Additional Proposal Information

(This is as uploaded, a blank page will show if nothing was submitted)

Final Report August 2010.pdf

CDM

East Volusia Regional Water Authority

Nova Canal Flood Control and Integrated Water Resource Program

August 2010

Final Report

East Volusia Regional Water Authority
Nova Canal Flood Control
And Integrated Water Resource Program
Final Report

Certification Page

In accordance with Section 471 Florida Statutes, this Report and associated analyses have been prepared under the direct supervision of a registered Professional Engineer in the State of Florida.

Camp Dresser & McKee, Inc.
8381 Dix Ellis Trail Suite 400
Tel: (904) 527-6735 Fax: (904) 519-7090

Michael F. Schmidt, P.E.
Florida Registered Professional
Engineer No. 42072

CDM

Executive Summary

ES.1 Purpose

Led by the Eastern Volusia Regional Water Authority (EVRWA), a Joint Project Agreement (JPA) for this project has been developed by the municipalities and agencies listed below:

- City of Ormond Beach
- City of Holly Hill
- Volusia County
- City of Daytona Beach
- City of South Daytona
- City of Port Orange
- Florida Department of Transportation (FDOT)

Camp Dresser & McKee Inc. (CDM) and Quentin L. Hampton & Associates (QLH) were contracted by the EVRWA to evaluate potential flood control improvements along the LPGA Blvd (11th Street) Canal, Reed Canal, and Halifax Canal as part of the Phase 1 Study of this project. The evaluation was performed with the updated Storm Water Management Model Version 5 (SWMM5). These improvements were proposed to include three pump stations and tidal weir-gates located along the three canal systems and are collectively referred to as Alternative 1. Operational parameters for these project components are described in Section 2.

The JPA desired construction of the stormwater pump stations and flood control weir-gates primarily to provide flood mitigation to the residents within the study area based on concerns from flooding caused by the May 2009 5-day storm, which had between 20 and 27 inches of rainfall. Statistical analysis performed on the May 2009 storm as part of this project determined an estimated rainfall recurrence interval of 310 years for this extreme event. During the storm, the tidal surge condition was approximately a 3-year event and the three major outfalls at Halifax, Reed, and LPGA canals maintained a significant gravity flow throughout the event. Tidal conditions and peak stage and peak flow summaries are presented in **Appendices A through C**.

Following the analysis of the Phase 1 improvements, it was determined that the proposed Phase 1 improvements (Alternative 1 pump stations and tide gates) did not yield significant flood stage reductions. This is due to several factors, including the fact that the three main outfalls at LPGA, Reed, and Halifax Canals were all flowing at gravity capacity during the May 2009 event and tide levels were not significant in causing backwater to reduce gravity flow capacity. Following additional analysis and consultation with the JPA Partners, it was determined that an additional evaluation

phase (Phase 3) should be performed to define and evaluate alternative conceptual program components to provide more significant flood control benefits within the study area prior to completing the Phase 2 Design and Permitting tasks.

As part of the Phase 3 additional alternatives analyses, various flood control components were evaluated individually and in combination to achieve greater comprehensive flood control benefits within the study area for the EVRWA. The potential flood reduction benefits provided by the project components were compared to the estimated capital costs to implement the components into the Nova Canal Flood Control and Integrated Water Resource Program. This section presents the individual program components, combinations of components and alternatives, flood reduction benefits (depth, area, and flood damage cost reduction), and capital costs.

This project could also be an initial phase of a longer term flood control and water supply program for the municipalities. The following report details the update, refinement, and validation of the stormwater model utilized to evaluate the original alternative of three stormwater pump stations and weir gates as well as six additional alternatives evaluated to identify improvements that would further increase the flood mitigation benefit-cost ratio. This report also addresses proposed project components, operational protocols, system bottlenecks, and improvements to system storage that could be implemented to increase the performance of the flood mitigation facilities.

ES.2 Study Area

The overall study area is located within Volusia County, Florida and encompasses 26 square miles in portions of Ormond Beach, Holly Hill, Daytona Beach, South Daytona, Port Orange, and unincorporated Volusia County (**Figure ES-1**).

ES.3 Stormwater Model Update and Refinement

The CDM\QLH team compiled, updated, and refined the existing Nova Canal stormwater models for the purposes of evaluating alternatives, permit support, and design of flood control features and multi-purpose pumping stations. The model evaluations were performed utilizing the current EPA Storm Water Management Model Version 5 (SWMM5).

Initial model development focused on validation based on comparison of model results to known high water conditions measured or reported during the May 2009 storm event. The validated model was then applied to evaluate the conveyance system performance for design storms which varied by return period, storm duration, and tailwater elevation conditions. Stormwater model development is described further in Section 2 of the report.

In order to provide a more refined stormwater analysis of the study area for existing and alternative conditions, the Phase 1 SWMM5 was extended to the Laurel, Thompson, and Strickland Creek systems to the north (as previously modeled for the City of Ormond Beach). The updated model was also extended south to include the

CDM

East Volusia
Regional Water Authority
(EVRWA)

Figure ES-1
Nova Canal Flood Control and
Integrated Water Resources Program
Study Area

UPDATED
07-30-10

Friday, July 30, 2010 9:54:00 AM D:\Volusia June 2009\Phase 3 Report\Fig ES-1_0730 10.mxd

primary system from the Halifax Canal outlet to the railroad crossing downstream of Nova Road. Runoff from the tributary area that contributes to this area south of the Halifax Canal outfall (generally areas south of Nova Road and Dunlawton Avenue) is accounted for in the updated SWMM5 by using time-flow hydrographs as previously modeled in ICPR by QLH.

ES.4 Project Component Descriptions and Development

An initial project alternative (Alternative 1) was evaluated as part of the Phase 1 study, and included combination tidal weir-gates and pump stations at the LPGA, Reed and Halifax Canals. This configuration was a "pump only" option as opposed to a pump and force main to the Halifax River. The general concept of each canal component is to reduce the peak stages and duration of flooding by preventing tidal backflows into the conveyance system, pumping down the system before or at the start of major storm events, and increasing capacity of the system during high tailwater conditions that limit gravity outflow. Operating rules and appropriate pump capacities were evaluated initially based on the May 2009 rainfall and tidal conditions. The alternative was then evaluated for the various design storm durations and return periods for both 1-year and 100-year stillwater downstream tidal boundary conditions.

In addition to the flood control components considered in Alternative 1, additional conceptual project components within the study area were developed. Existing stormwater and other potential surface water storage facilities, as well as ongoing watershed projects that are currently committed to or in construction were also considered in developing these components. The flood control components for Alternative 1 and the additional conceptual project components are presented in **Figure ES-2**. Detailed conceptual layouts for the project components are provided in Section 3 and **Appendix D**.

Project components evaluated typically consist of one or more of the following elements:

- **Tidal weir-gate**. The tidal weir-gate is defined as a rectangular structure located in the canal. Based on JPA discussion, the tidal weir-gate is expected to typically operate in the open position. The weir-gate is then closed under specified design conditions such as elevated tidal conditions or to allow pumping down the system in advance of a storm. Closing (raising) the weir gates could also allow diversion of the surface water for water supply purposes. The weir-gates would operate by either inflating or rotating from the bottom of the canal to allow a range of tidal control along with gravity outflow.

