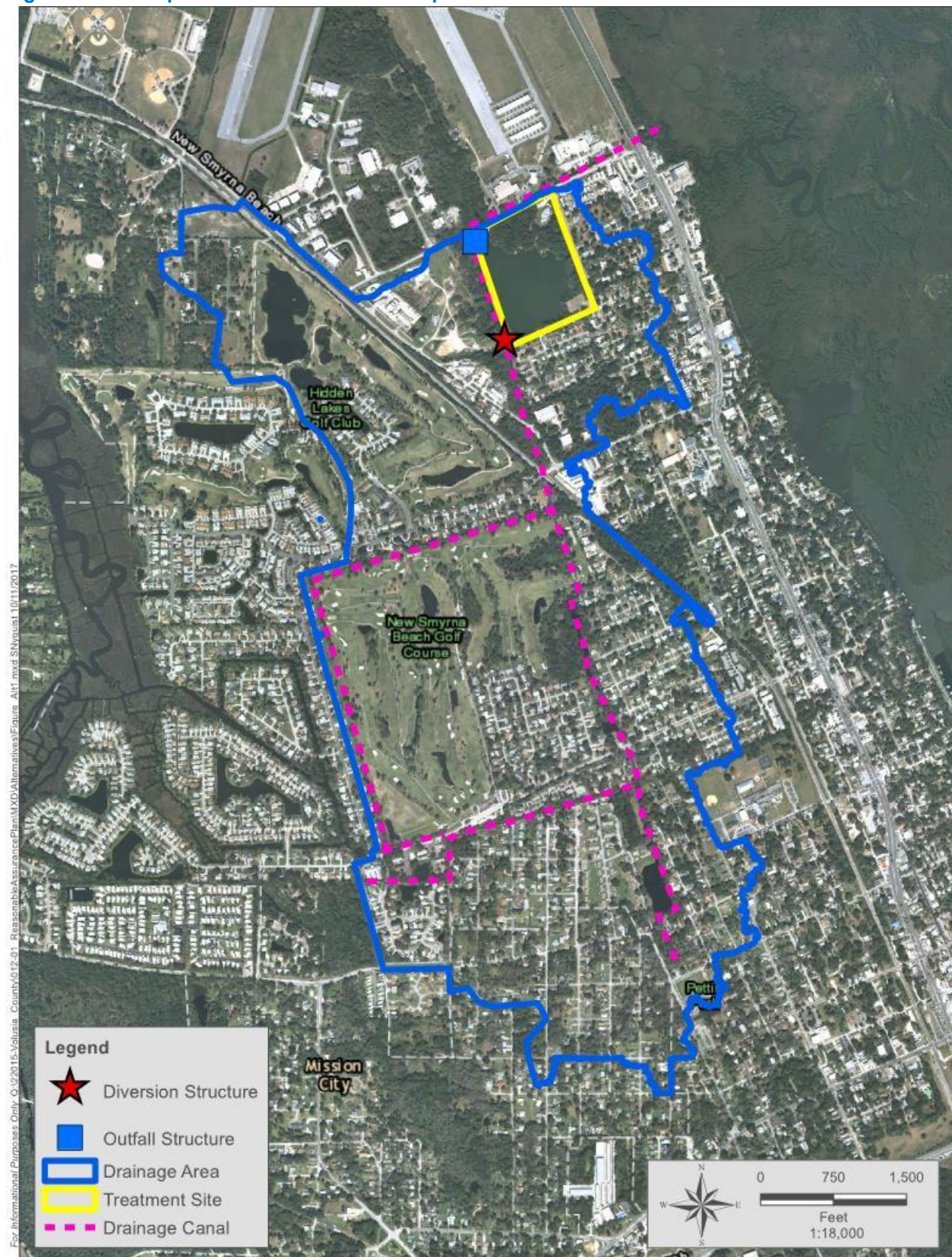


Table 2-1 shows the opinion of probable cost for Option 1 is between \$560,000 and \$910,000. This cost includes design, permitting, and construction. The annualized maintenance cost, which does not include the potential lease cost, is estimated to be \$10,000.

Table 2-1 Opinion of Probable Cost for Option 1

OPINION OF PROBABLE COST				
OWNER:		ESTIMATED BY:		
Volusia County		Amy Goodden		
CLIENT:		CHECKED BY:		
Volusia County		Jamie Bell		
PROJECT TITLE:		PROJECT SEGMENT		
Mosquito Lagoon Reasonable Assurance Plan Options Analysis				
PROJECT NUMBER:		DATE:		
22015-012-01		10/23/2017		
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):		SUBJECT		
ROM		Option 1 - Roslyn Avenue Pond		
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
LAND ACQUISITION				
Long-term Lease Agreement	LS	1	\$ -	\$ -
CONSTRUCTION				
Dewatering and Flow Diversion	LS	2	\$ 15,000	\$ 30,000.00
Sheetpile Low Head Dam - 70 LF X 15 ft	SF	1050	\$ 40	\$ 42,000.00
Temporary Rock Check Dam	LS	2	\$ 1,500	\$ 3,000.00
Diversion Weir - FDOT Type H DBI, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Diversion Weir - 36" RCP	LF	32	\$ 133	\$ 4,256
Outlet Structure - FDOT Type H, Modified, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Outlet Structure - 36" RCP	LF	32	\$ 133	\$ 4,256
Outlet Structure - Manatee Grate 36" RCP	EA	1	\$ 3,600	\$ 3,600
Concrete driveway apron- FDOT turnout	SY	49	\$ 23	\$ 1,124
Gravel access road 1800LF, clearing and grubbing	AC	0.58	\$ 12,000	\$ 6,942
Gravel access road 1800LF, Stabilized base, Group 6	SY	2400	\$ 14	\$ 33,600
Gravel access road 1800LF, #57 stone	TN	835	\$ 90	\$ 75,150
Soil Tracking Prevention Device	EA	1	\$ 2,500	\$ 2,500
Staked Silt Fence	LF	1800	\$ 4	\$ 7,200
Staked Turbidity Barrier	LF	80	\$ 4	\$ 320
Subtotal				\$ 236,000
Miscellaneous Items and Fine Grading (15%)	LS	1	\$ 35,400	\$ 35,400
Mobilization (10%)	LS	1	\$ 23,600	\$ 23,600
TOTAL CONSTRUCTION COST ESTIMATE				\$ 300,000
PLANNING, DESIGN, PERMITTING				
FAA Permitting and Management Plan	LS	1	\$ 50,000	\$ 50,000
Wetland Mitigation	CR	2	\$ 150,000	\$ 300,000
Engineering & SJRWMD Permitting (15%)	LS	1	\$ 45,000	\$ 45,000
Subtotal				\$ 395,000
SUBTOTAL PROJECT COST ESTIMATE				\$ 700,000
TOTAL PROJECT COST ESTIMATE RANGE		\$ 560,000	to	\$ 910,000

2.2 OPTION 2: 10TH STREET TREATMENT FACILITY

Volusia County has a project under design to improve 10th Street from Myrtle Avenue to US Highway 1. The project is adjacent to the Gabordy Canal and requires the acquisition of parcels for the road improvements and associated stormwater treatment. By acquiring the parcels north of West Knapp Avenue south of the Gabordy Canal, the project could treat the upstream area of Gabordy Canal as well as Canals G2 and G11. Due to the size of the treatment area versus the contributing area, the treatment facility would treat base flows and small storm flows. Larger flows would need to be bypassed. Wet detention would be the primary treatment mechanism, and the pond size would be approximately 5 acres. If enough head is available without causing flooding impacts, the use of bio-sorption activated media (BAM) filters to increase nutrient reduction may be possible. That detail would need to be addressed during the design phase. For costing this option and estimating pollutant load reductions, we did not include the BAM filter because sufficient head will likely not be available without introducing a pump station. Figures 2-2 and 2-3 show the general location and concept of Option 2.

Although a wetland delineation on the parcels has not been performed, wetland impacts for Option 2 would apparently be small. A small amount of mitigation was considered in our opinion of probable cost.

Figure 2-2 shows the area served by Option 2, which is approximately 4,600 acres. Approximately 60 percent of the contributing area is in the City of Edgewater, with the remainder in unincorporated Volusia County. The contributing area is approximately equal parts of urban and natural land uses.

Option 2 is estimated to reduce base flow and surface runoff TN loads by approximately 20 percent, TP loads by 45 percent, and BOD loads by 50 percent. These percentages translate to average annual reductions of approximately 5,600 lb/yr, 1,400 lb/yr, and 35,000 lb/yr, respectively.

Table 2-2 shows the opinion of probable cost for Option 2 is between \$2,800,000 and \$4,500,000. This cost includes design, permitting, and construction. Annualized maintenance costs are estimated to be \$30,000.

If difficulties arise when designing and permitting Option 2, an alternate option would be for it to only serve Canals G2 and G11. Under that condition, Option 3 (described below) would become more favorable for implementation.