- **Diversion channel at pump station site**. This channel conveys water from the upstream side of the weir-gate to the pond at the pump station site.

- **Pond at pump station site**. A pond is included at the pump station site. This pond represents the wet well from which water is pumped.

Figure ES-2
Nova Canal Flood Control and
Integrated Water Resources Program
Alternatives Components

East Volusia
Regional Water Authority
(EVRWA)

CDM

UPDATED
07-30-10

Friday, July 30, 2010 10:04:00 AM D:\Volusia June 2009\Phase 3 Report\Fig ES-2_073010.mxd

- **Storage pond**. In addition to ponds at pump station sites, additional storage ponds may also be considered in order to capture and store stormwater runoff for additional flood control.

- **Force main**. A pressurized pipe system extending from the pump station to the downstream receiving water (typically the Halifax River for this project).

- **Pump station**. The pump station is located at the project site, and will pump water from the proposed pond. The "pump only" option pumps to downstream of the weir-gate, while the "pump with force main" option pumps through a force main routed to a downstream water body (Halifax River).

- **Emergency spillway**. An emergency spillway is provided at the pump station pond to promote additional flow conveyance when the pump is inoperable or not sufficient to pass peak flows for extreme events.

LPGA Canal Project Component

The LPGA Canal project component was originally configured in the Phase 1 Study as part of Alternative 1. Several options were evaluated to determine this location in Phase 1, which was chosen by the City of Holly Hill to be a pump station at the existing pond in Centennial Park, and a tide weir-gate located just downstream. The pump station was operated in the pump only (no force main) configuration. Specific operational parameters for the LPGA Canal component considered as part of Alternative 1 are described in Section 2.

During Phase 3, two important modifications were made to this project component including:

1. The pump station was relocated from Centennial Park to property adjacent to SICA Hall and Peterson Court and the tide weir-gate was relocated to Riverside Drive; and

2. The pump station was changed to a pump with force main configuration.

The parameters for the original and modified LPGA Canal components are summarized in **Table ES-1**.

Reed Canal Project Component

The Reed Canal project component was originally configured in the Phase 1 Study as part of Alternative 1. The original configuration included a pond, pump station, and tidal weir-gate located at the CEMEX Site. The pump station was operated in the pump only (no force main) configuration. Specific operational parameters for the Reed Canal component considered as part of Alternative 1 are described in Section 2.

Table ES-1 Summary of Project Component Parameters

Project Component	Pump Size (cfs)	Force Main Diam/Length (ft/ft)	Proposed Storage (Acres)	Tide Gate Locations
LPGA Canal (original configuration)	600	N/A	N/A	Centennial Park
LPGA Canal (modified configuration)	500	8/700	22.0	SICA Hall
Reed Canal (original configuration)	1,125	N/A	4.0	East of Railroad
Reed Canal (modified configuration)	500	10/1,100	4.0	East of Railroad
Halifax Canal	300	N/A	8.0	South of Nova Road
Laurel Creek Area	150	6/8,000	10.6	N/A
North Street Pond	500	10/6,700	N/A	N/A
Samuel Butts Pond	550	10/7,200	31.0 (total)	N/A
Navy Canal Diversion	N/A	N/A	120	N/A
Buschman Pond	300	8/4,800	53.5 (total)	North of Nova Road

Note: reported proposed storage includes proposed pond and additional proposed storage in watershed

During Phase 3, an important modification was made to this project component to change the pump configuration to a smaller pump with a 10-foot diameter force main. The parameters for the original and modified Reed Canal components are summarized in Table ES-1.

Halifax Canal Project Component

The Halifax Canal project component was originally configured in the Phase 1 Study as part of Alternative 1. The original configuration included a pond, pump station, and tide weir-gate located on property south of Nova Road. The pump station was operated in the pump only (no force main) configuration. Specific operational parameters for the Halifax Canal component considered as part of Alternative 1 are described in Section 2.

During Phase 3, it was determined that this property was no longer available, flood reduction benefits were greater at the Buschman Park location (e.g., to address Dunlawton Avenue flooding), and this project component was eliminated. The parameters for the original Halifax Canal components are summarized in Table ES-1.

Laurel Creek Area Project Component

The Laurel Creek project component includes a 150-cfs pump station, an 8,000-foot force main (6-foot diameter) along Division Street to the Halifax River, and a 10.6-acre pond. These elements are intended to complement proposed improvements in this area by the City of Ormond Beach. City improvements include better connection of existing surface water bodies (borrow ponds) and additional storage. The parameters for this component are summarized in Table ES-1.

North Street Pond Project Component

The North Street Pond project component includes a 500-cfs pump station, a 6,700-foot force main (10-foot diameter) along Fairview Avenue to the Halifax River, and draws from the recently constructed 9-acre North Street pond. Improved connection from Nova Canal to the North Street Pond is also considered in this component. These elements are intended to complement the improvements by the City of Daytona Beach in the area. The parameters for this component are summarized in Table ES-1.

Samuel Butts Pond Project Component

The Samuel Butts Pond project component includes an existing 19-acre pond, a 550-cfs pump station, a 7,200-foot force main (10-foot diameter) from the existing pond along Niles Street and Wilder Boulevard to the Halifax River, a 9-acre pond on school property, and a 22-acre pond along the golf course. Improved connection from the Nova Canal to the Samuel Butts Pond is also considered in this component. These elements are intended to complement existing and proposed improvements by the City of Daytona Beach in the area. The parameters for this component are summarized in Table ES-1.

Navy Canal Diversion Project Component

The Navy Canal Diversion project component includes various channel and culvert improvements, a diversion weir just west of Clyde Morris Boulevard, and more than 100-acres of additional surface water storage south of the Daytona Beach International Airport (DBIA). The concept is to store water within this topographic high-spot for the area and reduce the flow volume and rate that is discharged into the Nova Canal system. These elements are intended to complement upcoming proposed improvements by the City of Daytona in and adjacent to the DBIA. The parameters for this component are summarized in Table ES-1.

Bottleneck Removal in the Primary System

The Bottleneck removal project component included identification and evaluation of the potential flood reduction benefits from the removal of various culverts, bridge, and channel bottlenecks in the three canal systems (LPGA, Reed, and Halifax) as well as the primary tributary canals such as Nova Canal.

Once identified, field confirmation of the bottleneck element was performed to verify the actual configuration (e.g., pipe diameter) of the bottleneck. Where bottlenecks were confirmed, their removal was analyzed using larger conduits to determine the potential flood control benefits and impacts. However in all cases reviewed, removal of bottlenecks resulted in increased flooding conditions (impacts) downstream. Since reducing localized flooding in some areas at the expense of other areas is not acceptable nor permittable, no bottlenecks were ultimately identified that could be recommended for removal. Greater study may be warranted regarding the feasibility of bottleneck removal in project-specific locations. Additional supporting information for the bottleneck evaluation is provided in **Appendix E**.

Buschman Pond Project Component

The Buschman Pond site was chosen for the alternative Halifax Canal Pump Station. This project component includes a 300-cfs pump station, a 4,800-foot force main (8-foot diameter) along Commonwealth Boulevard to the Halifax River, the existing 3.2-acre Buschman Pond and additional storage in the basin. The parameters for this component are summarized in Table ES-1.

ES.5 Alternatives Descriptions and Development

In order to determine the incremental and comprehensive benefits of the potential project components discussed above, seven alternatives were developed that consider the project components in various combinations. The alternatives are described below.

Alternative 1

Alternative 1 includes the base improvements that were originally evaluated in the Phase 1 Study (see Section 2). This alternative includes pump stations (pump only configuration), ponds, and tide gates at each of the three existing outfall canals (LPGA Canal at Centennial Park, Reed Canal, and Halifax Canal) in their original configurations.

Alternative 2

Alternative 2 considers the existing system with removal of the culvert, bridge, and canal bottlenecks from the three canal systems (LPGA, Reed, and Halifax) as well as the Nova Canal. Since bottleneck removal was not found to be feasible, this alternative is not further considered.

Alternative 3

Alternative 3 considers the existing system with the Navy Canal Diversion.

Alternative 4

Alternative 4 includes four new pump station outfalls to the Halifax River to be located in the Laurel Creek area, the North Street Pond, the Samuel Butts Pond, and the Buschman Pond (serving the Halifax Canal).

Alternative 5

Alternative 5 combines Alternatives 3 and 4. This alternative includes the Navy Canal Diversion as well as four new pump stations outfalls to the Halifax River (at Laurel Creek, North Street Pond, Samuel Butts Pond and Buschman Pond).

Alternative 6

Alternative 6 combines Alternatives 1, 2, 3, and 4 and includes all project components. The pump stations at the LPGA Canal (Centennial Park), Reed Canal, and Halifax Canal are considered in their original configurations as “pump only” systems.

Alternative 7

Alternative 7 combines the modified configuration of Alternative 1 with Alternatives 2, 3, and 4 and includes all project components (except the original pump station at the Halifax Canal). The modified Alternative 1 configurations includes pump stations with force mains located on the LPGA (Sica Hall site) and Reed Canals.

ES.6 Flood Damages and Flood Control Benefits

Assessment of costs and benefits is necessary to determine which alternative provides the best flood mitigation investment for the JPA Partners and to demonstrate benefit versus cost for potential Federal and/or State funding support. For purposes of assessing flood control benefits of the alternatives, the project team and JPA Technical Advisory Group agreed that empirical evidence and damage assessments from the May 2009 event suggests that flood inundation in excess of one foot above ground surface on improved parcels is a good indicator of when significant structural damage begins to accrue.

Model results under existing and alternatives conditions for the 25- and 100-year, 24-hour design storms and the May 2009 storm event (presented in **Appendix F**) were used to support the estimates of flood damage and flood control benefits. Using modeled flood stages and LiDAR topographic information, colorized flood inundation maps were developed for the May 2009 storm, 100-year 24-hour storm, and 25-year 24-hour storm for the existing stormwater infrastructure and with the proposed infrastructure improvements for each alternative. These maps are presented in **Appendix G**.

Conceptual cost estimates were developed for all of the alternatives except Alternative 2 (removal of bottlenecks in the LPGA, Reed, Halifax, and Nova Canals) since no bottleneck removals were identified to be beneficial. A summary of preliminary opinions of conceptual project costs (construction and enginering) for the alternatives are presented in **Table ES-2**. Detailed conceptual project costs for each of the project components are included in **Appendix H**.

Volusia County Property Appraiser data on improved property within the watershed were used to eliminate undeveloped properties from the inundated acreage for purposes of estimating flood damage reduction benefits for each alternative and for allocation of flood control benefits among the JPA Partners. Alternative cost estimates, flood inundation mapping, and predicted flood damage reduction benefits for each alternative were presented to the JPA Technical Advisory Group on May 10, 2010 and May 21, 2010. Estimated flood inundation and damages under existing and alternatives conditions for the design storms as well as the May 2009 event are presented in **Appendix I.**

Table ES-2: Preliminary Opinion of Conceptual Cost of Project Alternatives

Facility	Conceptual Cost
Alternative 1	
LPGA Canal at Centennial Park (Pump Only)	$10,649,000
Reed Canal (Pump Only)	$12,966,000
Halifax Canal-Summitt	$5,694,000
Total Alternative 1	**$29,309,000**
Alternative 2	
Bottleneck Removal Only	N/A
Alternative 3	
Navy Canal Diversion	**$10,112,000**
Alternative 4	
Ormond Beach Laurel Creek	$14,980,000
Daytona Beach North Street Park	$31,951,000
Daytona Beach Samuel Butts Park	$30,008,000
Port Orange Buschman Park	$21,383,000
Total Alternative 4	**$98,322,000**
Alternative 5	
Bottleneck Removal	N/A
Ormond Beach Laurel Creek	$14,980,000
Daytona Beach North Street Park	$31,951,000
Daytona Beach Samuel Butts Park	$30,008,000
Port Orange Buschman Park	$21,383,000
Navy Canal Diversion	$10,112,000
Total Alternative 5	**$108,434,000**
Alternative 6	
Alternative 1	$29,309,000
Bottleneck Removal	N/A
Ormond Beach Laurel Creek	$14,980,000
Daytona Beach North Street Park	$31,951,000
Daytona Beach Samuel Butts Park	$30,008,000
Port Orange Buschman Park	$21,383,000
Navy Canal Diversion	$10,112,000
Total Alternative 6	**$137, 743,000**
Alternative 7	
LPGA Canal Pump Station with Force Main (at Sica Hall)	$11,193,000
Reed Canal Pump Station with Force Main	$11,448,000
Bottleneck Removal	N/A
Ormond Beach Laurel Creek	$14,980,000
Daytona Beach North Street Park	$31,951,000
Daytona Beach Samuel Butts Park	$30,008,000
Port Orange Buschman Park	$21,383,000
Navy Canal Diversion	$10,112,000
Total Alternative 7	**$131,075,000**

ES.7 Conclusions

Flooding within the watershed from the May 2009 storm (310 year event) is not fully eliminated by any of the seven alternatives evaluated. As discussed earlier and in the JPA presentations, the Nova Canal watershed contains significant portions of historic wetland floodplain that have been developed since the original US Department of the Interior reclamation project in the 1920s. Many buildings were constructed on very low ground and the pump stations required would not be constructable within the limits of available rights-of-way for the major canals without significant property acquisition and associated storage. However, significant flood control benefits can be provided by several of the proposed alternatives as indicated by the model results.

The pump stations, ponds, and weir-gates also offer opportunities for water quality benefits and alternative water supply use. To various degrees, the five proposed pump, pond, and weir-gate alternatives offer the following benefits:

1. Reduced peak stages;
2. Reduced inundated areas
3. Shortened flood durations;
4. Capability to pump down the system in advance of an approaching storm;
5. Prevention of tidal back surge for more extreme tidal conditions (e.g., Hurricane Dora or King); and
6. Capture of stormwater before release to tide to allow future design modifications to pump flow west for water supply and/or additional water quality benefits.