Figure 2-2 Option 2 Location and Description

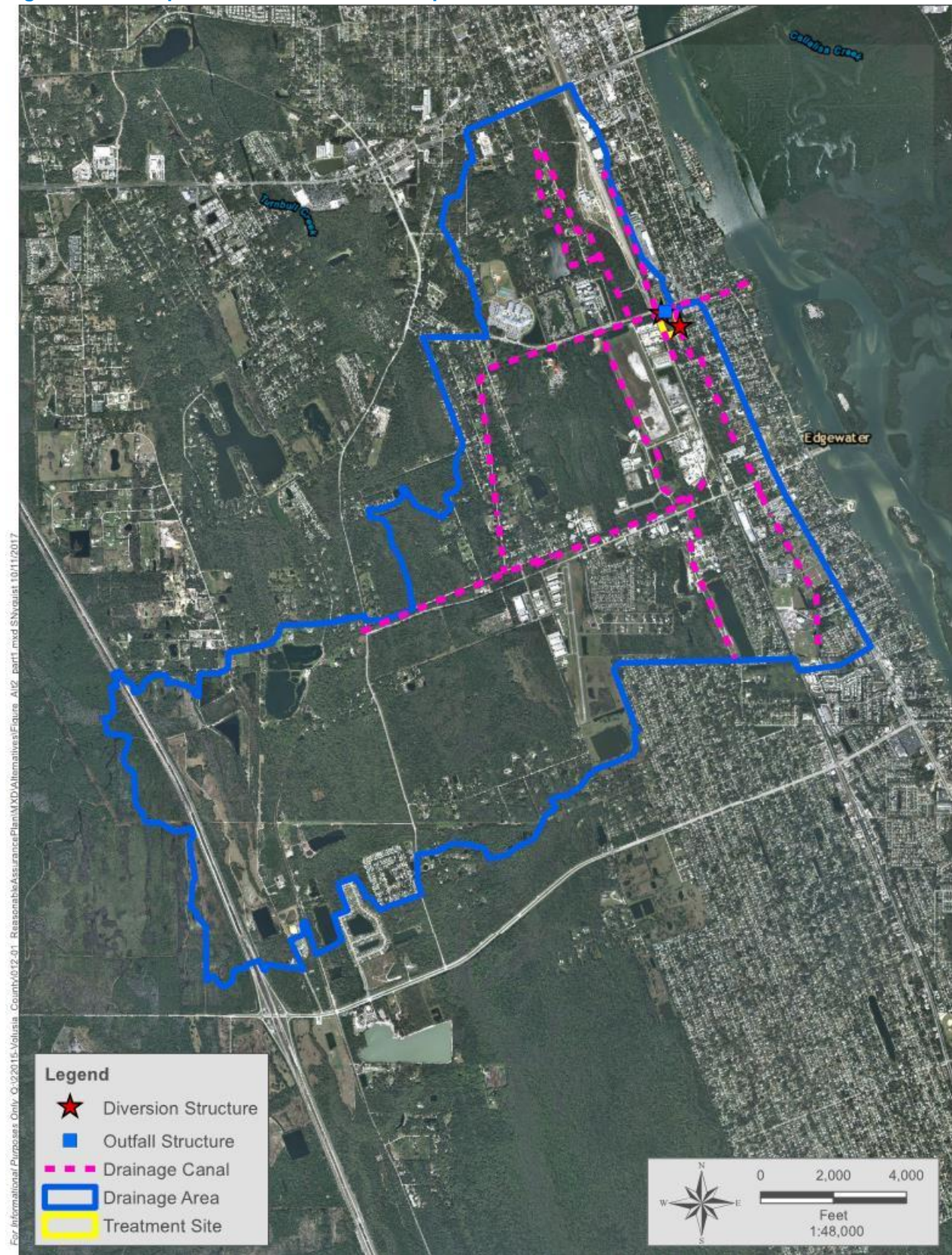


Figure 2-3 Option 2 Treatment Site Location and Description

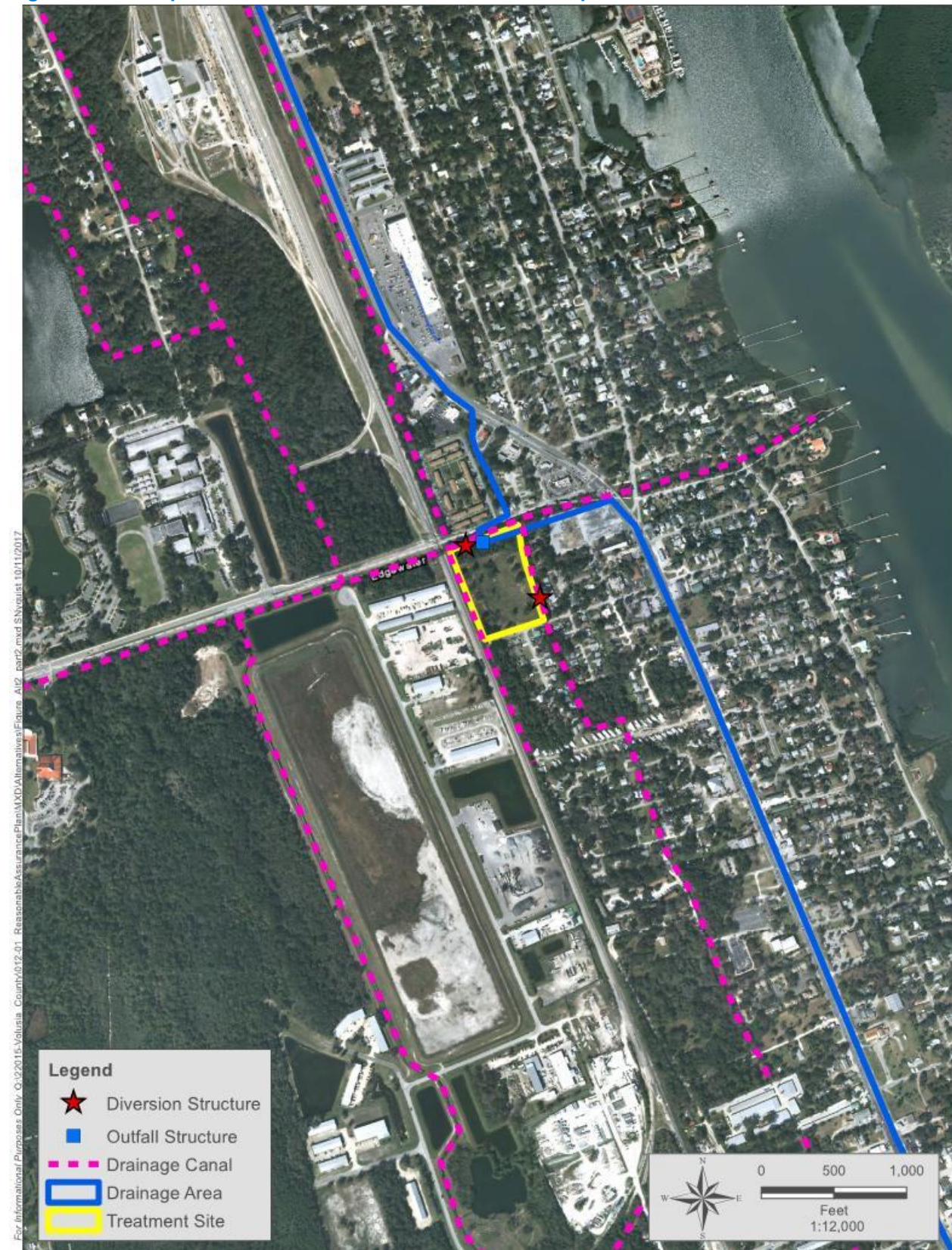


Table 2-2 Opinion of Probable Cost for Option 2

OPINION OF PROBABLE COST				
OWNER:		ESTIMATED BY:		
Volusia County		Amy Goodden		
CLIENT:		CHECKED BY:		
Volusia County		Jamie Bell		
PROJECT TITLE:		PROJECT SEGMENT		
Mosquito Lagoon Reasonable Assurance Plan Options Analysis				
PROJECT NUMBER:		DATE:		
22015-012-01		10/23/2017		
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):		SUBJECT		
ROM		Option 2 - 10th St. Treatment Facility		
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
LAND ACQUISITION				
Property Acquisition - Assume No Added Cost	LS	1	\$ -	\$ -
CONSTRUCTION				
Dewatering and Flow Diversion	LS	3	\$ 15,000	\$ 45,000.00
Sheetpile Low Head Dam - 70 LF X 15 ft	SF	1050	\$ 40	\$ 42,000.00
Excavation Channel - 700 LF	CY	20,000	\$ 35	\$ 700,000.00
Temporary Rock Check Dam	LS	3	\$ 1,500	\$ 4,500.00
Diversion Weir - FDOT Type H DBI, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Diversion Weir - 36" RCP	LF	32	\$ 133	\$ 4,256
Diversion Weir - FDOT Type H DBI, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Diversion Weir - 36" RCP	LF	32	\$ 133	\$ 4,256
Outlet Structure - FDOT Type H, Modified, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Diversion Weir - 36" RCP	LF	32	\$ 133	\$ 4,256
Outlet Structure - Manatee Grate 36" RCP	EA	1	\$ 3,600	\$ 3,600
Concrete driveway apron- FDOT turnout	SY	196	\$ 23	\$ 4,498
Box culvert under driveway to bridge existing canal	LF	32	\$ 12,000	\$ 384,000
Gravel access road 1800LF, clearing and grubbing	AC	0.58	\$ 12,000	\$ 6,942
Gravel access road 1800LF, Stabilized base, Group 6	SY	2400	\$ 14	\$ 33,600
Gravel access road 1800LF, #57 stone	TN	835	\$ 90	\$ 75,150
Soil Tracking Prevention Device	EA	1	\$ 2,500	\$ 2,500
Staked Silt Fence	LF	1800	\$ 4	\$ 7,200
Staked Turbidity Barrier	LF	80	\$ 4	\$ 320
Clearing and Grubbing	AC	5.2	\$ 12,000	\$ 62,782
Borrow Excavation (Haul)	CY	89733	\$ 11	\$ 987,068
Subtotal				\$ 2,405,000
Miscellaneous Items and Fine Grading (15%)	LS	1	\$ 360,750	\$ 360,750
Mobilization (10%)	LS	1	\$ 240,500	\$ 240,500
TOTAL CONSTRUCTION COST ESTIMATE				\$ 3,000,000
PLANNING, DESIGN, PERMITTING				
Wetland Mitigation	Credit	1	\$ 150,000	\$ 150,000
Engineering & Permitting (15%)	LS	1	\$ 450,000	\$ 450,000
Subtotal				\$ 450,000
SUBTOTAL PROJECT COST ESTIMATE				\$ 3,450,000
TOTAL PROJECT COST ESTIMATE RANGE		\$ 2,800,000	to	\$ 4,500,000

2.3 OPTION 3: ELIZABETH STREET TREATMENT FACILITY

The County owns a 7.2-acre parcel adjacent to Edgewater Canal (C-04) south of Elizabeth Street, for which they have developed a design for a stormwater treatment pond that treats flow from the Edgewater Canal. The area that would be served by this pond is also part of the area served by Option 2. The County also owns a 1.3-acre parcel adjacent to the 7.2-acre parcel that contains what used to be an old borrow pit. The borrow pit does not appear in the St. Johns River Water Management District's (SJRWMD) Environmental Resource Permit layer, so we assume that it is not a permitted stormwater treatment facility. The concept for Option 3 is to use both parcels and the existing borrow pit to create a stormwater treatment pond that is larger than the one currently designed for the 7.2-acre parcel. Due to the size of the treatment area versus the contributing area, the treatment facility would treat base flows and small storm flows. Larger flows would need to be bypassed. Wet detention would be the primary treatment mechanism, and the pond size would be approximately 7 acres due in part to avoidance of existing wetlands on the parcel. If enough head is available without causing flooding impacts, the use of BAM filters may be possible to increase nutrient reduction. That detail would need to be addressed during the design phase. For costing this option and estimating pollutant load reductions, we did not include the BAM filter because sufficient head will likely not be available without introducing a pump station. Figure 2-4 shows the general location and concept of Option 3.

Figure 2-4 shows the area served by Option 3, which is approximately 2,300 acres. Approximately 75 percent of the contributing area is in unincorporated Volusia County, with the remainder in the City of Edgewater. The contributing area is lightly urbanized.

Option 3 is estimated to reduce base flow and surface runoff TN loads by approximately 30 percent, TP loads by 55 percent, and BOD loads by 60 percent. These percentages translate to average annual reductions of approximately 4,300 lb/yr, 720 lb/yr, and 18,000 lb/yr, respectively.

Table 2-3 shows the opinion of probable cost for Option 3 is between \$2,100,000 and \$3,500,000. This cost includes design, permitting, and construction. Annualized maintenance costs are estimated to be \$25,000.