Based on review of model results, estimated flood damage reduction benefits and construction cost estimates, Alternative 4 was selected by the project team and the JPA Technical Advisory Group as the alternative with the best benefit-cost ratio for presentation to the JPA Board. Alternative 4 components are presented on **Figure ES-3** and the estimated construction costs are provided in Table ES-2. Flood inundation maps associated with the May 2009 storm for the existing stormwater management infrastructure and after implementation of Alternative 4 are presented in Appendix G.

Table ES-3 shows the computation of the Alternative 4 flood damage reduction benefits for the May 2009 storm. In summary, Alternative 4 is estimated to cost $98 million (plus land) and reduce flood damages from $52 million to $26 million for the May 2009 storm alone. Overall project life flood damage reduction includes other potential events (e.g., mean annual 5, 10, 25, and 100-year) and is estimated to be approximately $111 million as shown in **Table ES-4**, which considers the probability of storm event damages over the 50 year design life for the proposed facilities (flood damage reduction for multiple storms in 50 years).

Figure ES-3
Nova Canal Flood Control and
Integrated Water Resources Program
Alternative 4 Components

East Volusia
Regional Water Authority
(EVRWA)

CDM

UPDATED
07-30-10

Friday, July 30, 2010 10:07:00 AM D:\Volusia June 2009\Phase 3 Report\Fig ES-3_073010.mxd

Table ES-3: May 2009 Flooding Extents by Component Area for Alternative 4

Location	Area Flooded >1 ft (ac)			Potential Flood Damage (>1ft Flooding) ($)		Potential Flood Damage Reduction ($)	
	Existing	Alternative 4	Reduction (%)	Existing	Alternative 4	Existing	Alternative 4
Laurel Creek Pump	51.7	29.7	43%	$2,200,000	$1,200,000	--	$1,000,000
North Street Pump	102.5	40.7	60%	$4,300,000	$1,700,000	--	$2,600,000
Samuel Butts Pump	245.6	66.0	73%	$10,300,000	$2,800,000	--	$7,500,000
Buschman Pump	80.2	50.8	37%	$3,400,000	$2,100,000	--	$1,300,000
Component Total	480.0	187.2	61%	$20,200,000	$7,800,000	$ --	$12,400,000
Overall Study Area Total	**1,231.0**	**623.4**	**49%**	**$51,700,000**	**$26,200,000**	**$ --**	**$25,500,000**

Basis for Estimate:

1. Homes per acre	2
2. Flood Damage per home	$21,000
3. Flood Damage per acre	$42,000
4. Developed area (structures)	100%

Use of the May 2009 storm as a level of service objective establishes a need for very large and costly pumping and conveyance systems. These facilities will also provide flood control benefits for all smaller flood-producing storms. These additional benefits could be further estimated and refined to strengthen eligibility for federal funding. Typically, the cumulative benefit-cost ratio must exceed 1.0 to qualify for federal funding. Alternative 4 satisfies this requirement, and Table ES-4 and **Figure ES-4** show the estimated flood control benefits that should accrue from implementation of Alternative 4. It is important to note that these estimates of cumulative project benefits do not yet include potential alternative water supply benefits, water quality benefits, or ecosystem restoration benefits that may result from these improvements. Therefore the benefit-cost ratio would likely be higher with water supply and water quality benefits considered.

Constructing additional storage within low-lying properties in the study area is also an effective means of reducing flood stages as well as removing flood-prone properties from the floodplain. When used in combination, creating additional storage also provides an opportunity to downsize the pumping and conveyance facilities required to provide substantial flood control. Figures provided in **Appendix J** show the estimated 100-year 24-hour flood volumes based upon the modeling performed for each of JPA Partner jurisdictions.

Table ES-4: Alternative 4 – Laurel Creek, North Street, Samuel Butts, & Buschman Pumps

Event (Yr)	Rainfall (inches)	Event (Probability)	Potential Flood Damage Reduction ($)	Annualized Flood Damage Reduction ($)	Design Life	Project Life Flood Damage Reduction ($)	Rectangle Representing Approximation
310	20-27	0.003	$25,500,000	$136,000	50	$6,800,000	1
100	13.0	0.010	$14,700,000	$347,000	50	$17,350,000	2
25	9.5	0.040	$8,400,000	$438,000	50	$21,900,000	3
10	8.0	0.100	$6,200,000	$525,000	50	$26,250,000	4
5	6.5	0.200	$4,300,000	$768,000	50	$38,400,000	5
2.33	5.2	0.429	$2,400,000	**	50	**	**
					Total	**$110,700,000**	

**Area accounted for in midpoint approximation of rectangle 5

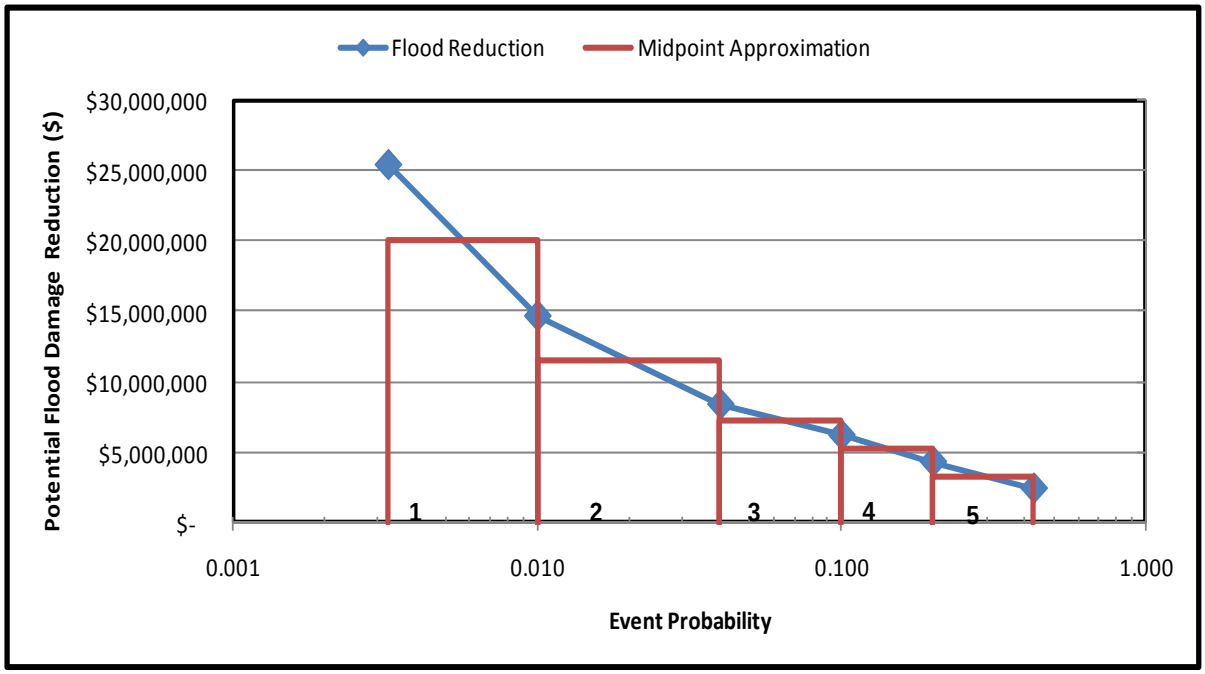


Figure ES-4: Alternative 4 - Potential Flood Damage Reduction

ES.8 Recommendations

Based on the results indicated within this report, CDM/QLH recommend that the JPA Partners move forward with Alternative 4 under a prioritized implementation schedule as funding becomes available as follows:

1. Obtain finished floor elevations and map locations for all structures that incurred damage within the study area. This is important for verification of the actual and projected flood damages and flood damage reduction for the project components;

2. Continue to coordinate with FEMA as a group on the Flood Insurance Study (FIS) and Digital Flood Insurance Rate Map (DFIRM) updates;

3. Continue to pursue grant and loan funding individually and as a group to facilitate project implementation;

4. Confirm and update stormwater design standards consistently across the watershed as noted in this report;

5. Purchase land for Alternative 4 components and supplemental storage and treatment, where feasible, to optimize the storage and pumping relationships such that the maximum benefit-cost ratio can be achieved for cost-effective implementation and to position for federal and other funding;

6. Construct supplemental storage on acquired properties;

7. Implement pump stations at:

    i. Ormond Beach Laurel Creek
    ii. Daytona Beach North Street
    iii. Daytona Beach Samuel Butts Park
    iv. Port Orange Buschman Park

8. Consider implementing the Navy Canal Diversion Project (Alternative 5) in a subsequent phase for alternative water supply as well as flood control for smaller storm events (e.g., significant benefits for the 25-year storm); and

9. Consider implementing the tide gate-weirs at the LPGA, Reed, and Halifax Canal outfalls as funding becomes available. These provide benefits beyond this flood reduction project for potential extreme high-tide backflow control, alternative water supply coordination with the cities, and potential treatment credits with SJRWMD. Also, consider the potential need for implementation of other backflow prevention devices for connected systems that may be pumped down (in advance of storms and/or for alternative water supply-reuse harvesting).

Other upstream improvements of new and existing stormwater infrastructure would improve overall system capacity and connectivity. Improvements such as localized storage facilities and flood control structures would capture and attenuate peak flows and provide water quality and groundwater recharge benefits. In general, the localized project objectives should be to increase storage and treatment, decrease flood stages and flows for flood-prone areas, increase conveyance to storage and reuse areas where possible (without offsite stage increases), and increase recharge. Ultimately the overall system should be linked to the water supply and stormwater harvesting-reuse options being considered by the JPA Partners.

Additional specific near-term recommendations for each JPA Partner are also provided in Section 4 of this report.

As soon as decisions are made regarding property acquisition and supplemental storage, model refinements should be made and designs should proceed to at least a 30 percent stage to further refine cost estimates and identify utility coordination needs and permitting requirements. More advanced designs should be completed, where practical, so that projects are as close to "shovel-ready" as possible when funding opportunities arise.

Contents

Executive Summary ES-1

Section 1 Introduction

1.1 Purpose 1-1
1.2 Project Site 1-2
1.2.1 Site Location 1-2
1.2.2 Site Descriptions 1-2

Section 2 Surface Water Hydrology and Hydraulics

2.1 Hydrologic and Hydraulic Model 2-1
2.2 Study Area Model Update and Refinement 2-2
2.2.1 Model Version Update 2-2
2.2.2 Hydrologic Model Data Review 2-7
2.2.3 Hydraulic Model Data Review 2-7
2.3 Model Validation 2-8
2.3.1 Rainfall Data 2-8
2.3.2 Flow and Stage Data 2-9
2.3.3 Downstream Boundary Conditions 2-9
2.3.4 High Water Mark Data 2-10
2.3.5 Validation Model Results 2-11
2.4 Model Design Storm Evaluation 2-11
2.4.1 Rainfall Data 2-11
2.4.2 Downstream Boundary Conditions 2-17
2.4.3 Design Storm Model Results 2-17
2.5 Model Project Alternative Evaluation 2-22
2.5.1 Project Components 2-22
2.5.2 Results for May 2009 Event 2-24
2.5.3 Results for Design Storms 2-27
2.6 Conclusions 2-32

Section 3 Additional Flood Control Alternatives and Conceptual Plan

3.1 Introduction 3-1
3.2 Project Component Descriptions and Development 3-1
3.2.1 LPGA 3-2
3.2.2 Reed Canal Project Component 3-4
3.2.3 Halifax Canal Project Component 3-7
3.2.4 Laurel Creek Area Project Component 3-7
3.2.5 North Street Pond Project Component 3-7
3.2.6 Samuel Butts Pond Project Component 3-7
3.2.7 Navy Canal Diversion Project Component 3-12
3.2.8 Bottleneck Removal in the Primary System 3-12
3.2.9 Buschman Pond Project Component 3-14

3.3 Alternatives Descriptions and Development 3-14
3.3.1 Alternative 1 3-14
3.3.2 Alternative 2 3-14
3.3.3 Alternative 3 3-14
3.3.4 Alternative 4 3-14
3.3.5 Alternative 5 3-14
3.3.6 Alternative 6 3-16
3.3.7 Alternative 7 3-16
3.4 Alternatives Evaluation 3-16
3.4.1 Model Extension 3-16
3.4.2 Model Results 3-16
3.4.3 Alternatives Cost Estimates 3-16
3.4.4 Flood Damages and Flood Control Benefits 3-18
3.4.5 Increased System Storage 3-18
3.5 Conculsions 3-19

Section 4 Recommendations 4-1

Appendices

Appendix A Tidal Measurements, Predictions, and Interpolations
Appendix B Peak Stage Summary
Appendix C Peak Flow Summary
Appendix D Concept Layouts
Appendix E Bottleneck Identification in the Primary System
Appendix F Alternative Analysis Model Results
Appendix G Flood Inundation Maps
Appendix H Cost Esimates
Appendix I Inundation and Damages
Appendix J 100-Year Storage Volumes

Figures

ES-1 Study Area ES-3
ES-2 Alternatives Components ES-5
ES-3 Alternative 4 Components ES-13
ES-4 Alternative 4 – Potential Flood Damage Reduction ES-15
1-1 Project Area 1-3
1-2 SJRWMD Catchments 1-4
1-3 Vicinity Map 1-6
1-4 LPGA Boulevard Site 1-7
1-5 Reed Canal Site 1-8
1-6 Rose Bay Site 1-9
2-1 Nova Canal Schematic 2-3
2-2 Nova Canal Schematic - North 2-4
2-3 Nova Schematic – Central 2-5
2-4 Nova Canal Schematic - South 2-6
2-5 LPGA (11th Street) Canal Stages 2-13
2-6 LPGA (11th Street) Canal Flows 2-13
2-7 Reed Canal Stages 2-14
2-8 Reed Canal Flows 2-14
2-9 Halifax Canal Stages 2-15
2-10 Halifax Canal Flows 2-15
2-11 SJRWMD 25-year 24-hour Design Storm Distribution 2-16
2-12 SJRWMD 25-year 96-hour Design Storm Distribution 2-16
2-13 FEMA Tidal Stillwater Elevations in the Halifax River 2-18
3-1 Alternarives Components 3-1
3-2 LPGA Canal Project Component 3-5
3-3 Reed Canal Project Component 3-6
3-4 Halifax Canal Project Component 3-8
3-5 Laurel Creek Project Component 3-9
3-6 North Street Pond Project Component 3-10
3-7 Samuel Butts Pond Project Component 3-11
3-8 Navy Canal Diversion Project Component 3-13
3-9 Buschman Pond Project Component 3-15
3-10 Alternative 4 Components 3-20
3-11 Alternative 4 – Potential Flood Danage Reduction 3-22