Figure 2-4 Option 3 Location and Description

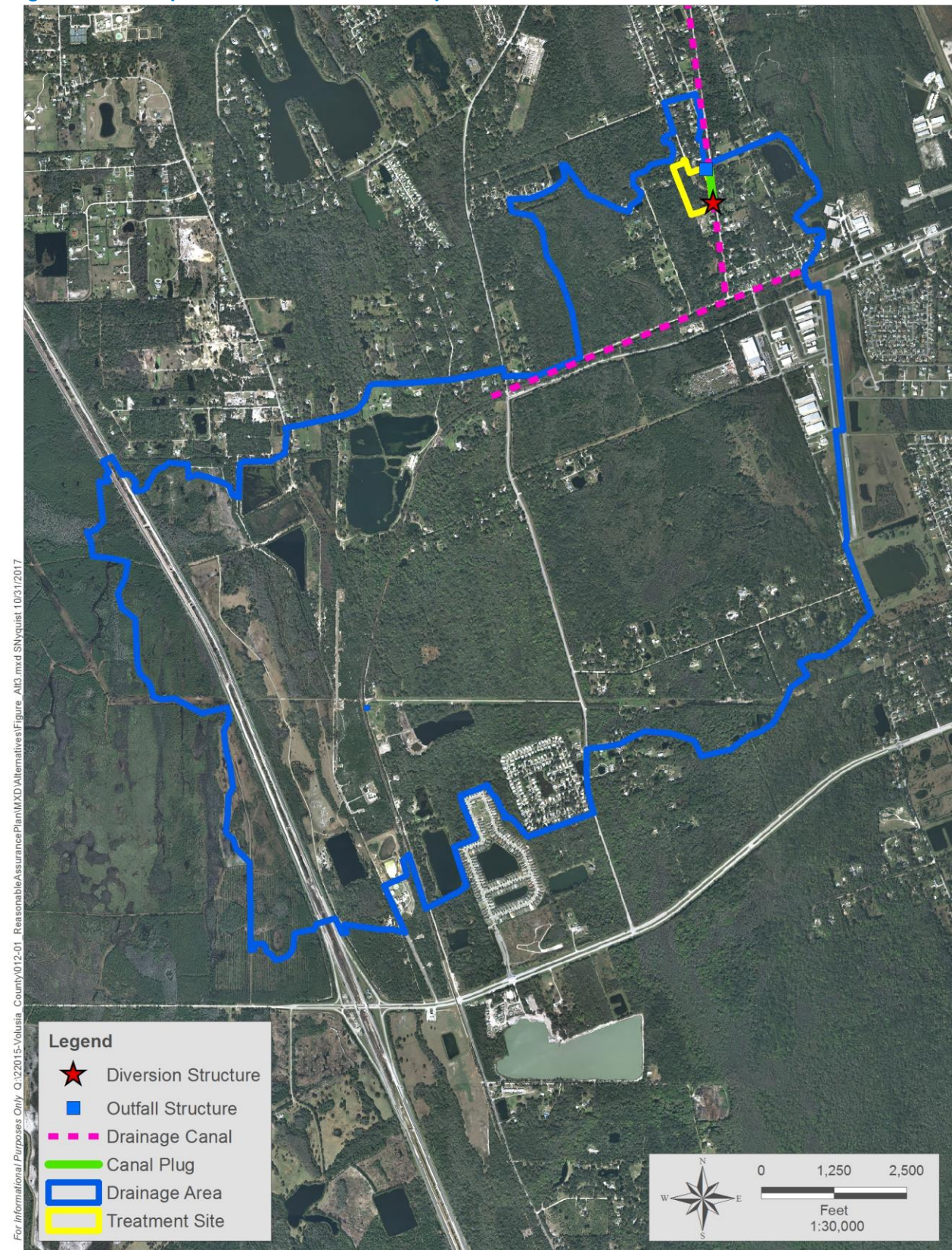


Table 2-3 Opinion of Probable Cost for Option 3

OPINION OF PROBABLE COST				
OWNER:		ESTIMATED BY:		
Volusia County		Amy Goodden		
CLIENT:		CHECKED BY:		
Volusia County		Jamie Bell		
PROJECT TITLE:		PROJECT SEGMENT		
Mosquito Lagoon Reasonable Assurance Plan Options Analysis				
PROJECT NUMBER:		DATE:		
22015-012-01		10/23/2017		
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):		SUBJECT		
ROM		Option 3 - Elizabeth Street Pond		
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
LAND ACQUISITION				
County owned parcels	LS	1	\$ -	\$ -
ADDITIONAL CONSTRUCTION				
Dewatering and Flow Diversion	LS	2	\$ 15,000	\$ 30,000.00
Sheetpile Low Head Dam - 70 LF X 15 ft	SF	1050	\$ 40	\$ 42,000.00
Temporary Rock Check Dam	LS	2	\$ 1,500	\$ 3,000.00
Diversion Weir - FDOT Type H DBI, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Diversion Weir - 36" RCP	LF	32	\$ 133	\$ 4,256
Outlet Structure - FDOT Type H, Modified, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Diversion Weir - 36" RCP	LF	32	\$ 133	\$ 4,256
Outlet Structure - Manatee Grate 36" RCP	EA	1	\$ 3,600	\$ 3,600
Concrete driveway apron- FDOT turnout	SY	196	\$ 23	\$ 4,498
Box culvert under driveway to bridge existing canal	LF	32	\$ 12,000	\$ 384,000
Gravel access road 700LF, clearing and grubbing	AC	0.22	\$ 12,000	\$ 2,700
Gravel access road 700LF, Stabilized base, Group 6	SY	933	\$ 14	\$ 13,067
Gravel access road 700LF, #57 stone	TN	325	\$ 90	\$ 29,250
Soil Tracking Prevention Device	EA	1	\$ 2,500	\$ 2,500
Staked Silt Fence	LF	700	\$ 4	\$ 2,800
Staked Turbidity Barrier	LF	80	\$ 4	\$ 320
Clearing and Grubbing	LS	1	12000	\$ 12,000
Grading	LS	1	10000	\$ 10,000
Borrow Excavation	CY	36125	11	\$ 397,375
Stone Rubble Rip Rap Installed	TN	18	175	\$ 3,150
Seeding and Planting (sod, littoral shelf, trees)	LS	1	17000	\$ 17,000
Subtotal				\$ 988,000
Miscellaneous Items and Fine Grading (15%)	LS	1	\$ 148,200	\$ 148,200
Mobilization (10%)	LS	1	\$ 98,800	\$ 98,800
TOTAL NEW CONSTRUCTION COST ESTIMATE				\$ 1,200,000
ENGINEERS OPINION FOR ELIZABETH STREET FLOOD MANAGEMENT AREA				
Survey and Layout	LS	1	\$ 2,500	\$ 2,500.00
Dewatering and Flow Diversion	LS	1	\$ 15,000	\$ 15,000.00
Temporary Rock Check Dam	LS	1	\$ 1,500	\$ 1,500.00
Silt Fence	LF	1643	\$ 4	\$ 6,572.00
Soil Tracking Prevention Device	EA	2	\$ 2,500	\$ 5,000.00
Clearing and Grubbing	LS	1	30000	\$ 30,000.00
Embankment, Backfill and Compaction (onsite material)	CY	2851	8	\$ 22,808.00
Grading	LS	1	35000	\$ 35,000
Borrow Excavation	CY	32900	11	\$ 361,900
Borrow Excavation (Haul Off)	CY	30049	11	\$ 330,539
Excavation (Onsite material)	CY	3000	5	\$ 15,000
Demucking (Canal and Wetland)	CY	1500	12	\$ 18,000
Stabilization for maintenance berms	SY	4200	4	\$ 16,800
Connect existing pipe to proposed drainage structure	EA	1	500	\$ 500
Modified Type D Control Structure	EA	1	5600	\$ 5,600
J-7 Manhole	EA	1	6600	\$ 6,600
24" Reinforced Concrete Pipe	LF	62	90	\$ 5,580
36" Reinforced Concrete Pipe	LF	45	160	\$ 7,200
48" Reinforced Concrete Pipe	LF	172	180	\$ 30,960
24" Mitered End Section	EA	1	1700	\$ 1,700
36" Mitered End Section	EA	1	3400	\$ 3,400
48" Mitered End Section	EA	4	6700	\$ 26,800
Stone Rubble Rip Rap Installed (includes excavation/ underlay)	TN	45	175	\$ 7,875
Gabion Mattress	SY	1875	100	\$ 187,500
Chain link fence gate (double 8' openings)	LF	750	24	\$ 18,000
Chain link fence (type B -5' high)	EA	2	1800	\$ 3,600
Seeding and Planting	LS	1	60000	\$ 60,000
Subtotal				\$ 1,226,000
Mobilization (10%)	LS	1	\$ 122,600	\$ 122,600
TOTAL CONSTRUCTION COST ESTIMATE				\$ 1,300,000
PLANNING, DESIGN, PERMITTING				
Additional Engineering & Permitting (15%)	LS	1	\$ 180,000.00	\$ 180,000
Subtotal				\$ 180,000
SUBTOTAL PROJECT COST ESTIMATE				\$ 2,680,000
TOTAL PROJECT COST ESTIMATE RANGE		\$ 2,100,000	to	\$ 3,500,000

2.4 OPTION 4: EAST INDIAN RIVER BOULEVARD BIOREACTOR

The 18th Street Canal (D-04) serves most of central Edgewater. Much of the contributing area receives some form of stormwater treatment – mostly through swales and wet detention. However, there is still an opportunity for a significant reduction in pollutant loads if the best management practice (BMP) is complementary to the upstream treatments due to the large volume of flow that passes through the canal. The City of Edgewater is contemplating improvements on East Indian River Boulevard, which is adjacent to the downstream end of the 18th Street Canal and has room for infrastructure beyond transportation needs. This location is best suited for a BAM filter, which is also an excellent complement to the upstream stormwater treatments. Therefore, Option 4 consists of a diversion structure in the 18th Street Canal east of US Hwy 1 and a bioreactor on the south side of the canal. Because of depth of the 18th Street Canal at this location, long-term maintenance considerations, and other site constraints, flows would likely need to be pumped into the bioreactor. Therefore, a pump station is included in our opinion of probable cost. Construction of Option 4 would likely be coordinated with the improvements being considered by the City of Edgewater. We have also included costs for reconstruction of the road and a bioswale in the reconstructed median.

The bioreactor would treat base flows and small storm flows. Larger flows would bypass the diversion structure and be conveyed to Mosquito Lagoon in the 18th Street Canal. Figures 2-5 and 2-6 show the general location and concept of Option 4.

Figure 2-5 shows the area served by Option 4, which is approximately 2,200 acres. Nearly all of the contributing area is in the City of Edgewater and is heavily urbanized with primarily single-family residential land use.

Option 4 is estimated to reduce base flow TN loads by approximately 50 percent, TP loads by 70 percent, and BOD loads by 30 percent. The estimated reduction of direct runoff TN loads is approximately 10 percent, TP loads is 15 percent, and BOD loads is 5 percent. These percentages translate to average annual reductions of approximately 3,900 lb/yr, 730 lb/yr, and 5,200 lb/yr, respectively.

Table 2-4 shows the opinion of probable cost for Option 4 is between \$2,000,000 and \$3,300,000. This cost includes design, permitting, and construction. Annualized maintenance costs are estimated to be \$70,000.

Options 5 and 6 or 5 and 7 should be considered for implementation only if Option 4 is not feasible. Option 4 serves the areas treated by Options 5, 6, and 7 plus additional area.