Tables

ES-1 Summary of Project Component Parameters ES-7
ES-2 Preliminary Opinion of Conceptual Cost of Project Alternatives ES-11
ES-3 May 2009 Flooding Extents by Component Area for Alternative 4 ..... ES-14
ES-4 Alternative 4 – Laurel Creek, North Street, Samuel Butts, & Buschman Pumps..... ES-15
2-1 Relative Distances of Outfalls 2-10
2-2 Comparison of SWMM5 Model Output and Measured High Water Marks/Estimated Ground Elevations - May 2009 Storm Event 2-12
2-3 FEMA Coastal Stillwater Elevations 2-17
2-4 Nova Canal Flood Control and Integrated Water Resources Project Baseline Conditions – 24-hour Design Storms Level of Service..... 2-20
2-5 Nova Canal Flood Control and Integrated Water Resources Project Baseline Conditions – 96-hour Design Storm Level of Service 2-21
2-6 Critical Operational Parameters for Pump/Tide Weir-Gate..... 2-24
2-7 Existing and Alternative 1 - Peak Stages for May 2009 Storm LPGA Canal System 2-25
2-8 Existing and Alternative 1 - Peak Stages for May 2009 Storm LPGA Canal Branch Systems 2-25
2-9 Existing and Alternative 1 - Peak Stages for May 2009 Storm Reed Canal System 2-26
2-10 Existing and Alternative 1 - Peak Stages for May 2009 Storm Halifax Canal System 2-26
2-11 Existing and Alternative 1 - Peak Stages for May 2009 Storm Nova Canal System 2-27
2-12 Nova Canal Flood Control and Integrated Water Resources Project Baseline and Alternative 1 Conditions – 24-hour Design Storms Level of Service 2-28
2-13 Nova Canal Flood Control and Integrated Water Resources Project Baseline and Alternative 1 Conditions – 96-hour Design Storms Level of Service 2-29
2-14 Nova Canal Flood Control and Integrated Water Resources Project Baseline Conditions – Average Stage Reductions and Increases for Design Storm Simulations 2-31
3-1 Summary of Project Component Parameters 3-4
3-2 Preliminary Opinion of Conceptual Cost of Project Alternatives 3-17
3-3 May 2009 Flooding Extents by Component Area for Alternative 4 3-21
3-4 Alternative 4 – Laurel Creek, North Street, Samuel Butts & Buschman Pumps..... 3-21

Section 1
Introduction

1.1 Purpose

Camp Dresser & McKee Inc. (CDM) and Quentin L. Hampton & Associates (QLH) were contracted by the East Volusia Regional Water Authority (EVRWA) to evaluate, design, and provide permit support for stormwater improvements to the Nova and Halifax Canal system. This is another implementation phase of stormwater improvements in this system. Led by the EVRWA, a Joint Project Agreement (JPA) for this project has been developed by the municipalities and agencies listed below:

- City of Ormond Beach
- City of Holly Hill
- Volusia County
- City of Daytona Beach
- City of South Daytona
- City of Port Orange
- Florida Department of Transportation (FDOT)
- St. Johns River Water Management District (SJRWMD)

CDM\QLH (the Team) have compiled and updated the existing Nova Canal stormwater models for the purposes of evaluating, permit support, and designing flood control structures and multi-purpose pumping stations on the LPGA (also known as 11th Street), Reed, and Halifax Canals. The model evaluations were performed utilizing the EPA Storm Water Management Model Version 5 (SWMM5) and include the three proposed flood control structures and associated pumping systems.

The JPA intends to develop, permit, and construct three stormwater pump stations and flood control weir-gates to provide flood mitigation to the residents of Volusia County within the study area. The following report details the development, updates, and validation of the stormwater model utilized to evaluate the three stormwater pump station alternatives. This report also addresses proposed project components and operational protocols, water quantity benefits, as well as recommendations for project modifications to improve the flood control cost-benefit ratio.

The following goals were achieved by the stormwater improvements proposed herein:

- Mitigate flood stages and durations;
- Provide water quality treatment and attenuation; and
- Preservation of existing flow patterns.

1.2 Project Site

1.2.1 Site Location

The overall study area is located within Volusia County, Florida and encompasses portions of Ormond Beach, Holly Hill, Daytona Beach, South Daytona, Port Orange, and unincorporated Volusia County. The three pump stations are to be located as follows:

1. LPGA (11th Street) Canal– The pump station would be located on the south side of LPGA Boulevard immediately to the west of the Florida East Coast (FEC) Railroad tracks at Centennial Park.

2. Reed Canal – The Reed Canal pump station would be located on the south side of the Reed Canal immediately to the East of the Florida East Coast (FEC) Railroad tracks.