Figure 2-5 Option 4 Location and Description



Figure 2-6 Option 4 Treatment Site Location and Description



Table 2-4 Opinion of Probable Cost for Option 4

OPINION OF PROBABLE COST				
OWNER:		ESTIMATED BY:		
Volusia County		Amy Goodden		
CLIENT:		CHECKED BY:		
Volusia County		Jamie Bell		
PROJECT TITLE:		PROJECT SEGMENT		
Mosquito Lagoon Reasonable Assurance Plan Options Analysis				
PROJECT NUMBER:		DATE:		
22015-012-01		10/23/2017		
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):		SUBJECT		
ROM		Option 4 - East Indian River Blvd. Bioreactor		
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
LAND ACQUISITION				
County owned parcels	LS	1	\$ -	\$ -
CONSTRUCTION				
Dewatering and Flow Diversion	LS	1	\$ 15,000	\$ 15,000
Sheetpile Low Head Dam - 70 LF X 15 ft	SF	1050	\$ 40	\$ 42,000.00
Temporary Rock Check Dam	LS	1	\$ 1,500	\$ 1,500
Silt Fence	LF	1643	\$ 4	\$ 6,572
Clearing and Grubbing	AC	1.19	\$ 11,500	\$ 13,728
Stabilization	SY	3733	\$ 4	\$ 14,933
New Road Base, Group 4	SY	3733	\$ 14	\$ 52,267
New Asphalt Road	TN	308	\$ 96	\$ 29,568
Borrow Excavation (Haul off)	CY	3481	\$ 11	\$ 38,296
Diversion Weir - FDOT Type H DBI, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Diversion Weir - 36" RCP	LF	32	\$ 133	\$ 4,256
Outlet Structure - FDOT Type H, Modified, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Diversion Weir - 36" RCP	LF	32	\$ 133	\$ 4,256
Outlet Structure - Manatee Grate 36" RCP	EA	1	\$ 3,600	\$ 3,600
Gabion Mattress	SY	667	\$ 100	\$ 66,667
Pump Station - 15 cfs	LS	1	\$ 600,000	\$ 600,000
BAM Filtration System	LS	2	530000	\$ 1,060,000
Planting	LS	1	\$ 30,000	\$ 30,000
Subtotal				\$ 2,005,000
Miscellaneous Items and Fine Grading (15%)	LS	1	\$ 300,750	\$ 300,750
Mobilization (10%)	LS	1	\$ 200,500	\$ 200,500
TOTAL CONSTRUCTION COST ESTIMATE				\$ 2,200,000
PLANNING, DESIGN, PERMITTING				
Additional Engineering & Permitting (15%)	LS	1	\$ 330,000.00	\$ 330,000
Subtotal				\$ 330,000
SUBTOTAL PROJECT COST ESTIMATE				\$ 2,530,000
TOTAL PROJECT COST ESTIMATE RANGE		\$ 2,000,000	to	\$ 3,300,000

2.5 OPTION 5: FERN PALM DRIVE BAM OUTFALL

The City of Edgewater has a wet detention pond just south of the 18th Street Canal between Fern Palm Drive and Evergreen Drive. The pond currently has a conventional outfall structure. Retrofitting the outfall structure with a BAM outfall should be possible – at least for a portion of the live pool volume. Figure 2-7 shows the general location and concept of Option 5. As stated above, Option 5 should not be implemented if Option 4 is implemented.

The area served by Option 5 is approximately 175 acres, with some interconnectivity with other outfalls possible. Figure 2-7 shows the area served by Option 5. Nearly all of the contributing area is in the City of Edgewater and is heavily urbanized with primarily single-family residential land use.

Option 5 is estimated to reduce base flow TN loads by approximately 50 percent, TP loads by 70 percent, and BOD loads by 30 percent. The estimated reduction of direct runoff TN loads is approximately 15 percent, TP loads is 20 percent, and BOD loads is 10 percent. These percentages translate to average annual reductions of approximately 630 lb/yr, 120 lb/yr, and 850 lb/yr, respectively.

Table 2-5 shows the opinion of probable cost for Option 5 is between \$200,000 and \$365,000. This cost includes design, permitting, and construction. Annualized maintenance costs are estimated to be \$9,000.

Figure 2-7 Option 5 Location and Description

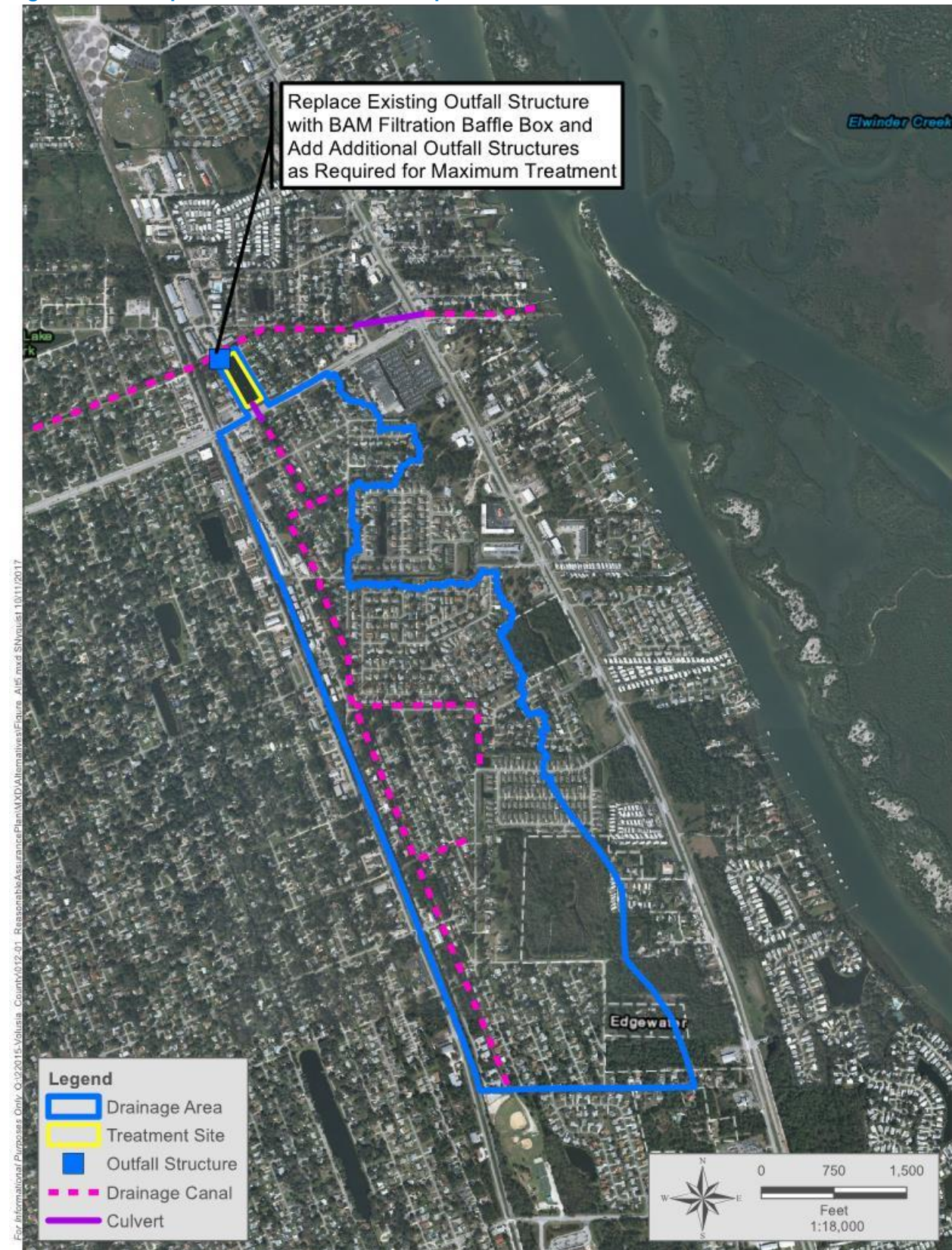


Table 2-5 Opinion of Probable Cost for Option 5

OPINION OF PROBABLE COST				
OWNER:		ESTIMATED BY:		
Volusia County		Amy Goodden		
CLIENT:		CHECKED BY:		
Volusia County		Jamie Bell		
PROJECT TITLE:		PROJECT SEGMENT		
Mosquito Lagoon Reasonable Assurance Plan Options Analysis				
PROJECT NUMBER:		DATE:		
22015-012-01		10/23/2017		
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):		SUBJECT		
ROM		Option 5 - Fern Palm Drive		
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
LAND ACQUISITION				
Pond owned by FDOT and City of Edgewater	LS	1	\$ -	\$ -
CONSTRUCTION				
Connect existing pipe to proposed drainage structure	EA	5	500	\$ 2,500
Sheetpile Low Head Dam - 70 LF X 15 ft	SF	1050	\$ 40	\$ 42,000.00
Outlet Structure - FDOT Type H, Modified, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Outlet Structure - 24" RCP	LF	32	\$ 81	\$ 2,592
Dewatering and Flow Diversion	LS	1	\$ 15,000	\$ 15,000.00
Temporary Rock Check Dam	LS	1	\$ 1,500	\$ 1,500.00
Staked Silt Fence	LF	15	\$ 4	\$ 60
Excavation	CY	10	11	\$ 110
BAM Filtration Media	CY	10	\$ 12,000.00	\$ 120,000
Subtotal				\$ 195,000
Miscellaneous Items and Fine Grading (15%)	LS	1	\$ 29,250	\$ 29,250
Mobilization (10%)	LS	1	\$ 19,500.00	\$ 19,500
TOTAL CONSTRUCTION COST ESTIMATE				\$ 244,000
PLANNING, DESIGN, PERMITTING				
Engineering & Permitting (15%)	LS	1	\$ 36,600.00	\$ 36,600
Subtotal				\$ 37,000
SUBTOTAL PROJECT COST ESTIMATE				\$ 281,000
TOTAL PROJECT COST ESTIMATE RANGE		\$ 200,000	to	\$ 365,000

2.6 OPTION 6: 20TH STREET BAM OUTFALL

The City of Edgewater has a wet detention pond just south of 20th Street between Kumquat Drive and Lime Tree Drive. The outfall from the pond is currently controlled by the downstream culvert and channel. Retrofitting a BAM outfall structure on the pond should be possible. Modeling during preliminary design would be needed to confirm that no adverse off-site impacts are caused with the addition of the control structure, but a high-flow bypass would likely achieve that. The BAM outfall would treat base flow and a small portion of storm flows. Figure 2-8 shows the general location and concept of Option 6. Option 6 would likely not be implemented if Option 4 is implemented.

The area served by Option 6 is approximately 640 acres, with some interconnectivity with other outfalls possible. Figure 2-8 shows the area served by Option 6. Nearly all of the contributing area is in the City of Edgewater and is heavily urbanized with primarily single-family residential land use.

Option 6 is estimated to reduce base flow TN loads by approximately 50 percent, TP loads by 70 percent, and BOD loads by 30 percent. The estimated reduction to direct runoff TN loads is approximately 15 percent, TP loads is 20 percent, and BOD loads is 10 percent. These percentages translate to average annual reductions of approximately 1,100 lb/yr, 210 lb/yr, and 1,500 lb/yr, respectively.

Table 2-6 shows the opinion of probable cost for Option 6 is between \$600,000 and \$925,000. This cost includes design, permitting, and construction. Annualized maintenance costs are estimated to be \$24,000.

Figure 2-8 Option 6 Location and Description

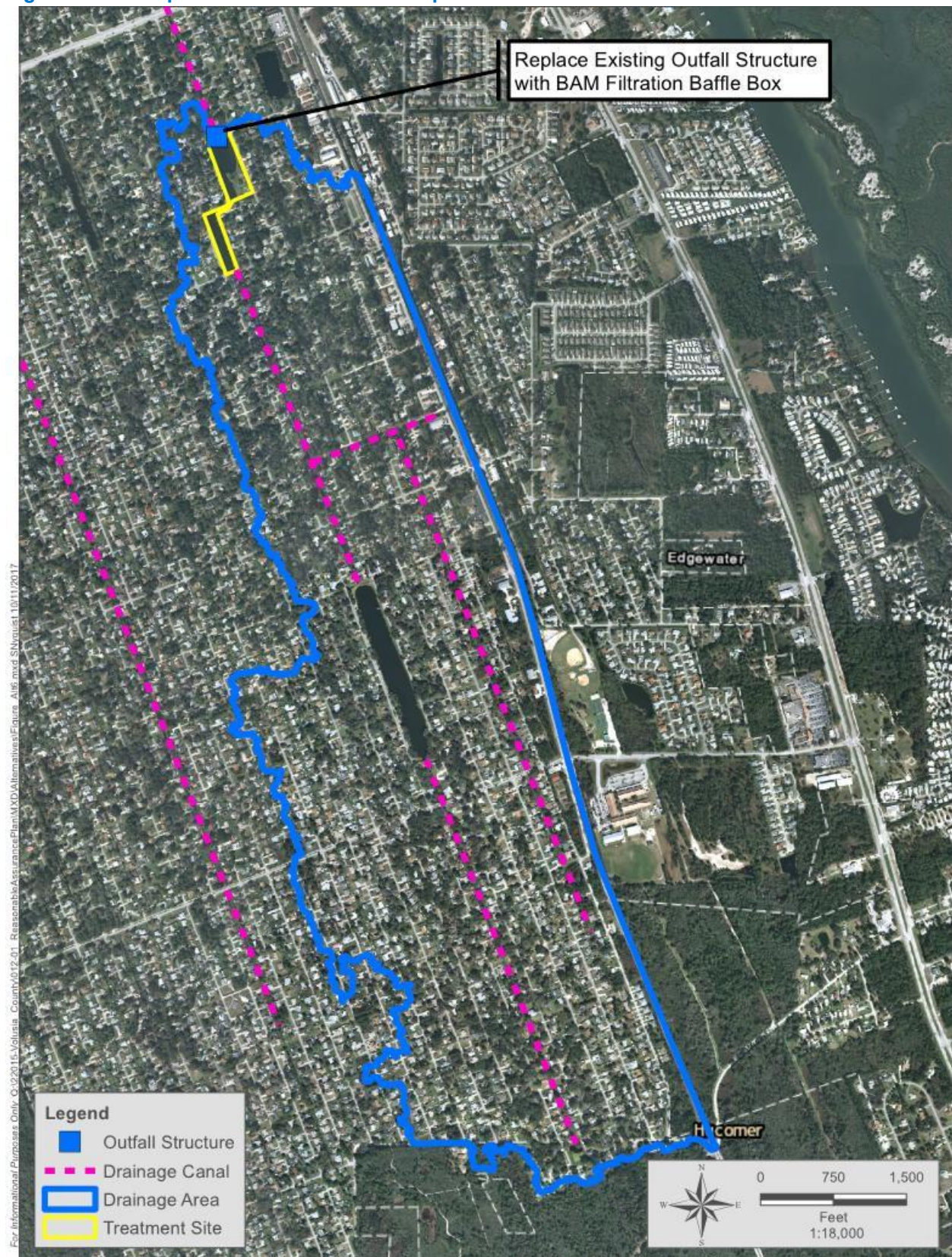


Table 2-6 Opinion of Probable Cost for Option 6

OPINION OF PROBABLE COST				
OWNER:		ESTIMATED BY:		
Volusia County		Amy Goodden		
CLIENT:		CHECKED BY:		
Volusia County		Jamie Bell		
PROJECT TITLE:		PROJECT SEGMENT		
Mosquito Lagoon Reasonable Assurance Plan Options Analysis				
PROJECT NUMBER:		DATE:		
22015-012-01		10/23/2017		
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):		SUBJECT		
ROM		Option 6 - 20th St.		
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
LAND ACQUISITION				
Ponds owned by City of Edgewater	LS	1	\$ -	\$ -
CONSTRUCTION				
Connect existing pipe to proposed drainage structure	EA	5	500	\$ 2,500
Sheetpile Low Head Dam - 70 LF X 15 ft	SF	1050	\$ 40	\$ 42,000.00
Outlet Structure - FDOT Type H, Modified, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Outlet Structure - 24" RCP	LF	32	\$ 81	\$ 2,592
Dewatering and Flow Diversion	LS	1	\$ 15,000	\$ 15,000.00
Temporary Rock Check Dam	LS	1	\$ 1,500	\$ 1,500.00
Staked Silt Fence	LF	15	\$ 4	\$ 60
Excavation	CY	40	11	\$ 440
BAM Filtration Media	CY	35	\$ 12,000.00	\$ 420,000
Subtotal				\$ 495,000
Miscellaneous Items and Fine Grading (15%)	LS	1	\$ 74,250	\$ 74,250
Mobilization (10%)	LS	1	\$ 49,500.00	\$ 49,500
TOTAL CONSTRUCTION COST ESTIMATE				\$ 619,000
PLANNING, DESIGN, PERMITTING				
Engineering & Permitting (15%)	LS	1	\$ 92,850.00	\$ 92,850
Subtotal				\$ 92,850
SUBTOTAL PROJECT COST ESTIMATE				\$ 711,850
TOTAL PROJECT COST ESTIMATE RANGE		\$ 600,000	to	\$ 925,000

2.7 OPTION 7: 27TH STREET BAM OUTFALL

The City of Edgewater has a wet detention pond just south of 27th Street between Lime Tree Drive and Mango Tree Drive. The outfall from the pond is currently controlled by the downstream culvert and channel. Retrofitting a BAM outfall structure on the pond should be possible. Modeling during preliminary design would be needed to confirm that no adverse off-site impacts are caused with the addition of the control structure, but a high-flow bypass would likely achieve that. The BAM outfall would treat base flow and a small portion of storm flows. Figure 2-9 shows the general location and concept of Option 7. Option 7 should not be implemented if Option 4 or 5 is implemented.

The area served by Option 7 is approximately 345 acres. Figure 2-9 shows the area served by Option 7. Nearly all of the contributing area is in the City of Edgewater and is heavily urbanized with primarily single-family residential land use.

Option 7 is estimated to reduce base flow TN loads by approximately 50 percent, TP loads by 70 percent, and BOD loads by 30 percent. The estimated reduction of direct runoff TN loads is approximately 15 percent, TP loads is 20 percent, and BOD loads is 10 percent. These percentages translate to average annual reductions of approximately 600 lb/yr, 110 lb/yr, and 800 lb/yr, respectively.

Table 2-7 shows the opinion of probable cost for Option 7 is between \$400,000 and \$589,000. This cost includes design, permitting, and construction. Annualized maintenance costs are estimated to be \$14,000.