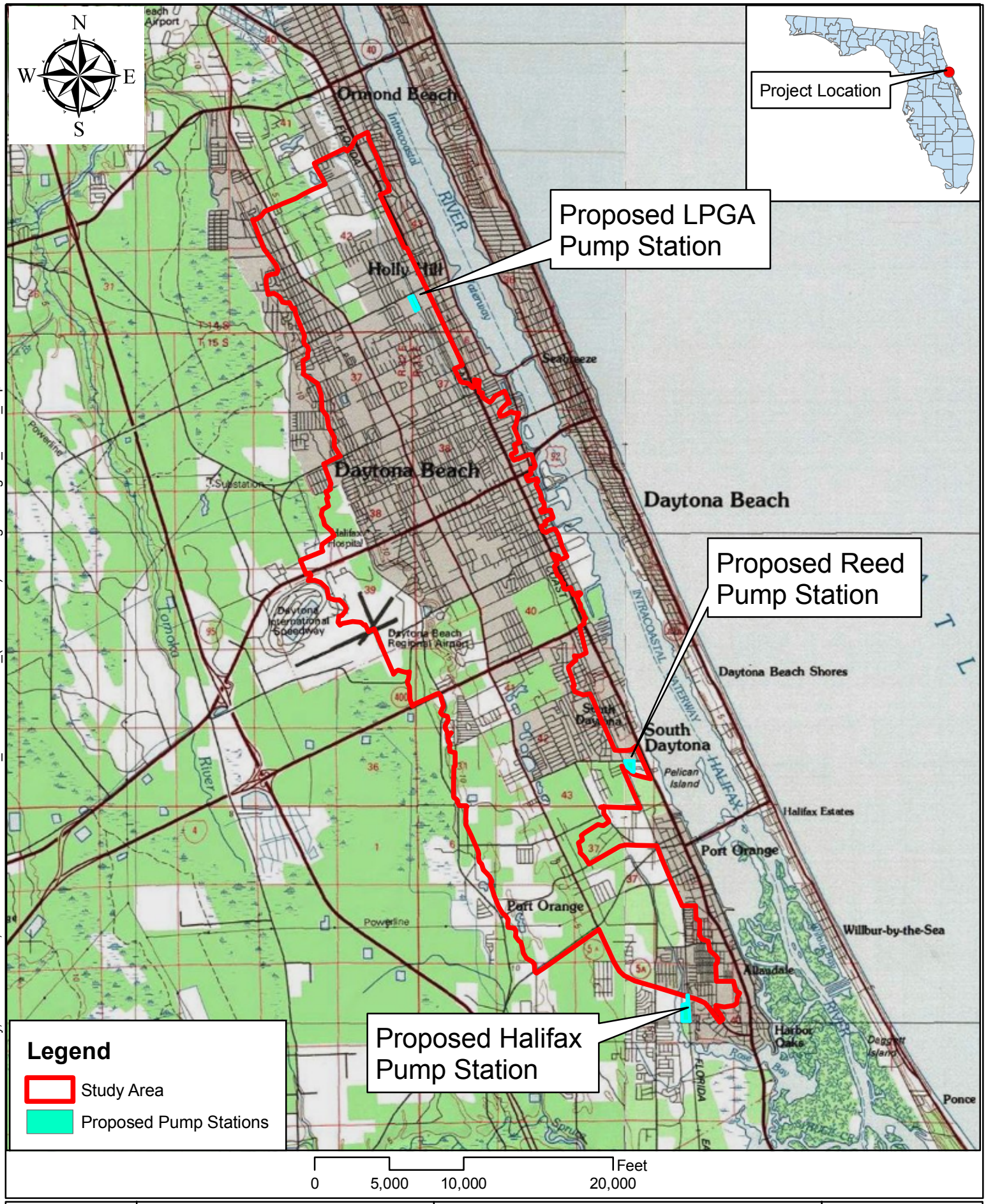
3. Halifax Canal – The Halifax Canal pump station would be located at on the east side of the Reed Canal, immediately south of Nova Road (SR5).

The study area and pump station locations are shown on the United States Geological Survey (USGS) quadrangle map (**Figure 1-1**).

1.2.2 Site Descriptions

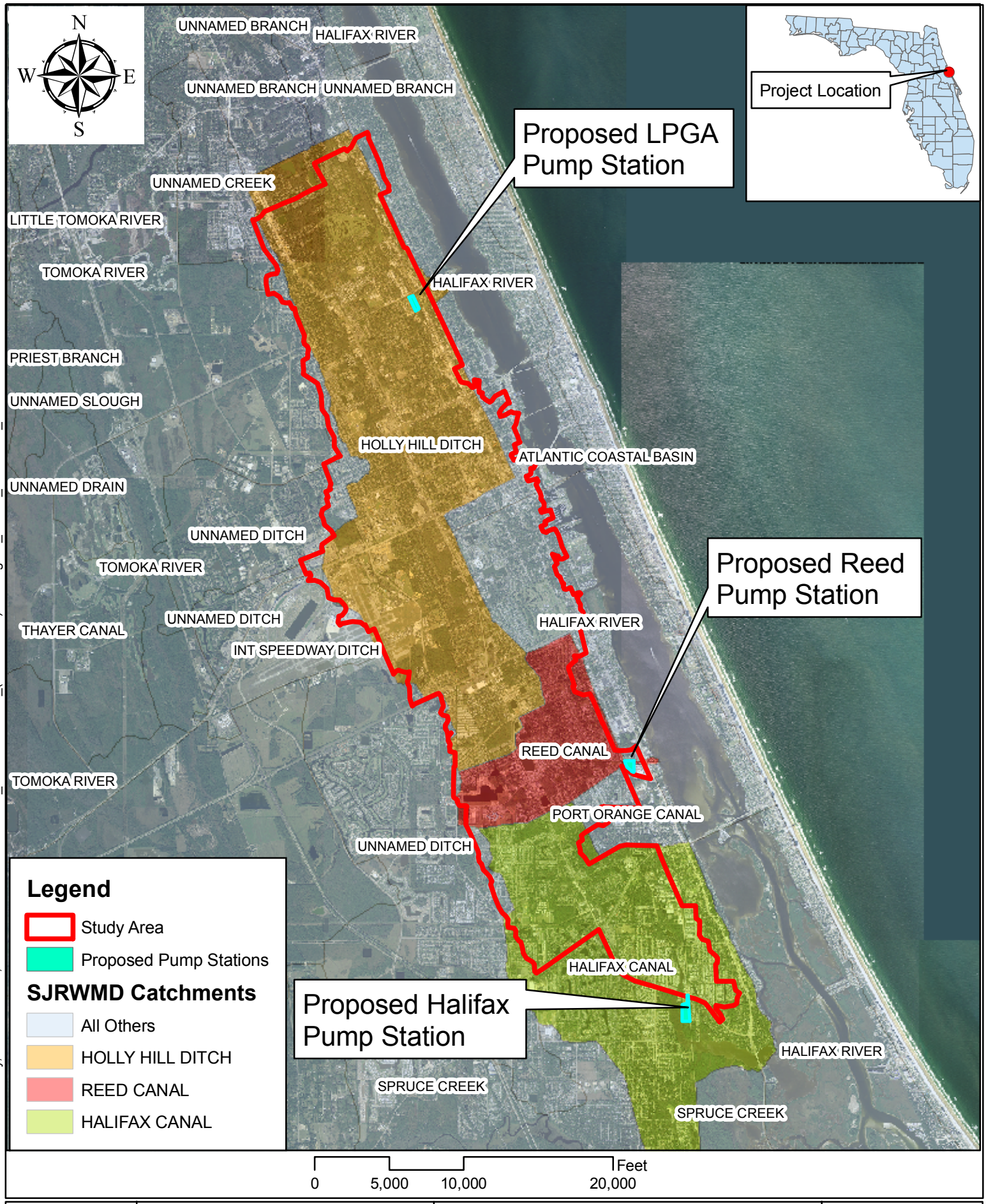
The study area is located in East Central Volusia County in the Northern Coastal Basin within the Halifax River Planning Unit, bounded to the east by the Halifax River. The Halifax River physically separates the mainland portion of the study area from the Atlantic Beach Ridge, which extends along the eastern part of Volusia County. The beach ridges are relic formations caused over time by the actions of wind and waves upon the shoreline.

The original canal system was constructed by the U.S. Department of the Interior in the 1920s to drain the depressional areas between US 1 and the Atlantic Coastal Ridge. Stormwater runoff drains from west to east toward the Halifax River. The study area is composed of three St. Johns River Water Management District catchments: the Holly Hill Ditch, the Reed Canal, and the Halifax Canal and comprises approximately 23 square miles. **Figure 1-2** shows the locations of the three basins in the EVRWA watershed.