Figure 2-9 Option 7 Location and Description

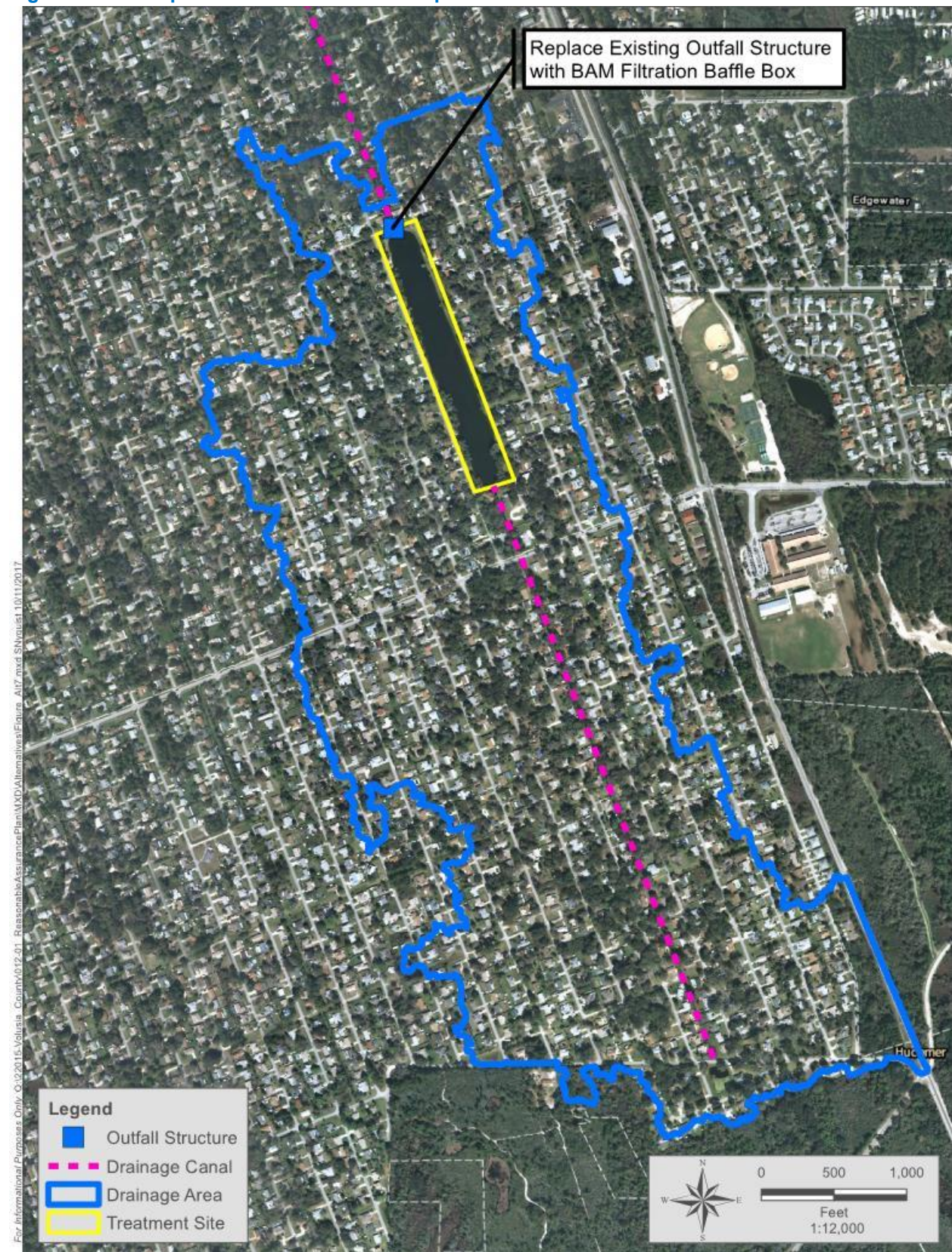


Table 2-7 Opinion of Probable Cost for Option 7

OPINION OF PROBABLE COST				
OWNER:		ESTIMATED BY:		
Volusia County		Amy Goodden		
CLIENT:		CHECKED BY:		
Volusia County		Jamie Bell		
PROJECT TITLE:		PROJECT SEGMENT		
Mosquito Lagoon Reasonable Assurance Plan Options Analysis				
PROJECT NUMBER:		10/23/2017		
22015-012-01				
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):		SUBJECT		
ROM		Option 7 - 27th St.		
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
LAND ACQUISITION				
Pond owned by City of Edgewater	LS	1	\$ -	\$ -
CONSTRUCTION				
Connect existing pipe to proposed drainage structure	EA	5	500	\$ 2,500
Sheetpile Low Head Dam - 70 LF X 15 ft	SF	1050	\$ 40	\$ 42,000.00
Outlet Structure - FDOT Type H, Modified, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Outlet Structure - 24" RCP	LF	32	\$ 81	\$ 2,592
Dewatering and Flow Diversion	LS	1	\$ 15,000	\$ 15,000.00
Temporary Rock Check Dam	LS	1	\$ 1,500	\$ 1,500.00
Staked Silt Fence	LF	15	\$ 4	\$ 60
Excavation	CY	20	11	\$ 220
BAM Filtration System	CY	20	\$ 12,000.00	\$ 240,000
Subtotal				\$ 315,000
Miscellaneous Items and Fine Grading (15%)	LS	1	\$ 47,250	\$ 47,250
Mobilization (10%)	LS	1	\$ 31,500.00	\$ 31,500
TOTAL CONSTRUCTION COST ESTIMATE				\$ 394,000
PLANNING, DESIGN, PERMITTING				
Engineering & Permitting (15%)	LS	1	\$ 59,100.00	\$ 59,100
Subtotal				\$ 59,100
SUBTOTAL PROJECT COST ESTIMATE				\$ 453,100
TOTAL PROJECT COST ESTIMATE RANGE		\$ 400,000	to	\$ 589,000

2.8 OPTION 8: INDIAN HARBOR ESTATES/OAK HILL SEPTIC TO SEWER

Volusia County developed a Water Quality Plan in 2015 that had a Septic System Reduction component. As stated in the Water Quality Plan, *Volusia County has established a long term goal of eliminating all septic systems in areas where they are an inappropriate method of effluent disposal. Due to the costs of retrofitting these areas with central wastewater collection systems, the County must prioritize the elimination of septic systems.* The Mosquito Lagoon watershed was identified as one of the priority areas for the County. Within the Mosquito Lagoon watershed, the County prioritized the following 10 areas for septic tank elimination:

- Area 1 – Indian Harbor Estates (approximately 300 lots), \$6.08 million.
- Area 2 – Jackson Hole RV Park, Mosquito Lagoon RV Park, and Seminole Rest State Park (approximately 25 on-site septic systems), \$0.42 million.
- Area 3 – Waterway Estates (approximately 240 lots), \$6.03 million.
- Area 4 – Cory Estates (approximately 180 lots), \$4.70 million.
- Area 5 – Waterfront Park (approximately 40 lots), \$1.20 million.
- Area 6 – Lyon Subdivision (approximately 50 lots), \$1.47 million.
- Area 7 – Jones Fish Camp (approximately 65 lots), \$2.11 million.
- Area 8 – Oak Hill East (approximately 230 lots), \$6.19 million.
- Area 9 – Mobile Village (approximately 175 lots), \$4.73 million.
- Area 10 – Oak Hill West (approximately 170 lots), \$4.59 million.

The approximate number of lots above does not represent the current number of septic systems because some lots are unoccupied. Appendix A shows the approximate locations of the areas in a figure excerpted from Volusia County's Water Quality Plan. These areas would likely be served by the County's Southeast Regional Wastewater Facility, which has excess capacity. As identified in the Water Quality Plan, these projects could only be implemented incrementally as grant funding is available due to the high cost of the projects. The costs shown are from Volusia County's Water Quality Plan and are assumed to be in 2015 dollars.

Reasonable estimates of nutrient contributions per septic systems proximate to a water body are 15 to 25 lb/yr of TN and 4 to 6 lb/yr of TP. Therefore, the Indian Harbor Estates septic-to-sewer project could be expected to eliminate 4,600 to 7,600 lb/yr of TN and 1,200 to 1,800 lb/yr of TP at full buildout. These estimates assume that none of the effluent disposal would be loaded to Mosquito Lagoon, which may not be a conservative assumption. The Water Quality Plan estimated the cost of the Indian Harbor Estates project to be \$6.08 million, based in part on the assumption of using gravity sewers. Lowering the capital cost is possible by using alternative collection systems, but annual operation and maintenance costs increase substantially for those systems. These estimates equate to approximately \$900 to \$1,500 per lb/yr of TN reduction. These estimates are comparable to the estimates in the *Save Our Lagoon Project Plan for Brevard County, Florida* (Tetra Tech, Inc. and Closewaters, LLC, 2016). Pollutant loading from project areas farther from water bodies can be significantly lower (e.g., 20 to 80 percent) due to attenuation in the surficial aquifer, making the cost-effectiveness of septic-to-sewer projects much lower.

The City of Oak Hill is considering creating incentives for economic development within the City, particularly in the downtown area. One incentive is providing water and sewer services. The City has not yet obtained grant funding for a project of this nature, but they have been pursuing it. In addition to providing economic incentives, this project would achieve a nutrient load reduction to the Mosquito Lagoon. The amount of reduction will ultimately depend on the extent and location of the sewer system.

2.9 OPTION 9: ARIEL CANAL WATER QUALITY IMPROVEMENT ENHANCEMENT (AKA RIVER BREEZE STORMWATER PARK)

Volusia County constructed the Ariel Canal Water Quality Improvement Enhancement (aka River Breeze Stormwater Park) to provide retrofit treatment for approximately 1,500 acres of mixed land uses in south Edgewater, north Oak Hill, and Volusia County. The treatment facility is described as a wet pond and aquatic plant treatment system in the Environmental Resource Permit application. Although the facility should be effective at pollutant removal, further reduction of nutrient concentrations should be possible by retrofitting it with a BAM outfall. The BAM outfall would treat base flow and a portion of storm flows. Figures 2-10 and 2-11 show the general location and concept of Option 9.

Option 9 is estimated to reduce base flow and direct runoff TN loads by approximately 15 percent, TP loads by 20 percent, and BOD loads by 10 percent. These percentages translate to average annual reductions of approximately 1,300 lb/yr, 210 lb/yr, and 2,000 lb/yr, respectively.

Table 2-8 shows the opinion of probable cost for Option 9 is between \$1,300,000 and \$2,178,000. This cost includes design, permitting, and construction. Annualized maintenance costs are estimated to be \$40,000.

Figure 2-10 Option 9 Location and Description

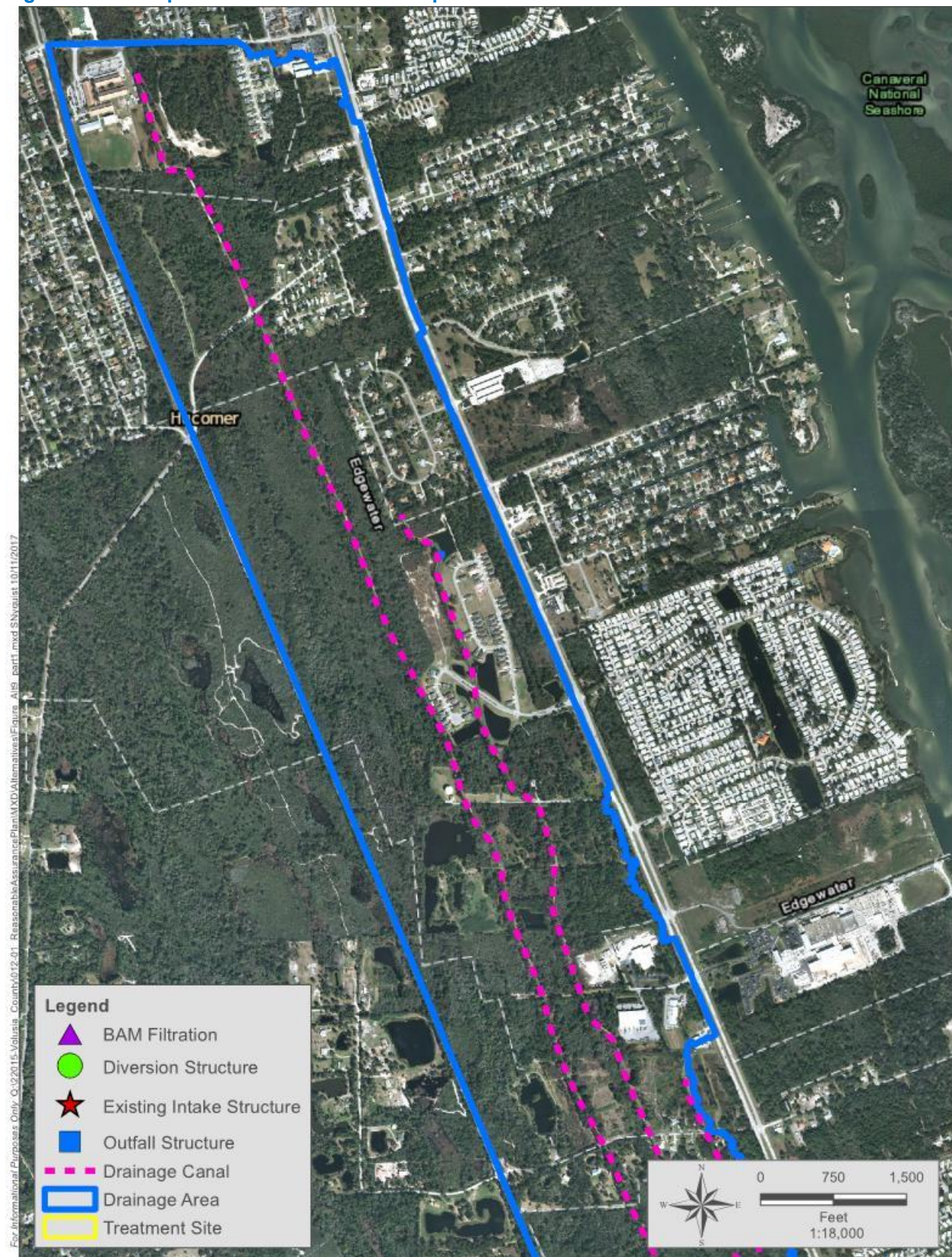


Figure 2-11 Option 9 Treatment Site Location and Description

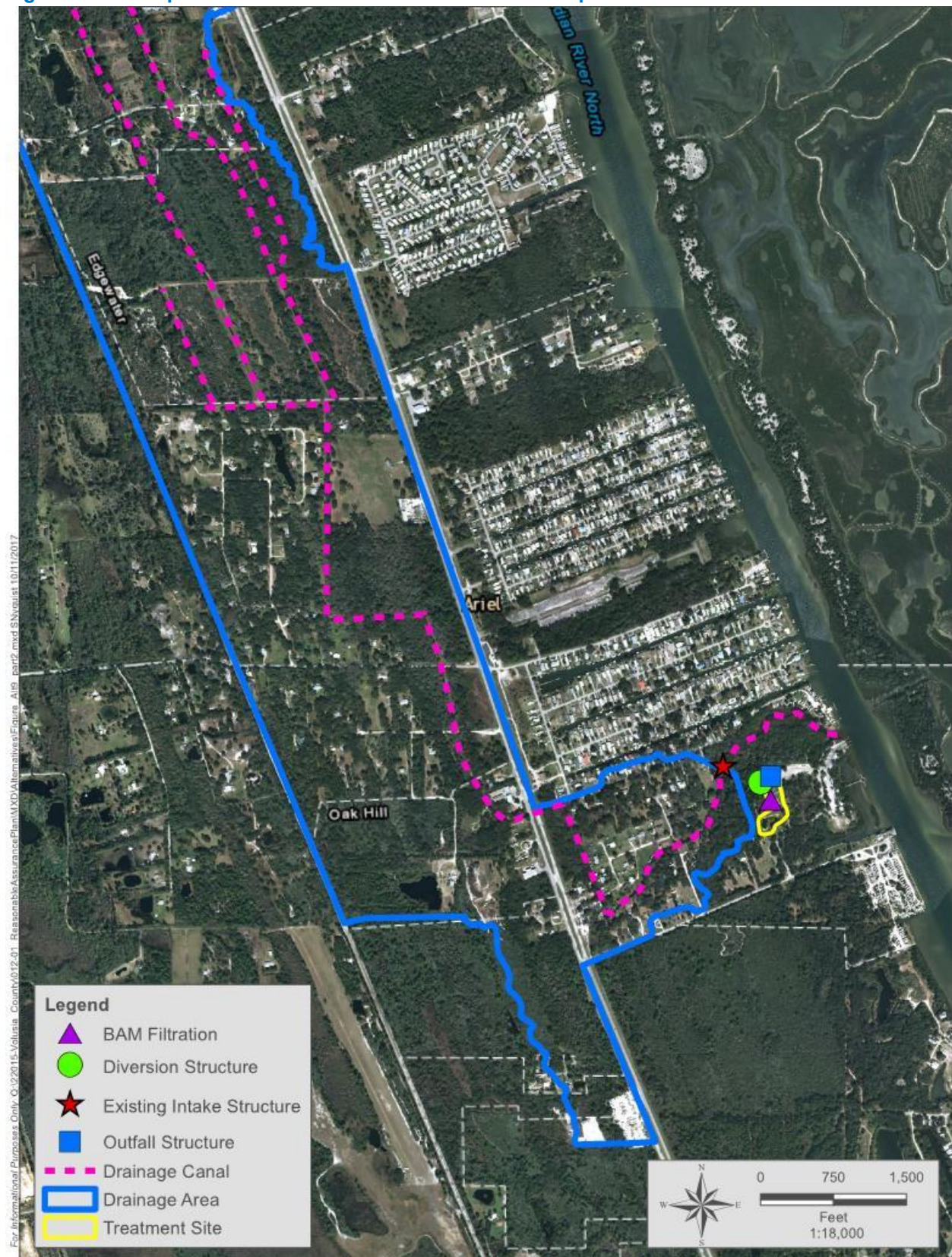


Table 2-8 Opinion of Probable Cost for Option 9

OPINION OF PROBABLE COST				
OWNER:		ESTIMATED BY:		
Volusia County		Amy Goodden		
CLIENT:		CHECKED BY:		
Volusia County		Jamie Bell		
PROJECT TITLE:		PROJECT SEGMENT		
Mosquito Lagoon Reasonable Assurance Plan Options Analysis				
PROJECT NUMBER:		10/23/2017		
22015-012-01				
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):		SUBJECT		
ROM		Option 9 - River Breeze Stormwater Park		
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
LAND ACQUISITION				
Pond owned by Volusia County	LS	1	\$ -	\$ -
CONSTRUCTION				
Sheetpile Low Head Dam - 70 LF X 15 ft	SF	1050	\$ 40	\$ 42,000.00
Diversion Weir - FDOT Type H DBI, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Diversion Weir - 36" RCP	LF	180	\$ 133	\$ 23,940
Outlet Structure - FDOT Type H, Modified, Assumed depth 10 ft	EA	1	\$ 11,000	\$ 11,000
Diversion Weir - 36" RCP	LF	180	\$ 133	\$ 23,940
Outlet Structure - Manatee Grate 36" RCP	EA	1	\$ 3,600	\$ 3,600
Dewatering and Flow Diversion	LS	1	\$ 15,000	\$ 15,000.00
Temporary Rock Check Dam	LS	1	\$ 1,500	\$ 1,500.00
Staked Silt Fence	LF	15	\$ 4	\$ 60
Earthwork to reconfigure Ponds	CY	20000	11	\$ 220,000
Excavation	CY	60	11	\$ 660
BAM Filtration System	CY	60	\$ 12,000.00	\$ 720,000
Subtotal				\$ 957,000
Miscellaneous Items and Fine Grading (15%)	LS	1	\$ 143,550	\$ 143,550
Mobilization (10%)	LS	1	\$ 95,700.00	\$ 95,700
TOTAL CONSTRUCTION COST ESTIMATE				\$ 1,196,000
PLANNING, DESIGN, PERMITTING				
Wetland Mitigation	CR	2	\$ 150,000	\$ 300,000
Engineering & Permitting (15%)	LS	1	\$ 179,400.00	\$ 179,400
Subtotal				\$ 479,000
SUBTOTAL PROJECT COST ESTIMATE				\$ 1,675,000
TOTAL PROJECT COST ESTIMATE RANGE		\$ 1,300,000	to	\$ 2,178,000

2.10 OPTION 10: LIGHTHOUSE COVE TREATMENT FACILITY

The area served by the Golden Bay Canal (Canal D-03) is a mix of primarily untreated residential and natural land uses in the City of Oak Hill and unincorporated Volusia County. If a suitable parcel could be purchased near the downstream end of the Canal in the Lighthouse Cove area, the area could be retrofitted with a wet detention pond. The pond would be approximately 5 acres and would treat base flow and direct runoff. Large storm flows would be diverted around the pond. Additional treatment would be possible through use of a BAM outfall. However, the cost and estimated pollutant load reductions presented in the subsection assume that the outfall are not included. Retrofitting the outfall later should be possible if additional load reduction is required. Figure 2-12 shows the general location and concept of Option 10.

Figure 2-12 shows the area served by Option 10, which is approximately 420 acres. Option 10 is estimated to reduce base flow and surface runoff TN loads by approximately 30 percent, TP loads by 45 percent, and BOD loads by 60 percent. These percentages translate to average annual reductions of approximately 760 lb/yr, 180 lb/yr, and 3,900 lb/yr, respectively.

Table 2-9 shows the opinion of probable cost for Option 10 is between \$1,700,000 and \$2,700,000. This cost includes design, permitting, and construction. Annualized maintenance costs are estimated to be \$18,000.