Saturday, December 12, 2009 11:19:57 AM Z:\87458_EVRWA\73553_(NovaCanal)\GIS\Figures\Fig1-1_USGS_Topo.mxd

CDM	East Volusia Regional Water Authority (EVRWA)	**Figure 1-1** Nova Canal Flood Control and Integrated Water Resources Program Project Area	UPDATED 12-12-09



Monday, December 14, 2009 11:53:39 AM Z:\87458_EVRWA\73553_(NovaCanal)\GIS\Fig1-2_USGS_SJRWMD_Catchments.mxd

CDM

East Volusia Regional Water Authority (EVRWA)

Figure 1-2

Nova Canal Flood Control and Integrated Water Resources Program

SJRWMD Catchments

UPDATED 12-14-09

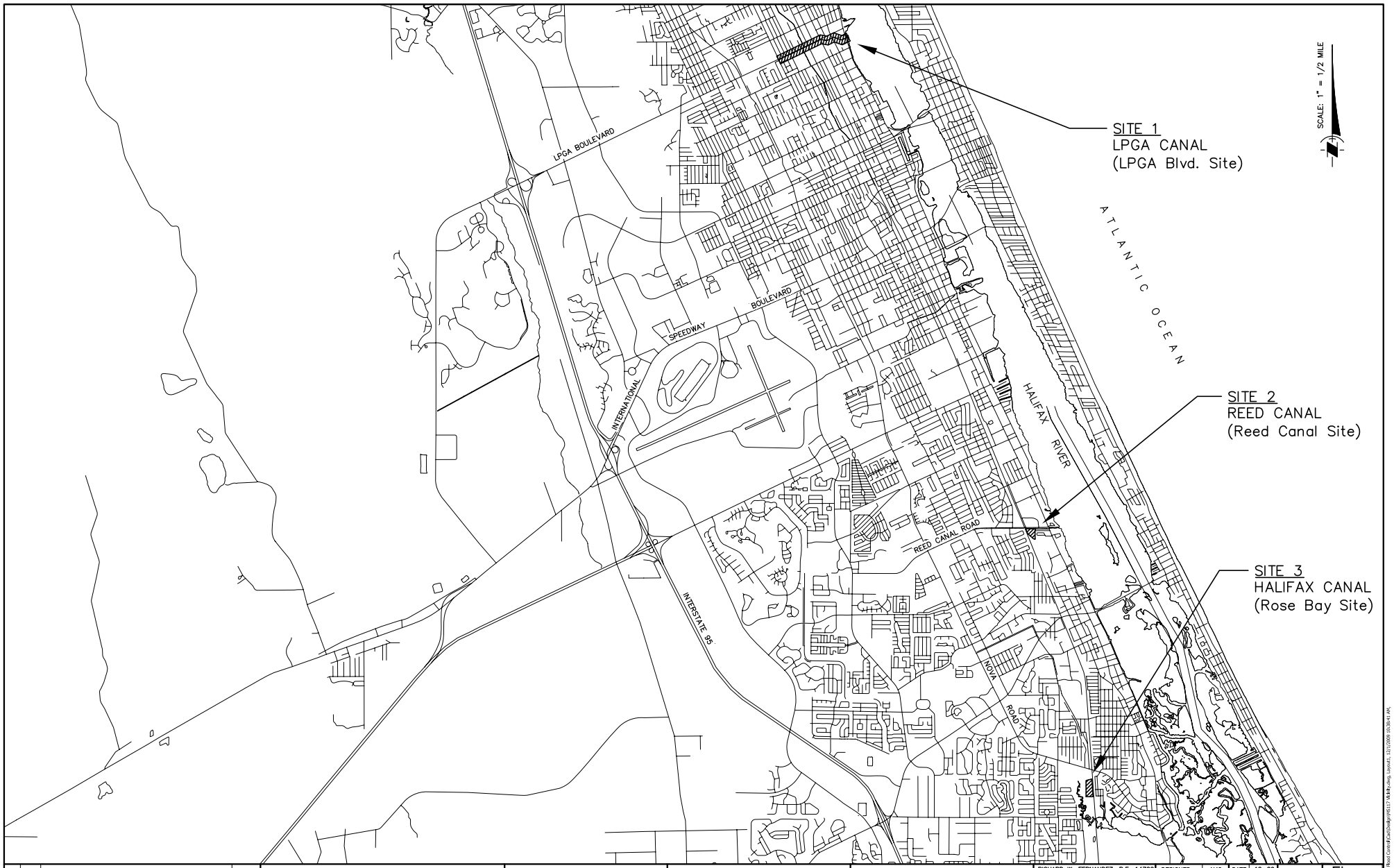
The specific pump station sites proposed to service the three aforementioned basins are located throughout eastern Volusia County (see **Figure 1-3**), and can be described as follows:

1. LPGA (11th Street) – The pump station is located on approximately 7 acres of land owned by the City of Holly Hill (Centennial Park). The area is currently utilized for stormwater management with elevations ranging from approximately 7 feet NGVD (National Geodetic Vertical Datum) down to 1 foot NGVD (see **Figure 1-4**).

2. Reed Canal – The Reed Canal pump station is located on approximately 7.5 acres of land owned by the City of South Daytona. The area is currently utilized for stormwater management with elevations ranging from approximately 13 feet NGVD down to 3 feet NGVD (see **Figure 1-5**).

3. Halifax Canal – The Halifax Canal pump station is located on approximately 14.0 acres of land which the City of Port Orange is in the process of acquiring. The area is currently utilized as a golf driving range facility with elevations ranging from approximately 7 feet NGVD down to 2 feet NGVD (see **Figure 1-6**).

The model update and validation as well as the analysis of the proposed improvements are described in detail in the following sections.



No.	BY	REVISIONS	DATE
1	TS	REVISED	12/09

QUENTIN L. HAMPTON ASSOCIATES, INC.
CONSULTING ENGINEERS
FLORIDA CERTIFICATE-of-AUTHORIZATION No. 626
PHONE: (386) 761-6810 FAX: (386) 761-3977
P.O. DRAWER 290247, PORT ORANGE, FLORIDA 32129-0247

PREPARED FOR
COUNTY OF VOLUSIA
123 W. INDIANA AVENUE
DELAND, FLORIDA 32720

East Volusia
Nova Canal
Flood Control

VICINITY MAP

RICHARD W. FERNANDEZ, P.E. 14722
MARK A. HAMPTON, P.E. 27391
BRADLEY T. BLAIS, P.E. 47130
DAVID A. KING, P.E. 50609
ANDREW M. GIANNINI, P.E. 46601

DESIGNED	AMG	DATE	12-09
DRAWN	RRW	DATE	12-09
CHECKED	TAS	DATE	12-09
APPROVED	BTB	DATE	12-09

SCALE AS SHOWN
JOB NO. MS117

Figure 1-3

S:\MS\MS117 East Volusia Nova Canal Flood Control\Cad\Design\MS117 Vicinity.dwg, Layout1, 12/1/2009 10:38:41 AM, TS