Figure 2-12 Option 10 Location and Description

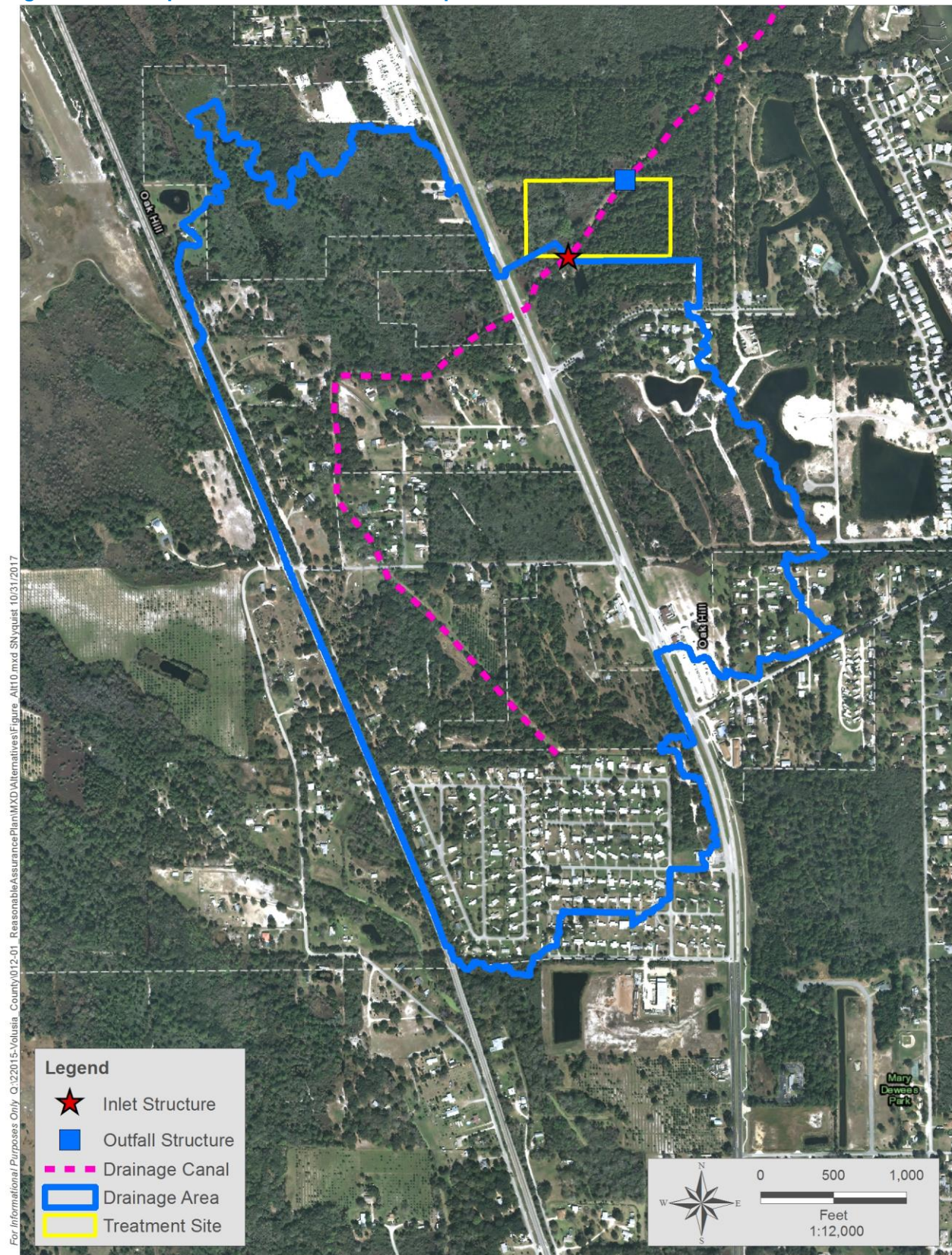


Table 2-9 Opinion of Probable Cost for Option 10

OPINION OF PROBABLE COST				
OWNER:		ESTIMATED BY:		
Volusia County		Amy Goodden		
CLIENT:		CHECKED BY:		
Volusia County		Jamie Bell		
PROJECT TITLE:		PROJECT SEGMENT		
Mosquito Lagoon Reasonable Assurance Plan Options Analysis				
PROJECT NUMBER:		DATE:		
22015-012-01		10/23/2017		
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):		SUBJECT		
ROM		Option 10 - Lighthouse Cove		
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
LAND ACQUISITION				
Property	AC	12	\$ 15,000.00	\$ 180,000
CONSTRUCTION				
Dewatering and Flow Diversion	LS	3	\$ 15,000	\$ 45,000.00
Temporary Rock Check Dam	LS	3	\$ 1,500	\$ 4,500.00
Sheetpile Low Head Dam - 70 LF X 15 ft	SF	1050	\$ 40	\$ 42,000.00
Diversion Weir 1 - FDOT Type C DBI, Assumed depth 10 ft	EA	1	\$ 3,300	\$ 3,300
Diversion Weir 1 - 18" RCP	LF	32	\$ 69	\$ 2,208
Outlet Structure - FDOT Type D, Modified, Assumed depth 10 ft	EA	1	5600	\$ 5,600
Outlet Structure - 18" RCP	LF	32	\$ 69	\$ 2,208
Concrete driveway apron- FDOT turnout	SY	196	\$ 23	\$ 4,498
Box culvert under driveway to bridge existing canal	LF	32	\$ 12,000	\$ 384,000
Gravel access road 1800LF, clearing and grubbing	AC	0.58	\$ 12,000	\$ 6,942
Gravel access road 1800LF, Stabilized base, Group 6	SY	2400	\$ 14	\$ 33,600
Gravel access road 1800LF, #57 stone	TN	835	\$ 90	\$ 75,150
Soil Tracking Prevention Device	EA	1	\$ 2,500	\$ 2,500
Staked Silt Fence	LF	1800	\$ 4	\$ 7,200
Staked Turbidity Barrier	LF	80	\$ 4	\$ 320
Clearing and Grubbing	AC	5.2	\$ 12,000	\$ 62,782
Borrow Excavation (Haul)	CY	89733	\$ 11	\$ 987,068
Clearing and Grubbing	AC	5	\$ 12,500.00	\$ 62,500
Excavation	CY	70110	\$ 10.00	\$ 701,100
Type H Inlets	EA	2	\$ 7,500.00	\$ 15,000
48" Mitered End Section	EA	2	\$ 4,500.00	\$ 9,000
Sodding	SY	5000	\$ 2.60	\$ 13,000
BAM Filtration System	LS	1	\$ 530,000.00	\$ 530,000
Subtotal				\$ 1,330,600
Miscellaneous Items and Fine Grading (15%)	LS	1	\$ 199,590	\$ 199,590
Mobilization (10%)	LS	1	\$ 133,060.00	\$ 133,060
TOTAL CONSTRUCTION COST ESTIMATE				\$ 1,800,000
PLANNING, DESIGN, PERMITTING				
Engineering & Permitting (15%)	LS	1	\$ 270,000.00	\$ 270,000
Subtotal				\$ 270,000
SUBTOTAL PROJECT COST ESTIMATE				\$ 2,070,000
TOTAL PROJECT COST ESTIMATE RANGE		\$ 1,700,000	to	\$ 2,700,000

2.11 OPTION 11: DRAGLINE DITCH RESTORATION

Draglines were used several decades ago to cut deep, wide ditches in the estuarine wetlands. The spoil was piled in mounds between the ditches. Dragline ditching altered the topography and bathymetry in a way the left areas that typically had been inundated by high-tide and dry during low-tide either always dry or always wet. The mounded spoils areas that are now almost always dry are prone to invasive plants. The deeper areas that are now always wet have typically not recruited saltwater marsh vegetation, leaving a bare sand bottom. SJRWMD and Volusia County have been restoring dragline ditches in the Mosquito Lagoon.

An abundance of research suggests estuarine wetlands remove nutrients. With approximately 1,300 acres of dragline ditch recently restored or planned for restoration, the nutrient reduction benefit to Mosquito Lagoon from the restoration efforts may be significant. Currently, the Basin Management Action Plan process does not provide a reduction credit for dragline ditch restoration. The purpose of this option is to propose a defensible method for estimating nutrient reduction benefits from dragline ditch restoration and to quantify the nutrient load reduction from the approximately 1,300 acres of recently restored or planned restoration.

We reviewed more than 50 sources and found nine with potentially useful information. We are defining useful information in part as denitrification rates for salt marshes or unvegetated estuarine areas expressed in units of mass per area per time. Despite variability in the findings across the sources, the general consensus is that the presence of saltmarsh vegetation significantly increases the rate of denitrification (Caffrey and Kemp, 1990) and likely results in long-term sequestration or sedimentation of nutrients. Other pathways of increased nutrient uptake in saltwater marshes were not considered for this effort because whether they offer a significant long-term net reduction in available nutrients is not clear or the literature sources contained greater variability (e.g., anammox). Additionally, long-term double-counting of sedimentation and denitrification is possible if a major source of denitrification is in the sediment. Conservatively, we are proposing the credit to be the increased denitrification taken from literature values between an unvegetated bottom and saltmarsh vegetation. Future research may support a higher credit, but a conservative approach is currently more defensible.

Unfortunately, literature sources with useful information were generally from study areas outside Florida. The difference in conditions makes how transferable the results of these studies are to the Mosquito Lagoon questionable. In discussions with Florida Department of Environmental Protection (FDEP) on this subject, they believe that using Florida-based values or values from systems that are demonstrably similar to the Mosquito Lagoon is important to have reasonable assurance that the values are appropriate. In part to explore how valuable research to achieve this may be, we used literature values to estimate increases in denitrification rates in restored dragline ditches.

The most comprehensive review of denitrification rates we found was documented in *Measurements of Denitrification in Aquatic Ecosystems: Literature Review and Data Report* (S.E. Green, 2005). One of the tables in this document provides statistics (min, max, mean, median, range, and n) of denitrification rates grouped by type. The mean and median denitrification rates for estuaries listed in this report are 197 and 40 $\mu\text{mol N m}^{-2} \text{ h}^{-1}$, respectively, with a sample size of 1,188. The respective values for mudflats, which is the closest category to dragline ditch areas but likely different in terms of denitrification rates, are 71 and 31 $\mu\text{mol N m}^{-2} \text{ h}^{-1}$, respectively, with a sample size of 61. The report does not provide enough information to ascertain the distribution of the data; therefore, we do not know if mean or median is the better statistic for central tendency. To explore the potential importance of dragline ditch restoration for pollutant load reduction in Mosquito Lagoon, we used the difference between the medians of the rates listed above (40 $\mu\text{mol N m}^{-2} \text{ h}^{-1}$ minus 31 $\mu\text{mol N m}^{-2} \text{ h}^{-1}$, since that difference was the smaller of the two) and multiplied it by 1,300 acres. That resulted in a TN reduction of 12,800 lb/yr. The magnitude of that number

suggests that research into denitrification rates specific to restored and unrestored dragline ditches in Mosquito Lagoon may be very valuable for restoration efforts.

2.12 OPTION 12: PUBLIC EDUCATION AND OUTREACH

FDEP provides credits in watershed restoration efforts for public education and outreach. The pollutant load-reduction credit can be up to 6 percent, depending on the level of engagement in activities by the local government. The credit is typically only applied to urban land uses. Each key stakeholder provided information on their public education and outreach efforts. Based on that information and FDEP's credit procedure, we calculated reduction percentages ranging from 1 percent to 3 percent for the key stakeholders. We then applied these credits to the urban areas within the respective stakeholders' jurisdictions within the watershed. Table 2-10 shows the results of these calculations. An additional 3 percent is possible through increased participation in the Florida Yards and Neighborhoods program. Since the local government stakeholders are likely to participate in this program in the future, Table 2-10 also shows these values for information purposes.

Table 2-10 Public Education and Outreach Pollutant Load Reductions

Stakeholder	Percent Reduction	Annual Load Reduction (lb/yr)		
		BOD	TP	TN
City of Edgewater	3	2000	91	670
City of New Smyrna Beach	3	2500	100	750
City of Oak Hill	3	490	22	160
Department of Transportation	1	210	9	70
Volusia County	3	1400	63	460
<u>With Increased Participation in Florida Yards and Neighborhoods</u>				
City of Edgewater	6	3900	180	1300
City of New Smyrna Beach	6	4900	210	1500
City of Oak Hill	6	980	43	310
Volusia County	6	2800	130	920

2.13 OPTION 13: REDUCED FLUX FROM NORTH IRL

Because of the exchange between the South ENR of Mosquito Lagoon and the North Indian River Lagoon (IRL) through Haulover Canal, there is a potential pollutant load-reduction benefit to the South ENR from the TMDL being met for the North IRL. Without a fully vetted hydrodynamic model that includes water quality, it was necessary to make an assumption to quantify this benefit. The assumption we made was that if the North IRL loads were reduced by the recently refined North IRL TMDL load reduction of 22.5 percent, the resulting ambient concentration would also be reduced by 22.5 percent. As such, we reduced the mean monthly nitrogen concentration in the North IRL by 22.5 percent and used that to calculate the intersegment nitrogen fluxes as the reduced mean monthly nitrogen concentration multiplied by the net monthly hydrologic flux between the segments. We determined the hydrologic flux as the volume of water exchanged through the Haulover Canal from the current St. Johns River Water Management District EFDC model for the IRL and identified the direction of the net monthly flux. When the net movement was from west to east (or from the North IRL to the South ENR), we summed the values for a given year. Table 2-11 shows the results. For this analysis, the data were available from 2004 through 2010. The result is an estimate of the adjusted North IRL load to the South ENR of Mosquito Lagoon when the North IRL meets the TMDL and the load reduction.

Table 2-11 Public Education and Outreach Total Nitrogen Load Reductions

Year	North IRL Load to South ENR (tons/yr)	Percent Reduction Due to Refined TMDL	Adjusted North IRL Load to South ENR (tons/yr)	Reduction in Load from North IRL to South ENR (tons/yr)
2004	634	22.5	491	143
2005	269	22.5	208	61
2006	280	22.5	217	63
2007	250	22.5	194	56
2008	401	22.5	311	90
2009	586	22.5	454	132
2010	268	22.5	208	60
Mean	384	—	298	86
Total	2689	—	2084	605

The lowest annual reduction of load of 56 tons/yr (112,000 lb/yr) is nearly an order of magnitude higher than the total nitrogen load-reduction target in the South ENR of 12,400 lb/yr, and the mean reduction of 86 tons/yr (172,000 lb/yr) is more than an order of magnitude higher than the target.

3 REFERENCES

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Appendix A

Excerpt from Volusia County Water Quality Plan